

Appendix A  
Hazard Mitigation Planning  
Committee Member List

# Hazard Mitigation Planning Committee Member List

Community	First Name	Last Name	Title	Agency
Hampton	James	Freas		Planning Dept.
	Libby	Griebel		Senior Appraiser
	Allan	Lambert		GIS Manager
	David	Langille		Chief Inspector
	Jim	Redick	Deputy E. M. Coordinator	Emergency Mgmt
	Tammy	Waldroup	Assistant Planner	Planning Dept.
	Donald	Whipple		Senior City Planner
Newport News	Carol	Caldwell	Codes Compliance	
	David E.	Gossett	Self-Insurance Programs, Admin.	Self-Insurance Programs
	Mark	Hargrave	GIS Supervisor	Dept. of Engineering
	Ralph	Harris	Senior Appraiser	Real Estate Assessor
	Kenny	Holloway	Street Division, Asst. Admin.	Public Works, Street Div
	Kathy	James-Webb	Planner, Senior	Dept. of Planning
	Doug	Kennedy	Superintendent of Landscape Services	Parks & Recreation
	Kris E.	Keyes	Human Resources Manager	Waterworks
	Eric	Lamberton	Public Works, Asst. Director	Public Works
	Theresa	Lazar	Deputy Coordinator	Office of Emergency Management
	Lou	Marks	Codes	Codes Compliance
	Antonio	Risk	Engineering, Senior Tech.	Public Works
	Harold	Roach	Codes	Codes Compliance
	Emily	Seward	Planner, Emergency	Emergency Management
	Joe	Street	City Assessor	Real Estate Assessor
	Dick	Tyson	Shelter Coordinator	Public Schools
	David	Watson	Environmental Planner	Dept. of Planning
	Deirdre	Wells		Engineering
	Andrew S.	Wilks	Property Manager	Department of Development
	Williamsburg	Jason	Beck	Zoning Officer
Bert		Geddy	Fire Chief, Deputy & Deputy Coord	Williamsburg Fire Dept
Cindy		Greczek	Colonial Williamsburg	Deputy Dir. Of Safety
Bob		Iversen	Utilities Superintendent	Utilities
Robert		Johnson	Fire Safety Officer	Facilities Management
Ted		Lyman		GIS Consultant
John		Mattson		City Assessor
Jim		Murphy		Deputy Coord.
Lori		Rierson	Recreation Dept.	Deputy Director
College of William & Mary		Larry	Richards	Safety & Environmental Health
William & Mary	Jack	Williamson	Emergency Mgmt, Coordinator	Emergency Management
W'burg-JCC Schools	Jay	Sexton		Williamsburg Police
James City County	George	Adams	Utility Operations Administrator	JCSA

<b>Community</b>	<b>First Name</b>	<b>Last Name</b>	<b>Title</b>	<b>Agency</b>
	Wilton	Bobo	Emergency Services	Deputy Coord.
	Ellen	Cook	Planner	Development Management
	Pat	Foltz	GIS, Development Tech.	Development Management
James City County	Emmett H.	Harmon	Deputy Chief of Police	County Police Department
	Kim	Hazelwood		GIS
	Jane	Leonard	Administrative Services Coordinator	James City County
	A. Vaughn	Poller	Planner, Community Dev.	JCC Office of Housing & Community Development
	Doug	Powell	Assistant Manager	Community Services
	Bob	Ryalls		
	Matt	Smolnick		
	Alan	Robertson	Facilities Manager	W'burg JCC Schools
York County	Connie	Bennett	Stormwater Engineer	Env'l & Development
	Timothy	Cross	Planner, Principal	Planning Division
	Jim	Dishner	FM, Asst. Chief, Dep Coord	York Co. Fire Dept.
	Marianne G.	Harris	Building Code Official	Building Regulation
	Korine	Leonard	GIS Supervisor	York County
	Al	Maddalena	Chief of Development & Compliance	Development & Compliance
	Amy	Parker	Planner, Senior	Planning Division
	Stephanie	Peters	GIS Analyst	York County
	Judith N.	Riutort	Emergency Mgmt, Deputy Coord.	Fire & Life Safety
	Greg	Thacker		County Assessor
HRPDC	Tammy	Kaarlgaard	HRPDC	Planner
Langley AFB	MSGT Darryl	Hart	USAF	1st Civil Engineering
State of Virginia	Hibak	Hersi	Va. Dept. of Emerg. Mgmt.	Local Haz. Mit. Planner
State of Virginia	Brittany	Schaal	Va. Dept. of Emerg. Mgmt.	Local Haz. Mit. Planner

# Appendix B

## Hazard Specific Mapping

B-2 – B-4 Peninsula Hurricane Tracks

B-5 Peninsula Tornadoes, 1950-2002

B-6 Landslide Hazard Map

## Peninsula Hurricane Tracks, 1851-1899

### Hurricanes Passing Within 25 Nautical Miles of Newport News, VA

Year	Month	Day	Storm Name	Wind Speed (Kts)	Pressure (Mb)	Category
1854	September	10	not named	40	not available	Tropical Storm
1856	August	19-20	not named	50	not available	Tropical Storm
1859	September	17	not named	50	not available	Tropical Storm
1861	September	27	not named	60	not available	Tropical Storm
1863	September	18	not named	50	not available	Tropical Storm
1872	October	25-26	not named	40	not available	Tropical Storm
1874	September	29	not named	50	not available	Tropical Storm
1877	October	4	not named	50	not available	Extratropical
1881	September	10	not named	50	not available	Tropical Storm
1882	September	11	not named	40	not available	Tropical Storm
1882	September	23	not named	40	1005	Tropical Storm
1886	July	2	not named	35	not available	Tropical Storm
1889	September	24-25	not named	40	not available	Tropical Storm
1894	October	10	not named	60	not available	Tropical Storm



Source: NOAA CSC Hurricane Mapping Tool

## Peninsula Hurricane Tracks, 1900-1949

### Hurricanes Passing Within 25 Nautical Miles of Newport News, VA

Year	Month	Day	Storm Name	Wind Speed (Kts)	Pressure (Mb)	Category
1902	June	16	not named	40	not available	Extratropical
1904	September	15	not named	55	not available	Tropical Storm
1924	September	30	not named	35	not available	Extratropical
1928	August	12	not named	30	not available	Extratropical
1928	September	19	not named	40	989	Tropical Storm
1933	August	23	Chesapeake-Potomac Hurricane	60	971	Tropical Storm
1944	October	20-21	not named	35	996	Tropical Storm



Source: NOAA CSC Hurricane Mapping Tool

## Peninsula Hurricane Tracks, 1951-2004

### Hurricanes Passing Within 25 Nautical Miles of Newport News, VA

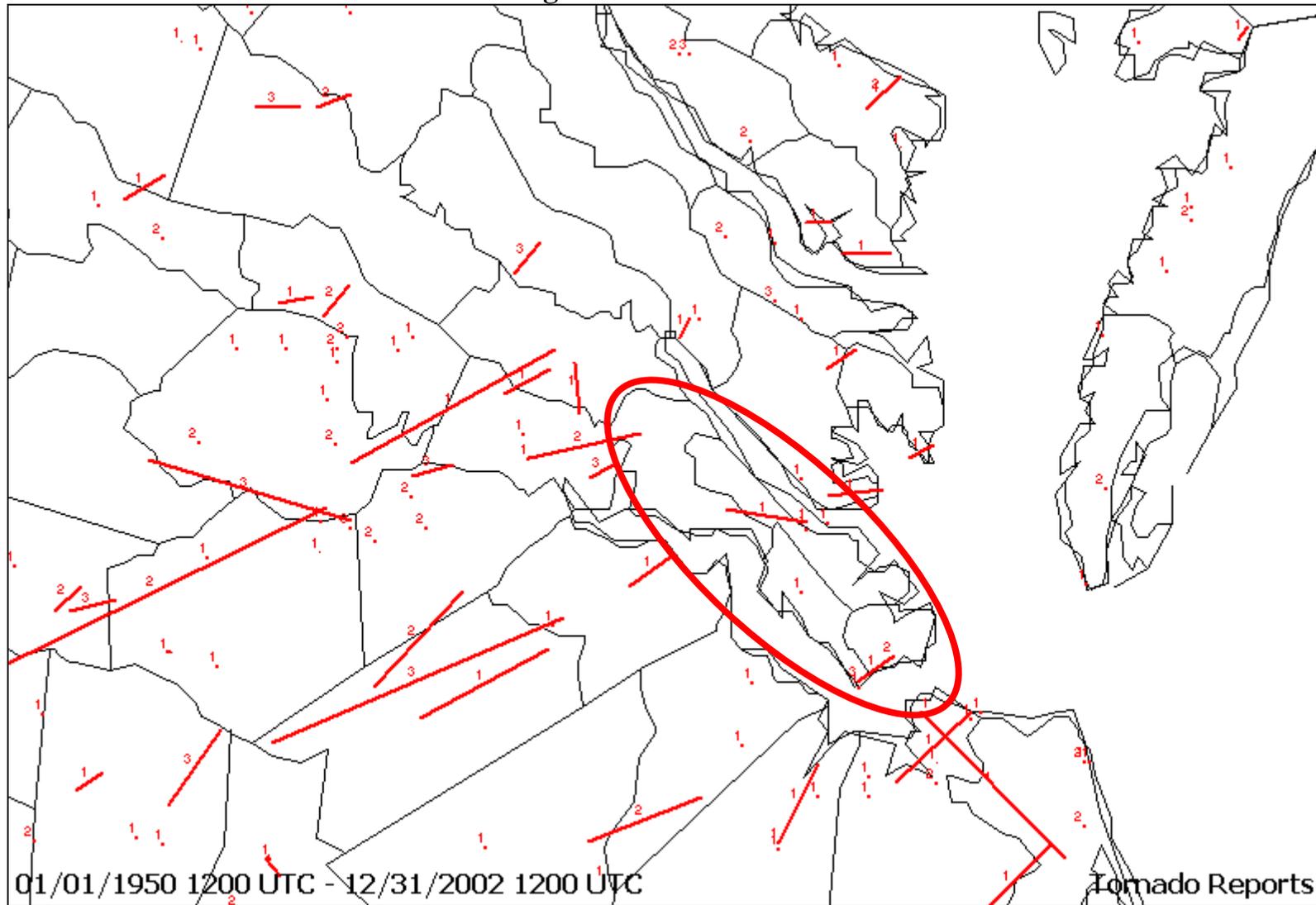
Year	Month	Day	Storm Name	Wind Speed(Kts)	Pressure(Mb)	Category
1959	July	10	Cindy	30	0	Tropical Depression
1960	July	30	Brenda	50	0	Tropical Storm
1961	September	14	not named	35	0	Tropical Storm
1969	August	20	Camille	25	0	Tropical Depression
1970	May	27	Alma	25	1003	Extratropical
1971	August	28	Doria	55	0	Tropical Storm
1971	October	2-3	Ginger	30	0	Tropical Depression
1979	July	14-15	Bob	20	1010	Tropical Depression
1981	July	1	Bret	30	1006	Tropical Depression
1985	August	19	Danny	25	1012	Extratropical
1996	July	13	Bertha	60	993	Tropical Storm
1999	September	16	Floyd	70	967	Hurricane – Category 1
2004	August	30-31	Gaston	30	1002	Tropical Depression

Note: The eye of Hurricane Isabel (2003) did not pass within 25 nautical miles of the Peninsula and, therefore, does not appear in this database or mapping.



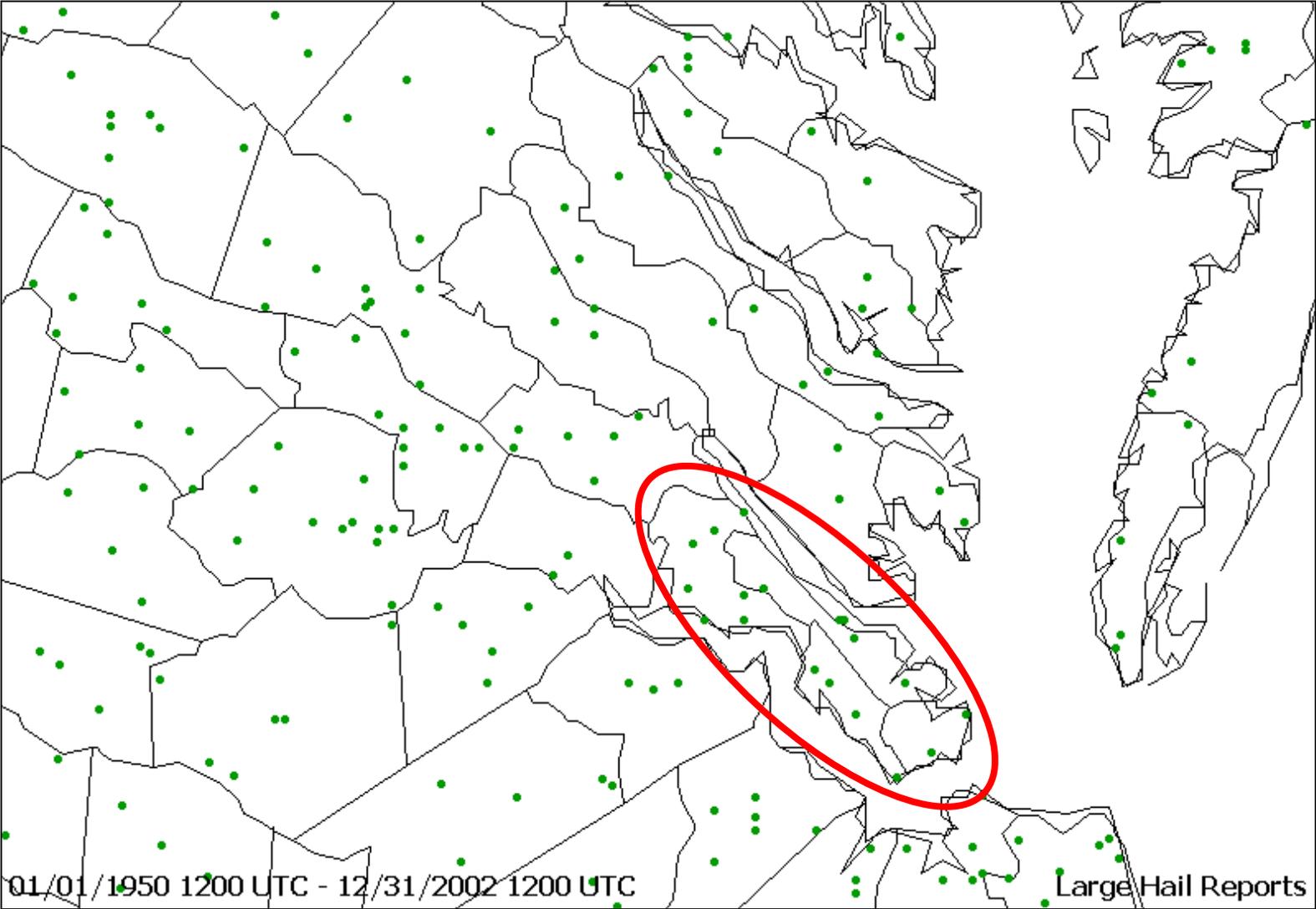
Source: NOAA CSC Hurricane Mapping Tool

### Peninsula Reported Tornado Tracks, 1950-2002 Magnitude F1 or Greater



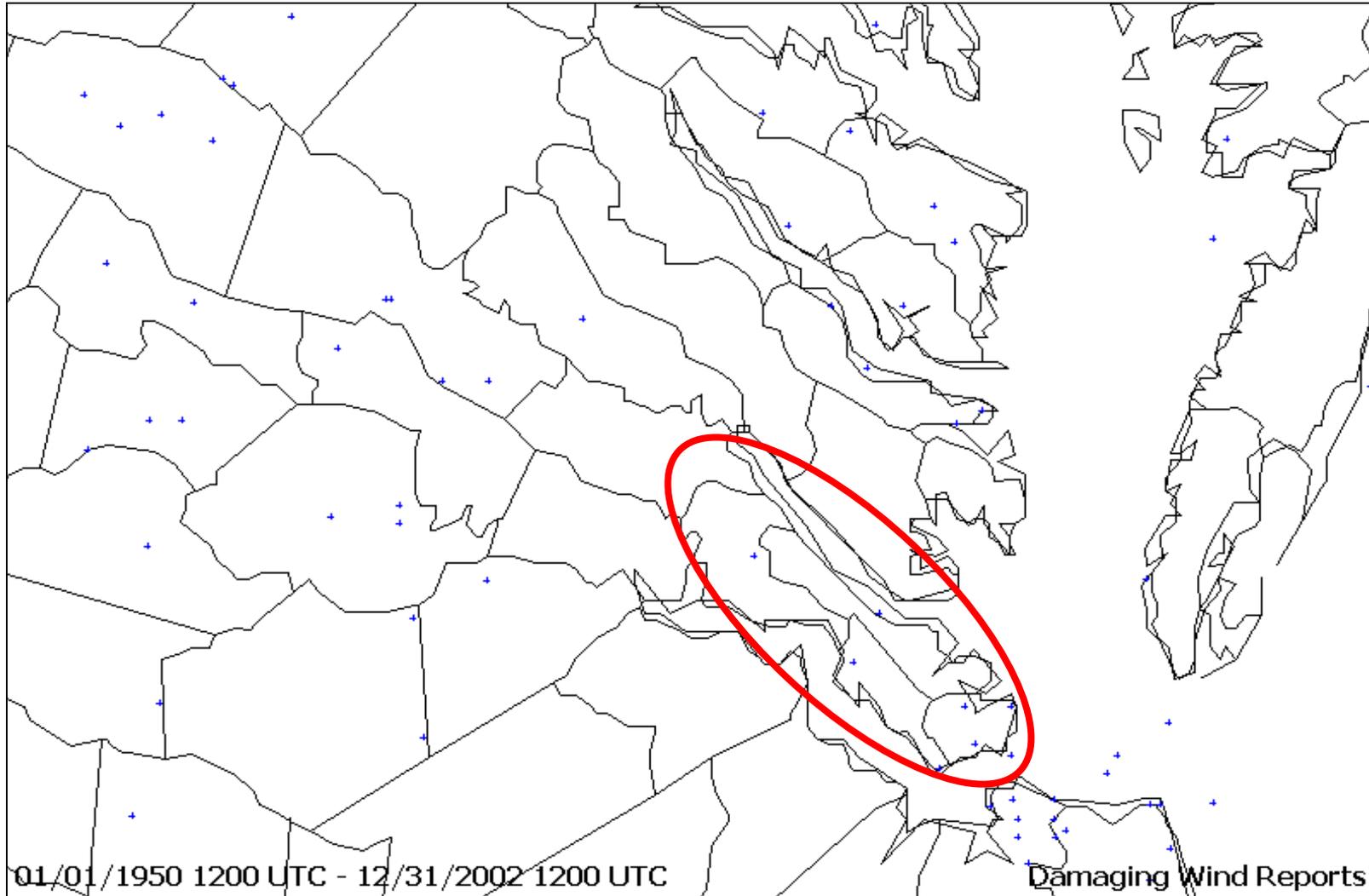
Source: NWS SVRPLOT Output

**Peninsula Large Hail Reports, 1950-2002**  
**Hail Greater than 1 inch**



Source: NWS SVRPL0T Output

**Peninsula Damaging Wind Reports, 1950-2002**  
**Sustained Wind Greater than 60 knots**



Source: NWS SVRPLLOT Output

Appendix C  
Catalog of Virginia's Historical  
Hurricanes

# Catalog of Virginia's Historical Hurricanes

The following catalog has been compiled from records of the National Weather Service, Wakefield Office ([www.erh.noaa.gov/akq](http://www.erh.noaa.gov/akq)), and a web site on *Virginia's Hurricane History* researched by David Roth with the Hydrometeorological Prediction Center in Camp Springs, Maryland, and Hugh Cobb, with the National Weather Service Forecast Office in Wakefield, Virginia (<http://www.hpc.ncep.noaa.gov/research/roth/vahur.htm>).

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Continuous weather records for the Hampton Roads Area of Virginia began on January 1, 1871 when the National Weather Service was established in downtown Norfolk. The recorded history of significant tropical storms that affected the area goes back much further. Prior to 1871, very early storms have been located in ship logs, newspaper accounts, history books, and countless other writings. The residents of coastal Virginia during Colonial times were very much aware of the weather. They were a people that lived near the water and largely derived their livelihood from the sea. To them, a tropical storm was indeed a noteworthy event. The excellent records left by some of Virginia's early settlers and from official records of the National Weather Service are summarized below. Learning from the past will help us prepare for the future.

## SIXTEENTH CENTURY

Note: Dates before September 2, 1752 converted from the Julian to the Gregorian calendar

The Spanish were becoming nervous about French activity in the New World, particularly along the Atlantic coast. This worried the Spanish because they used the Gulf Stream to move their plunder from old Mexico and Florida back to Spain. King Phillip II demanded the settlement of the coast in 1558, leading to the first explorations of the region around Virginia (Lewis & Loomie).

**1564** The Native American population of the area told of a shipwreck during that year. A "christian shippe" was beaten by a storm; none aboard survived the ordeal. The natives made instruments from the nails and spikes off the vessel. (Chapman)

**1566 June 14** (Old Style): Four vessels of Angel Villafañe's fleet were passing offshore Hatteras. On the 14th, two small vessels perished, while Villafañe's caravel nearly foundered. The remaining two vessels eventually made their way to Havana (Lewis & Loomie).

**1586 June 23-26** Sir Francis Drake arrived near Roanoke Island, only to be greeted by a storm. It was described as "extraordinary" and lasted three days. His fleet was in great danger during the tempest. The Primrose broke its 250-pound anchor. Hail the size of hen eggs pelted the colony. Waterspouts also threatened the mariners. The settlers evacuated back to England soon after the storm.

**1587 August 31** Admiral Drake encountered a hurricane at Roanoke Island during the following year. Strong northeast gales caused him and his crew to "cut his cables" and set out to sea. It took six days to regroup after this treacherous storm.

**1591 August 26** Roanoke Island was again struck by a severe storm. The winds blew out of the northeast, directly into the harbor. Waves crashed on a sandbar and currents in the area became quite dangerous.

## SEVENTEENTH CENTURY

**1609 August 4 (The Tempest):** Sir Thomas Gates, future governor of Virginia, was on his way to England from Jamestown. On Saint James Day, while between Cuba and the Bahamas, a "most terrible and vehement storm" raged for 44 hours. One of the small vessels in the fleet sank to the bottom of the Florida Straits. Four of the remaining vessels reached Virginia soon after the storm...followed a few days later by three other ships.

The flagship, known as Sea Adventure, disappeared and was presumed lost. A small bit of fortune befell the ship and her crew when they made landfall on Bermuda. Although the vessel was damaged on a surrounding coral reef, all survived and spent ten months on the unsettled isle. The Spaniards, though shipwrecked on the island many times, had failed to colonize there.

The British claimed the island and quickly settled the subtropical isle. In May 1610, they set forth for Jamestown, this time arriving at their destination. This near catastrophe provided the inspiration and background for William Shakespeare's play, *The Tempest*.

**1635 August 24:** First historical reference to a major hurricane that could have affected the VA coast. A major hurricane affected the Virginia coast as it moved to the east of the colony. Despite its impact in New England, no references to damage in Virginia has been found.

**1649:** A "great storm and tide" destroyed a large quantity of tobacco stored in various rolling houses (Chapman).

**1667 September 6 (The "dreadful hurricane of 1667"):** It appears likely this hurricane caused the widening of the Lynnhaven River. The Bay rose 12 feet above normal and many people had to flee.

This system is considered one of the most severe hurricanes to ever strike Virginia. On the first, this same storm was reported in the Lesser Antilles. The hurricane devastated St. Christopher as no other storm had done before. The "great storm" went on to strike the northern Outer Banks of North Carolina and southeastern Virginia. The wind turned from the northeast to due south and finally to the west, which suggested a track similar to the August 1933 hurricane, a benchmark storm for the Hampton Roads area in the 20<sup>th</sup> century (see page 33). This 1667 hurricane lasted about 24 hours and was accompanied by very violent winds and tides.

Approximately 10,000 houses were blown over. Area crops (including corn and tobacco) were beat into the ground. Many cattle drowned in area rivers and bays by the twelve foot storm surge and "many people had to flee." The foundations of the fort at Point Comfort were swept into the river. A graveyard of the First Lynnhaven parish church tumbled into the waters. Twelve days of rain followed this storm across Virginia. This system is blamed for the widening of the Lynnhaven River. Ships in regional rivers sustained great damage.

Several accounts attest to the fury of this great storm. The first was published in London from *Strange News from Virginia*. Sir having this opportunity, I cannot but acquaint you with the relation of a very strange tempest which hath been in these parts (with us called a hurricane) which had began August 27<sup>th</sup> (September 6<sup>th</sup> Julian calendar) and continued with such violence, that it overturned many houses, burying in the ruines much goods and many people, beating to the ground such as were any wayes employed in the fields, blowing many cattle that were near the sea or rivers, into them., whereby unknown numbers have perished, to the great affliction of all people, few having escaped who have not suffered in their persons or estates, much corn was blown away, and great quantities of tobacco have been lost, to the great damage of many, and utter undoing of others. Neither did it end here, but the trees were torn up by the roots, and in many places whole woods blown down so that they cannot go from plantation to plantation. The sea (by the violence of the wind) swelled twelve feet above its usual height drowning the whole country before it, with many of the inhabitants, their cattle and goods, the rest being forced to save themselves in the mountains nearest adjoining, while they were forced to remain many days together in great want.

The tempest, for the time, was so furious, that it hath made a general desolation, overturning many plantations, so that there was nothing that could stand its fury.

The following is a letter from Secretary Thomas Ludwill to Lord Berkeley on the subject of this "dreadful hurricane" of September 6<sup>th</sup> gives added information about the cyclone:

Jamestown Colony - this poore country is now reduced to a very miserable condition by a continental course of misfortune. On the 27th of August followed the most dreadful Hurry Cane that ever the Colony (Jamestown) groaned under. It lasted 24 hours, began at North East and went around northerly till it came to west and so it came to Southeast where it ceased. It was accompanied with a most violent rain but no thunder. The night of it was the most dismal time I ever knew or heard of, for the wind and rain raised so confused a noise, mixed with the continued cracks of failing houses.....The waves were impetuously beaten against the shores and by that violence forced and as it were crowded into all creeks, rivers and bays to that prodigious height that it hazarded the drowning of many people who lived not in sight of the rivers, yet were then forced to climb to the top of their houses to keep themselves above water. The waves carried all the foundations of the Fort at Point Comfort into the river and most of furnished and garrison with it....but then morning came and the sun risen it would have comforted us after such a night, had it not lighted to us the ruins of our plantations, of which I think not one escaped.

The nearest computation is at least 10,000 houses blown down, all the Indian grain laid flat on the ground, all the tobacco in the fields torn to pieces and most of that which was in the houses perished with them. The fences about the corn fields were either blown down or beaten to the ground by trees which fell upon them.

The storm passed inland northeast of Jamestown into northern Virginia. A severe storm in Manhattan on the 8<sup>th</sup> was most likely a continuation of this cyclone, as it recurved northeast. Another hurricane may have passed very close to the Virginia coastline on September 10<sup>th</sup> since the "dreadful hurricane of 1667" was accompanied by twelve days and nights of rain. A second storm passing close to the Virginia coast would have extended the period of rain.

**1669 August 18:** This hurricane struck the northern Outer Banks of North Carolina, and most likely affected Virginia.

**1683 August 23:** A hurricane which made landfall in Virginia caused a tremendous flood in the Connecticut Valley.

**1683 September 5-10:** William Dampier, a sailor and buccaneer, gave a "vivid account" of a hurricane in the North Atlantic, three days after leaving Virginia. He addressed it in his chapter titled "Discourse of the Trade-Winds, Breezes, Storms, Seasons of the Year, Tides and Currents of the Torrid Zone throughout the World," published between 1703 and 1705. This writing became a classic of maritime literature (Ludlum).

**1693 October 29:** From the Royal Society of London, "There happened a most violent storm in VA which stopped the course of ancient channels and made some where there never were any." The great storm was violent as it passed through Accomack, which was located on the Delmarva peninsula between Chesapeake Bay and the Atlantic, sixty miles northeast of Norfolk. This storm may have created Fire Island Cut, to the east of New York City.

## **EIGHTEENTH CENTURY**

**1703 October 18:** A hurricane caused great damage along the Mid-Atlantic coast. In Maryland and Virginia, many vessels left their moorings. Ten tobacco houses were overturned. Damage occurred northward to Philadelphia. Across the Northeast, northeast winds caused a very cold rain to fall. The timing of this storm was quite unusual, as it followed a very early season snowstorm by eight days.

**1706 November 6:** A severe storm raged offshore of Virginia before it swept up the coast. A fleet met the storm soon after departing the Virginia shore. Fourteen ships foundered on the north coast of Cape Charles; those ships that returned sustained extensive damage to masts and sails.

**1713 September 17:** A great storm attended by immense inundation affected the Carolinas and Virginia. The effects were most significant in Currituck county, North Carolina near the Virginia-North Carolina border, where the storm surge breached the Outer Banks and opened several inlets into the Currituck Sound. William Byrd, one of the commissioners who established the Virginia-North Carolina boundary, stated

"...There was no tide in Currituck until 1713, when a violent storm opened a new inlet five miles south of the old one, since which convulsion the old inlet is almost choked up by the sand, and grows narrowed and shallower everyday"

One of the new inlets carved out by the storm became the location where the Virginia-North Carolina line begins on the Atlantic coast.

**1724 August 23 (Great Gust of 1724):** Almost all tobacco and much of the corn crops were destroyed by a violent tropical storm, which struck Chesapeake Bay. "Violent floods of rain" and "prodigious gust of wind" were seen upon the James river. Some homes were wrecked and several vessels were driven ashore (Ludlum). One ship was wrecked while on the James river. It may have been followed by a second tropical cyclone on the 28<sup>th</sup>, as rains continued in Virginia for days.

**1747 September 15:** The next report of a hurricane in the area came twenty three years after the "Great Gust". A ship load of indentured servants, whose goal was to cross the Atlantic and pay for it with years of servitude, was lost in the Rappahannock river. She was struck just south of Urbanna by a "sudden violent hurricane" and immediately capsized. More than fifty drowned during the storm (Shomette).

**1749 October 19:** A tremendous hurricane tracked offshore Virginia, northeast to Cape Cod. At 1:00 a.m. at Norfolk, winds became violent from the northeast. The fury of the storm peaked between 10:00 a.m. and 2:00 p.m.. In Williamsburg, one family drowned as flood waters carried their house away. At Hampton, water rose to four feet deep in the streets; many trees were uprooted or snapped in two. Torrents of rain flooded northern Virginia and Maryland. The Bay rose to fifteen feet above normal...destroying waterfront buildings.

An account of this tremendous storm was given in the biography of Commodore James Barron, *An Affair of Honor*, by William Oliver Stevens. Barron's grandfather witnessed the hurricane first hand while stationed at Fort George. The account is as follows:

A threatening sky was observed to the southeast over the Chesapeake Bay. The wind increased which soon brought the rain. As the hours wore on the wind and rain increased in fury. Sometimes the downpour slackened. One could hear the sand picked up by the wind from the beach outside and blasted against every object that still withstood the gale. All the while the rising tide was rapidly being piled up to a height never seen before in that area. The waves were pounding on the shore, finally to the very foot of the outside wall at Fort George. A large tree crashed over on its side with its roots in the air and was driven against the land side of the Fort. With the impact the wall yawned and broke. Shortly afterwards the seawall lurched and sank at the point where it was exposed to the wave fury of the storm. Finally the outside wall of the fort gave way, and the filling of sand poured out, leaving the inner wall exposed to the blast without support. When this too fell apart and collapsed, the barracks took the full force of the wind. About sundown, the storm slackened and in another hour the rain and wind had diminished to such a degree that it was clearly spent.

The next morning Commodore Barron swept the distant waters with his spy glass. He was astonished to see across Hampton Roads a wide, sand promontory which had not existed there before. A sand spit had been thrown up during the fury of the storm, which was the beginning of Willoughby Spit.

Another account of the storm given by a letter written at Annapolis, Maryland describes the storm as such:

"...On Saturday October 18<sup>th</sup>, the wind began to blow hard and by 1:00 a.m. (The 19<sup>th</sup>) was very violent from the northeast with rain. The hardest portion of the storm occurred from 10 a.m. to 2 p.m. on the 19<sup>th</sup>. The bay (Chesapeake) rose 15 feet perpendicular, according to one witness. The tide kept fluxing and ran some small craft nearly a mile from common high water and left some in cornfields.

At least four ships were destroyed at the south end of Chesapeake Bay (Shomette). Bodies washed ashore from the shipwrecks for days afterward. Damage in the area totaled £30,000...as currency of the colonies was British. Benjamin Franklin was keeping an eye on this one. It confirmed his hypothesis, the first of its kind, that storms along the coast moved from southwest to northeast (Ludlum).

**1752 October 22:** A storm caused great damage in southern Chesapeake Bay. Only one ship, named *Peggy and Nancy*, was lost during the northeast gale. She was driven ashore on Willoughby Point at 10:00 p.m.. The ship broke up in the morning; only the sails, rigging, and five of her original 338 hogsheads of tobacco could be recovered (Shomette).

**1761 September:** A hurricane of great strength raked the Virginia and North Carolina coasts. The schooner *Good Intent* was overtaken by the storm just after entering the Chesapeake Bay. This storm also carved a new inlet on the northern Outer Banks of North Carolina.

**1761 October:** A major hurricane brushed Cape Hatteras and remained east of the Virginia Capes.

**1766 September 11:** A hurricane struck the Virginia coast.

**1769 September 7-8:** Considered one of the worst storms of the Eighteenth century, this hurricane passed over Williamsburg. Winds increased at 1:00 a.m., blowing a violent gale between 10 and 11 a.m.. Winds increased out of the northwest and continued "until dinnertime". Many old homes and trees were leveled. Heavy rain ruined tobacco crops and flooded roads. Tobacco in storage was also damaged at the warehouse.

