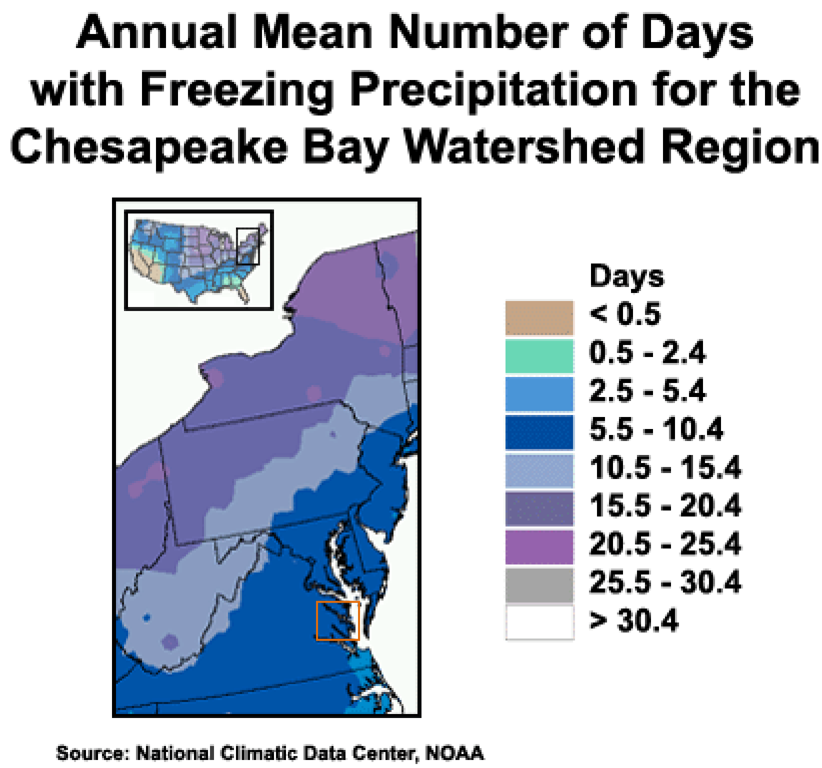


Figure 25: Annual mean number of days with freezing precipitation *(rain or drizzle) for the Chesapeake Bay Watershed region. The area encompassing the Middle Peninsula is highlighted on the map with a red square.*

As with snow, the frequency with which freezing rain occurs varies throughout the Chesapeake Bay watershed. In the northern part of the watershed, around Binghamton, NY, the incidence of freezing rain is one of the highest in the country. Although less common, freezing rain is still a threat even to the southern parts of the watershed. Figure 25 shows how the number of days with freezing precipitation (both rain and drizzle) in an average year varies throughout the Chesapeake Bay region. The Middle Peninsula generally experiences between 5.5 and 10.4 days of freezing rain annually. During the winter of 1993-1994, a series of ice storms struck Virginia. The conditions for the formation of an *ice storm* are not completely unlike those for the formation of a Nor'easter. High pressure over New England funnels cold, dry arctic air south over the state. The air tries to push west but cannot rise over the - 65 - Appalachian Mountains and becomes trapped on the east side. A storm moves northeast from the southern plains or Gulf Coast region. Instead of passing south and east of Virginia, it often moves up the western slopes of the mountains. As this warm, moist air rises over the mountains and the trapped cold air on the east side, precipitation begins (Watson and Sammler, 2004) (Figure 26). The type of precipitation depends on the depth of the cold air. At first the thickness of the 3cold air mass is often enough to produce snow, but as the warm air passes over the cold air and erodes it, the cold air mass gets more and more shallow. Soon the cold air mass is too thin to produce snow. Rain droplets freeze into small ice pellets, or *sleet*, as it falls through the cold air. When sleet hits the ground, it bounces and does not stick to objects (Watson and Sammler, 2004).

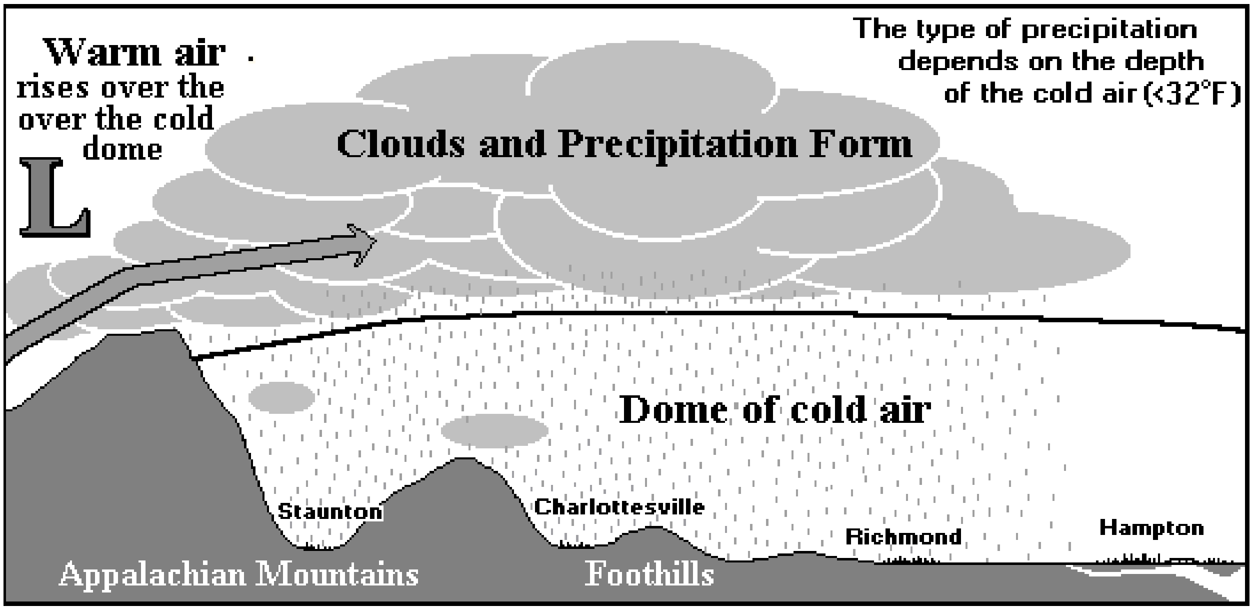


Figure 26: Ice Storm-Formation *(Watson and Sammler 2004).*

Eventually, the cold air mass is so shallow that the rain does not freeze. If the temperature of the earth's surface is below freezing, then rain will freeze as it hits the ground, producing *freezing rain*, a very dangerous on roadways or walkways. As the ice accumulates on trees and wires, the weight eventually causes them to break, knocking out power and phone service. Sometimes, so much ice can accumulate that structural damage and collapse can occur to buildings and communication towers. This is precisely what occurred during the "Christmas Ice Storm" of December 1998, which hit southeast Virginia, including the Middle Peninsula. Icy conditions caused injuries from slips, falls, and numerous vehicle accidents. Ice accumulations of up to an inch brought down trees and power lines. Outages were so widespread (400,000 customers on Christmas Eve) that some people were without power for up to ten days (Watson and Sammler, 2004). Other types of weather systems generally do not cause major problems for Virginia. Storms such as the "*Alberta Clipper*," a fast moving storm from the Alberta, Canada region, or a cold front sweeping through from the west generally do not bring more than one to four inches of snow in a narrow 50 to 60 mile-wide band. Sometimes, the high pressure and cold arctic air that follow in the wake of a clipper become the initial set up for a Nor'easter. In very rare cases, elements combine to produce very localized heavy snow without any fronts or storm centers nearby. These events are nearly impossible to forecast with any accuracy (Watson and Sammler, 2004).

However in November 2009, Tropic Storm Ida made landfall in Alabama, but weakened, losing its tropical storm characteristics, as it crossed to North Carolina. The storm redeveloped off the coast of Carolina in the Atlantic Ocean. The resulting coastal low combined with an unusually strong Canadian high over New England resulted in a strong pressure gradient over Coastal Virginia and the Carolinas. This caused storming northeasterly winds, high waves and record high water levels. Stations of the coastline of the Virginia recorded wind speeds, gusts and barometric pressures of this Nor'easter (Table 21).

Table 21: Maximum observed wind speeds, gusts and barometric pressure by stations located near Middle Peninsula Localities during the November 2009 Nor'easter.								
Station Name	**Maximum Wind Speed**			**Maximum Wind Gust**			**Minimum Barometric Pressure**	
	Date & Time (GMT)	**m/s***	**Kt****	**Date & Time (GMT)**	**m/s**	**Kt**	**Date & Time (GMT)**	**mb*****
Kiptopeke, VA	11/13 00:00	14.7	29	11/12 21:12	22.3	43	n/a	n/a
Lewisetta, VA	11/12 00:00	12.3	24	11/12 21:30	19.5	38	11/12 8:24	1006.7
Yorktown USCG Training Center, VA	11/12 23:06	21.4	42	11/12 23:12	25.9	50	11/12 23:06	1001.5
Chesapeake Bay Bridge Tunnel, VA	11/12 22:42	26.6	52	11/13 4:24	33.4	65	11/12 4:24	997.0
* 1 m/s (meters/second) = 2.2 miles per hour (mph) = 1.9 knots ** 1 kt (knot) = 1.2 mph = 0.05 m/s *** mb (millibar) = 0.03 inches								

Winter Ice Storms Vulnerability

Winter ice storms can impact individuals, property as well as the overall community. At the individual level ice has the potential to cause automobile accidents and reduce the walkability of community due to ice-covered walkways. Personal property may be impacted as pipes freeze or structural failures occur due to the weight of the ice. The overall community may also be impacted as transportation will be interrupted or halted, and the weight of ice to snap tree limbs could damage power lines or infrastructure.

Winter Ice Storm Extent (Impact)

While a winter ice storm may be measured based the damages caused by the ice storm, wind speed and the barometric pressure, winter ice storms may also be measure on the Sperry-Piltz Ice Accumulation Index (2009). This scale can predict the projected footprint, total ice accumulation and the resulting potential damages from approaching ices storms (Table 22).

Table 22: The Sperry-Piltz Ice Accumulation Index, or "SPIA Index". The below categories of damages are based upon combinations of precipitation totals, temperatures and wind/speeds/directions (SPIA, 2009).	
ICE DAMAGE INDEX	DAMAGE AND IMPACT DISCRIPTIONS
0	Minimal risk of dame to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
2	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
3	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1-5 days
4	Prolonged and widespread utility interruptions with extensive damage to main distribution feeder lines and some high voltage transmission lines/structures. Outages lasting 5-10 days.
5	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.

4.4.2. Coastal Flooding

According to the Virginia Hazards Mitigation Plan coastal flooding occurs when strong onshore winds push water from an ocean, bay or inlet onto the land. In addition, coastal areas experience flooding from overland flow, ponding and inadequate storm water drainage. Coastal flooding may arise from tropical cyclones (hurricanes and tropical storms) or Nor'easters (extra tropical storms).

Flooding is the most frequent and costly natural hazard in the United States - besides fire. Nearly 90% of Presidential Disaster Declarations result from natural events where flooding is a major component. Excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto adjacent floodplains and other low-lying land adjacent to rivers, lakes, ponds and the Chesapeake Bay. Based on data

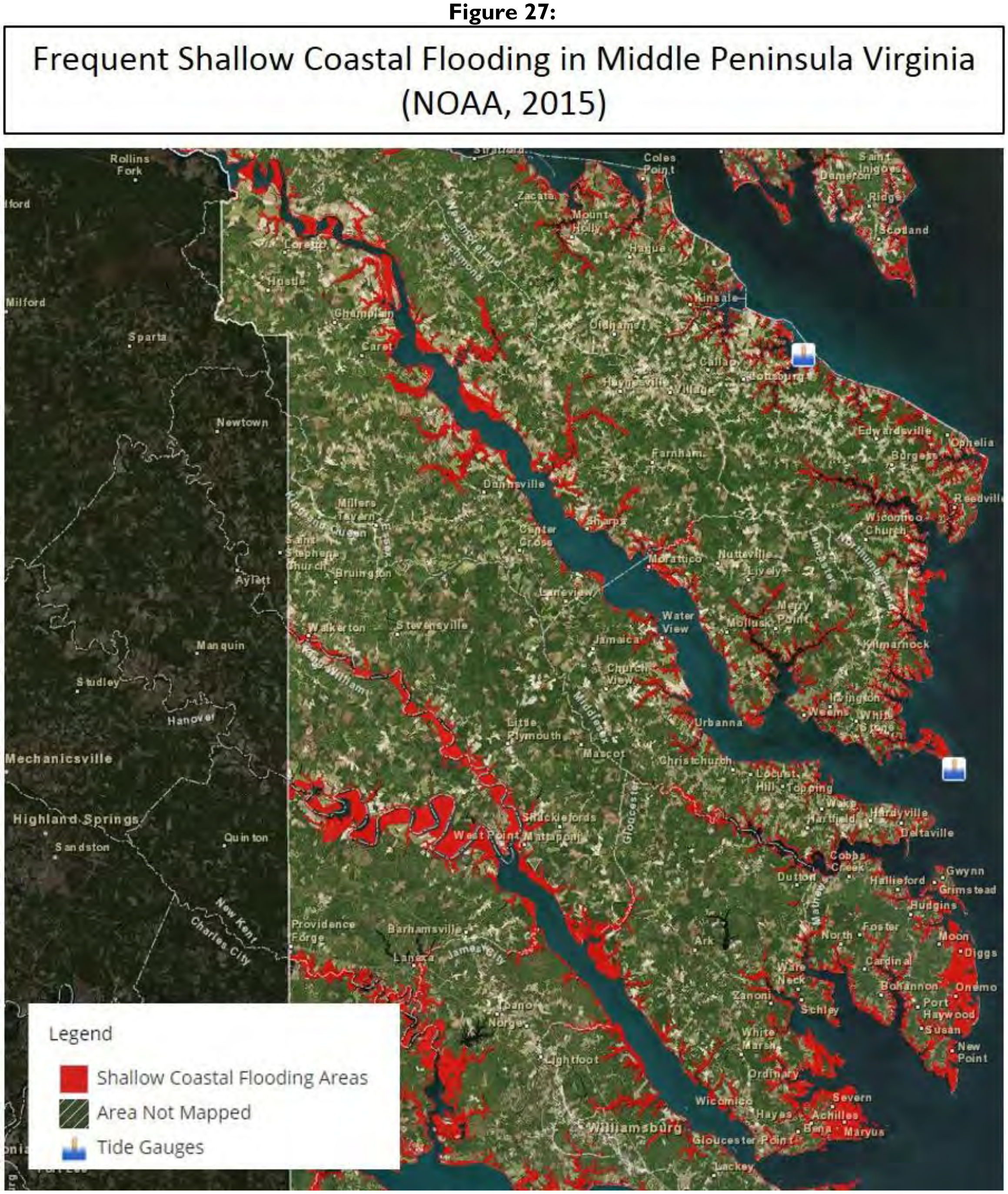
Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall. These conditions are produced by hurricanes during the summer and fall, and nor'easters and other large coastal storms during the winter and spring. Storm surges may overrun barrier islands and push sea water up coastal rivers and inlets, blocking the downstream flow of inland runoff.

Coastal Flooding Vulnerability

Thousands of acres of crops and forest lands may be inundated by both saltwater and freshwater. Escape routes, particularly from barrier islands, may be cut off quickly, stranding residents in flooded areas and hampering rescue efforts. Coastal flooding is very dangerous and causes the most severe damage where large waves are driven inland by the wind. These wind driven waves destroy houses, wash away protective dunes, and erode the soil so that the ground level can be lowered by several feet. Because of the coastal nature of the Middle Peninsula, the region is very susceptible to this type of flooding and resulting damage.

Based on NOAA's Coastal Management Digital Coast Database frequent shallow flooding occurs in the Middle Peninsula region. As many coastal areas experience periodic mini-to-moderate shallow coastal flooding events – typically as result of meteorological factors that include high tides, winds, and rain. Figure 27 is a map of the Middle Peninsula showing the areas impacting the coastal areas. One can see that there is varying degree of impact amongst Middle Peninsula localities.

Figure 27:



Coastal Flooding Extent (Impacts)
To help identify coastal flooding, FEMA will conduct engineering studies referred to as Flood Insurance Studies (FISs). Using the information gathered in these studies, FEMA engineers and cartographers delineate Special Flood Hazard Areas (SFHAs) on flood maps. SFHA are subject to inundation by a flood that has a 1-percent or greater chance of being equaled or exceeded in any given year. This type of flood is commonly referred to as the 100-year flood or base flood. A 100-year flood is not a flood that occurs every 100 years. In fact, the 100-year flood has a 26 percent chance of occurring during a 30 year period, the length of many mortgages. The 100- year flood is a regulatory standard used by Federal agencies and most states, to administer floodplain management programs. The 100-year flood is also used by the NFIP as the basis for insurance requirements nationwide. The FEMA Special Flood Hazard Area designations area associated with the probability of flooding (Table 18):

4.4.3. Lightning

Virginia averages 35 to 45 thunderstorm days per year statewide (Watson, 2001). Thunderstorms are generally beneficial because they provide needed rain for crops, plants, and reservoirs. Thunderstorms can occur any day of the year and at any time of the day, but are most common in the late afternoon and evening during the summer months. About five percent of thunderstorms become severe and can produce tornadoes, large hail, damaging downburst winds, and heavy rains causing flash floods. Thunderstorm can develop in less than 30 minutes, allowing little time for warning. All thunderstorms produce lightning, which can be deadly. The NWS does not issue warnings for ordinary thunderstorms nor for lightning. The NWS does highlight the potential for thunderstorms in the daily forecasts and statements. The VDEM suggests that the public be alert to the signs of changing weather, such as darkening skies, a sudden wind shift, and drop in temperature, and having a warning device such as NOAA Weather Radio.

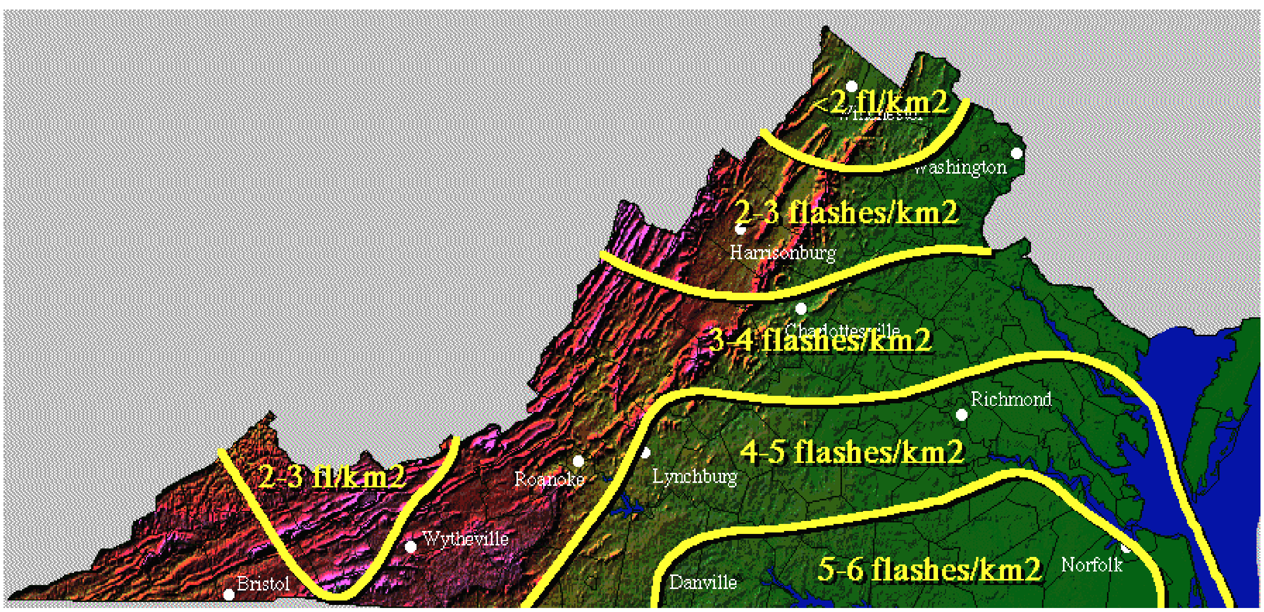


Figure 28: Lightning Flash Density Map *computed for 1989 (Electric Power Institute) (University of Virginia Climatology Office, 1989).*

Lightning can strike up to 10 to 15 miles from the rain portion of the storm. The lightning bolt originates from the upper part of the thunderstorm cloud known as the anvil. A thunderstorm can grow up to 8 miles into the atmosphere where the strong winds aloft spread the top of the thunderstorm cloud out into an anvil. The anvil can spread many miles from the rain portion of the storm but it is still a part of that storm. Lightning, from the anvil, may strike several miles in advance of the rain. Lightning bolts may also come from the side or back of the storm, striking after the rain and storm have seemed to pass, or hitting areas that were totally missed by the rain.

Lightning Vulnerability
Between 1959 and 2014, lightning killed 66 people in Virginia and from 1959 to 1994 has injured at least 238 people. Many additional injuries from lightning go unreported or are not captured by NWS data collection techniques. Nationally, from 1959 through 2014, there have been 4049 deaths due to lightning. Most deaths were males between the ages of 20 and 40 years old who were caught outdoors on fishing, camping, boating or farming /ranching. A national network of 114 lightning ground stroke detectors was put in place by the Electric Power Research Institute (EPRI), a private organization, that serves the needs of power companies and other subscribers interested in lightning across the country (Virginia Climate Advisory, 1992). These detectors sense the characteristic electromagnetic impulses of cloud-to-ground lightning strikes that occur up to several hundred kilometers away. Then, by using triangulation techniques, the network is able to describe the location of every ground strike that it detects in the continental U.S. (Figure 28). It's important to realize that the contours on the map are very general and because accurate, long term records of lightning strikes do not exist, the illustration may not be representative of long-term patterns. Historic data shows that the Middle Peninsula is at a low risk of suffering damages from lightning and thunderstorms, yet it is important to note that thunderstorms and lightning can be very dangerous and can accompany hurricanes and other severe weather events.

Although lightning can be dangerous and/or life threatening, it is hard to generate specific mitigation strategies for this potential natural hazard other than a general public awareness/education campaign associated with thunderstorm/lightning activity.

4.4.4. Hurricanes

Hurricanes are cyclonic storms that originate in tropical ocean waters. Most hurricanes develop in an area 300 miles on either side of the equator. Hurricanes are heat engines, fueled by the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, sufficiently warm sea surface temperature, a rotational force resulting from the spinning of the earth and the absence of wind shear in the lowest 50,000 feet of the earth's atmosphere.

Hurricanes that impact Virginia form in the so-called Atlantic Basin - from the west coast of Africa towards the Caribbean Sea and Gulf of Mexico. Hurricanes in this basin generally form between June 1 and November 30 – with a peak around mid-September. In an average season, there are about 10 named tropical storms in the Atlantic Basin with 6 of these likely to develop into hurricanes. The busiest hurricane season in the 20th century was in 1933, which saw 21 hurricanes/tropical storms. Two of these storms hit the Tidewater Region and caused significant devastation in the Middle Peninsula - known as the "Chesapeake-Potomac Hurricanes of 1933". By contrast, the 1914 season saw no hurricanes and only one tropical storm.

As a hurricane develops, barometric pressure at its center falls and winds increase. A weather system with winds at or exceeding 39 mph is designated as a tropical storm, which is given a name and closely monitored by the NOAA National Hurricane Center in Miami, Florida. When winds are at or exceed 74 mph, the tropical storm is deemed to be a hurricane. Hurricane intensity is measured using the Saffir-Simpson Scale, ranging from a Category 1 (minimal) to a Category 5 (catastrophic) hurricane.
The scale categorizes the intensity of hurricanes using a linear method based upon maximum sustained winds, minimum barometric pressure and storm surge potential, which are combined to estimate the potential flooding and damage to property given a hurricane's estimated intensity. See the table below for greater details on the characteristics of Category 1 thru Category 5 hurricanes.

Hurricane Vulnerability

Hurricanes have the greatest potential to inflict damage as they cross the coastline from the ocean, which is called landfall. Because hurricanes derive their strength from warm ocean waters, they are generally subject to deterioration once they make landfall. The forward momentum of a hurricane can vary from just a few miles per hour to 40 mph. This forward motion, combined with a counterclockwise surface air flow, makes the right front quadrant of the hurricane the location of the most potentially damaging winds.

Hurricanes have the potential to spawn dangerous tornadoes. The excessive rainfall and strong winds can also cause flash floods, flooding and abnormal rises in sea levels known as storm surges. Although a hurricane may cause a tremendous amount of wind and water damage, the accompanying storm surge is much more dangerous to life and property in coastal regions. The storm surge is a great dome of water typically 50 miles wide that comes sweeping across the coastline near the area where the eye of the hurricane makes landfall. This storm surge, aided by the hammering effect of breaking waves, acts like a giant bulldozer as it sweeps everything in its path. The stronger the hurricane, the higher and more dangerous the storm surge will be. Nine out of ten hurricane fatalities are caused by the storm surge.

The vulnerability will vary amongst localities within the Middle Peninsula. In particular, as Gloucester and Mathews County are located within the Chesapeake Bay Carter, and therefore these lower lying areas of the region will be the most vulnerability. Also, generally, as hurricane hit land the storm is slowed therefore those coastal areas of the region will be at most risk. However secondary impacts may be experienced inland and in upland counties (i.e. King William, King & Queen, and Essex Counties).

Hurricane Extent (Impact)

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 categorization based on the hurricane's intensity at the indicated time. The scale – originally developed by wind engineer Herb Saffir and meteorologist Bob Simpson – has been an excellent tool for alerting the public about the possible impacts of various intensity hurricanes. The scale provides examples of the type of damage and impacts in the United States associated with winds of the indicated intensity. In general, damage rises by about a factor of four for every category increase.

Category One Hurricane

Very dangerous winds will produce some damage

(Sustained winds 74-95 mph, 64-82 kt, or 119-153 km/hr)

People, livestock, and pets struck by flying or falling debris could be injured or killed. Older (mainly pre-1994 construction) mobile homes could be destroyed, especially if they are not anchored properly as they tend to shift or roll off their foundations. Newer mobile homes that are anchored properly can sustain damage involving the removal of shingle or metal roof coverings, and loss of vinyl siding, as well as damage to carports, sunrooms, or lanais. Some poorly constructed frame homes can experience major damage, involving loss of the roof covering and damage to gable ends as well as the removal of porch coverings and awnings. Unprotected windows may break if struck by flying debris. Masonry chimneys can be toppled. Well-constructed frame homes could have damage to roof shingles, vinyl siding, soffit panels, and gutters. Failure of aluminum, screened-in, swimming pool enclosures can occur. Some apartment building and shopping center roof coverings could be partially removed. Industrial buildings can lose roofing and siding especially from windward corners, rakes, and eaves. Failures to overhead doors and unprotected windows will be common. Windows in high-rise buildings can be broken by flying debris. Falling and broken glass will pose a significant danger even after the storm. There will be occasional damage to commercial signage, fences, and canopies. Large branches of trees will snap and shallow rooted trees can be toppled. Extensive damage to power lines and poles will likely result in power outages that could last a few to several days. Hurricane Dolly (2008) is an example of a hurricane that brought Category 1 winds and impacts to South Padre Island, Texas.

Category Two Hurricane
Extremely dangerous winds will cause extensive damage
(Sustained winds 96-110 mph, 83-95 kt, or 154-177 km/hr)
There is a substantial risk of injury or death to people, livestock, and pets due to flying and falling debris. Older (mainly pre-1994 construction) mobile homes have a very high chance of being destroyed and the flying debris generated can shred nearby mobile homes. Newer mobile homes can also be destroyed. Poorly constructed frame homes have a high chance of having their roof structures removed especially if they are not anchored properly. Unprotected windows will have a high probability of being broken by flying debris. Well-constructed frame homes could sustain major roof and siding damage. Failure of aluminum, screened-in, swimming pool enclosures will be common. There will be a substantial percentage of roof and siding damage to apartment buildings and industrial buildings. Unreinforced masonry walls can collapse. Windows in high-rise buildings can be broken by flying debris. Falling and broken glass will pose a significant danger even after the storm. Commercial signage, fences, and canopies will be damaged and often destroyed. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. Potable water could become scarce as filtration systems begin to fail. Hurricane Frances (2004) is an example of a hurricane that brought Category 2 winds and impacts to coastal portions of Port St. Lucie, Florida with Category 1 conditions experienced elsewhere in the city.

Category Three Hurricane
Devastating damage will occur
(Sustained winds 111-130 mph, 96-113 kt, or 178-209 km/hr)
There is a high risk of injury or death to people, livestock, and pets due to flying and falling debris. Nearly all older (pre-1994) mobile homes will be destroyed. Most newer mobile homes will sustain severe damage with potential for complete roof failure and wall collapse. Poorly constructed frame homes can be destroyed by the removal of the roof and exterior walls. Unprotected windows will be broken by flying debris. Well-built frame homes can experience major damage involving the removal of roof decking and gable ends. There will be a high percentage of roof covering and siding damage to apartment buildings and industrial buildings. Isolated structural damage to wood or steel framing can occur. Complete failure of older metal buildings is possible, and older unreinforced masonry buildings can collapse. Numerous windows will be blown out of high-rise buildings resulting in falling glass, which will pose a threat for days to weeks after the storm. Most commercial signage, fences, and canopies will be destroyed. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to a few weeks after the storm passes. Hurricane Sandy (2012) is an example of a hurricane that brought Category 3 winds and impacts to coastal portions of Cuba, but it downgraded to a Category 2 storm off the coast of the Northeast.

Category Four Hurricane
Catastrophic damage will occur
(Sustained winds 131-155 mph, 114-135 kt, or 210-249 km/hr)
There is a very high risk of injury or death to people, livestock, and pets due to flying and falling debris. Nearly all older (pre-1994) mobile homes will be destroyed. A high percentage of newer mobile homes also will be destroyed. Poorly constructed homes can sustain complete collapse of all walls as well as the loss of the roof structure. Well-built homes also can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Extensive damage to roof

coverings, windows, and doors will occur. Large amounts of windborne debris will be lofted into the air. Windborne debris damage will break most unprotected windows and penetrate some protected windows. There will be a high percentage of structural damage to the top floors of apartment buildings. Steel frames in older industrial buildings can collapse. There will be a high percentage of collapse to older unreinforced masonry buildings. Most windows will be blown out of high-rise buildings resulting in falling glass, which will pose a threat for days to weeks after the storm. Nearly all commercial signage, fences, and canopies will be destroyed. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Long-term water shortages will increase human suffering. Most of the area will be uninhabitable for weeks or months. Hurricane Charley (2004) is an example of a hurricane that brought Category 4 winds and impacts to coastal portions of Punta Gorda, Florida with Category 3 conditions experienced elsewhere in the city.

Category Five Hurricane
Catastrophic damage will occur
(Sustained winds greater than 155 mph, greater than 135 kt, or greater than 249 km/hr)
People, livestock, and pets are at very high risk of injury or death from flying or falling debris, even if indoors in mobile homes or framed homes. Almost complete destruction of all mobile homes will occur, regardless of age or construction. A high percentage of frame homes will be destroyed, with total roof failure and wall collapse. Extensive damage to roof covers, windows, and doors will occur. Large amounts of windborne debris will be lofted into the air. Windborne debris damage will occur to nearly all unprotected windows and many protected windows. Significant damage to wood roof commercial buildings will occur due to loss of roof sheathing. Complete collapse of many older metal buildings can occur. Most unreinforced masonry walls will fail which can lead to the collapse of the buildings. A high percentage of industrial buildings and low-rise apartment buildings will be destroyed. Nearly all windows will be blown out of high-rise buildings resulting in falling glass, which will pose a threat for days to weeks after the storm. Nearly all commercial signage, fences, and canopies will be destroyed. Nearly all trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Long-term water shortages will increase human suffering. Most of the area will be uninhabitable for weeks or months. Hurricane Andrew (1992) is an example of a hurricane that brought Category 5 winds and impacts to coastal portions of Cutler Ridge, Florida with Category 4 conditions experienced elsewhere in south Miami-Dade County

Hurricane Isabel in 2003 was one of Virginia's costliest disasters, causing widespread devastation and disrupting the lives of thousands of citizens – including those living in the Middle Peninsula. This deadly storm was a Category 2 hurricane when it made landfall between Cape Lookout and Cape Hatteras on North Carolina's Outer Banks on Thursday, September 18, 2003. By the time it reached Virginia, it was downgraded to a Category 1 hurricane. Even though the storm followed a path west of the City of Richmond, Isabel's destructive effects were felt throughout Tidewater Virginia and the entire Mid-Atlantic Region.

Hampton Roads remained in the right front quadrant through most of the storm's landfall, which helped to push the storm surge into many inland areas along the rivers. Property damage resulting from the 4 to 12-foot storm surge was extensive in many parts of the region. Homes, bulkheads and piers were damaged and the winds resulted in significant damage to properties and power lines. Rainfall totaled between 2 and 11 inches along the storm's track. Trees, especially those with shallow root systems, were blown over. Damages due to wind, rain, and storm surge resulted in flooding, electrical outages, piles of debris, transportation interruptions and damaged homes/businesses. Many citizens were without power for several days - with others in remote locations of the Middle Peninsula without power for up to three weeks.

Statewide losses to residential property were estimated to exceed $590 million and businesses reported over $84 million in losses. Thirty-two deaths were directly or indirectly attributed to this storm in Virginia. One of these deaths was in Gloucester County when an individual died of a heart attack after their vehicle was swept up in high water. Hurricane Isabel is considered one of the most significant tropical cyclones to affect portions of northeastern North Carolina and east-central Virginia since Hurricane Hazel in 1954 and the Chesapeake-Potomac Hurricane of 1933 (Beven and Cobb, 2004).

