1969 - Westland Beach - Windmill Point Shoreline Stabilization Project

Application Details

Funding Opportunity:	1447-Virginia Community Flood Preparedness Fund - Project Grants - CY23 Round 4
Funding Opportunity Due Date:	Nov 12, 2023 11:59 PM
Program Area:	Virginia Community Flood Preparedness Fund
Status:	Under Review
Stage:	Final Application
Initial Submit Date:	Nov 10, 2023 11:29 AM
Initially Submitted By:	Olivia Hall
Last Submit Date:	
Last Submitted By:	

Contact Information

Primary Contact Information

Active User*: Yes

Type: External User

Name*: Mrs. (Salutation) Olivia (First Name) Leahanne (Middle Name) Hall (Last Name)

Title: Director of Planning & Land Use

Email*: ohall@lancova.com

Address*: 8311 Mary Ball Road

Lancaster (City) Virginia (State/Province) 22503 (Postal Code/Zip)

Phone*: 804-462-5081 Ext.
Phone
###-###-####

Fax: ###-###-####

Comments:

Organization Information

Status*: Approved

Name*: Lancaster County

Organization Type*: County Government

Tax ID*: 54-6001382

Unique Entity Identifier (UEI)*: REGTREN9KDV6

Organization Website: http://lancova.com

Address*: 8311 Mary Ball Road

Lancaster Virginia 22503-
City State/Province Postal Code/Zip

Phone*: 804-462-5081 Ext.
###-###-####

Fax: ###-###-####

Benefactor:

Vendor ID:

Comments:

VCFPF Applicant Information

Project Description

Name of Local Government*: Lancaster County

Your locality's CID number can be found at the following link: Community Status Book Report

NFIP/DCR Community Identification Number (CID)*: 510084

If a state or federally recognized Indian tribe,

Name of Tribe:

Authorized Individual*: Olivia Hall
First Name Last Name

Mailing Address*: 8311 Mary Ball Road
Address Line 1

Address Line 2

Lancaster Virginia 22503
City State Zip Code

Telephone Number*: 804-462-5081

Cell Phone Number*: 804-436-6147

Email*: ohall@lancova.com

Is the contact person different than the authorized individual?

Contact Person*: No

Enter a description of the project for which you are applying to this funding opportunity

Project Description*:

Westland Beach-Windmill Point has lost 110 feet of beach shoreline in the past decade. The Westland Beach-Windmill Point Shoreline Stabilization project is a public/private partnership which will use a multi-faceted approach of armor stone breakwaters, armor spurs and nature-based solutions, including beach nourishment and beach and dune vegetation planting to stabilize 1,324 feet or eroding shoreline along the Rappahannock River.

Low-income geographic area means any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. A project of any size within a low-income geographic area will be considered.

Is the proposal in this application intended to benefit a low-income geographic area as defined above?

Benefit a low-income geographic area*: Yes

Information regarding your census block(s) can be found at census.gov

Census Block(s) Where Project will Occur*: 2040

Is Project Located in an NFIP Participating Community?*: Yes

Is Project Located in a Special Flood Hazard Area?*: Yes

Flood Zone(s) (if applicable): AE5 & AE6

Flood Insurance Rate Map Number(s) (if applicable):

Eligibility CFPF - Round 4 - Projects

Eligibility

Is the applicant a local government (including counties, cities, towns, municipal corporations, authorities, districts, commissions, or political subdivisions created by the General Assembly or pursuant to the Constitution or laws of the Commonwealth, or any combination of these)?

Local Government*: Yes

Yes - Eligible for consideration
No - Not eligible for consideration

Does the local government have an approved resilience plan and has provided a copy or link to the plan with this application?

Resilience Plan*: Yes

Yes - Eligible for consideration under all categories
No - Eligible for consideration for studies, capacity building, and planning only

If the applicant is not a town, city, or county, are letters of support from all affected local governments included in this application?

Letters of Support*: N/A

Yes - Eligible for consideration
No - Not eligible for consideration
N/A - Not applicable

Has this or any portion of this project been included in any application or program previously funded by the Department?

Previously Funded*: No

Yes - Not eligible for consideration
No - Eligible for consideration

Has the applicant provided evidence of an ability to provide the required matching funds?

Evidence of Match Funds*: Yes

Yes - Eligible for consideration
No - Not eligible for consideration
N/A - Match not required

Scoring Criteria for Flood Prevention and Protection Projects - Round 4

Scoring

Category Scoring:
Hold CTRL to select multiple options

Project Category*: Any other nature-based approach

Is the project area socially vulnerable? (based on ADAPT Virginia?s Social Vulnerability Index Score)
Social Vulnerability Scoring:
Very High Social Vulnerability (More than 1.5)
High Social Vulnerability (1.0 to 1.5)
Moderate Social Vulnerability (0.0 to 1.0)
Low Social Vulnerability (-1.0 to 0.0)
Very Low Social Vulnerability (Less than -1.0)

Socially Vulnerable*: Moderate Social Vulnerability (0.0 to 1.0)

Is the proposed project part of an effort to join or remedy the community?s probation or suspension from the NFIP?

NFIP*: No

Is the proposed project in a low-income geographic area as defined below?

"Low-income geographic area" means any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. A project of any size within a low-income geographic area will be considered.

Low-Income Geographic Area*: Yes

Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?

Reduction of Nutrient and Sediment Pollution*: No

Does this project provide ?community scale? benefits?

Community Scale Benefits*: More than one census block

Expected Lifespan of Project

Expected Lifespan of Project*: Over 20 Years

Comments:

VIMS breakwater system data was consulted to determine the useful life of the project. The oldest data that they have on breakwaters is 37 years old. Based on this, we assigned 37+ years as the useful life.

Scope of Work - Projects - Round 4

Scope of Work

Upload your Scope of Work

Please refer to Part IV, Section B. of the grant manual for guidance on how to create your scope of work

Scope of Work*: Scope of Work.pdf

Comments:

Scope of Work is attached.

Budget Narrative

Budget Narrative Attachment*: Budget Narrative.pdf

Comments:

Scope of Work Supporting Information - Projects

Supporting Information - Projects

Provide population data for the local government in which the project is taking place

Population*: 10928.00

Provide information on the flood risk of the project area, including whether the project is in a mapped floodplain, what flood zone it is in, and when it was last mapped. If the property or area around it has been flooded before, share information on the dates of past flood events and the amount of damage sustained

Historic Flooding data and Hydrologic Studies*: HISTORIC FLOODING DATA FLOOD INFO.pdf

Include studies, data, reports that demonstrate the proposed project minimizes flood vulnerabilities and does not create flooding or increased flooding (adverse impact) to other properties

No Adverse Impact*: PERMITS AND COMMENTS FROM STATE AND FEDS AND VIMS BREAKWATER STUDY.pdf

Include supporting documents demonstrating the local government's ability to provide its share of the project costs. This must include an estimate of the total project cost, a description of the source of the funds being used, evidence of the local government's ability to pay for the project in full or quarterly prior to reimbursement, and a signed pledge agreement from each contributing organization

Ability to Provide Share of Cost*: LETTER OF AGREEMENT.pdf

A benefit-cost analysis must be submitted with the project application

Benefit-Cost Analysis*: Benefit-Cost Analysis - Updated Nov 7 2023.pdf

Provide a list of repetitive loss and/or severe repetitive loss properties. Do not provide the addresses for the properties, but include an exact number of repetitive loss and/or severe repetitive loss structures within the project area

Repetitive Loss and/or Severe Repetitive Loss Properties*: Lancaster County Coastal Flood Reported Property Damage Graph.pdf

Describe the residential and commercial structures impacted by this project, including how they contribute to the community such as historic, economic, or social value. Provide an exact number of residential structures and commercial structures in the project area

Residential and/or Commercial Structures*:

This public/private partnership between the County of Lancaster and the Windmill Point Marina owner will provide the marina with a stabilized shoreline, protecting the marina infrastructure and buildings while also providing public access by expanding and protecting the County's only public beach. The Marina tenants and guests will benefit from this shoreline stabilization project through its protection against erosion of the beach and the protection of Marina infrastructure against property damage related to erosion and storm damage. This project will also include shoreline protection for the neighboring community, The Landing Townhomes at Windmill Point. There are eight townhomes adjacent to this project that will benefit from stabilization of their shoreline. In addition to protection of the private infrastructures (including critical infrastructure (the Windmill Point Marina)), the shoreline (including public beach access and private beach), and VDOT infrastructure (Windmill Point Road) will also be better protected from storm damage, continued erosion and the subsequent migration of mean high water. The Windmill Point Marina has historically served as a community gathering place and a port in a storm. The Marina continues to serve in both capacities. We hope with the stabilization of the shoreline and the revitalization and expansion of the public beach, will provide added economic value in the form of recreation and tourism opportunities. Calmer waters resulting from the breakwaters will provide opportunities for the community to fish, view the waterfront, wade, swim, nature bathe (eco therapy based on Shinrin-Yoku), paddle, baptize, and perform other beach and water activities. This public access will include a fishing pier. The fishing pier will provide a place for residents and visitors to catch fish either recreationally or to supplement their diets. The fishing pier construction was not included in this grant request and will be paid for by the County's Capital Improvement budget.

If there are critical facilities/infrastructure within the project area, describe each facility

Critical Facilities/Infrastructure*:

Critical facilities/infrastructure includes the Windmill Point Marina (which serves as a port in storms) and the adjacent County boat ramp. This public access boat ramp to the Rappahannock River continues to be well used and loved by the community. In addition to recreational and commercial boating, the ramp serves as a launching spot for marine emergency services.

Explain the local government's financial and staff resources. How many relevant staff members does the local government have? To what relevant software does the local government have access? What are the local government's capabilities?

Financial and Staff Resources*:

The County's match will be paid for using monies from the FY2023 Capital Improvement budget. Lancaster County has the following relevant staff members: County Administrator, Director of Planning & Land Use, two Environmental/Codes Compliance Inspectors, two maintenance staff, a permit technician, one solid waste management staff, one Building Official, and a soon to be hired Parks Coordinator. The County utilizes GIS mapping and Microsoft Office Suite. The County employees are adept in maintenance, grant writing, grant implementation, plan review, inspection, and permitting. In 2002 a Citizens Advisory Group was formed to address the need for public access to state waters in Lancaster County. Their report contained specific recommendations for expansion of public access to the state waters while acknowledging obstacles. In 2005, the Virginia General Assembly enabled the formation of the Northern Neck Chesapeake Bay Public Access Authority (NNCBPAA). On September 12, 2006, three counties in the Northern Neck - Lancaster, Northumberland and Westmoreland executed the operating agreement to form the Northern Neck Chesapeake Bay Public Access Authority to enhance public access within their jurisdictions. There are seven duties that the authority is charged with undertaking: 1. Identify land, either owned by the Commonwealth or private holdings that can be secured for use by the general public as a public access site, 2. Research and determine ownership of all identified sites, 3. Determine appropriate public use level of identified access sites, 4. Develop appropriate mechanisms for transferring title of Commonwealth or private holdings to the Authority, 5. Develop appropriate acquisition and site management plans for public access usage, 6. Determine which holdings should be sold to advance the mission of the Authority, 7. Perform other duties required to fulfill the mission of the Northern Neck Chesapeake Bay Access Authority. In October 2007 at the seventh meeting of the Northern Neck Chesapeake Bay Public Access Authority, Lancaster County representatives requested funding from the NNCBPAA to conduct environmental studies on a potential access site on a tributary to the Chesapeake Bay within Lancaster County. The NNCBPAA granted this request for funding to be used by Lancaster County in assessing the suitability of the parcel for public water access.

Identify and describe the goals and objectives of the project. Include a description of the expected results of the completed project and explain the expected benefits of the project. This may include financial benefits, increased awareness, decreased risk, etc.

Goals and Objectives*:

The Lancaster County Comprehensive plan includes three goals related to shoreline protection: (1) Actively encourage shoreline protection measures that are equal to the erosion potential at a particular site; (2) Encourage vegetative enhancement of Resource Protection Area (RPA) sections; and (3) Encourage coordinated shoreline protection efforts in existing waterfront communities and in new subdivisions. The County's Comprehensive Plan encourages setting aside open space for conservation purposes. The Westland Beach - Windmill Point Shoreline Stabilization

Project will protect the eroding shoreline, add vegetation plantings, and set an example of a coordinated shoreline protection strategy through a public/private partnership. The Westland Beach - Windmill Point project will stabilize a shoreline, stopping the risk of ongoing erosion due to unbridled wave action and destructive wave energy. Both public and private property and infrastructure will be protected. Public beach access will also be expanded to around 400 ft through an agreement/easement with the Marina. If this project is not implemented, continued erosion of the shoreline will eventually result in total loss of the 50' public beach access, which is the only public beach access in Lancaster County. Continued erosion will also result in the loss of private beaches and dunes (both at the Windmill Point Marina and at The Landing Owners Association property). Windmill Point Road (VDOT infrastructure) will continue to be damaged. Continued erosion of the shoreline will put Windmill Point Marina infrastructure at risk, including critical infrastructure. The installed breakwaters will provide habitat for aquatic organisms. Stabilization of the shoreline will help prevent sedimentation of the Rappahannock River in this area and the nearby oyster beds and aquatic ecosystem, thus improving water quality. A stabilized shoreline will be more resilient against the 100-year storm and will be better equipped to weather the changing climate, including resilience to increased storm frequency, increased high tide flood events and rising sea levels. The revitalization of the beach will provide recreation and tourism opportunities to the community.

Outline a plan of action laying out the scope and detail of how the proposed work will be accomplished with a timeline identifying expected completion dates. Determine milestones for the project that will be used to track progress. Explain what deliverables can be expected at each milestone, and what the final project deliverables will be. Identify other project partners

Approach, Milestones, and Deliverables*: Schedule Deliverables and Partners.pdf

Where applicable, briefly describe the relationship between this project and other past, current, or future resilience projects. If the applicant has received or applied for any other grants or loans, please identify those projects, and, if applicable, describe any problems that arose with meeting the obligations of the grant and how the obligations of this project will be met

Relationship to Other Projects*:

Lancaster County completed the installation of a Public Boat Ramp at Windmill Point in 2016. This project was funded in part with a Large Power Boating Access Grant in the amount of $150,000.00 through the Virginia Department of Game and Inland Fisheries. Initial planning for the project began in 2014 and originally the County was up against opposition from the community, as there were concerns regarding access to the ramp using an existing community access road. The county worked with the local community to resolve this concern. Ultimately, the County installed a separate and improved access road for the community, thus removing their opposition to the project. A joint permit application was submitted to the Virginia Marine Resources Commission, the Virginia Department of Environmental Quality, and the Army Corps of Engineers for review. All permitting requirements were met (including nonpoint nutrient offset credit and phragmites eradication plan) and approved February 2016. Final site plans were prepared March 2016 and requests for bid and award of base bid occurred in April of 2016. Change orders totaled $91,555.00 for a final construction cost of $413,962.00. Construction began May 16, 2016 and was completed on time and under the Capital Improvement budgeted amount. VDGIF approved final construction and authorized $150,000.00 in grant reimbursement on September 19, 2016. This boat ramp and courtesy pier were named in honor of Frederick H. Ajootian, past chairman of the Lancaster County Wetlands Board, who was a lifelong advocate for public access in Lancaster County. This public access to the Rappahannock River continues to be well used and loved by the community and in addition to recreational and commercial boating, the ramp serves as a launching spot for marine emergency services. The County has worked hard to address community concerns regarding this project, including purchasing an adjacent oyster lease which may have been affected by the project, and being transparent and open with community members to achieve our common goal of shoreline stabilization. The County continues to work with community members to address any and all concerns.

For ongoing projects or projects that will require future maintenance, such as infrastructure, flood warning and response systems, signs, websites, or flood risk applications, a maintenance, management, and monitoring plan for the projects must be provided

Maintenance Plan*: MAINTENANCE AGREEMENT AND MAINTENANCE PLAN.pdf

Describe how the project meets each of the applicable scoring criteria contained in Appendix B. Documentation can be incorporated into the Scope of Work Narrative

Criteria*:

This hybrid approach resulting in a nature-based solution to shoreline stabilization serves more than one census block. The project is located in an area which scores as moderate for social vulnerability but will serve other areas of the county with a lower social vulnerability. The expected lifespan of the project is over 20 years. This project is not the result of an NFIP suspension. The proposed project will benefit a low-income geographic area. VIMS shoreline study is included in the benefit cost analysis and a VIMS breakwater study is included in this packet.

Budget

Budget Summary

Grant Matching Requirement*:	Projects that will result in nature-based solutions - Fund 70%/Match 30%
Total Project Amount*:	$2,319,119.00
REQUIRED Match Percentage Amount:	$695,735.70

BUDGET TOTALS

Before submitting your application be sure that you meet the match requirements for your project type.

Match Percentage: 30.00%

Verify that your match percentage matches your required match percentage amount above.