Heavy damage was seen in Chesapeake Bay. High winds tore off the top of a wharf at Yorktown; a schooner rammed a nearby storehouse. Four ships in the York river were driven ashore. Two ships on the James River were also wrecked. A vessel from Norfolk, filled with coal from Williamsburg, was forced up to Jamestown before it went to pieces. At least six perished due to shipwreck. The storm tracked northeast along the coast, accelerating as it passed by New England and into Canada.

**1772 September 1:** A tropical storm forced fourteen vessels ashore at Ocracoke Bar in North Carolina with 50 persons perishing. It is likely this storm caused significant winds in southeastern Virginia.

**1773 August 26:** The Virginia Gazette reported a storm in Virginia.

**1775 August 29-September 2 (The Independence Hurricane):** This savage hurricane raged from North Carolina to Newfoundland. Heavy rains began to fall across the colony on the 29<sup>th</sup> of August and slowly increased with time. The coast was ravaged from Currituck to Chincoteague. Wharves and storehouses on the waterfront of Norfolk were devastated. Bridges were carried away by the raging waters. At Williamsburg, mill dams broke and corn stalks were blown flat. Winds blew furiously until 10:00 p.m.

Many ships were damaged as they were thrown ashore at Norfolk, Hampton, and York. Around twenty-five vessels were run ashore, or "irrecoverable gone." The gun ship *H.M.S. Mercury* was driven hard aground on Portsmouth Point at 5:00 p.m. on the 2<sup>nd</sup>. It was stranded in two feet of water for eight days (Shomette). The *Liberty* became "hopelessly stranded" in Back River, near Hampton. A number of locals boarded her, captured the crew, secured her goods, and set the ship afire in the first outright act of war. A full blockade of Hampton Roads thereafter brought shipping to a halt for three months. At least twenty-five died due to shipwreck.

**1776 July 10:** A strong gale played a role in a battle between the Royal Governor of Virginia, Dunmore, and General Lewis of the rebel forces. The royal fleet had been injured prior to the storm by General Lewis' forces and was sailing from Gwynn's Island toward St. George's Island, in the Potomac. The British crew was without water and enduring smallpox when the gale struck.

A flour-laden supply ship ran aground. One ship foundered at the Mouth of the Rappahannock, while another was stranded on the Eastern shore (Shomette). The *H.M.S. Otter*, the Governor's ship, was rescuing another ship in distress. They were rescued just in time. After loading the distressed ship's cargo, the ship sunk. The governor later left Virginia for good on August 5<sup>th</sup>. Many ships in the area suffered damage to their rigging, sails, and anchors. Two vessels were driven ashore in St. Mary's county (Shomette).

**1777 August 10:** A storm of tropical origin affected the North Carolina and Virginia coasts.

**1778 August 12:** A hurricane passed quite near the Virginia coast generally on a track which extended from Charleston, South Carolina through New Bern, North Carolina and was next detected in southeastern New England. It prevented a major naval battle between the British and the French during the American Revolution.

**1781 August 11:** A gale prevailed for forty hours at Wilmington, North Carolina moving slowly northward just inside the coastline. This storm probably affected Virginia as well.

**1781 October 16:** A storm of "unknown character" struck Virginia. The Earl of Cornwallis, at Yorktown, was trapped by the French Fleet and the Patriot Army, under the command of George Washington. The Earl decided to flee to the north to Gloucester Point under the cover of darkness. A "furious storm" doomed the plan to failure, as

seas ran high and every boat was "swamped". He sent forward his flag of truce and surrendered, thus ending the battle (Chapman).

**1783 October 8:** The first of three major storms to affect the East coast that month made landfall near Charleston on the 7<sup>th</sup>. At Richmond, violent winds blew in from the northeast for 24 hours. Norfolk saw a 25 foot rise in the tide, which caused damage there and at Portsmouth totaling around £9000. The reference to 25 foot tides was probably more of a reference to wave heights. This cyclone moved offshore New Jersey and continued past Providence, Rhode Island.

**1785 September 22-24:** The "most tremendous gale of wind known in this country" passed over the Lower Chesapeake Bay and went along a track very similar to the Chesapeake-Potomac Hurricane of 1933. At Norfolk, lower stories of dwellings were flooded. Warehouses were totally carried away by the storm surge, causing large amounts of salt, sugar, corn, and lumber to disappear. A large number of cattle drowned, and people hung onto trees for dear life during the tempest. At Portsmouth, the entire town was submerged. Forrest's book, *Sketches of Norfolk*, offers this account of the storm:

"...This year, 1785, was noted for the highest tide ever before known to Norfolk, completely deluging a large portion of its site on the water side".

Almost all ships in the area were driven from their moorings near Norfolk. Many ships were dismantled as well. The brig *Nancy*, coming from Madiera with a cargo of wine, was dashed to pieces on the Virginia Capes. Only two aboard survived the ordeal. The sloop *Phobe* lost its bowsprit and was laid upon her beam ends. A Dutch ship was found fully loaded, with no one aboard. Vessels floated inland into cornfields and wooded areas. No less than 30 vessels were seen beached after the storm. Damages totaled £30,000. At least two died due to shipping disasters. After ravaging Virginia, the system tracked up the coast to Boston.

**1788 July 23-24 (George Washington's Hurricane):** This storm originated near Bermuda on the 19<sup>th</sup> before making landfall in Virginia. It passed directly over the Lower Chesapeake Bay and Mount Vernon, the home of George Washington. This track is very similar to the track of the Chesapeake-Potomac hurricane of 1933. At Norfolk, winds increased at 5 p.m. on the 23<sup>rd</sup> with the wind originating from the northeast. At 12:30 a.m., the wind suddenly shifted to the south and "blew a perfect hurricane, tearing down chimneys, fences"...some corn was also leveled. In addition, large trees were uprooted and houses were moved from their foundations.

Port Royal and Hobb's Hole experienced a violent northeast gale which drove several vessels ashore. In Fredricksburg, great quantities of corn, tobacco, and fruit were destroyed. Houses and trees fell in great numbers across Northumberland, Lancaster, Richmond, and Westmoreland counties. Crops were destroyed and many livestock perished in Lower Mathews county. Many plantations saw their houses leveled. Homes were flooded with water six feet deep... several inhabitants drowned. Gloucester county was inundated, \$400,000 in damage was incurred.

Historical figures of the time logged the storm's antics. George Washington noted the sinking of the small ship *Federalist* and uprooted trees. Colonel James Madison, father of the future president, experienced the passing of great winds and rains near Orange. In Alexandria, damage to wheat, tobacco, and corn was "beyond description" (Ludlum).

The schooner *Patriot* was stranded and bilged near Portsmouth. The schooner *Serenity* was driven aground at the Portsmouth distillery, proving a total loss. A newly constructed brig, most likely the *Neptune*, was lifted up from here moorings and left in the main street of town. The *Mermaid* was dismantled. The *Favorite* was completely destroyed at Hampton Roads...only two ships in Hampton Roads escaped the hurricane. Many small craft were "torn to pieces".

**1795 August 2:** A hurricane which passed through North Carolina passed to the south of Norfolk. A ship foundered off Cape Charles. Heavy rains in northwestern Virginia flooded Winchester and Martinsburg. Roads were impassable beyond Baltimore, disrupting mail service. A large amount of corn and hay were in ruin. Mills and mill

dams were swept away. Great damage was noted across Culpeper and Orange counties. It then recurved across Maryland and passed south of New York City to Halifax. Several vessels were lost off Norfolk. The brig *Esther* was lost, with most of her cargo from Jamaica, twenty-five miles south of Ocracoke Bar.

**1795 August 12-13:** A major hurricane...only ten days after the previous storm...struck North Carolina and produced high winds as far inland as Winston-Salem. At Monticello, near Charlottesville, Thomas Jefferson noted that the loss of soil from the heavy rain thus far that month could be "modestly estimated at a year's rent" (Ludlum). A "powerful torrent of rain" deluged Petersburg; creeks were at their highest point of the past 70 years.

**1797 September 5-6:** A sloop was lost at Currituck Inlet on the 5<sup>th</sup> during a storm. The sloop *Betsy* was returning from Cape Hatteras during the 6<sup>th</sup>. In sight of the Cape Henry lighthouse, she "was obliged to bare away in a gale of wind" (Chapman).

### NINETEENTH CENTURY

**1803 August 29:** The schooner *Jupiter* sprung a leak off the Virginia Capes in heavy seas during a storm off the Virginia Capes, before heading into the Chesapeake. As the ship was sinking, the captain jumped overboard, but was pulled into the whirlpool created by his sinking ship and drowned (Chapman).

**1804 September 8 (Antigua-Charleston Storm):** This system was first spotted near the Northern Leeward Islands on the 3<sup>rd</sup> and moved west-northwest, to very near the Florida coast. It then moved inland near Charleston with disastrous consequences, before moving northeast along the coast of the Atlantic Seaboard.

**1804 October 9 (New England's Snow Hurricane of 1804):** At Norfolk, winds shifted from Force 3 southwest (on the Beaufort scale) to Force 6 northwest by 2 p.m.. A schooner *Rising Stakes*, off Cape Henry, went through the "dreadful squall" at 11 a.m.. The system passed through Chesapeake Bay, then inland between Philadelphia and Atlantic City before moving onward to New York City and Boston. Eight perished offshore.

As it passed through the Northeast, it became a nontropical low as cold air rapidly enveloped the circulation of the cyclone. Snow fell from the hills of Connecticut northward into Canada. As much as 24 to 30 inches of snow fell in the Berkshires of Massachusetts...which in a wet snow could be approximated to six inches or more of liquid precipitation. This was the first reference to snow involved with a landfalling tropical cyclone, but not the last, as the reader will see later on in this history.

**1806 August 21-23 (Great Coastal Hurricane of 1806):** The appearance of the weather from the 20<sup>th</sup> indicated a nearby storm. Heavy squalls broke upon the bar off Norfolk. A hurricane which went inland in South Carolina took 36 hours to go through North Carolina. The system accelerated into the offshore waters of Virginia.

A gale developed out of the north-northeast on the 22<sup>nd</sup> before noon. At Norfolk, the wind blew with "great violence" out of the north between midnight and 3 a.m.. A considerable amount of rain fell. A "long and uncommon" drought in Petersburg was ended by the cyclone (National Intelligencer). This saved the corn crop. Several new buildings and chimneys were blown down. Two vessels were grounded.

The hurricane caught British and French ships off guard, while engaged in the Napoleonic Wars in the U.S. shipping lanes. The British man-of-war *L'Impeteax* drifted under jury masts for 23 days before finally beaching near Cape Henry. The ship *Atlantic* and brig *Martha Bland* were driven ashore. The vessels *Haleyon*, *Hope*, and the Revenue cutter schooner *Eagle* went ashore at James Island.

Ships of the two warring nations put in for repair and refitting at the port of Norfolk after the storm. This hurricane, due to its slow movement and consequent erosion of the coastline completed the creation of Willoughby Spit. A seawall built to prevent further erosion at Smith Point lighthouse was damaged.

**1806 September 28-29:** The first signs of the system were seen in Georgia, when several days of heavy rain fell at Augusta, Georgia on the 25th (National Intelligencer). Gales began from the northeast during the night of the 28<sup>th</sup> at

Norfolk. Winds became southeast in the morning before shifting to the west, as the center moved inland of the coastline. Tides rose "uncommonly high". The schooner *Charming Mary* fell victim four leagues north of Chincoteague, with many of her masts seen above the waterline after her sinking (Chapman).

**1808 September 12:** A hurricane again damaged the seawall surrounding Smith Point lighthouse. The ship *Mary* was destroyed during the gale, while anchored at Baltimore.

**1813 August 27-28:** A hurricane struck Charleston and spread gale force winds as far north as Maryland. An all-day easterly gale was seen in the Upper Chesapeake Bay on the 28<sup>th</sup>. A north-northeast wind began on the 27<sup>th</sup>. By 10 p.m., it shifted to southeast, accompanied by squalls. As winds became southwest, strong winds buffeted the region until 1 a.m. the 28<sup>th</sup>. By 11 a.m., winds were dying and the sun was shining once more. The U.S. schooner *Carolina* went ashore near James Island.

The War of 1812 was in progress. A large prison ship, with 50 passengers aboard composed of the British schooner *Dominico*, parted cables and was driven into the marsh of James Island by the gale (Chapman).

**1814 August 24-25 (Burning of Washington):** A very hot day accompanied the retreating of Federal troops from the Capitol. As Dolly Madison and an armed escort stopped in Tennallytown (Tenlytown) during their retreat, a strong wind accompanied by dark clouds rolled over Washington county. Winds near hurricane force and a prolonged downpour added to the drama of the day. The rains were helpful, as they helped firefighters quench the fires set by the British (Helm). The weather signs mentioned point to this either being a severe thunderstorm, or a tropical cyclone.

**1815 October 24-26:** On the 18<sup>th</sup>, a powerful hurricane struck St. Bartholomew in the Caribbean Sea. By the 24<sup>th</sup>, it progressed west and northwest to a position east of Chesapeake Bay. The schooner *Friendship* was knocked on her beam ends by unfriendly winds and seas. For 48 hours, the storm passed offshore, delaying ship arrivals into Norfolk with its strong northwest wind (Chapman).

**1816 September 18:** A tropical storm affected Virginia before moving northeast into New York. Heavy rains caused the James river in Richmond to rise only an inch or two lower than the High Fresh of 1814. Flood waters invaded the first floors of area homes. One bridge was submerged, cutting off travel (Chapman).

**1817 August 8-9:** A tropical storm with heavy rain moved through the state. At Norfolk, floods to the north delayed the passage of mail. The gale moved slowly northeast, reaching New York on the 12<sup>th</sup>. (Chapman)

**1821 September 2-3 (Long Island Hurricane):** One of the most violent hurricanes on record. A fast moving hurricane traveled from Puerto Rico to Norfolk in only two days. The storm passed by Turks Island in the Bahamas on the 1<sup>st</sup>. This hurricane moved inland near Wilmington, North Carolina the following day. The center then tracked west of Ocracoke but east of Edenton. In Currituck, N.C. all but a half dozen houses were destroyed and several people killed.

It was a "tremendous storm", causing great wind damage and damaging ships in the harbor. At Norfolk, rains began at 6 a.m.. By 8 o'clock, a northeast gale ensued and increased in intensity to hurricane force by 11:30. By 12:30 p.m., rains ended; conditions were beautiful by mid afternoon. An account from the *Norfolk Herald* described the storm as such:

From half past 11:00 until half past 12:00, so great the fury of the elements, that they seemed to threaten a general demolition of everything within their reach. During that period the scene was awful. There was the deafening roar of the storm, with the mingled crashing of windows and falling of chimneys, while the rapid rise of the tide threatened to inundate the town. The continuous cataracts of rain swept impetuously along darkening the expanse of vision and apparently confounding the heaven, earth and seas in a general chaos; together with now and then a glimpse caught through the gloom, of shipping forced from their moorings and driven with rapidity, as the mind might well conjecture in such a circumstance to inevitable destruction. (Ludlum).

Trees were uprooted. Part of the front of the Episcopal church was blown in; its organ left in ruin. The courthouse was partially unroofed. Several new homes suffered complete destruction while many others experienced damage. The new stone bridge on Granby Street was damaged by the incessant banging of heavy timbers against it. The tides inundated the ground floors of all the warehouses on the wharf lining the Elizabeth River. The waters surged as far inland as Wide Water Street some several hundred yards from the river. The surging waters of the Elizabeth River swept away the bridge on Catherine Street. The drawbridge across the Elizabeth river was swept away. The U.S. Frigates *Congress* and *Gurriere* were grounded while numerous other brigs, schooners, and smaller ships suffered an untimely demise.

Crops were destroyed in the vicinity of Chesapeake Bay. At Chincoteague, waters surrounding the island were evacuated such that miles of sandbars lay exposed to the air, as winds were initially offshore. The following is an account of what happened next from Howard Pyles, written in 1876:

"...then a dull roar came nearer and nearer, and suddenly a solid mass of wind and rain and salt spray leaped upon the devoted island with a scream. Great pines bent for a moment, then, groaning and shrieking, were torn from their centuried growth like wisps of straw and hurled one against another; houses were cut from their foundations and thrown headlong; and then a deeper roar swelled the noise of the tempest, and a monstrous wall of inky waters rushed with the speed of lightning toward the island. It struck Assateague, and in a moment half the land was a waste of seething foam and tossing pine trunks; and the next instant it struck Chincoteague, and in an unbroken mass swept away men and ponies like insects; rushing up the island, tearing its way through the stricken pine woods." (Barnes & Truitt)

At Pungoteage, a ten foot storm surge led to "unexampled destruction". Damage spread north with the storm into New York and New England over succeeding days. It was considered one of the most violent hurricanes on record... with damage totaling \$200,000 in Virginia. Five drowned at Chincoteague.

**1822 September 27-28:** This hurricane struck Charleston, then moved through central North Carolina and western Virginia, accompanied by a "tropical deluge". Richmond had endured a long drought until this storm visited the region. "Very copious rains" and "equinoctial winds" quickly ended the drought. Flash flooding occurred on the James River, rising feet in depth in a matter of one hour (Washington Gazette). Mail south of Richmond was unable to be delivered for three days, as the storm rendered roads impassable. At Monticello, near Charlottesville, Thomas Jefferson's granddaughter noted that a violent storm broke branches and felled one of their willows. At Lynchburg, winds uprooted trees and toppled chimneys. Along the Staunton River, rains began on the 27<sup>th</sup> and continued until 9 a.m. the next day. The river rose to "the greatest height ever known" (Chapman).

**1825 June 3-4:** Forming before what is nowadays considered as the beginning of the hurricane season, a severe tropical storm tormented the Atlantic seaboard from Florida to New York City. It was first sighted near Santo Domingo on May 28<sup>th</sup> and moved across Cuba on June 1<sup>st</sup>. Gales began at St. Augustine as the cyclone approached U.S. soil on the 2<sup>nd</sup>, and at Charleston on the 3<sup>rd</sup>.

It raked Norfolk with "undiminished violence" for 27 hours from the morning of the 3<sup>rd</sup>, as the storm passed by to the east. The wind came in "flaws". Trees were uprooted. At noon on the 4<sup>th</sup>, stores on the wharves were flooded up to five feet in depth. High winds howled through Washington D.C.. Along with a cold rain, winds leveled crops. The storm then moved northeast past Nantucket on the 5<sup>th</sup>.

An account of the storm was given by Ann Waller Tazewell, wife of the then governor of Virginia in a letter to her son. She describes the storm as such

"...The rain commenced on Friday morning (3<sup>rd</sup>), and continued pretty steadily all day, at night the wind blew so hard that this house rocked considerably. I was so much alarmed as to be unable to sleep but very little - I thought of my flowers, but could not expect anyone so much as to look after my cows or anything, as the rain fell in torrents, and the wind came in flaws, which made it like thunder yesterday (4<sup>th</sup>) the storm continued until five in the evening, there was a strong northwest wind all day, and the highest tide I ever saw in my life. The wind and tide together tore down all our enclosures at the other lot, upset our cow-house and then dashed it to pieces, tore up some of the wharf logs, upset the Temple there, and drifted it into the flower garden.....We sat at the front windows witnessing the destruction all the time it was going on. Our front lot was two thirds covered by the tide. Some vessels that we saw pass rapidly by, were driven ashore at the Hospital Point (Portsmouth)....."

Ann Tazewell later compares the storm to the great gale of September 1821 in this following passage: "....Such a storm was never experienced here before, by anyone that I have heard speak of it. It is thought to have been far worse than the September gale of 1821." Mrs. Tazewell's letter also mentions that they could not prepare dinner since the tide level was even with the kitchen floor.

An account of the storm as given by the Norfolk and Portsmouth Herald described the storm as such. It is interesting to note the contrasting opinions between the Norfolk and Portsmouth Ledger and the letter from Mrs. Tazewell regarding the comparisons between this storm and the September gale of 1821

....It is uncommon to hear of violent storms and hurricanes on any part of our extensive coast in the month of June; but we have to notice a visitation of stormy weather, which commenced about 9 o'clock on Friday night (3<sup>rd</sup>), rarely if ever equaled within the life span of the oldest inhabitant. The storm of the 3<sup>rd</sup> of September 1821 was perhaps more violent but it only lasted three or four hours, while this storm continued with undiminished violence, from the hour we have stated until 12 o'clock on Saturday night (4<sup>th</sup>), or about 27 hours. The wind at the commencement of the storm was northeast and so continued until about 12 o'clock on Saturday, when it began to haul gradually to the northwest and westward, and held up at southwest....

According to this account, the tides in this storm were higher than those in the September gale of 1821.

....considerable damage was done by the high tide which rose at least eighteen inches higher than it was known to be within the last forty years. The highest pitch of the tide was at 12 o'clock on Saturday, at which time the stores on the wharves generally were inundated from the depth of three to five feet, and the water extended up to the doors on the north side of Wide Water Street. The whole Town Point to within a few feet of Main Street was over-flown, as also was that part of town extending eastward from Market Place to the Drawbridge, the water rising considerably above the line of Union Street. In most of the stores on the wharves, all articles liable to be damaged by the tide were found (too late for remedy) that the precaution was unavailing in consequences of the unusual rise of the tide, and the articles were of course damaged....

**1827 August 24-27 (St. Kitts Hurricane):** A hurricane originating near the Windward Islands struck Cape Hatteras, before moving northeast offshore Virginia, Maryland, and New England. The track of this storm was to the east of Norfolk. Initial reports from Wilmington, N.C. indicated that this was a storm of great intensity as it passed by to their east. One report gave an account of waves over the top of garden fences some 6900 feet from the beach. Other reports indicated storm tides greater than 10 feet above normal levels. The town of Washington, North Carolina, on the western end of Pamlico Sound, reported water levels 12 to 15 feet above ordinary levels.

The following first hand account of this storm in Virginia was from the Tazewell Papers in the Virginia State Library. Henry Tazewell wrote to his brother John in New York and described the storm as such.

"....A severe gale which continued for three days changed the climate here entirely and persons are clad generally in full suits of winter clothing; the same gale has done great injury to shipping and to present crops. The fodder is worthless and the corn in many places is much broken by the wind."

The Norfolk newspapers, The American Beacon and The Norfolk Herald reported little in the way of tidal damage in this storm due to an ebb tide. There was much less damage to property in the area than in the memorable 1821 gale, but this storm was almost as violent as that gale.

Both papers reported a gale of wind which was accompanied by a copious fall of rain. The gale

"...commenced in the forenoon of August 25<sup>th</sup> and continued to increase until the evening, when it blew tremendously. About midnight, the rain ceased and the gales somewhat abated, though it continued to blow fresh all day on the 26<sup>th</sup>."

At the height of the storm, winds unroofed a two story building on Talbot street in Norfolk and commenced to blow away the second floor of the building. Livestock was swept away in large numbers. Corn was leveled at Belleview...a mill dam was torn to shreds and the bridge over it was swept away. The sloop *Flag* capsized on the Middle Ground of the Chesapeake; the vessel had no survivors. The brig *Liberty* of Boston broke away and drove itself ashore, on the south side of Portsmouth. The schooner *Mulberry* saw its bow stove in, shrouds and jib-stay carried away, and jib torn off while off Common's Marshes. A "considerable quantity" of cargo was thrown overboard to prevent it from sinking. "Considerable mischief" was caused by the tempest as far north as Baltimore.

**1829 August 26-29:** A tropical storm of considerable strength moved northward through eastern North Carolina and Virginia, accompanied by a tornado near Sunbury, North Carolina in Gates County. Torrential rains were reported in Norfolk. At Georgetown, the rice crop experienced great injury. Santee also saw damage. A vessel fifty miles east of Chincoteague was dismantled. The American Beacon reported the following account from this storm.

"...The earth is completely saturated and the grounds covered in water, while the roads, in many places, are rendered impassable by the rise of the water courses." (Chapman)

**1830 August 16-18 (Atlantic Coast Hurricane):** This hurricane passed northeast of the Caribbean Sea and tracked west north-west to a point very near Daytona Beach, Florida before recurving to the north and northeast. The center made landfall on the morning of the 16<sup>th</sup> near Cape Fear and moved back out into the Atlantic by nightfall. The area's three-month drought came to a sudden end. Complete damage was done to corn crops as a considerable amount of rain fell.

A number of ships that arrived at Alexandria on the 22nd spoke of a severe gale on the 18th...one lost its topsail. The schooner *Dove*, while thirty miles east of the Virginia Capes, experienced a severe hurricane and lost most of her upper works. On the morning of the 19th, an empty ship in full sail was seen just off the Virginia coast.

**1833 August 24:** As a rare act of foreshadowing, a northeast gale detained around 100 vessels at Norfolk. This system passed well off of the Virginia coast. Unlike the storm exactly a century later, no damage was reported (Chapman).

**1834 September 5:** A hurricane that struck the North Carolina coast also created problems for Virginia. A "severe" northwest wind capsized the schooner *E. Pluribus Unum*, laden with stones. The crew escaped with their lives. The schooners *Susan* and *George Wheaton* bumped into each other at Newport News. The *Susan's* upper work was carried away (Chapman).

**1837 August 18-20 (Calypso Hurricane):** A hurricane which skirted the North Carolina Outer Banks also affected Virginia. Damage was considered lighter than at Wilmington, where bridges washed out during the storm. This was referred to as the worst storm in Norfolk since 1822. The storm was observed east of the West Indies on the 13<sup>th</sup>, moved into the central Bahamas on August 16<sup>th</sup> and began to affect the North Carolina coast on the 18<sup>th</sup>, where the Norfolk newspapers reported it had continued with unusual severity for forty-eight hours.

The *Norfolk-Herald* offers this account of the storm.

"...One of those cracking northeasterly blows commonly called "September gales" which, however, more frequently visit our coast in August commenced here on Saturday the 19<sup>th</sup>, but as our harbor is completely sheltered "land-locked", we believe the sailors call it, none but the weather-wise had any idea that it was blowing a gale outside, until 11 o'clock at night, when the symptoms of a regular-built gale were easily recognized in the roar and rustle which it kept up, and the splashing of the torrents of rain which it drove before its streamed flows. This strife of elements continued until 12 o'clock Sunday the 20<sup>th</sup>, when the wind hauled around to the northwest but without clearing off and continued to blow a heavy gale from that point, accompanied with rain the remainder of the day."

The *American Beacon* offers this account of the storm.

"...The weather on Saturday morning (19<sup>th</sup>) indicated a gale. It commenced raining that morning and continued but with little intermission, until about 3 p.m. the next day. The wind blew fresh from the northeast all day Saturday, and at night increased to a gale, blowing down fences, trees, chimneys and prostrating the corn....In walking the streets after the storm, it was melancholy to see some of the stoutest trees prostrated. The tide is very high."

**1837 October 8-9 (Racer's Storm):** This hurricane was named after the British sloop-of-war, the *H.M.S. Racer*, which encountered it on September 28<sup>th</sup> in the central Caribbean Sea. It was the tenth known storm of that destructive season. After moving northwest into the far western Gulf of Mexico, the storm slowly recurved along the coasts of Texas and Louisiana before it struck Venice, Louisiana on the 7<sup>th</sup>.

The system then passed back out into the Gulf before making a second landfall near Pensacola late on the 7<sup>th</sup>. The storm moved northeast and went off the East Coast near Wilmington late on the 9<sup>th</sup>. Norfolk experienced a northeast gale on the 8<sup>th</sup> and 9<sup>th</sup>. This prevented steamboats from leaving their docks.

**1839 August 29-30:** A tropical cyclone which struck Charleston on the 28<sup>th</sup> passed through eastern North Carolina on the 29<sup>th</sup> and then Norfolk just past midnight that night. The hurricane raged until 3 p.m..

**1841 October 3-4:** An intense hurricane raced through the shipping lanes offshore the Mid-Atlantic. On the western fringe of the cyclone, several ships were beached at Cape Henry. The system went on to devastate eastern New England, when cold air encircling the increasingly nontropical storm led to "a violent storm of snow and sleet" at New Haven, Connecticut.

**1846 September 8:** This hurricane created Hatteras and Oregon Inlets.

**1846 October 12 (Great Havana Hurricane):** The Great Havana Hurricane struck the Florida Keys with great violence before moving northward, inland of the Eastern seaboard. It destroyed the Old Key West lighthouse; fourteen inside the structure perished (DeWire). The Potomac at Alexandria and Washington D.C. reached its highest heights in 20 years. Tides at Washington, D.C. rose to 6.9 feet above low water datum. Extensive damage was seen as far north as Baltimore, Philadelphia, and New York.

**1850 July 18:** The first of three hurricanes to affect the upper Eastern Seaboard moved into North Carolina on the 18<sup>th</sup>. As it moved north, Chesapeake and Delaware Bays took a beating as high waves and tides flooded the coast. It moved almost due north into central New York state.

**1850 August 24:** A powerful Gulf hurricane struck Apalachicola on the 24<sup>th</sup>; a great storm surge inundated the northeast Gulf coast. As the system moved north, enormous amounts of rain fell from Georgia northward to Virginia. Major flooding occurred along numerous rivers. The Dan rose to a level twenty feet above normal. The cyclone continued northeast, causing damage in its wake through New England (Barnes II).

**1851 August 24-25 (Apalachicola Storm):** A hurricane moved across the Greater Antilles past western Cuba on the 22<sup>nd</sup>, then moved north to strike Apalachicola with a high storm surge on the 23<sup>rd</sup>. Thereafter, the storm tracked through Georgia and the Carolinas, moving into northern Chesapeake Bay on the night of the 24<sup>th</sup>.

High southeast gales made it the worst storm in thirty years for the region. The wheelhouse of the *Osceola* was torn away and blown overboard. Crops and small buildings were leveled. The system continued moving northeast offshore Nantucket, before making its final landfall in Nova Scotia.

**1854 September 7-9:** A very destructive hurricane swept the East Coast from Florida to New York. Norfolk experienced the force of the storm on the 9<sup>th</sup>.

**1856 August 19 (Charter Oak Storm):** This weather disturbance was first noted in Virginia. Washington D.C. had east and southeast winds throughout the day, accompanied by heavy rain.

**1856 September 1:** This storm went through the interior of the Southeast before affecting Virginia. At Norfolk, the gale was considered an equal of the 1846 hurricane. It began at 4 a.m. and raged throughout the day. The spire of the Baptist church was blown off. A twenty year old tree met an untimely fate at Portsmouth. Much damage occurred at the Navy Yard.

**1861 October 28 & November 2 (Expedition Hurricane):** Occurring during the first year of the Civil War, an expedition by "the largest fleet of war ships and transports ever assembled" started at Fortress Monroe, inside the entrance of the Chesapeake Bay. As the ships were assembling, high winds and gales played havoc with their coordination, just prior to setting sail. The fleet was hit by another storm on November 2<sup>nd</sup>. Two vessels were sunk off the Carolina Capes. This second system continued northeast to Boston by late that day.

**1872 October 25:** A storm from the Gulf of Mexico moved across North Florida, before striking Charleston and moving up the Appalachians. Very heavy rains of four to eight inches drenched areas around Norfolk, with the 6.29" on the 24<sup>th</sup> at Norfolk setting a daily rainfall record.

**1874 September 28-29:** This hurricane struck southern North Carolina. It entered Virginia west of Norfolk. It was the first hurricane ever represented on a weather map (Barnes II).

**1875 September 18-19 (Indianola Hurricane):** The first of a series of hurricanes to end Indianola, Texas' reign as one of the leading ports in Texas, this system tracked through the Caribbean and Gulf of Mexico before striking the unlucky port on the 16<sup>th</sup>. The storm made a sharp right-hand turn through the Southeast, re-emerging into the Atlantic on the morning of the 19<sup>th</sup> in the vicinity of Chesapeake Bay.

**1876 September 16-17:** This hurricane moved over the Greater Antilles, and recurved just off the coast of West Palm Beach, before finally coming ashore near Cape Fear. As the system tracked through Interior Virginia, it brought a five minute sustained wind of 78 mph to Cape Henry and dumped 8.32" of rain. The 7.18" that fell on the 16th set a 24-hour rainfall record for September. High tides were seen at Washington D.C., when the level rose to 7.9 feet above low water datum. Average 5 minute wind speed at Cape Henry was 78 mph.

**1877 October 3-4:** A storm was first seen near St. Vincent and Grenada in the eastern Caribbean Sea...the island of Curacao was devastated. The hurricane then moved through the Caribbean Sea and the Gulf of Mexico before making landfall at Panama City Beach, Florida. It then moved north and northeast across the Carolinas, before moving out to sea near Norfolk. During the year 1877, tropical storms accounted for eleven inches of rain in the Norfolk/ Hampton Roads area.

After causing extensive flooding across North Carolina, heavy rains established floods of record. Along the James river, Lick Run (33 feet), Buchanan (34.9 feet) and Cartersville (30.4 feet) ran well above flood stage. Washington, D.C. set a 24-hour rainfall record for the month of October when 3.98" fell on the 4th. Many ships were wrecked all along the Atlantic coast, Chesapeake, and Delaware Bays. The cyclone continued northeast towards Newfoundland.

**1878 September 12:** As this tropical cyclone moved through the Caribbean, hundreds of lives met an untimely end. It tracked west, then northwest, moving due north from the Florida Keys to Lake Erie thereafter. Five significant tornadoes were recorded (Watson). At 1 p.m., the first tornado touched down southeast of Petersburg. The second tornado in Dinwiddie county was more destructive as it moved through Ford's Depot. Trees were leveled, while small homes and a barn were destroyed. Other tornadoes wrought havoc in Henrico county, Nottoway, and Goochland. The Goochland tornado tracked 28 miles after it descended around 4 p.m. (Watson). A great many ships were disabled and wrecked.

**1878 October 23 (Gale of '78):** One of the most severe hurricanes to affect eastern Virginia in the latter half of the 19<sup>th</sup> century struck on October 23, 1878. This hurricane moved rapidly northward from the Bahamas on October 22<sup>nd</sup> and struck the North Carolina coast late that same day moving at a forward speed of 40 to 50 mph. The storm continued northward passing through east central Virginia... Maryland and eastern Pennsylvania. To find out what it did to the Eastern Seaboard, check out the [Gale of '78](#) website.