Although Virginia was spared a direct hit, the hurricane season of 2004 may be the costliest on record in the United States. Fifteen tropical or subtropical storms formed in the North Atlantic. Nine of these storms become hurricanes with six becoming major hurricanes of Category 3 or higher on the Safflir-Simpson Hurricane Scale. Six of the hurricanes, Alex, Charley, Frances, Gaston, Ivan and Jeanne, and three tropical storms struck the United States in 2004. The strongest hurricane was Ivan, which reached Category 5 status. Ivan was directly blamed from 26 deaths and damage estimates were $13 billion in the United States.

With 4 hurricanes and tropical storms hitting the United States in a 5-week period, 2004 has been labeled as the year of the hurricane according to leading experts who participated in a Center for Health and the Global Environment briefing at Harvard Medical School (Compass Publications, Inc. 2004). They report that the intense period of destructive weather may be a harbinger of what is to come. Hurricanes have been on the increase over the past decade as part of a natural multi-decadal cycle (Ananthaswamy, 2003). These storms are more likely to form when the Atlantic is warm, as it was from the 1930s to the 1960s.

Although the decades since the 1960s have seen fewer hurricanes, numbers have risen since 1995 and may not have reached the predicted peak yet. There is growing evidence and concern that tropical storms will be more intense and pronounced as future climate changes are expected to persist.

By virtue of its position along the Atlantic Ocean and near the Gulf Stream, southeastern Virginia is frequently impacted by hurricanes. 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. However, the recorded history of significant tropical storms that affected the area goes back much further.

Prior to 1871, very early storms have been described 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 in the "*Chronology of Middle Peninsula Hazard Events.*"

Since 1953, Atlantic tropical storms have been named from lists originated by the National Hurricane Center. The lists featured only women's names until 1979, after which male and female names were included in the lists for both the Atlantic and Gulf of Mexico storms. Whenever a hurricane has had a major impact, any country affected by the storm can request that the name of the hurricane be "retired" by agreement of the World Meteorological Organization (WMO). Retiring a name actually means that it cannot be reused for at least 10 years, to facilitate historic references, legal actions, insurance claim activities, etc. and to avoid public confusion with another storm of the same name. Retired names for storms that hit the Tidewater Region include Agnes (1972), Cleo (1964), David (1979), Donna (1960), Floyd (1999), Fran (1996), Gloria (1985), Gracie (1959), Hazel (1954), and Isabel (2003) (NOAA Atlantic Oceanographic and Meteorological Laboratory, Hurricane Research Division).

Middle Peninsula Storm Surge Hazard Maps

In order to estimate the geographic extent of potential damage from these hurricanes, a review of the 2008 Middle Peninsula Storm Surge Hazard Maps show the worst case scenario of hurricane storm surge inundation at mean tide. Figures 29- 32 are maps developed by the U.S. Corp of Engineers in conjunction with the VDEM as part of their 2008 Virginia Hurricane Evacuation Study.

Due to the nature of the study, only Mathews, Gloucester and Middlesex Counties in the Middle Peninsula were included since they are considered coastal counties that suffer greatly from tidal surge impacts and therefore have impacts for evacuating residents from low-lying areas. Although the limits of the study only included the lower half of our region, it should be noted that all of the Middle Peninsula localities experienced storm surges during the latest severe storm - Hurricane Isabel in September 2003.

The data reflects only still salt water flooding. Freshwater flooding may also occur with hurricane events from heavy rainfall runoff, and waves may accompany the surge and cause further inundation. The maps represent the surge from Category 1 through 4 hurricanes. State and federal officials do not include storm surges from a Category 5 hurricane since they do not believe that the ocean water temperature off of the Virginia Coast is warm enough for such an intense storm.

Figures 21 through 24 summarize surge height estimates using the SLOSH (Sea, Lake, and Overland Surges from Hurricane) Model. The model was developed by Chester Jelesnianski of the NOAA, NWS. The storm surge computations and analysis were conducted by the Storm Surge Group of the National Hurricane Center.

The SLOSH model was used to develop data for various combinations of hurricane strength, wind speed, and direction of movement. Hurricane strength was modeled by use of central pressure (defined as the difference between the ambient sea level pressure and the minimum value in the storm's center), the storm eye size, and the radius of maximum winds (using four of the five categories of each hurricane intensity as depicted in the Saffir-Simpson Hurricane Scale). The modeling for each hurricane category was done using the mid-range wind speed for that category. Six storm track headings (WNW, NW, NNW, N, NNE, NE) were selected as being representative of storm behavior in the Virginia region, based on observations by forecasters at the National Hurricane Center. Additional inputs into the model included depths of water offshore, the heights of the terrain and onshore barriers.

Figure 29: Storm Surge Inundation Map of Middlesex, Gloucester, and Mathews Counties (VDEM, 2014).

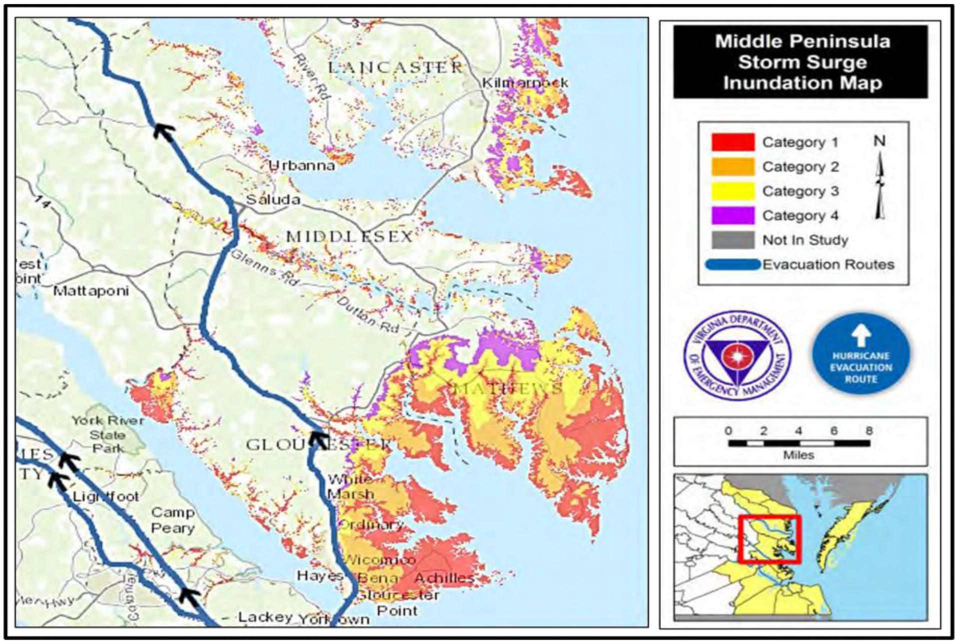


Figure 30: Storm Surge Inundation Map *of Middlesex County (VDEM, 2014).*

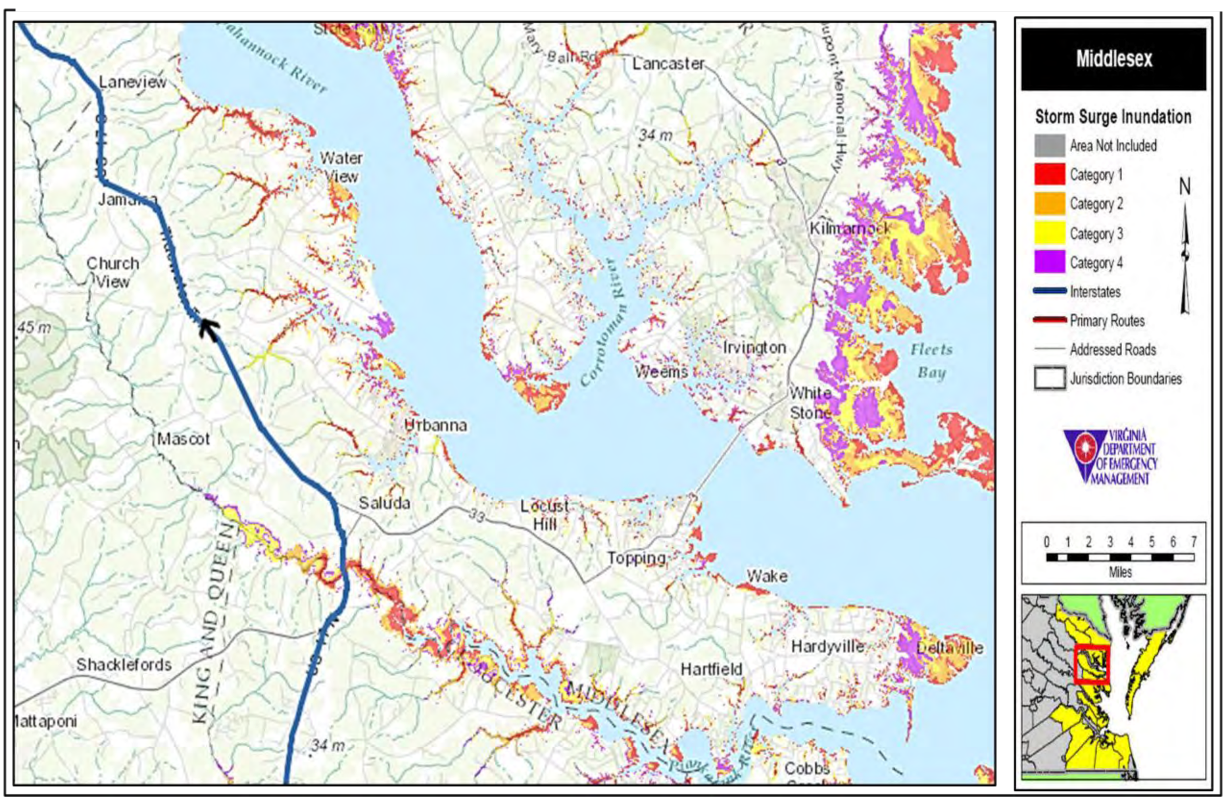


Figure 31: Storm Surge Inundation Map *of Mathews County (VDEM, 2014).*

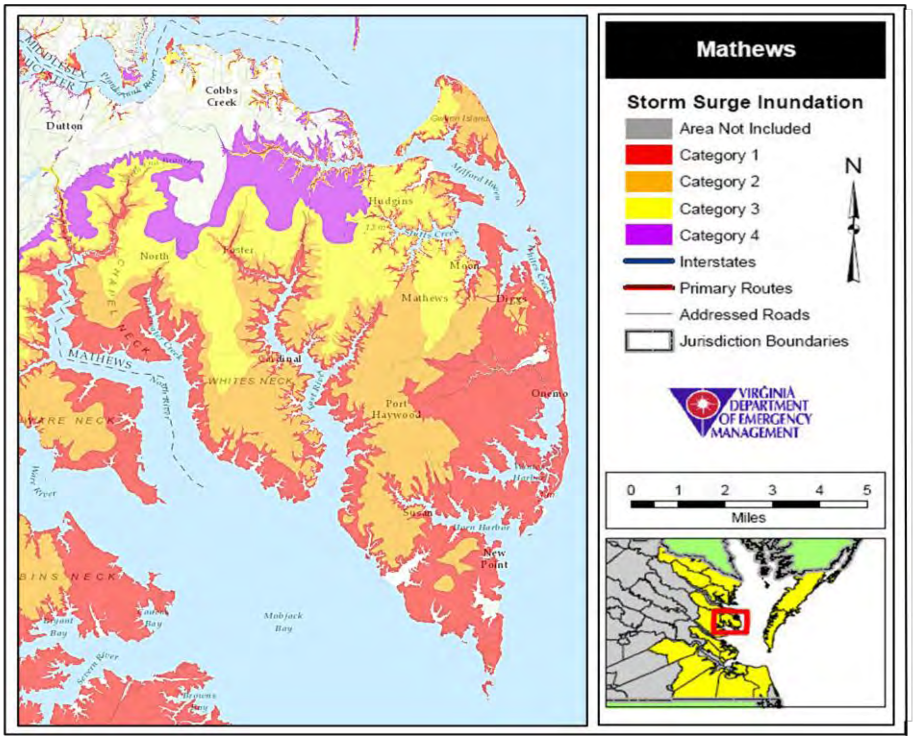
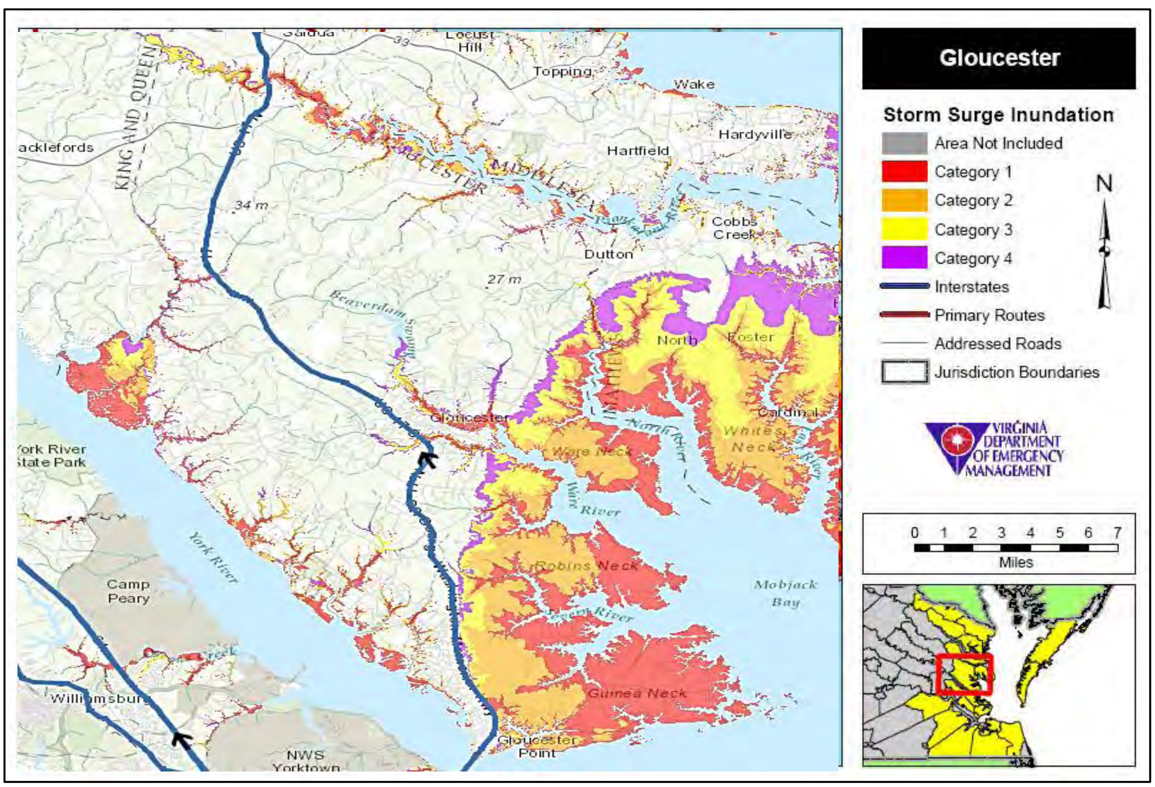


Figure 32: Storm Surge Inundation Map *of Gloucester County (VDEM, 2014).*



Historical Occurrences
In evaluating localized threats of hurricanes and tropical storms to the Middle Peninsula Region, NOAA hurricane tracking data from 1851 to 2014 was analyzed to identify storms that may have posed a threat to the region.

Based on these data, 43 storms - including hurricanes, tropical storms and tropical depressions - passed within 25 nautical miles of the Middle Peninsula Region. Of these storms 2 were hurricanes, 22 were tropical storms, 8 were tropical depressions, and 11 were extra-tropical storms (Table 23). Over the same period of time, 60 storms passed within 50 nautical miles of the region, including 4 hurricanes, 31 tropical storms, 11 tropical and subtropical depressions, and 14 extra-tropical storms (Table 23).

Table 23: Historic Storm Tracks within 50 and 25 nautical mile radii of the Middle Peninsula between 1851 and 2014.

Type of Storm	Quantity passing within 50 nm	Quantity passing within 25 nm
Hurricane – Category 5 (winds >155 mph)	0	0
Hurricane – Category 4 (winds 131-155 mph)	0	0
Hurricane – Category 3 (winds 111-130 mph)	0	0
Hurricane – Category 2 (winds 96-110 mph)	1	1
Hurricane – Category 1 (winds 74-95 mph)	3	1
Tropical Storm (winds 39-73 mph)	31	22
Tropical Depression (winds <38 mph)	10	8
Subtropical Storm (winds 39-73 mph)	0	0
Subtropical Depression (winds <38 mph)	1	0
Extra-tropical Storm (winds <39 mph)	14	11
Total:	**60**	**43**

General Chronology of Middle Peninsula Coastal Storm Hazard Events
Because of its proximity to the Atlantic Coast and Chesapeake Bay, the Middle Peninsula has been impacted by coastal storms throughout recorded history, and therefore it is not surprising that hurricanes, coastal flooding, nor'easters, and coastal/shoreline erosion were among the top ranked hazards affecting the Middle Peninsula Region as ranked by the Regional Risk Assessment and Mitigation Planning Committee in 2005 and re-affirmed by the Middle Peninsula Flood Mitigation Plan Team Members in 2009.

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. Historical records are invaluable to researchers trying to understand long-term patterns in the frequency and intensity of coastal storms and such data on storms and weather go back a long time in Virginia, thanks to record keeping by early weather observers such as George Washington, James Madison and Thomas Jefferson as well as journals/articles written by early settlers. The following is a brief synopsis of the major coastal storm events that have impacted the Middle Peninsula Region.

From 1564 to 1799
Hurricanes played an important role during the European exploration and colonization of the Americas. Great storms that besieged Virginia influenced the establishment of new settlements and changed the coastal geography, particularly on the Middle Peninsula. While official weather records did not begin until 1871 in Norfolk, tremendous coastal storms were often recorded through the shipwrecks they induced and in the writings of the early Virginia colonists.

The records of hurricane and tropical storm occurrences during this era are sparse compared to modern-day accounts, since the colonies were not settled until the early 1600's. The original settlers at Jamestown experienced the wrath of such storms firsthand and it is suggested that the lost colony of Roanoke Island may have been doomed by a coastal storm. The first such storm to be recorded occurred in 1564. Others followed in June 1566, June 1586, August 1587, and August 1591. A September 1667 storm, deemed the "Dreadful Hurry Cane of 1667", destroyed thousands of homes in Virginia (Brinkley, 1999). Twelve days of rain was said to have followed this storm, causing the Chesapeake Bay to rise 12 feet. This storm and a July 1788 hurricane may have followed a similar track as the 1933 hurricane, which caused massive devastation to the Middle Peninsula.

The October Hurricane of 1749 was a great disaster for Virginians. It formed Willoughby Spit in Norfolk and put the city streets of Hampton 4 feet below water. The Bay was said to have risen 15 feet above normal, destroying waterfront buildings (Ludlum, 1963). At least 50 vessels were driven ashore along the Virginia coast, with a loss of 22 lives. Damage in and around the city of Norfolk was estimated to be at least 30,000 Virginia Pounds (approximately $3 million in today's currency – Brinkley, 1999).

The September 8, 1769 hurricane, considered one of the worst storms of the eighteenth century, passed over Williamsburg. Damage was "inconceivable" and crops were destroyed. Many old homes and trees were leveled. Heavy rain ruined tobacco crops and flooded roads. Tobacco in storage warehouses was also damaged. Heavy damage was seen in Chesapeake Bay. High winds tore off the top of a wharf at Yorktown and 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 (Roth and Cobb, 2001).

"The Independence Hurricane" of September 1775 ravaged the coast between Currituck, N.C. and Chincoteague on the Eastern Shore. Wharves and storehouses on the waterfront of Norfolk were devastated. Raging waters carried bridges away. At Williamsburg, mill-dams broke and corn stalks were blown flat. Many ships were damaged as they were thrown ashore at Norfolk, Hampton, and York. A full blockade of Hampton Roads thereafter brought shipping to a halt for three months. At least 25 died due to a shipwreck. On September 9, 1775, a Williamsburg correspondent of the Virginia Gazette wrote, "The shocking accounts of damage done by the rains last week are numerous; most of the mill-dams are broke, the corn laid almost level with the ground, and fodder destroyed; many ships and other vessels drove ashore and damaged at Norfolk, Hampton, and York. The death toll in Virginia and North Carolina was 163 lives (Roth and Cobb, 2001).

A strong gale played a role in a battle between the Royal Governor of Virginia, Dunmore, and General Lewis of the rebel forces on July 10, 1776. The royal fleet had been injured prior to the storm by General Lewis' forces and was sailing from Gwynn's Island (Mathews County) 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 (Roth and Cobb, 2001).

On October 16, 1781, a storm of "unknown character" struck Virginia. The French Fleet and the Patriot Army, under the command of George Washington, trapped the Earl of Cornwallis at Yorktown. 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 (Roth and Cobb, 2001).

The "most tremendous gale of wind known in this country" passed over the Lower Chesapeake Bay September 22-24, 1785 and went along a track very similar to the Chesapeake-Potomac Hurricane of 1933 and likely severely impacted the Middle Peninsula. 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. Vessels floated inland into cornfields and wooded areas (Roth and Cobb, 2001).

"George Washington's Hurricane" of July 23-24, 1788, made landfall in Virginia and 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 23rd 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, and leveling corn." In addition, large trees were uprooted and houses were moved from their foundations. Port Royal (Caroline County) and Hobb's Hole (Essex County) experienced a violent northeast gale, which drove several vessels ashore. In Fredericksburg, great quantities of corn, tobacco, and fruit were destroyed. Houses and trees fell in great numbers across Northumberland, Lancaster, Richmond and Westmoreland Counties on the Northern Neck. 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 and several inhabitants drowned. Gloucester County was inundated, and an estimated $400,000 (in 1788 dollars) in damage was incurred (Roth and Cobb, 2001).

1800-1899

Great Coastal Hurricane of 1806 (August 23) caught British and French ships off guard, while engaged in the Napoleanic 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. 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 at Hampton Roads. A seawall built to prevent further erosion at Smith Point lighthouse at the mouth of the Potomac River was damaged (Roth and Cobb, 2001).

A severe coastal storm dropped heavy rains on the Fredericksburg area in January 1863. It rained for 30 hours, dropping more than twelve inches, making mud so deep that mules and horses died attempting to move equipment. The rivers became too high and swift to cross, disrupting the Union Army offensive operation in the ill-famed "Mud March" (Watson and Sammler, 2004).

The Gale of '78 was one of the most severe hurricanes to affect eastern Virginia in the latter half of the 19th century and struck on October 23, 1878. This hurricane moved rapidly northward from the Bahamas on October 22nd and struck the North Carolina coast later 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. Cobb and Smith Islands on the Eastern Shore were completely submerged during this storm (Roth and Cobb, 2001).

A September 1882 tropical storm, the "protracted and destructive rain storm", swept away four mills near Ware's Wharf along the lower Rappahannock. The brunt of the cyclone only extended fifty miles inland. Heavy rains were also seen at Washington, D.C. (Roth and Cobb, 2001).

During an April 1889 Nor'easter, the Tidewater Region had sustained winds from the north of 75 mph measured at Hampton Roads and 105 mph at Cape Henry. Tides at Norfolk reached 8.37 feet above Mean Low Water, which is over 4 feet above flood stage level (Watson and Sammler, 2004).

Noteworthy hurricanes or tropical storms also occurred in September 1821 (one of the most violent on record for the 19th century), June 1825, August 1837, September 1846 (which formed Hatteras and Oregon

Inlets in North Carolina), August 1850, September 1856, September 1876, August 1879, October 1887, August 1893, September 1894, October 1897 (tides in Norfolk rose 8.1 feet above Mean Lower Low Water), and October 1899 (tide in Norfolk rose 8.9 feet above Mean Lower Low Water).

From 1900 to 1999

A number of coastal storms hit the Tidewater Region in the early part of the 20th century. Hurricanes and tropical storms in October 1903, August 1924, September 1924, August 1926, and September 1928 each brought high winds (in excess of 70 mph measured in Norfolk and in Cape Henry). The 1903 and 1928 storms also raised tides as much as 9 feet and 7 feet, respectively, higher than normal in the region (Roth and Cobb, 2001).

The summer of 1933 was the most active storm season for eastern Virginia in the 20th century. Two hurricanes, one on August 23 and one on September 16, struck the North Carolina and Virginia coasts and caused much devastation on the Middle Peninsula. In Chesapeake lore, the "Storm of '33" is recalled by older residents and enshrined in legend as the worst storm in memory (Mountford, 2003). The August storm brought winds in excess of 80 mph and a storm surge that forced the tide nearly 10 feet above normal.

The September storm struck the area 24 days later and had sustained winds as high as 88 mph (measured at the Naval Air Station in Norfolk) and the tide reached 8.3 feet above Mean Lower Low Water (Roth and Cobb, 2001). Much of the land around the New Point Comfort lighthouse, the third oldest light on the Bay located at the entrance to Mobjack Bay and the mouth of the York River in Mathews County, was washed away and caused the lighthouse to be stranded on a very small island a few 100 yards from the tip of the mainland.

Hurricane Hazel hit eastern Virginia on October 15, 1954. This storm brought with it gusts of 100 mph which is the highest wind speed record at the Norfolk Airport location. A reliable instrument in Hampton recorded 130 mph winds (Roth and Cobb, 2001).
A severe nor'easter gave gale force winds (40+ mph) and unusually high tides to the Tidewater Virginia area on April 11, 1956. At Norfolk, the strongest wind gust was 70 mph. The strong northeast winds blew for almost 30 hours and pushed up the tide, which reached 4.6 feet above normal in Hampton Roads. Thousands of homes were flooded by the wind-driven high water and damages were huge. Two ships were driven aground. Waterfront fires were fanned by the high winds. The flooded streets made access by firefighters very difficult, which added to the losses (Watson and Sammler, 2004).

The "Ash Wednesday Storm" hit Virginia during "Spring Tide" (sun and moon phase to produce a higher than normal tide) on March 5-9, 1962. The storm moved north off the coast past Virginia Beach and then reversed its course moving again to the south and bringing with it higher tides and higher waves which battered the coast for several days. The storm's center was 500 miles off the Virginia Capes when water reached 9 feet at Norfolk and 7 feet on the coast. Huge waves toppled houses into the ocean and broke through Virginia Beach's concrete boardwalk and sea wall. Houses on the Middle Peninsula also saw extensive tidal flooding and wave damage. The beaches and shorefront had severe erosion (Watson and Sammler, 2004).

Hurricane Cleo in September 1964 produced the heaviest coastal rainfall in the area (11.40 inches in 24 hours) since records began in 1871 (Roth and Cobb, 2001).

Hurricane Agnes was downgraded to a tropical depression by the time it moved into Virginia in June 1972, but the rainfall produced by Agnes made this storm more than twice as destructive as any previous hurricane in the history of the United States (Roth and Cobb, 2001).

In July 1996, Hurricane Bertha passed over portions of Suffolk and Newport News. Bertha spawned 4 tornadoes across east-central Virginia. The strongest, an F1 tornado, moved over Northumberland County injuring 9 persons and causing damages of several million dollars. Other tornadoes moved over Smithfield, Gloucester and Hampton (Roth and Cobb, 2001).

In September 1999, Hurricane Floyd produced 10 to 20 inches of rain on saturated ground and resulted in a recorded 500-year flood for Franklin, VA. While North Carolina and southeastern Virginia were hit with the brunt of this storm, significant damage from downed trees and localized flooding occurred and all of the counties of the Middle Peninsula were included in the Federal Disaster Declaration (FEMA FEMA-1293-DR, Virginia).

From 2000 to 2009

Hurricane Isabel hit the coasts of North Carolina and Virginia on September 18, 2003. It was a Category 1 hurricane when it made landfall. The highest sustained wind was 72 mph at Chesapeake Light. Storm surge varied significantly across the region. At Sewell's Point in Norfolk, the maximum water level was 7.9 feet above MLW. This represented a 5-foot storm surge - the biggest in the region since Hurricane Hazel in 1954. Thirty six deaths were attributed to Hurricane Isabel in Virginia, including one in Gloucester County. Total damages for the Hampton Roads area amounted to $506 million.

In 2004, Tropical Storm Gaston caused serious damage to a handful of VDOT Secondary Roads in the Central Garage/Manquin sections of King William County.

In 2006, Tropical Storm Ernesto caused residential and roadway flooding damage as well as beach erosion damage in Mathews County.

There were an additional 5 named tropical events during this period to hit the Middle Peninsula region resulting in minor severe weather damage.

In 2009 Middle Peninsula coastal localities experienced a significant Nor-Easter with high winds and coastal flooding.

From 2010-2015

Hurricane Irene was hit the coast of North Carolina and had impacts on the Virginia coastal on August 26-27, 2011. Heavy rain, including some totals more than 10 inches, fell on eastern sections of Virginia. Irene lashed the eastern third of Virginia with tropical storm and isolated hurricane force gusts.

In early September 2011, the remand of Tropical storm Lee produced flash flooding in some sections of eastern Virginia, with the Washington, DC, suburbs particularly hard hit.

Hurricane Sandy ate season hurricane that passed off the Mid Atlantic coast, before turning west, and striking the New Jersey & New York coast on October 29, 2012. Sandy was a very large storm that was transitioning from a tropical to a non-tropical storm as it moved north paralleling the U.S. East coast during the October 27-29 time frame. Sandy's impact was relatively small in Virginia, with very heavy rainfall and some flooding the biggest impacts. The most significant impact was felt on the DELMARVA, especially on the east side of the Chesapeake Bay from Salisbury, MD southward to Onancock, VA, where severe coastal flooding and storm surge inundated many areas, as Sandy passed by to the north. Crisfield, MD and Saxis, VA were hardest hit, with millions of dollars in damage to homes and businesses. Damage and flooding were worse than that which occurred in the same area during Hurricane Floyd (1999).

On record for the 2014 season, eight name tropical or subtropical storms formed in the North Atlantic. Six of these became hurricanes and two of these reached major hurricanes of Category 3 or higher on the Saffir-Simpson Hurricane Scale. Six of the hurricanes, Arthur, Bertha, Cristobal, Edouard, Fay, Gonzalo and Hanna, and one tropical storm struck the United States. According to the NWS, activity in the basin in 2-14 was only about 63% of the 1981-2010 average.

Soil Erosion

Hurricanes and nor'easters produce severe winds and storm surges that create significant soil erosion along rivers and streams in the Middle Peninsula. In addition to the loss of soil along these water bodies, there is damage to man-made shoreline hardening structures such as bulkheads and rap-rap as well as to piers, docks, boat houses and boats due to significant storm surges.

These damages are more severe along the broad open bodies of water on major rivers located closer to the Chesapeake Bay. In general terms, the damage is less intense as you move up the watershed from the southeastern area of the region towards the northwestern end of the Middle Peninsula. Therefore, the soil erosion would is most severe in Mathews, Gloucester and Middlesex Counties and to a lesser degree in the 3 remaining Middle Peninsula Counties of King and Queen, King William and Essex Counties.

The location and the angle at which these hurricanes/nor'easters come ashore region can significantly affect the amount of soil erosion during a particular storm. It can generally be said that hurricane generated soil erosion is uneven in occurrence and that the storm surge affords 2 opportunities for erosion – once as water inundates low-lying amount coast lands and again as floodwaters ebb.

For example with Hurricane Isabel in 2003, its enormous wind field tracked in a north-northwest direction to the west of the Chesapeake Bay with the right front quadrant blowing from the south-southeast. This pushed the storm surge up the Bay and piling it into the western shore – causing serious soil erosion to the eastern land masses in Mathews, Gloucester and Middlesex Counties.

Destructive as it was, Hurricane Isabel might have been worse. If it had been stronger at landfill, the storm surge generated in the Chesapeake Bay may have been higher. Had it stalled along its path and lingered through several tide cycles, prolonged surge conditions, exacerbated by high winds, might have cause more severe erosion. If rainfall has been higher, bank erosion due to slope failure might have been more common, particularly given the wetter than normal months that preceded Hurricane Isabel.

Middle Peninsula Resources at Potential Risk of Loss

Floodplain Properties and Structures

While floodplain boundaries are officially mapped by FEMA's National Flood Insurance Program (NFIP), flood waters sometimes go beyond the mapped floodplains and/or change courses due to natural processes (e.g., accretion, erosion, sedimentation, etc.) or human development (e.g., filling in floodplain or floodway areas, increased imperviousness areas within the watershed from new development, or debris blockages from vegetation, cars, travel trailers, mobile homes and propane tanks).

Since the floodplains in the United States are home to over 9 million households and there continues to be a high demand for residential and commercial development along water features, most property damage results from inundation by sediment and debris-filled water. Flooding is one of the most significant hazards faced by the Middle Peninsula. A majority of the flooding that has damaging effects on the region is tidal flooding, which primarily occurs in conjunction with severe coastal storms such as hurricanes or nor'easters.

In addition to tidal flooding, some regions of the Middle Peninsula are subject to flooding events induced by rain associated with a hurricane or a tropical storm, which can produce extreme amounts of rainfall in short periods of time. In August 2004, Tropical Storm Gaston dumped 14 inches of rain in a matter of hours on King William County, washing out numerous roads and bridges. This storm qualified the county for disaster aid through a Presidential Disaster Declaration.

Flooding of vacant land or land that does not have a direct effect on people or the economy is generally not considered a problem. Flood problems arise when floodwaters cover developed areas, locations of economic importance, infrastructure or any other critical facility. Low-lying land areas of Essex, Gloucester, Mathews, and Middlesex Counties and the lower reaches of King and Queen and King William Counties are highly susceptible to flooding, primarily from coastal storm when combined with tidal surges.