Total Requested Fund Amount: $1,623,383.30

Total Match Amount: $695,735.70

TOTAL: $2,319,119.00

Personnel

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Fringe Benefits

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Travel

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Equipment

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Supplies

Description	Requested Fund Amount	Match Amount	Match Source
Dredging Channel Markers	$7,000.00	$3,000.00	Lancaster County FY23 Approved Capital Improvement Budget Project
Beach Nourishment with Dredge Materials	$52,430.00	$22,470.00	Lancaster County FY23 Approved Capital Improvement Budget Project
Beach Nourishment with Imported Materials	$401,191.00	$171,939.00	Lancaster County FY23 Approved Capital Improvement Budget Project
Beach Re-vegetation	$48,974.80	$20,989.20	Lancaster County FY23 Approved Capital Improvement Budget Project
	$509,595.80	**$218,398.20**	

Construction

Description	Requested Fund Amount	Match Amount	Match Source
Demolition & Clearing	$73,150.00	$31,350.00	FY23 Capital Improvement Budget
Breakwater Installation	$567,087.50	$243,037.50	FY23 Capital Improvement Budget
Marina Channel Mechanical Dredge	$337,050.00	$144,450.00	FY23 Capital Improvement Budget
Dredge Material Dewatering Area -Install, Maintain, Remove	$17,500.00	$7,500.00	FY23 Capital Improvement Budget
	$994,787.50	**$426,337.50**	

Contracts

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Maintenance Costs

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Pre-Award and Startup Costs

Description	Requested Fund Amount	Match Amount	Match Source

No Data for Table

Other Direct Costs

Description	Requested Fund Amount	Match Amount	Match Source
Mobilization and Permitting	$119,000.00	$51,000.00	Lancaster County FY23 Adopted Capital Improvement Budget Project
	$119,000.00	**$51,000.00**	

Long and Short Term Loan Budget - Projects - VCFPF

Budget Summary

Are you applying for a short term, long term, or no loan as part of your application?

If you are not applying for a loan, select "not applying for loan" and leave all other fields on this screen blank

Long or Short Term*: Not Applying for Loan

Total Project Amount: $0.00

Total Requested Fund Amount: $0.00

TOTAL: $0.00

Salaries

Description	Requested Fund Amount

No Data for Table

Fringe Benefits

Description	Requested Fund Amount

No Data for Table

Travel

Description	Requested Fund Amount

No Data for Table

Equipment

Description	Requested Fund Amount
No Data for Table	

Supplies

Description	Requested Fund Amount
No Data for Table	

Construction

Description	Requested Fund Amount
No Data for Table	

Contracts

Description	Requested Fund Amount
No Data for Table	

Other Direct Costs

Description	Requested Fund Amount
No Data for Table	

Supporting Documentation

Supporting Documentation

Named Attachment	Required	Description	File Name	Type	Size	Upload Date
Detailed map of the project area(s) (Projects/Studies)		Joint Permit Application drawing showing project location. Maps will also be included as additional attachments.	WESTLAND BEACH - WINDMILL POINT PLAN.pdf	pdf	1 MB	11/09/2023 04:28 PM
FIRMette of the project area(s) (Projects/Studies)		FIRMette	FIRMette.pdf	pdf	694 KB	11/09/2023 04:29 PM
Historic flood damage data and/or images (Projects/Studies)		Photos illustrating loss of 110 ft of beach in the past decade.	Westland Beach - Windmill Point Aerial Comparison 2006 - 2022.pdf	pdf	266 KB	11/09/2023 04:24 PM
A link to or a copy of the current floodplain ordinance		Lancaster County Floodplain Ordinance	LANCASTER COUNTY FLOODPLAIN ORDINANCE.pdf	pdf	1 MB	11/09/2023 03:29 PM
Maintenance and management plan for project		Maintenance Agreement and Maintenance Plan	MAINTENANCE AGREEMENT AND MAINTENANCE PLAN.pdf	pdf	46 KB	11/09/2023 05:12 PM

A link to or a copy of the current hazard mitigation plan	Hazard Mitigation Plan	PLAN - 2018 Northern Neck Hazard Mitigation - FINAL.pdf	pdf	26 MB	11/09/2023 03:28 PM
A link to or a copy of the current comprehensive plan	Here is a link to the Lancaster County Comprehensive Plan: http://lancova.com/page2.asp?pageID=70	Click here to view the Lancaster County Comprehensive Plan.docx	docx	12 KB	11/09/2023 03:23 PM
Social vulnerability index score(s) for the project area	According to the CDC, the 2018 overall social vulnerability index for the area including the Westland Beach-Windmill Point Shoreline Stabilization Project was 0.431, which is a low to moderate level of vulnerability. However, this index does not apply to all of Lancaster County. There are areas of the County with a social vulnerability index of 0.6168, which is a moderate to high level of vulnerability (see attached 2018 Social Vulnerability Index Map for Lancaster County).	CDC Social Vulnerability Index for Lancaster County.pdf	pdf	1 MB	11/09/2023 03:27 PM
Authorization to request funding from the Fund from governing body or chief executive of the local government	This letter of agreement serves as authorization.	LETTER OF AGREEMENT.pdf	pdf	26 KB	11/09/2023 03:47 PM
Signed pledge agreement from each contributing organization	Letter of Agreement	LETTER OF AGREEMENT.pdf	pdf	26 KB	11/09/2023 03:46 PM
Maintenance Plan	Maintenance Agreement and Maintenance Plan	MAINTENANCE AGREEMENT AND MAINTENANCE PLAN.pdf	pdf	46 KB	11/09/2023 05:12 PM

Benefit-cost analysis must be submitted with project applications over $2,000,000. in lieu of using the FEMA benefit-cost analysis tool, applicants may submit a narrative to describe in detail the cost benefits and value. The narrative must explicitly indicate the risk reduction benefits of a flood mitigation project and compares those benefits to its cost-effectiveness.

Benefit Cost Analysis	This BCA was updated to reflect an increase in estimated cost.	Benefit-Cost Analysis - Updated Nov 7 2023.pdf	pdf	8 MB	11/09/2023 03:49 PM
Other Relevant Attachments	This document includes the following: Qualitative Evaluation of project, endangered species review and response, permits, comments on project from various state and federal agencies.	ADDITIONAL DOCUMENTS.pdf	pdf	27 MB	11/09/2023 05:33 PM

Letters of Support

Description	File Name	Type	Size	Upload Date
	No files attached.			

Resilience Plan

Resilience Plan

Description	File Name	Type	Size	Upload Date
DCR approval letter of the Norther Neck Planning District Commission's Hazard Mitigation Plan as the Resilience Plan.	NNPDC RP Approval 2023.pdf	pdf	146 KB	11/09/2023 02:23 PM
DCR approval of using the Northern Neck Planning District Commission's Hazard Mitigation Plan/Resilience Plan as Lancaster County's Resilience Plan.	Lancaster NNPDC RP Approval 2023.pdf	pdf	207 KB	11/09/2023 02:17 PM
Letter requesting approval of the County's use of the Northern Neck Planning District Commission's Hazard Mitigation / Resilience Plan as the County's Resilience Plan.	LANCASTER CO RESILIENCE PLAN AFFIRMATION LETTER.pdf	pdf	829 KB	11/09/2023 02:20 PM
The Northern Neck Hazard Mitigation Plan, which also serves at the County's Resilience Plan.	PLAN - 2018 Northern Neck Hazard Mitigation - FINAL.pdf	pdf	26 MB	11/09/2023 02:25 PM

Travis A. Voyles
Acting Secretary of Natural and Historic Resources

Matthew S. Wells
Director

Andrew W. Smith
Chief Deputy Director

COMMONWEALTH of VIRGINIA

DEPARTMENT OF CONSERVATION AND RECREATION

Frank N. Stovall
Deputy Director for Operations

Darryl Glover
Deputy Director for Dam Safety, Floodplain Management and Soil and Water Conservation

Laura Ellis
Deputy Director for Administration and Finance

November 6, 2023

Olivia Hall
Director of Planning and Land Use
County of Lancaster
8311 Mary Ball Road
Lancaster, VA 22503

RE: Resilience Plan Submission

Dear Ms. Hall,

Thank you for submitting Lancaster County's affirmation of intent to use the Northern Neck Planning District Commission's Hazard Mitigation Plan / Resilience Plan as the County's Resilience Plan. The Department of Conservation and Recreation confirmed that NNPDC's plan met the criteria specified in the 2021 Community Flood Preparedness Fund grant manual. A detailed review of the plan is attached for your records.

Lancaster County is now eligible to submit applications in the "project" category of the Community Flood Preparedness Fund. This approval will remain in effect for a period of three years, ending November 6, 2026.

VA DCR looks forward to working with you as you strive to make Lancaster County more resilient. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Angela Davis, State NFIP Coordinator and Acting Director
Division of Floodplain Management

cc: Darryl M. Glover, DCR

Travis A. Voyles
Acting Secretary of Natural and Historic Resources

Matthew S. Wells
Director

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COMMONWEALTH of VIRGINIA
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Frank N. Stovall
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Laura Ellis
Deputy Director for Administration and Finance

September 28, 2023

Jerry Davis, AICP
Executive Director
Northern Neck Planning District Commission
P.O. Box 1600
457 Main Street
Warsaw, VA 22572

RE: NNPDC Resilience Plan Submission

Dear Mr. Davis,

Thank you for submitting the Northern Neck Planning District Commission's Resilience Plan. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete, meeting all criteria outlined in the 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending September 28, 2026.

The following elements were evaluated as part of this review:

Element 1: It is project-based with projects focused on flood control and resilience.

Meets criteria as written. The *2023 Northern Neck Regional Hazard Mitigation Plan (NNHMP),* includes flood resilience projects at both regional and locality scales. Section 9, "Mitigation Action Plan," explains that these projects derive from re-examination of the 2017 HMP, results of RAFT scorecards, preparation for joining the Community Rating System, and direct engagement with localities.

Element 2: It incorporates nature-based infrastructure to the maximum extent possible.

Meets criteria as written. Proposed projects span many categories including planning, regulations, flood preparedness outreach, technical assistance and warning systems. Nature-based solutions, both structural and non-structural figure prominently. These include natural resource protection measures such as land acquisition, slope stabilization, erosion control, riparian buffers, and wetland restoration.

Element 3: It considers of all parts of a locality regardless of socioeconomics or race.

Meets criteria as written. The *Comprehensive Economic Development Strategy* (*CEDS*) and the- "Community Profile" section of the *NNHMP* discuss the prevalence and distribution of minority populations, low-income households, elderly, disabled and non-English speaking residents across member localities. According to *CEDS*, over 30% of the Northern Neck population has three or more risk factors that could impede their personal resilience. Goal #5 of the *NNHMP* "Mitigation Action Plan," specifically targets these vulnerable populations for preparedness outreach, and localities list increased emergency communication efforts for these populations as potential projects of high priority.

Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for implementation.

Meets criteria as written. Virginia's *Coastal Resilience Master Plan (CRMP)* of 2021, local Comprehensive Plans, NNPDC's *CEDS*, and the *Regional Water Supply Plan* all serve as direct sources for context and action items listed in the *2023 Northern Neck Hazard Mitigation Plan*. *ASCE 24-5: Flood Resistant Design and Construction* provides a reference for several of the proposed planning items, as improved compliance with the NFIP and higher standards are critical elements for achieving resilience. Table 9.4 of *NNHMP* ranks the importance of each project and gives timelines for completion.

Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.

Meets criteria as written. Sections 6 and 7 of the *NNHMP* assess the current and future risks posed to member localities by climate change, sea level rise, and storm surge. In addition to firsthand experiential data, sources include "*The North Atlantic Coast Comprehensive Study*" from USACE, "*Future Sea Level and Recurrent Flooding Risk Report for Coastal Virginia*" from the Commonwealth Center for Recurrent Flooding Resiliency, and other reports of both state and federal origin (listed in Appendix B).

VA DCR looks forward to working with you as you strive to make the NNPDC's member localities more resilient. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Angela Davis, State NFIP Coordinator and Acting Director
Division of Floodplain Management

cc: Darryl M. Glover, DCR

COUNTY OF LANCASTER

FOUNDED 1651 IN VIRGINIA

LANCASTER COURTHOUSE
8311 MARY BALL ROAD
LANCASTER, VIRGINIA 22503

804-462-5129
804-462-0031 (FAX)
www.lancova.com

Don G. Gill
County Administrator

October 27, 2023

Stacey Farinholt, CFM PLA
Floodplain Program Planner
Virginia Department of Conservation and Recreation
600 East Main St.
Richmond, VA 23219

Re: NNPDC/Lancaster County Resilience Plan

Dear Ms. Farinholt,

On September 28, 2023, the Department of Conservation confirmed, in a letter to the Northern Neck Planning District Commission, that the Northern Neck Planning District Commission's Resilience Plan, which is also the 2023 Northern Neck Hazard Mitigation Plan, meets all criteria outlined in the 2021 Community Flood Preparedness Grant Manual and was approved for a period of three years, remaining in effect until September 28, 2026.

Lancaster County submits this letter of affirmation stating the County's intention to use the 2023 Northern Neck Hazard Mitigation Plan/Resilience Plan as the County's Resilience Plan, until September 28, 2026.

The Lancaster County Board of Supervisors approved the resolution to adopt the 2023 Northern Neck Hazard Mitigation Plan on March 30, 2023. A copy of this adopted resolution is attached. Thank you for your consideration of this request.

Sincerely,

Don G. Gill

Don G. Gill
County Administrator

Cc Jerry Davis, NNPDC

A RESOLUTION
ADOPTED BY THE LANCASTER COUNTY BOARD OF SUPERVISORS

2023 NORTHERN NECK REGIONAL HAZARD MITIGATION PLAN ADOPTION RESOLUTION

WHEREAS, the municipalities of the Northern Neck Region are most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to FEMA, a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, Lancaster County acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the *2023 Northern Neck Regional Hazard Mitigation Plan* has been developed by the Northern Neck Planning District Planning Commission in cooperation with other Commonwealth agencies, local municipal officials, and the citizens of the Northern Neck Region, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the *2023 Northern Neck Regional Hazard Mitigation Plan*, and

WHEREAS, Representatives from Lancaster County actively engaged and participated in the development of the *2023 Northern Neck Regional Hazard Mitigation Plan*, attended meetings of the Hazard Mitigation Planning Committee, completed a Capabilities Assessment for Lancaster County, and provided recommendations for mitigation activities, and

WHEREAS, the *2023 Northern Neck Regional Hazard Mitigation Plan* recommends mitigation activities that will reduce losses to life and property affected by both natural and human-made hazards that face the County and its municipal governments,

NOW THEREFORE BE IT RESOLVED by the Lancaster County Board of Supervisors that:

1. The *2023 Northern Neck Regional Hazard Mitigation Plan* is hereby adopted as the official Hazard Mitigation Plan of the Northern Neck Planning District Commission and the County of Lancaster, and

2. The respective officials and agencies identified in the implementation strategy of the *2023 Northern Neck Regional Hazard Mitigation Plan* are hereby directed to implement the recommended activities assigned to them.

Adopted this 30th day of March 2023

Attest: Don G. Gill

Don G. Gill
County Administrator

Travis A. Voyles
Acting Secretary of Natural and Historic Resources

Matthew S. Wells
Director

Andrew W. Smith
Chief Deputy Director

Frank N. Stovall
Deputy Director
for Operations

Darryl Glover
Deputy Director for
Dam Safety,
Floodplain Management and
Soil and Water Conservation

Laura Ellis
Deputy Director for
Administration and Finance

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

September 28, 2023

Jerry Davis, AICP
Executive Director
Northern Neck Planning District Commission
P.O. Box 1600
457 Main Street
Warsaw, VA 22572

RE: NNPDC Resilience Plan Submission

Dear Mr. Davis,

Thank you for submitting the Northern Neck Planning District Commission's Resilience Plan. After careful review and consideration, the Virginia Department of Conservation and Recreation has deemed the Plan complete, meeting all criteria outlined in the 2021 Community Flood Preparedness Grant Manual. This approval will remain in effect for a period of three years, ending September 28, 2026.

The following elements were evaluated as part of this review:

Element 1: It is project-based with projects focused on flood control and resilience.

Meets criteria as written. The *2023 Northern Neck Regional Hazard Mitigation Plan (NNHMP),* includes flood resilience projects at both regional and locality scales. Section 9, "Mitigation Action Plan," explains that these projects derive from re-examination of the 2017 HMP, results of RAFT scorecards, preparation for joining the Community Rating System, and direct engagement with localities.

Element 2: It incorporates nature-based infrastructure to the maximum extent possible.

Meets criteria as written. Proposed projects span many categories including planning, regulations, flood preparedness outreach, technical assistance and warning systems. Nature-based solutions, both structural and non-structural figure prominently. These include natural resource protection measures such as land acquisition, slope stabilization, erosion control, riparian buffers, and wetland restoration.

Element 3: It considers of all parts of a locality regardless of socioeconomics or race.