Winds began to freshen at midnight, reaching gale force at 2 a.m.. Immense waves broke over the upper deck of the steamer *Express*. Winds reached hurricane force at 4 a.m.. The ship then wandered through the middle of Chesapeake Bay. The barometric pressure fell to 28.78". The five minute sustained wind reached 84 mph at Cape Henry. At 5 a.m., waves tore away the saloon deck and flipped the ship on her side. After rolling completely over, survivors gathered timber to make a tiny escape craft. It sank immediately. The Quartermaster was rescued at noon that day, twenty miles from the scene of the wreck. The weather map above is from just after the time of the shipwreck, reconstructed from the original U.S. Signal Service data, obtained from the Library of Congress.

The steamboat *Shirley* was driven ashore Barren Island. A schooner in Chesapeake Bay was reported to have drifted into the woods. Cobb and Smith Islands were completely submerged during this storm. The *A.S. Davis* went ashore at Virginia Beach, killing 19. At least 22 ships met their demise in this hurricane.

Damage from this hurricane was widespread along the East Coast. Many of Virginia's life saving stations were damaged, with one lifted from its foundation and moved half a mile. An account of the storm's effects in the Norfolk area was provided by the Norfolk Landmark.

"...Only strong willed people could sleep while dwellings so violently oscillated with the ravings of the tempest Tuesday night (22<sup>nd</sup>). At an early hour a severe gale sprung up from the northeast and by 9 o'clock old Boreas was knocking things around town in a lively style. The rain came down in torrents and the streets at times were a driving sheet of water. Yesterday morning (23<sup>rd</sup>), after the abatement of the storm it was found that considerable damage and loss was involved in the destruction of various sorts of property around the city and vicinity. The maddening fury of the elements will long be remembered as making one of the most severe storms in the annals of our city's experience...."

There is another first hand account of the storm from Mr. Bolton, an employee of the U.S. Signal Service, an early version of the National Weather Service. Mr. Bolton was a repairman of the telegraph line between Cape Henry and Kitty Hawk and was stationed at the Life Saving Station No. 3 in False Cape.

"...I was at the station when the gale, which proved so disastrous to human to human life commenced. A severe rain storm has prevailed all day Tuesday (22<sup>nd</sup>) but the gale did not reach the station until 9 p.m. It rapidly increased in velocity until it almost became a hurricane. The members of the crew at this station, whose duty it is to patrol the beach that night, performed their duties with the upmost difficulty, as they could scarcely make any headway against it, and often had to cling to some stationary object like a telephone pole to prevent themselves from being carried away at the mercy of the fearful tempest..."

Mr. Bolton described the wreckage of the ship *A.S. Davis*, which had sunk off of present day Virginia Beach.

"...The debris was thickly scattered along the beach for a distance of fully 4 miles...I proceeded to Cape Henry, Virginia to assist the Signal Officer there. The body of one of the crew was there. About 1 ½ miles south of Cape Henry the bodies of eleven of the crew had been washed ashore....During the heaviest part of the gale, the wind at Kitty Hawk, North Carolina registered 100 mph. The instrument itself was finally blown away and therefore no further record was made. It was the severest gale that had occurred on this coast for sometime."

**1879 August 18:** An extreme hurricane moved north and went on the rampage from the Bahamas to Eastport, Maine (track to the right). In the immediate Mid-Atlantic region, the track of this storm ran very close to a Wilmington - Elizabeth City, N.C. axis to just southeast of Norfolk. It was considered one of the most severe to strike coastal Virginia in the last half century and was probably as severe as the June 1825 storm.

The passage of this storm was accompanied by a rapid pressure fall from 29.58 inches at 9:00 am to 29.12 inches at 11:15 am on the 18<sup>th</sup>, which was the lowest pressure observed in the storm. Five-minute sustained winds rose to 76 mph with gusts toward 100 mph at Cape Henry, before the anemometer was destroyed. The tide at Norfolk rose to 7.8 feet above mean lower low water. Dozens of ships were damaged from the Carolinas northward to Cape Cod. The rainfall from this storm was one of the heaviest in the history of Norfolk, 6.17 inches, with 6.03 inches falling on the 18<sup>th</sup>...of which 5.13 inches fell in just over 9 hours. On the next page is a chronology of Observations taken at Norfolk, Virginia during the August 1879 hurricane.

The Norfolk Virginian described the "red-letter" storm in the following account.

"...Yesterday (18<sup>th</sup>) was one of the red letter days in Norfolk's history. It was the occasion of one of the severest storms which have ever visited this section. The severity of the wind and the extent of the rains were such as have never been experienced in Virginia, and we doubt if the hurricanes of countries subject to such inflictions as visited Norfolk yesterday, have ever suffered to a greater extent from the ravings of the storm than did our city for a number of hours.....

....In the early morning the wind blew from the northeast with a strength which betokened a settled rain storm and gave everyone acquainted with our climate to understand that a bad day and heavy blow was to be expected. As the day wore on the wind became more boisterous....

....At about ten o'clock the wind had gained such strength that it was dangerous to appear on the streets, while the rain fell in such torrents that it was most disagreeable to do so.....the wind swept along with prodigious strength while the rain fell in torrents, which inundated wharves, streets and the lower floors of a number of buildings. About eleven o'clock it had reached its height, and dealt destruction on every hand. Roofs were blown off houses, trees were up-rooted, wharves destroyed and other injuries to properties inflicted....

....Water street was inundated and boats were to be seen on the water from the western terminus to Market Square. It is almost impossible to describe the appearance of the city at that time, with its frightened inhabitants running to and fro, the debris scattered along the streets and the wind playing havoc with the signs, trees, roofs, etc.

Several ships had run aground in the harbor between Norfolk and Portsmouth. The steamer *N.P. Banks* was run aground not on the flats of the Norfolk Naval Hospital (in Portsmouth) but on the very grounds of the hospital itself due to the excessive tides. The ferry boat *Berkeley* filled and sank in her dock on the Berkeley side of the river. The schooner *John C. Henry* foundered off Gwynn's Island.

The storm was described in Portsmouth as the most terrific storm to have visited the area in many years. From the Norfolk-Portsmouth Herald:

"....As early as 3 a.m. the rain began to fall in torrents, and the wind rising about the same time, increased in violence until it reached its height between 10 o'clock and noon. To those on shore and in a safe place, if such a place can be found, it was indeed a terrifically grand sight, one not often seen in this harbor, and seen once suffices a life time. The high wind brought in the waters of old ocean, wave piled upon wave until our wharves were submerged, our streets flooded and converted to many places to temporary canals, the tide being the highest ever known. On the waterfront exposed to the full play of the wind and wave, the sight was best seen. At the northward of North Street the waves dashed against the breakwaters, throwing the spray as high as the neighboring houses, while in the harbor and river the wind striking the caps of the waves filled the atmosphere with a fine mist like spray, so that at times it was impossible to see Norfolk, Berkeley or the ships in the harbor...."

**1879 October 19-22:** At Cobb's Island, a steady rain began on the 19<sup>th</sup>. Offshore, high winds and seas had already led to the destruction of the *Ellie Bodine*, a schooner, 4 ½ miles south of Smith Island. North winds shifted to the southeast late on the 21<sup>st</sup> at Cobb's Island. By 9 p.m., hurricane force winds overspread the islands and "shrieked in its mad glee". Tides rose past the high water mark around midnight. Bath houses were swept away. The coast guard's house began drifting inland with the storm surge.

At 4 a.m., the New York House was destroyed. By 5 a.m., water briefly invaded the Cobb Island Hotel, then the waters began to recede. Several cottages were no longer on the island. Sand dunes rose where none stood before. It took several years before the island recovered from the hurricane (Barnes & Truitt).

**1881 September 9:** For the first time in 33 days, rain fell at Washington D.C.. Wires from Wilmington, North Carolina south were downed by this "tropical hurricane".

**1882 September 10-11:** A tropical cyclone moved across Cuba and the Gulf of Mexico before striking the Florida panhandle. It crossed Georgia, the Carolinas, and went offshore near the lower end of Chesapeake Bay. On the Washington and Western railroad, a portion of the trestle work was washed out by heavy rains. At Amherst, a

landslide delayed rail traffic for 5 ½ hours. Several bridges on the Alexandria and Fredericksburg railroad were "injured" by the deluge. The gale caused mischief to shipping off the Northeast and Nova Scotia.

**1882 September 21-23:** This tropical storm formed near the northern Bahamas and moved north into North Carolina near Cape Lookout. Along the Lower Rappahannock, the "protracted and destructive rain storm" swept away four mills near Ware's Wharf. The brunt of the cyclone only extended fifty miles inland. Heavy rains were also seen at Washington, D.C.. It then moved into Chesapeake Bay before moving out to sea on the 23<sup>rd</sup>. Eleven inches of rain were measured at Philadelphia. Extensive flooding was reported from North Carolina northward to Massachusetts.

**1883 September 12:** A "protracted drought" was ended across Virginia on the 11<sup>th</sup>, as the rains from this tropical cyclone reached the Old Dominion. Unfortunately, it came too late for the peanut crop, which had already failed. A train wreck which occurred on the Norfolk and Western railroad near Nottoway Court House Station may be attributed to this cyclone. Ten freight cars were derailed. The schooner *E.C. Knight Jr.* wrecked near Cape Henry.

**1885 August 25:** Floods accompanied this storm as it passed by the area. Copious rains fell in Baltimore, dropping the temperature 24 degrees in two hours. Flooding rains were seen across Maryland. In Maryland, lightning set fire to a residence in Ellicott City (\$16,000 damage). On the steamer *Arrowsmith*, just offshore Cedar Point, high seas and a strong gale burst the bulkhead of the wheelhouse. For twenty minutes, the crew worked feverishly to fix the ship, which made it to Washington, D.C. only an hour late.

**1885 October 12:** A tropical system moved from southwest of Florida northward into the panhandle, reaching southwestern Virginia around midnight on the 12<sup>th</sup>. A large sea lion escaped its pen during the cyclone, and was last seen swimming down the Chesapeake.

**1886 June 22:** At Lynchburg, a "terrific rain" led to street flooding, setting a new record for the wettest June at the site (5.44"). In Washington, D.C., 4.16" of rain fell on the 22<sup>nd</sup> alone, setting a 24-hour rainfall record for June.

**July 1-2, 1886:** Two days of heavy rain led to flooding in southeast Virginia. The James at Richmond was ten feet above the high water mark, submerging all wharves, and leading to evacuations. Several trestles on the Richmond and Allegheny railroad were washed away, hampering travel. Washouts on the Richmond and Danville railroad led to a further stoppage in travel.

**1886 August 24:** This hurricane was first noted in the eastern Caribbean Sea in the middle of August. It tracked westward, before turning on a more northwest rack southeast of Jamaica. The beginning of a destructive week, it was followed by the strong Charleston Earthquake on the 31<sup>st</sup> (Vojtech).

**1887 August 21:** The British steamer *Propitious* encountered the storm sixty miles below Cape Henry. The captain of the vessel was swept overboard as heavy seas crashed over the decks. It was the worst weather system the ship had encountered in sixteen years.

**1887 October 31-November 1:** On the 29<sup>th</sup>, this storm moved northeast from Florida some distance off the Atlantic coast. Heavy gales were seen along the coasts of North Carolina and Virginia. The "furious northeasterly gale" caused telegraph lines to go down between Norfolk and Cape Henry. Winds were sustained at 78 mph for five minutes at Cape Henry.

A record number of maritime mishaps were caused by the storm. Four ships, the *Mary D. Cranmer*, *Carrie Holmes*, *Manantico*, and *Harriet Thomas* were lost. Two lives were claimed offshore (Pouliot). The *Carrie Holmes* was driven so high into the beach that its crew jumped off the schooner and waded safely to shore; it proved a \$7000 loss.

**1888 August 21-22:** This hurricane initially devastated southeast Louisiana before recurving northeast through the Ohio Valley. At Wheeling, West Virginia, heavy rains led to a two to six foot submersion of area roads. Bridges

were washed out. A piece of the Baltimore and Ohio wooden bridge from Pittsburg collided with one of their other bridges at Main and 16<sup>th</sup> streets, leading to its second destruction in six weeks. A quarter million in damages were reported.

In Petersburg, a "terrific wind storm" blew through town, uprooting trees. At Carter's Wharf, lightning struck during a baptism ceremony, killing three and stunning all that were present. The storm was severe around southern Chesapeake Bay, demolishing numerous wood-frame houses, barns, and two schooners. An immense waterspout swept out of Chesapeake Bay onto Poole's Island.

Heavy showers and high winds were experienced in Washington, D.C.. Winds were sustained between 40 and 50 mph, with gusts above sixty. These gales led to the destruction of the tower of the Church of the Covenant around 4:40 a.m. on the 22<sup>nd</sup> (\$30,000 in damage). . At least two tornadoes were spawned in Delaware. Another tornado moved from Springfield across Glendale and Bowie, destroying homes, trees, and a chapel along the way. Nine perished in Maryland. Floods inundated Ohio, West Virginia, Pennsylvania, Maryland, Delaware, and Massachusetts.

**1888 September 10:** A tropical storm moved through the Bahamas on the morning of the 7th, before moving across the Sunshine State. The cyclone re then curved northeast around the Bermuda High, reaching Virginia by the afternoon of the 10th (track to the right). Four months of drought abruptly ended at Southside. Heavy rains completely submerged corn and tobacco crops. The Appomatox flooded wharves; the river reached its highest level since 1877. It was considered a "terrific gale" at Onacock. The British schooner Elk was driven ashore and stranded at Parramore Beach. All aboard were rescued.

**1888 October 11:** A hurricane moved northeastward from the Eastern Gulf of Mexico through North Carolina and crossed just west of Norfolk.

**1888 November 25:** A tropical system which moved about 150 miles off of Cape Hatteras produced high winds along the Mid Atlantic coast as it was becoming extratropical. Cape Henry saw sustained winds reach 72 mph for five minutes. Norfolk experienced winds howling at 50 mph for five minutes which knocked down telegraph lines and high tides flooded lower parts of the city; their pressure fell to 29.50".

Vessels were blown from their moorings. The sloop *Lizzie Jane* wrecked 1/4 mile north of Cobb Island. Cold air rapidly enveloped the storm, as the surfman at the False Cape Life-Saving Station reported blinding snow (Pouliot). Fortress Monroe, Winchester, and Richmond also went through a snow storm. Flurries in Washington, D.C. were accompanied by blustery north winds. Wires in the District were downed, and a telegraph pole broke off 25 feet from its base.

**1889 April 6-7:** Although this cyclone was not likely to have been a true hurricane, it showed all the telltale signs to those in Virginia Beach at the time. Winds were blowing at a "hurricane rate" from the north-northwest. Gusts exceeded 100 mph at the Signal Service station in Cape Henry. Trees were uprooted and sand dunes quickly transformed into quicksand during the heavy rain. The Cape Charles lighthouse saw its south end protection wall undermined as it was pounded by high waves. High tides totally surrounded the station (Vojtech).

Lower portions of Norfolk flooded as tides rose to 8.4 feet. A fire on Water Street raged out of control, consuming the entire block. Roofs of the Opera House, Masonic Temple, and many dwellings were blown away. The Virginia Beach railroad depot saw damage, as well as hundreds of yards of its track. A fire at Portsmouth destroyed a lime and lumber yard. The U.S. vessel *Pensacola* sank while in dry dock. High tides flooded its dock, and as the ship filled with salt water, its keel sank.

Richmond experienced its worst storm of the winter and spring. Heavy winds, rain, sleet, and snow pelted the state capital. Charlottesville's snow storm led to downed wires and delayed rail traffic. Petersburg experienced a horrible blizzard, as trees were uprooted, and houses "rocked" with the wind. Winchester measured fourteen inches of snowfall while at its height, with thunder startling their citizens. Telegraph wires were strewn across the countryside.

In Washington, D.C., rain turned to snow by 8:30 a.m. on the 7<sup>th</sup>. By 10:30, lightning and thunder were observed, leaving residents in awe. The Weather Bureau could not explain the occurrence of snow and thunder, but mentioned it would be known within a "few years". The blizzard caused thousands of dollars in damage, as telegraph and telephone lines were downed in great numbers. The White House had its communications cut off by the storm between 1 and 2 p.m., as the weight of the wet snow downed area lines. A tornado actually touched down amidst the chaos along the waterfront, as five telegraph poles were snapped at the base.

Three schooners stranded on Virginia Beach near the Seatack Life-Saving Station. The four-masted vessel *Benjamin F. Poole* was left high and dry on the beach after the severe cyclone. Blowing rain and sand almost blinded the surf men trying to rescue the *Emma F. Hart*. At 7 a.m. on the 7<sup>th</sup>, the Cobb Island Life-Saving Station keeper observed the sloop *J.O. Fitzgerald* race towards Bone Island, running aground 3/4 of a mile away. All offshore survived the tempest.

**1889 September 9-12:** This hurricane moved from Puerto Rico on the 5<sup>th</sup> to just offshore the Virginia capes on the 10<sup>th</sup> before stalling. The steamer *El Mar*, on its maiden voyage, encountered the hurricane on the night of the 9<sup>th</sup> just north of Cape Hatteras. The vessel fought seas higher than 45 feet and strong winds for the next couple days.

Destructive gales and unusually high tides were felt from Virginia northward to New York. Winds increased to 30 mph at Cape Henry on the 11<sup>th</sup>, temporarily knocking down telegraph lines to Norfolk. By the 12<sup>th</sup>, the lower coast experienced 40 mph winds. Along the Eastern Shore, bridges were swept away, telegraph lines were downed, lowlands inundated, and crops ruined. The wind "blew a hurricane" at Onancock, with high tides completely submerging its wharves.

Vessels at Hampton Roads dragged anchor. A brigantine-rigged steamer went ashore Cape Henry at 7 p.m.. The British steamship *Godrevy* grounded 3/4 of a mile northeast of the Cape Henry Life-Saving Station, just before 8 p.m. on the 12<sup>th</sup>, which proved a \$11,900 loss. The crew of 23 were saved. Winds and seas moderated by midnight.

**1889 September 24:** President Harrison was visiting Elkins, West Virginia at the time, and noted that it rained considerably.

**1891 October 10-12:** A system born in the Western Caribbean moved northward to just off the North Carolina coast. The U.S.S. *Despatch*, the President's ship, foundered 2 1/2 miles north of Assateague Beach on its way to pick up the Commander-in-Chief. The sailing ship *Challenge* fell victim 1/2 mile southwest of Wachapreague (Pouliot).

**1893 June 15-16:** A hurricane hit Cedar Key, Florida and moved northward across coastal sections of the Carolinas before moving out to sea near Norfolk. Birdnest, in Northampton County, recorded 4.8" of rain on the 16<sup>th</sup>.

**1893 August 28 (Sea Islands Hurricane):** A hurricane passed just east of Cape Hatteras. Five minute sustained winds rose to 88 mph at Cape Henry. Cape Henry (3.97"), Hampton (3.92"), Langley Field (3.92"), and Norfolk (5.97") set 24 hour rainfall records for the month of August in this storm. Petersburg experienced a "perfect gale" between 4 and 5 p.m.. Trees and fences were leveled. Area orchards were greatly damaged. Corn, fodder, and tobacco were seriously injured. At Harper's Ferry, a damaging wind and rainstorm began at 7 p.m.. The District Militia's camp was demolished. A large number of trees were uprooted.

Alexandria plunged into darkness at 9 p.m., as power was cut off by the cyclone. Trees fell in by the score. Considerable damage was done to trees and the corn crop in Alexandria and Loudon counties. Small craft at the wharves sank. The river overflowed wharves, as the water from the river extended into Union Street. At the waterfront, the steamer *W.W. Colt* was badly damaged. The hull of the schooner *Franconia* was in serious disrepair. Fifty tons of coal were claimed by floods at Anacostia. A washout occurred at Cherry Hill Station, along the Washington and Southern railroad, rerouting train traffic.

In Washington, D.C., telegraph and telephone lines were "laid prostrate" on the night of the 28<sup>th</sup> as five-minute sustained winds reached 42 mph. For the first time in weeks, a good rain fell across the area. By 10 p.m., a smokestack was blown off a locomotive. The Pension Bureau roof was torn away by the high winds. Windows were

shattered throughout the Federal City. Tides at Washington, D.C. peaked at 6.5 feet above low water datum. One man near Raleigh Springs, in northern Virginia, perished while trying to ford a stream.

**1893 October 4 (Chenier Caminanda Hurricane):** In Louisiana, 2000 lives were lost when the hurricane crashed into the region around Grand Isle (track to the left). As the system was exiting the Mid-Atlantic coast, the schooner *Colter C. Davidson* sank south of Cape Henry. Two three-masted schooners were stranded on the beach near the Seatack Life-Saving Station. The northeast gale battered the schooners *W.M. Applegarth* and *C.C. Davidson* that evening.

In Washington, D.C., a "perfect deluge" led to the flooding of the Patent Office. All the examiners, clerks, messengers, and laborers began to rescue valuable records and property from the rising waters. Many cellars along the south side of Pennsylvania Avenue from Third to Thirteenth Street were flooded. The depot of the Baltimore and Potomac railroad looked like a "light-house, standing as it did in the centre of an immense lake" near the intersection of B and Sixth Street.

**1893 October 13-14:** While the previous system was moving across North Carolina, another hurricane lurked east of the Leeward Islands. This hurricane of large size tracked east of Florida to the Carolinas. High winds and tides were seen from Florida northward to New England (Barnes II).

At Richmond, winds became a "perfect gale" as rain fell in torrents. Homes were partially unroofed, and trees fell in the capital squares. Between Richmond and Danville, a passenger train struck a fallen tree while a freight train struck another tree. Many lines fell across Petersburg. Dwellings in town rocked to the wind gusts. Barns and outhouses were razed to the ground. Roanoke watched as their river rose to levels unseen since 1853. Washouts occurred along the Norfolk & Western railroad, delaying traffic from twelve to fourteen hours. The town of Elliston was submerged by the Roanoke river, sweeping away houses. During this storm, 2.98" of rain fell at Stone Gap, setting a 24 hour rainfall record for the month of October.

Alexandria saw its wharves crumble before the high waters (\$25,000). The James river eclipsed the level attained during the Johnstown Flood of 1889 by twelve inches. A fire in Baltimore burned down its electric light plant, giving the city more of the look of a "country town." Hyattsville saw a terrific gale by 5 p.m., putting its windmills briefly out of commission. Bladensburg saw winds level fences and partially unroof homes.

In Washington, D.C., the Calvary Baptist church's side wall blew down (\$3000). Associate justice of the Supreme Court Henry B. Brown was seriously injured when a plate glass window shattered at his new home at the northwest corner of 16<sup>th</sup> street and Riggs at 7:30 p.m.. Trees and their limbs were strewn throughout the city. Rainfall began in the morning and increased throughout the afternoon. Sewers were flooded by this downpour. By 6 p.m., gale force winds swept through the Federal City. Damage to police and fire wires was "greater than ever before been experienced." Waters on the Potomac rose six feet above the high tide, which was three feet below the high water mark. The Anacostia bridge became submerged.

Mariners experienced the wrath of this hurricane as well. The schooner *Edward Ewing* sank at Store Point, south of the Piankatank river. In the District of Columbia, the steam launch *Katherine Holbrook* sank. The *Nellie Marr* saw its bottom smashed by the high seas. The freight vessel *Mount Vernon* sank at her wharf. The *W.W. Colt* went on a rampage, injuring two other vessels before crashing against the ferry slip, smashing her port side.

**1894 September 29:** This hurricane passed just west of Hatteras. Winds sustained for five minutes at Cape Henry peaked at 80 mph with gusts to 90 mph. Vessels were wrecked along the coast from North Carolina northward to New England.

**1894 October 9:** A hurricane which formed just offshore Panama and Colombia moved north to hit Apalachicola, Florida and moved across coastal sections of the Carolinas before heading out to sea near Norfolk, striking the coast at New England. The storm was severe in the Chesapeake Bay. The steamer *Eastern Shore* was nearly buried by high seas. The *Henry Lippet* was severely damaged after a collision 3/4 of a mile below Fort Monroe. A steam barge ran aground near Baltimore Harbor.

At Newport News, a terrific rain and wind storm raged. Northeast winds reached up to 60 mph. Many maritime disasters were witnessed. Among the wrecks were the schooners *Lorena Reen*, *John H. Cross*, and the bark *Ogin*.

**1896 July 8-9:** This hurricane struck the Florida panhandle just east of Pensacola on the morning of the 7<sup>th</sup>. The decaying tropical storm moved north into the Ohio Valley. On the favorable eastern side of the system, tornadoes touched down across North Carolina and Virginia, leading to isolated pockets of destruction. A tornado swept through Dinwiddie and Prince Georges counties. Dwellings were leveled, along with trees and outhouses. Buildings were lifted up and moved fifty yards. Six perished.

Torrents of rain along the Atlantic & Danville railroad led to the Dan river overflowing its banks, flooding thousands of acres of low lands. Several bridges were swept away. Damage to crops, particularly corn, occurred with the flooding. Many cattle were drowned in swamps around Norfolk.

**1896 September 28-October 2:** A hurricane developed in the breeding grounds of the tropical Atlantic before moving through the Caribbean Sea and the Gulf of Mexico. The system then tracked inland through the Southeast to the west of Washington D.C..

Richmond suffered severely from the cyclone. Communication was gone early on during the storm... the only line that remained open belonged to Western Union, the wire than ran to Wilmington, N.C.. A "perfect wilderness" of uprooted trees and downed limbs lay everywhere. The steeple of the Second Baptist church yielded to the storm, falling across main street. The Governor's Mansion survived the cyclone reasonably well. Damage totaled \$150,000 at the state capital.

Petersburg witnessed a "perfect hurricane" between 7:30 and 10:30 p.m.. The Imperial Hotel was unroofed. Smaller buildings experienced great damage. The Western Union office took fire, but the blaze was quickly extinguished. All lines were downed. "Needed rains" fell at Leesburg, but high winds at that locale led to high timber losses. Fredericksburg saw its St. George's church steeple injured by the cyclone.

In Alexandria, damage was widespread. The Third Baptist Colored church was razed to the ground (\$5000). Over forty windmills were wrecked at Falls Church. Travel was virtually impossible due to the volume of downed trees which blocked the roadways. Hyattsville and Bladensburg experienced injury, as windmills fell, and numerous windows and skylights were shattered. Wood-frame buildings were blown from their foundations. Manassas saw its Evangelical Lutheran church blown six inches off its foundation.

At the nation's capital, a rapidly moving deck of low clouds streamed in from the Atlantic on the heels of brisk southeast winds. After the wind shifted to southwest, thunderstorms caused continuous lightning to light up the night sky. It was one of the worst storms on record in the District of Columbia as five-minute sustained winds peaked at 66 mph and gusts reached 80 mph; the pressures fell to 29.14" around 11 p.m.. At 10:30 p.m., the steeple to the New York Avenue Presbyterian Church crashed to the ground. A five story brick building was demolished, injuring the adjoining buildings, trapping five men under debris. The tower of the Grand Opera House was "hurled to the sidewalk."

Uprooted trees blockaded several streets in the District. A horse perished after stepping on a live wire. Many buildings were unroofed. The Metropolitan Railroad Power House in South Washington caved in, causing all buildings within one-half block to shake; its crash was audible a mile away. Capitol Hill saw even greater damage. Georgetown experienced its worst storm ever. The Baseball Park saw \$500 in damage. A few panes of glass at the White House were shattered as well. Winds began to subside by 12:55 a.m.. In all, a \$390,000 in damage was incurred.

Heavy rains fell as well...see the chart to the left for 24-hour rainfall records set for September during this cyclone. A flash flood at Staunton, along Lewis Creek, overran its banks, killing five. Seven inches of rain on the 30<sup>th</sup> swelled a large lake near the town, bursting its dam at 10 p.m.. Alarms were sounded as torrents of water rushed down Central Avenue, submerging everything in its path. As it invaded the Water Works and electric plant, fires in their furnaces were quickly extinguished, plunging the city into darkness. The gas works was swept away by the raging

flood. Twenty-five houses were moved from their foundations before crumbling in the angry waters (\$500,000). Great washouts occurred along the Norfolk & Western railroad from Roanoke to Hagerstown. Streets in Roanoke became rivers. On the 1<sup>st</sup>, the Potomac and Chesapeake & Ohio Canal merged into one as flood waters increased their height and breadth. At Buena Vista, the fire department wall called in to save those in peril from their floods.

Tides rose to 7.0 feet above low water datum at Washington, D.C.. The scene at the waterfront was "one of indescribable confusion." Power was out, and mud had invaded surrounding land areas. Most everything, including vessels in and around the wharf was destroyed. The steamer *George Leary* ran amok when her wharf succumbed to the storm. Careening with the current, she crashed against the *Sylvester*, when then took part in the joyride. They crashed into four other vessels before coming to rest against the Norfolk steamer *Washington*. From Cedar Point to Sandy Point, fourteen vessels went ashore. The schooner *Capital* foundered at anchor, taking the lives of here crew (three in all).

Cobb's Island was submerged. Its hotel was demolished, along with any remaining cottages and private dwellings that weren't destroyed during the powerful nor'easter of 1895. This storm led to the abandoning of the island by Fall of 1897 (Barnes & Truitt). Damaging winds spread northward through northern Virginia, Maryland, and Pennsylvania. Its gale force winds extended from New York to Chicago. Sixteen perished across the region: three in D.C., seven in Virginia, and six in Maryland. Total losses exceeded \$1.5 million in Virginia and the District of Columbia.

**1896 October 11-13:** Serious damage occurred at Virginia Beach, amounting to several thousand dollars from this cyclone. Winds of 40 mph blew through Norfolk while 70 mph lashed the Capes. The Cape Henry lighthouse keeper's residence was submerged by the system's storm surge. High tides reached the life-saving station. Water was blown up to the boardwalk of the Princess Anne hotel. All telegraph wires and poles were carried away by the tide. Around Norfolk, the Dismal Swamp canal was badly flooded; its banks "honey-combed and caving in many places." Two perished.

A northeast wind arose at Cobb's Island on the morning of the 5<sup>th</sup> and increased as the day wore on. It became a gale, then a hurricane, which moved the islanders into action. All furniture was moved into the upper floors of structures to escape the rising waters. Soon the island was completely submerged. As people watched from their second stories, stock and cattle were swimming around their homes, expressing their distress. Among the animals in the surging waters were horses, cows, goats, and dogs. The highest points went underwater before the lifeguard went from house to house, saving people's lives.

The Baltimore cottage was a total wreck, battered by the waves. Several cottages were found half buried in the sand. The island shrunk to a size of only fifty acres after this storm (Barnes & Truitt). At False Cape, eight fishermen took refuge at the life-saving station. Two women on Cobb Island were rescued by surfmen, as heavy swells were sweeping them out to sea. It was two days before the weather improved, and the coastal flooding receded (Pouliot). The bark *Henry A. Litchfield*, with a cargo of lumber, went ashore Pleasure House Beach between 4 and 5 a.m. on the 12<sup>th</sup>, twenty four days out of Brunswick, Georgia. It braved the previous storm at the end of September, before succumbing to this cyclone.

**1897 October 20:** A rapidly moving storm of tropical origin passed northeastward off Cape Hatteras. Maximum winds of 60 mph blew through Cape Henry.

**1897 October 24-26:** On the 24<sup>th</sup>, this misbehaved tropical cyclone went from a northeast course to a more dangerous northwest course towards the Mid Atlantic region. It completed a small loop off the Virginia capes before heading westward into extreme northern North Carolina. A number of small craft had already washed ashore on the 24<sup>th</sup>. At Cape Henry, winds reached 64 mph on the 24<sup>th</sup>. Low streets of Norfolk were flooded. Two fatalities occurred when one person came in contact with a live wire and another was on the telephone. On the 25<sup>th</sup>, the James river rose to five feet above high tide. The catboat *Louise* was blown ashore Newport News, proving a total loss. Winds at Cape Henry rose to 70 mph. Increasing tides cut a break through Willoughby Spit, washing away the Old Point Comfort railroad tracks.

Trees were leveled at Hampton. Cobb's Island went totally underwater, forcing the crew of the life-saving station to abandon the isle. The 26<sup>th</sup> brought continued northeast gales to the coast. A Norwegian sailing ship was being destroyed while in tow fifty miles southeast of Cape Henry, and was abandoned. All aboard survived. Four fatalities were reported at Newport News. In all, this storm lasted for 60 hours and produced tides of 8.1 feet above mean lower low water. Winds and high water inundated the business section of Chincoteague. The hotel on Metompkin Beach was wrecked. Cedar Island was "leveled to a mere flat breath of sand" (Barnes & Truitt). The schooner *L.A. Rose* went down one mile southeast of Assateague Beach while the steamer *Polaria* wrecked one mile northwest of Cape Henry.

**1899 August 17-18 (San Ciriaco Hurricane):** The damage produced by this storm in North Carolina is considered unparalleled. It left its mark in Virginia as well. On the 16<sup>th</sup>, wind at Cape Henry reached 52 mph. By the 17<sup>th</sup>, Cape Henry saw winds peak at 68 mph for five minutes, and gales expanded westward past Norfolk...low lying areas were inundated. Norfolk's pressure fell to 29.62" as five-minute sustained winds reached 42 mph.

The storm was quite severe along the James,. At Suffolk, livestock drowned in the flood waters. At Petersburg, a "heavy northeastern storm" began the night of the 17<sup>th</sup>. Corn and tobacco experienced considerable damage as crops were leveled by the wind.

**1899 October 30-31:** This storm took a similar path to Hazel. It was becoming a nontropical low while passing through North Carolina, but that didn't weaken the system at all. Cape Henry saw winds of 74 mph over a five minute period. Norfolk tides reached 8.9 feet above mean lower low water. Norfolk experienced 50 mph winds level trees and signs...windows in the area shattered. Brighton experienced the leveling of several homes. Tides again created a break in Willoughby Spit, damaging railroad tracks. In Danville, the gale reached its height between 7 and 8 p.m. on the 30<sup>th</sup>, unroofing several houses and damaging shade and fruit trees. Winds died down by noon on the 31<sup>st</sup>.