These flood-prone regions include marsh areas adjacent to waterways, and the wide, flat outlets where its streams and rivers meet the Chesapeake Bay and its tributaries. Fluctuations in the surrounding water levels produce a mean tidal range of approximately 3 feet. The timing or coincidence of maximum surge-producing forces with the normal high tide is an important factor in consideration of flooding from tidal sources. Strong winds from the east or southeast can push Chesapeake Bay water into the mouth of the York and Rappahannock Rivers and Mobjack Bay – thereby flooding lower portions of the Middle Peninsula. This surge combined with the normal high tide can increase the mean water level by 15 feet or more.

The Flood Insurance Rate Maps (FIRMs) show flooding during a 100-year storm event or, in other words, the storm that has a 1% chance of being equaled or exceeded in any given year. The FIRMs account for both coastal surge driven flooding, as well as flooding generated from rain events. The 1% annual-chance-flood (or the 100-year flood as it is commonly referred to) represents a magnitude and frequency that has a statistical probability of being equaled or exceeded in any given year. Another way of looking at it is that the 100-year flood has a 26% (or a 1 in 4) chance of occurring over the life of a 30-year mortgage on a home (FEMA, 2002).

Along with nearly 20,000 communities across the country, all of the localities in the Middle Peninsula voluntarily participate in the National Flood Insurance Program by adopting and enforcing floodplain management ordinances in order to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities (FEMA, 2002).

The U.S. Congress established the National Flood Insurance Program (NFIP) with the passage of the National Flood Insurance Act of 1968. Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage is reduced by nearly $1 billion a year by communities implementing sound floodplain management requirements and property owners purchasing flood insurance.

Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80% less damage annually than those not built in compliance with these standards. It is estimated that for every $3 paid in flood insurance claims, there is $1 spent in disaster assistance payments (FEMA, 2002).

Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for local floodplain management programs and to provide flood insurance actuarial rates for new construction (FEMA, 2002).
Floodplain maps covering the Middle Peninsula Region have recently been updated. FEMA produced these new digital maps in the following years:

2015
Essex County
Middlesex County

2014
Gloucester County
Mathews County

2013
King & Queen County
King William County

The recently completed digital floodplain maps/data can be integrated into the GIS of those Middle Peninsula localities that utilize GIS technology.

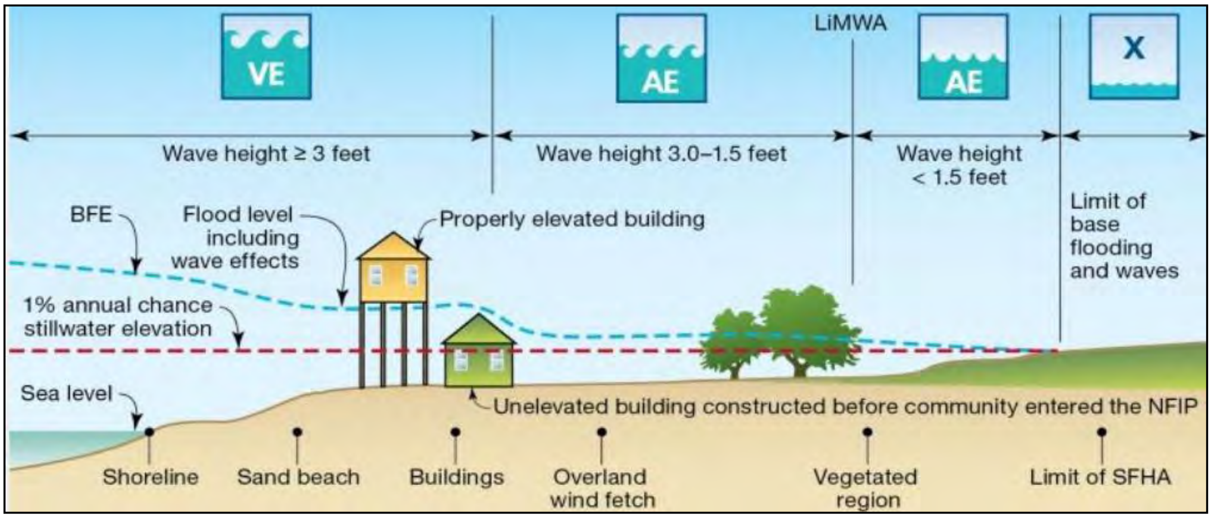
In recent years, FEMA has comprehensively analyzed Region III's coastal flood hazard and integrated the lasted topographic data sets with state-of-the-art storm modeling techniques (FEMAI, 2015). This new information replaces maps and studies that are based on data and modeling technology from as far back as the 1970's (FEMA, 2015). With this new data and technology, new FIRMs have been generated. The FIRMs reflect floodplain zones are standardized to the 100-year flood and assigned an area called the Special Flood Hazard Area (SFHA). A SFHA is a high-risk area defined as any land that would be inundated by a flood having a 1-percent chance of occurring in any given year (FEMA, 2002). In the Middle Peninsula, the SFHA includes zones designated as VE, A, Coastal A, AE, AO, X, and X500. Table 24 provides definitions for the zones.

Table 24: FEMA Flood Zone Designations found in the Middle Peninsula Region.	
Zone VE & V	SFHA along coasts subject to inundation by the 100-year flood with additional hazards due to velocity (wave action). Base flood elevations derived from detailed hydraulic analyses are shown within these zones. This delineated flood hazard includes wave heights equal to or greater than three feet. *Mandatory flood insurance purchase requirements apply.*
Zone A	SFHA subject to inundation by the 100-year flood. Because detailed hydraulic analyses have not been performed, no base flood elevation or depths are shown. *Mandatory flood insurance purchase requirements apply.*
Zone AE	SFHA subject to inundation by the 100-year flood determined in a Flood Insurance Study by detailed methods. Base flood elevations are shown within these zones. This delineate flood hazard includes wave heights less than three feet. *Mandatory flood insurance purchase requirements apply.*
Zone AO	SFHA inundated by the 100year flood where flooding is anticipated to average depth of 1 to 3 feet, where a clearly defined channel does not exist, where the path of flooding is unpredictable, and where velocity flow may be evident.
Zone X	These areas have been identified in the Flood Insurance Study as areas of moderate or minimal hazard from the principal source of flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. Local storm water drainage systems are not normally considered in the community's FIS. The failure of a local drainage system creates areas of high flood risk within these rate zones. *Flood insurance is available in participating communities, but is not required by regulation in these zones.*
Zone X500	The same description as Zone X, however, this area falls between the 100 and 500-year flood zone.
UNDES	Undescribed. No information available.

To further assist community official and property owners in recognizing an increased potential for damage due to wave action in the AE zone, FEMA issued guidance in December 2008 on identifying and mapping the 1.5-foot wave high line, referred to as the Limit and Moderate Wave Action (LiMWA) (Figure 33). As

LiMWA addresses the fact that wave action does cease at the AE Zone delineate, a new SFHA has been developed between the VE and AE Zone called Zone Coastal A. Zone Coastal A is landward of a V Zone, or land ward of an open coastal without mapped V Zones. While the Coastal A Zone in not a NFIP mandate, it offers design and construction practice for communities that wish to adopt high floodplain management standards. Within the Middle Peninsula, Gloucester County, Mathews County and the Town of Wet Point are the only locality that has included Coastal A Zone within their FIRMs and floodplain management policy.

Figure 33: Diagram of coastal flood zones (FEMA, 2015).



Under the NFIP regulations, participating NFIP communities are required to regulate all development in the SFHAs. Development is defined as:

> *"any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials."*

Before a property owner can undertake any development in the SFHA, a permit must be obtained from the locality. The locality is responsible for reviewing the proposed development to ensure that it complies with the locality's floodplain management ordinance. Localities are also required to review proposed developments in the SFHAs to ensure that all necessary permits have been received from those governmental agencies from which approval is required by Federal or State law, such as 404 Wetland Permits from the Army Corps of Engineers or permits under the Endangered Species Act.

Under the NFIP, localities must review all new development proposals to ensure that they are reasonably safe from flooding and that the utilities and facilities serving these developments are constructed to minimize or eliminate flood damage.

In general, the NFIP minimum floodplain management regulations require that new construction or substantial improvements to existing buildings in the Zone A must have their lowest floor, including basements, elevated to or above the Base Flood Elevation (BFE). Non-residential structures in Zone A can be either elevated or dry-flood proofed. In Zone V, the building must be elevated on piles/columns and the bottom of the lowest horizontal structural member of the lowest floor of all new construction or substantially improved existing buildings must be elevated to or above the BFE.

When the NFIP was created, the U.S. Congress recognized that insurance for "existing buildings" constructed before a community joined the Program would be prohibitively expensive if the premiums were not subsidized by the Federal Government. Congress also recognized that most of these flood-prone buildings were built by individuals who did not necessarily have sufficient knowledge of the flood hazard to make informed decisions.

Under the NFIP, "existing buildings" are generally referred to as pre-FIRM buildings. These buildings were built before the flood risk was known and identified on the locality's FIRM. Currently, about 26% of the 4.3 million NFIP policies in force are pre-FIRM subsidized policies as compared to 70% of the policies that were being subsidized in 1978 (FEMA, 2002).

Middle Peninsula Flood Insurance Data
According to data from FEMA dated March 31, 2015 there are a total of 4,354 flood insurance policies covering Middle Peninsula properties (Table 25). The following is a summary of flood insurance policy data by locality:

Table 25: Flood Insurance Policies within the Middle Peninsula (FEMA, 2015).			
Locality	**Total Policies**	**# of Claims Since 1978**	**Total Value of Claims**
Essex	229	239	$6,197,534.36
Tappahannock	66	16	$193,571
Gloucester	1693	1339	$30,285,748.62
King & Queen	55	22	$584,113.30
King William	18	8	$158,306.60
West Point	102	76	$2,165,826.96
Mathews	1637	1179	$20,165,826.96
Middlesex	488	225	$2,943,857.77
Urbanna	20	12	$277,744.64
Totals	4308	3116	$62,972,530.21

Table 26: Repetitive Loss Properties in the Middle Peninsula				
County	**# of Properties**	**# of Claims**	**Total Building Claims**	**Average Claim**
Essex	32	82	$1,855,068.89	$22,622.79
Mathews	169	417	$8,252,285.42	$19,789.65
Gloucester	146	384	$3,310,607.84	$21,642.21
Middlesex	35	78	$1,084,995.57	$13,910.20
Town of Urbanna	2	4	$120,595.91	$30,148.98
Town of Tappahannock	2	4	$66,220.74	$16555.19
Town of West Point	9	21	$644,314.91	$30,681.66

According to the Virginia Hazards Mitigation Plan repetitive loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling ten-year period, since 1978 (Table 26). In 2004 the National Flood Insurance Reform Act recognized repetitive loss as a significant and problem and defined severe repetitive loss (SRL) as: "a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000 and with cumulative amount of such claims payments exceeding $20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property. Table 27 show the number of SRL properties within the Middle Peninsula region.

Table 27: Severe Repetitive Loss Properties in the Middle Peninsula.

County	# of Properties	# of Claims	Total Building Payments	Average Pay
Essex	2	9	$142,973.31	$22,884.81
Mathews	11	49	$1,288.909.58	$34,179.62
Gloucester	13	63	$1,857,182.84	$33,028.95
Middlesex	2	6	$157,821.97	$37,271.90

4.4.5. Summer Storms

Summer Storms are weather systems accompanied by strong winds, lightning, heavy rain, and possibly hail and tornadoes. They can occur at any time in the Middle Peninsula of Virginia, although they are most frequent during the warm spring and summer months from April through September. The most common summer storm is the thunderstorm, with the severe thunderstorm with the most potential to cause damage. The potential thunderstorm threat is often measured by the number of "thunderstorm days" – defined as days in which thunderstorms are observed.

Thunderstorms form when a shallow layer of warm, moist air is overrun by a deeper layer of cool, dry air. Cumulonimbus clouds, frequently called "thunderheads," are formed in these conditions. These clouds are often enormous (up to six miles or more across and 40,000 to 50,000 feet high) and may contain tremendous amounts of water and energy. That energy is often released in the form of high winds, excessive rains, lightning, and possibly hail and tornadoes.

Thunderstorms are typically short-lived (often lasting no more than 30-40 minutes) and fast moving (30-50 miles per hour). Strong frontal systems, however, may spawn one squall line after another, composed of many individual thunderstorm cells. Severe thunderstorms may also cause severe flood problems because of the torrential rains that they may bring to an area. Thunderstorms sometimes move very slowly, and can thus dump a tremendous amount of precipitation onto a location. Flooding can result, including flash floods, "urban flooding," and river flooding.

4.5. Locality Specific Critical Facilities and Public Utilities

4.5.1. King and Queen County Critical Facilities and Public Utilities

The County's Courthouse Complex is located in the central portion of the county along the Route 14 ridgeline, which runs in a southeasterly/northwesterly direction. This Complex is the center of county government and contains all county offices. The law enforcement and public safety functions are located in the new courts/administration building, which has a generator that serves these areas of the building during a power outage. This complex is located outside of the 500-year floodplain.

Additional properties that the County owns include 4 solid waste facilities located at 4 different locations in the county and the property that the regional library is located on. All 5 of these properties lie outside of the 500-year floodplain.

There are 4 volunteer fire departments (VFD) and 2 volunteer rescue squads (VRS) located at scattered positions throughout the county. All of these emergency response facilities are located outside the 500-year floodplain.

The County's 3 school sites are all located along the high and dry Route 14/721 corridor. Central High School, located in the King and Queen Courthouse area in the middle portion of the county, is the County's designated shelter due to flooding or any other type of natural disaster.

The Middle Peninsula Regional Airport is located in the southern portion of the county and is owned and operated by a regional authority. The Airport Authority is made up of 4 local governments including King and Queen, King William and Gloucester Counties as well as the Town of West Point. Life-Evac, a medical transport helicopter service, is located at the airport. The airport terminal and runway are located outside the 500-year floodplain.

There are no public water or sewer facilities anywhere in the County - all properties in the County are served by individual wells and septic systems.

Repetitive and Severe Repetitive Loss Residential Structures in King and Queen County
According to FEMA's records, King and Queen County has no Repetitive Loss residential properties or Severe Repetitive Losses as of 5/31/15.

According to VDOT and County officials, flood prone roads in King and Queen County include the following in Table 28.

Table 28: King and Queen County Flood Prone Roads		
Route	**Road Name**	**Location of Flooding**
749	Kays Lane	At Root Swamp
721	Newtown Road	near Bradley Farm Road
721	Newtown Road	near Level Green Road
721	Newtown Road	near Glebe Road
623	Indian Neck Road	near Rappahannock Cultural Center
625	Poplar Hill Road	near Spring Cottage Road
628	Spring Cottage Road	near Eastern View Road
628	Todds Bridge Road	near Gunsmoke Lane
628	Pattie Swamp Road	at swamp
631	Fleets Mill Road	at Fleets Millpond
631	Norwood Road	at Dickeys Swamp
636	Minter Lane	at Walkerton Creek
620	Powcan Road	at Poor House Lane
620	Duck Pond Road	at Garnetts Creek
634	Mt. Elba Road	at flat areas
633	Mantua Road	at Garnetts Creek
617	Exol Road	at Exol Swamp
614	Devils Three Jump Road	Devils Three Jump Road
14	The Trail	at Truhart

613	Dabney Road	At Little Tastine Swamp
611	Tastine Road	At Little Tastine Swamp
603	Lombardy Road	At Little Tastine Swamp
608	Clancie Road	At Bugan Villa Drive
601	Stratton Major Road	Near Union Prospect Baptist Church
601	Stratton Major Road	Near Union Road
644	Jonestown Road	At Meadow Swamp
605	Plain View Lane	At Guthrie Creek
601	Cheery Row Lane	At Guthrie Creek and swamp
666	Tuckers Road	Entire road including Tuckers R.P.
667	Wrights Dock Road	Entire road
640	Lyneville Road	At 36" cross-pipes
625	Bryds Mill	At cross-pipes
615	Union Hope Road	At Exol Swamp
604	Bryds Bridge Road	At Bryds Bridge
612	Lilly Pond Rod	At Dragons Swamp Bridge
610	Dragonville Rod	At Timber Brook Swamp
614	Rock Springs Road	At bridge
14	Buena Vista Road	at K&Q/ Gloucester County line

Public Boat Ramps
There are 2 public boats ramps in the county along the Mattaponi River that are operated/maintained by the Virginia Department of Game and Inland Fisheries (VDGIF):

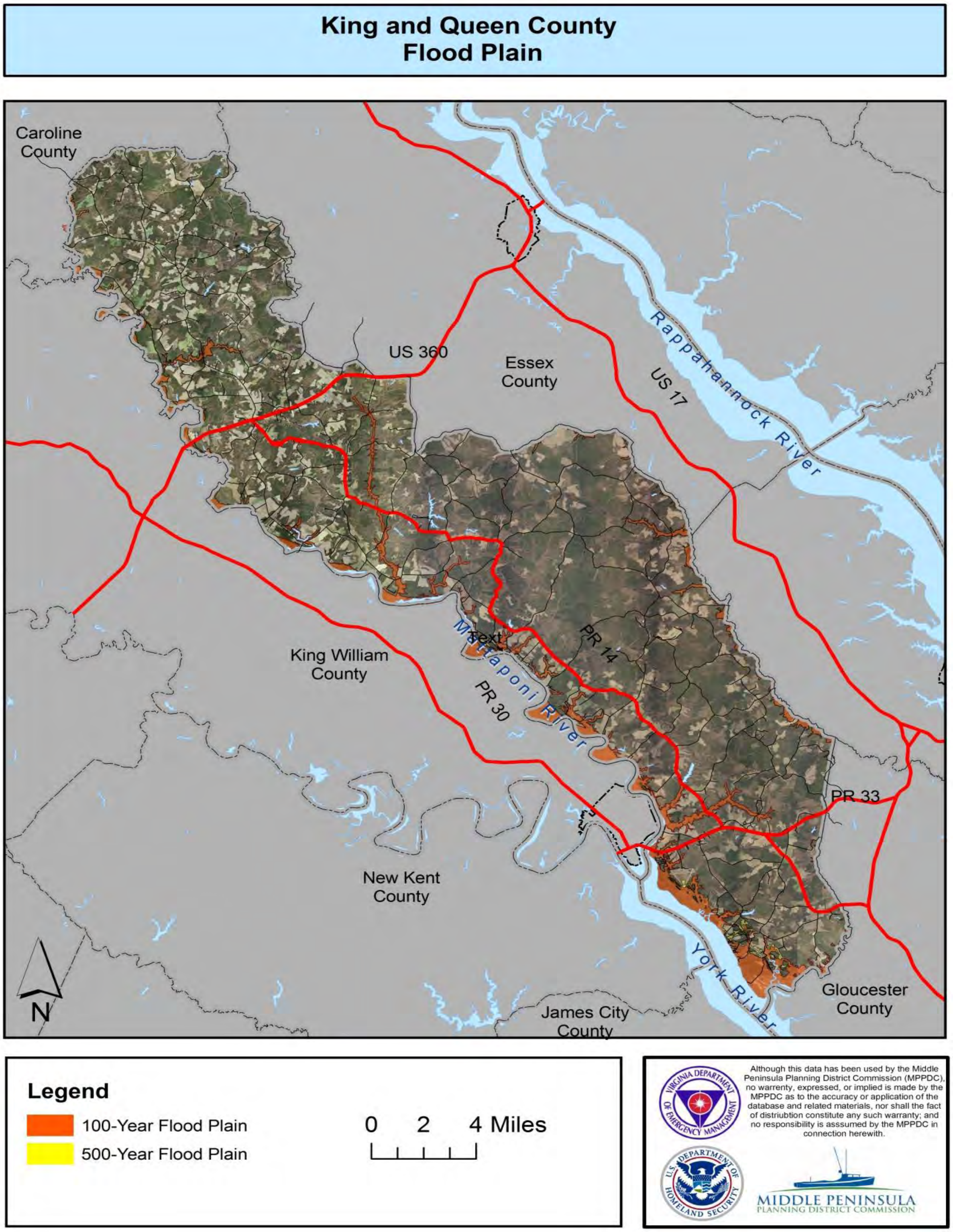
Water Body	Access Area	Barrier Free	Type	Ramps	Latitude	Longitude
Mattaponi River	Melrose	Yes	Concrete Ramp	1	37° 38' 14" N 37.6372145	76° 51' 18"W -76.8549627
Directions: From King & Queen Courthouse, Rt. 14 South (2.8 miles); Right onto Rt 602 (1.2 miles) to Ramp						
Mattaponi River	Waterfence	Yes	Concrete Ramp	1	37° 35' 31" N 37.5920552	76° 47' 55"W -76.7987125
Directions: From West Point, Rt 33 East, turn Left onto SR 14 (5 miles), turn Left onto SC 611 to end						
Virginia Department of Game an Inland Fisheries, 2015						

In addition to the VDGIF sites, there is a water access site to the Mattaponi River in Walkerton. Located at the base of the bridge off Route 629, this site is privately owned; however the owner allows public access upon receipt of a donation for use.

Due to the low velocity of the flood waters along this section of the Mattaponi River, none of these boat landings sustain damage from flood waters.

Properties in the 100-year Floodplain by Census Block Groups
The following series of maps show the location of structures in King and Queen County that are either in Flood Zone A or Flood Zone AE in the100-year flood plain. The map also shows structures in the 500-year plain that are labeled: "0.2% annual chance flood hazard". The legend is color coded to indicate the specific flood zone in which each structure lies.

Figure 34:



King and Queen County
Flood Plain
Caroline County
US 360
Essex County
Rappahannock River
US 17
King William County
Text
River
PR 14
PR 30
PR 33
New Kent County
York River
Gloucester County
James City County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
0 2 4 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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PLANNING DISTRICT COMMISSION

Figure 35:

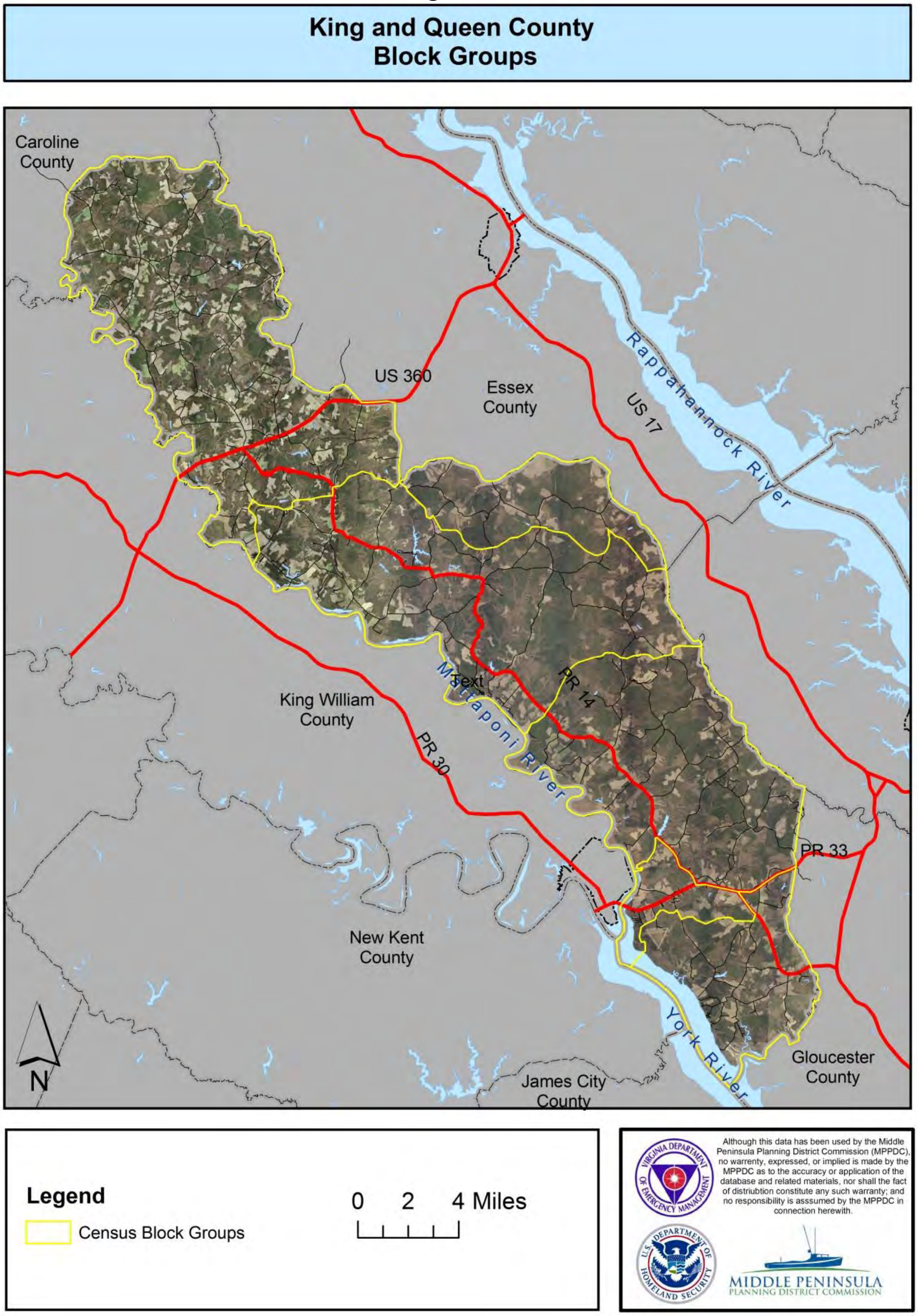
King and Queen County
Block Groups
Caroline County
US 360
Essex County
Rappahannock River
US 17
Mattaponi River
Text
PR 14
King William County
PR 30
PR 33
New Kent County
York River
Gloucester County
James City County
N
Legend
Census Block Groups
0 2 4 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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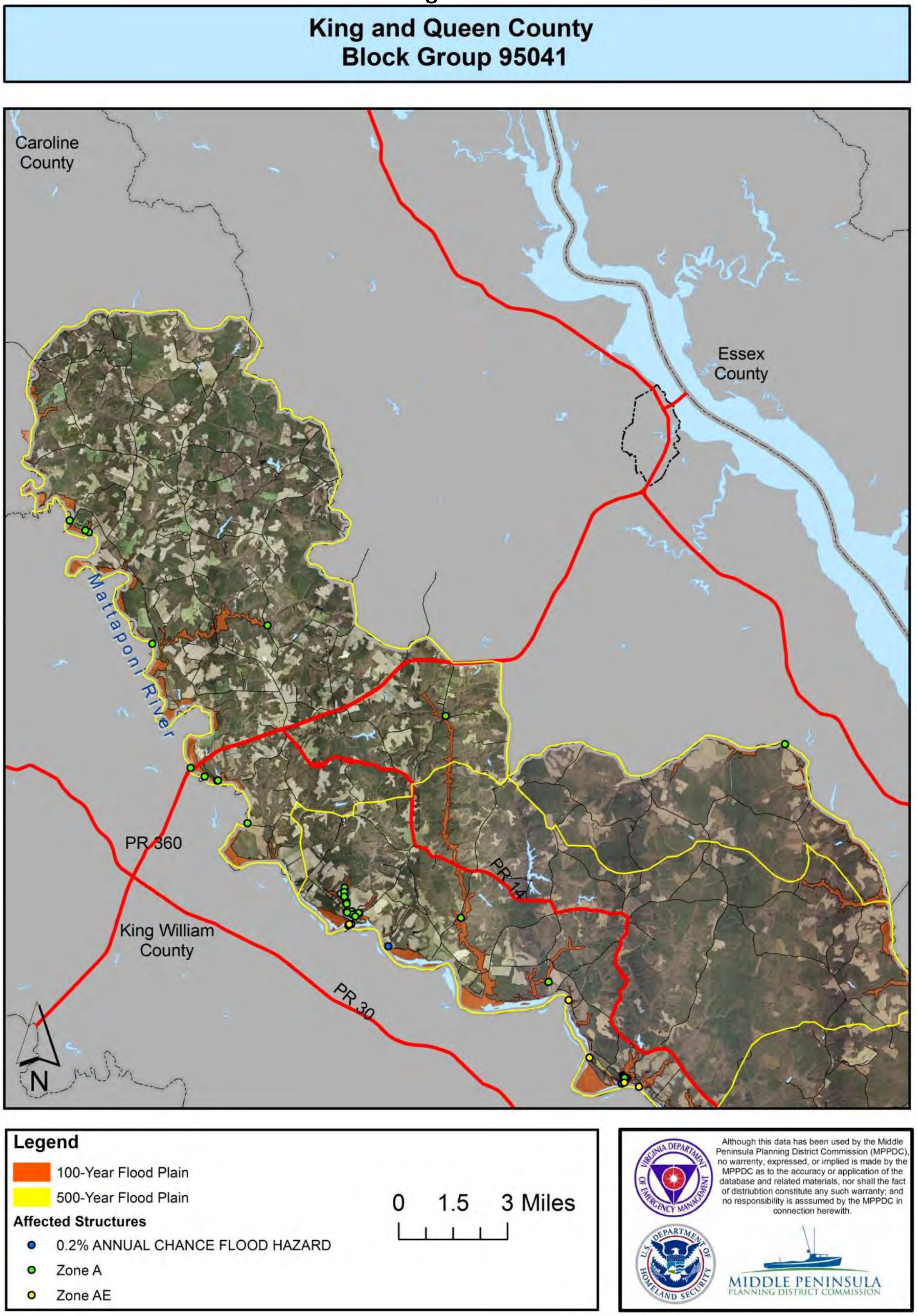
Figure 36:


King and Queen County
Block Group 95041
Caroline County
Essex County
Mattaponi River
PR 360
PR 14
King William County
PR 30
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
0.2% ANNUAL CHANCE FLOOD HAZARD
Zone A
Zone AE
0 1.5 3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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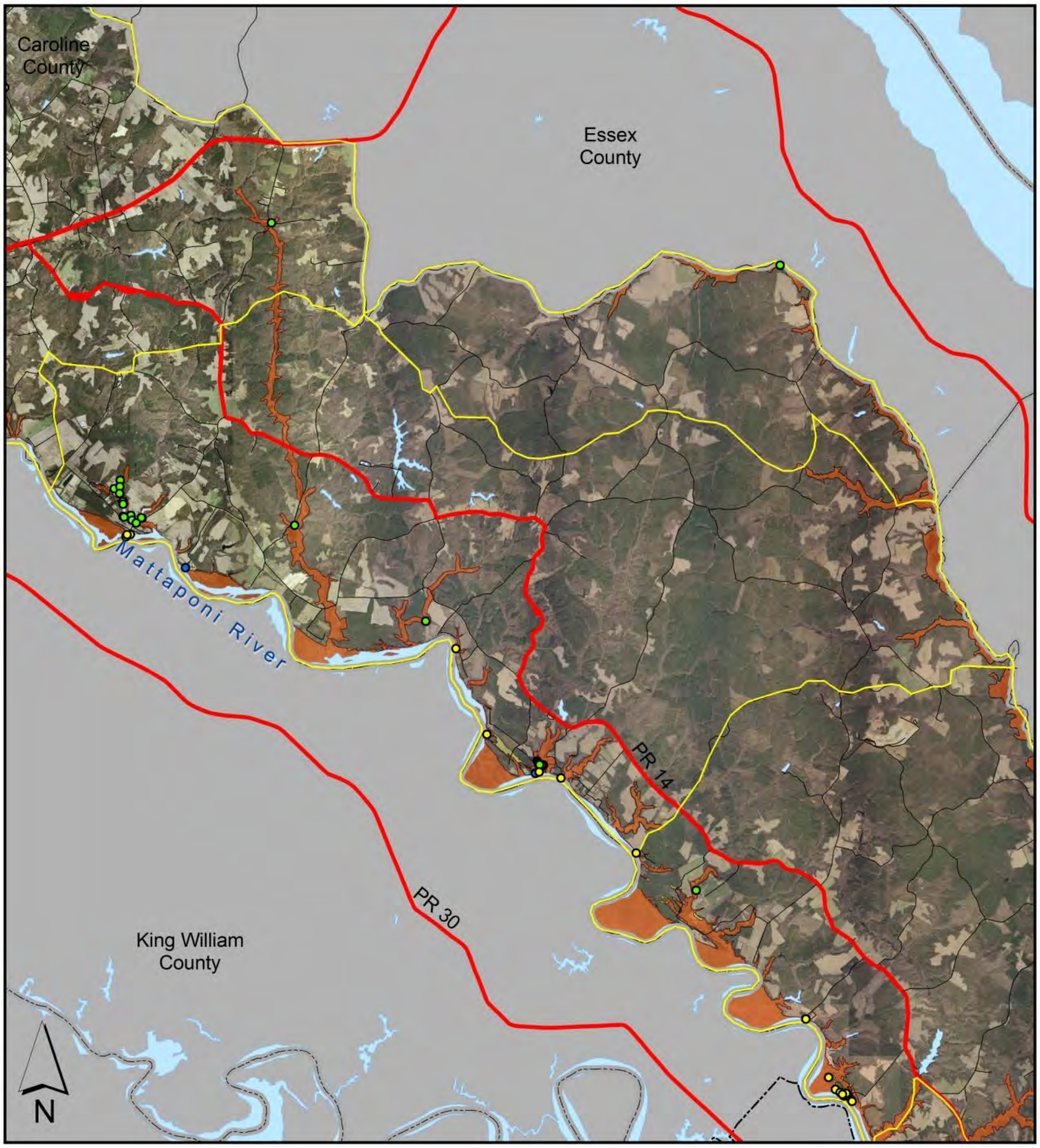
PLANNING DISTRICT COMMISSION

Figure 37:

King and Queen County
Block Group 95042



Legend

- 100-Year Flood Plain
- 500-Year Flood Plain

Affected Structures

- 0.2% ANNUAL CHANCE FLOOD HAZARD
- Zone A
- Zone AE

0 1.25 2.5 Miles

Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warranty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.