Meets criteria as written. The *Comprehensive Economic Development Strategy* (*CEDS*) and the- "Community Profile" section of the *NNHMP* discuss the prevalence and distribution of minority populations, low-income households, elderly, disabled and non-English speaking residents across member localities. According to *CEDS*, over 30% of the Northern Neck population has three or more risk factors that could impede their personal resilience. Goal #5 of the *NNHMP* "Mitigation Action Plan," specifically targets these vulnerable populations for preparedness outreach, and localities list increased emergency communication efforts for these populations as potential projects of high priority.

Element 4: It includes coordination with other local and inter-jurisdictional projects, plans, and activities and has a clearly articulated timeline or phasing for implementation.

Meets criteria as written. Virginia's *Coastal Resilience Master Plan (CRMP)* of 2021, local Comprehensive Plans, NNPDC's *CEDS*, and the *Regional Water Supply Plan* all serve as direct sources for context and action items listed in the *2023 Northern Neck Hazard Mitigation Plan*. *ASCE 24-5: Flood Resistant Design and Construction* provides a reference for several of the proposed planning items, as improved compliance with the NFIP and higher standards are critical elements for achieving resilience. Table 9.4 of *NNHMP* ranks the importance of each project and gives timelines for completion.

Element 5: Is based on the best available science, and incorporates climate change, sea level rise, storm surge (where appropriate), and current flood maps.

Meets criteria as written. Sections 6 and 7 of the *NNHMP* assess the current and future risks posed to member localities by climate change, sea level rise, and storm surge. In addition to firsthand experiential data, sources include "*The North Atlantic Coast Comprehensive Study*" from USACE, "*Future Sea Level and Recurrent Flooding Risk Report for Coastal Virginia*" from the Commonwealth Center for Recurrent Flooding Resiliency, and other reports of both state and federal origin (listed in Appendix B).

VA DCR looks forward to working with you as you strive to make the NNPDC's member localities more resilient. If you have questions or need additional assistance, please contact us at cfpf@dcr.virginia.gov. Again, thank you for your interest in the Community Flood Preparedness Fund.

Sincerely,

Angela Davis, State NFIP Coordinator and Acting Director
Division of Floodplain Management

cc: Darryl M. Glover, DCR

Northern Neck Regional Hazard Mitigation Plan 2017 Update
January 2018

Lancaster County

Town of Irvington

Town of Kilmarnock

Town of White Stone

Northumberland County

Richmond County

Town of Warsaw

Westmoreland County

Town of Colonial Beach

Town of Montross

This report was funded in part by the Federal Emergency Management Agency through the Virginia Department of Emergency Management via grant agreement number PDM-2016-006 for $71,675.00.

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1.0 Executive Summary

1.1 Hazard Mitigation

Hazard mitigation is commonly defined as sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects. A hazard mitigation plan states the aspirations and specific courses of action that a community intends to follow to reduce vulnerability and exposure to future hazard events. These plans are formulated through a systematic process centered on the participation of citizens, businesses, public officials, and other community stakeholders.

A multi-jurisdictional hazard mitigation plan is the physical representation of a group of local jurisdictions' commitment to reduce risks from natural hazards. Local officials can refer to the plan in their day-to-day activities and in decisions regarding land use and planning decisions, regulation and ordinance creation and enforcement, granting permits, capital improvement investments, and other community initiatives. Additionally, multi-jurisdictional hazard mitigation plans can serve as the basis for states to prioritize future grant funding as it becomes available.

The *Northern Neck Regional Hazard Mitigation Plan 2017 Update* will continue to be a useful tool for all community stakeholders by increasing public awareness about local hazards and risks, and providing information about options and resources available to reduce those risks. Educating the public about potential hazards will help each jurisdiction protect itself against the effects of future hazards, and will enable informed decision-making regarding where to live, purchase property, or locate business.

The 2011 plan was updated during 2017 by the Northern Neck Planning District Commission. The 2017 version of the plan includes the most recent population, demographics, a review of all mitigation strategies, goals, and objectives, and a review and update of most maps.

1.2 Authority

Beginning in 2003, the Commonwealth of Virginia encouraged the twenty-one planning districts in the Commonwealth to take the lead on development of local hazard mitigation plans. These plans, which are required by the Disaster Mitigation Act of 2000 (DMA 2000), help local governments determine risks and vulnerabilities and identify projects to reduce these risks. The Northern Neck Regional Hazard Mitigation Plan was developed through the coordination of the Northern Neck Planning District Commission (NNPDC). It should be noted that the area covered by this plan includes the unincorporated areas of Lancaster, Northumberland, Richmond, and Westmoreland Counties. Towns included in this plan are Colonial Beach, Irvington, Kilmarnock, Montross, Warsaw, and White Stone.

The communities of the Northern Neck have established a Local Emergency Planning Committee (LEPC) to address local emergency management issues. Members of the LEPC are appointed by resolution by the counties. The mission of this committee was closely aligned to the needs of a Mitigation Advisory Committee. The planning district commission, therefore, decided to utilize the existing LEPC as its Mitigation Advisory Committee. Representatives included county administrators, planning directors, emergency services staff, school board officials, local non-profits and state agencies such as the Virginia Department of Transportation.

1.3 Planning Area

The Northern Neck is a coastal region that is situated within easy driving distance of the major urban centers of Richmond, Norfolk, and Northern Virginia. The region is bordered to the east by the Chesapeake Bay, and situated between the Potomac River to the north and the Rappahannock River to the south.

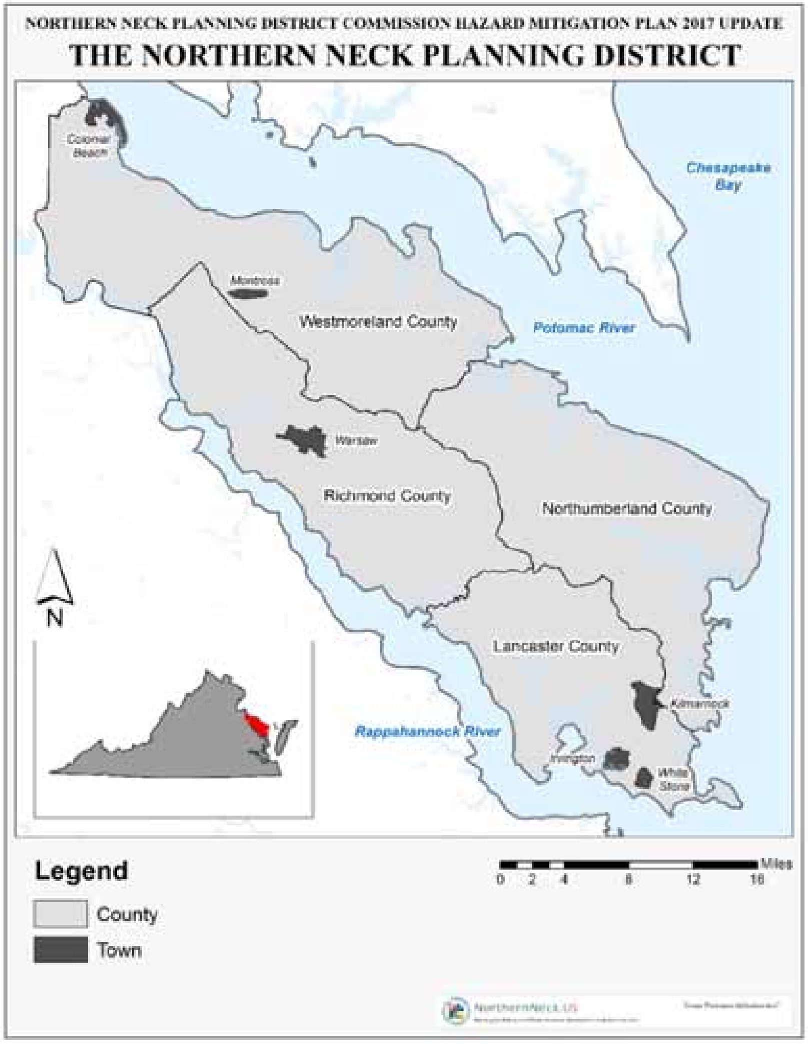

Figure 1-1. Northern Neck Planning District

1.4 Planning Committee Membership

The following agencies are designated members of the Mitigation Advisory Committee:

Table 1-1. Northern Neck Local Emergency Planning Committee 2017

Name	Title	Affiliation
Jerry W. Davis	Executive Director	NNPDC
John Bateman	Regional Planner	NNPDC

Table 1-1. Northern Neck Local Emergency Planning Committee 2017

Name	Title	Affiliation
Alex Eguiguren	Technical Assistant	NNPDC
Frank Pleva	County Administrator	Lancaster County
Wally Beauchamp	Board of Supervisors	Lancaster County
Terrence McGregor	Chief of Emergency Services	Lancaster County
Heather Brown	Department Coordinator	Lancaster County
Luttrell Tadlock	County Administrator	Northumberland County
Rick McClure	Emergency Services Chief	Northumberland County
Stuart McKenzie	County Planner	Northumberland County
Morgan Quicke	County Administrator	Richmond County
Greg Baker	Emergency Services Chief	Richmond County
Mitch Paulette	Captain	Richmond County
Jeff Beasley	Emergency Services Chief	Westmoreland County
David Farmer	Assistant Chief Emergency Services	Westmoreland County
Beth McDowell	Planner	Westmoreland County
Darrin Lee	Planner	Westmoreland County
Bill Cease	IT Director	Westmoreland County
Val Foulds	Town Manager	Town of Colonial Beach
Bob Hardesty	Town Administrator	Town of Irvington
Marshall Sebra	Planning/Zoning Administrator	Town of Kilmarnock
Patricia Lewis	Town Manager	Town on Montross
Patrick Frere	Town Manager	Town of White Stone
Tricia Chappell	VDEM Region V	VDEM
Andy John	Response & Recovery VDEM Region V	VDEM
Amy S. Howard	Grant Administrator	VDEM

1.5 Hazard Identification and Risk Assessment

The Hazard Identification and Risk Assessment (HIRA) is a key component of a hazard mitigation plan because it provides the solid fact base on which to base mitigation goals and strategies. The HIRA consists of three components:

1. Identification of hazards that could affect the Northern Neck
2. Profiling hazard events and determining what areas and community assets are the most vulnerable to damage from these hazards
3. Estimation of losses and prioritization of potential risks to the community

Hazards were ranked by the steering committee and reevaluated during the planning process to determine the hazards with the largest impact on the Northern Neck communities. Certain hazards such as tsunami were not addressed due to the infrequency of occurrence and/or limited impact. The “severe weather” hazard category includes thunderstorm, severe wind, lightning and hail. Table 1-2 summarizes the results of the hazard identification, which are explained fully in Section 4 of this plan.

Table 1-2. Northern Neck Hazard Planning Consideration Levels

Hazard	Planning Consideration
Coastal Flooding	Significant
Riverine Flooding	Significant
Hurricane	Significant
Tornado	Significant
Coastal Erosion	Medium
Severe Weather	Medium
Wildfire	Low
Winter Storm	Low
Drought	Low
Earthquake	Low

The HIRA describes each of these hazards in varying levels of detail consistent with the planning consideration level. In general, coastal flooding, riverine flooding, hurricanes, and tornados were found to be the most significant hazards in the Northern Neck.

1.6 Mitigation Goals and Strategies

The Northern Neck committee members used the results of the Hazard Identification and Risk Assessment (HIRA) as well as the Capability Assessment to develop goals and inform updated strategies, actions and projects for the region and their jurisdictions. The priorities differ somewhat from jurisdiction to jurisdiction. Each jurisdiction's priorities were developed based on historical damages, existing exposure to risk, community goals, and weaknesses identified in the Capability Assessment.

Mitigation strategy status on the 2011 Hazard Mitigation strategies, actions and projects may be found in Appendix C. Some strategies were completed and have outlived their relevancy while others are ongoing programmatic activities which are included in the new strategies outlined in Section 5.0 and listed in more detail in Appendix D.

The new 2017 to 2022 mitigation strategy, action and project types were re-organized into six categories shown in Table 1-3 that better correspond to County and Town government department organization, programs, and plans.

Table 1-3. Mitigation Categories and Project Types

Category	Project Type
Prevention	• Planning and zoning • Building codes • Open space preservation • Floodplain regulations • Stormwater management regulations • Drainage system maintenance • Capital improvements programming • Shoreline/riverine setbacks
Property Protection	• Acquisition/Demolition • Relocation • Building elevation • Critical facilities protection • Retrofitting (i.e., wind-proofing, floodproofing, seismic design) • Safe rooms, shutters, shatter-resistant glass • Insurance
Natural Resource Protection	• Land acquisition • Floodplain protection • Watershed management • Beach and dune preservation • Riparian buffers • Forest and vegetation management (i.e., fire resistant landscaping, fuel breaks) • Erosion and sediment control • Wetland preservation and restoration • Habitat preservation • Slope stabilization • Historic properties and archaeological site preservation
Structural Projects	• Reservoirs • Dams/levees/dikes/floodwalls/seawalls • Diversions/detention/retention • Channel modification • Beach nourishment • Storm sewers
Emergency Services	• Warning systems • Evacuation planning and management • Emergency response training and exercises • Sandbagging for flood protection • Installing temporary shutters for wind protection

Table 1-3. Mitigation Categories and Project Types

Category	Project Type
Education & Awareness	• Outreach projects • Speaker series/demonstration events • Hazard mapping • Real estate disclosure • Library materials • School children educational programs • Hazard expositions

In addition, MAC members and their staff identified and prioritized mitigation strategies for their organizations and programs who were engaged by email or phone conversations. Priorities were developed from data collected on past damages, existing exposure to risk, community goals, and needs based on local knowledge of County and Town needs.

The committee members reviewed the 2011 plan goals and revised them twice, at the April 5, 2017 HIRA and Mitigation Goals Meeting and at the final May 31, 2017 Goals, Actions and Plan Implementation Meeting. The 2017 – 2022 Updated plan goals are:

Goal 1: Promote new development that avoids undue risks posed by natural hazards and is resilient to natural disasters.

Goal 2: Address natural hazards and vulnerabilities that represent a threat to the community.

Goal 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents, property and critical infrastructure of the Northern Neck.

Goal 4: Enhance the capabilities of local government to address natural hazards to enhance the whole community for increased resilience.

Goal 5: Increase natural hazard awareness of our citizens. Educate Northern Neck citizens and part-time residents on citizen and community hazard resilience.

Goal 6: Participate and Comply with the National Flood Insurance Program (NFIP) through floodplain identification, mapping and floodplain management.

In addition, the committee reviewed the objectives and strategies from the previous plan update during a lengthy discussion at the May 31, 2017 committee meeting. At that time they discussed success stories and lessons learned along with actions worthy of continuing for the 2017 to 2022 planning cycle. Mitigation actions were organized into six strategy types further discussed in Section 5.0.

- Prevention
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Services
- Education and Outreach

Through discussions had by email, in person, and on the phone, 2011 actions to continue were supplemented with new 2017 to 2022 strategies, actions and projects. These were identified and prioritized for the planning district commission and each jurisdiction. Communities shared common strategies as well as developed community-specific actions that varied somewhat from jurisdiction to jurisdiction. Each jurisdiction's strategies were developed based on past damages, existing exposure to risk, community goals, and weaknesses identified in the Capability Assessment.

1.7 Capability Assessment, Implementation and Maintenance

The Capability Assessment evaluates the current capacity of the communities of the Northern Neck to mitigate the effects of the natural hazards identified in the Hazard Identification and Risk Assessment. By providing a summary of each jurisdiction's existing capabilities, the Capability Assessment serves as the foundation for designing an effective hazard mitigation strategy. Table 1-4 summarizes the results of the Capability Self-Assessment provided by participating jurisdictions.

Table 1-4. Community Capability Self-Assessment Results

Jurisdiction	Mitigation Assigned to Specific Department	GIS	Adequate Zoning Staff	Dedicated Floodplain Mgmt. Staff	Building Inspectors	Overall Technical Capabilities
Lancaster County	Yes	Yes (limited)	Yes	Yes	Yes (1)	Moderate
Northumberland County	Yes	Yes	Yes	Yes	Yes	Moderate
Richmond County	Yes	Yes	No	No	Yes	Moderate
Westmoreland County	Yes	Yes	Yes	Yes	Yes	Moderate
NNPDC	No	Yes	Local function	Yes	Local function	High
Town of Colonial Beach	No	Yes	No	No	Yes (1)	Moderate
Town of White Stone	Yes	No	Yes	Yes	No (county)	High
Town of Kilmarnock	Yes	Limited	Yes	Yes	No	Low
Town of Montross	Yes	No (1)	Yes	No (1)	No (1)	Low

High: No increase in capability needed.

Moderate: Increased capability desired but not needed.

Limited: Increased capability needed.

(1): County supports or provides service function

The towns of Irvington and Warsaw did not respond to the capability assessment survey.

The capability assessment evaluates the current capacity of the Northern Neck Planning District Commission and its member local governments to mitigate the effects of the natural hazards identified in the updated hazard identification, risk assessment and vulnerability analysis summarized in Section 4.0. By providing a summary of each jurisdiction's existing programs and policies, the capability assessment serves as the foundation for designing an effective hazard mitigation strategy.