The Cape Charles lightship was under significant strain; the starboard chain broke and carried away all the castings and connections. The three-masted schooner *Kate Darlington* wrecked on Ocean View Beach at 1 p.m. on the 30<sup>th</sup>, after being struck by a steamer on the Virginia Capes. The schooner *W.S. Rowley* beached at Nix's Wharf in Suffolk...two wharfs there were badly damaged. The 1000-ton, four-masted schooner *Bayard Barnes*, after springing a leak, became stranded on Willoughby Spit. Damage from the cyclone spread northward into Ontario and Newfoundland, in Canada.

## TWENTIETH CENTURY

**1900 October 13-14:** The six-masted schooner *Wells*, proclaimed as "the only of her kind in the world" sought shelter from the gale in Norfolk, with a 5000 ton cargo of coal.

**1901 July 10-11:** On the 10<sup>th</sup>, northerly gales commenced from Cape Hatteras to Henry. Winds averaged 50 mph at Cape Henry that night, which downed lines. A severe thunderstorm in Richmond, on the western fringe of this storm, claimed a victim when lightning struck a tree in her yard. In Berryville, heavy rains and winds did great damage to crops as it leveled trees and stripped off fruit during the cyclone. A barn was struck by lightning, instantly setting it ablaze (\$2000). Artillery practice in the Chesapeake Bay was interrupted as high winds wrecked floating targets.

**1901 September 16-18:** A "terrific northeaster" prevailed along the coast. Four men off Ocean View drowned after setting sail during the storm. Newport News reported 3.32" of rain, which set a 24-hour rainfall record for the month of September. The schooner *Joseph J. Pharo* went down 1 ½ miles south southeast of Assateague Beach on the 16<sup>th</sup>. By the 17<sup>th</sup>, the schooner *Edith G. Folwell* wrecked one mile north of Cape Henry. The sloop *Dude* capsized off Sewells Point. Those aboard clung to the wreck and were rescued and taken to Cape Charles. The schooner *Idle Times*, while in Chesapeake Bay, was "run down" by a Pennsylvania railroad barge that was in tow, killing the schooner's captain.

In Maryland, Braddock experienced significant damage leaving few homes, barns, or outbuildings untouched. Poplar Terrace was damaged as a water tank was swept off the house. Nearly 300 window panes were destroyed by the wind there. Two horses perished. Montevue hospital's roof was partially torn off as 1500 windows were demolished. At Liberty, twelve barns overturned. Growing corn was in ruin.

**1902 June 14-16:** On the 14<sup>th</sup>, the steamer *Falcon* fell victim to the storm two miles southeast of False Cape. Twenty-four hour rainfall records were set for the month of June during this cyclone at New Canton (3.70") and Fredericksburg (3.45") on the 16<sup>th</sup>. The deluge broke a drought, benefiting tobacco crops most.

**1903 September 15-17:** This deadly hurricane struck the New Jersey shore. It was considered the worst storm in forty years at Ocean City, MD. Salisbury saw several schooners break from their moorings, smashing themselves downstream. President Theodore Roosevelt experienced the hurricane firsthand while aboard the naval yacht *Sylph*, as winds increased to 65 mph in Long Island sound. Other than a drenching, all aboard fared well. At the Delaware Capes, 80-mph winds lashed the schooner *Hattie A. Marsh*, dashing the vessel upon the rocky shore; five perished. The torpedo boat destroyer *Lawrence* took on a foot of water while fighting the storm from Atlantic City to Norfolk.

In Virginia, a strange scene unfolded. As the cyclone passed northeast of Old Point Comfort, a shower of dead birds, most feathers plucked off by the wind, fell from the sky. Hundreds of birds, about the size of a wren, were downed around Old Point Comfort. The foremast of a schooner was claimed by a squall near Cape Henry around 3:30 a.m. the 17<sup>th</sup>. A few small craft were thrown ashore. The fishing schooner *Beatrice* disappeared into the cyclone several miles north of Chincoteague with a crew of 30 (\$25,000). In the District of Columbia, heavy rains washed out a baseball game between the Washington Senators and the Detroit Tigers. Strong west winds accompanied the deluge as it flooded the field.

**1903 October 8-10:** Cape Henry saw winds over five minutes average 74 mph with a tropical system that became nontropical off the Outer Banks of North Carolina. Norfolk's tide rose to 9 feet above mean lower low water. In Norfolk, a tree brought from the grave of Napoleon Bonaparte to the city was uprooted; it was one of most historic features of the city at the time. Plate glass windows shattered in the wind. Communication was wiped out as wind knocked down wires and cables. It was the worst storm in 15 years, as rain and wind plagued the city for over 48 hours.

At Richmond, a "furious wind storm" descended upon the city the morning of the 9<sup>th</sup>, accompanied by a 20 degree fall in temperature. Trees were uprooted and communications were "disturbed" in the state capital. An elderly man in Leesburg drowned while trying to cross over Little River on a log.

The coast of the Old Dominion was strewn with wreckage from Cape Henry to Dam Neck Mills on the 10<sup>th</sup>. Fourteen foot high waves battered the Back River lighthouse; stones from the light were moved out of place. It took 72 hours of continuous work to save the light, its house, and the walkway (Vojtech). The cruiser *Olympia*, in dry dock at Norfolk, saw the tide reach just six inches from the top of the outer edge of its caisson. Terminal piers of the Norfolk & Western and the Southern & Atlantic Coast lines were badly damaged. The Ocean View pleasure pier was wrecked.

At the nation's capital, the grain mill and elevator of S.S. Dalsh & Co., located on Florida Avenue, burst into flame during the storm at 11 a.m. on the 10<sup>th</sup>, leading to a \$90,000 loss. Another fire at a stable along Jackson Street Northeast was entirely destroyed, its two horses perished (\$400). A fierce gale blew throughout the 9<sup>th</sup> during the Columbia Golf tournament. It took more than two hours to go through the rounds.

Two men drowning off Virginia Beach were rescued by a member of the Cape Henry Life-Saving Station, earning him a Gold Life-Saving Medal (Pouliot). The Assateague Beach life savers rescued eight fishermen when their home was swept away by high waters. The Wachapreague Life Station was abandoned when it was becoming submerged by the storm surge. High water threatened other dwellings at False Cape.

In the Lower Chesapeake, two three-masted schooners were blown ashore on the 9<sup>th</sup>. The tug *Richmond* was battling a northeast gale by late on the evening of the 8<sup>th</sup>. The schooner barge *Georgia* parted cables and drifted ashore near

the Virginia Beach Life-Saving Station. Hurricane-force winds took their toll on the schooner barge *Ocean Belle*, before its cables broke at 10:30 a.m. on the 10<sup>th</sup>. The schooner landed broadside on the beach before immediately breaking up in the dangerous waves. Two perished. The *Nellie W. Howlett* sank three miles south of the Dam Neck Mills Station. In all, nine ships had mishaps offshore the Old Dominion. Three perished. As the cyclone moved north, rains amounting to ten inches drowned New York City. Damage was experienced up the coast to Block Island.

**1904 September 14-15:** This storm made landfall in eastern South Carolina before moving north and northeast to pass offshore as a nontropical low near Norfolk. Ashland recorded 3.88" of rain on the 14<sup>th</sup>.

**1904 November 13:** This hurricane moved north to near Cape Hatteras. As the system became nontropical, cold air on the west side of the circulation set up an early snowstorm across North Carolina. A twenty-four hour rainfall record was set for November at Farmville (3.17"). The schooner *Robert J. Poulson* went down one-half mile southwest of Hog Island on the 13<sup>th</sup>.

**1913 September 3:** Danville set a new 24-hour rainfall record for September (3.59").

**1920 September 30-October 1:** The schooner *Thomas F. Pollard* foundered off Cape Henry.

**1924 August 26:** This hurricane passed just east of Cape Hatteras. Maximum sustained winds reached 72 mph at Cape Henry.

**1924 September 29-30:** Norfolk saw winds reach 76 mph sustained from a cyclone that became nontropical over the Southeast U.S.. In Fauquier county, four inches of rain fell at Leads Manor on the 29<sup>th</sup>. In Richmond county, 4.6" of rain fell at Warsaw on the 30<sup>th</sup>. Leeds Manor (4.00"), Stuart (4.20"), Urbanna (3.80"), and Winchester (2.05") all set 24-hour rainfall records for September during this tempest. The moderate flood along the C & O canal created by the cyclone led to an end of boating operations (High).

**1925 December 2:** A rare hurricane formed in the Caribbean Sea and moved north northeast across South Florida and moved into the East coast between Wilmington and Cape Hatteras at 6 p.m.. The storm center passed out to sea near Cape Henry. Langley Field reported 3.36" of rain on the 2<sup>nd</sup>. Other 24-hour rainfall records for December were set during this storm at Callaville (2.24"), Onley (2.30"), Runnymede (2.51"), and Warsaw (3.10").

**1928 August 11-12:** A category two hurricane moved northwest across Florida on the 7<sup>th</sup> and 8<sup>th</sup>, weakening as it wandered northwest into Georgia. The decaying system dumped more than six inches of rain across the Carolinas and Virginia as it moved northeast, sending river levels well beyond flood stage (Barnes II). Norfolk recorded 39 mph sustained winds on the 12<sup>th</sup>. Heavy rains fell at the Sewer Department in Washington, D.C. when 7.31" deluged the area. The brig *Walton* foundered off Sandy Point, Maryland during the storm.

**1928 September 19 (San Felipe/Lake Okeechobee Hurricane):** This tropical cyclone was experienced by the *S.S. Commack* near 17N 48W, and send a radio report about their weather conditions. This was the most easterly radio report concerning a tropical storm in the Atlantic at the time (Barnes II).

Epic destruction and loss of life from this vicious storm spread across Puerto Rico and Florida before it tracked into North Carolina. This storm caused tremendous flooding in North Carolina. Maximum sustained winds were 72 mph at Cape Henry. Tides peaked at 7.2 feet above mean lower low water at Norfolk. Heavy rains were seen at Langley Field on the 18<sup>th</sup> (3.88") and Onley on the 19<sup>th</sup> (5.22").

**1933 August 21-24 (Chesapeake-Potomac Hurricane):** On the 17<sup>th</sup>, a tropical storm was discovered about 100 miles east of Puerto Rico. This system quickly strengthened into a hurricane by the 18<sup>th</sup>, as it tracked northwest (track to the right). As the cyclone neared Bermuda, a blocking high pressure ridge over New England changed the storm's course to more westerly. The British colony of Bermuda was lashed by 80 mph winds as the center passed 100 miles to the southwest of the island. \

Rough surf conditions developed near Hampton Roads during the afternoon of the 22<sup>nd</sup>. The system made landfall near Nags Head around 3 a.m. on the 23<sup>rd</sup>. By 9 am, the center passed over Norfolk, where the pressure fell to 28.68". Some of the lowest pressures ever measured in Virginia occurred with this hurricane. The lowest pressure of 28.68" occurred at 9:20 a.m..

This was the first time an eye of a hurricane had passed over Norfolk since the great hurricane of September 3, 1821. Sustained gales extended well inland over northern sections of Virginia. Maximum winds were 58 mph at Washington D.C., 70 mph at Norfolk, 82 mph at Cape Henry, and 88 mph at Norfolk Naval Air Station. Areas near the Chesapeake saw over 10 inches of rain (rainfall map below). Some areas measured eight inches of rain in one day. Washington D.C. experienced a 6.39" deluge.

This storm produced a record tide of 9.8 feet above mean lower low water at Sewells Point. Norfolk saw a tide of 9 feet above mean lower low water. Five feet of water flooded the city, damaging area crops.

A six to nine foot storm surge passed up the Chesapeake Bay. A combination of the storm's surge and back water flooding along the Potomac caused crests as high as 12 feet above mean lower low water on the river. Colonial Beach stood by helpless as four feet of water flooded the town and swept the town's amusement park away. Water also flowed into some hotels bordering the Potomac River.

Severe flooding occurred at Alexandria and Washington D.C.. In Washington, D.C., numerous trees were uprooted and many houses unroofed. The Potomac at Alexandria reached its highest stage since the Johnstown Flood of 1889. In Alexandria, high winds played havoc with phone and power lines. High water in Four Mile Run cut off Alexandria from the Federal City. Two men were nearly doomed when the Cameron Run bridge on Telegraph Road was washed out. Farms in Fairfax county suffered heavy damage; fields were flooded, ruining crops. All aviation activities out of Quantico were suspended. High winds and rains flattened corn crops and damaged peach orchards in Loudon county. St. Mary's county saw damage to corn and tobacco. In the Richmond area, damage was confined mainly to broken windows and downed tree limbs. In Anne Arundel county, 44 mph winds took a heavy toll on crops, leading to \$250,000 in damages alone.

Some high water marks in Alexandria included 2 feet at the Ford Motor Company Plant and 5 feet at the Old Dominion Boat Club. Flood waters completely inundated the lower end of King Street in the Old Town section of Alexandria. The Washington-Richmond highway (U.S. Route 1) was inundated to a depth of 8 feet in a few sections below Alexandria at the height of the storm. Mount Vernon Boulevard was under 5 feet of water. Flooding in the Anacostia river rose over the seawall.

The Washington Hoover airport was inundated to a depth of three feet at the height of the storm. The Benning Bridge was under two and a half feet of water blocking vehicular traffic. Of considerable note was the landing of a pilot named J.B. Duckworth at Washington, D.C., then an Eastern Air Transport night mail flyer who flew by instruments a large way from New York, just before the storm closed down the airport. He would later become the first pilot to intentionally fly into a hurricane off the Texas coast in 1943.

Tidal flooding from the hurricane extended up the tributaries draining into the Chesapeake Bay as well. The James River at Surry, some 40 miles from Hampton Roads reached the highest level in recorded history at 10 a.m. on the morning of August 23, 1933 as the tidal surge swept away the Surry Pier serving the Surry-Jamestown Ferry. The tidal surge moved further up the James River flooding Hopewell and portions of the city of Richmond. River levels were generally three to five feet above normal from Hopewell westward into Richmond.

On the other side of the James River, waters were estimated to be five to eight feet higher than any previous high water mark in the city of Newport News. The York river also went on a rampage and surged into Gloucester Point at the extreme southern end of Gloucester County. The town Post Office and Drug Store were completely demolished. Four feet of water stood in the lobby of the Robbins Hotel.

Wave action from the hurricane turned the Assateague peninsula into an island. Ocean City inlet was carved out by this cyclone. Most of what was left of the tourist industry on the Virginia barrier islands disappeared. The hotel on

Cedar Island was destroyed. The clubhouses on Wallop's, Parramore, Revel's, Hog, Cobb's, Mockhorn, Skidmore, and Smith's Islands were badly damaged....and they never recovered. An inlet was formed at Ocean City that remains to this day (Assateague Naturalist). At least ten vessels met their fate in the hurricane.

The fifty-foot schooner yacht *Bluejacket* put out to sea from Sandy Hook, NJ on the 20<sup>th</sup>. As the boat sailed offshore, high northeast gales developed, and the ship headed for Atlantic City. At daybreak on the 21<sup>st</sup>, while just off Chincoteague, gales increased just before a lull...the hurricane's eye. Sixty to seventy foot waves knocked the *Bluejacket* around as the winds reached "terrific force" from the southwest... estimated at 100 mph. Pyramidal seas knocked down the masts and the rudder was carried away. Eventually, conditions improved and by the 24<sup>th</sup>, the *S.S. M&J Tracy* rescued the aimlessly drifting vessel, and the crew arrived at Newport News that night. Fewer than 18 perished in Virginia. Tens of millions of dollars of damage was incurred by the hurricane.

**1933 September 16:** On the 8<sup>th</sup>, a tropical storm was sighted 180 miles east of the Leeward Islands. It moved north, then northwest, as the Bermuda-Azores High re-established itself across the western Atlantic. Following a parabolic course, the hurricane made landfall near Cape Lookout on the morning on the 16<sup>th</sup> as a formidable category three hurricane on the Saffir-Simpson scale. The hurricane quickly recurved northeast, passing 80 miles east of Norfolk around noon (track to the left).

Heavy damage was seen with this storm in Virginia. Winds rose to 75 mph at Hampton Roads, 87 mph at Cape Henry, and 88 mph at Norfolk Naval Air Station. Tides reached 8.3 feet above mean lower low water at Sewells Point. This hurricane reshaped the peninsula where New Point Comfort lighthouse stood into an island.

**1935 September 4-6 (Labor Day Hurricane):** The most powerful hurricane ever known to strike the United States, this storm of small diameter moved across the Florida Keys, killing 400 people on its way into the Gulf of Mexico. Its pressure of 26.35", as it passed over the north end of Long Key, became a record low for a land based station in the Western Hemisphere. The system recurved into Tampa Bay and crossed through Georgia and the Carolinas before emerging back into the Atlantic near the North Carolina/Virginia border.

Southeast Virginia saw winds gusting between 40 and 50 mph. Several tornadoes touched down in eastern sections of the state. The most significant tornado tore its way from Portsmouth across Craney Island, western sections of Norfolk, and Willoughby Spit. The oil screw vessel *Co* burned off Chesterton, Maryland. The steamship *Fannie Mae* foundered in the storm one mile east of Windmill Point lighthouse. Three died due to the storm. One million in damages was exacted from Virginia.

**1936 September 18:**A tropical storm formed deep within the tropical central Atlantic. It moved west northwest, becoming a hurricane by the 11<sup>th</sup>. Storm motion slowed, as a nontropical low passed well to the north, causing the system to turn more towards the north. By late on the 12<sup>th</sup>, high pressure re-established itself to the northeast, and the hurricane resumed its northwest track. Recurving as it made landfall in the Outer Banks of North Carolina, the system accelerated northeast, passing just offshore Norfolk, Cape Cod, and Nova Scotia (track to the right).

This storm was one of the most severe in the history of Cape Hatteras. Norfolk experienced severe flooding. The highway from Currituck to Norfolk was washed out by heavy rains. Buena Vista along the James River set a record crest (22 feet), as did Westham (23.4 feet). Maximum sustained winds reached 68 mph at Hampton Roads and 84 mph at Cape Henry, before the anemometer failed. Tides rose to 9.3 feet above mean lower low water at Sewells Point. The schooner *Clemmie Tavers* was left stranded at Norfolk. Only one person lost their life to the storm.

**1938 September 17-21 (Long Island Express):** One of the fastest hurricanes ever known to move across the western Atlantic (Emily in 1987 the most recent tropical cyclone to challenge its title), this major hurricane went on to devastate New England. As the low began to take on some nontropical characteristics, its wind field expanded as it passed about 175 miles off the Virginia coast. Gusty winds of 50 to 60 mph blew by the Virginia Capes, even though the state was on the weak west wide of the hurricane. Roanoke's pressure fell to 28.62". Cape Henry was lashed by sustained winds of 57 mph.

A stationary front was located along the East Coast prior to the storm's arrival. When the hurricane approached, rain fell in torrents from Virginia northward. Some areas along the Eastern Shore recorded over eight inches of rain with the passage of this great hurricane. Losses were minor compared to the catastrophic losses incurred in New England.

**1940 August 13-18:** First observed between St. Martin and St. Thomas on the 5<sup>th</sup>, this tropical storm began to curve northwest, to the northeast of the Bahamas. Winds reached hurricane force at that time. A high pressure system built in to the north of the cyclone, forcing it on a more westward course to the near the Georgia/South Carolina border. The system meandered across the Southeast U.S. for four days, before becoming diffuse on the 15<sup>th</sup>.

Rains began in Virginia on the 13<sup>th</sup>, as the dying storm entered the state from the west. Deluges flooded locations statewide. Hampton Roads measured 4.76 inches. Emporia, on the Meherrin river, reached a flood of record on the 17<sup>th</sup>, when the stage crested at 31.50 feet, which was 8 ½ feet above flood stage. Mountain rivers and streams went on the rampage, washing out bridges and causing landslides which blocked roads. Several principal highways between Norfolk and southwest Virginia and Asheville were closed. A collision on the 13<sup>th</sup> involving the Oil Screw *F.B. Scarbrough* five miles above Coles Point may have been caused by this system. Sixteen died in the mountains of Virginia, Tennessee, and North Carolina due to the storm.

**1944 September 14-15:** A storm which moved northward along the eastern seaboard from North Carolina up to Newfoundland caused widespread damage (track to the left). Hampton Roads saw winds of 72 mph gusting to 90 mph. Winds of 134 mph sustained with gusts to 150 mph lashed Cape Henry...a wind record which remains standing today for the state. Virginia Beach saw the pressure fall to 28.80". The gas screw *May Dee* foundered off Ocean View. See the table below for other pressures reported across the region.

Rainfall from the storm caused a flood of record at State Farm on the James river (26.4 feet). Damage totaled \$2.5 million. Forty-six perished. Also of note, this system was the first time that air force reconnaissance air craft were used to monitor a storm threatening the East Coast.

**1949 August 28 (Delray Beach Hurricane):** After devastating Florida with winds gusting to 160 mph, this cyclone tracked through Georgia and the Carolinas, where heavy rain caused river flooding (track of this storm above). One tornado touched down in Tidewater. Heavy rains spread northeast through New England, ending a long drought (Barnes II).

**1953 August 13 (Barbara):** Early on the 11<sup>th</sup>, a tropical storm was discovered in the southeastern Bahamas. It became a hurricane northeast of the Bahamas on the 11<sup>th</sup> and gained intensity as it moved north. At 10 p.m. on the 13<sup>th</sup>, it struck the North Carolina coast between Morehead City and Ocracoke (track to the right). The storm then moved north and northeast, before going out to sea just south of Norfolk. Winds reached 63 mph with gusts to 76 mph at Norfolk. Winds at Cape Henry were sustained at 72 mph. Cape Henry lighthouse saw its copper canopy torn loose during the cyclone. Rainfall amounts of five to eight inches were common across southeast Virginia. Portsmouth saw 9.3" of rain deluge the city in only 24 hours.

**1954 August 25-31 (Carol):** Hurricane Carol, a major hurricane when it made landfall in North Carolina, moved northward into New England (track above and below). It moved 100 miles off the Virginia Capes and brought winds of 40 mph to Virginia Beach. Norfolk received four inches of rain. Chincoteague reported the lowest pressure...29.28". The system helped ease drought conditions in Washington, D.C..

**1954 October 15 (Hazel):** On the 4<sup>th</sup>, a tropical storm moved through the Windward Islands into the Caribbean Sea. It quickly formed into a hurricane and continued on a westerly track until the 10<sup>th</sup>. An upper low in the western Caribbean steered Hazel northward through the Mona Passage on the 12<sup>th</sup>. As the hurricane did so, heavy rains caused mudslides in Haiti which killed 500 people. Its track became northwesterly as a cold front approached from the Mississippi Valley. The hurricane then accelerated into northeast South Carolina as a category four hurricane. On the 15<sup>th</sup>, it passed over Raleigh, Richmond, and West Virginia (track to the left).

Considerable damage was done to residential and business property in Washington as sustained winds peaked at 78 mph with gusts to 98 mph. At National Airport, a light plane flipped over and part of the hangar was blown away. The Weather Bureau radar had to be turned off for three hours when the motor began to heat up. As a cold front interacted with Hazel, a squall line swept through Washington, D.C. at 6:15 p.m., dropping the temperature 20 degrees in one hour. Frost was seen in the suburbs the following night.

Hundreds of trees fell across the Federal City. Many store front windows shattered. Falling trees damaged many houses in Fairfax. Winds whipped up white caps on the Potomac. Waters overflowed the seawall at Hains Point. Alexandria saw the Potomac flood reclaim two blocks of the city, flooding basements and first floors of businesses. U.S. 1 was flooding by 9 p.m. at Hunting Creek. Heavy rains fell in the mountains, with a couple locations measuring over 10 inches.

Norfolk's sustained winds reached at 78 mph with gusts to 100 mph. Hampton saw winds as high as 130 mph. Damage was extensive from strong winds and high tides. Several ships in the James River were sunk or wrecked. At the Old Dominion Boat Club in Alexandria, two cruisers sank and several docks washed away. Quantico saw most of its docks vanish. Fourteen sailboats met an untimely fate at the Washington Sailing Marina. Tides reached 8.7 feet above low water datum at Washington, D.C..

The battleship *Kentucky* broke its moorings and ran aground 100 feet away. The gun screw vessel *Pirate* was lost off West Norfolk. The Coast Guard beacon light on the Potomac at Morgantown was toppled by Hazel's winds. Thirteen across Virginia perished...2 in the District of Columbia ...damage estimates reached \$15 million.

**1955 August 12 (Connie):** Connie developed in the tropical middle Atlantic on the 4<sup>th</sup>, and moved west northwest to the north of Puerto Rico. Motion slowed on the 9<sup>th</sup>, as Connie began to interact with the developing Hurricane Diane. On the 11<sup>th</sup>, the system accelerated north- northeast and hit Cape Lookout, North Carolina (track to the right). It crossed the coast near Norfolk, emerging back into the Atlantic. Heavy rains and high winds were seen from North Carolina northward into New England.

Winds picked up on the upper Chesapeake Bay at 4 a.m., reaching gale force by daylight. The *Levi J. Marvel* was fighting the storm. When winds reached 50 mph, the canvas sails tore away. Twenty to twenty-five foot swells tormented the ship near Holland Point and it broke anchor. She took on water and capsized around 2:40 p.m.. Eleven drowned. The oil screw *La Forest L. Simmons* capsized 1 ½ miles north of Sharps Island Light in Maryland.

Norfolk's pressure fell to 28.77". The highest wind gusts were seen at Chincoteague, where winds peaked at 64 mph. National Airport at Washington D.C. reported sustained winds of 49 mph, with gusts to 58 mph, and 4.57" of rain. Power lines went down around the District. Scores of trees fell. Dozens of basements were flooded by the heavy rains. Eastern Virginia saw eight to ten inches of rain with Connie. Due to a drought which preceded the storm, any flooding was of minor consequence. Tides peaked at 6.6 feet above low water datum at Washington, D.C.. Four died in Rock Creek during the storm.

**1955 August 17-18 (Diane):** The category one hurricane named Diane caused heavy rains, compounding the flooding caused by Connie not even a week earlier. As Connie moved out to the north, Diane followed the storm and also struck North Carolina (track to the left). It passed west of Danville at 6 p.m.. The lowest pressure seen across Virginia was 29.48" at Lynchburg. Winds gusted to gale force across eastern Virginia and Washington D.C.. Winds peaked at 45 mph at Chincoteague. In the tidewater of Washington D.C., tide were four feet above normal... the peak level was 7.1 feet above mean lower low water on the morning of the 18<sup>th</sup>. Persistent east and southeast winds over the Chesapeake led to this condition.

The heaviest rain fell across northern Virginia, where amounts totaled over six inches. Several locations on the eastern slope of the Blue Ridge mountains recorded over a foot of rain. Flood stages were reached at most points in the Potomac Basin. Tides peaked at 7.0 feet above low water datum at Washington, D.C.. However, the heaviest flooding occurred along portions of the Shenandoah River Basin. High tides were also experienced, in addition to the rains. Damage in Virginia totaled \$10.7 million. This hurricane produced over \$686 million in damage, mainly due to its disastrous floods across the East Coast.

**1955 September 19-20 (Ione):** Ione was a major hurricane as it approached the Mid-Atlantic. Originally expected to move through Washington, D.C., the storm veered off to the right, proving to be far less of a menace than anticipated (track above). Sustained winds at Norfolk peaked at 47 mph with gusts to 58 mph. The pressure bottomed out at 29.13" (986 hPa). Total rainfall from the hurricane was 3.5". This cyclone gave a scare to the Mid-Atlantic, before it veered out to sea.

**1956 September 27 (Flossy):** This hurricane formed in the Gulf of Mexico and left a path of destruction from the Mouth of the Mississippi river through the Florida panhandle, Georgia, and South Carolina. As a nontropical gale, the system alleviated drought conditions across the region. Shortly after midnight, winds peaked at 45 mph in Washington, D.C.. One thousand phones were dead due to disabled phone lines. Three inches of rain fell across Virginia. Some streets in Norfolk were flooded with 2 ½ feet of water (Barnes II). The Back River lighthouse collapsed during the storm. The gas screw vessel *Mary Anne* was lost at Hampton Roads Naval Base.

**1958 September 27 (Helene):** Maximum sustained winds at Norfolk peaked at 41 mph with gusts to 56 mph as this hurricane moved by to the southeast.

**1959 July (Cindy):** Winds at Norfolk peaked at 45 mph with gusts to 46 mph. Small yet violent tornadoes were spawned by Cindy in Norfolk and Portsmouth. Over four inches of rain fell in Hopewell.

**1959 September 30 (Gracie):** This tropical cyclone initially struck the Atlantic coast south of Charleston, and moved west of Charlotte into western Virginia (track above). A tornado (one of three) touched down eight miles west of Charlottesville, killing 11. Heavy rains were seen in the Appalachians and near Norfolk. Norfolk saw 6.79" of rain in twenty-four hours. In all, twelve perished.

**1960 September 11-12 (Donna):** From the beginning, Donna was a ferocious storm. On August 29<sup>th</sup>, squalls in the vicinity of Dakar, in the country of Senegal on the west coast of Africa, forced the crash of an airliner, killing 63 aboard. The system moved out in the Cape Verde Islands on the 30<sup>th</sup>, and arrived at the Leeward Islands on the 4<sup>th</sup>. Amazing flash flooding was seen across the Virgin Islands and eastern Puerto Rico, when up to 15 inches of rain fell in less than four hours. Winds gusted to 180 mph across the Florida Keys, as the hurricane turned northward.

Thereafter, Hurricane Donna affected the entire length of the Atlantic coast of the United States. Donna became the first hurricane since complete records were kept in 1871 which traversed the Florida peninsula, the southeastern United States, the Mid-Atlantic region and New England. Donna made a second landfall between Wilmington and Morehead City on the evening of the 11<sup>th</sup> as a category three hurricane. The system tracked across the Albemarle and Pamlico sounds of North Carolina and re-emerged into the Atlantic Ocean just southeast of Virginia Beach shortly after 5:00 AM September 12, 1960. Above is a list of the lowest pressure measured in the region during Donna.

Virginia Beach saw the pressure fall to 28.51"...and winds gusted to 89 mph. Maximum sustained winds reached 73 mph at Norfolk and 80 mph at Cape Henry. The Chesapeake lightship estimated 138 mph winds as the pressure dove to 28.65". Eastern Virginia saw the most rain...where six to eight inches fell. The vessels *Peggy* and *Tender* were wrecked off Norfolk. Three died in Virginia due to Donna.

**1964 August 29-September 1 (Cleo):** This hurricane passed through the inland sections of the state from west to east. Washington, D.C. could only watch it rain to the south, as record drought plagued the area throughout much of the summer and fall. Southern sections of the Old Dominion saw inundating rains. In Tidewater Virginia, ten to fourteen inches of rain fell in about 12 hours. Two perished...both deaths were caused by motorists, who after being stranded in flood waters, were poisoned by carbon monoxide. Damages totaled \$3 million.

**1964 September 11-14 (Dora):** As Dora moved northeast from Cape Hatteras out to sea 120 miles southeast of Norfolk, its influence was felt across southeast Virginia. Tides of three feet above normal in Hampton Roads caused moderate flooding of low lying areas. Heavy rain led to flooding at Suffolk and Yorktown. The heaviest rain was seen at Diamond Springs, 5.83 inches. Norfolk saw winds peak at 63 mph, causing minor damage. Near Cape Henry, a large freighter was driven aground.

**1967 September 9-11 & 15-18 (Doria):** An extreme example of how erratic a path of a hurricane can be, it remained near the southeast coast of the United States for 13 days, moving different directions every few days. As a hurricane on the 13<sup>th</sup>, it moved westward. The storm made landfall near the Virginia Capes before meandering south for a brief skirmish with North Carolina on the 17<sup>th</sup>, then eastward back out to sea.

Two periods of rain were associated with Doria in Virginia. The highest amount recorded was 4.66" at Lake Drummond, near Wallaceton. As the storm passed offshore the Virginia Capes by 225 miles on the 10<sup>th</sup> and 11<sup>th</sup>, winds gusted to a mere 36 mph at Norfolk. Cool air invaded the Mid-Atlantic. Washington, D.C.'s temperature fell to 49 degrees on the 11<sup>th</sup>.

The second approach on the 15<sup>th</sup> and 16<sup>th</sup> caused winds to gust to 55 mph...the pressure fell to 29.60" at Norfolk. Gusts to 60 mph were seen at Wallops Island on the 16<sup>th</sup>. Torrential rains and squalls buffeted the Eastern Shore. Winds damaged trees, roofs, signs, and billboards. Twenty to thirty foot seas came in advance of Doria's second coming towards Virginia. The superstructure of a 38-foot boat was torn off by high seas off the Atlantic coast near the Virginia/Maryland border...three perished from the vessel (Bailey). Tides were four feet above normal at Virginia Beach.

**1969 August 19-20 (Camille):** One of the strongest hurricanes ever recorded, Camille became Virginia's worst natural disaster ever. Camille weakened as it moved through the Southeast...until reaching the Appalachian mountains. As a cold front approached from the northwest, a burst of heavy rains developed across southeast West Virginia and western Virginia. To the right is a NIMBUS III satellite image of Camille just offshore the Mid-Atlantic on the 21st, provided by NCDC.

A band of rain and thunderstorms about 45 miles wide stretched from White Sulphur Springs, West Virginia to Fredericksburg. Rainfall increased rapidly along the west slopes of the Blue Ridge mountains; more than ten inches fell at Clifton Forge. In Nelson county, one location reported a whopping 27" of rain in only eight hours. This caused 133 bridges to be wiped out throughout Nelson county, making transportation nearly impossible. As Camille intensified back into a tropical storm over Virginia, four inches of rain fell along the coastal plain, in the path of the redeveloping storm.

When the rains began in earnest, telephone lines were downed, preventing the true nature of the flooding to be known until much later. Extensive flash flooding and landslides caused a major disaster on the Tye and Rockfish river basins. Landslides swept into hollows, destroying roads, homes, bridges, and railroads. Charlottesville was isolated as rock and mud slides blocked roads.

The James River experienced a flood of record as far downstream as Richmond. To the right is a table of values for different locations within the James River system. Buena Vista had 5 ½ feet of water in its business district. Glasgow, at the confluence of the Maury and James rivers, saw its entire business district destroyed by water nearly 14 feet deep. Flash flooding caused 153 people to perish, mainly across Virginia. The oil screw *Leader* foundered four miles east of Cape Henry. Damage totaled \$113 million.