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Figure 38:

King and Queen County
Block Group 95051

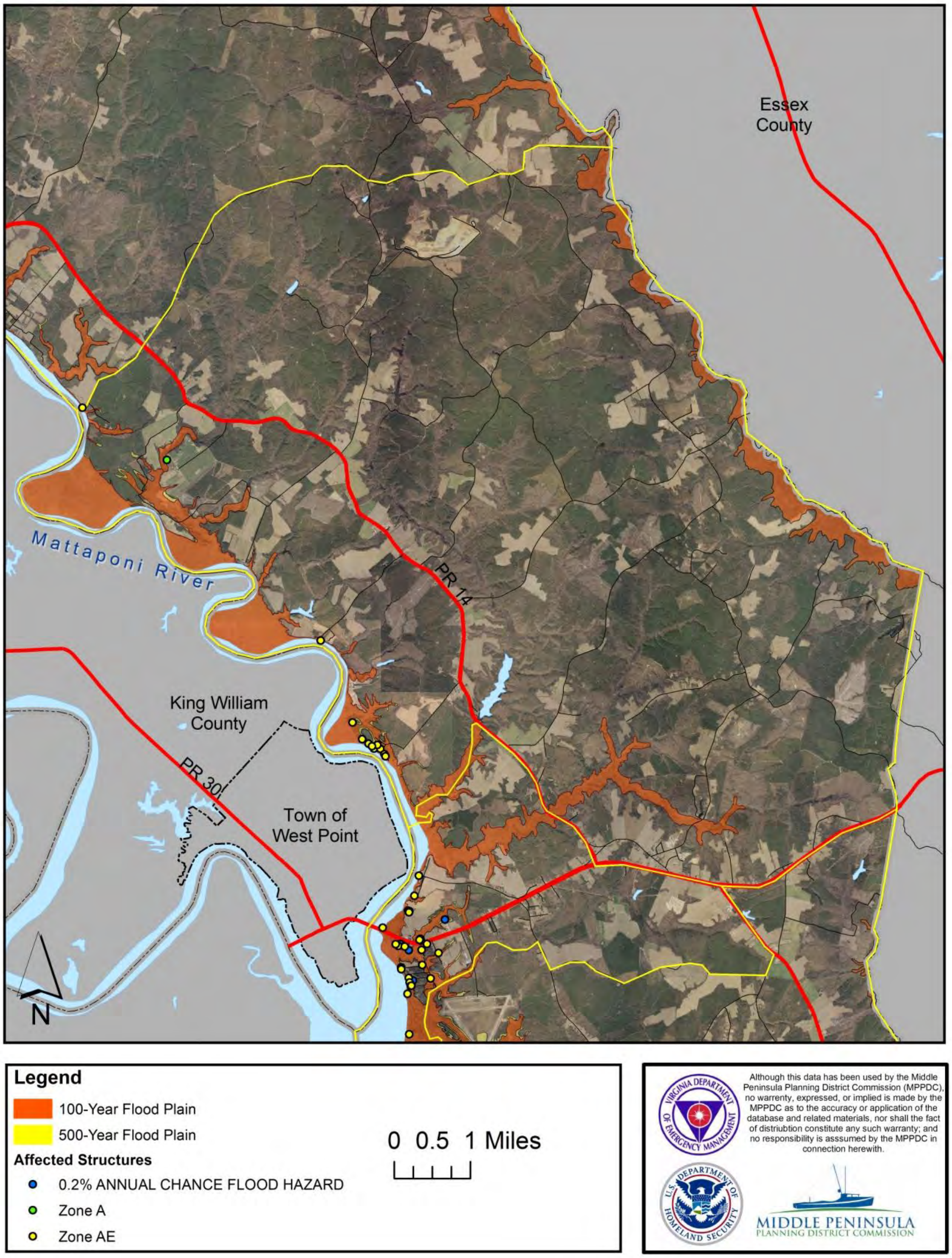

Figure 39:

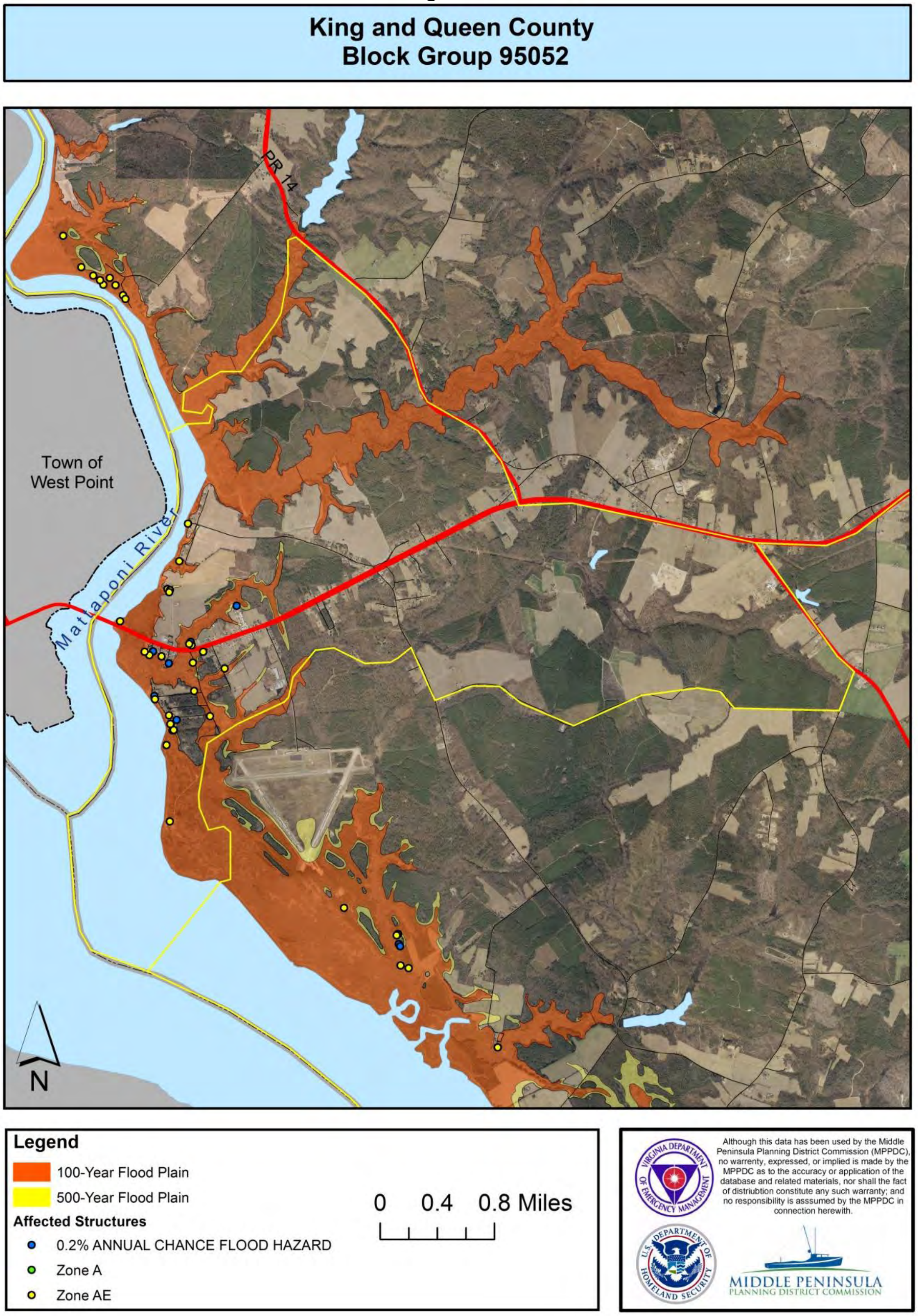
King and Queen County
Block Group 95052
PR 14
Town of
West Point
Mattaponi River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
0.2% ANNUAL CHANCE FLOOD HAZARD
Zone A
Zone AE
0 0.4 0.8 Miles
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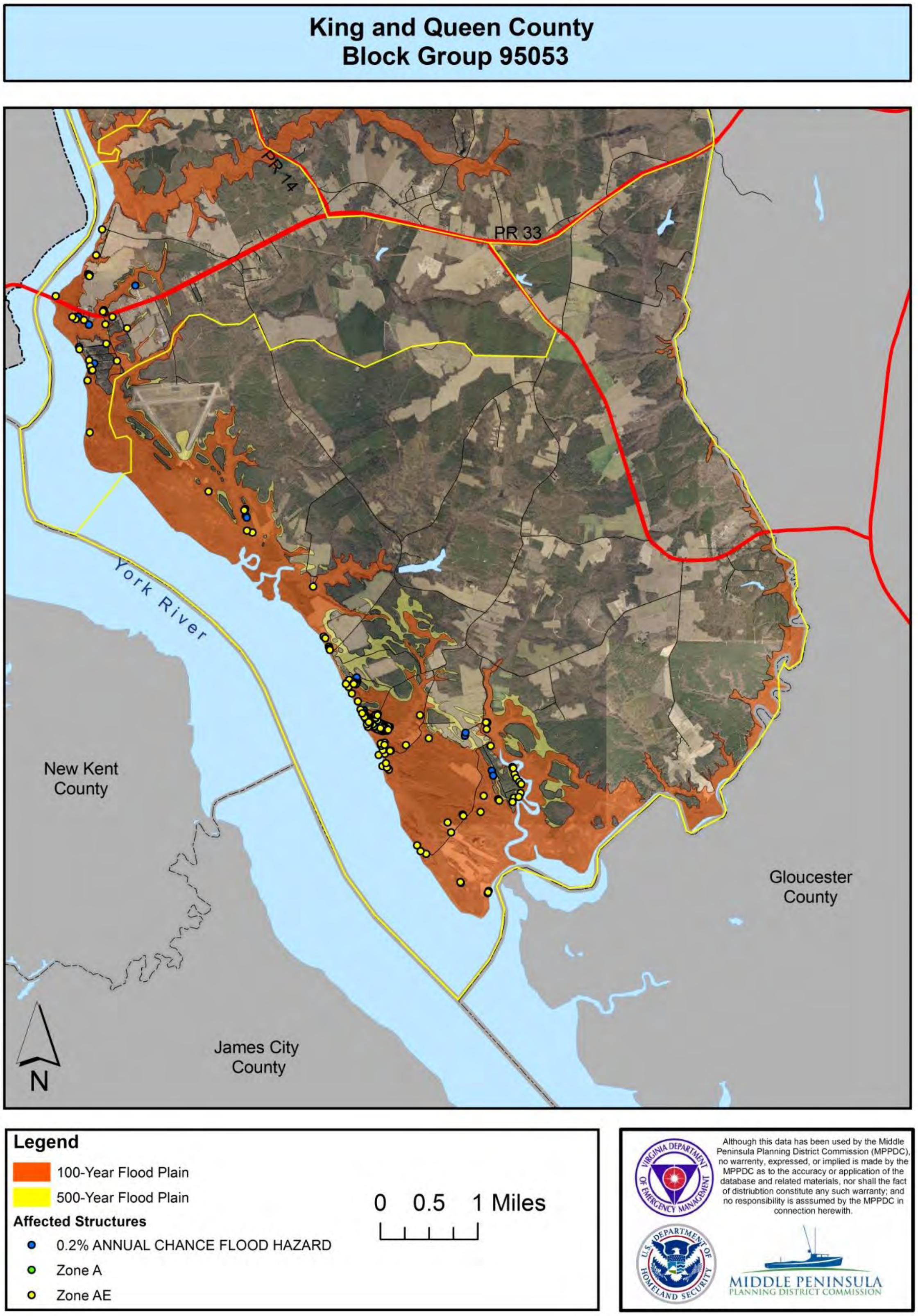
Figure 40:


King and Queen County
Block Group 95053
PR 14
PR 33
York River
New Kent County
Gloucester County
James City County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
0.2% ANNUAL CHANCE FLOOD HAZARD
Zone A
Zone AE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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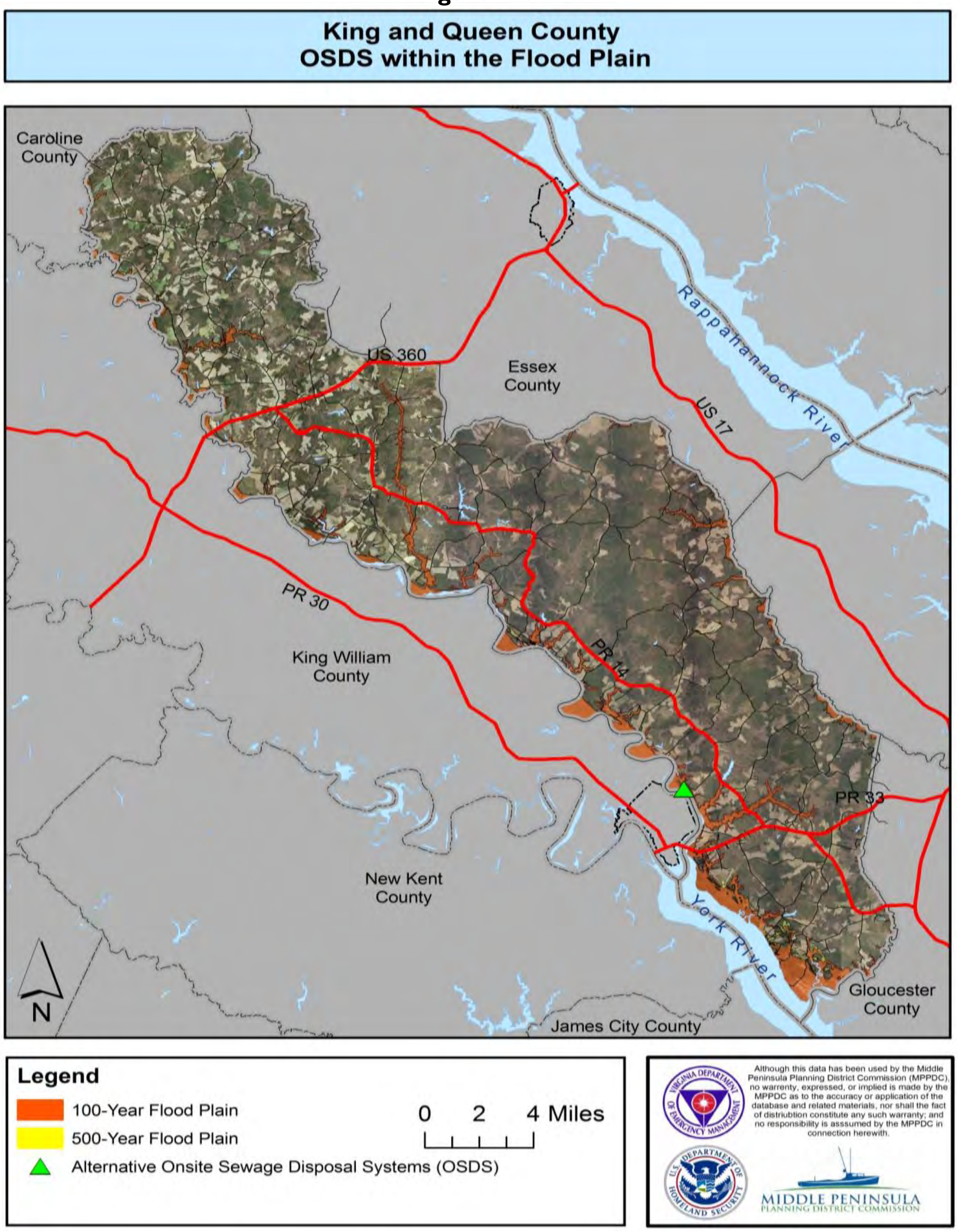
Alternative On-site Sewage Disposal Systems (OSDS)

The Virginia Department of Health (VDH) regulations have changed dramatically in recent years to keep pace with improvements in technology. Now, there are a number of "alternative on-site sewage disposal systems" that are allowed to be constructed where poor soils and/or a high water table prevented the construction of a conventional septic system on the property. As of 2009, there were 1,208 OSDSs permitted and installed in the Middle Peninsula. There are an additional 2,006 OSDSs permitted by the health department, but not yet installed (Figure 41).

Many of these are located in the 100-year floodplain, some of which could suffer damage during flooding events since most of the systems have essential mechanical and other components at-grade or slightly above grade.

Figure 41:



4.5.2. Essex County Critical Facilities and Public Utilities

The County's Offices are located within the Town of Tappahannock, which is centrally located mid-county along the Route 17 corridor. The County Offices are located in a handful of buildings in downtown Tappahannock in an area that is outside of the 500-year floodplain. There are emergency generators at the County Administration Building and at the Sheriff's Office/Dispatch Center.

Additional properties that the County owns includes 2 solid waste facilities located at Center Cross and Bray's Fork, the county library, the elementary school/school board offices and the middle school/high school complex. All of these properties are located outside of the 500-year floodplain. The new middle school has an emergency generator.

The county/town is served by 1 volunteer fire department that has 3 fire stations. One station is located in Tappahannock along Airport Road, another is located at the northern end of the county along Route 17 at Loretto and the third station is located at the southern end of the County near Center Cross. The Tappahannock Volunteer Rescue Squad is located in downtown Tappahannock and it serves town residents as well as all county residents. All of these emergency response facilities are located outside of the 500-year floodplain. The fire department on Airport Road and the EMS facility downtown have emergency generators.

The new Tappahannock-Essex County Community Airport is located off of Route 360 at Paul's Crossroads. The airport is located on a high ridge-line, which is obviously outside of the 500-year floodplain.

The new animal shelter that serves the town and county is located at the town's former maintenance facility along Airport Road, which does not flood.

Repetitive and Severe Repetitive Loss Residential Structures in Essex County

According to FEMA's records, Essex County has 32 Single-Family Repetitive Loss properties and 2 Single-Family Severe Repetitive Losses as of 5/31/15.

According to VDOT officials, flood prone roads in the Essex County/Tappahannock area include the following:

Table 29: Essex/Tappahannock Flood Prone Roads

Route	Road Name	Location
17	Church Lane	Tickners Creek at June Parker Marina
617	Island Farm Road	Piscataway Creek
646	Fort Lowery Lane	Rappahannock River
680	River Place	Rappahannock River

Route 17 is the main south/north road serving the county. This primary road has been designated as a hurricane evacuation route by the Commonwealth of Virginia for some Tidewater residents evacuating northward during a Category 2 or stronger hurricane. However, a portion of Route 17 on the north side of Tappahannock (near the June Parker Marina) floods on a regular basis during storms of minor to moderate intensity. As Essex County and Town of Tappahannock developed plans and proposed them to VDOT in 2014 VDOT began construction on this section of the highway. VDOT will elevate the road and install a bridge to reduce the occurrence of flooring on Route 17, a hurricane evacuation route, from just north Marsh Street to just south of Airport Road. Construction work will began in January 2014 and will conclude by May 2016.

Also according to town officials, all roads that dead end at the Rappahannock River flood, but sustain little damage since flood velocities are low along this section of the river through Tappahannock.

Properties in the 100-year Floodplain by Census Block Groups

The following series of maps show the location of structures in Essex County that are either in the Flood Zone A or in Flood Zone AE in the 100-year flood plain. The map also shows structures in the 500-year plain that are labeled: "0.2% annual chance flood hazard". The legend is color coded to indicate the specific flood zone in which each structure lies.

Figure 42:

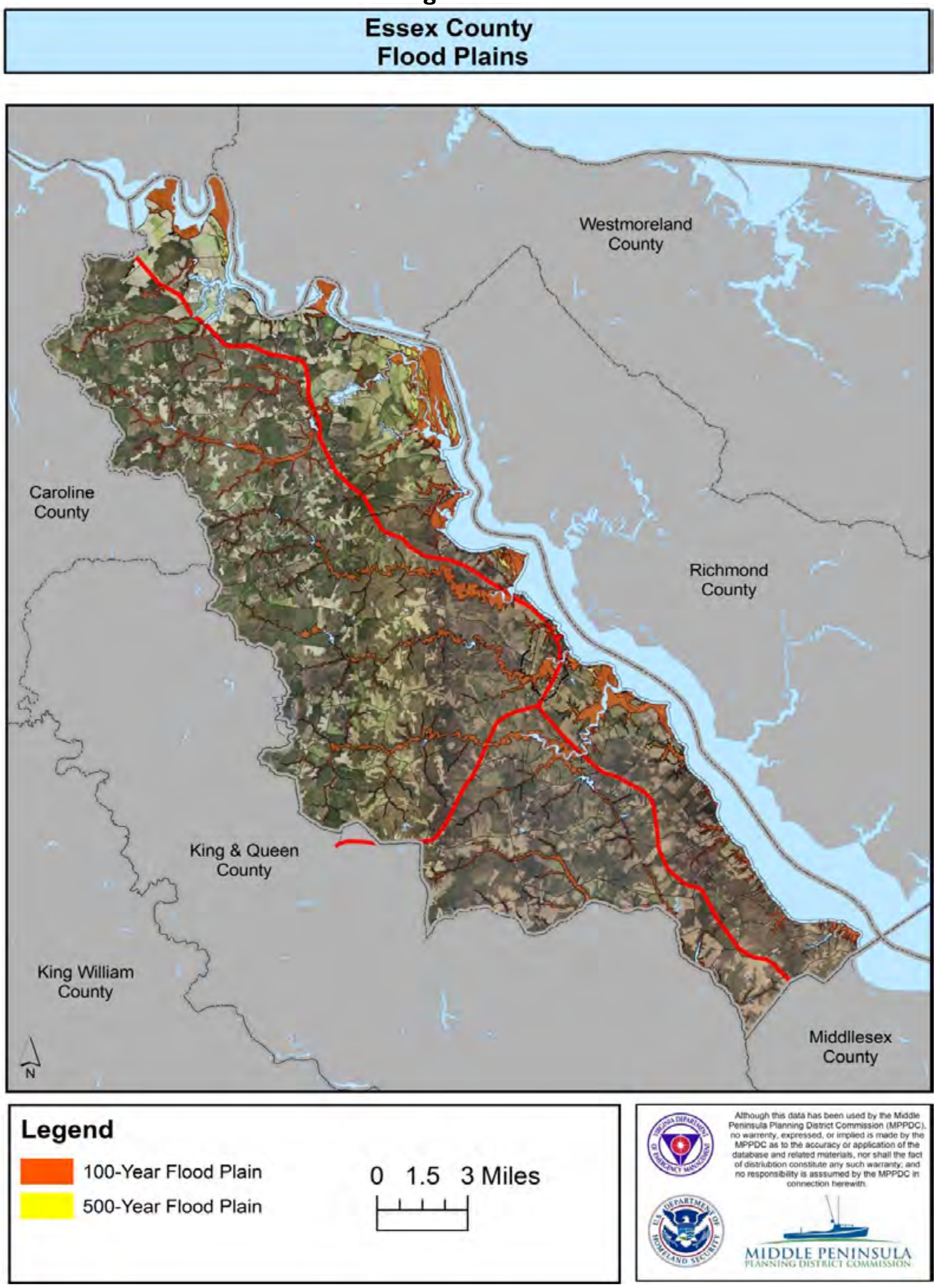
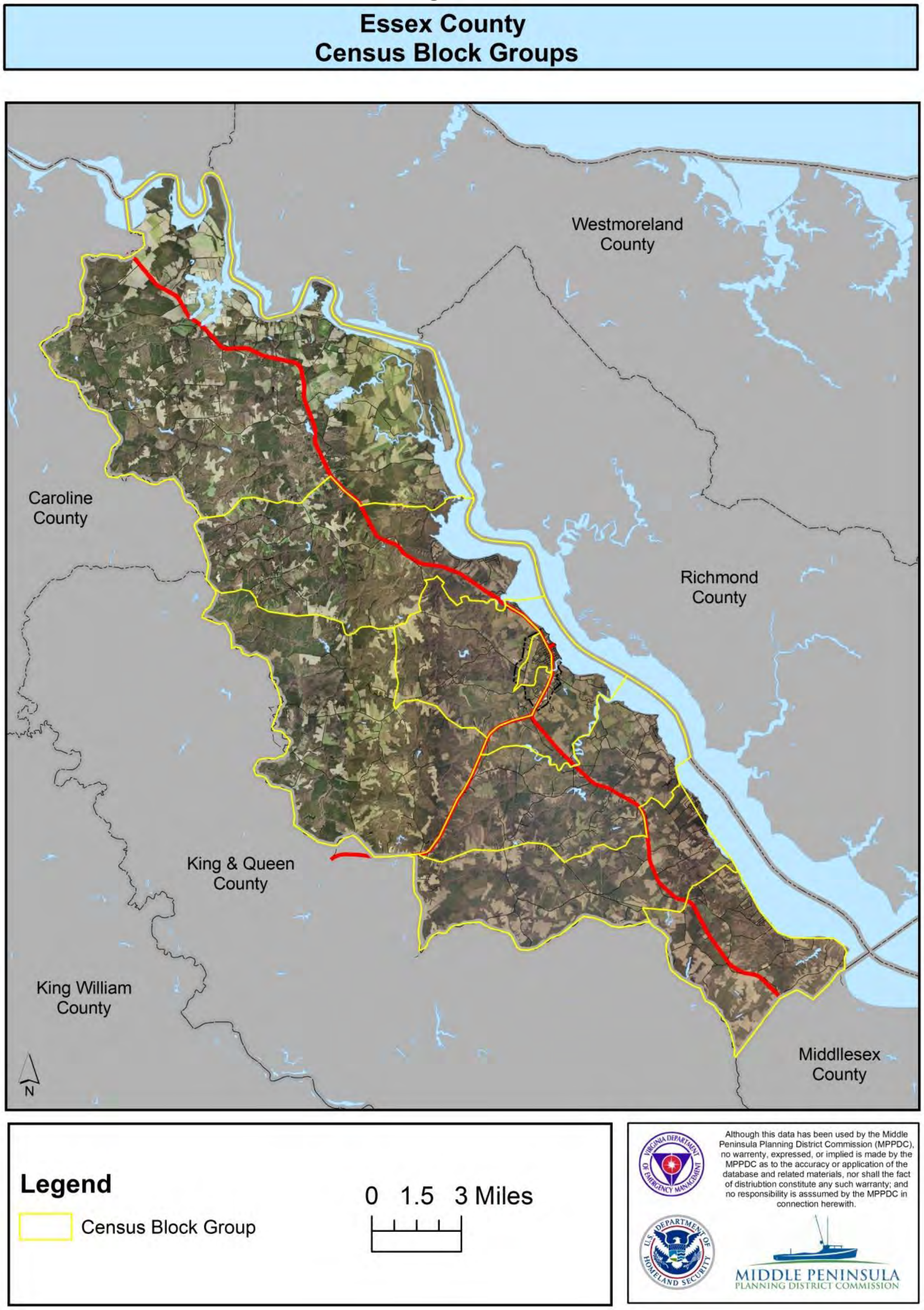


Figure 43:


Essex County
Census Block Groups
Westmoreland County
Caroline County
Richmond County
King & Queen County
King William County
Middllesex County
N
Legend
Census Block Group
0 1.5 3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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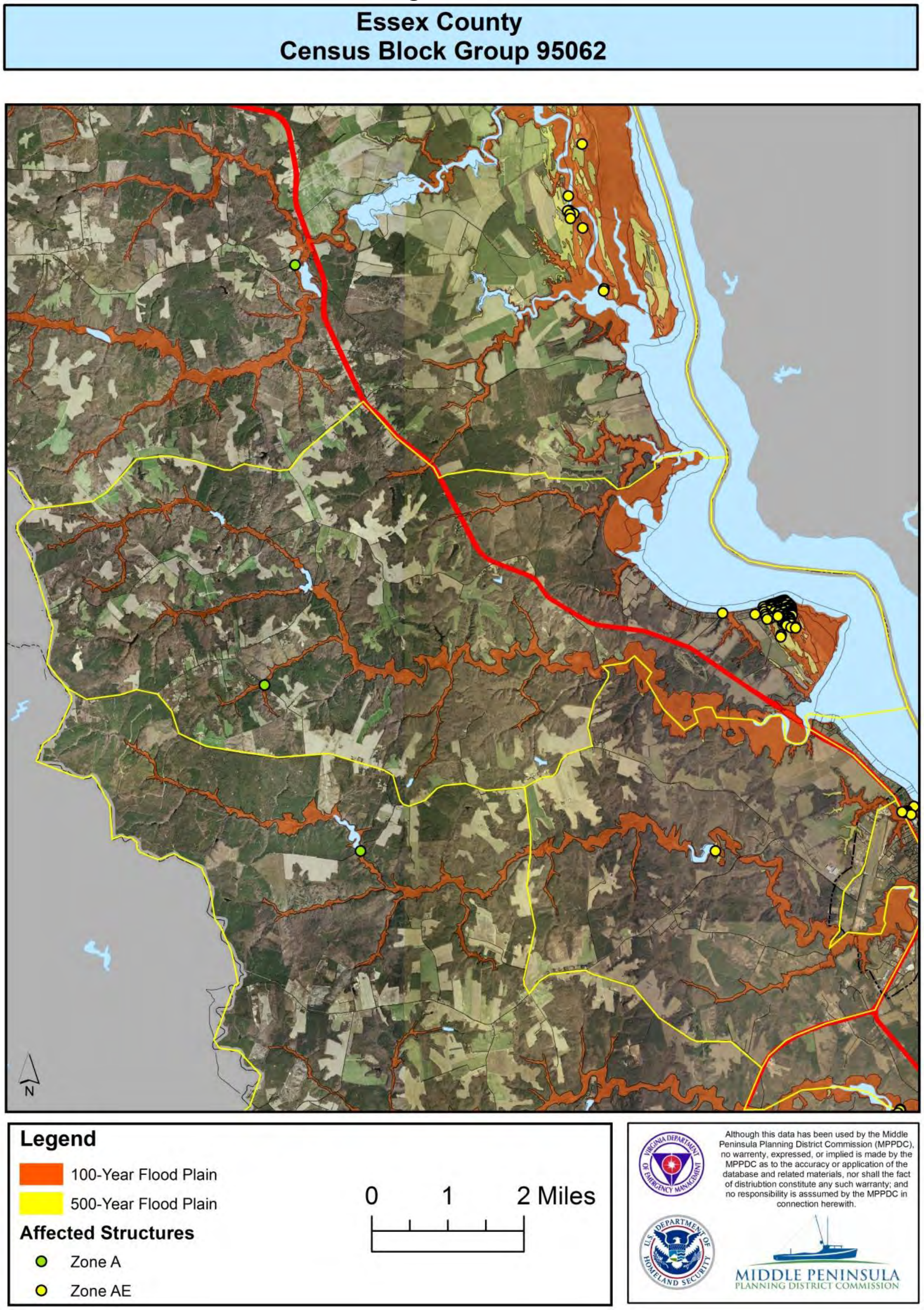
PLANNING DISTRICT COMMISSION

Figure 44:

Essex County
Census Block Group 95061

Figure 45:


Essex County
Census Block Group 95062
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
0 1 2 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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PLANNING DISTRICT COMMISSION

Figure 46:

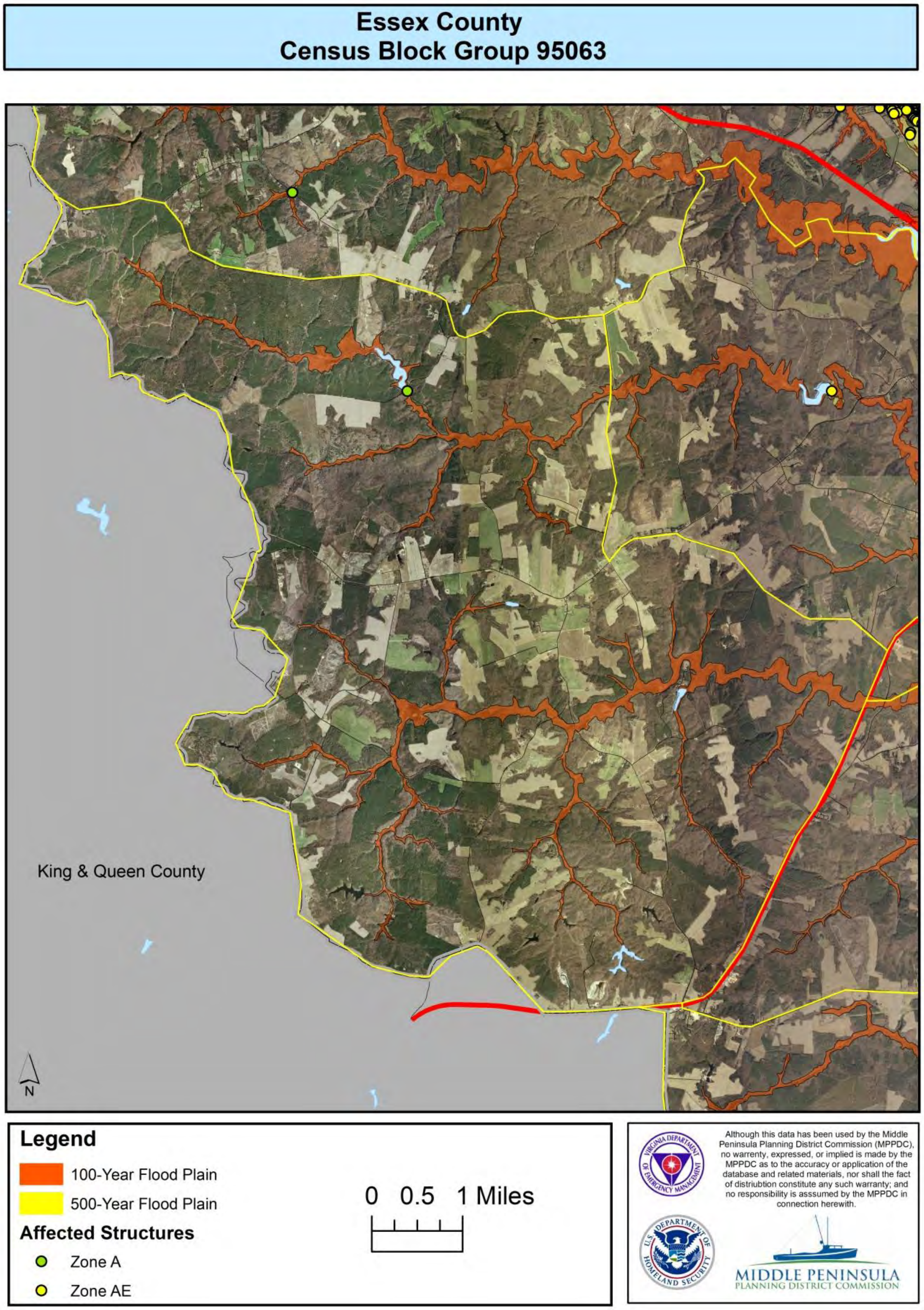
Essex County
Census Block Group 95063
King & Queen County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 47:

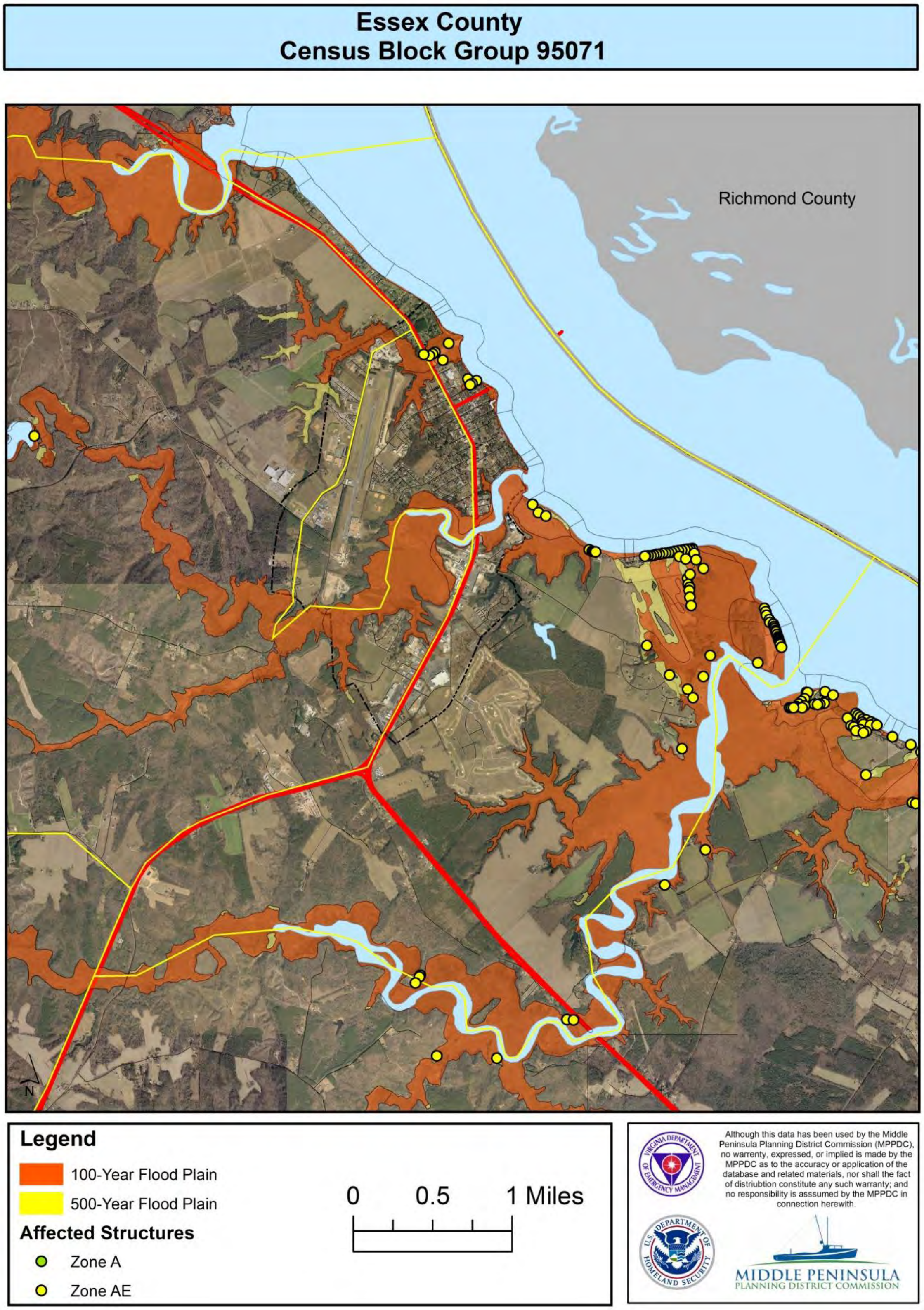
Essex County
Census Block Group 95071
Richmond County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
0
0.5
1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 48:

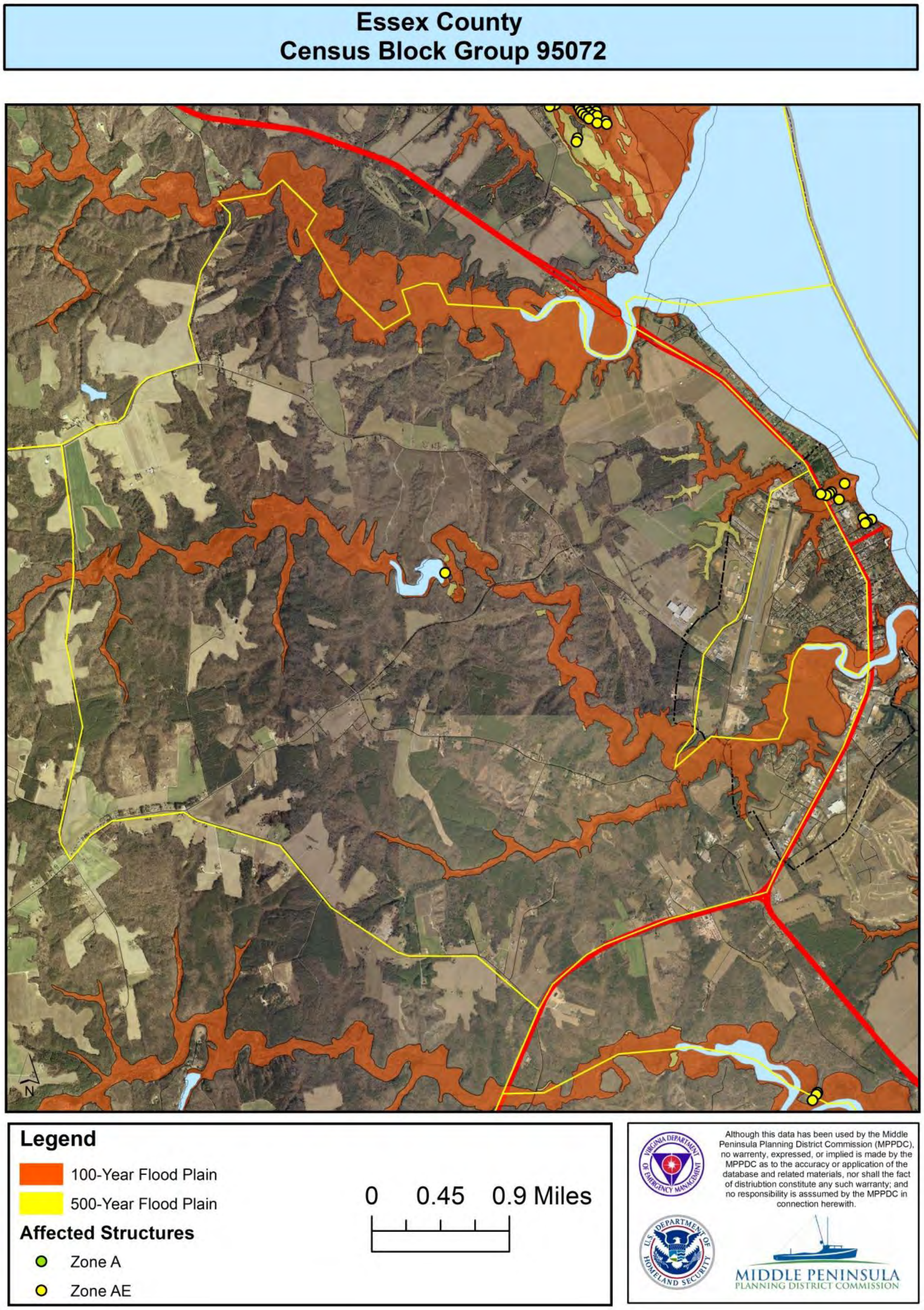
Essex County
Census Block Group 95072
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
0 0.45 0.9 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 49:

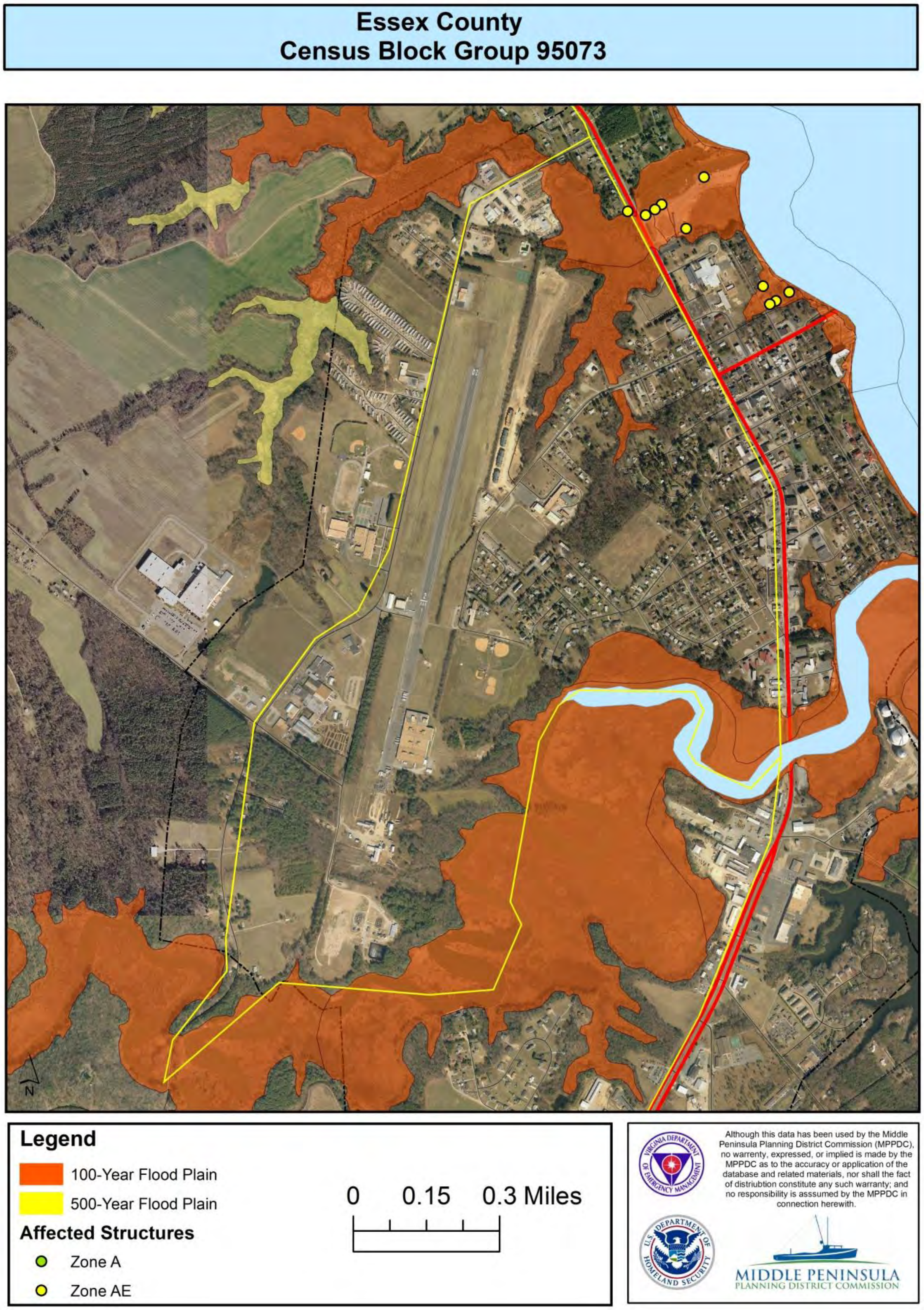
Essex County
Census Block Group 95073
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
0 0.15 0.3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 50:

Essex County
Census Block Group 95081

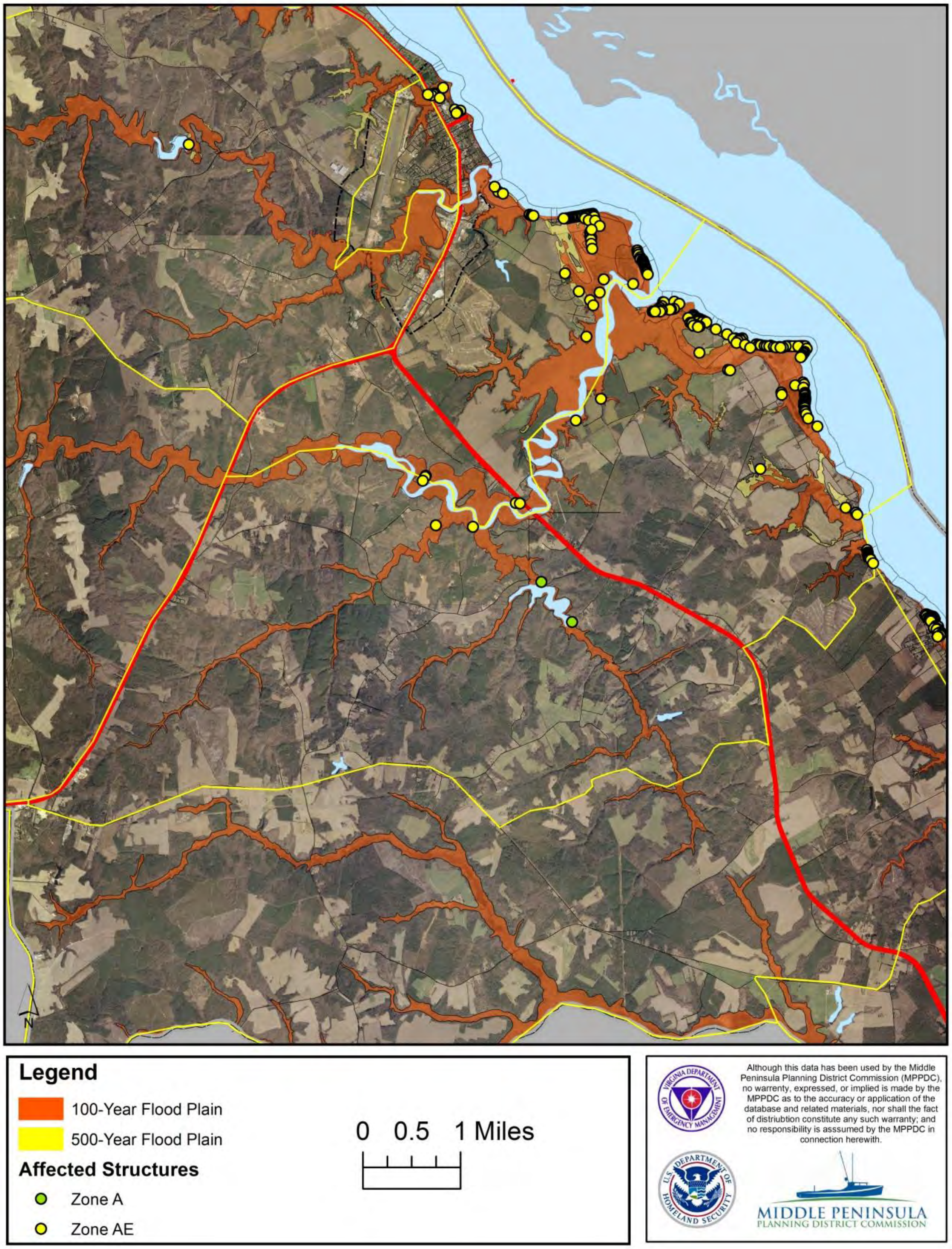

Figure 51:

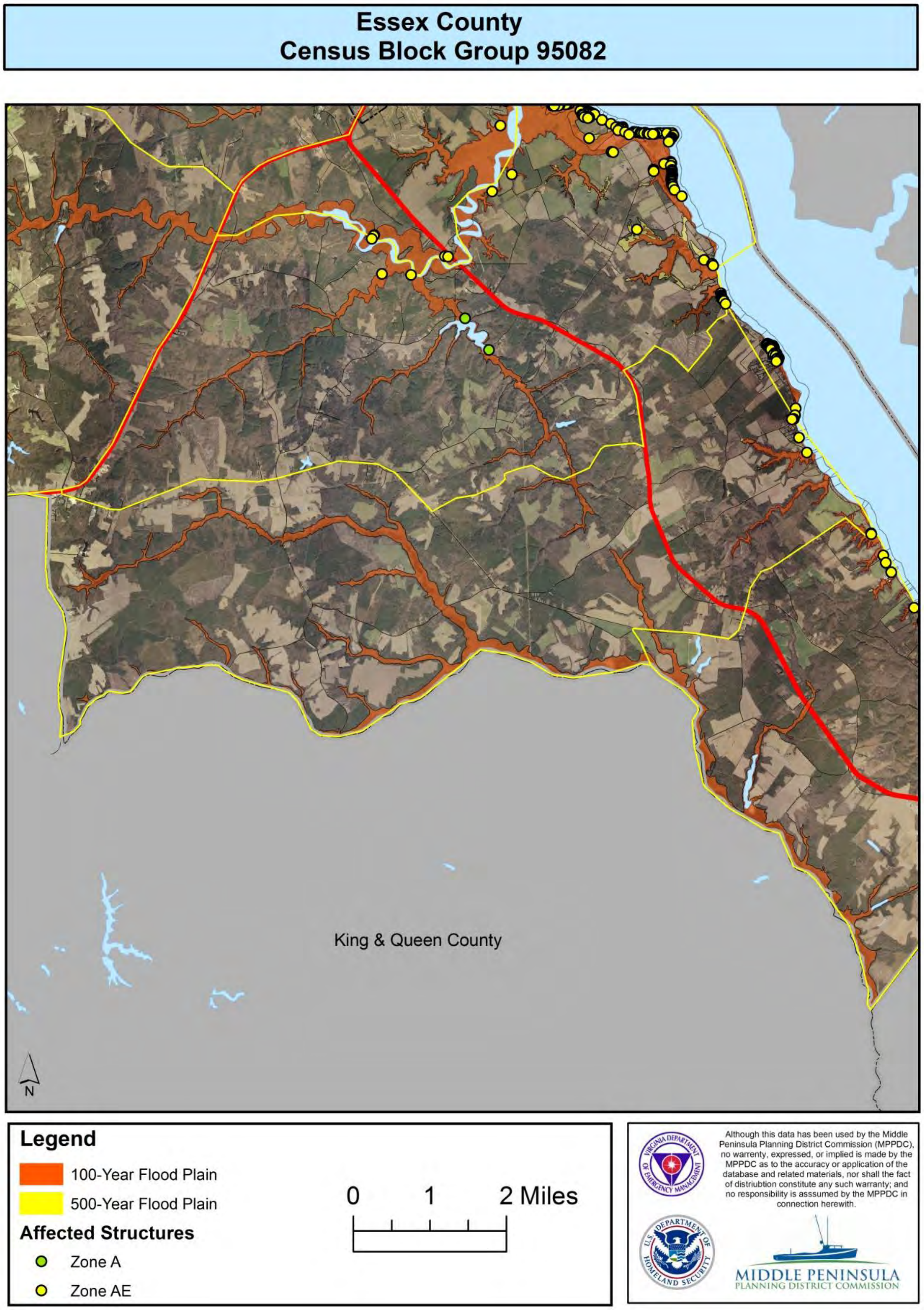
Essex County
Census Block Group 95082
King & Queen County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
0 1 2 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 52:


Essex County
Census Block Group 95083
King & Queen County
MIddlesex County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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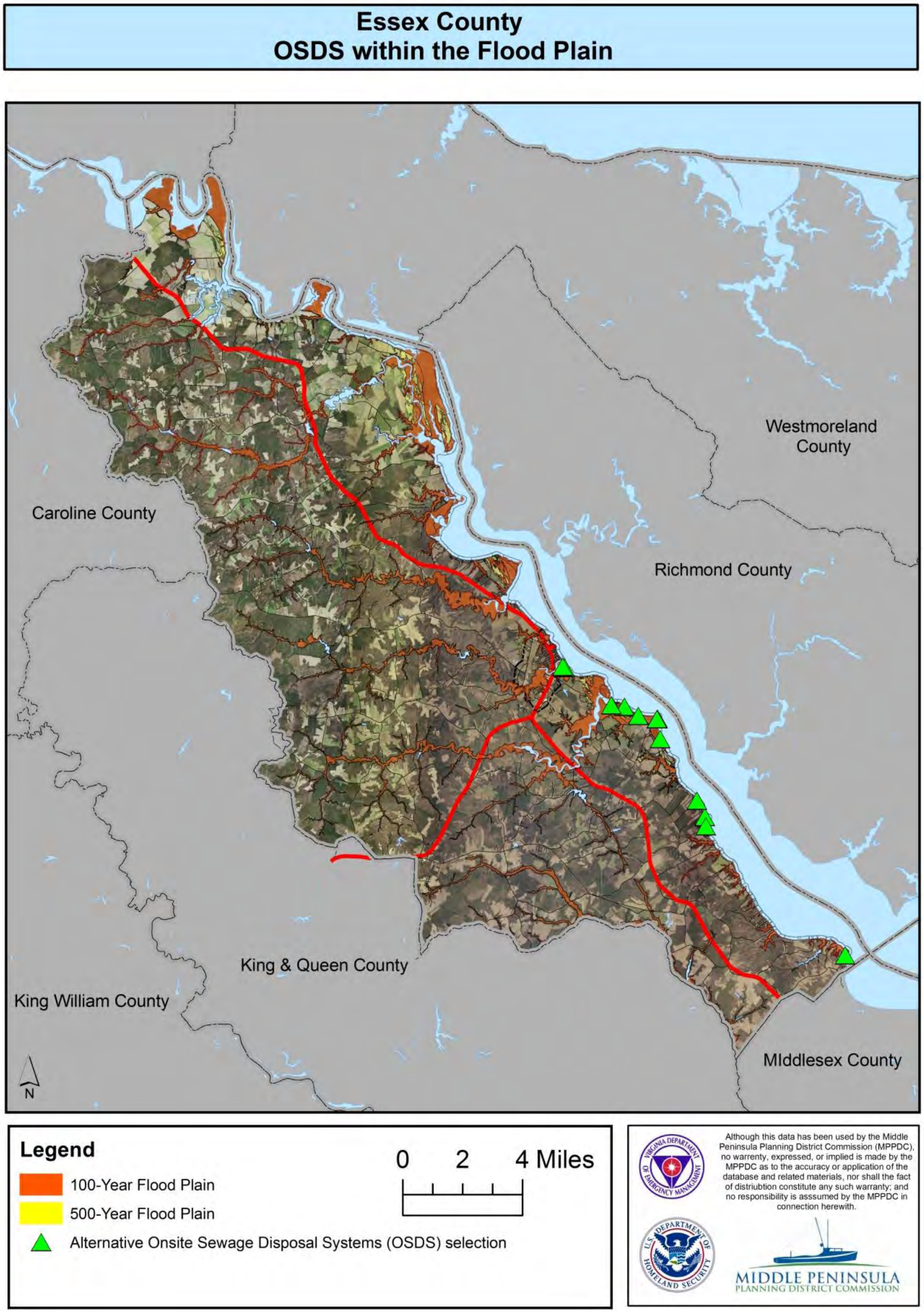
PLANNING DISTRICT COMMISSION

Alternative On-site Sewage Disposal Systems (OSDS). The following map (Figure 53) show the location of the OSDS systems constructed in the 100-year and 500-year floodplain in Essex County:

Figure 53:



Tappahannock Critical Facilities and Public Utilities
The Town of Tappahannock provides public water and sewer services to its citizens. The water system does not sustain damage during floods.

The wastewater treatment plant is located along Hoskins Creek on the west side of Route 17. The wastewater treatment plant does not suffer damage during severe flooding events. In the last plan there was mention that there was one sewerage pump station located along Newbill Drive that received flood damage during hurricane strength storms. During Hurricane Isabel in 2003, the electrical controls needed to be repaired since there was flood damage. However since the last plan the Newbill Drive electrical controls have been raised to above the flood line of Hurricane Isabel in hopes to avoid future issues.

Public Boat Landings
There is one public boat ramp in the Town of Tappahannock along Hoskin's Creek that is operated/maintained by the VDGIF:

Water Body	Access Area	Barrier Free	Type	Ramps	Latitude	Longitude
Hoskin's Creek	Hoskin's Creek	No	Concrete Ramp	1	35° 55' 12" N 37.9200873	76° 51' 26"W -76.8571004
Directions: Town of Tappahannock, Rt. T-1002 (Dock Street)						
Virginia Department of Game an Inland Fisheries, 2015						

In addition to Hoskin's Creek, there is public access at the Prince Street road ending which is owned by the Middle Peninsula Chesapeake Bay Public Access Authority. While Prince Street may suffer minor damage during severe storm events, Dock Street does not sustain damage from flood waters according to town officials.

Repetitive and Severe Repetitive Loss Residential Structures in the Town of Tappahannock
According to FEMA's records, the Town of Tappahannock has 2 Single Family Repetitive Loss properties and no Severe Repetitive Losses as of 5/31/15.

4.5.3. King William County Critical Facilities and Public Utilities

Public water and sewerage systems serve portions of the Route 360 growth corridor in Central Garage. A package wastewater treatment plant discharges sewer effluent into an unnamed tributary that leads into Moncuin Creek, which then flows into the Pamunkey River. Floodwaters do not adversely impact the wastewater treatment plant.

The public water system serves the relatively high and dry Central Garage area. Therefore, this Route 360/30 area water system does not sustain damage from flooding events.

According to VDOT officials, flood prone roads in the King William County/West Point area include the following:

Table 30: King William County/West Point Flood Prone Roads		
Route	**Road Name**	**Location**
30	King William Road	Cypress Swamp at Olson's Pond
636	VFW Road	Cypress Swamp
632	Mt. Olive- Cohoke Road	Intersection of Route 633
609	Smokey Road	Herring Creek
628	Dorrel Road	Herring Creek
1006	Thompson Ave	West Point Creek
1003	Chelsea Road	West Point Creek to dead end
1130	Glass Island Road	Mattaponi River
1107	Kirby Street	1st to 7th Streets
n/a	1st to 7th Streets	Between Kirby St. and Pamunkey River
n/a	2nd to 5th Streets	Between Lee St. and Mattaponi River

Public Boat Landings

There are 2 public boat ramps in King William County that is owned and maintained by VDGIF:

Water Body	Access Area	Barrier Free	Type	Ramps	Latitude	Longitude
Mattaponi River	Aylett	Yes	Concrete Ramp	1	37° 47' 8" N 37.7855806	77° 6' 11"W -77.1030150
Directions: Aylett, Rt 360 East, Right onto Rt 600						
Pamunkey River	Lestor Manor	Yes	Concrete Ramp	1	37° 35' 10" N 37.5861120	76° 59' 4"W -76.9845725
Directions: From King William Courthouse, Rt 30 South (.7 miles); Right on Rt 633 (7.4 miles); Left on Rt 672 (.4 miles)						
Virginia Department of Game an Inland Fisheries, 2015						

Additionally there is a very small canoe/kayak launce at Zoar State Forest located a few miles north of Route 360.

Due to the low velocity of the flood waters along these upper reaches of the Mattaponi River, neither of these boat landings sustain damage from flood waters.

Repetitive and Severe Repetitive Loss Residential Structures in King William County

According to FEMA's records, King William County has no Repetitive Loss residential properties or Severe Repetitive Loss as of 5/31/15.

Properties in 100-year Floodplain by Census Block Group

The following series of maps show the location of structures in King William County that are either in the Flood Zone A or in Flood Zone AE in the 100-year flood plain. The map also shows structures in the 500-year plain that are labeled: "0.2% annual chance flood hazard". The legend is color coded to indicate the specific flood zone in which each structure lies.

Figure 54:

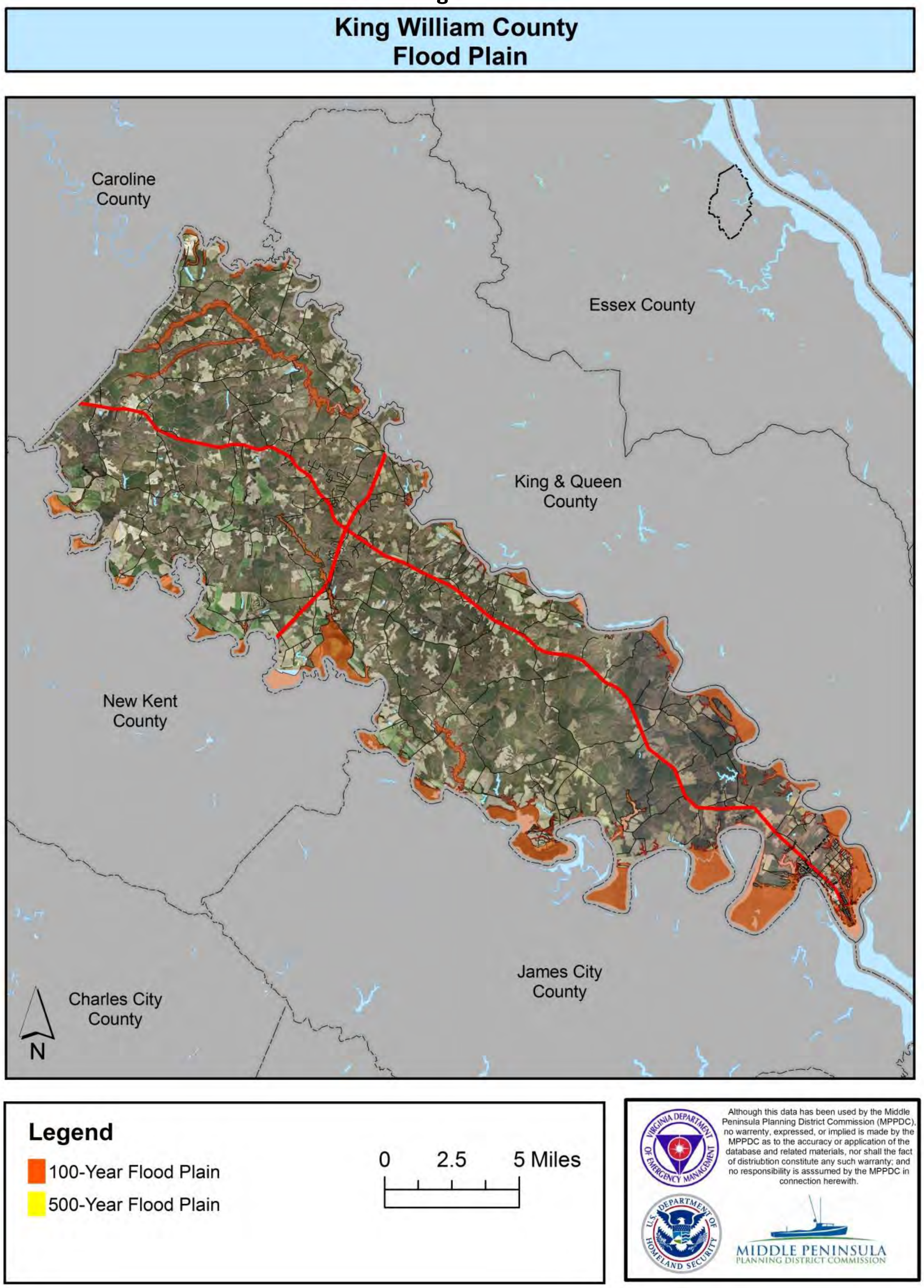

King William County
Flood Plain
Caroline County
Essex County
King & Queen County
New Kent County
James City County
Charles City County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
0
2.5
5 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 55:

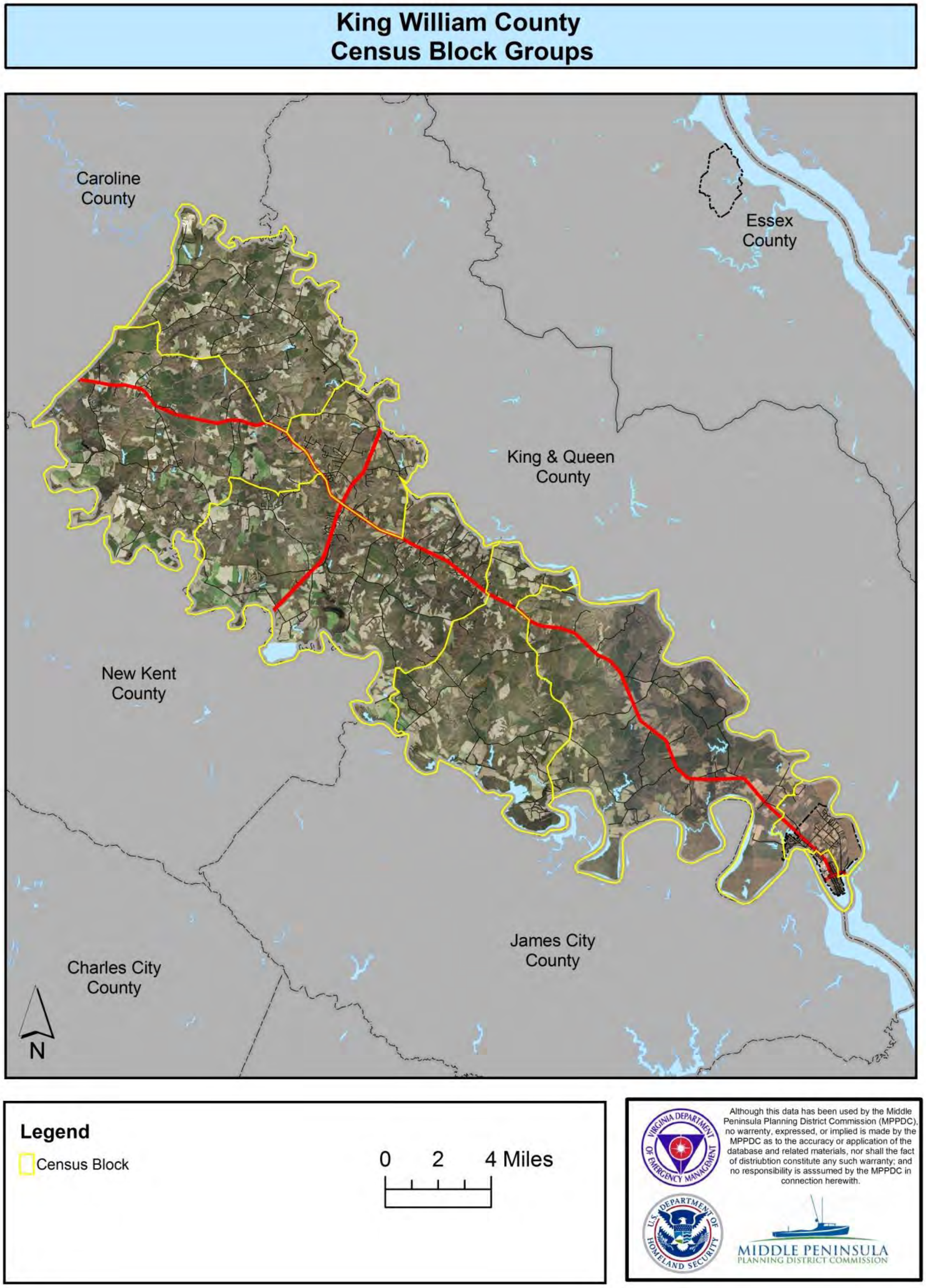

King William County
Census Block Groups
Caroline County
Essex County
King & Queen County
New Kent County
Charles City County
James City County
N
Legend
Census Block
0 2 4 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 56:

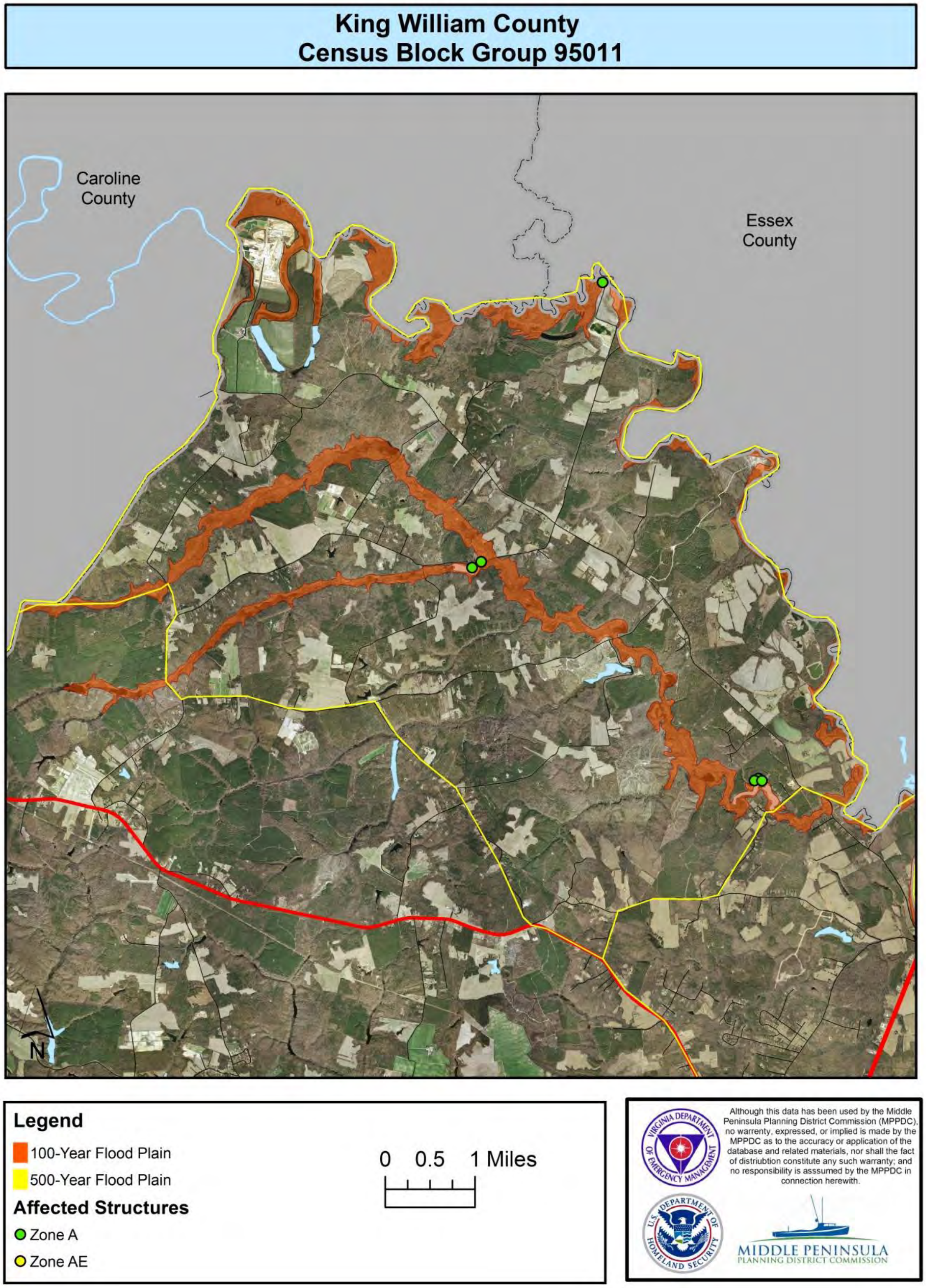

King William County
Census Block Group 95011
Caroline County
Essex County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 57:

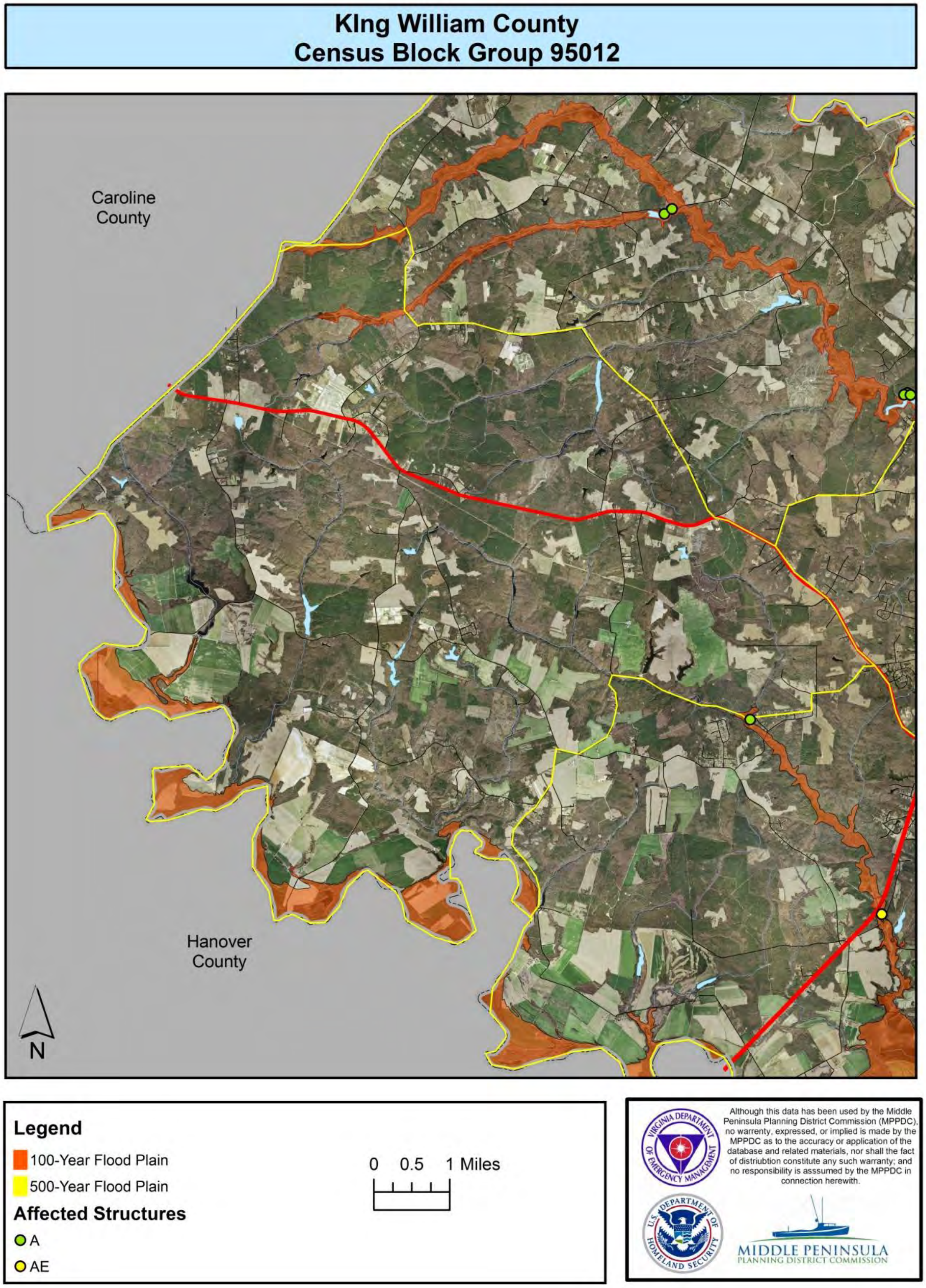

KIng William County
Census Block Group 95012
Caroline County
Hanover County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
A
AE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 58:

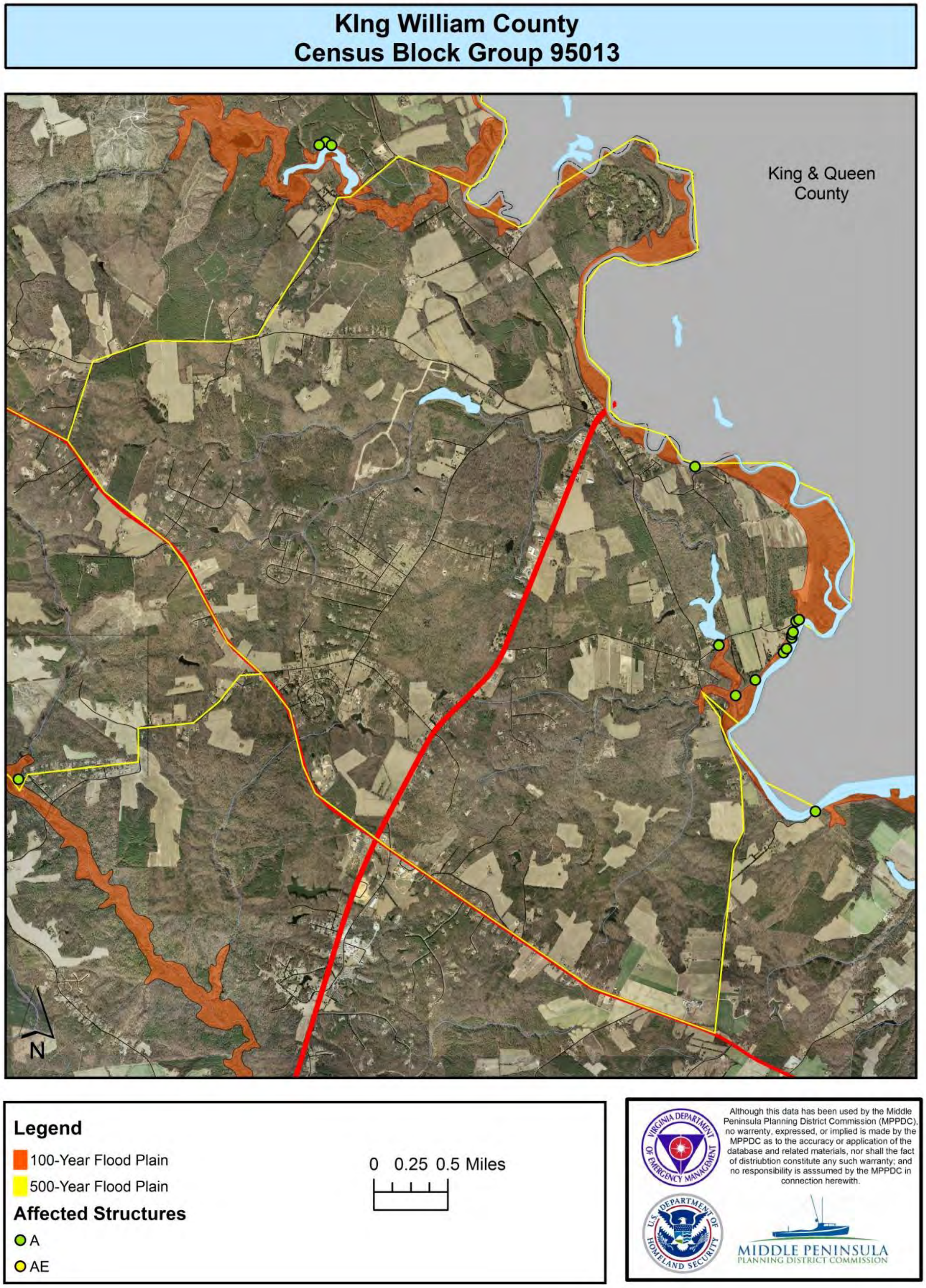

KIng William County
Census Block Group 95013
King & Queen County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
A
AE
0 0.25 0.5 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 59:

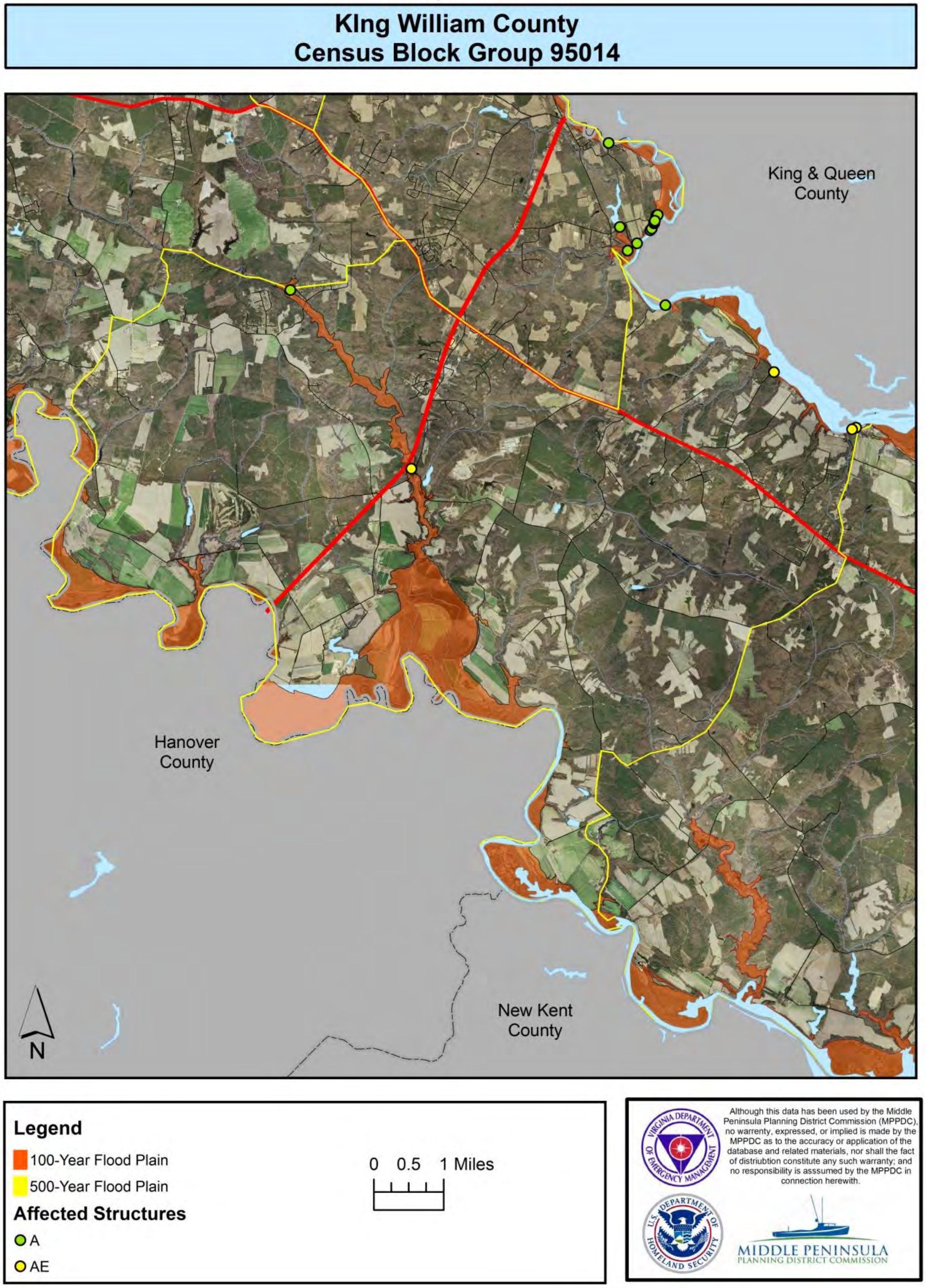

KIng William County
Census Block Group 95014
King & Queen
County
Hanover
County
New Kent
County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
A
AE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 60:

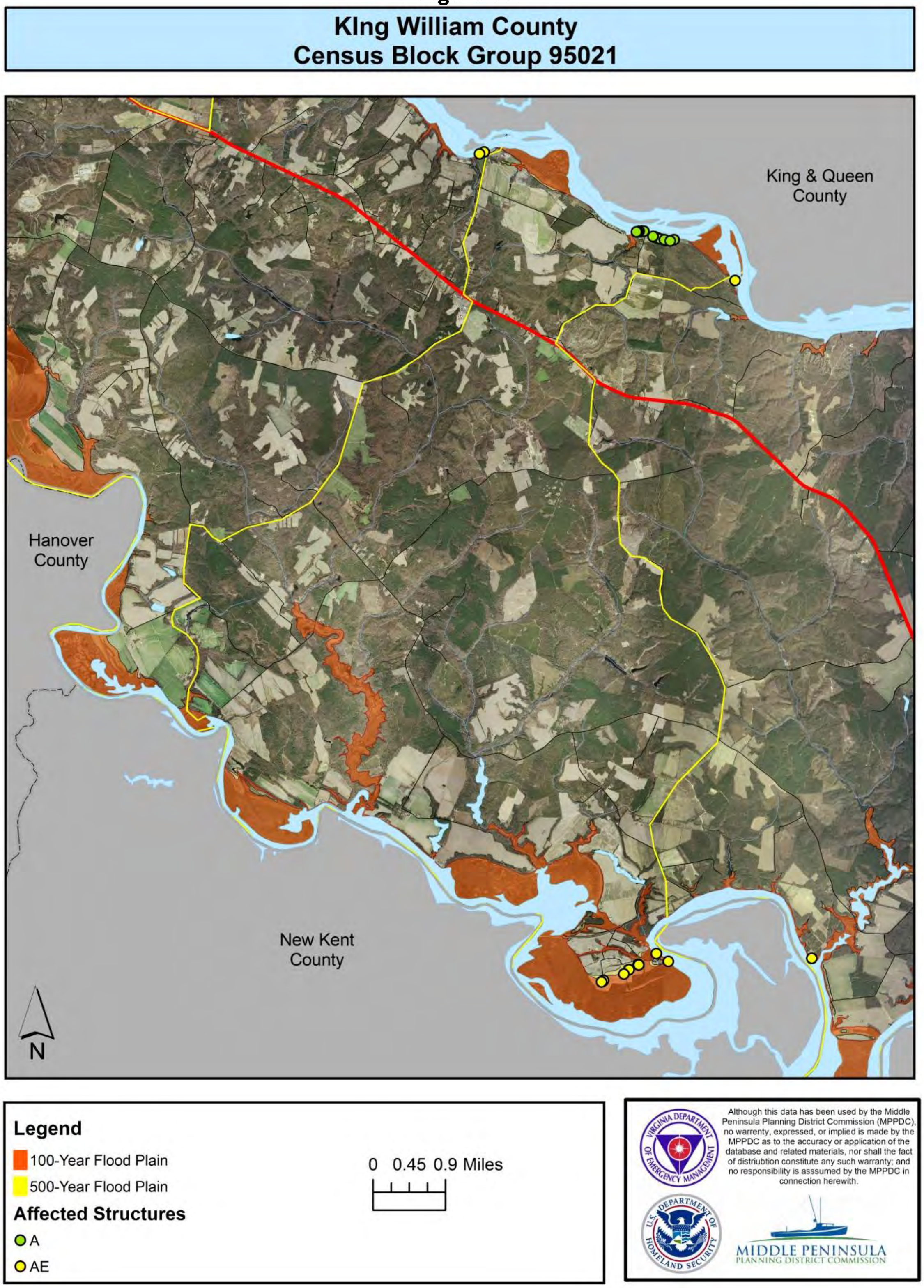

KIng William County
Census Block Group 95021
King & Queen
County
Hanover
County
New Kent
County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
A
AE
0 0.45 0.9 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 61:

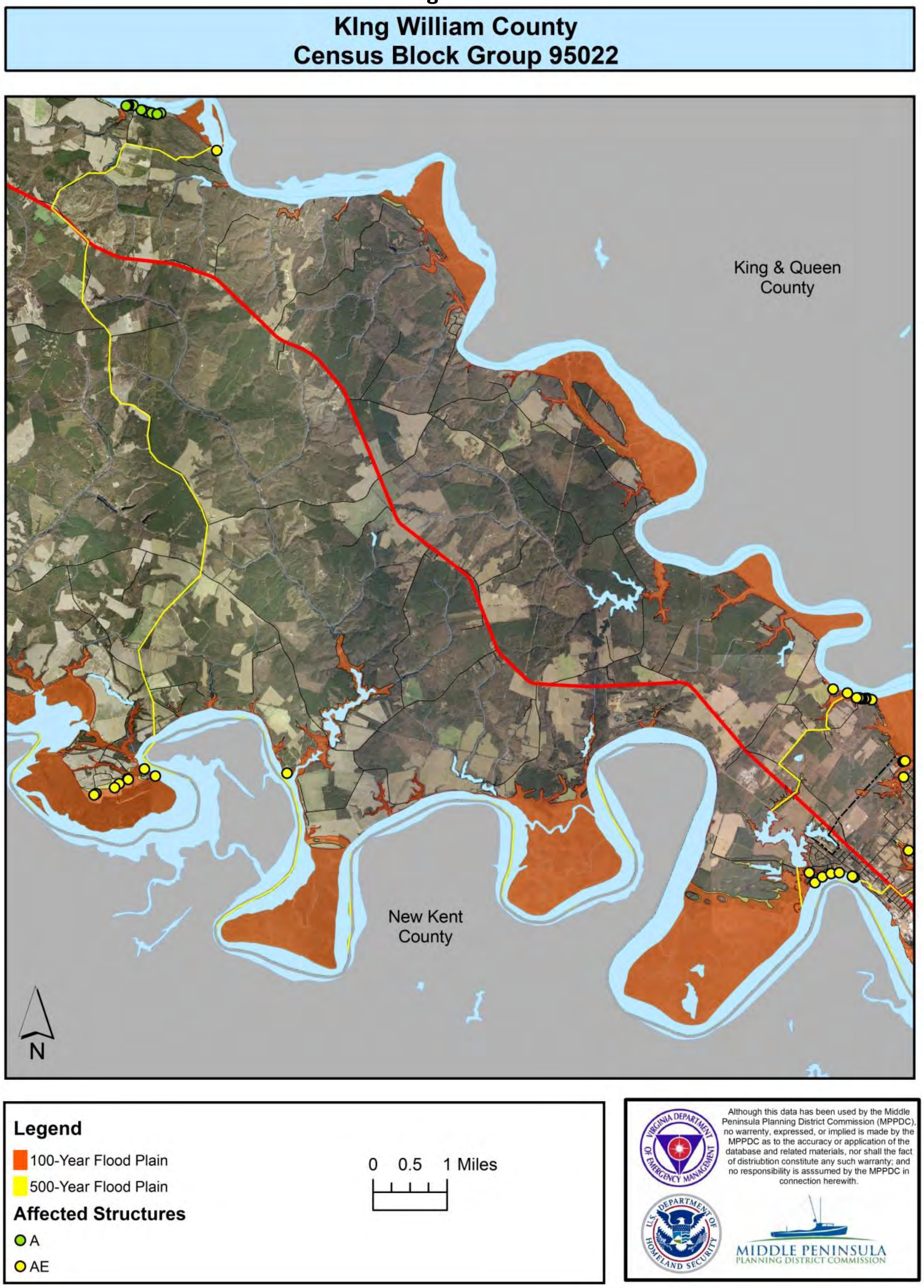

KIng William County
Census Block Group 95022
King & Queen
County
New Kent
County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
A
AE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 62:

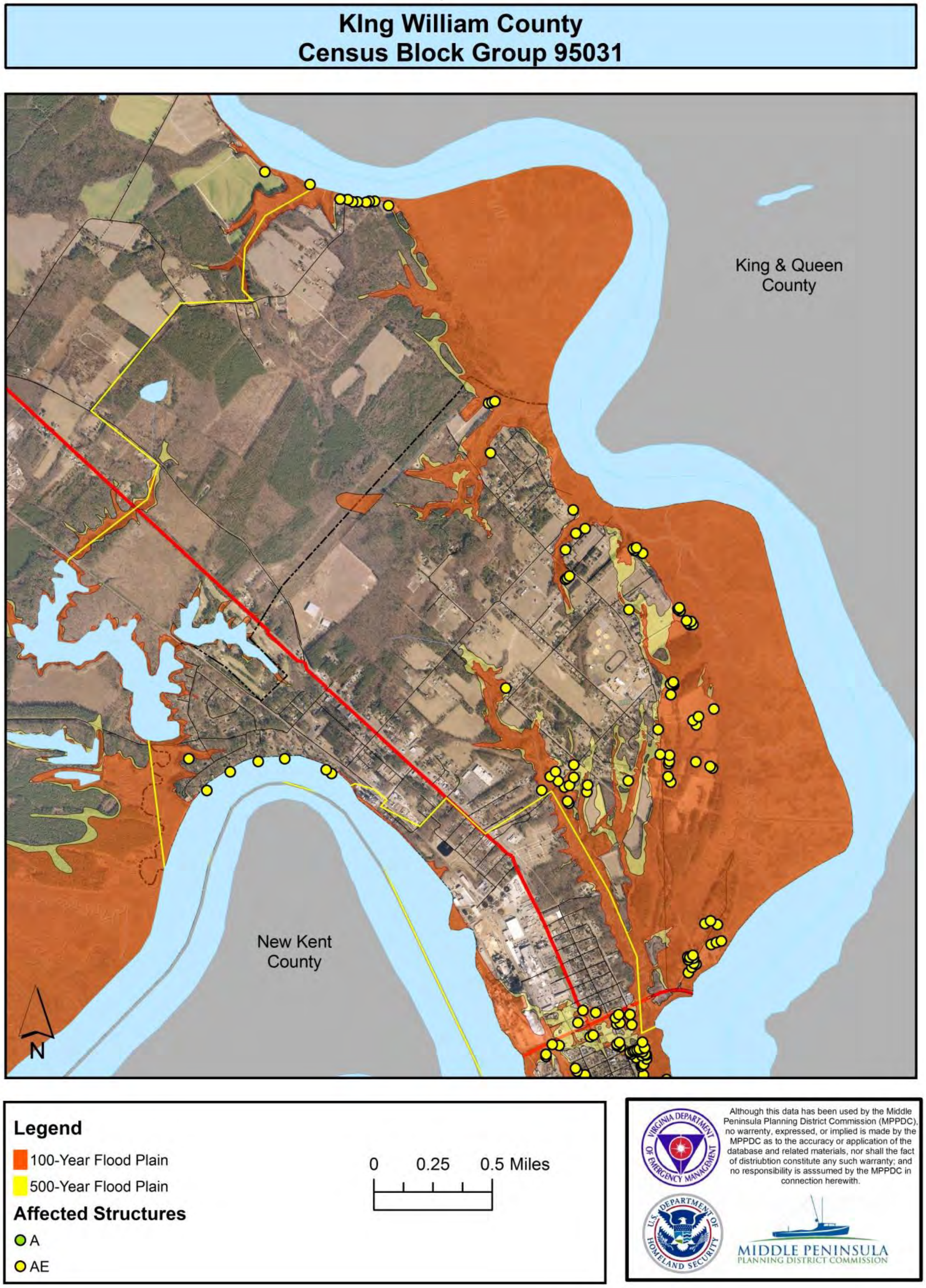
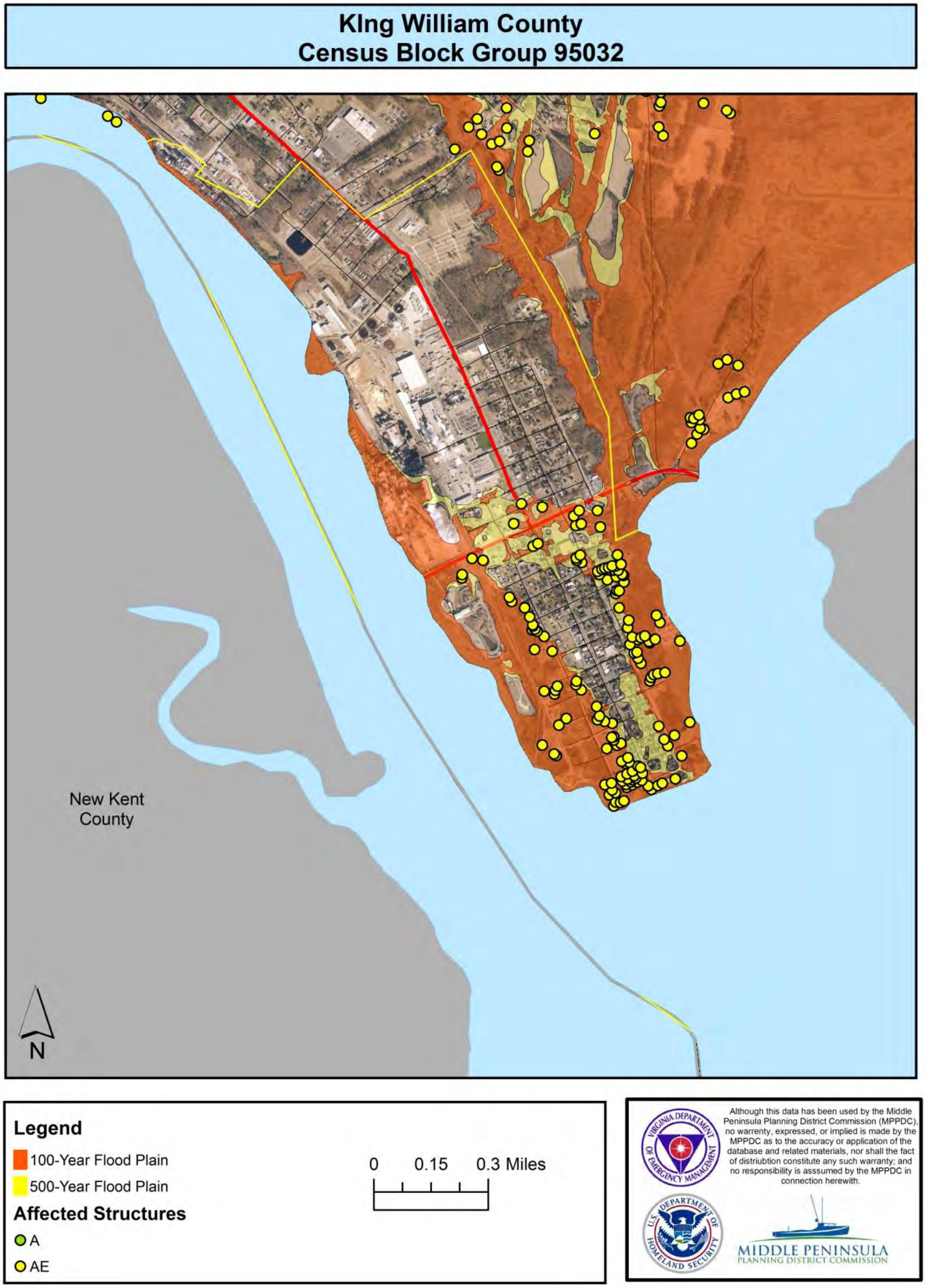

KIng William County
Census Block Group 95031
King & Queen
County
New Kent
County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
A
AE
0 0.25 0.5 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

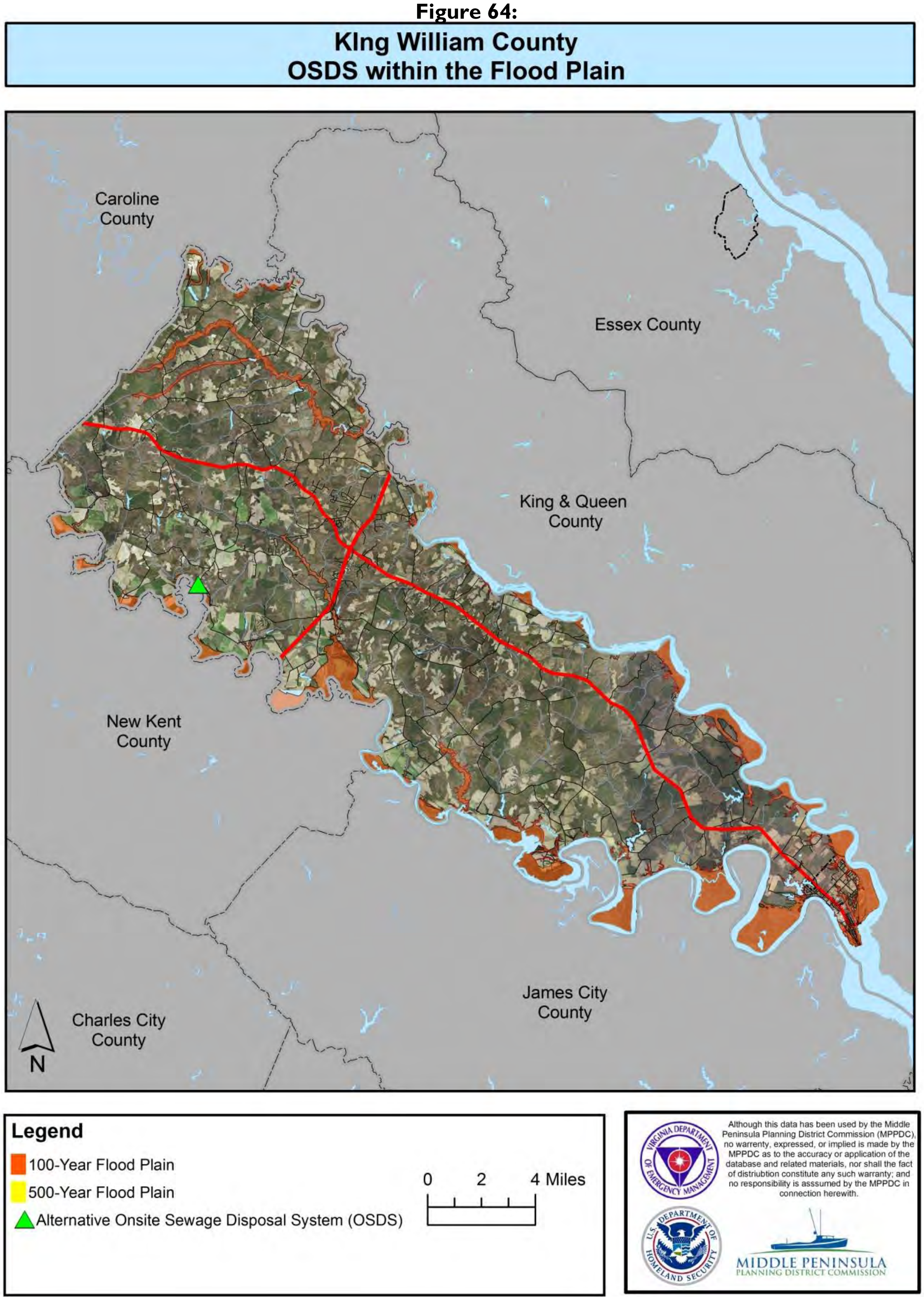
Figure 63:


KIng William County
Census Block Group 95032
New Kent County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
A
AE
0 0.15 0.3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Alternative On-site Sewage Disposal Systems (OSDS)

The map (Figure 64) below shows the locations of the installed OSDS facilities constructed in the 100-year floodplain in King William County.