The plan outlines a procedure for implementation, maintenance, and plan updates. The Northern Neck Planning District Commission in partnership with the Local Emergency Planning Committee (LEPC) will be responsible for monitoring this plan. The Planning District Commission will request an annual progress update from the LEPC (Mitigation Advisory

Committee) participants and others designated as "Lead Agencies" for 2017 – 2022 Mitigation Strategies Alliance each January 31. Information will be consolidated and provided in a report to the Virginia Department of Emergency Management (VDEM) and the Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA) Region III. These annual progress reports will begin in 2018 and will include corrective action plans if needed, based on evaluation criteria set by the PDC, MAC or VDEM. In accordance with Federal Emergency Management Agency (FEMA) regulations, a written update will be submitted to the Virginia Department of Emergency Management and FEMA Region III every five years from the original date of the plan, unless circumstances (e.g., Presidential disaster declarations, changing regulations, etc.) require a formal update earlier. The public will be continually informed of changes to the plan as they occur.

1.8 Acknowledgements

The 2017 Plan update was supported by a Hazard Mitigation Assistance Pre-Disaster Mitigation grant program planning grant administered by VDEM with funding from the FEMA. The project was facilitated by Dewberry in Fairfax, Virginia.

1.9 Conclusion

The *Northern Neck Regional Hazard Mitigation Plan 2017 Update* embodies the continued commitment and dedication of the local governments and community members of the region to enhance the safety of residents and businesses by taking action before a disaster strikes. While nothing can be done to prevent natural hazard events from occurring, the region is poised to minimize the disruption and devastation that so often accompanies these disasters.

1.10 Plan Organization

The plan is organized as follows with detailed table and figure lists provided, by section, in the Table of Contents.

Section 1.0 – Executive Summary provides the plan update context of counties, towns, and the planning area which is the area that the Northern Neck Planning District encompasses. The Local Emergency Planning Committee (LEPC) that served as the update project's Mitigation Advisory Committee (MAC) is described, along with the planning process, Hazard Identification Risk Assessment outcome, refreshed mitigation plan goals and a brief summary of updated mitigation action organization and plan implementation.

Section 2.0 – Introduction and Planning Process summarizes the nearly two-decade planning history behind the Disaster Mitigation Act of 2000, its regulatory requirements and the planning process used by the Northern Neck MAC during the plan's update.

Section 3.0 –Community Profile defines the processes followed throughout the update of this plan including a description of stakeholder involvement and outreach. This section also provides a physical and demographic profile of the Northern Neck examining characteristics such as geography, hydrography, development, people, and land uses.

Section 4.0 – Hazard Identification and Risk Assessment evaluates the natural hazards likely to affect or impact the Northern Neck localities, quantifying whom, what, where, and how the area might be affected by natural hazards. Critical facility information has been redacted and is located in Appendix G, available upon request from the Northern Neck Planning District Commission in consultation with the LEPC.

Section 5.0 – Multiple Hazard Mitigation Strategy addresses local and regional hazard-related issues and concerns by establishing a revised framework for mitigation activities and policies. The strategy includes six revised goals and a range of updated mitigation strategies, actions and projects to support achievement of the goal to reduce hazard exposure to area citizens and to increase community resilience. Status on the 2010 mitigation strategies may be found in Appendix C and new 2017 – 2022 strategies, organized by six major mitigation project types, may be found in Appendix D.

Section 6.0 – Community Capability Assessment, Implementation and Plan Maintenance Procedures describes available programs and resources that can support plan implementation. This section describes how the plan will be monitored, evaluated, and updated, including a process for continuing stakeholder involvement after the plan is completed.

Section 7.0 – Plan Adoption described the local plan adoption process following FEMA Region III conditional approval of the plan update draft.

Section 8.0 – References includes a list of the reports and data used to develop this plan.

Section 9.0 –Appendices are included at the end of the plan, and contain supplemental reference materials and more detailed calculations and methodologies used in the planning process. The complete meeting and outreach support materials, history of federal disaster declarations in the region, additional HIRA data, and 2010 mitigation strategy status updates may all be found in the Appendices along with a detailed summary of updated information in the 2017 plan.

Appendix A – Meetings and Outreach

Appendix B – Additional Risk Assessment Information

Appendix C – 2011 Mitigation Actions Update

Appendix D – 2017 – 2022 Mitigation Actions

Appendix E – Record of Changes

Appendix F – Sample Adoption Resolutions

Appendix G – Redacted Materials

Appendix H – List of Abbreviated Terms

Appendix I – Capability Assessment Summary

2.0 Introduction and Planning Process

2.1 Introduction

Mitigation is commonly defined as the sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects. A mitigation plan states the aspirations and specific courses of action that a community intends to follow to reduce vulnerability and exposure to future hazard events. These plans are formulated through a systematic process centered on the participation of citizens, businesses, public officials, and other community stakeholders.

A local mitigation plan is the physical representation of a jurisdiction's commitment to reduce risks from natural hazards. Local officials can refer to the plan in their day-to-day activities and in decisions regarding regulations and ordinances, granting permits, and funding of capital improvements and other community initiatives. Additionally, these local plans will serve as the basis for states to prioritize future grant funding as it becomes available.

The Northern Neck Hazard Mitigation Plan will continue to be a useful tool for all community stakeholders by increasing public awareness about local hazards and risks, and providing information about options and resources available to reduce those risks. Educating the public about potential hazards will help each jurisdiction protect itself against the effects of future hazards, and will inform decision-making regarding where to live, purchase property, or locate business.

The areas covered by this plan includes:

Town of Colonial Beach
Town of Irvington
Town of Kilmarnock
Lancaster County
Town of Montross
Town of White Stone
Northumberland County
Richmond County
Town of Warsaw
Westmoreland County

2.1.1 The Local Mitigation Planning Impetus

On October 30, 2000, President Clinton signed into law the Disaster Mitigation Act of 2000 (DMA2K), which required state and local mitigation plans that would help to reduce loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters.

DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act and added a new section to the law, Section 322, Mitigation Planning. Section 322 requires local governments to prepare and adopt jurisdiction-wide hazard mitigation plans for disasters declared after November 1, 2004, as a condition of receiving Hazard Mitigation Grant Program (HMGP) project grants and other non-disaster related mitigation grant assistance programs. Local governments must review and, if necessary, update their mitigation plans every five years from the original date of the plans in order to continue Hazard Mitigation Assistance (HMA) program eligibility.

The requirements for local mitigation plans are found in Section 44 Code of Federal Regulations Part 201.6. FEMA's "*Local Multi-Hazard Mitigation* Planning Guidance" issued on October 1, 2011 provides updated FEMA interpretation and explanation of local plan mitigation regulations and FEMA's expectations for mitigation plan updates. In addition, VDEM and FEMA now use the 2013 *Local Mitigation Plan Review Tool* to ensure that a plan meets FEMA's regulatory requirements as well as additional requirements identified by the Commonwealth.

2.2 Planning Process

The Northern Neck Planning District Commission (PDC) is a voluntary organization of the region's four county governments, whose primary goal is to help find regional solutions to common problems. The Planning District Commission was formed by local governments in 1969 under the authority of the Regional Cooperation Act. The commission was established to plan for the orderly and efficient physical, social, and economic development of Virginia's Northern Neck region. Activities and policies of the Commission, which are set by sixteen Commissioners appointed by local governing bodies, include a wide range of comprehensive planning, technical assistance, grant seeking, and regional coordination activities.

The Northern Neck Regional Hazard Mitigation Plan incorporates a number of other plans, studies and reports that have been produced about the Northern Neck. These documents include county comprehensive plans, and shoreline erosion studies. Information about these plans and studies is included in Sections 3.0, 4.0, 5.0 and Section 6.0 of the plan and full reference information is provided in Section 8.0.

The following jurisdictions agreed to participate and collaborate to develop the 2017 regional hazard mitigation plan update:

- Lancaster County
  - Town of Kilmarnock
  - Town of Irvington
  - Town of White Stone
- Northumberland County
- Richmond County
  - Town of Warsaw
- Westmoreland County

- Town of Colonial Beach
- Town of Montross

2.2.1 The Hazard Mitigation Technical Advisory Committee

The communities of the Northern Neck established a Local Emergency Planning Committee (LEPC) to address local emergency management issues. Members of the LEPC are appointed by resolution by the counties. The membership of this committee is closely aligned to the needs of a Mitigation Advisory Committee so the Planning District Commission decided to use the existing LEPC as its Mitigation Advisory Committee. Additional members of the committee include county and town staff within the planning district commission. The Local Emergency Planning Committee is comprised of planning directors, emergency management personnel and staff.

The Mitigation Advisory Committee worked with the Northern Neck Planning District Commission to update the Northern Neck Regional Hazard Mitigation Plan starting in 2017. The Northern Neck Planning District Commission acknowledges the following persons and their representative departments and organizations who served as the Mitigation Advisory Committee to this project through their role as the Northern Neck Local Emergency Planning Committee.

Table 2-1. Northern Neck Mitigation Advisory Committee

Name	Jurisdiction/Organization	Title	Department
Jerry W. Davis	NNPDC	Executive Director	Administration
John Bateman	NNPDC	Regional Planner	Administration
Alex Eguiguren	NNPDC	Technical Assistant	Administration
Frank Pleva	Lancaster County	County Administrator	Administration
Wally Beauchamp	Lancaster County	Board of Supervisors	Administration
Terrence McGregor	Lancaster County	Chief of Emergency Services	Emergency Services
Heather Brown	Lancaster County	Department Coordinator	Emergency Services
Luttrell Tadlock	Northumberland County	County Administrator	Administration
Rick McClure	Northumberland County	Emergency Services Chief	Emergency Services
Stuart McKenzie	Northumberland County	County Planner	Planning Commission
Morgan Quicke	Richmond County	County Administrator	Administration
Greg Baker	Richmond County	Emergency Services Chief	Richmond County
Mitch Paulette	Richmond County	Captain	Richmond County
Jeff Beasley	Westmoreland County	Emergency Services Chief	Emergency Services

Table 2-1. Northern Neck Mitigation Advisory Committee

Name	Jurisdiction/Organization	Title	Department
David Farmer	Westmoreland County	Assistant Chief Emergency Services	Emergency Services
Beth McDowell	Westmoreland County	Planner	Planning
Darrin Lee	Westmoreland County	Planner	Planning
Bill Cease	Westmoreland County	IT Director	Information Technology
Val Foulds	Town of Colonial Beach	Town Manager	Administration
Bob Hardesty	Town of Irvington	Town Administrator	Administration
Marshall Sebra	Town of Kilmarnock	Planning/Zoning Administrator	Planning
Patricia Lewis	Town on Montross	Town Manager	Administration
Patrick Frere	Town of White Stone	Town Manager	Administration
Tricia Chappell	VDEM	VDEM Region V	Local Emergency Services Region V
Andy John	VDEM	Response & Recovery VDEM Region V	Local Emergency Services Region V
Amy S. Howard	VDEM	Grant Administrator	Finance

Between November 2004 and July 2005, the Mitigation Advisory Committee held four meetings and supervised work on the area's first hazard mitigation plan. The Mitigation Advisory Committee members coordinated and consulted with other entities and stakeholders to identify and delineate natural hazards within the ten local jurisdictions, and to assess the risks and vulnerability of public and private buildings, facilities, utilities, communications, transportation systems, and other vulnerable infrastructure. A consultant helped facilitate development of the first plan.

During late 2010, the Northern Neck Planning District Commission began working with local LEPC members and others to update the plan which was updated by PDC staff. In early 2011, the plan review process was formally kicked off and review of the plan began.

In 2016, the PDC requested funding to update the 2011 plan and subsequently received a FEMA Pre-Disaster Mitigation program grant to support the 2017 plan update. The PDC contracted with Dewberry, on behalf of all participating jurisdictions, to update the plan during 2017. The Planning District Commission staff and the Mitigation Advisory Committee members worked with the consultants throughout the planning process to ensure that potential stakeholders participated in the planning process including reviewing the draft and final versions of the plan.

2.2.2 Documentation of the Planning Process

The plan update followed a traditional mitigation plan update process initiated with a regional HMP update kick-off meeting, followed by draft updating of the capability analysis, community profile, and HIRA during March 2017. During April 2017, the draft HIRA was presented to the Mitigation Advisory Committee who then revised the 2011 plan goals.

Local and PDC 2011 strategies were updated through phone calls and electronic communication. Following the final Mitigation Advisory Committee meetings on May 31, 2017, where the new goals were slightly revised, 2017 to 2022 actions were developed by the PDC and the participating jurisdictions. The new mitigation actions were prioritized and categorized into six traditional types of mitigation actions. In addition, the local government department who would lead accomplishment of the action and the local resources necessary for action achievement were documented for each new action. The final plan was drafted, made available through a variety of media outlets, and submitted to VDEM for review. Stakeholder engagement was encouraged through invitations to meetings, newsletter updates, and the outreach process throughout the project. Localities also engaged stakeholders at the community level, inviting discussion whenever possible.

In the Commonwealth, the regional Planning District Commissions are composed of local jurisdictional elected officials such as members of county boards of supervisors, town council members, their appointees and chief administrative official such as the county/town administrator/manager. The majority of members are elected offices. For all land development activity, these are the officials who make final land development decisions, approve their comprehensive plans and ultimate adoption of the Northern Neck Hazard Mitigation Plan 2017 Update. Throughout the update process, beginning with application for financial support through a VDEM/FEMA Hazard Mitigation Assistance grant, each respective local jurisdiction has been updated on plan development progress in monthly PDC reports and at monthly PDC meetings. The approval responsibility of these elected officials connects the plan update, which they adopt upon FEMA conditional approval, to local comprehensive plan, zoning change and land use development decisions which they also approve.

Dewberry supported the update process of the Draft Northern Neck Planning District Commission Hazard Mitigation Plan 2017 Update. Since the Hazard Identification and Risk Assessment had only been minimally updated during the 2011 planning process, it was overhauled during the 2017 update to reflect priority hazards as advised by the Mitigation Advisory Committee. As part of the review and update process, the Northern Neck Planning District Commission conducted three Mitigation Advisory Committee meetings at the Northern Neck Planning District Commission office in Warsaw, Virginia. Follow-up meetings to work on 2011 mitigation action updates, 2017 to 2022 new mitigation actions and local government program capacity were conducted by telephone meetings and email correspondence.

The majority of necessary communication with local governments occurred through telephone calls and emails, as directed by the Mitigation Advisory Committee, to best accommodate budgets and schedules following numerous severe storm events that impacted the Northern Neck localities during the spring 2017. Table 2-2 documents formal meeting dates and their purposes.

Table 2-2. Mitigation Advisory Committee Meeting Dates

Meeting Date	Summary of Discussions
February 27, 2017	**Kick-off Meeting:** Introduced mitigation plan update process to the Mitigation Advisory Committee (Local Emergency Planning Committee), half of which had not participated in the 2011 update. Introductions were made, the schedule was presented and a visioning exercise was conducted to prioritize hazards for analysis.
April 5, 2017	**HIRA Presentation Meeting:** The Draft Hazard Identification and Risk Assessment which informed the Vulnerability Analysis for the Northern Neck region was presented to the Committee.
May 31, 2017	**Goals, Mitigation Actions & Implementation Meeting:** As only half of the committee was able to attend the April 5 meeting, the HIRA result highlights were reviewed. The plan goals, which had been revised during the April 5 meeting were also slightly revised. Each locality who had not responded to requests for 2011 mitigation action status as well as new 2017 mitigation actions was provided with printed copies of their localities actions to supplement a digital MS Excel jurisdiction action table which had been emailed to each committee member. Plan public participation, outreach and local adoption processes were also discussed.

Copies of the plan were made available to the Northern Neck's neighbors, the George Washington Regional Commission and the Middle Peninsula Planning District Commission for their review and input. Further copies of the plan were made available to the public at Rappahannock Community College and at the Northern Neck Planning District Commission. No comments were received from the public nor the George Washington Regional Commission and the Middle Peninsula Planning District Commission.

Table 2-3. Local Government Participation in Northern Neck Regional Plan 2017 Update

Jurisdiction/ Organization	Kick-off Meeting	Capability Survey/2011 Action Status	Data Provided	HIRA Meeting	2017 Mitigation Actions	Outreach Activities	Final Meeting
Town of Colonial Beach	X	X	X		X		X
Town of Irvington	X		X	X			X
Town of Kilmarnock	X	X	X				
Lancaster County	X	X	X	X	X		X
Town of Montross	X	X	X	X			
Town of White Stone	X	X	X				X
Northumberland County	X	X	X	X	X		X

Table 2-3. Local Government Participation in Northern Neck Regional Plan 2017 Update

Jurisdiction/ Organization	Kick-off Meeting	Capability Survey/2011 Action Status	Data Provided	HIRA Meeting	2017 Mitigation Actions	Outreach Activities	Final Meeting
Richmond County	X	X	X				X
Town of Warsaw			X		X		
Westmoreland County	X	X	X	X	X		X
Northern Neck PDC	X	X	X	X	X	X	X

When local jurisdictions reviewed their 2011 mitigation actions to report on status (Appendix C), they indicated whether to continue each action. Those to be continued were added to a slate of 2017 to 2022 planning update cycle mitigation strategies which are included in Appendix D. The Town of Warsaw had no 2011 mitigation actions to update. Documentation of the Mitigation Advisory Committee meetings, including the sign-in sheets and presentations, are included in Appendix A.