**1970 May 26-27 (Alma):** On the subsident side of the cyclone, at 1:15 p.m. on the 27<sup>th</sup>, a strong dust devil at Radford picked up a roof of a school hallway and dumped it onto the school grounds, injuring six.

**1971 August 27 (A second Doria):** A weak tropical depression formed in the eastern Atlantic and moved swiftly to the west, passing through the northern Leeward Islands on the 23<sup>rd</sup>, and moving just to the east of the Bahamas on the 25<sup>th</sup>. While recurving to the north, Doria became a tropical storm and continued to intensify as it approached the coast. Maximum sustained winds were 65 mph with the system as it made landfall in North Carolina (see track below).

Maximum sustained winds were 52 mph at Norfolk, 59 mph at Wallops Island, and 60 mph at Langley Air Force Base. A large warehouse near the Norfolk airport experienced severe damage. Appreciable losses were caused by a tornado as it tracked through Portsmouth and Chesapeake. Hundreds of trees fell and a dozen homes were damaged.

The highest rainfall amount was 6.44" two miles south-southeast of Halifax. Four-Mile Run flooded once more. A sewage plant in Virginia Beach became clogged with silt and sand. When the sewage was dumped into the Chesapeake, beaches were closed for days. A young girl drowned in Alexandria, when she fell into a drainage ditch.

**1971 September 30-October 3 (Ginger):** Tracked for 31 days as a cyclone through the Subtropical Atlantic, the very long-lived Ginger tormented Bermuda twice before moving west into North Carolina near Atlantic Beach. Maximum winds were under 50 mph across southern Virginia. Norfolk gusted to 49 mph from the northeast on the 30<sup>th</sup>. A few trees were leveled with isolated utility outages leading to minor inconvenience. The heaviest rains from the decaying tropical storm were seen in southeast Virginia. Diamond Springs reported a 7.49" deluge of rain. Tides ranged from two to four feet above normal. Moderate to heavy beach erosion ate away at Virginia Beach.

**1972 June 21-22 (Agnes):** Developing near the Yucatan peninsula of Mexico on the 15<sup>th</sup>, Agnes turned north and on the 16<sup>th</sup> attained hurricane status in the east-central Gulf of Mexico. A category one hurricane when it struck the Florida panhandle on the 17<sup>th</sup>, the storm weakened as it moved up the coast, east of the Appalachians. Pressures fell to 29.10" at Norfolk. Langley Air Force Base experienced wind gusts to 54 mph.

Big Meadows totaled 13.6" of rain from the decaying storm. The highest amount measured was 16" at Chantilly (See rainfall map to the upper right). An all-time 24 hour precipitation was set at Dulles Airport, when 11.88" deluged the area (Kocin). Associated severe flooding caused record river stages along the east half of the James River basin. Floods of record were recorded at Cartersville (37.87 ft.), the Richmond City Locks (36.5 ft.), and Richmond near Westham (28.62 ft.). This flood caused the James to swamp a 200 block area of downtown Richmond, the worst flooding since May 1771. Only one of the five bridges across the James was left usable. Moderate flooding occurred at Buena Vista.

Near Alexandria, Four Mile Run flooded the heavily populated section of Arlandria. Flooding was also severe along the Appomattox River Basin. The entire Potomac also flooded. Along the Potomac, 66 miles of towpath were scoured by the floods. Inundation led to a 300- foot cave-in at the Widewater section of the C & O Canal. Thousands of homes were flooded in Washington, D.C.. Even the White House experienced the wrath of Agnes, when heavy rains invaded its basement. Around 49,000 phones were put out of commission by downed lines. In the D.C. metropolitan area, ten people fell victim.

One hundred three highways were either destroyed or damaged across the state. The shellfish and oyster industry suffered due to excessive fresh water runoff into the Chesapeake destroying their marine habitat for weeks. Damage done across the state from Agnes totaled \$222 million....\$25 million in Fairfax county alone. The C & O Canal saw \$34 million in damages. Thirteen died from flash flooding in Virginia.

As the storm moved northeast through New York, destructive floods and tornadoes surged the damage total to over \$2.3 billion for the United States. The worst floods on record were experienced across Pennsylvania and southern New York, as over sixteen inches of rain fell in several locations.

**1975 September 24-26 (Eloise):** After striking the Florida panhandle as a major hurricane, Eloise accelerated inland and was downgraded to a tropical storm in Alabama (track above). Heavy rains began to fall across the Mid-Atlantic as Eloise interacted with a cold front. Street flooding was rampant in Virginia and Washington D.C.. The 9.08" of rain seen at Washington, D.C. from the cyclone led to the wettest September at the site since 1934. Flooding was experienced along the Patuxent River and Four-Mile Run. Arlandria experienced such a flood that 400 residents evacuated during the night of the 25/26th (\$11.9 million).

Forty residences were submerged near Manassas, on Bull Run. Rock Creek Parkway was closed due to mud slides. Nearly 300 secondary and thirteen primary roads were closed due to the flooding statewide. Damage totaled \$17.2 million.

**1976 August 9 (Belle):** A tropical wave moved offshore Africa on July 28<sup>th</sup> and moved uneventfully across the Atlantic and Caribbean Sea. A tropical depression formed on the north end of this wave on the 6<sup>th</sup>, in the vicinity of the northern Bahamas. Belle rapidly developed into a hurricane on the 7<sup>th</sup>. On the 8<sup>th</sup>, the system accelerated

northeast and it made its closest approach to North Carolina on the 9<sup>th</sup>. It passed 85 miles east of Norfolk at 1 p.m. EST. Later that day, the fast moving storm made landfall on the coast of western Long Island.

Although on the weak west side of this hurricane, Virginia noted the passing of Belle. Pressures fell to 29.44" at Wallops Island...where winds of 60 mph were seen in gusts. Over four inches of rain fell along the immediate coast of Virginia. At South Island along the CBBT, winds peaked at 63 mph. One died in a related traffic accident in Norfolk.

**1979 September 5 (David):** David was a classic Cape Verde hurricane which caused massive destruction along its path across the western Atlantic. Dominica was the first island to experience David. Almost three-fourths of the population was left homeless by the cyclone. It was their strongest hurricane since 1834. As it moved westward across Puerto Rico, \$70 million in damages was exacted from the island. Haiti was devastated the most by the borderline category 5 hurricane when heavy rains, mud slides, and high winds led to over 1,200 lost lives. Entire villages were swept away by the epic flood; the tempest caused \$1 billion in damage across Hispaniola.

As the menacing storm continued its parabolic course, a brief landfall occurred at West Palm Beach. Now moving northward, the system moved just inland of the Atlantic Seaboard after its final landfall near Hilton Head, SC. When squalls passed through Virginia on the 5<sup>th</sup>, two powerful tornadoes tracked through Newport News and Hampton, causing \$2.5 million in damage.

Most damage across the area was produced by gusty winds, as high as 60 mph. Trees and power lines were no match for David; this led to 140,000 people without power. A tornado touched down at the edge of Fairfax City at 7:22 p.m. on the 5<sup>th</sup>, severely damaging 22 homes (\$2 million damage). This tornado lifted briefly, before touching back down at Great Falls. Eight tornadoes touched down from Fairfax and Loudon counties south to Newport News.

Many funnel clouds and weak tornadoes played havoc with Washington, D.C.. Winds only gusted to 39 m.p.h at National Airport; rains at that location totaled 3.68". Flooding was seen along Rock Creek, leading to the road's undermining (\$374,000 damage). Floods also invaded the Alexandria waterfront. Heavy rains fell across the mountains of western Virginia and also in the vicinity of Norfolk. Big Meadows recorded 8.93" on the 9<sup>th</sup> while nine inches fell at Poor Mountain, near Roanoke. Flooding began around 9 p.m., inundating Colonial Heights-Petersburg, Rappahannock, Page, Madison, and Orange counties. Three perished in the storm. Total insured losses to the D.C. metropolitan area reached \$8 million.

**1985 July 25 (Bob):** A tropical depression formed in the southeast Gulf of Mexico. It slowly meandered east, becoming a tropical storm just prior to making landfall across southwest Florida. As the system reached the east coast, it turned to the north. Hurricane status was achieved to the east of Georgia. The cyclone moved north into South Carolina, weakening quickly back into a tropical depression.

As the low moved north through Virginia, Bob spawned two weak tornadoes of F0 intensity and one strong tornado of F3 intensity. The two weak tornadoes near Richmond and Charlottesville damaged ten houses. The strongest tornado in northern Albermarle country destroyed two homes. Funnel clouds were observed throughout the Washington, D.C. metropolitan area. Gusty winds downed power lines, disrupting the Boy Scout jamboree in Fredericksburg. Winds peaking at 48 mph at National Airport downed a seaplane in the Washington Channel, near Hains Point, shortly before 2 p.m..

High winds and heavy rains damaged trees and led to a loss of power to 30,000 throughout the D.C. suburbs of Virginia and Maryland. A house under construction in Great Falls collapsed. Two people were fatally injured in Germantown, MD when a car slid into another vehicle while attempting to enter a curve. In the District, a man perished when his van struck an eastbound car. At 2 p.m., a car accident claimed a life near Calverton, MD.

**1985 September 27 (Gloria):** For ten days, this system gained intensity as it moved across the Atlantic, becoming an extremely dangerous and large category four hurricane east of the Bahamas (track to the left). As the storm accelerated north, cooler water temperatures caused weakening of the once powerful hurricane. Still, Gloria moved over Cape Hatteras at 2 a.m., where a pressure of 27.98" was achieved.

Virginia Beach saw the pressure bottom out at 28.87". Norfolk experienced winds sustained at 46 mph, with gusts to 67 mph. Norfolk Naval Air Station reported wind gusts of 64 mph. Sustained winds of 94 mph, with gusts to 104 mph, blew through South Island's Chesapeake Bay Bridge Tunnel (CBBT).

Hampton Roads saw a 5.65" deluge of rain. Southeast Virginia measured the most rain; isolated locales saw over eight inches. The highest tide noted was 5.3 feet above mean lower low water. Damage totaled \$5.5 million statewide. This storm became nontropical in Canada and continued to rapidly move east. A record warm spell greeted Europe as Gloria made landfall on the continent early in October.

**1985 November 2-7 (Juan/"Killer Flood of 1985"):** This hurricane of non-tropical origin drifted aimlessly across Louisiana during the last week of October before moving east into Pensacola on Halloween. As the center of Juan moved north towards Michigan, a secondary low moved east across North Carolina, continuing the moderate rains. A third low pressure system, along Juan's cold front, transformed a minor flood into a major disaster. A massive rain shield developed as warm, tropical air overrode cooler air to the north of the center. This third system tracked across southwest Virginia on the 4th, and eventually through northern Virginia and Maryland.

Heavy rains fell across the eastern slopes of the Blue Ridge mountains...19.77" two miles northeast of Montebello. The Bloomington Reservoir rose 80 feet in a mere 30 hours. It was considered more damaging, further upriver than Agnes was in 1972. Record-breaking flood discharges occurred at many locations within the Potomac, James, and Roanoke river basins (Carpenter). The heart of the destruction was across Virginia and West Virginia. In Virginia, 3500 homes were destroyed. Carpeting, dead animals, window frames, and numerous household items began flowing down the Potomac. The most extensive damage in the Old Dominion occurred in the Roanoke river basin, in the Roanoke-Salem metropolitan area. Many in Roanoke were rescued from rooftops via boats and helicopters. Waters rose to the third story of an apartment complex in Salem. Lynchburg experienced the James rising to seven feet above the previous record, set in 1877. Stored tobacco was in ruin; losses totaled \$8 million. Extensive flooding invaded Richmond. Monetary losses exceeded those of Camille and Agnes. Forty counties and twelve independent cities were declared Federal disaster areas.

Waters rose to within two inches of the top stones of Georgetown's Lock 3, stopping just shy of a catastrophe for Washington, D.C.. Waters were high for four days. Total damages along the C & O Canal from Cumberland to Georgetown was over \$9 million. Overall, the Potomac saw \$113 million in damages. In Virginia, 22 perished and \$753 million of damage was incurred. In West Virginia, almost 2600 residents were left homeless after the floods, and damages skyrocketed to \$500 million. It was the worst flood in West Virginia history as several small towns were almost destroyed (Stanton). Total damage across West Virginia, Virginia, Pennsylvania, and Maryland totaled \$1.4 billion.

**1986 August 17 (Charley):** Forming as a tropical depression over the northeast Gulf of Mexico, the system wandered east and northeast to off the South Carolina coast before finally becoming a tropical storm. (track above and below). Charley briefly became a hurricane immediately off the Mid Atlantic coast. Norfolk saw winds of 40 mph, gusting to 63 mph. Cape Henry experienced sustained winds of 54 mph with gusts to 82 mph. South Island's CBBT saw hurricane conditions as 94 mph sustained winds, with gusts to 104 mph, lashed the station.

A light twin engine plane crashed into the Chesapeake Bay at around 7 p.m., killing all three aboard. Tides rose to 5.5 feet above mean lower low water. Damage totaled less than \$1 million statewide.

**1989 September 21-22 (Hugo):** Hugo was a well organized tropical disturbance as it emerged off the coast of Africa. It developed modestly as it crossed the ocean and became a category five hurricane as it approached the northeastern Caribbean Sea. Puerto Rico took its toll on Hugo (and vice versa) and Hugo weakened into a minor hurricane. Over the next few days, the system re-attained hurricane status and strengthened rapidly in the hours before landfall near Charleston. The track of Hugo then took a northward turn, across western Virginia, before transitioning into a nontropical low (track to the upper right, satellite picture to the upper left provided by NCDC). Winds peaked at 37 mph at National Airport. The low pressure system later merged with a cold front. Six died in Virginia due to Hugo.

**1990 October 11-13 (Klaus & Marco):** Klaus, once a hurricane northeast of the Caribbean, moved west-northwest to the north of the Greater Antilles as a weakening, sheared tropical storm. At this time, Marco was forming in the Florida Straits. The two low pressure systems moved in tandem on opposite sides of the Florida peninsula. The remains of Klaus came ashore along the east coast, accelerating northward into the Appalachians. Meanwhile, Marco limped ashore the Florida panhandle and moved slowly northeast. The combination of these two systems dropped around eight inches of rain to the mountains of western Virginia.

**1994 August 17-18 (Beryl):** This tropical storm formed very close to the Florida panhandle on the 14<sup>th</sup>. Landfall took place near Panama City at 8 p.m. EST on the 15<sup>th</sup>. Thereafter, the cyclone weakened to a tropical depression and moved northeast. Around five inches of rain fell across western Virginia. Heavy rains spread northeast to New York state. One tornado touched down just north of Ridgeway and tracked 4 1/4 miles. One hundred homes and thirty businesses were damaged along its path, and ten people were injured (\$8.7 million).

Seven inches of rain fell in Carrol and Grayson counties, flooding roads and low bridges. Flood waters on Kerrs Creek sent one family evacuating. Evacuations also took place near the New River in Pulaski county. Roads in western Augusta county were closed. Faquier county saw mud and gravel slides damage and close roads. Over twenty roads were flooded in Shenandoah county. Winchester was inundated in a foot and a half of standing water. Damages totaled \$15 million statewide.

**1995 August 6-7 (Erin):** The remains of Erin spread eastward from the Ohio Valley across West Virginia, northern Virginia, and Maryland. Almost six inches of rain fell in some areas of extreme northwest Virginia. It caused brief relief from an otherwise excessively hot and dry July, August, and early September. A tornado was spawned near the Patuxent Naval Research Center.

**1995 October 5 (Opal):** After accelerating northward out of the Gulf of Mexico, Opal moved quickly through the Eastern United States. The satellite picture to the left was taken as the cyclone was accelerating through northwest Georgia at 4 a.m. on the 5<sup>th</sup>, provided by NCDC. Despite hundreds of miles of travel from the Gulf of Mexico, gale force winds blew through western Virginia. Winds sustained at 40 mph, with gusts past 60 mph, blew down trees mainly above 2000 feet elevation in the Shenandoah Valley and along the Allegheny Plateau. Dozens of trees were blown down along Skyline Drive in Page and Warren counties.

In Waynesboro, a canopy over a service station was ripped off. South Winchester and Elkton saw 2600 homes and businesses without power as lines were downed by the winds. Two tornadoes struck the tidewater. One touched down at West Point airport in New Kent county. It tore the roof off a hangar, destroying a small airplane and damaging four others. The second tornado uprooted trees and damaged outhouses.

In Madison county, five inches of rain fell on Graves Mountain, washing out a bridge previously destroyed by floods that June. A minor mudslide occurred in Grayson county. A vehicle was swept off the road by flood waters six miles southwest of Fancy Gap in Carroll county. Washington, D.C. saw local street flooding from the system's rainfall. Four to eight inches of rain fell across southwestern Virginia. This helped end drought conditions brought on from a very dry July, August, and September. Damage totaled \$220,000.

**1996 July 12-13 (Bertha):** The earliest Cape Verde hurricane ever witnessed to cross the Atlantic unscathed, unprecedented Bertha lashed the Mid Atlantic coast (track below). To the right is an image of the hurricane as it was making landfall in North Carolina, provided by the National Climatic Data Center (NCDC). Portsmouth reported winds gusting to 54 mph on the 13<sup>th</sup>... the pressure fell to 29.37". Tree limbs falling on power lines caused temporary power outages. Over four inches of rain fell across southeastern Virginia.

**1996 September 5-8 (Fran):** The major hurricane known as Fran struck the North Carolina coast between Wrightsville and Topsail beaches (track to the upper left, satellite picture to upper right courtesy of NCDC). Extensive flooding was endured from North Carolina and Virginia northward, as the center passed over Danville. Widespread flooding occurred in the mountains. Norfolk saw southeast winds of 41 mph, with gusts to 47 mph. At Portsmouth, winds peaked at 60 mph at 4:19 a.m.; the pressure fell to 29.67". The storm raged more severely at Hampton, where gusts to 71 mph occurred.

Lynchburg experienced a 6.94" deluge of rain. Tom's Branch received 14.3"...causing flash flooding which cut the city off from the rest of the area. The town of Luray was split in half by flooding. Columbia saw winds of 46 mph. In all, 360,000 lost power due to the cyclone. In Washington, D.C., power lines and trees were downed. Fourteen inches of rain fell in isolated locations southwest of the city. To the left is a picture of flooding in Alexandria, courtesy of the Associated Press. Along the C & O Canal, the devastating flood swept through Harpers Ferry and Point of Rocks. A Virginia woman perished as her all-terrain vehicle was swept away, while crossing a flooded creek. Three perished due to Fran.

**1997 July 24 (Danny):** This hurricane made landfall in southeast Louisiana before stalling in Mobile Bay for over 24 hours. Thereafter, it moved north into western Alabama before making a hard right towards the east across the lower Appalachians. While the system was in transit across the length of North Carolina, it restrengthened into a tropical storm. It later emerged into the Atlantic near Pungo, Virginia.

The pressure fell to 29.73" at Portsmouth as winds gusted to 56 mph at 3:17 p.m.. Norfolk Naval Air Station experienced wind gusts to 67 mph. Langley Air Force Base, the Chesapeake Bay Bridge Tunnel, and Cape Henry gusted to 61 mph. Trees and power lines were downed throughout the Norfolk metropolitan area. At 1:09 p.m., a tornado touched down in the South Norfolk section of Chesapeake or about two miles east of Portsmouth and destroyed a car wash, along with six other businesses. A tractor trailer was overturned. Another tornado near Norfolk destroyed windows and tracked a mile east across the eastern branch of the Elizabeth River. A third tornado touched down at Knotts Island.

**1998 August 27-28 (Bonnie):** This hurricane formed in the tropical Atlantic before recurving to move over the Outer Banks. Portsmouth gusted to 63 mph while the pressure fell to 29.53". Norfolk experienced winds of 46 mph with gusts to 64 mph. Winds howling to 90 mph blew past the Cape Henry Light Station. South Island CBBT had 90 mph with gusts to 104 mph. The combination of four to seven inches of rain and high winds knocked out power to nearly 1,000,000 people...most of which were in the vicinity of Hampton Roads. Tides peaked at 6.0 feet above mean lower low water.

**1999 August 29-September 7 (Dennis):** On the 22nd, a tropical disturbance formed north of Puerto Rico. Over the next two days, the system gradually became a tropical depression while located near the southeasternmost Bahamas. Strengthening was slow to ensue to to upper level westerly winds inhibiting development. Despite the shear, Dennis became a tropical storm on the night of the 24th, as it drifted west-northwest.

The cyclone was in a state of constant reorganization through the 26th, but slowly intensified into a hurricane by that morning while located in the central Bahamas. An upper level trough swung through the northern Plains and into the Northeast over succeeding days. This allowed the storm to turn slowly to the north, while continuing to strengthen. It came perilously close to Wilmington, North Carolina during the night of the 29th before finally moving northeast, paralleling the coast. To the left is a satellite picture showing this hurricane near the time of its closest first approach, at 11:15 a.m. on the 30th.

Cold and dry air began to envelop the system during the night of the 30th, leading to a collapse of all the deep convection (thunderstorm activity) around the system. Weakening began soon after, returning to category one status by the morning of the 31st, and a tropical storm late that night. Showers and thunderstorms temporarily redeveloped each day, keeping the system at tropical storm strength. The cyclone then meandered slowly west from the 1st through the 3rd...before accelerating during the day of the 4th into southeast North Carolina, as it reintensified into a strong tropical storm. After landfall that night, Dennis moved westward into central North Carolina, finally reaching the Old Dominion late on the night of the 5th as a weakening tropical depression. On the 6th, it accelerated northward across the state.

Gale-force winds were experienced along the coasts of North Carolina and Virginia from the night of the 29th through the 31st. On the 4th, gusts to gale force redeveloped along the Virginia coast. As the center approached North Carolina, a tornado touched down in Chesapeake at 11:15 a.m. on the 4th, damaging two buildings. The second tornado, in Hampton at 1:21 p.m. was the most menacing. Ten cars and an eighteen-wheel truck overturned.

Three nursing and retirement homes were struck...sending their residents for safer shelter. Many homes lost their roofs. Six people were injured from this tornado.

Rainfall amounts for the past week in southeast Virginia approached seven inches for the entire event. The highest rainfall total reported was 9.25" at Upper Shernando. As of 1 a.m. on the 6th, Apple Orchard Mountain in Bedford county had measured 8.83". Other locations that measured over seven inches of rain included Monterey, Toms Branch, Montebello, Sugar Grove, and Big Meadows. The tropical deluge affected areas from North Carolina northward to Pennsylvania, as of the 6th. High tides invaded Norfolk/Virginia Beach by the morning of the 31st...3.1 feet above normal at 8 am on the 31st, but they slowly receded over following days.

The highest gust reported in Virginia was 54 mph at Norfolk Naval Air Station at 5:06 p.m. EDT on the 30th. The lowest pressure seen in the Old Dominion thus far has been 29.77" at Norfolk at 4:25 p.m. on the 4<sup>th</sup>.

**1999 September 16 (Floyd):** Passed directly over Virginia Beach on a track similar to Hurricane Donna in 1960. Lowest pressure of 28.85" (977 MB) at Norfolk Int'l Airport 4<sup>th</sup> lowest for a hurricane this century. Fastest 1 minute wind NE 31mph with gust to 46 mph. Rainfall 6.80" with amounts of 12-18" in interior portions eastern Virginia. Franklin, VA reported 500 year flood of record. Largest peacetime evacuation in U.S. History.

## **TWENTY-FIRST CENTURY**

**2003 September 18 (Isabel):** Made landfall near Ocracoke NC. The center passed west of Emporia and west of Richmond. Fastest 1 minute wind speed NE 54 mph with gusts to 75 mph at Norfolk NAS; NE 61 mph with gusts to 74 mph at the South Island CBBT. Highest tide at Sewells Point was 7.9 feet above MLLW, which was a 5 ft surge. Significant beach erosion was reported. Numerous trees and power lines down over a wide area, with over 2 million households without power in VA. VA damage was over \$625 million, and there were over 20 deaths in VA.

**2004 August 3 (Alex):** made its closest approach to land on August 3, 2004 with its center located about 9 nm southeast of Cape Hatteras/Outer Banks, NC as a Category 1. Alex produced locally heavy rainfall across portions of southeast Virginia, but little in the way of damage or flooding.

**2004 August 14 (Charley):** made a second landfall near Cape Romain, SC as a weakening Category 1, after devastating portions of central and southwest Florida. Charley brought locally heavy rainfall and strong winds to much of southeast Virginia, especially near the coast. A wind gust to 72 mph was recorded at the Chesapeake Light buoy. In the U.S., 10 deaths and \$14 billion in damage resulted from Charley.

**2004 August 30 (Gaston):** made landfall near Awendaw, SC, on August 29, 2004 as a Category 1. Gaston weakened as it lifted northward through North Carolina, then northeastward across southeast Virginia on August 30th. Gaston produced a swath of 5 to 14 inch rains extending from Lunenburg and Mecklenburg counties northeast into Caroline and Essex counties. The heaviest rainfall, centered on the Richmond metro area, produced a major flash flood which killed 8 people. Five of these deaths resulted from people driving into flooded roadways. A total of 13 tornadoes were observed in central and eastern Virginia, all producing F0 damage. Total damage is estimated at \$130 million.

**2004 September 8 (Frances):** made landfall over east central Florida as a Category 2. It then moved northeast into the northern Gulf of Mexico, eventually turning north, making a second landfall in the panhandle of Florida, and then weakening into a tropical depression. It tracked through western Virginia, then northeast and offshore the mid Atlantic coast. A total of 6 tornadoes were observed in central and eastern Virginia, the strongest producing F1 damage.

**2004 September 17 (Ivan):** made landfall near the Florida/Alabama border as a category 3. It weakened to a tropical depression, and moved northeast, tracking along the Appalachian Mountains through western Virginia, then northeast and offshore the mid Atlantic coast. A total of 40 tornadoes were produced in Virginia, most in central and northern Virginia. This was a record single day outbreak for Virginia, and exceeded the previous ANNUAL tornado record (31). Most of these tornadoes were F0 or F1 in intensity, although 10 F2 tornadoes and 1 F3 tornado touched down in south central...west central and northern Virginia.

Hurricanes come close enough to produce hurricane force winds approximately three times every 20 years. Two or three times a century winds and tides produce considerable damage and significantly threaten life. Three known storms have been powerful enough to alter coastal features.

MLLW = Mean Lower Low water which is the mean of the lowest of the low tide values.

### **Bibliography for Appendix C**

Assataeague Naturalist. The Great Hurricane of 1933. World Wide Web, 1998.

Bailey, Morton H.: "Special Weather Summary" Climatological Data Virginia : September 1967. Environmental Science Services Administration: Asheville, 1967.

Barnes, Brooks M., Barry R. Truitt. Seashore Chronicles: Three Centuries of the Virginia Barrier Islands. University Press of Virginia: Charlottesville, 1997.

Barnes, Jay. North Carolina's Hurricane History. University of North Carolina Press: Chapel Hill, 1995.

\_\_\_\_\_. Florida's Hurricane History. University of North Carolina Press: Chapel Hill, 1998.

Carpenter, D. H.. Floods in West Virginia, Virginia, Pennsylvania, and Maryland, November 1985. U.S. Geological Survey Water-Resource Investigations Report 88-4213: Towson, 1990.

Cobb, Hugh D. "The Chesapeake-Potomac Hurricane of 1933" Weatherwise: Heldref Publications: Princeton, 1991.

Crappuli, Robert. Hurricane and Tropical Storm Data: 1600-present...Georgia and South Carolina Storms. World Wide Web, 1998.

Crockett, Curtis W.: "Special Weather Summary" Climatological Data Virginia: August 1971. Environmental Data Service: Asheville, 1971.

Environmental Science Services Administration. Hurricane Camille: August 14-22, 1969. Department of Commerce: Washington D.C., 1969.

Fernandez-Partagas, J., Henry Diaz, 1996. A Historically Significant Revision of Atlantic Tropical Cyclone Frequency 1851 to 1890. Climate Diagnostics Center, ERL/NOAA, 62 pp.

Green, Timothy. "Frederickburg, July 31" Virginia Herald and Fredericksburg Advertiser 31 July 1788: 3. \_\_\_\_\_. "Frederickburg, August 7" Virginia Herald and Fredericksburg Advertiser 7 August 1788: 3. \_\_\_\_\_. "Fredericksburg, August 4" Virginia Herald, and Fredericksburg Advertiser 4 August 1795: 3. \_\_\_\_\_. "Norfolk, August 12" Virginia Herald, and Fredericksburg Advertiser 21 August 1795: 2.

Henry, Alfred J.. "Climatological Tables" Monthly Weather Review August 1928. Government Printing Office: Washington, 1929.

High, Mike. The C & O Canal Companion. Johns Hopkins University Press: Baltimore, 1997.

House, Donald C. The Virginia Floods: August 19-22, 1969. Environmental Science Services Administration: Washington D.C., 1969.

Hutchins, Stilson. "Very Welcome Rain" Washington Post 10 September 1881: 1. \_\_\_\_\_. "The Coming Cold Wave" Washington Post. 11 September 1881: 1. \_\_\_\_\_. "Damage by the Storm" Washington Post 12 September

1882: 3. \_\_\_\_\_. "Alexandria Annals" Washington Post 13 September 1882: 3. \_\_\_\_\_. "A Destructive Storm" Washington Post 24 September 1882: 1. \_\_\_\_\_. "The Equinoctial" Washington Post 25 September 1882: 1.

Hutchins, Stilson. "Welcome Rain in Virginia" Washington Post 12 September 1883: 1. \_\_\_\_\_. "Wreck of the Norfolk and Western" Washington Post 13 September 1883: 1. \_\_\_\_\_. "Virginia Peanuts a Failure" Washington Post 16 September 1883: 1. \_\_\_\_\_. "A Widespread Storm" Washington Post 26 August 1885: 1. \_\_\_\_\_. "Panic on a Steamer" Washington Post 27 August 1885: 1. \_\_\_\_\_. "A Widespread Storm" Washington Post 14 October 1885: 5.

Jennings, Arthur H. Technical Paper No. 16: Maximum 24-Hour Precipitation in the United States. Hydrologic Services Division: Washington D.C., 1952.

Kocin, Paul J. Tropical Cyclones in the Northeast United States. Unpublished: Camp Springs, 1995.

Kutschenreuter, Paul H. Technical Paper No. 26: Hurricane Rains and Floods of August 1955 Carolinas to New England. Department of Commerce: Washington D.C., 1956.

Lewis, Clifford M., Albert J. Loomie. The Spanish Jesuit Mission in Virginia 1570-1572. University of North Carolina Press: Chapel Hill, 1953.

Ludlum, David M. Early American Hurricanes: 1492-1870. American Meteorological Society: Boston, 1963. \_\_\_\_\_. Weather Record Book. Weatherwise: Princeton, 1971.

Morton, Robert A. An Overview of Coastal Land Loss: With Emphasis on the Southeastern United States. USGS Open File Report 03-337. Online at: <http://pubs.usgs.gov/of/2003/of03-337/waves.html>.

National Climatic Data Center. May 1970 Storm Data. NESDIS: Asheville, 1970. \_\_\_\_\_. August 1971 Storm Data. NESDIS: Asheville, 1971. \_\_\_\_\_. September 1971 Storm Data. NESDIS: Asheville, 1971. \_\_\_\_\_. June 1972 Storm Data. NESDIS: Asheville, 1972. \_\_\_\_\_. September 1975 Storm Data. NESDIS: Asheville, 1975. \_\_\_\_\_. August 1976 Storm Data. NESDIS: Asheville, 1976. \_\_\_\_\_. September 1979 Storm Data. NESDIS: Asheville, 1979. \_\_\_\_\_. August 1994 Storm Data. NESDIS: Asheville, 1994. \_\_\_\_\_. October 1995 Storm Data. NESDIS: Asheville, 1996. \_\_\_\_\_. July 1997 Storm Data. NESDIS: Asheville, 1996.

NWSO Wakefield, VA. The Hurricane History of Coastal Virginia. National Weather Service: Wakefield, 1998. \_\_\_\_\_. The Hurricanes of the 1930s in Virginia and North Carolina. World Wide Web, 1998. \_\_\_\_\_. The Hurricanes 1950-1954 in Virginia and North Carolina. World Wide Web, 1998.

Office of Meteorological Operations. Hurricane Agnes: June 14-22, 1972. National Weather Service: Silver Spring, 1972. \_\_\_\_\_. Hurricane Fran. National Weather Service: Silver Spring, 1996.

Pouliot, Richard A., Julie J. Pouliot. Shipwrecks on the Virginia Coast and the Men of the United States Life-Saving Service. Tidewater Publishers: Centreville, 1986.

Proctor, John Clogett. "New York Avenue Church" Sunday Star 21 March 1948: Washington. \_\_\_\_\_. "Storm Fury Faced By Churches Here" Sunday Star 30 September 1934: Washington.

Richards, George and Company. Virginia Journal and Alexandria Advertiser 6 October 1785: Alexandria, 3.

Ryan, Bob. Bob Ryan's 1991 Weatherwise Almanac. WRC-TV: Washington, 1991.

Secretary of the Army. Washington, D.C., Metropolitan Area: Letter from the Secretary of the Army Transmitting a Letter From the Chief of Engineers, Department of the Army, Dated April 28, 1964, Submitting a Report, Together

With Accompanying Papers and an Illustration, on an Interim Hurricane Survey of Washington, D.C., Metropolitan Area, Authorized by Public Law 71, Eighty-Fourth Congress, Approved June 15, 1955. U.S. Government Printing Office: Washington, 1964.

Shomette, Donald G. Shipwrecks of the Chesapeake: Maritime Disasters on Chesapeake Bay And Its Tributaries, 1608-1978. Tidewater Publishers: Centreville, 1982.

Stanton, Richard L. Potomac Journey: Fairfax Stone to Tidewater. Smithsonian Institution Press: Washington, 1993.

Stevenson, James D. A Historical Account of Tropical Cyclones that Have Impacted North Carolina Since 1586. NOAA Technical Memorandum NWS ER-83: Bohemia, 1990.

Tannehill, Ivan R. Hurricanes. Princeton University Press: Princeton, 1943.