Figure 64:



West Point Critical Facilities and Public Utilities
Located at the confluence of the Mattaponi and Pamunkey Rivers where they become the headwaters of the York River, there is public infrastructure, private residences and downtown businesses that are at risk of flooding during severe storms.

The town provides both public water and sewer service to its residents. The water system is owned and operated by the town and sustains little damage during flooding events.

The ownership and operation of the town's sewerage system has been turned over to the Hampton Roads Sanitation District (HRSD). The wastewater treatment plant is located at the east end of 23rd Street. The facility did not flood during Hurricane Isabel in 2003 and the vital electrical and mechanical controls are on a slightly elevated portion of the site and therefore, the facility's location does not pose a risk of flooding.

A sewer pump station located on 2nd Street near the point does have a flooding problem. During Hurricane Isabel, the pump motors in the well house flooded and needed to be dried out. However, the electrical controls are mounted high enough in the pump house so that they did not sustain flood damage. There is a sewer pump station located on 13th street that did not flood during Hurricane Isabel, but the floodwaters did reach within 1-foot of the facility.

Public Boat Landings
There is one public boat landing located along the Mattaponi River on the north side of the Lord Delaware Bridge on Glass Island Road. This facility does receive minor damage to the roadway and parking areas during severe storms.

Water Body	Access Area	Barrier Free	Type	Ramps	Latitude	Longitude
Mattaponi River	West Point	Yes	Concrete Ramp	2	37° 47' 8" N 37.5406099	76° 47' 23"W -76.7896487
Directions: Town of West Point on Rt 33						
						VDGIF, 2015

Public Park Facility
On the south side of the Lord Delaware Bridge, there is a small town park with walking trails and benches adjacent to the water's edge. This is a new facility that was built in conjunction with the new bridge construction that was completed in 2006. Due to the minimal amount of infrastructure at this shoreline facility, it is an anticipated that there will be no more than minor damages from rising waters in this wetlands area adjacent to the Mattaponi River.

Repetitive and Severe Repetitive Loss Residential Structures in West Point
According to FEMA's records, the Town of West Point has 8 Single Family and 1 Non-Residential Repetitive Loss properties and zero Severe Repetitive Losses as of 5/31/15.

The properties in the 100-year floodplain and 500-year floodplain are shown in the previous set of maps that also include King William County structures in the floodplain.

Numerous homes and downtown businesses at the southern end of West Point flood during severe storms particularly as flood waters reached 8 feet 6 inches above mean low water which is 6 inches above the 8 ft 100-year flood plan elevation. Additionally winds were sustained at excess of 80 miles per hour. Of the homes that underwent repairs, 2 of them were elevated by the homeowners at their own expense.

The West Point School Complex, which serves as the town's shelter, is located on the northern side of the town and the buildings are not subjected to floodwaters. However, Chelsea Road is located along the Mattaponi River and it is 1 of 2 routes that are used to access the school complex. This roadway does flood during severe storms.

4.5.4. Gloucester Critical Facilities and Public Utilities

The county has a relatively extensive network of public water and sewer facilities in and around the Gloucester Courthouse area. The Beaverdam Reservoir, located just north of the courthouse area, serves as the drinking water source for the county's public water supply system. As discussed earlier in the Dam Impoundment Section of the plan, the dam is structurally well-built and remains fully certified by the DCR (Figure 3). Below the dam there are approximately 200 homes that would flood if the Reservoir structure failed. However, in 1999 the impoundment overflowed during Hurricane Floyd yet no flood damage to the home since the excess water flowed downstream using the emergency spillway.

Table 31 provides a list of dams within the locality that may be impacted by natural hazards as well.

Table 31: The following is a list of dams in Gloucester County that are on the Virginia Department of Conservation and Recreation's Certification List.

Dam Name	Class	Height	Capacity in Acre Feet	Water Body
Woodberry Farm	3	8	158	Jones Creek
Weaver Dam	3	6	81	Jones Creek
Haynes	3	15	366	Carter Creek
Robins Creek	3	16	219	Wilson
Cow Creek	2	16	931	Cow
Burke Stream	3	20	481	Burke Mill
Cypress Shores River	3	15	143	Piankatank
Haines Pond	3	9	50	Carter Creek
Beaverdam Reservoir	1	39	20,523	Beaverdam Creek
Wood Duck Pond	4	Unknown	Unknown	Unknown
Leigh Lake	4	12	unknown	Jones Creek

The water distribution system does not suffer damage during severe storm events since it is a closed underground system. The sewerage collection lines and pumps stations are owned and operated by Gloucester County. There are 2 pump stations in the Gloucester Courthouse area (Pump # 11 and Pump #13) that sustained damage during Hurricane Floyd in 1999. The damage was caused by floodwaters resulting from the overtopping of the Beaverdam Reservoir as previously mentioned. After the wastewater is collected, it is transported in a large force main that runs down Route 17, crosses under the York River and then flows into the York River Wastewater Treatment Plant in York County. The large force main and treatment plant are owned and operated by the Hampton Roads Sanitation District. The force main is a closed underground system that does not sustain damage during severe flooding events.

The Achilles Elementary School site, located in the southeastern section of the county, is adversely affected by flood waters from storms surges associated with a Category 1 hurricane.

According to VDOT officials, flood prone roads in Gloucester County include the following:

Table 32: Gloucester County Flood Prone Roads		
Route	**Road Name**	**Location of Floodwaters**
684	Starvation Road	From Big Oak Lane to ESM
662	Allmondsville Road	From Rte. 606 to Rte. 618
618	Chappahosic Road	From Rte. 662 to Rte. 639
636	Brays Point Road	From Eagle Lane to ESM
1303	Carmines Islands Road	From Gardner Lane to ESM
646	Jenkins Neck Road	Various spots from Owens Road to ESM
648	Maundys Creek Road	From Rte. 649 to ESM
649	Maryus Road	From Haywood Seafood Lane to ESM
652	Rowes Point Road	From 653 to ESM
649	Severn Wharf Road	Various spots from 653 to ESM

Public Boat Ramps

There are **4** public boat landings in Gloucester County that are owned and operated by the VDGIF:

Water Body	Access Area	Barrier Free	Type	Ramps	Latitude	Longitude
Piankatank River	Deep Point	Yes	Concrete Ramp	1	37° 32' 10" N 37.5361228	76° 29' 43"W -76.4953889
Directions: From Glenns, Rt 198 East (7.5 miles); Left on Rt 606 (1.5 miles)						
Porpoptank River	Tanyard	No	Concrete Ramp	1	37° 27' 17" N 37.4548078	76° 40' 5"W -76.6679753
Directions: From Gloucester, Rt 14 North (4.3 miles); Left on Rt 613 (3.3 miles); Right on Rt 610 (.6 miles); left on Rt 617 (.5 miles)						
Ware River	Warehouse	Yes	Concrete Ramp	1	37° 24' 11" N 37.4031611	76° 29' 23"W -76.4896286
Directions: East of Gloucester on Rt 621						
York River	Gloucester Point	Yes	Concrete Ramp	2	37° 14' 45" N 37.2457058	76° 30' 17"W -76.5048003
Directions: Town of Gloucester Point, Rt 1208 – TEMPORARILY CLOSED						
VDGIF, 2015						

In addition to VDGIF there is a list of other public boat ramps throughout the County, including:

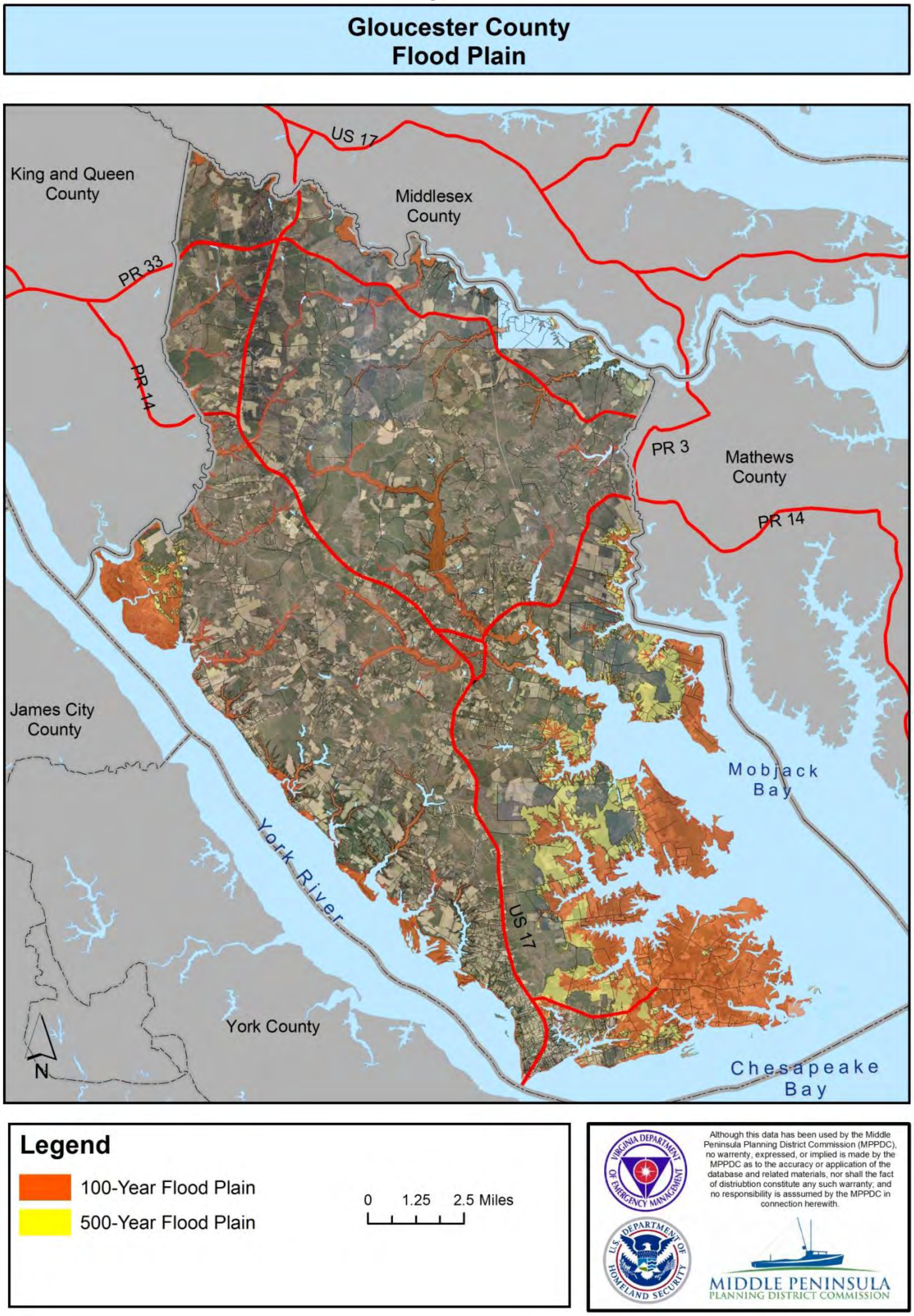
- ***Cappahosic Landing Location***: End of Cappahosic Road. York River Access. Bank fishing, beach, Picnicking, limited parking, and restrooms - May thru October. Park area maintained by Gloucester County while the Landing is maintained by VDOT.
- ***Cedar Bush, Oliver's Landing Location***: End of Cedar Bush Road. York River Access. Gravel ramp and finger pier. Maintained by Gloucester County and VDOT.
- ***Field's Landing***: End of Field's Landing Road. York River Access. Car top boats only, no trailer access. Maintained by VDOT.
- ***Glass Point Landing***: End of Glass Road. Severn River Access. Car top boats only, no trailer access Maintained by Gloucester County and VDOT.
- ***Gloucester Point Beach Park Location***: End of Greate Road, next to Coleman Bridge. York River Access. Sandy beach, swimming, picnicking, outdoor showers – seasonal, restrooms, playground, fishing pier, parking and two landings. One landing is maintained by Gloucester County and one by DGIF (see above for details).
- ***John's Point Landing*** - End of John's Point Road . Small boats only, gravel ramp and sand ramp for car top boats : Fishing Parking Maintained by Gloucester County and VDOT

- ***Miller's Landing*** - car top boats only, no trailer access Location: End of Miller's Landing Road Poropotank River Access Fishing Parking Maintained by VDOT
- ***Payne's Landing***: End of Paynes Landing Road. Ware River Access. Car top boats only, no trailer access. Maintained by Gloucester County.

Repetitive and Severe Repetitive Loss Residential Structures in Gloucester County
According to FEMA's records, Gloucester County has 146 (ie.141 Single Family, 1 Non-Residential, 3 Assmd Condo, and 1 2-4 Family properties) Repetitive Loss properties and 13 (i.e. 11 Single Family and 2 non-residential properties) Severe Repetitive Losses as of 5/31/15.

Properties In 100-year Floodplain by Census Block Group
The following series of maps show the location of structures in Gloucester County that are in Flood Zone A, Flood Zone AE or Flood Zone VE. This 2004 information is the latest structure data available. The legend is color coded to indicate the specific flood zone in which each structure lies.

Figure 65:



Gloucester County
Flood Plain
US 17
King and Queen
County
Middlesex
County
PR 33
PR 14
PR 3
Mathews
County
PR 14
James City
County
Mobjack
Bay
York River
US 17
York County
N
Chesapeake
Bay
Legend
100-Year Flood Plain
500-Year Flood Plain
0 1.25 2.5 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 66:

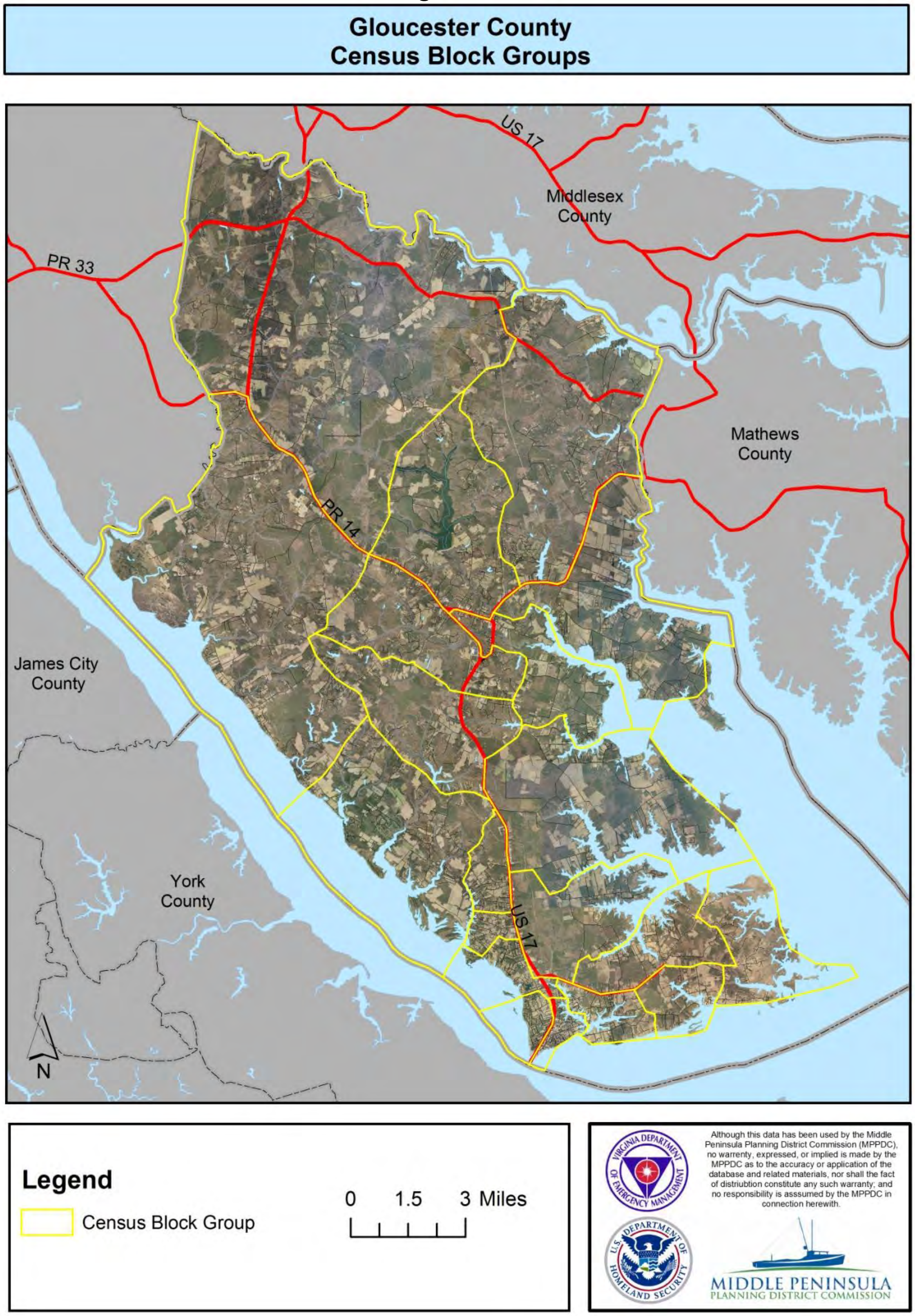

Gloucester County
Census Block Groups
US 17
Middlesex County
PR 33
Mathews County
PR 14
James City County
York County
US 17
N
Legend
Census Block Group
0 1.5 3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 67:

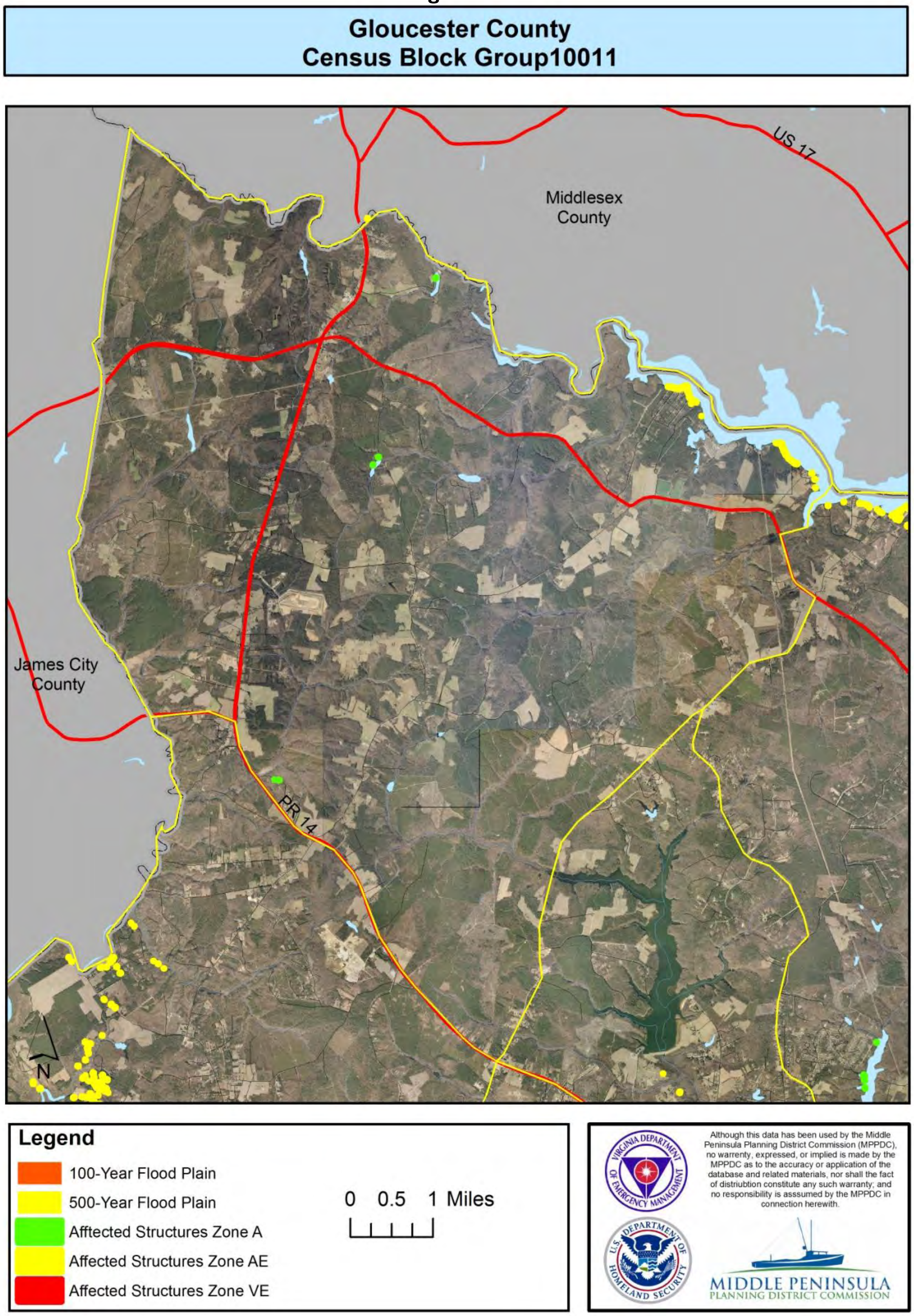

Gloucester County
Census Block Group10011
US 17
Middlesex County
James City County
PR 14
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Afftected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warranty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 68:

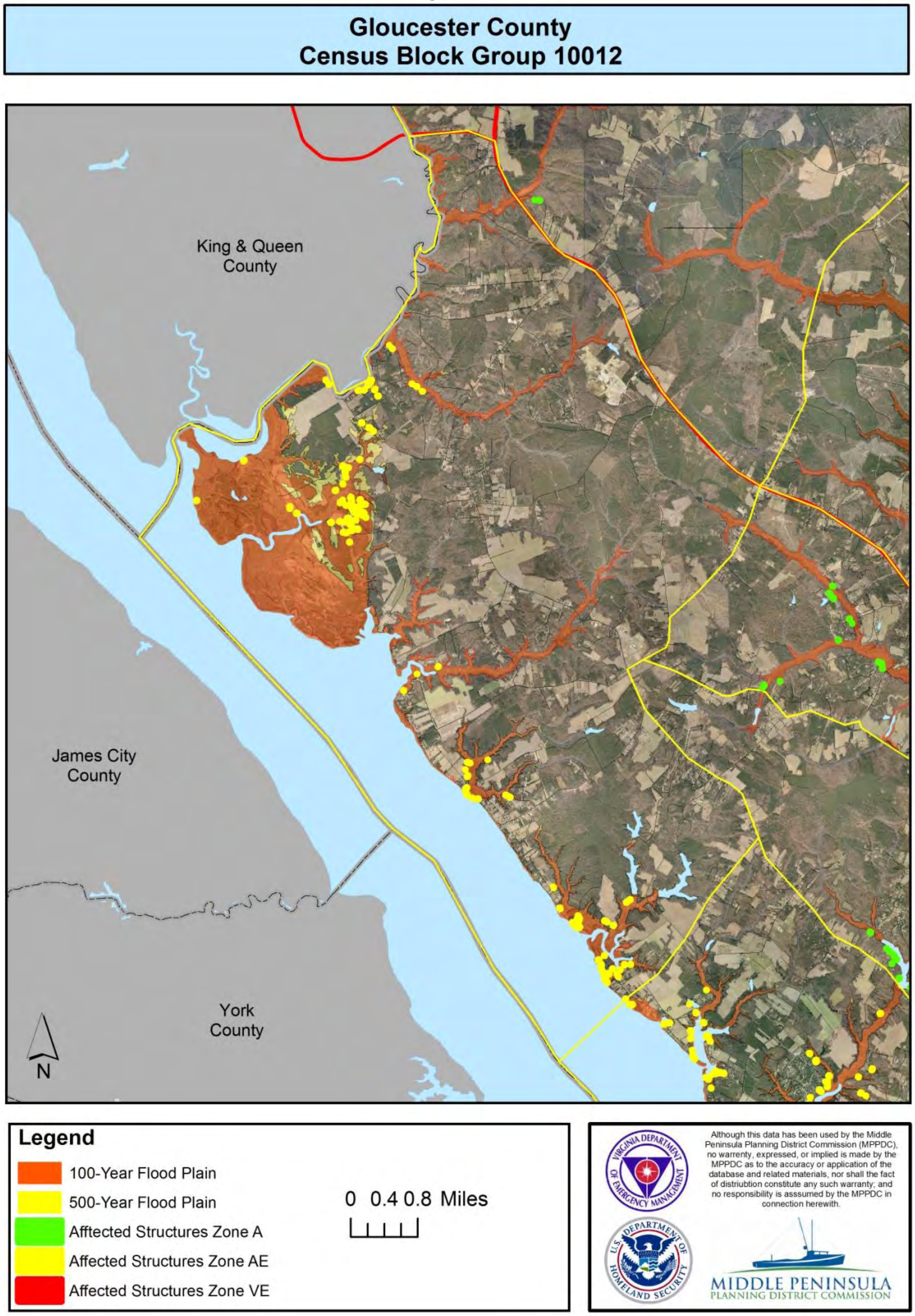

Gloucester County
Census Block Group 10012
King & Queen
County
James City
County
York
County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Afftected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.4 0.8 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 69:

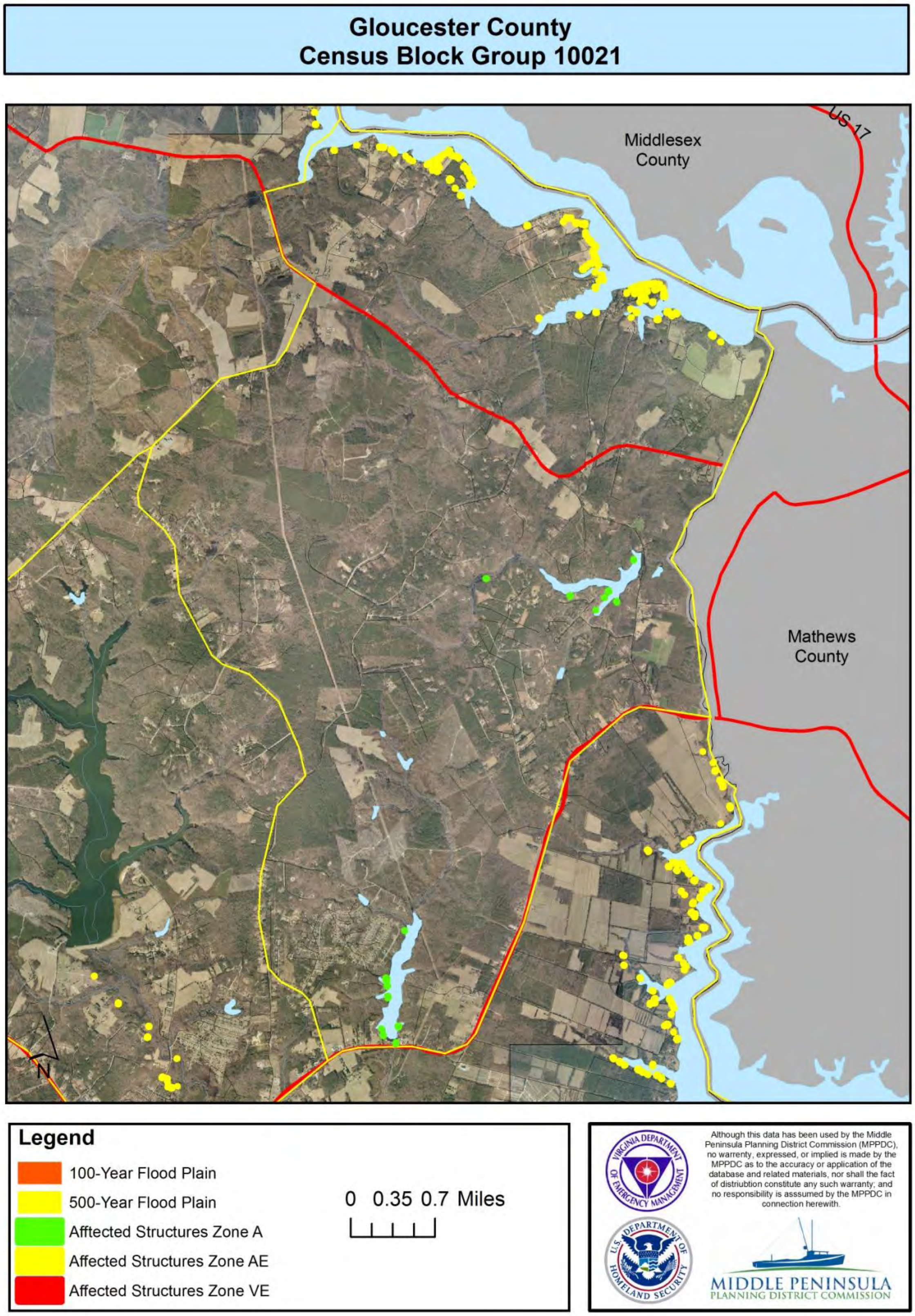
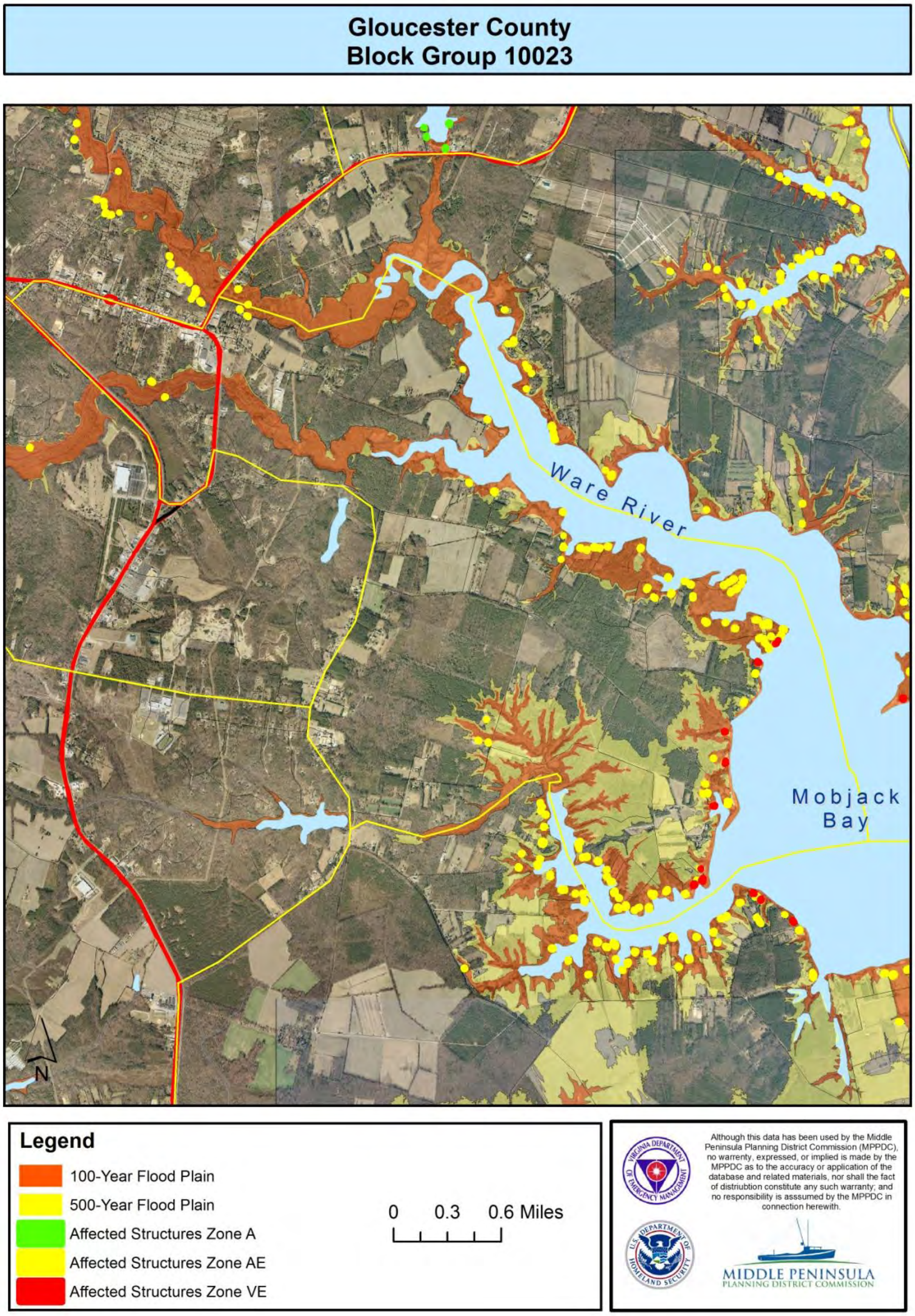