2.2.3 Public Participation and Stakeholder Input

From 2006 to present, the Northern Neck Local Emergency Planning Committee (LEPC) has represented the community and their local government through appointment by member jurisdictions. The LEPC monitors mitigation activities and reports back to government bodies, administrators, and the public on progress made in mitigation goals and strategies.

Given the rural nature of the Northern Neck communities, public officials and staff have a high degree of contact and interaction with the public and are fully informed of their concerns regarding hazards. The Planning Committee represented a comprehensive cross-section of constituents within the Northern Neck and was able to represent the spectrum of interests and concerns found there.

The Northern Neck PDC publicized the 2017 plan update progress on their website located at http://northernneck.us/hazard-mitigation-planning/. Dates of the various meetings and the presentations given were posted for public review. Further opportunities will be provided to comment on the plan during a public comment period initiated by the Northern Neck Planning District Commission as part of the 2017 regional adoption process.

No feedback from the public was received through these efforts.

2.2.4 Incorporation of Existing Plans and Studies

The Northern Neck Regional Hazard Mitigation Plan 2017 Update incorporates information from a number of other plans, studies, and reports. These documents include:

- College of William and Mary Virginia Institute of Marine Sciences Coastal Erosion Studies
- 2013 Virginia State Hazard Mitigation Plan, VDEM.
- 2012 Commonwealth of Virginia Emergency Operations Plan, VDEM
- Virginia Department of Conservation & Recreation (DCR) climate reports

- Virginia Employment Commission Economic Data
- Virginia Department of Forestry wildfire data and reports
- Landslide Incidence and Susceptibility in the Conterminous United States, U.S. Geological Survey (USGS).
- FEMA TEIF 2.0 Analysis 2014 and 2016
- Jurisdictional Comprehensive and Emergency Operations Plans
- USDA Census of Agriculture
- 2010 US Census Bureau and UVA Weldon Cooper Institute population data
- 2010 – 2016 American Community Survey population estimates

Information about how these plans and studies were incorporated into in Sections 3.0, 4.0, and 6.0 is in those sections where relevant and more specific data sources and information is cited. Full reference information is provided in Section 8.0, References. The progress of plan implementation, including the monitoring schedule, evaluating progress, success and lessons learned, and updates is included in Section 6.0 Capability, Maintenance and Monitoring.

3.0 Community Profile

The Northern Neck encompasses four counties and six towns in the eastern part of Virginia:

Counties:

- Lancaster
- Northumberland
- Richmond
- Westmoreland

Towns:

- Town of Colonial Beach
- Town of Irvington
- Town of Kilmarnock
- Town of Montross
- Town of Warsaw
- Town of White Stone

The Northern Neck is bound by the Potomac River on the north and east, the Chesapeake Bay on the east, the Rappahannock River to the south and west. In total, the planning area encompasses approximately 745 square miles. Based on total land mass, Lancaster County is the smallest county in the Northern Neck with 133 square miles. Westmoreland County is the largest at 229 square miles. Northumberland and Richmond Counties are comparable at 192 and 191 square miles, respectively. The four counties share more than 1,110 miles of shoreline. Figure 3-1 shows the Northern Neck Planning District with its associated towns and counties.

Nearby localities to the south include Caroline County, Essex County, and Middlesex County. The Northern Neck is approximately 65 miles northeast of the City of Richmond, the state capital, and 120 miles southeast of Washington, D.C. The region's northern border is the Potomac River and the State of Maryland.

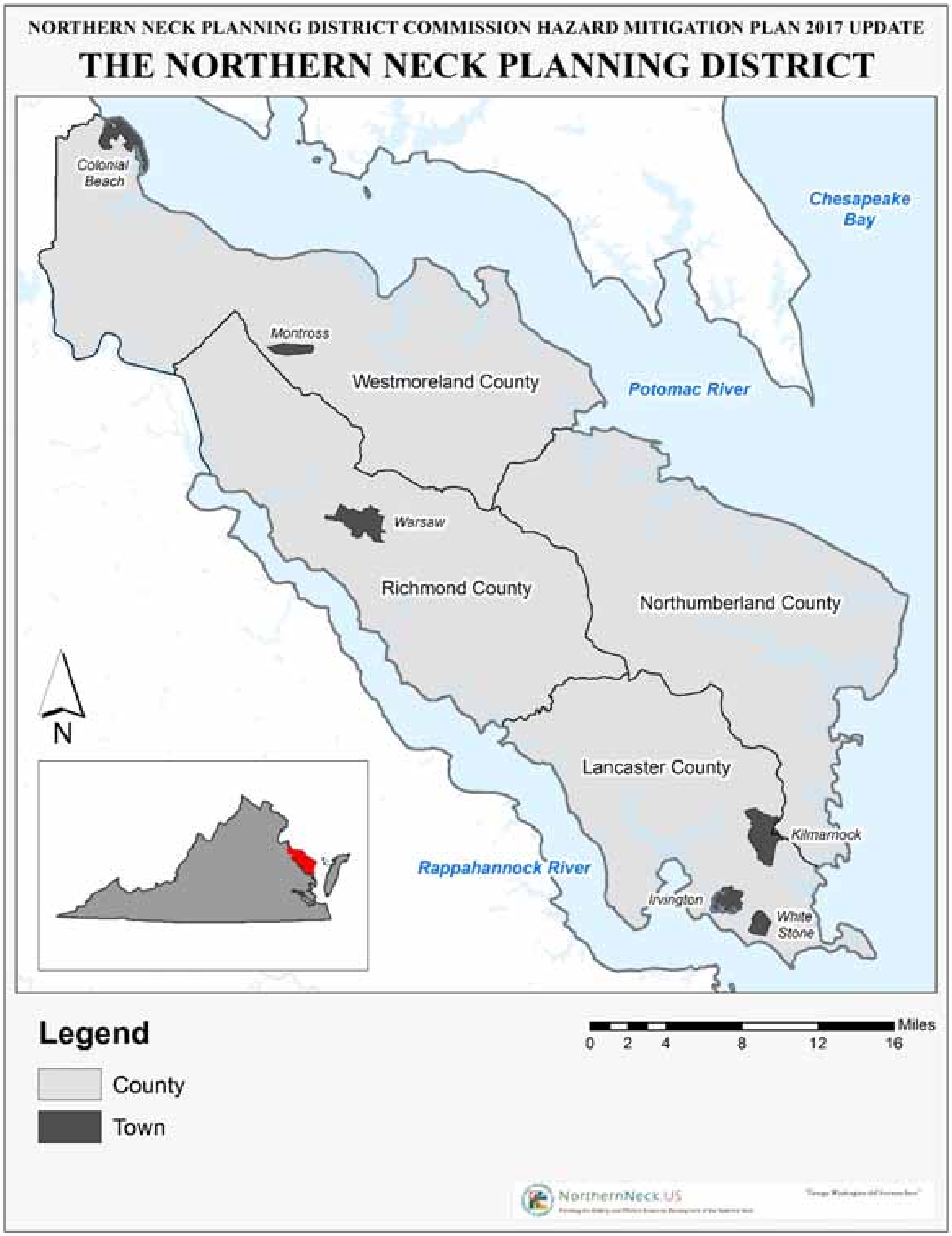

Figure 3-1. The Northern Neck Planning District

3.1 Physiography

The Planning District is part of the greater Atlantic Coastal Plain, a landscape that is characterized by gently rolling hills and valleys, but also can be locally quite rugged where short, high-gradient streams have incised steep ravine systems. The Planning District falls within two subprovinces of the Coastal Plain of Virginia. The Upland subprovince is characterized by low slopes and gentle drainage divides. Steep slopes develop in areas dissected by streams, and are also present where the upland meets the Potomac and Rappahannock Rivers. Elevations in the Upland subprovince range from 60 to 250 feet. The other subprovince is the Lowland subprovince, which is the flat, low-relief region along major rivers and near the Chesapeake Bay. Elevations in the Lowland subprovince range from 0 to 60 feet. The fall line, which delineates the division between Coastal Plain and Piedmont, lies to the west of the Northern Neck.

3.2 Hydrology

The Northern Neck lies within three major watersheds: the Potomac, the Rappahannock, and the Chesapeake Bay Coastal. Numerous creeks crisscross the Northern Neck, and the shoreline is marked by numerous inlets and coves. Figure 3-2 show the major watersheds of Virginia, emphasizing the Northern Neck in black bold outline.

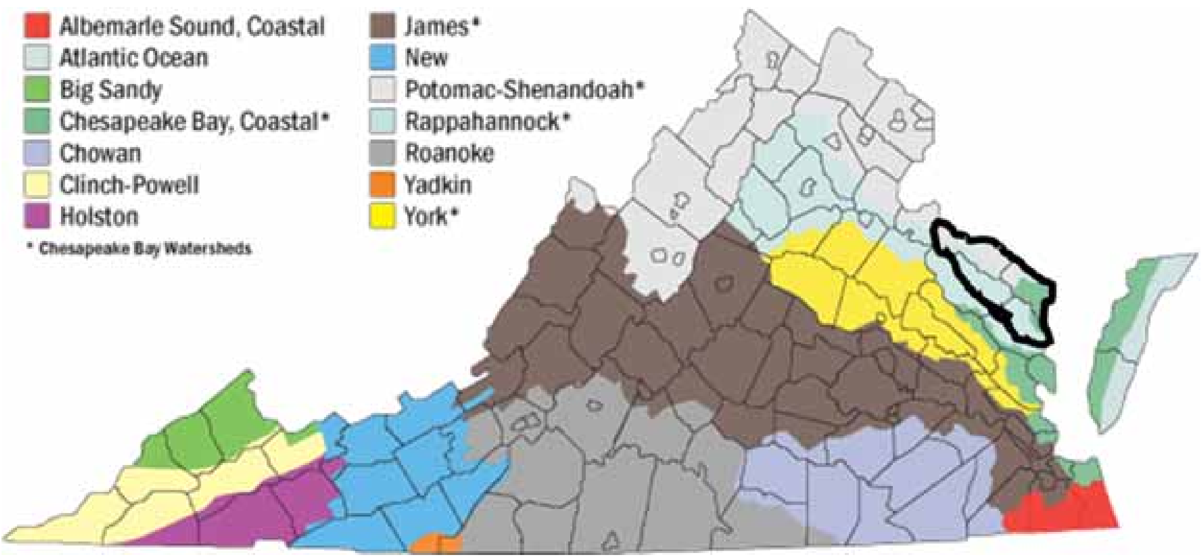

Figure 3-2. Virginia's Major Watersheds[1]

The Potomac Watershed comprises about 20% of the Chesapeake Bay watershed and is a major factor in the bay's restoration. The Potomac Watershed spans 5,702 square miles, is the third largest in Virginia, and is fed mainly by the Shenandoah, South Branch Potomac, Monocracy, and Anacostia Rivers and also by the Conocoheague Creek. Major uses of water in this area are for public and domestic water supply, power plant cooling, industrial use, and agriculture. About 600 million gallons per day (mgd) is used for the water supply, of which 500 mgd is used for the Washington area. About 1.6 billion gallons, most of which is returned to streams, is used daily for power plant cooling and industrial use. Population increases in the Washington area put major strain on the supply of drinking water, leading to issues related to water quality, legacy pollution, emerging contaminants, and reliability and safety of drinking water supplies.

The Rappahannock Watershed is fed primarily by the Rappahannock River, Rapidan River, and Hazel River to the west of the planning district commission. The majority of the Northern Neck

[1] Source: Virginia Department of Conservation and Recreation

falls within the bounds of this watershed. The Rappahannock Watershed covers about 2,715 square miles and supports a variety of land uses: largely fishing with manufacturing, light industrial, and retail applications in the Northern Neck. According to U.S. Geological Survey data, the Rappahannock Watershed (above the fall line) has the highest yield (load/unit area) of total nitrogen, total phosphorous, and total suspended solids of all the Chesapeake Bay tributary basins in Virginia. This contributes to localized dead zones (little or no oxygen) closer the mouth of the Rappahannock each summer due to excess nutrient pollution. According to the Virginia Marine Resources Commission, commercial fish landings for shad and oyster in this area of the Rappahannock have declined precipitously since the early 1970s.

The Chesapeake Bay Coastal Watershed is comprised of the Chesapeake Bay and is 2,577 square miles, though only a small portion of the Northern Neck falls within it. The Great Wicomico and Corrotoman Rivers flow through it. The Chesapeake Bay Coastal, along with the Potomac and the Rappahannock watersheds, are part of the larger Chesapeake Bay Watershed. The Chesapeake Bay is the largest estuary in North America and the third largest in the world. More than 150 major rivers and streams flow into the bay's 64,299 square mile drainage basin, which covers parts of six states (New York, Pennsylvania, Delaware, Maryland, Virginia and West Virginia) and all of Washington, D.C. The bay is approximately 200 miles long from its northern headwaters in Havre de Grace, Maryland to its outlet in the Atlantic Ocean in Virginia Beach, Virginia. The bay and its tidal tributaries have 11,684 miles of shoreline—more than the entire U.S. west coast. Approximately eight million acres of land in the Bay watershed are permanently protected from development.

Since the early twentieth century, the Chesapeake Bay has experienced serious environmental degradation. Problems include large reductions in sea grass, reduced amounts of finfish and shellfish (especially oysters and crab), seasonal depletions in dissolved oxygen, and increases in sedimentation. Environmental concerns were voiced in the 1970s over the damage to key habitats and the decline in water quality. Species in bay waters were being negatively affected, resulting in threats to the commercial and recreational activities. Most marine scientists believe that these changes are related to ecological stress due to increased human activities. Causes include deforestation, agriculture (including fertilizers), urbanization, pollution, and sewage. Between 1990 and 2016, there was an observed 28% increase in the watershed's population. In 2016, the Chesapeake Bay Program estimated 18.1 million people lived in the Chesapeake Bay Watershed, a 0.4% increase from 2015. Experts predict the watershed's population will pass 20 Million by 2030 and reach 21.1 Million by 2040.

3.3 Climate

The Northern Neck lies within the Atlantic Coastal Plain, with flat topography and sandy or muddy soil. This region has a humid subtropical climate, with hot, humid summers and a short, mild to cool winter. This humid subtropical climate is strongly influenced by Chesapeake Bay and the Atlantic Ocean, both of which moderate the weather but do not prevent ice formation almost every winter on the bay's northern tributaries. Mountains to the west produce blocking and steering effects on storms and air masses from the Great Lakes. The open water bodies that border the Northern Neck provide a buffer to atmospheric changes and allow for breezes that offset humidity.

Average high temperatures in the Northern Neck are about 77°F in the summer and 38°F in the winter. Precipitation is high, particularly along the coast, and seasonal. Average annual rainfall is approximately 43 inches and average annual snowfall is 15 inches.

3.4 Land Use and Development Trends

The jurisdictions in the Northern Neck are primarily rural. There are six incorporated towns in the four counties. The towns typically have a more suburban development pattern with a central node around the intersection of two primary roads, or as a corridor along a primary road.

3.4.1 Lancaster County

Lancaster County covers approximately 135 square miles, or approximately 86,267 acres of land. The county is rural in nature with limited public infrastructure. Due to limited public water supply and wastewater treatment infrastructure, development in Lancaster County usually requires on-site sewage facilities for disposal of waste and individual or community wells for domestic water supplies. Therefore, development of land in Lancaster County is closely tied to the physical characteristics of the land. This close bond with the land is further magnified by the wide variety of environmentally sensitive areas found in the county including steep slopes, floodplains, prime agricultural lands, wetlands, and soils not suitable for septic systems.

Roughly 65% of Lancaster County land is limited in some form. Specific physical limitations to development that cause concern include the suitability of soils for septic systems, the loss of prime agricultural farmlands to development, and the presence and location of shrink-swell soils. The continuing loss of farmland to other uses is a trend that needs to be stopped and ideally reversed. Farmlands provide acres of pervious land surface that act as recharge areas for groundwater aquifers. As more land is developed, remaining recharge areas become increasingly important. This is of particular importance to Lancaster County, which is entirely dependent on groundwater aquifers for its drinking water supply. Loss of prime agricultural farmlands also strains local employment. According to the 2010 Census, employment related to farming, fishing and forestry declined over 72% between 1990 and 2010 (253 jobs to 69 jobs).

Fortunately, some of the recent development activity in Lancaster County has focused on areas near existing towns, leaving many farms intact. However, it is likely that development momentum could start impacting rural areas as farmers retire and capitalize on their equity in the land. Furthermore, from a development economics standpoint, the attractiveness of farmland due to the flat topography and lower site clearing and preparation costs will increase development pressure on these areas. There is still a large quantity of land without development limitations that is suitable for development. About one-third of the county land is without development constraints.