Trotter, William. Hurricane Bertha Storm Report Portsmouth, Virginia. PWRS: World Wide Web, 1996. \_\_\_\_\_. Hurricane Fran Storm Report Portsmouth, Virginia. PWRS: World Wide Web, 1996. \_\_\_\_\_. Tropical Storm Danny Visits Portsmouth! PWRS: World Wide Web, 1997. \_\_\_\_\_. Hurricane Bonnie 1998! PWRS: World Wide Web, 1998.

U.S. Department of Commerce. Weather Bureau Technical Paper No. 2: Maximum Recorded United States Point Rainfall. Weather Bureau Analysis Center: Washington, D.C., 1947. \_\_\_\_\_. Climatological Data Virginia: September 1959. Weather Bureau: Asheville, 1959. \_\_\_\_\_. Climatological Data Virginia: October 1959. Weather Bureau: Asheville, 1959. \_\_\_\_\_. Climatological Data Virginia: August 1964. Weather Bureau: Asheville, 1964. \_\_\_\_\_. Climatological Data Virginia: September 1964. Weather Bureau: Asheville, 1964. \_\_\_\_\_. Hurricane Cleo: August 20-September 4, 1964. Weather Bureau: Washington D.C., 1964. \_\_\_\_\_. Climatological Data Virginia: September 1971. Environmental Data Service: Asheville, 1971. \_\_\_\_\_. Climatological Data Virginia: October 1971. Environmental Data Service: Asheville, 1971.

Vojtech, Pat. Lighting the Bay: Tales of Chesapeake Lighthouses. Tidewater Publishers: Centreville, 1996.

Washington Post Company. "Heavy Rain in Lynchburg" Washington Post 23 June 1886: 1. \_\_\_\_\_. "Great Floods in Virginia" Washington Post 3 July 1886: 1. \_\_\_\_\_. "A Cyclone Off Cape Henry" Washington Post 23 August 1887: 1. \_\_\_\_\_. "Ruin of Wind and Rain" Washington Post 22 August 1888: 1. \_\_\_\_\_. "The Edge of a Tornado" Washington Post 22 August 1888: 2. \_\_\_\_\_. "In the Storm's Pathway" Washington Post 23 August 1888: 1. \_\_\_\_\_. "Death at a Colored Baptizing" Washington Post 24 August 1888: 2. \_\_\_\_\_. "Drouth Followed by Flood" Washington Post 12 September 1888: 2. \_\_\_\_\_. "British Schooner Wrecked" Washington Post 13 September 1888: 2. \_\_\_\_\_. "The First Winter Storm" Washington Post 26 November 1888: 1. \_\_\_\_\_. "Out of Death's Jaws" Washington Post 27 November 1888: 1. \_\_\_\_\_. "A Strange April Day" Washington Post 7 April 1889: 2. \_\_\_\_\_. "Wind, Water and Fire" Washington Post 8 April 1889: 1. \_\_\_\_\_. "A Storm's Fury" Washington Post 12 September 1889: 1. \_\_\_\_\_. "Wrecks on the Seashore" Washington Post 13 September 1889: 1. \_\_\_\_\_. Washington Post 14 September 1889: 1. \_\_\_\_\_. "Caught in a Storm" Washington Post 25 September 1889: 1. \_\_\_\_\_. "Will Be a Total Loss" Washington Post 11 October 1891: 1. \_\_\_\_\_. "Struck By a Storm" Washington Post 29 August 1893: 1. \_\_\_\_\_. "Scores Were Lost" Washington Post 30 August 1893: 1-2.

# Appendix D

## Hazard Ranking Sheets

## Hampton - Priority of Hazards

### Methodology

Hazards were identified and prioritized through an exercise that was conducted with the City of Hampton, VA . In the exercise participants were asked to identify natural hazards that occur in the City of Hampton and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for the City of Hampton." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	Probability of Occurrence	<sup>1</sup> Public Perception of Occurrence	Historical Occurrence	References
<b>NATURAL HAZARDS</b>				
<b>Winter Weather</b>	L	M		HMPC, FEMA, NCDC
<b>Thunderstorm / Lightning</b>	M-H	M-H		HMPC, NOAA-NCDC
<b>Wind</b>	M	H		HMPC, NOAA-NCDC
<b>Hurricanes</b>	M	H <sup>2</sup>		HMPC
<b>Tornadoes</b>	L	L		HMPC
<b>Drought</b>	L	M		HMPC
<b>Earthquakes</b>	N	L		HMPC, USGS
<b>Landslides</b>	N	N		HMPC
<b>Sea Level Rise</b>	L	L		HMPC
<b>Wildfires</b>	L	L		HMPC
<b>Biological Hazards</b>	L	L		HMPC
<b>Floods - Riverine<sup>3</sup></b>	M	H		HMPC, FEMA, NCDC
<b>Floods - Coastal</b>	M	H		HMPC, FEMA, NCDC
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; OEM=City of Newport News Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

<sup>1</sup> Back up with a survey using the "Household Natural Hazards Preparedness Questionnaire"

<sup>2</sup> Post Floyd and Isabel

<sup>3</sup> Flash Floods

# Newport News - Priority of Hazards

## Methodology

Hazards were identified and prioritized through an exercise that was conducted with the City of Newport News, VA . In the exercise participants were asked to identify natural hazards that occur in the City of Newport News and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for the City of Newport News." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	Probability of Occurrence	Public Perception of Occurrence	Historical Occurrence	References
<b>NATURAL HAZARDS</b>				
<b>Winter Weather</b>	M	M	M	HMPC,FEMA, NCDC
<b>Thunderstorm / Lightning</b>	L	L	L	HMPC,NOAA-NCDC
<b>Wind</b>	M	H	M	HMPC,NOAA-NCDC
<b>Hurricanes</b>	L	M	L	HMPC
<b>Tornadoes</b>	L	L	L	HMPC
<b>Drought</b>	L	L	L	HMPC
<b>Earthquakes</b>	L	L	L/NO	USGS
<b>Landslides</b>	L	L	NO	HMPC
<b>Sea Level Rise</b>	L	L	L	HMPC
<b>Wildfires</b>	L	L	L	HMPC
<b>Biological Hazards</b>	L	M	L	HMPC
<b>Floods - Riverine</b>	M/H	H	M/H	HMPC, FEMA, NCDC
<b>Floods - Coastal</b>	H	H	H	HMPC, FEMA, NCDC
<b>Dam Failures</b>	L	L	NO	HMPC
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; HMPC = Newport News Hazard Mitigation Planning Committee; OEM=City of Newport News Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

# Williamsburg - Priority of Hazards

## Methodology

Hazards were identified and prioritized through an exercise that was conducted with the City of Williamsburg, VA . In the exercise participants were asked to identify natural hazards that occur in the City of Williamsburg and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for the City of Williamsburg." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	Probability of Occurrence	Public Perception of Occurrence	Historical Occurrence	References
<b>NATURAL HAZARDS</b>				
Winter Weather	M	M	M	HMPC, FEMA, NCDC
Thunderstorm / Lightning	H	H	H	HMPC, NOAA-NCDC
Wind	L	L	L	HMPC, NOAA-NCDC
Hurricanes	L	L	L	HMPC
Tornadoes	L	L	L	HMPC
Drought	L	L	L	HMPC
Earthquakes	L	L	L	HMPC, USGS
Landslides	L	L	L	HMPC
Sea Level Rise	L	L	L	HMPC
Wildfires	L	L	L	HMPC
Biological Hazards	L	L	L	HMPC
Floods - Riverine	M	L	M	HMPC, FEMA, NCDC
Floods - Coastal	L	L	L	HMPC, FEMA, NCDC
Dam Failures	L	L	L	
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; HMPC= Williamsburg Hazard Mitigation Planning Committee; OEM=City of Williamsburg Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

# James City County - Priority of Hazards

## Methodology

Hazards were identified and prioritized through an exercise that was conducted with James City County, VA. In the exercise participants were asked to identify natural hazards that occur in James City County and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for James City County." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	Probability of Occurrence	Public Perception of Occurrence	Historical Occurrence	References
<b>NATURAL HAZARDS</b>				
Winter Weather	H			HMPC, FEMA, NCDC
Thunderstorm / Lightning	H			HMPC, NOAA-NCDC
Wind	H			HMPC, NOAA-NCDC
Hurricanes	H			HMPC
Tornadoes	H			HMPC
Drought	H			HMPC
Earthquakes	L			HMPC, USGS
Landslides	L			
Sea Level Rise	L			HMPC
Wildfires	L			HMPC
Biological Hazards	L			
Floods - Riverine	L			HMPC, FEMA, NCDC
Floods - Coastal	L			HMPC, FEMA, NCDC
Dam Failures				
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; HMPC = James City Hazard Mitigation Planning Committee; OEM=James City County Office of Emergency Management; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey;				

# York County - Priority of Hazards

## Methodology

Hazards were identified and prioritized through an exercise that was conducted with York County, VA . In the exercise participants were asked to identify natural hazards that occur in York County and rank the selected hazards from highest to lowest priority. The results of those exercises are included in the table below titled "Prioritization of Hazards for York County." The priority hazards were determined using a combination of historical occurrences, public perception of hazard risk, and the probability of future occurrence based on other technical resources.

Hazard	Probability of Occurrence	Public Perception of Occurrence	Historical Occurrence	References
<b>NATURAL HAZARDS</b>				
Winter Weather	L	M	1998	HMPC, FEMA, NCDC/NWS/Newspaper
Thunderstorm / Lightning	H	H		HMPC, NOAA-NCDC/Newspaper
Wind	M	L	1990-2003	HMPC, NOAA-NCDC/NWS
Hurricanes	M	M	1999-2003	HMPC, NWS/Newspaper
Tornadoes	L	L	2003	HMPC, NWS/Newspaper
Drought	L	L	2002	HMPC, NWS/Newspaper
Earthquakes	L	L	1995	HMPC, USGS/Newspaper
Landslides	L	L	N/A	NONE
Sea Level Rise	H	L		HMPC, VIMS/Website
Wildfires	M	L		Fire Marshal/Park Service
Biological Hazards	M	H		Mosquito Control
Floods - Riverine	L	L		HMPC, FEMA, NCDC
Floods - Coastal	M/H	M		HMPC, FEMA, NCDC
Dam Failures	L	L		
H=High; M=Moderate; L=Low; N=No; N/A=Not Applicable, Unknown=Historical Data Unavailable; OEM=York County Office of Emergency Management; HMPC = York County Hazard Mitigation Planning Committee; NCDC=National Climatic Data Center; FEMA=Federal Emergency Management Agency; USGA=United States Geological Survey; MHA=Multi-Hazard Atlas				

# Appendix E

## Critical Facilities Inventory

# Critical Facilities Inventory

The following coding was used for identification of critical facilities on the large format Multi-Hazard Mapping in Appendix F.

School	SC
Police	PO
Hospital	HO
Fire	FR
Airport	AI
Nursing Home	NH
Trailer Park	TP
Emergency Operations Center	EC
Day Care	DC
Clinics	CL
Pump Stations	PS
Communications	CO
E-911	E9
Government	GO
Sub Station	SB

<b>Name</b>	<b>Code</b>	<b>Number</b>
Station 6	FR	2
Station 9	FR	3
Station 10	FR	4
Station 8	FR	5
Station 7	FR	6
Station 2	FR	7
Station 3	FR	8
Station 1	FR	9
Station 5	FR	10
Station 4	FR	11
Fire Administration (City Hall)	FR	12
Fire Training Center	FR	13
Sentara Careplex	HO	3
Veterans Administration Center	HO	4
Dolittle	PO	2
Merrimac	PO	3
Police Headquarters	PO	4
LaSalle	PO	5
Police Field Office	PO	6
Coliseum Central	PO	7
Kecoughtan Court	PO	8
Briarfield	PO	9
Police	PO	54
Emmanuel Lutheran School	SC	5
Hampton Roads Convention Center/Hampton Coliseum	GO	1
Francis Asbury Elementary School	SC	8
Samuel P Langley Elementary School	SC	30
Machen Elementary School	SC	18
Thomas Nelson Community College	SC	36

<b>Table E-1: City of Hampton Critical Facilities</b>		
<b>Name</b>	<b>Code</b>	<b>Number</b>
New Horizon Regional Education Center	SC	23
Phillips Elementary School	SC	27
Willow Oaks Learning Foundation	SC	39
Booker Elementary School	SC	41
Gloria Dei Lutheran School	SC	9
Kecoughtan High School	SC	15
Syms Middle School	SC	34
Burbank Elementary School	SC	42
Hampton Christian Schools Inc	SC	10
Merrimack Elementary School	SC	21
Cooper Elementary School	SC	1
Bethel High School	SC	43
Kraft Elementary School	SC	16
Tyler Elementary School	SC	38
Eaton Middle School	SC	3
Barron Elementary School	SC	44
Cary Elementary School	SC	45
Jones Middle School	SC	14
Smith Elementary School	SC	31
Calvary Christian Academy	SC	47
Fox Hill Private School	SC	7
Davis Middle School	SC	2
North Hampton Early Learning Child Center	SC	25
Spratley Middle School	SC	32
Peninsula Primary School	SC	26
Forrest Elementary School	SC	6
Mary Peake – Y.H. Thomas Center	SC	20
Phoebus High School	SC	28
Aberdeen Elementary School	SC	48
Tucker Capps Elementary School	SC	37
Calvary Covenant School	SC	49
Jane Bryan Elementary School	SC	13
Moton Elementary School	SC	22
Mallory Elementary School	SC	19
Hampton High School	SC	11
Hampton University	SC	12
Tarrant Elementary School	SC	35
Bethel Christian School	SC	50
Robert E Lee Elementary School	SC	29
New Mount Olive Christian Academy	SC	24
Lindsay Middle School	SC	17
Bassette Elementary School	SC	51
St Mary Star Of The Sea School	SC	33
Armstrong Elementary School	SC	52
Emmanuel Grace Baptist Church	SC	4
Bradford Hall	SC	53
Wythe Elementary School	SC	40

<b>Table E-2 City of Newport News Critical Facilities</b>		
<b>Name</b>	<b>Code</b>	<b>Number</b>
Mary Immaculate	CL	2
Sentara Urgent Care	CL	3
Public Health Center	CL	4
Peninsula Medical Center	CL	7
Dr Cecil F Evans Office	CL	8
Doctor's Office	CL	9
Now Care Medical Center	CL	10
East End Health Center	CL	11
Whittaker Hosp Medical Office	CL	12
Stephen's Child Care	DC	2
Child Care	DC	3
Early Start Learning Center	DC	4
The Garden Of Children Ltd	DC	5
Holloman Child Care Center	DC	6
Teddy Bear	DC	7
Bright Horizons	DC	8
Children's World Inc	DC	9
Riverside Employee Child Care	DC	10
Unique Child Care	DC	11
Lollipop Lane	DC	12
Hampton Roads Montessori School	DC	13
Kinder Care	DC	14
While Away School	DC	15
While Away School	DC	16
United Child Care	DC	17
Bellwood Tender Care	DC	18
Warwick Kids Academy	DC	19
Youth Campus Day Care	DC	20
Ding Dong Kindergarden	DC	21
Tic-Toc Kindergarten	DC	22
Quality Nursery & Garden Center	DC	23
Jimmy's Nursery	DC	24
Emergency Operations Center	EC	2
Emergency Operations Center	EC	3
Station 5	FR	2
Fire Warehouse	FR	3
Station 9	FR	4
Station 4	FR	5
Station 6	FR	6
Station 3	FR	7
Station 8	FR	8
Station 10	FR	9
Station 2	FR	10
Station 7	FR	11
Station 1	FR	12
Fort Eustis Station	FR	13
Fort Eustis Station	FR	14
Fire Training Center	FR	15
Riverside Medical Center	HO	2
Mary Immaculate Hospital	HO	3
McDonald Army Hospital	HO	4
Woodside Hospital	HO	6
Serenity Inc	NH	2
Zion Baptist Convalescent	NH	3
Hilton Plaza Adult Home	NH	4
St Francis Nursing Center	NH	5
Newport News Nursing Center	NH	6
Newport Convalescent Center	NH	7
James River Convalescent Center	NH	8
James River Convalescent Center	NH	9

<b>Table E-2 City of Newport News Critical Facilities</b>		
<b>Name</b>	<b>Code</b>	<b>Number</b>
Because We Care Home for Adults	NH	10
Huntington Nursing Home	NH	11
Nursing Home	NH	12
Mdn Center	NH	13
Mennowood Retirement Community	NH	14
Spratley Housing	NH	15
Pump Station	PS	098
Pump Station	PS	099
Pump Station	PS	101
Pump Station	PS	102
Pump Station	PS	088
Pump Station	PS	089
Pump Station	PS	090
Pump Station	PS	091
Pump Station	PS	112
Pump Station	PS	
Pump Station	PS	
Pump Station	PS	115
Pump Station	PS	116
Pump Station	PS	117
Pump Station	PS	084
Pump Station	PS	085
Pump Station	PS	086
Pump Station	PS	087
Pump Station	PS	095
Pump Station	PS	096
Pump Station	PS	097
Pump Station	PS	118
Pump Station	PS	119
Pump Station	PS	120
Pump Station	PS	121
Pump Station	PS	122
Pump Station	PS	123
Pump Station	PS	124
Pump Station	PS	125
Pump Station	PS	126
Pump Station	PS	127
Pump Station	PS	
Pump Station	PS	129
Pump Station	PS	130
Pump Station	PS	131
Pump Station	PS	132
Pump Station	PS	133
Pump Station	PS	134
Pump Station	PS	135
Pump Station	PS	136
Pump Station	PS	137
Pump Station	PS	138
Pump Station	PS	139
Pump Station	PS	140
Pump Station	PS	141
Pump Station	PS	142
Pump Station	PS	143
Pump Station	PS	144
Pump Station	PS	145
Pump Station	PS	146
Pump Station	PS	147
Pump Station	PS	093
Pump Station	PS	094
Pump Station	PS	
Pump Station	PS	

<b>Table E-2 City of Newport News Critical Facilities</b>		
<b>Name</b>	<b>Code</b>	<b>Number</b>
Pump Station	PS	092
Pump Station	PS	
Pump Station	PS	108
Pump Station	PS	
Pump Station	PS	110
Pump Station	PS	
Pump Station	PS	
Pump Station	PS	148
Pump Station	PS	149
Pump Station	PS	150
Pump Station	PS	158
Pump Station	PS	159
Pump Station	PS	160
Pump Station	PS	161
Pump Station	PS	
Pump Station	PS	163
Pump Station	PS	164
Pump Station	PS	
Pump Station	PS	152
Pump Station	PS	153
Pump Station	PS	154
Pump Station	PS	155
Pump Station	PS	156
Pump Station	PS	171
Pump Station	PS	172
Pump Station	PS	173
Pump Station	PS	174
Pump Station	PS	182
Pump Station	PS	183
Pump Station	PS	184
Pump Station	PS	157
Pump Station	PS	165
Pump Station	PS	166
Pump Station	PS	167
Pump Station	PS	168
Pump Station	PS	169
Pump Station	PS	170
Pump Station	PS	185
Pump Station	PS	186
Pump Station	PS	187
Pump Station	PS	054
Pump Station	PS	055
Pump Station	PS	056
Pump Station	PS	057
Pump Station	PS	058
Pump Station	PS	059
Pump Station	PS	060
Pump Station	PS	061
Pump Station	PS	062
Pump Station	PS	063
Pump Station	PS	064
Pump Station	PS	065
Pump Station	PS	066
Pump Station	PS	067
Pump Station	PS	068
Pump Station	PS	069
Pump Station	PS	070
Pump Station	PS	071
Pump Station	PS	072
Pump Station	PS	073
Pump Station	PS	074
Pump Station	PS	075

<b>Table E-2 City of Newport News Critical Facilities</b>		
<b>Name</b>	<b>Code</b>	<b>Number</b>
Pump Station	PS	076
Pump Station	PS	077
Pump Station	PS	078
Pump Station	PS	079
Pump Station	PS	080
Pump Station	PS	081
Pump Station	PS	082
Pump Station	PS	188
Pump Station	PS	175
Pump Station	PS	083
Pump Station	PS	176
Pump Station	PS	177
Pump Station	PS	178
Pump Station	PS	179
Pump Station	PS	180
Pump Station	PS	181
Pump Station	PS	189
Pump Station	PS	190
Pump Station	PS	191
Pump Station	PS	192
Pump Station	PS	193
Pump Station	PS	194
Pump Station	PS	195
Pump Station	PS	196
Pump Station	PS	197
Pump Station	PS	198
Pump Station	PS	199
Pump Station	PS	200
Pump Station	PS	001
Pump Station	PS	002
Pump Station	PS	003
Pump Station	PS	004
Pump Station	PS	005
Pump Station	PS	006
Pump Station	PS	007
Pump Station	PS	008
Pump Station	PS	009
Pump Station	PS	011
Pump Station	PS	012
Pump Station	PS	013
Pump Station	PS	013
Pump Station	PS	014
Pump Station	PS	015
Pump Station	PS	015
Pump Station	PS	017
Pump Station	PS	018
Pump Station	PS	019
Pump Station	PS	020
Pump Station	PS	021
Pump Station	PS	022
Pump Station	PS	023
Pump Station	PS	024
Pump Station	PS	025
Pump Station	PS	026
Pump Station	PS	027
Pump Station	PS	028
Pump Station	PS	029
Pump Station	PS	030
Pump Station	PS	031
Pump Station	PS	032
Pump Station	PS	033
Pump Station	PS	034

<b>Table E-2 City of Newport News Critical Facilities</b>		
<b>Name</b>	<b>Code</b>	<b>Number</b>
Pump Station	PS	035
Pump Station	PS	036
Pump Station	PS	037
Pump Station	PS	038
Pump Station	PS	039
Pump Station	PS	040
Pump Station	PS	042
Pump Station	PS	043
Pump Station	PS	044
Pump Station	PS	045
Pump Station	PS	046
Pump Station	PS	047
Pump Station	PS	048
Pump Station	PS	049
Pump Station	PS	050
Pump Station	PS	051
Pump Station	PS	052
Pump Station	PS	053
Pump Station	PS	WWPFS
Pump Station	PS	WWPBO
Pump Station	PS	WWPAP
Pump Station	PS	WWPAJ
Pump Station	PS	WWPDV

<b>Table E-3: City of Williamsburg Critical Facilities</b>		
<b>Name</b>	<b>Code</b>	<b>Number</b>
City Municipal Building	GO	501
911 Center	E9	502
Fire & EMS Department	FR	503
Police Department	PO	504
Emergency Operations Center	EC	505
Fire Administration	FR	506
Williamsburg/James City County Courthouse	GO	507
Sentara Williamsburg Community Hospital	HO	508
Williamsburg Center Genesis Elder Care	NH	509
Micand Retirement Center	NH	510
Blayton Building Elderly Housing	AP	511
Matthew Whaley Elementary School & City Shelter	SC	512
James Blair Middle School	SC	513
Berkeley Middle School	SC	514
Walsingham Academy Upper School	SC	515
Walsingham Academy Lower School	SC	516
Communications Towers	CO	517
Power Sub Station	SB	544
Power Sub Station	SB	545
Power Sub Station	SB	546
Communication Tower	CO	547
Pump Station	PS	522
Pump Station	PS	523
Pump Station	PS	524
Pump Station	PS	525
Pump Station	PS	526
Pump Station	PS	527
Pump Station	PS	528
Pump Station	PS	529
Pump Station	PS	530
Pump Station	PS	531
Pump Station	PS	533
Pump Station	PS	534
Pump Station	PS	535
Pump Station	PS	536
Pump Station	PS	532

<b>Table E-4: James City County Critical Facilities</b>		
<b>Name</b>	<b>Code</b>	<b>Number</b>
Williamsburg Airport	AI	1
Emergency Operations Center	EC	1
Fire Station 2	FR	2
Fire Station 5	FR	3
Fire Station 3	FR	5
Fire Station 1	FR	1
Dispatch Center	FR	4
Law Enforcement Center	PO	1
Toano School	SC	14
Noney School	SC	15
Stonehouse Elementary School	SC	16
James Blair Middle School	SC	2
Berkeley Middle School	SC	3
Lafayette High School	SC	4
Jamestown High School	SC	5
D.J. Montague Elementary School	SC	7
Clara Byrd Baker Elementary School	SC	8
Rawls Byrd Elementary School	SC	9
Matthew Whaley Elementary School	SC	12
James River Elementary School	SC	13

**Table E-5: York County Critical Facilities**

<b>Name</b>	<b>Code</b>	<b>Number</b>
Fire Station # 2	FR	53
Seaford Station Number 6	FR	62
Bruton Station Number 3	FR	65
Grafton Station Number 1	FR	114
Yorktown Station Number 4	FR	122
Tabb Station Number 2	FR	134
Skimino Station Number 5	FR	135
Yorktown Library	LB	221
Tabb Library	LB	222
Public Safety Building	GO	223
Solid Waste Management Center	GO	224
Environmental Services Building	GO	225
York/Poquoson Courthouse	GO	226
Finance Building	GO	227
Griffin-Yeates Center	GO	228
General Services	GO	229
Geo. Wash. Inn	PS	149
Bruton High Sch.	PS	150
Pinetree Road	PS	151
Royal Grant	PS	152
Hickory Hills	PS	153
Queenswood	PS	154
Penniman East	PS	155
Pierpoint Place	PS	156
Cedar Valley/Wal Mart	PS	157
Read Street	PS	158
Winders Pond	PS	159
Hornsbyville Road	PS	160
Cockletown Road	PS	161
Kings Villa	PS	162
Sommerville	PS	163
Oriana Road	PS	164
Landfill	PS	165
Hollywood	PS	166
Moss Avenue	PS	167
Ft. Eustis Boulevard	PS	168
Barcroft	PS	169
Route 17	PS	170
Don Juan	PS	171
Grafton Woods	PS	172
Pinehurst Vac	PS	173
Brandywine	PS	174
Mill Cove	PS	175
Scotch Toms	PS	176
Goosley Road	PS	177
Lodge Road	PS	178
York High	PS	179
Kiln Creek 1	PS	180
Kiln Creek 2	PS	181
Olde Port Cove	PS	182
Running Man 1	PS	183
Whispering Winds	PS	184
Marlbank Cove	PS	185
Lackey	PS	186
Yorkshire Downs	PS	187
Coventry	PS	188
Running Man 2	PS	189
Tabb Lakes	PS	190
York Co. Central	PS	191
Baptist Road	PS	192
Coburn Court	PS	193

<b>Table E-5: York County Critical Facilities</b>		
<b>Name</b>	<b>Code</b>	<b>Number</b>
Carys Chapel Rd.	PS	194
Lakes Of Dare	PS	195
Crestwoods	PS	196
Tidemill	PS	197
Seaford Vac. Sta	PS	198
Dandy Vac Sta.	PS	199
Cary's Chapel 2	PS	200
Calthop Neck Vac	PS	201
Belmount Apts	PS	202
Williamsburg Hosp.	PS	203
Schooner Blvd	PS	204
Corvette	PS	205
Jonadab Rd.	PS	206
Lindsay Landing	PS	207
Overlook Point	PS	208
Road Water Sta.	PS	209
Banbury Water	PS	210
Rochambeau Sta	PS	211
Lightfoot Sta.	PS	212
Dare Vacuum Sta.	PS	213
Yorktown Road	PS	214
Dare Heights	PS	215
Water Street	PS	216
Queenslake	PS	217
Kings Creek	PS	218
Coast Guard	PS	219
Colony Pines	PS	220
Tabb Middle School	SC	55
Mount Vernon Elementary School	SC	56
Grafton High/Middle School	SC	58
Yorktown Elementary School	SC	61
Yorktown Middle School	SC	63
Magruder Elementary School	SC	64
Bruton High School	SC	66
Coventry Elementary School	SC	77
Tabb High School	SC	80
York High School	SC	81
Tabb Elementary School	SC	83
Dare Elementary School	SC	131
Grafton Bethel Elementary School	SC	133
Waller Mill Elementary School	SC	136
Queens Lake Middle School	SC	137

Appendix F  
Multi-Hazard Mapping  
Large-Format Maps

Appendix G  
Alternative Multi-Hazard Mitigation  
Actions

# Alternative Multi-Hazard Mitigation Actions

**PREVENTION:** Preventive measures are designed to keep the problem from occurring or getting worse. Their objective is to ensure that future development is not exposed to damage and does not increase damage to other properties.

- *Planning*
- *Zoning*
- *Open Space Preservation*
- *Land Development Regulations*
  - *Subdivision regulations*
  - *Building Codes*
    - *Fire-Wise Construction*
  - *Floodplain development regulations*
  - *Geologic Hazard Areas development regulations (for roads too!)*
- *Storm Water Management*
- *Fuels Management, Fire-Breaks*

**EMERGENCY SERVICES** measures protect people during and after a disaster. A good emergency services program addresses all hazards. Measures include:

- *Warning* (flooding, tornadoes, winter storms, fire)
  - NOAA Weather/All-Hazards Radio
  - Sirens
  - “Reverse 911” (Emergency Notification System)
- *Emergency Response*
  - *Evacuation & Sheltering*
  - *Communications*
  - *Emergency Planning*
    - Activating the EOC (emergency management)
    - Closing/Reversing streets/bridges (police or public works)
    - Shutting off power to threatened areas (utility company)
    - Holding/releasing children at school (school district)
    - Passing out sand and sandbags (public works)
    - Ordering an evacuation (mayor)
    - Opening emergency shelters (Red Cross)
    - Monitoring water levels (engineering)
    - Security and other protection measures (police)
- *Critical Facilities Protection (Buildings or locations vital to the response and recovery effort, such as police/fire stations, hospitals, sewage treatment plants/lift stations, power substations)*
  - Buildings or locations that, if damaged, would create secondary disasters, such as hazardous materials facilities and nursing homes
  - Lifeline Utilities Protection
- *Post-Disaster Mitigation*
  - Building Inspections
  - ID mitigation opportunities & funding before reconstruction

**PROPERTY PROTECTION:** Property protection measures are used to modify buildings subject to damage rather than to keep the hazard away. A community may find these to be inexpensive measures because often they are implemented by or cost-shared with property owners. Many of the measures do not affect the appearance or use of a building, which makes them particularly appropriate for historical sites and landmarks.

- ***Retrofitting/disaster proofing***
  - ***Floods***
    - Wet/Dry floodproofing (barriers, shields, backflow valves)
    - Relocation/Elevation
    - Acquisition
    - Retrofitting
  - ***High Winds/Tornadoes***
    - Safe Rooms
    - Securing roofs and foundations with fasteners and tie-downs
    - Strengthening garage doors and other large openings
  - ***Winter Storms***
    - Immediate snow/ice removal from roofs, tree limbs
    - “Living” snow fences
  - ***Geologic Hazards (Landslides, earthquakes, sinkholes)***
    - Anchoring, bracing, shear walls
    - Dewatering sites, agricultural practices
    - Catch basins
  - ***Drought***
    - Improve water supply (transport/storage/conservation)
    - Remove moisture competitive plants (Tamarisk/Salt Cedar)
    - Water Restrictions/Water Saver Sprinklers/Appliances
    - Grazing on CRP lands (no overgrazing-see Noxious Weeds)
    - Create incentives to consolidate/connect water services
    - Recycled wastewater on golf courses
  - ***Wildfire, Grassfires***
    - Replacing building components with fireproof materials
      - Roofing, screening
    - Create “Defensible Space”
    - Installing spark arrestors
    - Fuels Modification
  - ***Noxious Weeds/Insects***
    - Mowing
    - Spraying
    - Replacement planting
    - Stop overgrazing
    - Introduce natural predators
- ***Insurance***

**NATURAL RESOURCE PROTECTION:** Natural resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas. In so doing, these activities enable the naturally beneficial functions of floodplains and watersheds to be better realized. These natural and beneficial floodplain functions include the following:

- storage of floodwaters
- absorption of flood energy
- reduction in flood scour
- infiltration that absorbs overland flood flow
- groundwater recharge
- removal/filtering of excess nutrients, pollutants, and sediments from floodwaters
- habitat for flora and fauna
- recreational and aesthetic opportunities

Methods of protecting natural resources include:

- o ***Wetlands Protection***
- o ***Riparian Area/Habitat Protection/Threatened-Endangered Species***
- o ***Erosion & Sediment Control/Dune Protection***
- o ***Best Management Practices***

Best management practices (“BMPs”) are measures that reduce nonpoint source pollutants that enter the waterways. Nonpoint source pollutants come from non-specific locations. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground’s surface by stormwater and flushed into receiving storm sewers, ditches and streams. BMPs can be implemented during construction and as part of a project’s design to permanently address nonpoint source pollutants. There are three general categories of BMPs:

1. Avoidance: setting construction projects back from the stream.
2. Reduction: Preventing runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage.
3. Cleanse: Stopping pollutants after they are en route to a stream, such as using grass drainageways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained

- o ***Dumping Regulations***
- o ***Set-back regulations/buffers***
- o ***Fuels Management***
- o ***Water Use Restrictions***
- o ***Landscape Management/Dune Management***
- o ***Weather Modification***

**STRUCTURAL PROJECTS** have traditionally been used by communities to control flows and water surface elevations. Structural projects keep flood waters away from an area. They are usually designed by engineers and managed or maintained by public works staff. These measures are popular with many because they “stop” flooding problems. However, structural projects have several important shortcomings that need to be kept in mind when considering them for flood hazard mitigation:

- They are expensive, sometimes requiring capital bond issues and/or cost sharing with Federal agencies, such as the U.S. Army Corps of Engineers or the Natural Resources Conservation Service.
- They disturb the land and disrupt natural water flows, often destroying habitats.
- They are built to a certain flood protection level that can be exceeded by a larger flood, causing extensive damage.
- They can create a false sense of security when people protected by a structure believe that no flood can ever reach them.
- They require regular maintenance to ensure that they continue to provide their design protection level.