Gloucester County
Census Block Group 10021
Middlesex County
US 17
Mathews County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Afftected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.35 0.7 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT
U.S. DEPARTMENT OF HOMELAND SECURITY
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 70:



Gloucester County
Block Group 10023
Ware River
Mobjack Bay
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.3 0.6 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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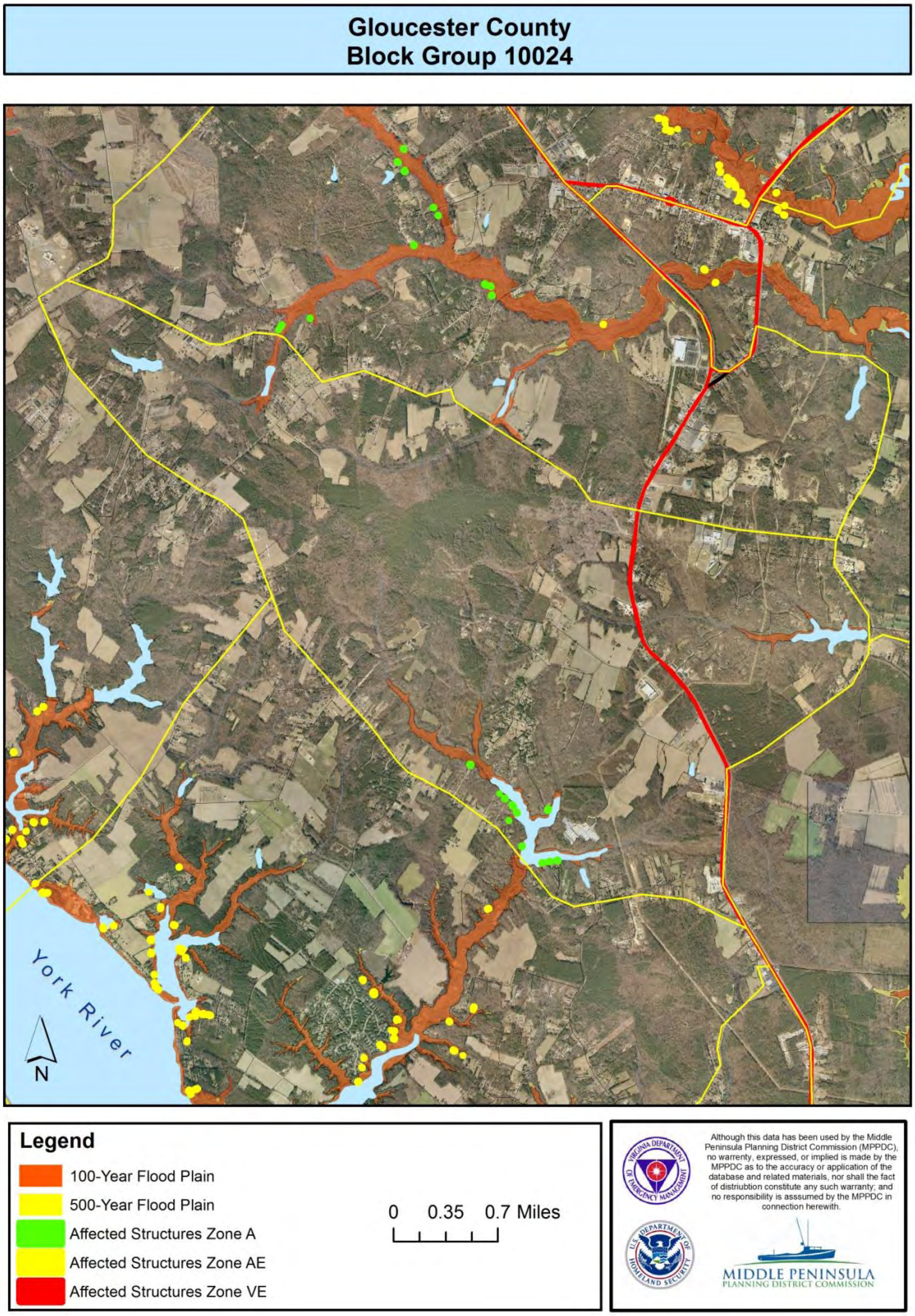
PLANNING DISTRICT COMMISSION

Figure 71:



Gloucester County
Block Group 10024
York River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.35 0.7 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 72:

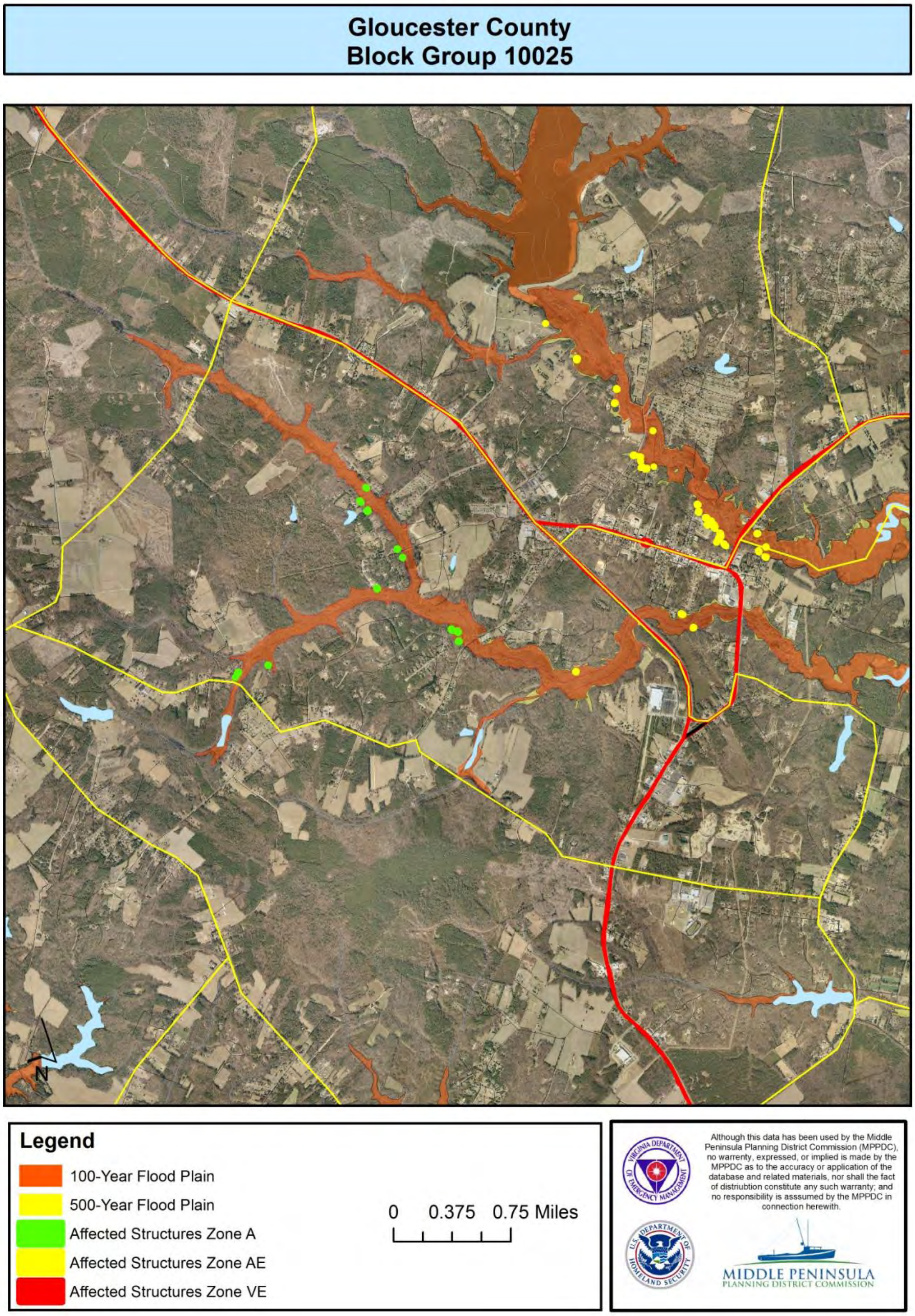
Gloucester County
Block Group 10025
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.375 0.75 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 73:

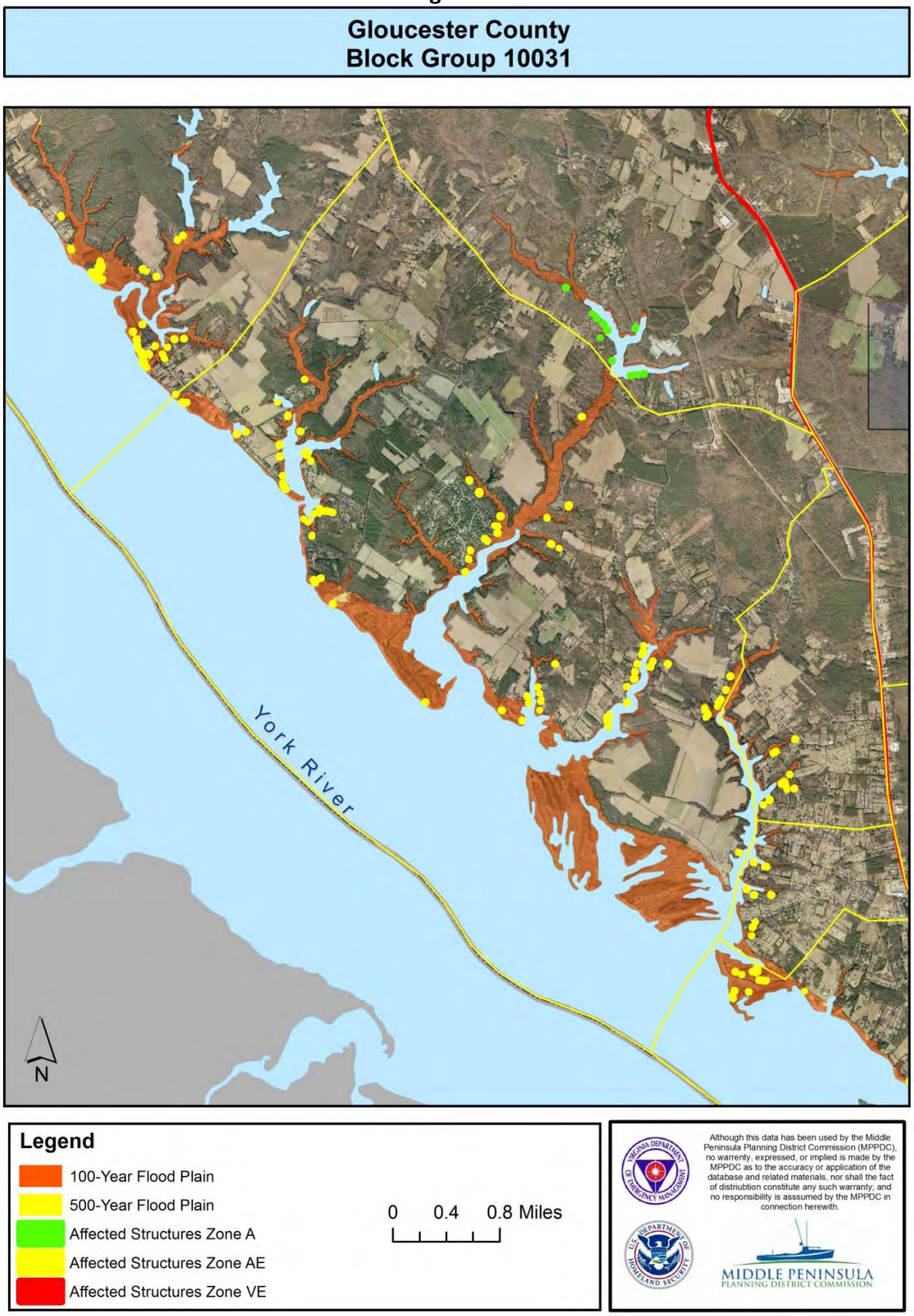
Gloucester County
Block Group 10031
York River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.4 0.8 Miles
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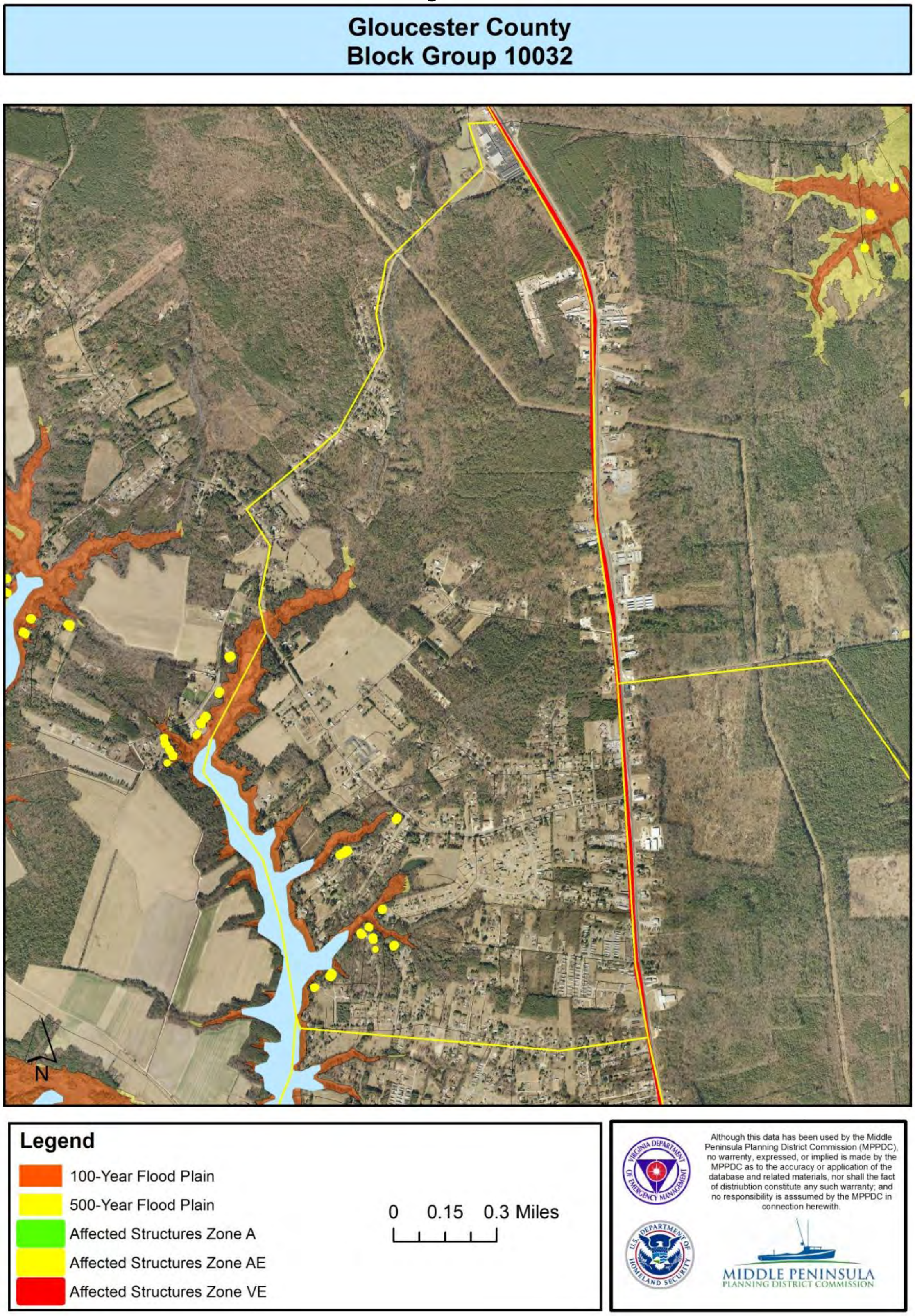
Figure 74:



Gloucester County
Block Group 10032
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.15 0.3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 75:

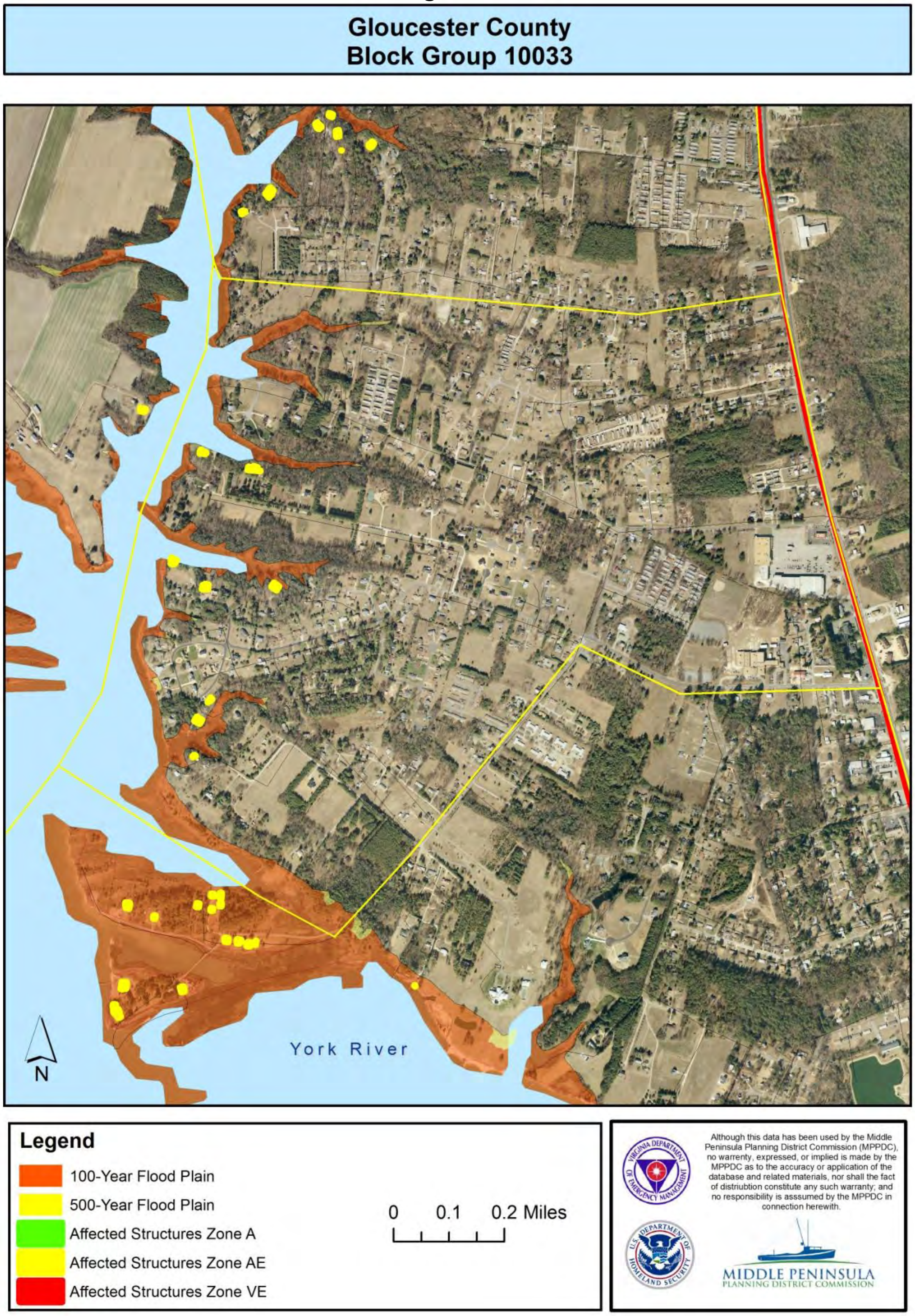
Gloucester County
Block Group 10033
York River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.1 0.2 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 76:

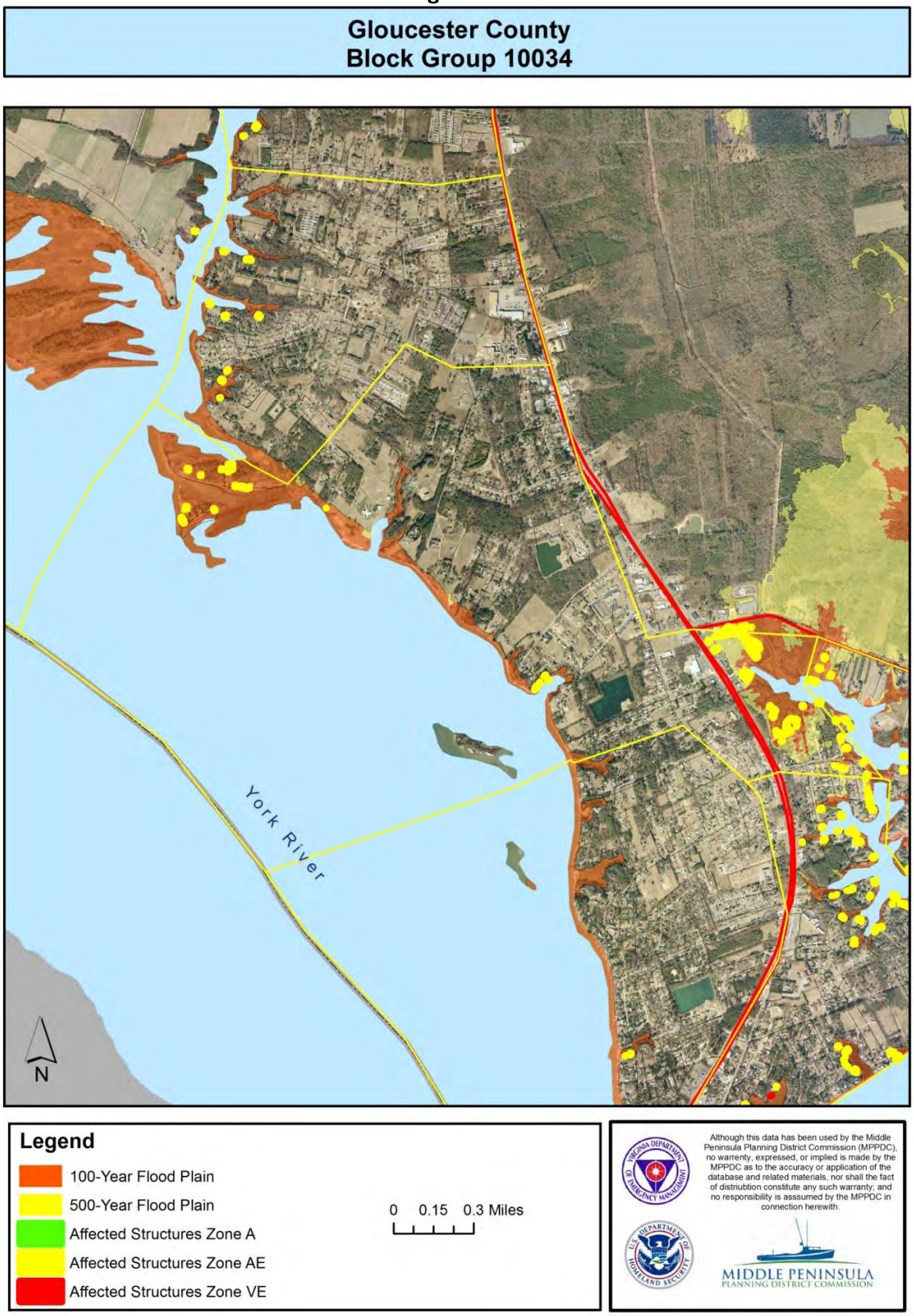
Gloucester County
Block Group 10034
York River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.15 0.3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 77:

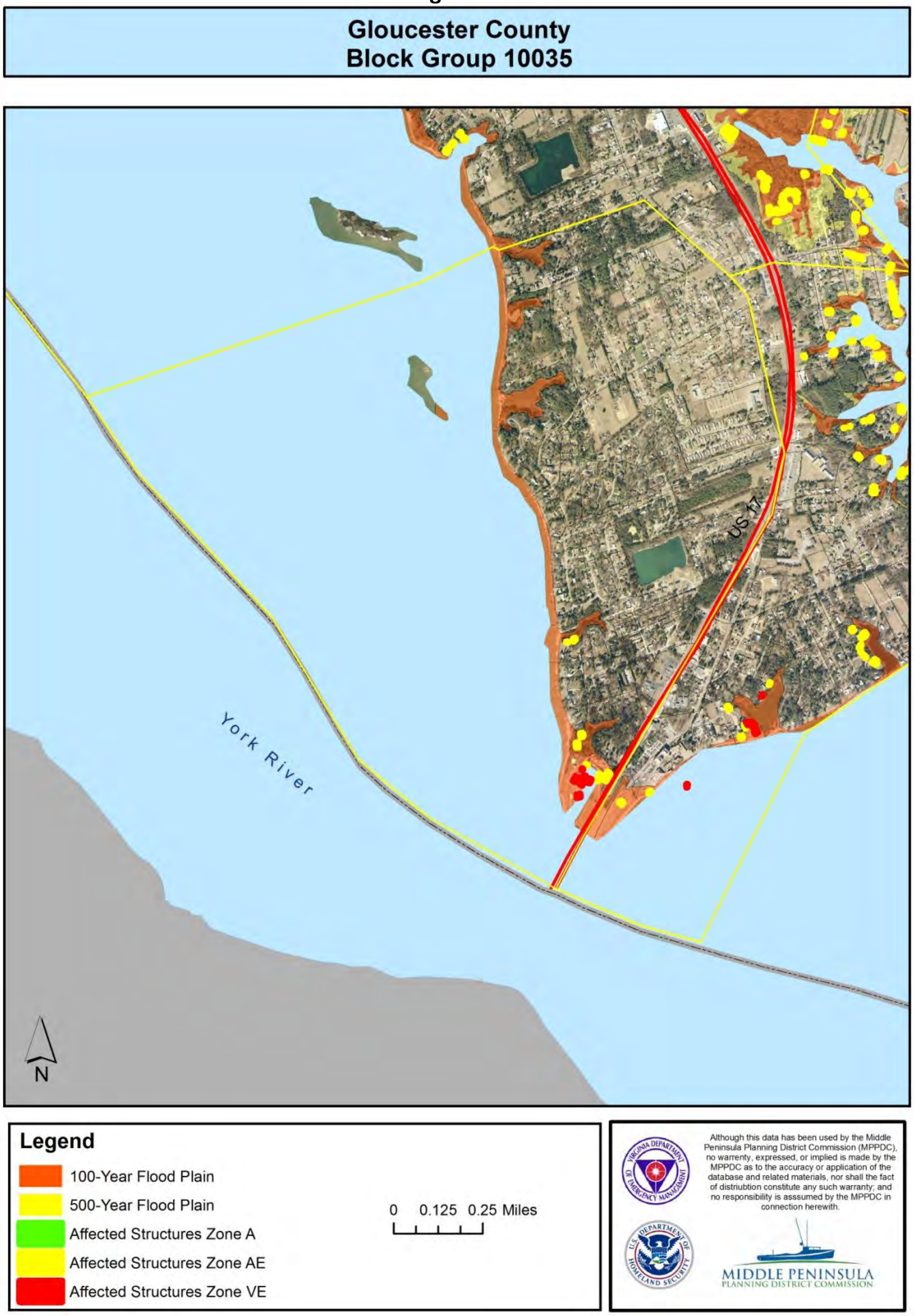
Gloucester County
Block Group 10035
US 17
York River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.125 0.25 Miles
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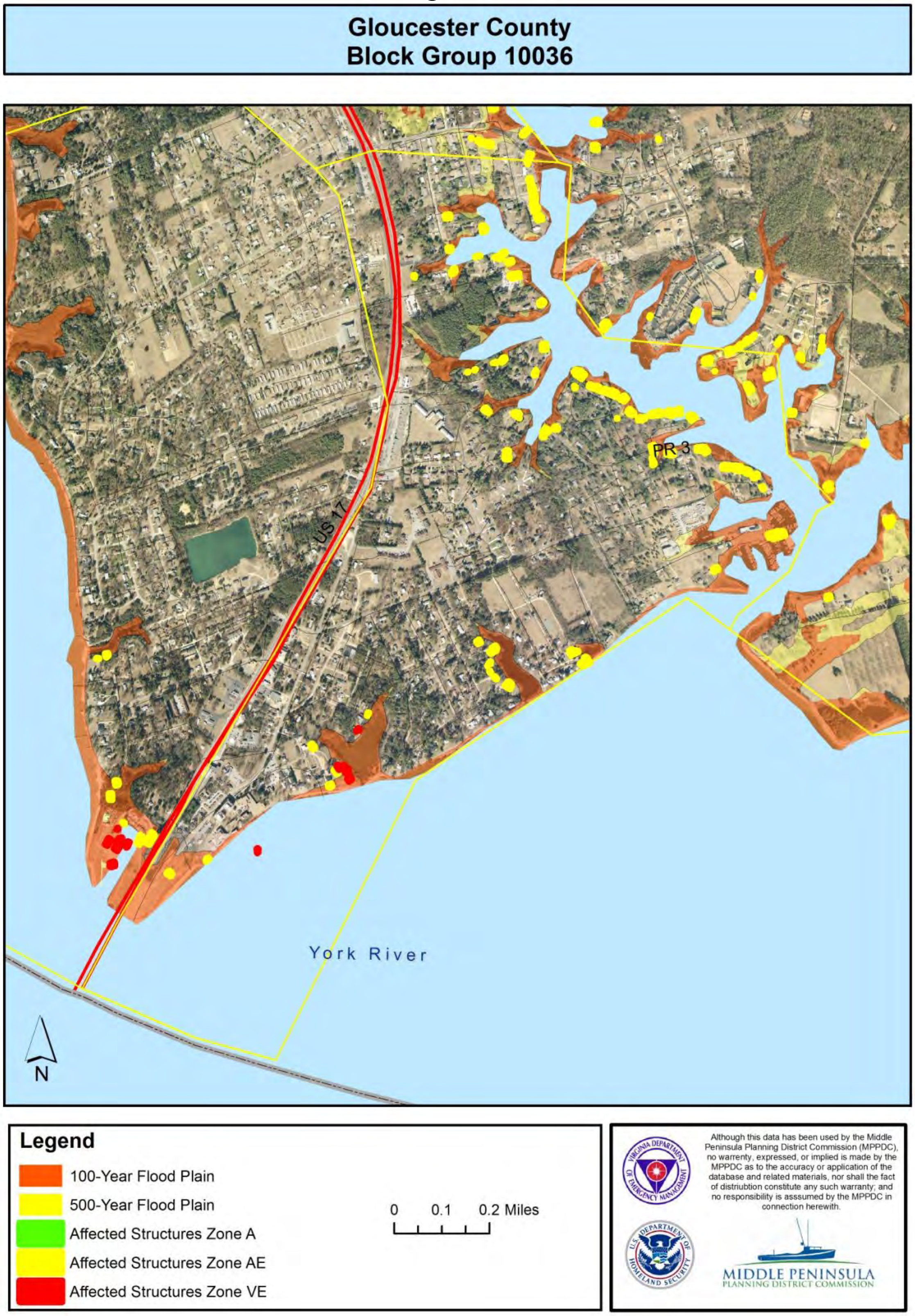
Figure 78:



Gloucester County
Block Group 10036
US 17
PR 3
York River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.1 0.2 Miles
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