Lancaster County is known for its tourist and recreational attractions. Historic sites, buildings and marinas attract visitors throughout the year. The retiree population is increasing while younger generations are leaving the area. The county's comprehensive plan states the need to retain the rural character of the county while providing economic opportunity to encourage younger generations to stay.

3.4.2 Northumberland County

According to the draft *2016 Northumberland County Comprehensive Plan*, the most significant land uses in Northumberland County are agriculture and forestry. Farming and forest uses have remained fairly untouched by development, except for conversions of land to development along waterfronts. Residential development is concentrated along roads and the waterfront. Manufactured homes are scattered throughout the county, but like other types of residential development, are found primarily along roads. Commercial development tends to occur along highways and in villages such as Fairport and Reedville. Marinas and industrial sites are found along the waterfront.

New subdivisions can serve as an important indicator to evaluate development potential because once subdivision lots are recorded and streets developed to serve them, the landscape of that site is changed forever. This is why subdivision ordinances were one of the first planning tools mandated by Commonwealth of Virginia legislation. Subdivisions have played an important role in Northumberland County development during the last two decades, particularly along the waterfront.

Prime farmland is a component of a healthy economy in Northumberland County. The county has policies in place that can protect prime farmland to maintain agricultural production at a high levels which supports taxable income, and reduce pollution at the same time. Deferred land use value taxation allows landowners to maintain their land in agricultural and forest production to reduce property taxes. If a landowner develops property enrolled in the program, they must repay the balance between the deferred and full tax rate for the previous five tax years. This program has helped maintain farm production in the county and has slowed conversion to residential development.

3.4.3 Richmond County

Agricultural land use dominates the landscape of primarily rural Richmond County. Agricultural and forest land protection is a primary objective of the county's Comprehensive Plan which designates most of the county land area for agriculture or forestry use. While forests cover approximately 59% of the county, agriculture is visible because the transportation network is adjacent to these lands. Many of the original roads found in Richmond County were constructed to accommodate the movement of people, equipment, and crops associated with farming. During the second half of the twentieth century roads evolved for automobile and truck use. Development is managed by ensuring that the best and most productive cultivated and forested lands are not divided into lots or removed from production.

Early in the 20th century, agriculture, fishing and timber were the main industries in Richmond County, but they have since been replaced by the retail trade and service industries centered in the Town of Warsaw. The retail trade and service industries work to support agricultural and forestry operations. Commercial and industrial designations for growth are limited to the Town of Warsaw. Convenient shopping, job opportunities, and a viable tax base are the most important components of business development. The Richmond County Board of Supervisors purchased 57 acres of land within the Town of Warsaw for development into Commerce Park. The site has been zoned for industrial and manufacturing uses and is the primary business development site for Warsaw and Richmond County.

The county recognizes the need for additional public recreational facilities. The Richmond County Board of Supervisors also purchased 85 acres of land adjoining Commerce Park for the development of a multi-function community park that would support the county fair and new sports facilities. It is anticipated that the adjoining facilities will provide an excellent opportunity for job creation and enhancement of cultural and recreational resources.

Richmond County envisions limited residential development along existing roads, predominantly in the southeastern half of the county. Roads in higher elevations, where soils are better, are seen as the predominant area for low density residential, while additional residential development is envisioned along the shorelines of the Rappahannock and its navigable tributaries where environmental and soil conditions will permit. According to the 2013 Richmond County

Comprehensive Plan, rural villages are planned at six locations throughout the county. Intensive development is rare except within and adjacent to the Town of Warsaw where it is possible that urban development will spill over into the county.

3.4.4 Westmoreland County

Westmoreland County remains a rural locality featuring numerous waterfront communities. The majority of the land is currently used for forestry or agriculture. Forestland is the most common land use in the county. Today, there are very few mature, diverse hardwood forests remaining in Westmoreland County. Intensive harvesting is occurring across the region, with retention only required for buffering along streams and wetlands. The forest landscape is extremely important to the future of the community for numerous reasons, including: maintained air quality, wildlife habitat, recreational and spiritual uses, tourism, and minimized soil erosion.

Agricultural land use is the second most common land use. Rotational grain - corn, soybeans and wheat –account for an estimated two thirds of the county's total annual agricultural income. While a downward trend is not clearly established, future development in the county will pose a threat to farming through displacement and conflicting land uses. Dust, smells, and nighttime operations are some of the complaints that nearby residents often make about farms that can discourage the farmer or cause a change in farm practices. A gradual decline in farming can also mean the loss of support services for the farms or distribution channels for farm products, making farming more difficult.

Residences and businesses are distributed throughout the county, but are often clustered near the Towns of Colonial Beach and Montross, or in one of the numerous small communities. Residential land use includes: multi-acre tracts, subdivisions, apartments, and townhouses. There is also an unusually high percentage of seasonal homes used recreationally. Recent construction of residential dwellings in the county has typically followed two paths: either isolated homes, usually on waterfront lots; or residential subdivisions and town neighborhoods. Residential subdivisions are mostly located along the county's creeks, bays, or rivers. Predominant businesses include construction, retail trade, accommodations and food services, architecture and engineering, real estate, health care and social assistance, and art and entertainment.

Westmoreland County will have to manage future development to maintain its rural atmosphere while still providing opportunities for growth near its towns. One approach to maintaining the rural economy is to identify areas where additional growth would be appropriate in existing development, while maintaining the existing character of the area. Use of this approach with the relatively slow recent rate of growth in the county may enable a long transitional period continuing the zoning districts that shaped existing development.

3.5 Population

The total population for the Northern Neck was 49,560 in 2016 using the newest population estimates from the U.S. Census Bureau's 2016 American Community Survey (Table 3-1). This is a 1.75% decrease in total population since 2010. Three of the four counties experienced negative growth rates, with Westmoreland experiencing the only positive growth rate of 0.8%. Population projections for the Northern Neck are somewhat consistent with the U.S. Census population percent change from 2010 to 2016. Lancaster and Northumberland counties are projected to experience population decreases through 2040, while Richmond and Westmoreland counties are projected to experience population growth (Table 3-2). Generally, population is projected to be relatively flat for the next two decades.

Table 3-1. Population Statistics for the Northern Neck

Jurisdiction	Estimated Population, 2016	Percent Change in Population, 2010 - 2016
Lancaster	10,972	-3.70%
Northumberland	12,222	-0.90%
Richmond	8,774	-5.20%
Westmoreland	17,592	0.80%
Northern Neck (total)	49,560	-1.75%

Source: 2016 American Community Survey (ACS), 2010 Decennial Census

Table 3-2. Population Projections for Northern Neck, 2020-2040

Jurisdiction	2020	2030	2040
Lancaster	11,192	10,935	10,533
Northumberland	12,099	11,989	11,716
Richmond	8,982	9,125	9,139
Westmoreland	17,941	18,482	18,758
Northern Neck (total)	50,214	50,531	50,146

Source: Demographics Research Group of the Weldon Cooper Center for Public Service, March 2017

3.6 Race and Gender

Nearly the entire population (98.3%) of the Northern Neck reports being a single race according to U.S. Census Bureau's 2015 Population Estimates Program. The region's average population by race is 69.6% White alone, 27.5% Black or African American alone, and 0.7% Asian alone (Table 3-3). An average of 0.5% of Northern Neck residents reported being other races alone, and 1.7% reported being two or more races.

Table 3-3. Racial Demographics of the Northern Neck

Jurisdiction	White Alone	African American Alone	Asian Alone	Other Races Alone	Two or More Races
Lancaster	69.9%	27.9%	0.8%	0.3%	1.1%
Northumberland	73.3%	24.7%	0.4%	0.3%	1.2%
Richmond	66.8%	30.2%	0.7%	0.5%	1.9%
Westmoreland	68.5%	27.3%	0.8%	0.8%	2.5%
Northern Neck (average)	69.6%	27.5%	0.7%	0.5%	1.7%

Jurisdiction	White Alone	African American Alone	Asian Alone	Other Races Alone	Two or More Races

Source: 2015 U.S. Census Bureau Population Estimates Program

In the Northern Neck, there are slightly more males than females, with male persons accounting for 50.1% of the population and female persons make up the remaining 49.9% of the population. Richmond County has the largest difference in percentage of population that are females versus males, likely do to the presence of a correctional center in Haynesville.

Table 3-4. Gender Statistics for the Northern Neck

Jurisdiction	Female	Male
Lancaster	53.10%	46.90%
Northumberland	50.90%	49.10%
Richmond	44.30%	55.70%
Westmoreland	51.40%	48.60%
Northern Neck (average)	49.90%	50.10%

Source: 2015 U.S. Census Bureau Population Estimates

3.7 Language

About 3.6% of residents in the Northern Neck were foreign-born and 4.5% of persons age five and older speak a language other than English at home. These statistics indicate there may be a portion of the Northern Neck that may require special consideration when developing hazard reduction and outreach strategies for the community.

Table 3-5. Language Statistics for the Northern Neck

Jurisdiction	Foreign born persons, percent, 2011-2015	Language other than English spoken at home, percent of persons age 5 years+, 2011-2015
Lancaster	1.90%	3.60%
Northumberland	2.50%	2.30%
Richmond	6.60%	8.50%
Westmoreland	3.20%	3.70%
Northern Neck (average)	3.60%	4.50%

Source: American Community Survey (ACS) 5-Year Estimates

3.8 Age

Age can be used to identify certain groups of the population that have heightened risk to certain hazards. The 2015 U.S. Census Bureau's Population Estimates Program data shows that about

4.2% of the population in the Northern Neck is under the age of five and approximately 16.5% is under the age of 18. The Northern Neck age distribution is less than the Virginia total of 6.1% under the age of five and 22.3% under the age of 18. Additionally, the population that is 65 and older (28.7%) is double that of the Commonwealth's (14.2%).

Table 3-6. Age Statistics for the Northern Neck

Jurisdiction	Persons under 5 years	Persons under 18 years	Persons between 18 and 65 years	Persons 65 years and over
Lancaster	3.60%	14.60%	45.80%	36.00%
Northumberland	3.80%	15.50%	45.80%	34.90%
Richmond	4.00%	17.00%	59.10%	19.90%
Westmoreland	5.50%	18.80%	51.70%	24.00%
Northern Neck (average)	4.20%	16.50%	50.60%	28.70%

Source: 2015 U.S. Census Bureau Population Estimates Program

The counties of the Northern Neck are recognized as popular retirement communities. Lancaster and Richmond Counties have seen a trend towards an aging population of both long-term residents and newly relocated retirees. New residents are attracted to the Northern Neck's proximity to water, reasonable land and housing prices, low taxes, and rural character. There has been an increase in demand for residential development, recreational opportunities, and medical services aimed at senior citizens. During the recent recession there was an abundance of listed residential property throughout the Northern Neck. Consideration for the needs of the younger and older generations should influence development of public awareness mitigation strategies.

3.9 Education

Data from the U.S. Census Bureau's 2015 Population Estimates Program approximates that about 84.6% of residents in the Northern Neck graduated from high school and 21.1% hold bachelor's degrees or higher. Education levels are lower than Virginia averages (88.3% graduated from high school and 36.3% with bachelor's degrees or higher). Lancaster County has a higher education rate that is closer to the state average (27.9%). Education levels, coupled with the population characteristics described in the previous paragraphs, should influence mitigation and emergency management public outreach program development. The content and delivery of public outreach programs should be consistent with the audiences' needs and ability to understand complex information.

Table 3-7. Education Statistics for the Northern Neck

Statistics	High school graduate or higher, percent of persons age 25 years+	Bachelor's degree or higher, percent of persons age 25 years+
Lancaster	90.00%	27.90%
Northumberland	88.10%	25.40%
Richmond	79.10%	12.70%
Westmoreland	81.10%	18.30%
Northern Neck (average)	84.60%	21.10%

Source: 2015 U.S. Census Bureau Population Estimates Program

3.10 Income

As of 2015, the average median household income in the Northern Neck was approximately $49,365, 24% lower than the state average of $65,015 according to the U.S. Census Bureau. About 14.65% of residents within the Northern Neck live below the poverty line. This rate is slightly lower than that of the national rate of 14.8% in 2015, but higher than the state rate of 11.2%. Northumberland County has a slightly higher median household income and per capita income than the other counties in the Northern Neck. Overall, the income statistics summarized in Table 3-8 indicate that a significant portion of the population in the Northern Neck may not have the resources available to them to undertake mitigation projects that require self-funding.

Table 3-8. Income Statistics for the Northern Neck

Jurisdiction	Median household income (in 2015 dollars), 2011-2015	Per capita income in past 12 months (in 2015 dollars), 2011-2015	Persons in poverty, percent
Lancaster	$50,374	$31,062	13.10%
Northumberland	$51,885	$31,280	13.70%
Richmond	$47,288	$19,407	17.70%
Westmoreland	$47,911	$25,992	14.10%
Northern Neck (average)	$49,365	$26,935	14.65%

Source: 2015 U.S. Census Bureau Population Estimates Program

3.11 Housing

As of 2015, there were an estimated 31,516 housing units in the Northern Neck according to the U.S. Census Bureau (Table 3-9). Westmoreland County has the most housing units and Richmond County has the least. Only 4.7% of the housing units in the Northern Neck are multi-unit structures. Lancaster County has the most multi-unit structures (560 units) while Richmond County has the highest percentage in the Northern Neck with 7.8% (308 units).

About 77% of residents own their homes in the Northern Neck. Northumberland County has the highest homeownership rate of 83.70% while Richmond County has the lowest at 74.40%. All of the homeownership rates are significantly higher than the national average of 63.90% or the state average of 66.20%. When considering mitigation options, special attention should be given to the difference in capabilities between owners and renters. As previously stated, it is a “buyer’s market” on the Northern Neck with more than 600 residential properties listed for sale currently. Many of these are “second” homes used as vacation or weekend homes by out-of-area owners from Northern Virginia or the Richmond Metropolitan area. A surge of homes was listed for sale during the recession during the past decade with many still remaining on the market.

Table 3-9. Housing Statistics for the Northern Neck

Jurisdiction	Housing units	Owner-occupied housing unit rate	Median value of owner-occupied housing units
Lancaster	7,607	75.00%	$229,100
Northumberland	9,156	83.70%	$242,000
Richmond	3,922	74.40%	$150,000
Westmoreland	10,831	74.60%	$191,600
Northern Neck	31,516	76.90%	$203,175

Source: 2015 U.S. Census Bureau Population Estimates

3.12 Business and Labor

Most Northern Neck counties face unemployment and underemployment challenges. The decline in traditional industries and the growth in retirement and second home development are changing employment landscape. The area’s unemployment rates are generally lower than the U.S. average but higher than Virginia’s average (Table 3-10). The Northern Neck region was impacted by the 2008 recession but is recovering at about the same rate as the U.S. average. The Virginia Employment Commission (VEC) projects that employment for the Northern Neck will increase by about 9.25% by 2024.

Table 3-10. Northern Neck Unemployment Rates

Year	Northern Neck	Virginia	United States
2006	4.30%	3.10%	4.60%
2007	4.30%	3.00%	4.60%
2008	5.30%	3.90%	5.80%
2009	8.30%	6.70%	9.30%
2010	8.40%	7.10%	9.60%
2011	8.10%	6.60%	8.90%
2012	7.50%	6.10%	8.10%
2013	7.00%	5.70%	7.40%
2014	6.70%	5.20%	6.20%
2015	5.70%	4.50%	5.30%
2016	4.90%	4.00%	4.90%

Source: Virginia Employment Commission, Economic Information & Analytics, Local Area Unemployment Statistics.

The rural nature of the communities in the Northern Neck is reflected in the top 10 employment sectors summarized in Table 3-11.

Table 3-11. Top Ten Employment Sectors in the Northern Neck

Industry	Employment
Local Government	2,127
Retail Trade	1,801
Health Care and Social Assistance	1,661
Manufacturing	1,416
Accommodation and Food Service	1,088
State Government	803
Construction	798
Other Services (except Public Administration)	572
Professional, Scientific, and Technical Services	455

Source: Virginia Employment Commission, Economic Information & Analytics, Quarterly Census of Employment and Wages (QCEW), 4th Quarter (October, November, December) 2016.

According to profiles developed by the Virginia Economic Development Partnership, major employers in the Northern Neck region are listed by county below.

Lancaster County:

- Rappahannock General Hospital
- Lancaster County School Board
- Rappahannock Westminster Canterbury
- Walmart
- Manufacturing Techniques, Inc.
- Tides Inn

Northumberland County:

- Northumberland County School Board
- Omega Protein
- County of Northumberland
- Carry On Trailer Corporation

Richmond County:

- Haynesville Correctional Center
- Richmond County School Board
- Rappahannock Community College
- County of Richmond

Westmoreland County:

- Westmoreland County School Board
- Carry On Trailer Corporation
- County of Westmoreland
- Bevans Oyster Company
- Town of Colonial Beach Schools

3.13 Agriculture

Agriculture is a major economic sector in the Northern Neck. Total agricultural sales exceed $77 million annually, with the vast majority of revenue from the sales of crops including those from nurseries, greenhouses and vineyards. Major crops in the Northern Neck include soybeans, corn, and wheat. According to the 2010 U.S. Census, employment in Lancaster County related to farming, fishing and forestry declined over 72% between 1990 and 2010 (253 jobs to 69 jobs).[2] Table 3-12 summarizes agriculture in the Northern Neck region based on 2012 Agricultural Census statistics.