Structural measures include:

- o *Detention/Retention structures*
- o *Erosion and Sediment Control*
- o *Basins/Low-head Weirs*
- o *Channel Modifications*
- o *Culvert resizing/replacement/Maintenance*
- o *Levees and Floodwalls*
- o *Anchoring, grading, debris basins (for landslides)*
- o *Fencing (for snow, sand, wind)*
- o *Drainage System Maintenance*
- o *Reservoirs(for flood control, water storage, recreation, agriculture)*
- o *Diversions*
- o *Storm Sewers*

**PUBLIC INFORMATION:** A successful hazard mitigation program involves both the public and private sectors. Public information activities advise property owners, renters, businesses, and local officials about hazards and ways to protect people and property from these hazards. These activities can motivate people to take protection

- o *Hazard Maps and Data*
- o *Outreach Projects* (mailings, media, web, speakers bureau, displays)
- o *Library Resources*
- o *Real Estate Disclosure*
- o *Environmental Education*
- o *Technical Assistance* **Health & Safety Maintenance (clean-up per hazard)**

# Appendix H

## Criteria for Selecting Mitigation Measures

# Criteria for Selecting Mitigation Measures

## 1. STAPLE

**Social:** Does the measure treat people fairly? (different groups, different generations)

**Technical:** Will it work? (Does it solve the problem? Is it feasible?)

**Administrative:** Do you have the capacity to implement & manage project?

**Political:** Who are the stakeholders? Did they get to participate? Is there public support?  
Is political leadership willing to support?

**Legal:** Does your organization have the authority to implement? Is it legal? Are there liability implications?

**Economic:** Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?

**Environmental:** Does it comply with Environmental regulations?

## 2. SUSTAINABLE DISASTER RECOVERY

Quality of Life

Social Equity

Hazard Mitigation

Economic Development

Environmental Protection/Enhancement

Community Participation

### **3. SMART GROWTH PRINCIPLES**

Infill versus Sprawl

Efficient Use of Land Resources

Full Use of Urban Resources

Mixed Uses of Land

Transportation Options

Detailed, Human-Scale Design

### **4. OTHER**

Does measure address area with highest risk?

Does measure protect ...

The largest # of people exposed to risk?

The largest # of buildings?

The largest # of jobs?

The largest tax income?

The largest average annual loss potential?

The area impacted most frequently?

Critical Infrastructure (access, power, water, gas, telecommunications)

Timing of Available funding

Visibility of Project

Community Credibility

Appendix I  
Public Meeting Notices and  
Community Resolutions of  
Adoption

## **MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN**

**Hampton, Newport News, Williamsburg, James City County, York County**

The purpose is to solicit input from the public in the development of this plan. These jurisdictions are developing a draft Natural Hazard Mitigation Plan in order both to reduce the impact of future disasters and also meet Federal Requirements.

Jurisdiction Planning Groups and AMEC Earth and Environmental will be at the following locations to discuss the planning process and receive public input:

**February 16, 2005, 7:00 P.M. - 8:00 P.M.**

*101 F Mounts Bay Building F, James City County*

**February 17, 2005 7:00 P.M. - 8:00 P.M.**

*York Hall, East Room, Yorktown, York County*

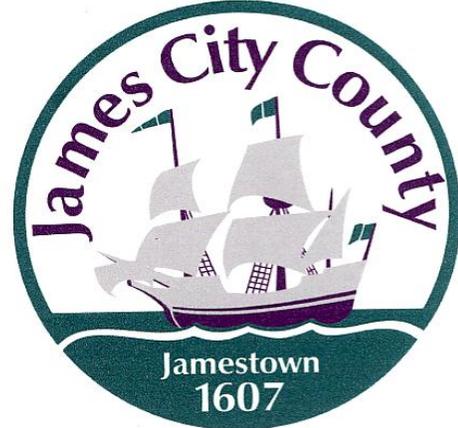
**February 28, 2005 7:00 P.M. - 8:00 P.M.**

*Sandy Bottom Nature Park, 1255 Big Bethel Rd, Hampton*

Citizens from participating jurisdictions can attend any of the three meetings listed. For further information please contact your local Emergency Management Office or Planning Department.

**PUBLIC MEETINGS FOR NATURAL HAZARD  
MITIGATION PLAN**

The Peninsula Hazard Mitigation Planning Committee, comprising of the City of Newport News, City of Hampton, City of Williamsburg, York County and James City County are sponsoring the development of a **regional comprehensive natural hazard mitigation plan** to better marshal County and Community resources in **addressing potential hazards before they occur**, and, to **maintain eligibility for mitigation funding from the Federal Emergency Management Agency (FEMA)**. Within the County and the City, this plan will help lower the cost of flood insurance.



We'd like **YOUR feedback** regarding this important document, which must be approved by each City Council, the County Board of Supervisors, the State and FEMA this fall.

The plan is being developed by a Hazard Mitigation Planning Committee (HMPC) with input from County and City agencies, including each incorporated community, Special Districts (e.g., reclamation, recreation, fire, community college), regional flood and state and federal agencies (e.g., FEMA, USACE, NWS).

Before the recommendations and the first draft plan are developed, the HMPC would like to present our research and findings regarding the natural hazards posing threats to the Peninsula Area, and our current ability to counter those threats. Your comments and ideas are invited and are welcome at the upcoming public meetings, scheduled as follows:

**Wednesday, February 16, 2005**  
James City County Government Complex  
Board Room  
101-F Mounts Bay Road  
Williamsburg, VA 23185  
7:00 p.m. - 8:30 p.m.

The program will include time for comments, questions and answers after a summary of each planning step is explained.

The deadline for public comment will be following the third phase this spring when the draft plan will be ready for review. Your feedback will be incorporated into the final version of the plan which will then reviewed by the Virginia Department of Emergency Management and FEMA, Region III. Upon approval, the plan will be presented to the County Board of Supervisors, and each incorporated community.

## **MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN**

**Hampton, Newport News, Williamsburg, James City County, York County**

The purpose is to solicit input from the public in the development of this plan. These jurisdictions are developing a draft Natural Hazard Mitigation Plan in order both to reduce the impact of future disasters and also meet Federal Requirements.

Jurisdiction Planning Groups and AMEC Earth and Environmental will be at the following locations to discuss the planning processing and receive public input:

**June 22, 2005 6:30 pm-7:30 pm**

*Pearl Bailey Library 2510 Wickham Avenue, Newport News*

**June 23, 2005 7:00 pm-8:00 pm**

*Kenny Wallace Neighborhood Resource Center 2315 Victoria Blvd, Hampton*

**June 27, 2005 7:00 pm-8:00 pm**

*Governement Center Building F 101 Mounts Bay Road, James City County*

Citizens from participating jurisdictions can attend any of the three meetings listed. For further information please contact your local Emergency Management Office or Planning Department.

From the *Daily Press*, 10/30/05

**MULTI-JURISDICTIONAL  
HAZARD MITIGATION PLAN**  
Hampton, Newport News, Williamsburg,  
James City County, York County

The purpose is to solicit input from the public in the development of this plan. These jurisdictions have developed a draft Natural Hazard Mitigation Plan in order both to reduce the impact of future disasters and also meet Federal Requirements.

Jurisdiction Planning Groups and AMEC Earth and Environmental will be at the following locations to discuss the planning processing and receive final public input:

**Tuesday November 1, 2005 7:00-8:00 pm**

*Quarterpath Recreation Center 202 Quarterpath Road, Williamsburg*

**Wednesday November 2, 2005 6:00-7:00 pm**

*Tabb Library, 100 Long Green Blvd, York County*

**Thursday November 3, 2005 7:00-8:00 pm**

*Pearl Bailey Library, 2510 Wickham Avenue, Newport News*

Citizens from participating jurisdictions can attend any of the three meetings listed. For further information please contact your local Emergency Management Office or Planning Department.

Hampton  
[insert here]

Newport News  
[insert here]

Williamsburg  
[insert here]

James City County  
[insert here]

York County  
[insert here]

# Appendix J

## Acronyms Used in this Plan

# Acronyms Used in this Plan

AMEC	AMEC Earth & Environmental, Inc.
ARB	Architectural Review Board
BMP	Best Management Practice(s)
CDC	Centers for Disease Control and Prevention
CERT	Community Emergency Response Team
CIP	Capital Improvements Program (York County)
CoBRA	Coastal Barrier Resource Act
CPTED	Crime Prevention through Environmental Design
CRS	Community Rating System of the National Flood Insurance Program
CZMA	Coastal Zone Management Act
DCR or VaDCR	Virginia Department of Conservation and Recreation
DMA 2000	Disaster Mitigation Act of 2000
DRC	Development Review Committee
DRU	Disaster Resistant University
EAS	Emergency Alert System
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPRI	Electric Power Research Institute
FAP	Flood Assistance Program (Newport News)
FAQ	Frequently Asked Question(s)
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GIS	Geographic Information System
HAZUS	Hazards U.S. – Multi Hazard (software package)
HI	Heat Index
HMGP	Hazard Mitigation Grant Program
HMPC	Hazard Mitigation Planning Committee
HREMC	Hampton Roads Emergency Management Committee
HRPDC	Hampton Roads Planning District Commission
IBC	International Building Code
ICC	Increased Cost of Compliance
JCSA	James City Service Authority
MM or MMI	Modified Mercalli Intensity Scale
MRC	Medical Reserve Corps
MSA	Metropolitan Statistical Area
NCDC	National Climatic Data Center
NEIDS	Neighborhood Emergency Information Distribution System
NFIP	National Flood Insurance Program
NGDC	National Geophysical Data Center
NGVD	National Geodetic Vertical Datum

NOAA	National Oceanic and Atmospheric Association
NPS	National Park Service
NWS	National Weather Service
PDI	Palmer Drought Index
PDM	Pre-Disaster Mitigation
PSA	Primary Service Area (James City County)
REMTAC	Regional Emergency Management Technical Advisory Committee
RMA	Resource Management Area
RPA	Resource Protection Area
SAC	Stormwater Advisory Committee (York County)
SEAS	Shoreline Erosion Advisory Service
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VCMP	Virginia Clean Marina Program
VDEM	Virginia Department of Emergency Management
VDH	Virginia Department of Health
VDOF	Virginia Department of Forestry
VDOT	Virginia Department of Transportation
VIPS	Volunteers in Police Service
VMRC	Virginia Marine Resources Commission
VPPSA	Virginia Peninsula's Public Service Authority
VS&WCB	Virginia Soil and Water Conservation Board
VTSO	Virginia Tech Seismological Observatory
VUSBC	Virginia Uniform Statewide Building Code
WNV	West Nile Virus

Appendix K  
Public Comments and  
Response to Comments Memos

**Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated Feb 1, 2005  
Draft #1**

Reviewer: Jim Murphy  
Agency: City of Williamsburg

**1. Page 81, Capability Matrix Table. Denote “0” for Number of Flood-Prone Buildings and Number of Repetitive Losses.**

**Response:** Corrected

Reviewer: Emily Seward  
Agency: City of Newport News

**1. Page 67, Framework for the Future, 4<sup>th</sup> bullet. Add “Port Warwick” after Oyster Point.**

**Response:** Corrected

**2. Page 68, Stormwater Program and Fees, 3<sup>rd</sup> paragraph, last sentence. Change to “The City’s Department of Planning and Department of Development . . . .”**

**Response:** Corrected

**3. Page 70, Emergency Preparedness, 4<sup>th</sup> paragraph, 3<sup>rd</sup> sentence. Change phone number to “269-2910.”**

**Response:** Corrected

**4. Page 70, Other Mitigation Activities, 3<sup>rd</sup> paragraph, 2<sup>nd</sup> sentence. Change to “Department of Development.”**

**Response:** Corrected

**5. Page 71, Other Mitigation Activities, 5<sup>th</sup> paragraph, 5<sup>th</sup> sentence. Change to “. . . the southeast community (flood-prone) part of the City . . . .”**

**Response:** Corrected, but left out “part” because it is redundant.

Reviewer: Jim Redick  
Agency: City of Hampton

**1. Page 52, Section 5.1.6, “. . .the planning team developed a local capability assessment for the City of Hampton.” We did?? Have the Emergency Management Local Capability Assessment Reports (LCAR) been reviewed?**

**Response:** AMEC conducted telephone and in-person interviews with planning team members to develop the capability assessment. LCAR were not reviewed, but have been requested from the City. Pertinent information from those reports will be incorporated as it relates to mitigation capability, as differentiated from emergency management capability.

**2. Page 52 – Recommends we be Storm Ready. We became Storm Ready in 2004.**

**Response:** Text removed.

3. *Page 52, Capability Matrix. It would be much more informative to have the materials dated and the source of the information. For instance, Hampton has a Comprehensive Plan. What is the date on the plan? Who houses it?*

**Response:** The matrix is intended to provide information at a glance. The date and department for the Comprehensive Plan has been added to the descriptive information below the table.

4. *Page 52, Capability Matrix. “Effective Flood Insurance Rate Map Date” – why is this 1995 when data earlier in the report was 1988?*

**Response:** The correct effective FIRM date for Hampton is 7-3-95, according to FEMA’s Community Status Book.

5. *Page 52, Capability Matrix. “Number of floodprone buildings” – is this info available from the info in Table 5.1.5a?*

**Response:** Hampton’s GIS staff have provided an estimate of floodprone buildings.

6. *Page 52, Capability Matrix. “Number of NFIP policies = 9,792” – as of when? Info is time sensitive.*

**Response:** Date information was added.

7. *Page 53, Capability Matrix. Since this is a public plan, acronyms should be explained.*

**Response:** Document will include an Appendix explaining acronyms.

8. *Page 53, Capability Matrix. “-other? (e.g., cable override)” – remove CERT.*

**Response:** Corrected.

9. *Page 53, Capability Matrix. Please explain what “not fully” means in regards to the protection of critical facilities.*

**Response:** Changed to “Not all facilities fully protected.”

10. *Page 53, Capability Matrix. “Natural Resources Inventory” – what does this include?*

**Response:** A Natural Resources Inventory might include detailed data on (for example) habitats (threatened/endangered/otherwise), planting zones, wetland functions, watershed protection areas, areas of high soil erodibility, areas with high water tables, areas with shrink/swell soils or areas with steep slopes. GIS staff for Hampton indicated that the City did not maintain databases with inventory of this type.

11. *Page 53, Capability Matrix. Please provide more data regarding the last 7 items on the capability matrix.*

**Response:** Additional notations were added to 6 of the 7; however, since a Natural Resources Inventory was not identified, additional information was not available.

12. *Page 54, section Guiding Community Documents. There is no Comprehensive Plan 2020. Remove that from the title and add a bullet that states “The City is currently working to adopt a new ten year plan, the City of Hampton Community Plan.”*

**Response:** Corrected. The final bullet was amended as requested.

13. Page 54 – Zoning & Development Standards. *”The Department of Codes Compliance enforced requirements for ‘substantially damaged’ homes after Hurricane Isabel, but the process was exceedingly difficult and some difficult decisions had to be made.”*

**Response:** Amended as requested.

14. Page 55, the earliest that the 2003 VUSBC would be adopted is the Fall of 2005 (that’s assuming that everything goes fine in the process); in each locality’s section, we state April, 2005 as the effective date.

**Response:** Corrected.

15. Page 55, Public Education – *“The City’s Department of Public Works...”* – there is also a Codes Academy, and info is also disseminated via the City’s Neighborhood College Leadership Institute.

**Response:** Corrected.

16. Page 55, Emergency Preparedness - *“EAS is now routinely used for...”* – remove *“now routinely.”*

**Response:** Corrected.

17. Page 56, Storm Ready - Should read *“As of February 2005, the National Weather Service... (provided this is still accurate).”*

**Response:** Corrected.

18. Page 56, Evacuation Plan - Paragraph should start by saying: *“The Virginia Department of Transportation’s Phase 1 and Phase 2 evacuation routes are shown and discussed online at... . They are also available in the local telephone directories. The City emergency management and other City officials are re-examining...”*

**Response:** Corrected.

19. Page 56, Hampton Citizen Corps and CERT Program. Remove *“and CERT Program”* in the paragraph title.

**Response:** Corrected.

20. Page 56. Replace *“USA Freedom Corps”* with *“Virginia Corps.”*

**Response:** Corrected.

21. Page 56. *“Hampton’s umbrella program...”* should read *“Hampton’s Citizen Corps includes 3 core programs: Neighborhood Watch, Volunteers in Police Service (VIPS), and Community Emergency Response Team (CERT). Medical Reserve Corps (MRC) is under development.”*

**Response:** Corrected.

22. *“CERT helps communities respond...”* If you are going to discuss CERT, you need to do the same for the other programs.

**Response:** Disagree. Added a clarification that CERT is the “core program most relevant to hazard mitigation.” The other programs do not appear to have capability related to hazard mitigation.

23. Page 56. The document mentions that all substations are out of the flood zone. I am not sure of every location but the one at Fox Hill and Old Buckroe is definitely in the A7 elevation 9 zone.

**Response:** Corrected.

24. *“The homes have not been elevated and the grants have not been approved or denied at the time this plan was prepared.” Not true. Although the first home elevation project is still in review at the Federal level, the second project was denied.*

**Response:** Corrected.

Reviewer: Judi Riutort  
Agency: York County

1. *Page 94, Section 5.4.6, 4<sup>th</sup> paragraph. Change “they have” to “it has.”*

**Response:** Corrected.

2. *Page 95, Capability Matrix. Change CRS Rating from “None” to “Conditional approval – Class 9.”*

**Response:** Corrected.

3. *Page 95, Capability Matrix. Change Hazard Mitigation Plan from “Yes, Surry Siren System” to “In Process.”*

**Response:** Corrected.

4. *Page 95, Capability Matrix. Add “Route alerting plans and an automated system in the planning phase” for Emergency Notification. Add “cable override and agreement with radio station” for Other.*

**Response:** Corrected.

5. *Page 95, Capability Matrix. Change “not fully” to “partially” for Critical Facilities Protected.*

**Response:** Corrected.

6. *Page 95, Form of Governance. First sentence, change “York County” to “elected.” Second sentence, change to “. . . elected annually by the five member board”, and delete “to serve for one year.” Third sentence, change “serves” to “serve”.*

**Response:** Corrected except for last change. “Board” is singular.

7. *Pages 95 and 96, Guiding Community Documents. First sentence, change “their” to “its”. Third sentence, change “City” to “County” and delete “ordinances” after “zoning”. Final sentence, change “its” to “its”.*

**Response:** Corrected.

8. *Page 96, Comprehensive Plan. Change title to “Charting the Course to 2015, the County of York Comprehensive Plan”. 2<sup>nd</sup> sentence, do not capitalize “Comprehensive Plan”. 7<sup>th</sup> bullet, change to “Potential Mixed Use areas identified along Route 17 and in the area of the interstate 64 Camp Peary interchange.” Final bullet, do not capitalize comprehensive plan and add “update for 2025.”*

**Response:** Corrected.

9. *Page 96, Zoning and Development Standards. First bullet, write out RPA/RMA, and add “for Chesapeake Bay protection.” 2<sup>nd</sup> full paragraph, add “the Department of” before Environmental and Development Services.*

**Response:** Corrected.

10. Page 97, Building Codes. First paragraph, take out “In January of 2005”. 2<sup>nd</sup> paragraph, 1<sup>st</sup> sentence, clarify local government department name.

**Response:** The “January of 2005” phrase has been left in the text to clarify the building codes at the time of the report. The codes will change soon, and we feel that the information should be dated for clarity. The Building Codes section was removed to the State Capabilities section and the pertinent, specific agency for each community is, therefore, not named.

11. Page 97, Stormwater Program. First paragraph, first sentence, clarify the department’s name. Second paragraph, first sentence, change to “. . . when the County receives complaints/inquiries about drainage problems, staff complete a study to determine if there are easements, if it is the County’s responsibility to correct the problems, and make recommendations for addressing the issue that can include developing a project plan and adding it to the Capital Improvement Plan list and ranking it with . . .” Delete sentence beginning, “The County Board of Supervisors . . .,” and combine with previous sentence.

**Response:** Corrected, with some editorial changes to shorten sentence.

12. Page 98, Stormwater Program. Third paragraph. Change “stormwater” to “storm water”.

**Response:** Industry standard is “stormwater” and York County documents and committee names also refer to “stormwater.”

13. Page 98, Stormwater Program. Additional paragraph. Text provided to append to this section.

**Response:** Text appended as requested.

14. Page 98, Public Education, first paragraph. Capitalize “Website”. Append to the end, “The County publishes a quarterly newsletter (CITIZEN NEWS), which is mailed to every household. The County maintains a government access TV channel using Cox Cable.

**Response:** Disagree with capitalization. Other corrections made as requested.

15. Page 98. Public Education, second paragraph. Text provided to append to this section.

**Response:** Text appended as requested.

16. Page 98. Public Education, third paragraph. Add “Department of . . .” to the first sentence.

**Response:** Corrected.

17. Page 98, Emergency Preparedness. Append introductory paragraphs on Dept. of Fire and Life Safety. Include sentence, “The following list some of the important considerations in an emergency management program: . . .”

**Response:** Text appended as requested. The sentence was modified to reflect the mitigation focus of the capability assessment.

18. Page 98, Emergency Preparedness. Add, “York County coordinates with Newport News Waterworks and Williamsburg Water to provide door-to-door notification in the inundation zone for their dams located in York County.”

**Response:** Text appended as requested.

19. Page 98, Emergency Preparedness. Add radio station name in parentheses (WXGM 99.1 FM), and replace phrase beginning “. . . previous arrangements with large area . . .” with the following, “the media became

*overwhelmed and summarized emergency information for the smaller media markets leaving out details residents needed for recovery activities.”*

**Response:** Text appended as requested.

*20. Page 98, Emergency Preparedness, Evacuation. Reword first sentence. Add “across the Coleman Bridge” to the last sentence.*

**Response:** First sentence was moved with the bulk of the evacuation text to the State capabilities section. Text appended as requested.

*21. Page 99, Emergency Preparedness, Special Needs Program. Rewrite paragraph as indicated, and add paragraph on CERT as provided.*

**Response:** Text rewritten as requested.

*22. Page 99, Emergency Preparedness, Other Mitigation Activities. Add sentence about Hazard Mitigation Grant Program funding in 2000 for \$7,937 to install impact resistant glazing in windows of EOC. 1<sup>st</sup> paragraph, 1<sup>st</sup> sentence, add “the” before “substantial damage regulations. . . .” 2<sup>nd</sup> paragraph, last sentence, append, “This brings it above the 100-year flood elevation.”*

**Response:** Text rewritten as requested with slight change to last sentence.

*23. Page 99, Emergency Preparedness, Other Mitigation Activities. Append text provided regarding Household Chemical Disposal program, generator back-up power, and Capital Improvements Program.*

**Response:** Household Chemical Disposal program and generator back-up power text appended. Capital Improvements Program projects are moved to recommended mitigation actions.

**Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated June 7, 2005  
Draft #2**

Reviewer: Jim Murphy  
Agency: City of Williamsburg

1. *Page 139, Action Item #1. Reword Schedule to denote “within 3 years of plan adoption.”*  
**Response:** Revised.
2. *Page 142, Action Item #4. Cost Estimate of \$25,000 per shelter is acceptable. Shelters will be ARC certified.*  
**Response:** Amended to include new information.
3. *Page 143, Action Item #5. Reduce cost to \$100,000, and note that existing hiking/biking trails will be widened and improved to provide firefighting access. Increase implementation to 5 years from plan adoption.*  
**Response:** Revised.
4. *Page 145, Action Item #7. Reword to indicate that this is a continuation of ongoing programs in both Williamsburg and Colonial Williamsburg. Remove references to history of drainage system.*  
**Response:** Revised.
5. *Page 145, Action Item #8. Remove this action item, as it does not accurately reflect existing conditions.*  
**Response:** Revised.
6. *Page 145, Action Item #8. Add Action Item for Colonial Williamsburg’s Annual Tree Maintenance Program.*  
**Response:** Action Item appended.
7. *Page 146, Action Item #9. Add Action Item for Disaster Resistant University planning assistance to the College of William and Mary.*  
**Response:** Action Item appended.

Reviewer: Cindy Greczek  
Agency: Colonial Williamsburg Foundation

8. *Page 145, Action Item #7. Revise last sentence of Issue/Background to read: “Colonial Williamsburg Foundation directs performs an annual storm drain maintenance program in the Historic Area, under the direction of the City of Williamsburg.”*  
**Response:** Revised.
9. *Page 145, Action Item #7. Revise potential funding to indicate that costs for projects in the Historic Area are shared with the Colonial Williamsburg Foundation.*  
**Response:** Revised.

Reviewer: Jim Redick  
Agency: City of Hampton

10. **Pg 4, 2.0 Community Profile – Population, 2<sup>nd</sup> paragraph: “Recent population projections...” “Recent” should be defined. Is it 2004? 2000? 1990? How recent is it?**  
**Response:** A wholesale revision of this section better explains recent projections and provides some more interpretation.
11. **Pg. 4, 2,1 City of Hampton – If you’re going to list all of the other installations, Langley AFB is also in the City of Hampton.**

**Response:** A wholesale revision of this section provides a better summary of the City’s history, and includes a brief discussion of Langley’s Field’s place in aeronautical history.

12. **Pg. 9, Step 1: Get Organized, 3<sup>rd</sup> sentence should read: “With the Committee’s commitment to participate, the first step... (remove AMEC). The Peninsula is the lead organization, and the customer. AMEC is the contractor.**

**Response:** Revised; also removed prepositional phrase beginning “with the Committee’s commitment . . .”, as the phrase states the obvious.

13. **Pg. 9, Step 2: Plan for Public Engagement – Hampton’s web address should read <http://www.hampton.gov/eoc>. Also, confirm with Newport News, but I believe “The Project Manager’s Office” is the Office of Emergency Management, which is reflected in the previous paragraph, Step 1.**

**Response:** Revised.

14. **Pg. 10, Relationship with Other Community... “The Committee identified a variety of comprehensive planning mechanisms such as land use and master plans, emergency response and mitigation plans, and municipal ordinances and building codes...” Too many “and’s.”**

**Response:** Revised.

15. **Pg. 10, bottom box – “2003 Hurricane Isabel Damage Survey Report (DSR)” What is a DSR? Should this read Damage Assessment Report?**

**Response:** Revised.

16. **Pg. 11 – The page states this template would be used for the community assessments, etc, but when you get to them, they don’t.**

**Response:** The section was substantially revised and the template was put in a narrative form that more accurately represents the information provided in Section 5.

17. **Pg. 11, Critical Facility Identification – Where did you get this definition? It may not be consistent with definitions used by utility companies or other entities.**

**Response:** This definition of critical facilities is generally recognized by FEMA for the purposes of mitigation planning. The phrase, “For the purposes of mitigation planning,” was appended to the definition for clarity.

18. **Pg. 15, 4.1 Hazard Identification – Still not sure why Biological Hazards/Epidemics is in a “natural” hazard mitigation plan.**

**Response:** Hazards are typically designated as “natural” or “manmade”. While there are some biological hazards that may fall in the manmade category (eg, chemical weaponry), there are others that fall in the natural category (eg, West Nile Virus). WNV is caused by a natural process, not through fault of man.

19. **Pg. 15, “There have been 34 Presidential disaster declarations in Virginia since 1969 (Table 4.1)” – Since this is a Peninsula plan, how many of these declarations affected the Peninsula?**

**Response:** Revised w/updated information and declaration numbers. Included column regarding Peninsula impacts. Attempted to gather additional information on early VA declarations.

20. **Pg. 16, 4.1.1 Earthquakes – Why start with earthquakes? Why not highest probability to least, or alphabetical order? Also, each jurisdiction has differing vulnerabilities, risk, etc. Each jurisdiction should have their own rating of each hazard in their jurisdiction-specific tab of the plan.**

**Response:** Revised. Hazards re-ordered roughly according to vulnerability.

21. **Pg. 17, top graphic – what does this mean?**

**Response:** Revised. Earthquake graphics were revised following an interview with Bill Sammler, NWS.

22. **Pg. 17, last paragraph - “Historical data is supportive of the moderate earthquake risk assessment for Virginia and the Peninsula area.” Define moderate in relation to risk analysis. Also, the end of the paragraph refers to map C-1. Where is it?**

**Response:** Revised. Earthquake graphics and text were revised following an interview with Bill Sammler, NWS.

23. **Page 18/19, Table 4.1.1 – Earthquake info for PA, TN, WV, and MD – How does this impact the Peninsula?**

**Response:** Revised. Earthquake graphics and text were revised following an interview with Bill Sammler, NWS.

24. **Pg. 20 – “Yorktown has taken a proactive stance...” So have other jurisdictions.**

**Response:** Revised.

25. **Pg. 21 – Figure 4.1.3a – Who is UVCD?**

**Response:** Revised.

26. **Pg. 22 – Table 4.1.3 – There are 12 lightning occurrences listed, but the previous paragraph on page 21 says 10.**

**Response:** Revised. Thunderstorm and lightning graphics and text were revised following an interview with Bill Sammler, NWS.

27. **Pg. 23 – second to last paragraph – “There have been numerous (add “urban and”) flash floods...”**

**Response:** Revised.

28. **Pg. 24 – sentence above Table 4.1.6a – For further information regarding community-specific dams, please contact the office of the local emergency services coordinator??**

**Response:** Revised.

29. **Pg. 28 – first paragraph refers to Map A-2. Where is map A-2?**

**Response:** Revised.

30. **Pg. 28 – Table 4.1.8b – Why was a TS in 1961 unnamed?**

**Response:** Revised.

31. **Pg. 33, 4.1.11, second paragraph – Direct sunlight dries vegetative fuels, etc... “conductive” should be “conducive”**

**Response:** Revised.

32. **Pg. 43 – Department of Housing and Community Development – this title should be in bold text.**

**Response:** Revised.

33. **Pg. 46 – Military Installations – Should not put a negative light on installations.**

**Response:** Revised language and relocated this paragraph to indicate that military installations liaisons were invited to participate in the planning meetings.

34. **Pg. 47, section 5.1.1 FEMA Flood Insurance Study: Since this is a public document, “100- and 500- year flood” should be defined.**

**Response:** Revised.

35. **Pg. 48, 5.1.2 Hurricanes – City of Hampton, last two paragraphs – was this in Hampton? If this is a jurisdiction specific section, then get down to specifics rather than the global picture. Why was flood insurance policy data removed in this draft? It would be the basis for showing the benefit of CRS!**

**Response:** The community specific discussion of hurricanes was significantly rewritten using best available data. If additional data regarding damages, injuries, and other specific numbers are available from the City, the City must provide it to AMEC in order for it to be included. Flood insurance policy data regarding the benefits of CRS was replaced in Hampton’s Action Item #1.

36. **Pg. 49, 5.1.3, Tornados, first paragraph – “Denis” should be “Dennis”**

**Response:** Revised.

37. **Pg. 50, 5.1.5, Vulnerability Assessment – Hurricanes, flooding, tornado, and wildfires have already been discussed. Now we are getting to the assessment?**

**Response:** The hazard ID and the vulnerability assessment are separate. See introduction to Section 4 for a summary of the two sections. However, Section 5.1.5 and the applicable sections for other communities have been rewritten to smooth the transition.

38. **Pg. 50, Table 5.1.5a – What is “other?” Is this government facilities? What is “No values?” Is this vacant land? Need to be defined.**

**Response:** Since this data was provided by Hampton, the definitions were requested from Allan Lambert on 9/21/05, and Libby Griebel on 9/32/05. Table revised to be as specific as possible, given known parameters in conjunction with guidance from Mr. Lambert and Ms. Griebel.

39. **Pg. 51, Repetitive Loss Areas – Needs to be Hampton-specific, not global.**

**Response:** Revised to include additional details on Hampton’s repetitive loss data. The following sentence was added, “City planners have identified specific areas of the City that contain large numbers of repetitive losses; however, in order to protect the privacy of those policyholders, that information cannot be shared in this plan.”

40. **Pg. 52, Hurricane Vulnerability Analysis – It should be emphasized here that this does NOT depict flooding damage. Table 5.1.5b – “Total \$ Value Exposed Structures” – from wind only**

**Response:** Revised table title and preceding paragraph.

41. **Pg. 53, Critical Facilities Analysis, second paragraph: The inventory of critical facilities for the City of Hampton (not Newport News).**

**Response:** Revised.

42. **Pg. 53, Table 5.1.5e: Text should all be uniform – some are all caps, some are not; Change 7-11 to Police Substation; and Remove Buckroe Skills Center.**

**Response:** Revised for all communities and the appendices.

43. **Pg. 54, 5.1.6 – “...the planning developed a local capability assessment for the City of Hampton.” This terminology could be confused with an LCAR (Local Capability Assessment Report).**

**Response:** Revised to read, “. . . assessed Hampton’s existing mitigation capabilities.”

44. **Pg. 54, Capability Matrix: Hampton does have a Floodplain Manager, Fred Whitley.**

**Response:** The key word in the matrix is “Certified.” The Association of State Floodplain Managers has established a national program for professional certification of floodplain managers. Those candidates who pass the test and meet certain minimum professional qualifications can become Certified Floodplain Managers. Mr. Whitley is not listed on the official list of CFMs for Virginia at [www.floods.org](http://www.floods.org).

45. **Pg. 55, Capability Matrix, Local Emergency Operations Plan: Why is CERT mentioned here?**

**Response:** Revised. CERT was removed from EOP and placed under Public Information Program.

46. **Pg. 55, Hazard Mitigation Plan – should read “Pending”?**

**Response:** Revised.

47. **Pg. 55, Form of Governance – Council-Manager Form of Government**

**Response:** Revised. A sentence was added to the beginning clearly indicating that Hampton has a Council-Manager Form of Government. The title of the section cannot be changed because the five jurisdictions covered by the plan do not all have Council-Manager forms.

48. **Pg. 56, bullet beginning with “The City is currently working to adopt a new ten year plan, the City of Hampton Community Plan. Remove sentence beginning with “The new plan will be based... replace it with “This plan will be adopted in the Fall of 2005.”**

- Response:** Revised.
49. *Pg. 56, last sentence before Stormwater Program and Fees: “The Emergency Management” should read “The Office of Emergency Management”*  
**Response:** Revised.
50. *Pg. 57, Public Education: website should read <http://www.hampton.gov>*  
**Response:** Revised.
51. *Pg. 57, Public Education, second paragraph, 3-1-1 information: Residents (add within the City limits) dial 3-1-1... 3-1-1 can also be accessed by residents with cell phones, or who are outside of the City limits by calling 727-8311.*  
**Response:** Revised.
52. *Pg. 57, Public Education: Emergency Preparedness information is also disseminated through the City PIO’s eNews, free e-mail briefs about what’s happening in Hampton, and the City’s local cable channel, Channel 47.*  
**Response:** Revised.
53. *Pg. 58, Other Mitigation Activities, second paragraph: At the time of this report, the project is in the procurement phase.*  
**Response:** Revised.
54. *Pg. 111, 6.0, second paragraph – “Each HMPC member was provided (remove with) a written...”*  
**Response:** Revised.
55. *Potential Funding: AMEC includes the funding sources that we provide, or states HMGP 75%; City of Hampton 25%. The expectation was that AMEC would let us know what other sources were available.*  
**Response:** Additional potential funding sources have been identified and added.
56. *Schedule: Since these are recommended, not required actions, I think it would be appropriate to remove the Schedule pieces on all action items.*  
**Response:** FEMA guidance and the review crosswalks require that a timeframe for implementation be included. In Section 5.5, 1<sup>st</sup> paragraph, 2<sup>nd</sup> sentence, we added the following phrase to address this comment: “the schedules and cost estimates are not binding and do not imply that the community must complete each action.”
57. *Pg. 120, Responsible Party – “Hampton’s NFIP administrator” – We don’t have an NFIP administrator.*  
**Response:** Please see Hampton comment number 43 above and comment 59 below. Any community participating in the NFIP must have an NFIP or floodplain administrator. Mr. Fred Whitley is the designated Floodplain Administrator or Floodplain Manager for the City of Hampton, according to the Virginia Dept. of Conservation and Recreation. We denoted “Floodplain Management”, rather than NFIP Administrator, to address this comment.
58. *Pg. 120, Cost Benefit: “resulting in approximately \$219,000 (add “annual”) savings”*  
**Response:** Revised.
59. *Pg. 121, Other Alternatives, Need to reword first sentence.*  
**Response:** Revised.
60. *Pg. 121, Responsible Office – Again, we do not have an NFIP administrator.*  
**Response:** Please see comments 43 and 56 above. We denoted “Floodplain Management”, rather than NFIP Administrator, to address this comment.

61. Pg. 122, *Responsible Office includes Codes Compliance, Procurement, Public Works, Floodplain Management. Cost estimate is more around \$40,000 - \$60,000 per structure – remove total of \$500,000. Cost benefit - ...*”when structures are elevated (replace “to or” with 1 foot) above Base Flood Elevation.”

**Response:** Revised.

62. Pg. 123: *Issue / Background – Outside 100-year floodplain. Responsible Office – Hampton City Schools, NFIP Administrator (?), Office of Emergency Management. Schedule – After first sentence, include “Grant denied. Future funding opportunities will determine schedule to complete this item.”*

**Response:** Revised.

63. Pg. 124, *Action Item 5 – based on BRAC, may want to include Buckroe through Ft. Monroe. Responsible Office – NFIP administrator in brackets, not consistent with previous statements. Schedule – see previous comment on pg. 123. (Grant denied...)*

**Response:** Revised.

64. Pg. 125 – *Potential Funding – DHS grants. Schedule – Grant denied... (see pg. 123, 124)*

**Response:** Revised.

65. Pg. 126 – *Wiring existing shelters and critical facilities (this is fine). Approximately 20 facilities (add and 20 pump stations) will be prewired for generator power. Responsible Office – Include Hampton City Schools, remove American Red Cross. Cost Benefit – Should read “Providing ability to contract for and install back generator power to shelters... Potential Funding – include CIP, other grant opportunities... Schedule – Add “Grant denied... (see pages 123, 124, 125).*

**Response:** Revised.

66. P.127 – *cost estimate – add “there would be a cost to the builder to elevate an additional 2’.”*

**Response:** Revised.

67. Pg. 128 – *Issue/Background – The answer to your question depends on the scenario. Certainly volunteers could conduct windshield assessments, but also report post-event conditions to the EOC, serve as a means of communications throughout the neighborhoods, traffic control, etc. This is where CERT / Citizen Corps come in.*

**Response:** Revised.

68. Pg. 129, *Action Item #10, Issue/Background: First sentence – instead of citing specific areas in the City, just say there is a city-wide history of flooding. Other Alternatives Considered: Should read “No action to preserve or create open space in the floodplain may result in residential...” Cost Estimate: Not high enough. Potential Funding – define HMGP, PDM, FMA, CDBG.*

**Response:** Revised as requested, except all acronyms will be fully described in an appendix to this document. Included an additional \$1,000,000 in Cost Estimate.

Reviewer: Wilton Bobo

Agency: James City County

69. Pg. 105, *Number of Floodprone Buildings is 200.*

**Response:** Revised.

70. Pg. 107. *2003 Comprehensive Plan, last paragraph. Add Powhatan District after Berkeley in first sentence.*

**Response:** Revised.

71. Pg. 108. *Public Education, last paragraph. Change Environmental Division to Development Management.*

**Response:** Revised.

Reviewer: Emily Flannigan

Agency: Newport News

72. Pg. 68 and 69. Remove question marks from Capability Matrix.  
**Response:** Revised.
73. Pg. 71, Emergency Preparedness, Storm Ready. Revise 1<sup>st</sup> sentence to read, “Newport News was one of the first 5 communities in Virginia to be Storm Ready. Storm Ready is a nationwide . . . .”  
**Response:** Revised.
74. Pg 72. Last paragraph. Remove the phrase, “outside of the floodplain.”  
**Response:** Revised.
75. Pg. 131. Action Item #3, Action Description. Add phrase, “which are certified by the American Red Cross” to clarify.  
**Response:** Revised.
76. Pg. 131. Issue/Background. Add the following sentence at the end, “During Hurricane Isabel, the shelters were left without power.”  
**Response:** Revised.
77. Pg. 132. Issue /Background. Add the following sentence at the end, “Future plans for acquired areas include park uses in allowed floodway.”  
**Response:** Revised; modified wording slightly to read “regulatory floodway.”
78. Pg. 132. Schedule. Add the following sentence at the end, “To date, about thirty homes have been acquired through the FAP.”  
**Response:** Revised.
79. Pg. 135. Responsible Office, include Planning. Cost Estimate, denote “Staff Time.”  
**Response:** Revised.
80. Pg. 136. Responsible Office, include Emergency Management. Cost Estimate, denote “\$25,000.”  
**Response:** Revised.
81. Pg. 138. Action Item #10, include introductory phrase, “Upgrade drainage system maintenance and increase maintenance frequency . . . .”  
**Response:** Revised.
82. Pg. 138. Issue Background, include final phrase, “system, which has resulted in flooding problems in low-lying areas such as City Line Apartments. Presently, City crews visit hot spots during intense rain storms resulting in extra man power and additional hours.”  
**Response:** Revised.
83. Pg. 138. Include Action Items 11 (Flood Hazard Awareness Program) and 12 (Community Rating System participation).  
**Response:** Revised.

Reviewer: Judi Riutort

Agency: York County

Note: Ms. Riutort provided comments via an edited document. Her version was wholly included in the main document, and the most important comments are summarized below.

84. Pg. 147. Responsible Office, use “Dept of Environmental and Developmental Services, Building Regulations”. Schedule should indicate, “Implementation contingent on funding and staffing availability.”  
**Response:** Revised.

85. **Actions Items 2 and 3. Reorder items so that 2 and 3 become 4 and 5, and vice versa.**  
Response: Revised.
86. **Pg. 148. Reword first action item as indicated in revised document provided to AMEC. Reword Issue/Background and include Office of Emergency Management, and Department of Fire & Life Safety under Responsible Office. Cost estimate should be increased to \$120,000. Revise Schedule to read, “Implementation contingent upon . . . .”**  
Response: Revised.
87. **Pg. 148. Reword 2<sup>nd</sup> action item, Issue/Background, and Other Alternatives Considered. Responsible office should be County administration, Planning Division and the York Co Board of Supervisors.**  
Response: Revised.
88. **Pg. 149. Reword Responsible Office for first action item on page. Change Priority to “High”. Change Schedule to “Ongoing.”**  
Response: Revised.
89. **Pg. 149. Reword Issue/Background for the 2<sup>nd</sup> action item on page. Take out sentence referring to VDOT maintenance. Change Priority to “High. Increase Cost Estimate to \$5,000,000, reword Cost Benefit, and include VDOT Revenue Sharing Program funds as a Potential funding source.**  
Response: Revised.
90. **Pg. 149. York County included 8 additional action items in their comments which were included in the revised draft of the hazard mitigation plan.**  
Response: Revised.
- Reviewer: Bill Sammler  
Agency: NWS Wakefield Office
91. **Hurricane Map – Hurricane track arrows are 180 degrees opposite what they should be. Also, there is considerable difference between the track data and the impact data in the body of the text, most likely due to the fact that most tropical systems which affect the Peninsula do NOT pass directly over the Peninsula.**  
Response: Revised using NOAA CSC mapping tool.
92. **Earthquakes (pp. 17) – data should also be derived from the [USGS Virginia page](#), which has more current information.**  
Response: Revised using data from USGS Virginia page and the Virginia Tech Seismological Observatory data. Table revised by striking non-Virginia quakes and adding recent data collected from various sources.
93. **Thunderstorms (pp.21-22) – VA averages 40-50 thunderstorm days per year (vs. 35-45). A better lightning strike density map should be available from the Internet. The use of a 1 year sample as a climatology (Figure 4.1.3a) is simply not valid. In addition, the last paragraph on page 21, and the table on page 22 do not depict lightning strikes, but depict incidents of lightning strike damage and/or deaths since about 1990. This is likely only a fraction of the actual damage, and deaths/injuries during that time. In addition, there is no data on hail/high wind damage/deaths as a result of severe thunderstorms. This data can be obtained by using the [SVRLOT2 software](#) available from the [Storm Prediction Center](#) in Norman OK.**  
Response: Revised text as indicated. Another lightning strike density map could not be located; however, discussion was added and the figure title revised to indicate that this is a 1-year climatology only. SVRLOT was used to create maps in Appendix C showing hail, high winds, and tornadoes as suggested.
94. **Extreme Heat (pp22-23) – Table 4.1.4a is a Heat Index table, not a table of temperature vs. RH. Suggested to AMEC that a 30% RH column be added. This is NOT a valid suggestion, as the NWS Heat Index table ends at 40%.**

**Response:** Revised table title and added column descriptors.

95. **Flooding (pp 23-24) – 3<sup>rd</sup> full paragraph on page 23, suggest starting with “There have been numerous urban and flash floods...”, as not all the flooding has been flash flooding. In fact, Isabel was not a flash flood due to rainfall, but Floyd had flash flooding, urban flooding, and longer term river flooding associated with it.**

**Response:** Paragraph was substantially revised.

96. **Drought (pp. 24-26) – Need to discuss the 2000-2002 drought, which was the most significant since 1931 for most of VA. Attached are a couple of graphics from that time period. Eliminate graphic at top of page 26. It’s not representative of drought.**

**Response:** Drought section was substantially revised to include data on 2000-2002 drought, and use U.S. Drought Monitor rather than Palmer Drought Severity Index.

97. **Hurricanes (pp. 26-28) – Lots of re-wording needed in the descriptive section (pages 26-27). 1933 Hurricane and Hurricane Hazel were missed completely, probably due to the lack of data in Storm Data, which really isn’t a good source for pre-1980 hurricane impact information. Newspaper clipping/archives, etc. are much better, even though more work is required to obtain this info. I have attached a document we prepared locally that might help. Also suggest using a larger radius around the Peninsula (say 150 miles from the center of the Peninsula) to map hurricanes. This will be more representative of the storms that have impacted the region. NOAA’s [Coastal Services Center \(CSC\)](#) has a [hurricane track web site](#) that should prove useful for this.**

**Response:** Hurricane section substantially revised. Mapping was not extended to 150 miles due to the community’s desire to focus more closely on the Peninsula. NOAA CSC mapping site used to provide new mapping.

98. **Also Table 4.1.8b, Donna (1960) is missing. Ginger (1971) is included twice, Floyd was a TS, Dennis (1999) is misspelled, Isabel was an H1.**

**Response:** This table was deleted. Tables in Appendix C were edited to remove duplications.

99. **Nor’easters (pp. 29-30) – Not sure where the Dolan-Davis rating scale came from, and whether it’s used operationally. We do not routinely use it.**

**Response:** This section was revised. Dolan-Davis scale remains in the plan, but a note was included that NWS and other media do not routinely use it. The table remains an insightful tool for describing varying degrees of damage.

100. **Tornadoes (pp30-32) – Need to use SVRLOT to map occurrences, rather than using Barbara Watson’s 1950-2000 map. Fujita scale is truncated at F4, should go through F5. In hurricane spawned tornadoes (table 4.1.10c), 5 tornadoes occurred on the peninsula with Gaston, not 1. There is also a discrepancy between the data showing hurricane occurrences and the data for hurricane spawned tornadoes.**

**Response:** This section was substantially revised. Table 4.1.10c was removed, and the information on associated hurricanes was added to the previous table to integrate the two databases and make the information more pertinent to the Peninsula. SVRLOT maps for tornados, damaging wind, and hail were added to the Appendices.

101. **Wildfires (pp. 33) – Do not understand the meaning for the paragraph above Table 4.1.11a.**

**Response:** The paragraph in question was removed. Table of fire risk was revised to add land area w/in each community.

102. **Winter Storms (pp 34-36) – Why aren’t most of the storms listed in Table 4.1.12a also in the Nor’easter table (4.1.9b)? Most of the winter storms listed in 4.1.12a are also nor’easters.**

**Response:** The nor’easter table was revised to include those winter storms *known* by editors to also be nor’easters.

103. **Sections 4.1.16/4.1.17 (pp. 38-39) – Section 4.1.16 needs to be re-worded, as the message is unclear. Table 4.1.17a is confusing to me, and I need to understand the logic behind the Hazard Level designations.**

**Response:** Text from 4.1.16 was moved forward in the document to ensure that this discussion is seen prior to the multi-hazard identifications, and readers understand that hazards can be interrelated. The hazard level designations in Table 4.1.17a were reviewed by the editors; however, ultimately, the team members themselves came up with the rankings and hazard levels, and the editors do not feel justified in changing them w/out community input.

**104. Jurisdictional Comments – Similar data issues appear to exist in the individual jurisdiction data. There appears to have been multiple data sources used, but little cross-checking between sources to ensure the data is complete, reasonable and accurate.**

**Response:** The individual sections were reviewed and revised as appropriate.

**Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated Sept 30, 2005  
Draft #4**

Reviewer: Jim Redick  
Agency: City of Hampton

1. **Pg. K-2. Mr. Redick's name was misspelled in this appendix.**  
**Response:** Revised.
2. **Pg. 9, Section 2.1. Reword second sentence of first paragraph to read, "The area now occupied by Hampton was first noted by English colonists. . . when they visited an Indian village called Kecoughtan."**  
**Response:** Revised.
3. **Pg. 148, Recommended Action #8. Reword action to include EM on site plan review, review of all development documents, processing Elevation Certificates and developing new forms for (eg) substantial damage.**  
**Response:** Revised.
4. **Mitigation recommendation #1 – elevate flood-prone homes. Generalize, don't specify 21 homes. This will be an ongoing strategy.**  
**Response:** Revised recommended action #3, and the Schedule notation, as well.
5. **Hurricane Dennis is mentioned under Tornados in Hampton, but not hurricanes. As Dennis stayed off the shore, it produced a good deal of rain and saturated the ground – allowing Floyd to cause more havoc.**  
**Response:** Revised. Also located and included local rainfall totals for Dennis and Floyd.

**Hampton Map Comments**

6. Please add a label at FR12 that indicates "City Hall".  
**Response:** Revised.
7. With regard to street names, add as many as possible to still make it legible.  
**Response:** Revised to the extent possible. Major roads were already included, however added a few more less primary roads. If more are added, clutter issues will develop.
8. Please add a label at FR12 that indicates "City Hall".  
**Response:** Revised.
9. Please add Hampton Roads Convention Center and Hampton Coliseum.  
**Response:** This comment was overlooked and will be addressed in the next revision.

Reviewer: Randy Hildbrandt et al (city officials meeting 10/12/05)  
Agency: City of Newport News

10. **Newport News Mitigation Action Item #5. Remove this item as it is an ongoing program with sufficient funding. Waterworks does not plan to devote additional funding.**  
**Response:** Revised
11. **Mitigation recommendation #10. City Line flooding is not a result of inadequate drainage maintenance. Revise wording.**  
**Response:** Revised

Reviewer: Mostafa Sabbah  
Agency: City of Newport News

12. **Pg. 151, Action Item #2. The City does not collect completed Elevation Certificates but collects data from the ECs. Engineering should be added to the responsible parties.**

**Response:** Revised.

13. **Pg. 152, Action Item #3. Engineering should be added to the responsible parties. This is currently the subject of a major study being managed by Engineering. Costs seem VERY low. Potential grant funding is helpful.**

**Response:** Revised. Increased costs substantially.

14. **Pg. 152. Action Item #4. The \$200K cost estimate represents only the annual City contribution and does not include FEMA funding obtained annually.**

**Response:** Revised to read “\$200,000 annual City funding, plus any grant funding that may become available. Program can be expanded based on available funds.”

15. **Pg. 155, Action Item #7. Engineering and City Attorney should be added to the responsible parties.**

**Response:** Revised.

16. **Pg. 157, Action Item #10. The background misrepresents maintenance deficiency as the cause of City Line flooding, which is actually more a function of tidal influence. It is unclear whether recent significant staff and equipment upgrades were considered in this recommendation.**

**Response:** Revised. Removed reference to \$1.30 per month and left it up to future stakeholders to set fee increase.

17. **Pg. 157, Action Item #11. Engineering is in discussion with Codes about integrating the building permit process with the City GIS, which would allow for direct linkages with mapping including the FIRM mapping. By including more detailed data, such as a full EC, in the application and approval process, we expect to increase the level of awareness significantly.**

**Response:** Revised to include discussion of the plans referenced above.

Reviewer: Stormwater Division, Stephen Land and Emergency Management, Emily Flannigan  
Agency: City of Newport News

18. **New Action Item #13. Mr. Land and Ms. Flannigan provided a new Action Item regarding floodproofing of 4 pump stations in the 100-year floodplain.**

**Response:** Revised to incorporate new Action Item.

Reviewer: Fran DeMarco  
Agency: Homeowner, City of Newport News (at Public Meeting #8, 11/2/05)

19. **Table 5.2.2. During Hurricane Floyd there was significant flooding in the northern part of Newport News, near Newport News Park. There was a townhome community where many families were affected by flooding up to the 2<sup>nd</sup> floor of their homes. I understood it was a drainage problem. The Hampton Roads Chapter of the ARC might be able to provide more details.**

**Response:** Revised to include discussion of the townhomes, and to include newly discovered data on rainfall amounts in Newport News.

#### **Newport News Map Comments**

20. Check once more for symbols and labels overlapping.

**Response:** Overlapping symbols were not moved due to the spatial inaccuracies that would be created. Review of overlapping labels has been performed and several overlapping labels were repositioned.

21. Remove trailer parks.

**Response:** Revised.

22. Nursing home symbol on legend isn't quite the same as the symbol

**Response:** Revised. Same symbol is represented in legend and map; however, tried to enlarge symbol in legend to make more visible.

23. Symbols layers need to be on top of water layer. East end and Mercury Blvd, there are some symbols obscured by water

**Response:** Revised.

24. Label creek names, from left to right:
- a. Along James City Co border, it's Skiffe's Creek
  - b. Upper left near FR5, its Lee Hall Reservoir
  - c. Next creek emptying into Warwick River near PS54, is Toney Run
  - d. Next creek near PS 108 is Lucas Creek
  - e. Deep Creek is labeled
  - f. Next creek is Fisher's Creek (near PS 92)
  - g. Next waterbody is Lake Maury (near PS 22)
  - h. Along the northeastern border w/York County is the Big Bethel Reservoir
  - i. Along the boundary with City of Hampton, near the 90 degree angle and PS 96 is Newmarket Creek
  - j. Waterbody near PS 125 is Salter's Creek
- Response:** Revised.

Reviewer: Bert Geddy  
 Agency: City of Williamsburg

25. **Revise Section 5.3.1 to include data on June 63 dam break, and Aug 89 rain event.**  
**Response:** Revised. Requested more info from B. Sammler, NWS, and will add what becomes available in time.
26. **Pg. 91. Listing of “designated growth/redevelopment areas” should not include College Woods.**  
**Response:** Revised.
27. **Pg. 84, Section 5.3.2. Second paragraph should be revised in accordance with the recommendations above for Section 5.3.1.**  
**Response:** Revised.
28. **At PHMPC meeting, Mr. Geddy and Ms. Morgan discussed adding an action item for requesting a review of the floodplain management ordinance by VaDCR.**  
**Response:** Revised.

**Williamsburg Map Comments**

29. Add Lake Matoaka  
**Response:** Revised.
30. Delete Water Tower 521, as it is the same as WT 548 3. PS 528 and an unlabeled pump station on the far east side. The symbols got cut off. Is there a way to put these on top of the county layer? Add label for the unlabeled PS.  
**Response:** Revised.

Reviewer: Richard Luzinski  
 Agency: Homeowner, York County (at Public Meeting #8, 11/2/05)

31. **James City County portions of the plan. The plan seemed thorough for “natural” events. But because of our location, planning for an event in Surry [Nuclear Power Plant] or the Naval Weapons Storage Depot in York [County], I feel, should have been taken into consideration.**  
**Response:** Mr. Luzinski’s comment was discussed with local planners at the meeting. The focus of this plan is natural hazards. Local communities anticipate that the five-year update of this initial planning effort will provide opportunities to more fully integrate the multiple operations plans for individual events with natural hazard mitigation planning.

Reviewer: Wilton Bobo  
 Agency: James City County

32. **Pg. 95, Section 5.4.1. Refine discussion of flooding to show that JCC is susceptible to tidal and non-tidal flooding, not just storm surge.**

**Response:** Revised

- 33. Pg. 107, Other Mitigation Activities. Third paragraph should be revised to indicate that Jamestown Elementary School and Stonehouse Elementary Schools are also prepared for an emergency generator.**

**Response:** Revised

- 34. Pg. 167, Action #1. Comments from AMEC and Mr. Bobo reflect a need to clarify that the Chickahominy Haven project is coincident with addressing repetitive losses.**

**Response:** Revised

- 35. Pg. 170, Action Item #6. Include discussion that the county has begun working with nursing homes, assisted living facilities, private schools and daycare centers on mitigation and disaster recovery.**

**Response:** Revised

**James City County Map Comments**

- 36. Show the railroad continuing through W'burg and York Co as you did with the main interstate.**

**Response:** Revised.

Reviewer: Lou Lafrenayz,

Agency: Homeowner, York County (at Public Meeting #8, 11/2/05)

- 37. Section 5.5.1. Mr. Lafrenayz provided general background on additional flood events and some urban flooding/drainage issues in York County and along the Newport News boundary at Little Brick Kiln Creek.**

**Response:** Revised report to include discussion of the flood events with data provided, and discussion of water level management practices at Bethel Reservoir and Newport News Reservoir.

Reviewer: PHMPC Team Member

Agency: York County

- 38. Pg. 176, Action Item #4. Revise action description, issue/background and cost estimate in accordance with revised text provided.**

**Response:** Revised with minor editing.

Reviewer: Judi Riutort

Agency: York County

- 39. Pg. 112, beginning of last paragraph. The parcel layer is now up to 25,100. If a specific number is included, then we should state a date or fixed point in time.**

**Response:** Revised to reference data from Spring 2005.

- 40. Pg. 121, Guiding Community Documents, 1<sup>st</sup> paragraph. Change "its" to "it".**

**Response:** Revised.

- 41. Pg. 122, Zoning and Development Standards, 3<sup>rd</sup> line of 1<sup>st</sup> main paragraph. Delete "a".**

**Response:** Revised.

- 42. Pg. 116, Critical Facilities. Correct subject verb agreement in 1<sup>st</sup> sentence of 2<sup>nd</sup> paragraph.**

**Response:** Revised for each community discussion of critical facilities.

- 43. Pg. 116, Table 5.5.5d. The last entry is coded as "RE", and there is no RE in Appendix E, list of codes.**

**Response:** Revised by deleting Yorktown Waterfront from Critical Facilities. Recreation facilities should not be listed as critical facilities.

- 44. Pgs 117-120. Delete facilities as indicated on marked up sheets.**

**Response:** Revised.

45. **Pg. 120, Table 5.5.6. The Land Use Plan is part of the Comprehensive Plan, and the Class 9 CRS rating is now certified.**

**Response:** Revised.

46. **Pg. 122, bulleted areas of growth and development. Delete “growth/redevelopment” and add “but not limited to”. Reword 3<sup>rd</sup> bullet as indicated on markup.**

**Response:** Revised.

47. **Pg. 124. The font of subtitle “Emergency Preparedness” is incorrect.**

**Response:** Revised.

48. **Pg. 125. Add another subheading “Warning” after “the County’s Department of Fire and Life Safety:”**

**Response:** Revised.

49. **Provide a summary of AMEC’s role in the planning process. Recommend inside front cover.**

**Response:** Provided summary of AMEC’s role in the Executive Summary.

50. **Ms. Riutort commented on critical facilities tables with instructions to remove some facilities that do not meet the definition of “critical”.**

**Response:** Revised. However, in Appendix E, first table, “DC” and “CL” cannot be removed because Newport News chose to keep these facilities on their maps.

#### **York County Map Comments**

51. Top center, label should read "Gloucester County", not "Cloucester"

**Response:** Revised.

52. Put the water label on top of the floodplain layer so that we get some semblance of a shoreline. This should be applied to all communities.

**Response:** Revised; but water layer is probably not what communities thought it would be.

53. Remove all hazardous materials from map and legend (and report.)

**Response:** Revised.

54. "Poquoson River" must be spelled "Poquoson River" and put on the water, not on land (or add an arrow)

**Response:** Revised.

55. Since orientation is not north-up, the symbols are all cock-eyed. Please rotate symbols.

**Response:** Symbol orientation was created with initial set-up of map. Currently we do not have a quick fix to this issue as additional research will be needed for a resolution. This issue has not been addressed due to time constraints.

Reviewer: Kris Keyes

Agency: Newport News Waterworks

56. **Dams and water towers in JCC and Williamsburg must be removed.**

**Response:** These facilities have been removed from the plan and tables, and will be removed from the maps when the final maps are produced.

57. **Page 153, Rec Action Item #5, Issue/Background:** The first two lines should be changed to read as follows. The other lines in the paragraph should remain the same. "Department of Public Utilities (Newport News Waterworks) developed a water conservation program approximately 15 years ago and was modified in 2005 (effective January, 2007). The plan is based on encouraging water conservation through surcharges and penalties for excess use, and restrictions during drought conditions. This plan..."

Other Alternatives Considered: Delete the sentence "The plan is under revision, to be effective FY2006."

**Page 179, Rec Action Item #9:** Should be the exact same changes as above for page 153.

**Response:** Revised.

**Comments and Responses to the Draft Natural Hazard Mitigation Plan, dated November 18, 2005**  
**Draft #5**

Reviewer: Hibak Hersi  
Agency: Virginia Department of Emergency Management

1. **Planning Process Element D (Crosswalk p.5)** – We included several sentences in Section 3 (Steps 1 and 3) to indicate that project managers invited Hampton University, Thomas Nelson Community College, the College of William & Mary, the SE Community Redevelopment Office, and school systems. Businesses were invited to participate in the team planning process through an invite extended to the Peninsula Chamber of Commerce. Non-profits were addressed through the public comment periods and notifications in local newspapers. We indicated that the letters and emails of invitation to these groups are not included in the plan, but maintained by Newport News Emergency Management.
2. **Profiling Hazards, Element B (Crosswalk p. 6)** – As you and I discussed, the surge maps are intended to be a part of the plan and we will be sure to include all community surge maps in the new submittal. We have included a complete subsection regarding storm surge and storm surge mapping in Section 4.1.3. We kept the surge discussion as a subsection of Hurricanes and Tropical Storms because the surge is a secondary hazard caused by the tropical systems; it can't occur on its own. We feel that the local erosion hazard is, likewise, a secondary hazard related to storms and sea level rise, so we added language to this effect in Section 4.1.1, Multi-Hazard Correlation. We provided a further description of erosion under nor'easters, and then include community-specific references for York Co b/c erosion is addressed in their Comprehensive Plan (see Section 5.5.4). The communities were asked to provide whatever additional info they could on winter storms and nor'easters on several occasions. They do not maintain collected records and have next to no data on damages or costs. Upon further inquiry, AMEC received some limited information from York County. They provided some general cost estimates on recent storms which were included in the text, however, the few sentences on separate hazards did not justify entire community sections devoted to these hazards so the data was included in the historical descriptions of events for the entire planning region in Table 5.5.1b.
3. **Assessing Vulnerability: Identifying Structures (Crosswalk p. 7)** – No change to the plan. We will recommend that the communities consider including future development plans in the plan when they do a 5-year update.
4. **Multi-Jurisdictional Risk Assessment (Crosswalk p.9)** – We understand the inclusion of “Thunderstorms” was a mistake, and that “Nor’easters” was intended. Under Risk Assessment, VDEM has asked that we address Nor’easters, winter storms, storm surge, and erosion more thoroughly for each jurisdiction. Again, erosion and storm surge are secondary hazards as they are a result of storms and/or sea level rise. The discussion of erosion and storm surge is addressed for each *storm* through the Hurricane discussions and the very detailed descriptions of individual historical hurricanes and their effects on regional jurisdictions. Please note that Appendix C, Catalog of Virginia’s Historical Hurricanes, provides detailed accounts of the effects of storm surge and erosion resulting from hurricanes since the mid-1500s. As FEMA requires that the risk assessment assess each jurisdiction’s risk “*where they vary from the risks facing the entire planning area*”, we are puzzled at how to differentiate between the jurisdictions with regard to winter storms and Nor’easters. All of the Peninsula is subject to these storms, and all jurisdictions have suffered their effects on many occasions over their history. The effects are often hard to quantify as they are primarily incurred by individual homeowners as a result of power outages, and by local governments from clearing/prepping roads. We attempted to contact Virginia Dominion Power and the Media Relations department thereof to determine the extent, duration, and costs of power outages as a result, and we again asked the communities to provide any data of costs from these storms. We did not receive any response from any of them. Additional data added to 4.1.16 on tsunamis, as available.
5. **Implementation of Mitigation Actions (Crosswalk p.11)** – We will modify wording of several Recommended Actions to include “continued compliance with the NFIP”, as this is the overall intent of the recommended actions. We will also provide a sentence that all communities are planning to have continued compliance with the NFIP.

## References

- Boesch, Donald and Jack Greer, et al. *Chesapeake Futures; Choices for the 21st Century Chesapeake Bay Program*, undated, available for viewing at <http://www.chesapeake.org/stac/futreport.html>
- Boston Globe, 2004, N.E. is not immune, scientists warn. December 28, 2004.
- Conrad, D., McNitt, B., and Stout, M., 1998. *Higher Ground: A Report on Voluntary Property Buyouts in the Nation's Floodplains, A Common Ground Solution Serving People at Risk, Taxpayers and the Environment*. National Wildlife Federation, Washington, D.C., July 1998.
- Driscoll, N.W., Weissel, J.K., and Goff, J.A., 2000, *Potential for large-scale submarine slope failure and tsunami generation along the US mid-Atlantic Coast (pdf)*. *Geology*: May 2000, v. 28, no. 5, p. 407-410.
- Fujita 1971. Fujita Damage Scale. (Online). Available at <http://www.ncdc.noaa.gov/oa/satellite/satelliteseye/educational/fujita.html>
- Maine Geological Survey (Online), *Tsunamis in the Atlantic Ocean*, at <http://www.maine.gov/doc/nrimc/mgs/explore/hazards/tsunami/jan05.htm>. October 2005.
- NOAA 1999. National Oceanic and Atmospheric Administration, National Weather Service. Climate of 1999 – June – August; Drought in the U.S., 15 September 1999. (Online). Available at [http://www.ncdc.noaa.gov/oa/climate/research/1999/sum/us\\_drought.html#heat](http://www.ncdc.noaa.gov/oa/climate/research/1999/sum/us_drought.html#heat). 8 December 2004
- NOAA Technical Report NOS CO-OPS 36, *Sea Level Variations of the United States 1854-1999*, July 2001.
- NOAA 2004. National Oceanic and Atmospheric Administration, National Weather Service. (Online). Available at <http://www.crh.noaa.gov/pub/heat.htm>. 8 December 2004.
- NWUIFPP undated. Wildland/Urban Interface Fire Hazard Methodology. National Wildland Urban Interface Fire Protection Program, undated. (Online) Available at <http://www.fema.gov/pdf/reg-viii/wham.pdf>
- Office of Technology Assessment, United States Congress, *Preparing for an Uncertain Climate*, 1993.
- Sammler, William. Personal interview, September 15, 2005. (National Weather Service, Warning Coordination Meteorologist, Wakefield, Virginia office.)
- United States Geological Survey (Online) *Earthquake History of Virginia*, available at [http://neic.usgs.gov/neis/states/virginia/virginia\\_history.html](http://neic.usgs.gov/neis/states/virginia/virginia_history.html), 2004.
- Virginia Department of Emergency Management. (Online) *Virginia Winters; Snow, Wind, Ice, and Cold*. Available at: <http://www.vdem.state.va.us/library/vawinter/va-win.htm> 2004.
- Virginia Drought Monitoring Task Force, *Drought Status Report*, August 19, 2002 and November 25, 2002.
- Virginia Employment Commission, Electronic Labor Market Analysis. (Online). Available at: <http://velma.virtuallmi.com/analyzer/startanalyzer.asp>. 2005
- Virginia Soil and Water Conservation Board. (Online) Available at <http://www.dcr.virginia.gov/sw/damsafety.htm>
- Virginia Tech Seismological Observatory. (Online) Available at <http://www.geol.vt.edu/outreach/vtso/> and <http://www.geol.vt.edu/outreach/vtso/Giles-Intensity.htm>.
- Weldon Cooper Center for Public Service, *Population Estimates for Virginia Cities & Counties, 2001-2004* (Online) Available at: [www.coopercenter.org/demographics](http://www.coopercenter.org/demographics), January 2005.