[2]Cited in the 2013 Lancaster County Comprehensive Plan

Table 3-12. Northern Neck Agriculture

Jurisdiction	Land in Farms (acres)	Total Value of Agricultural Products Sold	Total Value of Crops, including nursery and greenhouse crops	Total Value of livestock, poultry, and their products
Lancaster	10,695	$4,864,000	$4,690,000	$174,000
Northumberland	43,270	$21,357,000	$20,999,000	$359,000
Richmond	32,373	$15,467,000	$14,648,000	$819,000
Westmoreland	59,378	$35,758,000	$30,725,000	$5,032,000
Total	145,716	$77,446,000	$71,062,000	$6,384,000

Source: 2012 U.S. Census of Agriculture

3.14 Transportation

The Northern Neck is a peninsula bound by two rivers and the Chesapeake Bay. Transportation options are somewhat more limited than in surrounding counties.

US-360 is the main east-west route, while State Route-3 (SR-3) is the major north-south route in the Northern Neck. No interstate serves the Northern Neck directly, though Interstate-95, the major north to south route on the East Coast, is easily accessible via SR-3 (about 30 miles from the northern most point in Westmoreland County). US-17 is accessible via US-360 (across the Rappahannock River over Downing Bridge).

The closest commercial airports are in Richmond and Newport News (both approximately 55 miles away from the Northern Neck). Two general aviation facilities, Tappahannock Municipal Airport and Hummel Field, also serve the Northern Neck. There is no rail service to the Northern Neck.

A number of rivers run through the Northern Neck. The Potomac and Rappahannock Rivers and the Chesapeake Bay are all navigable by medium to large ships. However, the nearest major commercial ports are in Richmond and Norfolk, Virginia. There are several grain barge facilities in the Northern Neck that are used to transport agricultural products. Many local marinas servings dockage for pleasure craft dot the shorelines of the Northern Neck.

A bridge on SR-3 crosses the Rappahannock River between White Stone in Lancaster County and Grey's Point in Middlesex County. An additional bridge on US-360 spans the Rappahannock River at Richmond County and Tappahannock in Essex County. Seasonal (summer) passenger ferries run to Tangier Island and Maryland's Smith Island. VDOT operates two ferries in the Northern Neck, one at Sunnybank in Northumberland County and the other at Merry Point in Lancaster County.

3.15 Infrastructure

3.15.1 Electricity

The Northern Neck is served by two electricity providers: Dominion Virginia Power and the Northern Neck Electric Cooperative (Touchstone Energy Cooperatives). The Virginia Electric & Power Company operates a Petroleum Power Plant in the Town of Warsaw, in Richmond County.

Northumberland County's Middle/High School was the first of its kind at the time to have a wind turbine installed on February 11, 2011. The turbine is primarily used as an educational tool, giving the students the opportunity to learn through hands-on and interactive curricula.

3.15.2 Heating and Gas

AmeriGas Propane and Revere Gas serve the Northern Neck area's heating and gas needs.

3.15.3 Telephone

Telephone service for the Northern Neck is primarily provided by Verizon.

3.15.4 Public Water and Wastewater

Public water systems serve residents and businesses within the towns of Colonial Beach, Kilmarnock, Montross and Warsaw. Wastewater treatment is available in the towns of Colonial Beach, Montross, Kilmarnock, and Warsaw. The Reedville Sanitary District and Montross-Westmoreland Sewer Authority provide wastewater services. Westmoreland County also serves the Coles Point and Washington District areas with public wastewater services.

Private well and onsite sewage systems serve the remainder of the Northern Neck. According to the *2016 Northumberland County Comprehensive Plan*, there is a high concentration of soils of poor quality for septic tanks located in the low-lying areas seaward of the Suffolk Scarp, in addition to other upland areas located along stream beds and banks. This poor soil quality challenges future development in this region.

3.15.5 Television

Cable television is available in this area through MetroCast, DirecTV, Dish TV, and Verizon Fios.

3.15.6 Internet

Internet access varies throughout the Northern Neck. The following is a list of internet providers available: MetroCast (cable internet), Verizon (DSL), Cox (cable), SignaWave (fixed wireless), Virginia Broadband (fixed wireless), and HughesNet (satellite internet).

4.0 Hazard Identification and Risk Assessment

4.1 Introduction

The purpose of the Hazard Vulnerability Analysis is to provide an overview of how various natural hazards impact Virginia's Northern Neck. The Hazard Identification and Risk Assessment (HIRA) assesses all natural hazards deemed a threat through previous plan Hazard Identification Risk Assessments and the qualitative priorities of the Local Emergency Management Committee (LEMC) which serves as the plan update's "Mitigation Advisory Committee" or MAC. The analysis presented in Section 4.0 uses an all-hazards identification, classification, and vulnerability indexing process to ensure hazard analysis is comprehensive and as qualitative as possible based on all available data sources. The HIRA provides information to allow the planning district commission and its communities to better understand local hazards and the risks they pose to people, property and infrastructure so that mitigation goals and strategies, actions and projects can be developed to reduce risk exposure to hazards. This will make the Northern Neck more resilient.

For the purposes of the HIRA, a natural hazard is defined as a physical event or condition that has the potential to cause fatalities, injuries, property and infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.

Identifying the risk and vulnerability for a community is critical when determining how to allocate finite resources to carry out feasible and appropriate mitigation actions. The hazard analysis involves identifying all of the hazards that potentially threaten the Northern Neck, and then analyzing them to determine the degree of threat posed by each hazard and hazard vulnerability. Addressing risk and vulnerability through hazard mitigation measures will reduce societal, economic, and environmental exposure to natural hazard impacts.

The Northern Neck Planning District Commission includes four counties and six incorporated towns. All jurisdictions located throughout these counties have been included the risk analysis, but in many instances data is not granular enough to allow full analysis for towns. The Record of Changes in Appendix E details changes and updates to Section 4.0 HIRA.

The 2017 Hazard Mitigation Plan Section 4.0 HIRA consolidates, updates, and streamlines content from the 2011 HIRA. As part of the update, the following changes were made to the hazard identification and risk assessment section:

- Watershed information was moved to Section 3.0 Community Profile;
- Critical Facilities information was moved to Redacted Appendix G
- Earthquake, removed from the 2011 HIRA, is now included;
- Repetitive Loss and Severe Repetitive Loss Structures were summarized and mapped for each participating county;
- Wildfire analysis and historic occurrence by wildfire size and location was added to wildfire analysis and mapping; and
- Total Exposure in the Floodplain (TEIF) analysis was performed in place of Hazus to analyze the exposure of property to total loss during a 100 year (1% annual chance) and 500 year (2% annual chance) flood event. Exposure was summarized at the 1,000 square foot Census block level.

In addition, each section of the HIRA was also reformatted to improve clarity, and new maps and imagery were included.

4.2 Hazard Identification

4.2.1 Types of Hazards

The Northern Neck is exposed to a wide array of natural hazards that can affect people and property. The following hazard categories were reviewed during the 2017 plan update Kickoff Meeting where the LEMC agreed that the 2011 plan hazards were still relevant with the addition of earthquake:

- Riverine Flooding
- Coastal Flooding
- Coastal Erosion
- Hurricanes
- Severe Weather
- Tornadoes
- Winter Storm
- Drought
- Wildfire
- Earthquake

The "Severe Weather" hazard category was added by the plan update contractor to capture hazard-related damages in available datasets which were not captured otherwise. Tsunamis were not addressed. The impact of each natural hazard is presented in each respective hazard section.

4.2.2 NCEI Storm Events Database

The National Centers for Environmental Information (NCEI) Storm Events Database is published by the National Oceanic and Atmospheric Administration (NOAA)'s National Weather Service (NWS). The storm events database contains information on storms and weather phenomena that have caused loss of life, injuries, significant property damage, and/or disruption to commerce. The NCEI data currently provides information about events from January 1950 to January 2017. Records for the majority of weather events (48 types) were reported starting in 1996, as defined in NWS Directive 10-1605. The exception is tornado events that were recorded from 1950 through 1954 and tornado, thunderstorm and hail events that were recorded starting in 1955.

The NCEI Storm Events Database publishes data by county, therefore the storm events have been extracted for the four counties in the Northern Neck: Lancaster, Richmond, Northumberland, and Westmoreland. This data is summarized in Table 4-1 by county and by hazard category. It is important to note that for example if a winter storm occurred on February 5th, 2010 and affected the entire Northern Neck, that event would be reported by each of the four counties individually. Therefore, even though it is one storm for the region, each county has reported the event in the table below. Damages are reported by each county, therefore the sum of damages across counties is not duplicative. Table 4-2 reports the unique events that have impacted the entire Northern Neck, therefore accounting for duplication of reporting the same event between counties. The Severe Weather category consists of several hazards: Heavy Rain, High Wind, Thunderstorm Wind, Lightning, Hail, and Strong Wind. All of these reported hazard events were counted as unique events in Table 4-2 except for Heavy Rain, in which duplication across counties was accounted for.

Table 4-1. Hazard Events for Northern Neck Counties (January 2017)

Hazards	Reported Events	Property Damage (2017$)	Crop Damage (2017$)	Deaths	Injuries
Lancaster	164	$12,751,880.34	$6,377,132.06	0	3
Coastal Storms	9	$2,009,266.35	$0.00	0	0
Drought	3	$0.00	$5,833,250.55	0	0
Hurricanes	5	$868,611.49	$543,881.51	0	0
Riverine Flooding	5	$0.00	$0.00	0	0
Severe Weather	75	$3,945,636.61	$0.00	0	3
Tornado	7	$5,928,365.89	$0.00	0	0
Winter Storms	60	$0.00	$0.00	0	0
Northumberland	165	$44,516,378.49	$5,772,342.26	0	9
Coastal Storms	10	$24,576,638.17	$0.00	0	0
Drought	2	$0.00	$4,476,460.12	0	0
Hurricanes	5	$1,041,572.21	$1,295,882.13	0	0
Riverine Flooding	5	$0.00	$0.00	0	0
Severe Weather	71	$18,262,979.95	$0.00	0	0
Tornado	6	$635,188.16	$0.00	0	9
Winter Storms	66	$0.00	$0.00	0	0
Richmond	211	$7,268,586.05	$4,160,893.61	0	2
Coastal Storms	3	$2,156,905.99	$0.00	0	0
Drought	2	$0.00	$2,984,306.75	0	0
Hurricanes	2	$139,484.52	$877,995.60	0	0
Riverine Flooding	6	$954,781.12	$291,981.99	0	0
Severe Weather	119	$210,968.24	$6,609.27	0	0
Tornado	11	$3,785,259.67	$0.00	0	2
Winter Storms	68	$21,186.50	$0.00	0	0
Westmoreland	211	$2,729,405.29	$8,755,578.09	0	0
Coastal Storms	5	$250,709.66	$0.00	0	0
Drought	2	$0.00	$7,460,766.87	0	0
Hurricanes	3	$540,637.68	$1,135,471.65	0	0
Riverine Flooding	8	$284,682.44	$80,295.05	0	0
Severe Weather	115	$271,110.51	$0.00	0	0
Tornado	7	$1,361,078.49	$79,044.52	0	0
Winter Storms	71	$21,186.50	$0.00	0	0

Source: NOAA NCEI Storm Events Database

Table 4-2. Total Unique Hazard Events in the Northern Neck (January 2017)

Hazard	Total Unique Events
Coastal Storms	11
Drought	3
Hurricanes	7
Riverine Flooding	12
Severe Weather	345
Tornado	26
Winter Storms	93
Total:	**497**

Source: NOAA NCEI Storm Events Database

Table 4-1 only summarizes the NCEI database hazards and does not include other hazards that will be discussed in the analysis, such as earthquakes, wildfire and coastal erosion. These estimates are also believed to be an underrepresentation of the actual damages since some hazard losses go unreported or are difficult to accurately quantify; this is especially true with crop damage. Other best available national and local datasets were used in some hazard sections to quantify losses.

4.2.3 Presidential Disaster Declarations

The Federal Emergency Management Agency (FEMA) maintains the National Disaster Declarations Summary dataset. The first disaster declared in the national dataset was in 1953, and was supplemented with fire management assistance wildfire declarations per the Robert T. Stafford Disaster Recovery Act and related Department of Homeland Security regulations. For an event to be declared a disaster by FEMA, the Governor of Virginia must first declare a state of emergency and then formally demonstrate to the President that Commonwealth and local government resources to support disaster recovery are exhausted necessitating Federal assistance. Table 4-3 shows the FEMA Disaster Declarations Summary for events declared within the Northern Neck from 1953 to January, 2017. There were 14 major disasters declarations issued since 1969 and six emergency declarations issued since 1993, totaling 20 declarations.

Table 4-3. FEMA Declared Disasters for Northern Neck (1953-2017)

Disaster Number	Disaster Type	Incident Type	Incident Begin Date	Programs Declared			
				IH	IA	PA	HM
274	Major Disaster	Hurricane	8/23/1969	No	Yes	Yes	Yes
339	Major Disaster	Flood	6/23/1972	No	Yes	Yes	Yes
525	Major Disaster	Freezing	1/26/1977	No	Yes	No	No
3046	Emergency	Drought	7/23/1977	No	No	Yes	Yes
755	Major Disaster	Flood	11/9/1985	No	Yes	Yes	Yes
3112	Emergency	Snow	3/13/1993	No	No	Yes	Yes
1014	Major Disaster	Snow	2/8/1994	No	No	Yes	Yes
1086	Major Disaster	Snow	1/6/1996	No	No	Yes	Yes

Table 4-3. FEMA Declared Disasters for Northern Neck (1953-2017)

Disaster Number	Disaster Type	Incident Type	Incident Begin Date	Programs Declared			
				IH	IA	PA	HM
1135	Major Disaster	Hurricane	9/5/1996	No	Yes	Yes	Yes
1293	Major Disaster	Hurricane	9/13/1999	No	Yes	Yes	Yes
3147	Emergency	Hurricane	9/13/1999	No	No	Yes	No
1318	Major Disaster	Severe Storm(s)	1/25/2000	No	No	Yes	Yes
1491	Major Disaster	Hurricane	9/18/2003	Yes	Yes	Yes	Yes
3240	Emergency	Hurricane	8/29/2005	No	No	Yes	No
1661	Major Disaster	Severe Storm(s)	8/29/2006	No	No	Yes	Yes
4024	Major Disaster	Hurricane	8/26/2011	No	No	Yes	Yes
3329	Emergency	Hurricane	8/26/2011	No	No	Yes	No
4045	Major Disaster	Severe Storm(s)	9/8/2011	No	No	Yes	Yes
4092	Major Disaster	Hurricane	10/26/2012	Yes	No	Yes	Yes
3359	Emergency	Hurricane	10/26/2012	No	No	Yes	No

FEMA Disaster Declarations Summary – Open Government Dataset. https://www.fema.gov/media-library/assets/documents/28318

4.2.4 Hazard-Specific Datasets

The level and type of analysis that can be completed in the vulnerability assessment is dependent on the type and quality of data available. Table 4-4 provides a breakdown, by hazard, of the datasets used for this analysis and mapping in the hazard-specific sections that follow.

Best Available Data:

a. The recent NOAA national shoreline erosion evaluation was not granular enough to be relevant for planning district commission level or county planning so the College of William and Mary Virginia Institute of Marine Science county coastal erosion studies were used for each county as these represented the best available data. As coastal erosion rates are accelerating due to sea level rise and climate change it is anticipated that updated data will be available when the plan is updated during 2021 to 2022.
b. Building footprint data was available for Richmond and Westmoreland Counties, allowing a more precise flood hazard vulnerability analysis.
c. Preliminary 2020 Census information was used to assist with vulnerability analysis using updated population and property demographics.
d. Department of Forestry county wildfire occurrence information has not been available for several years so more detailed analysis of wildfire risk and vulnerability was limited.
e. Coastal hazards can be characterized in several ways. Damage information datasets often overlap or there are gaps among damages characterized by NOAA or FEMA as “coastal storm,” “hurricane,” “tropical depression,” etc. Coastal erosion damages are not specified but the risk exposure to structures proximate to the region’s shorelines is significant and coastal erosion resulting from these storm events does cause significant property damage.

Table 4-4. Hazard Specific Data Used for Analysis and Mapping

Hazard	Dataset	Source
Riverine and Coastal Flooding	Digital Flood Insurance Rate Maps (DFIRMs)	Federal Emergency Management Agency (FEMA)
	NFIP Policy & Claims	FEMA
	Repetitive & Severe Repetitive Loss Properties	FEMA
	NCEI Storm Events Database	NOAA NCEI
	FEMA HAZUS-MH	FEMA
	2012 U.S. Census Block Property Value	U.S. Census Bureau
Coastal Erosion	Shoreline Evolution Studies for Lancaster (2006), Northumberland (2006), Richmond (2011), and Westmoreland (2012) Counties	Virginia Institute of Marine Science
	2012 U.S. Census Block Property Value	U.S. Census Bureau
Hurricanes/Tropical Storms	NCEI Storm Events Database	NOAA NCEI
Severe Weather (thunderstorms, high wind, hail, and lightning)	NCEI Storm Events Database	NOAA NCEI
Tornadoes	NCEI Storm Events Database	NOAA NCEI
Winter Storms	NCEI Storm Events Database	NOAA NCEI
Drought	Agriculture General Information by County	2012 U.S. Census of Agriculture
	NCEI Storm Events Database	NOAA NCEI
Wildfires	Wildland Urban Interface (WUI) geospatial dataset	SILVIS Lab, University of Wisconsin - Madison
	Wildfire Risk Assessment model	2003 Virginia Department of Forestry (VDOF)

Table 4-4. Hazard Specific Data Used for Analysis and Mapping

Hazard	Dataset	Source
	Historical Wildfires in Virginia	VDOF
Earthquake	Latest Earthquakes	US Geologic Survey (USGS)

4.3 Risk Assessment

The purpose of the hazard identification and risk assessment is to provide a factual basis for developing mitigation strategies by prioritizing areas most threatened and vulnerable to natural hazards. During the Kickoff meeting for the plan held on February 27, 2017, the natural hazards applicable to the Northern Neck were discussed in terms of frequency and historic damages.

A standardized methodology, which allows for greater flexibility and room for subject matter expertise, was developed to compare different hazards' risk for the 2017 update. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCEI database and other available data sources. Some of the hazards assessed in the HIRA analysis did not have quantifiable probability or impact data, thus a semi-quantitative ranking system was used to compare all of the hazards of interest instead. The factors assessed include:

- ***Frequency of Events:*** Primarily based on the NCEI data for a specific hazard, a score from significant to low was given based on the annualized number of events for a given hazard. Significant was four or more times in a year, medium was between one and four times in a year, and low was less than one time annually. Not Applicable (N/A) is used when no events were recorded.
- ***Hazard Impact (Property Damages):*** Primarily based on the NCEI damages, scores from significant to low were given based on annual property damages provided and possible future damages.
- ***Northern Neck Ranking:*** A score was given from significant to low based on the feedback from local officials during the Kick-Off Meeting. Local officials are respected sources of information, and not all events are recorded in national, or state-wide databases.
- ***Warning Time:*** Based on how much perceived warning time would be given for a particular event. A hazard was ranked low for warning times of three or more days before an event. If an event can happen with less than 24 hours of warning time, it is ranked significant.
- ***Potential Exposure:*** Primarily based on the NCEI damages, scores from significant to low were assigned based on annual total damages provided and possible future damages. Unlike the Hazard Impact, potential crop damage was considered in addition to property damage.

A score of 0 to 3 was assigned to the ranking for each factor. A composite score for each hazard was computed by multiplying each factor's ranking score by the importance factor. Based on this total score, the hazards are separated into three categories based on the hazard level they pose to the communities: Significant, Moderate, and Limited. Table 4-5 summarizes the categories used to rank the hazards and their weighted values for the Composite Hazard Index. The overall hazard rankings are provided at the end of this section in Table 4-49. Hazard Rankings and Risk Assessment.

Table 4-5. Hazard Ranking Parameters

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure
1.5	1	2	0.5	1
Significant Events Recorded more than 4 times annually	**Significant** Annual Damages Exceeded $100,000 annually (adjusted for inflation)	**Significant** Ranked Hazard as Significant	**Significant** Less than 24 hours	**Significant** Vulnerability Analysis showed that Exposure Exceeded $1.0 Million
Medium Event Recorded between 1 to 3.9 times annually	**Medium** Annual Damages between $10,000 and $100,000 annually (adjusted for inflation)	**Medium** Voted Hazard as Moderate	**Medium** At least 1 Day	**Medium** Vulnerability Analysis showed Exposures between $100,000 and $1.0 Million
Low Events Recorded less than 1 time annually	**Low** Annual Damages less than $10,000 annually (adjusted for inflation)	**Low** Voted Hazard as Limited	**Low** At least 2 Days	**Low** Vulnerability Analysis showed Exposures less than $100,000
N/A Events not recorded	**N/A** No damages of any type were recorded	**N/A** Did not vote on Hazard	**N/A** 3 or more Days	**N/A** No potential exposure was analyzed or calculated

4.4 Vulnerability Assessment Overview

4.4.1 Critical Facilities

A critical facility is defined as a facility in the public or private sector that provides essential products and services to the general public; is necessary to preserve the welfare and quality of life in the community; or fulfills important public safety, emergency response, and/or disaster recovery functions. Examples include public safety facilities (police, fire, and emergency medical services), cell towers, courthouses, medical facilities, utilities, transportation networks and schools. Table 4-6 summarizes the number of critical facilities by type in the Northern Neck and Figure 4-1 maps their relative location. It is difficult to discern the exact location of the critical facilities on this map due to map scale and the co-location of many of these facilities.

More localized maps and additional critical facilities data and analysis can be found in the redacted Appendix G due to the sensitive nature of secure data within Northern Neck.

Table 4-6. Critical Facilities in Northern Neck

Facility Type	Number of Facilities
Emergency Medical Services (EMS)	8
Emergency Operations Centers (EOC)	5
Fire	11
Government	1
Medical	20
Police	9
School	17
Utility	13
Total	**80**

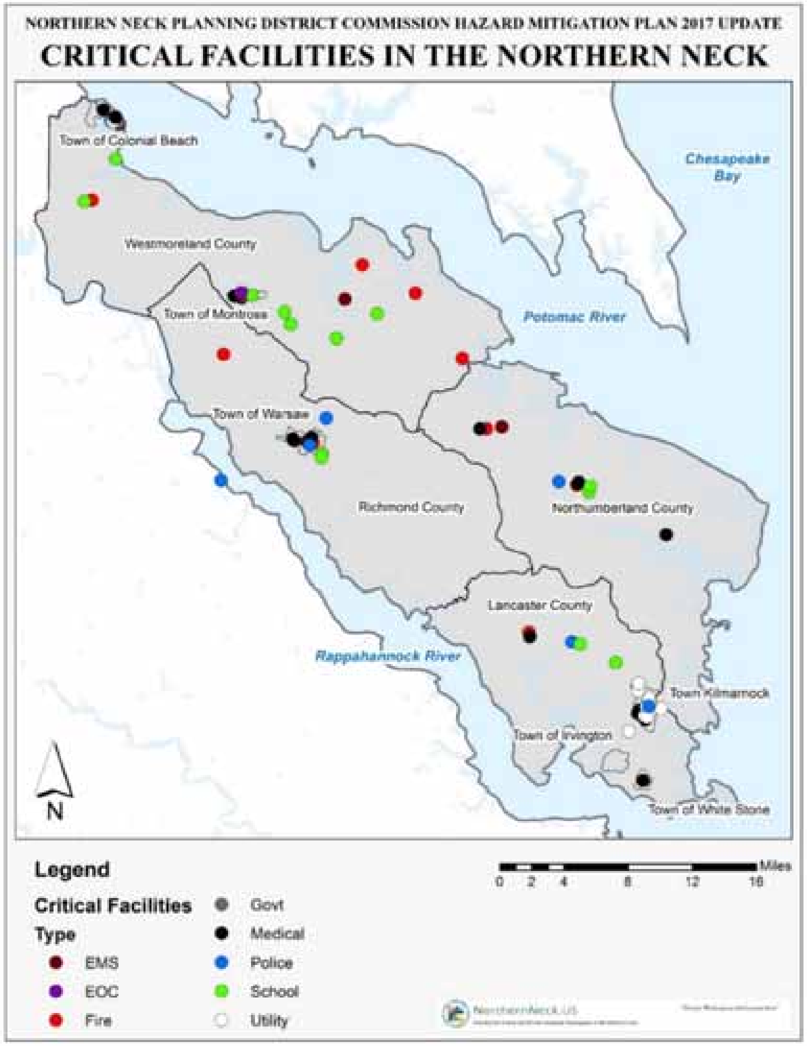

Figure 4-1. Critical Facilities in the Northern Neck

4.4.2 Building data

Building footprint data for Westmoreland and Richmond Counties was provided through the Virginia Geographic Information System Clearing House. The Virginia Geographic Information Network (VGIN), a part of the Clearinghouse, coordinates the development and maintenance of a statewide building footprint data layer in conjunction with local governments to create a seamless feature class with building footprints to complement the Virginia Base Mapping Program (VBMP). Building footprint data for Lancaster County or Northumberland County was not available so Census block information was used.

4.5 Riverine Flooding

4.5.1 Description

Flooding is the most frequent and costly natural hazard in the United States. A majority of presidential disaster declarations result from weather events where flooding was a major component. Flooding, as defined by the National Flood Insurance Program for insurance purposes is: "a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of inland or tidal waters, unusual and rapid accumulation or runoff of surface waters from any source, or a mudflow."

Floods generally result from excessive precipitation, and can be classified under two categories: general floods, precipitation within a watershed for an extended period of time that may include storm-induced wave or tidal action; and flash floods, the product of heavy localized precipitation in a short time period over a more localized location. The severity of a flood event is typically determined by a combination of several factors, including: stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing and impervious surface. This section will focus on riverine flooding, however there is also urban draining flooding and coastal flooding. Coastal flooding will be addressed in more detail in Section 4.6.

Riverine flooding occurs when a channel, such as a stream or river, receives more water than it can hold and the excess water overflows the channel banks flooding the surrounding area. Heavy rain and large amounts of snow melt can cause riverine flooding. In the Northern Neck, nor'easters, tropical storms, and hurricanes have been known to cause severe riverine flooding due to high rainfall rates. Nor'easters are very slow moving storms that rotate in a counter-clockwise direction that can also generate flooding and runoff when soil infiltration rates are exceeded.

4.5.2 Location and Extent

The Northern Neck is boarded by the Potomac River, Rappahannock River, and the Chesapeake Bay. The close proximity of multiple large rivers to this region puts it at high risk of experiencing riverine flooding. Areas of risk are delineated by the floodplain, an area typically adjacent to rivers, streams and shorelines that experiences periodic flooding that is expected to occur based upon established recurrence intervals. The recurrence interval of a flood is defined as the average time interval, in years, expected between a flood event of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

Floodplains are designated by the frequency of the flood that is large enough to inundate the area. Flood frequencies such as the 100-year flood are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. Another way of expressing the flood frequency is the chance of occurrence at any time, which is expressed as a percentage of the probability of flooding each year. For example, the 100-year flood has a one percent chance of occurring at any time. The 500-year flood zone has a 0.2 percent chance of occurrence in any given year. Flood Insurance Rate Maps (FIRMs) are developed as part of a FEMA Flood Insurance Study (FIS) to delineate the areas that are at risk of being flooded during a one percent chance or 100-year flood event. The one percent chance floodplains are also referred to as the Special Flood Hazard Area (SFHA).

The SFHA shown on a FIRM is typically labeled as Zones A/AE/AO/AH (areas subject to inundation by the one-percent-annual-chance, or 100 year flood event) and Zone VE (areas subject to inundation by the one-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action). FIRMs also delineate the 500-year flood event (0.2 percent annual chance of being equaled or exceeded). The 500-year flood event is labeled as a shaded X Zone. Areas of minimal flood hazard, outside the SFHA and higher in elevation than the 500-year flood zone, are labeled as unshaded X Zones.[3] It is important to note that while FEMA digital flood data is recognized as best available data for planning purposes, it does not always reflect the most accurate and up-to-date flood risk. Flooding and flood-related losses often do occur outside of delineated special flood hazard areas.

Figure 4-2 illustrates the location and extent of the higher risk flood zones (SFHA) in the Northern Neck based on the effective FEMA FIRMs for Lancaster, Northumberland, Richmond, and Westmoreland counties.

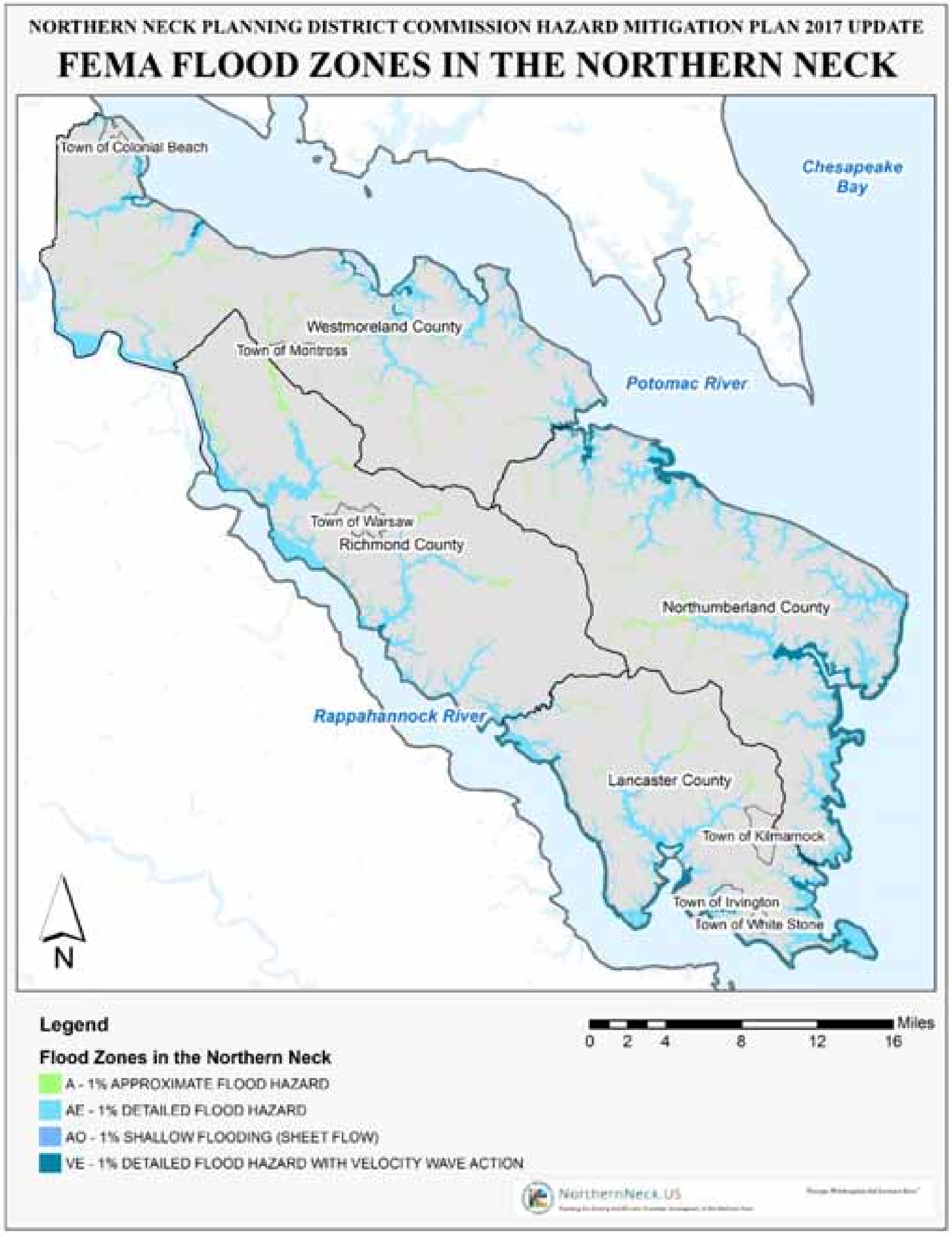

Figure 4-2. FEMA Flood Zones in the Northern Neck

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[3] https://www.fema.gov/flood-zones

4.5.3 Previous Occurrences

According to the NCEI database, there have been 12 riverine flood events recorded in the Northern Neck since 1996. These events, in particular flash floods, have caused more than $1.2 million in property damage (in 2017 dollars) and $370,000 in crop damage (Table 4-1). Table 4-7 lists the most significant of these events. While these events were caused by tropical storms or hurricanes, the specific events reported are the result of heavy rainfall associated with the storm, not flooding caused by storm surge which will be addressed in subsequent sections.

Table 4-7. Previous Occurrences of Flooding Events

Event Date	Hazard History
9/16/1999	Very heavy rain from Hurricane Floyd produced widespread flooding and flash flooding across much of central and eastern Virginia. The flooding was considered to be a 500-year flood of record. Richmond and Westmoreland counties reported property damages totaling $850,000 and crop damages of about $255,000.
8/27/2011	Heavy rains associated with Hurricane Irene produced widespread low-land flooding across much of the Northern Neck, including roadways which were washed out or closed. Storm total rainfall generally ranged from six to eleven inches. Lottsburg reported 8.67 inches of rain. Newland reported 10.50 inches of rain. Montross reported 7.20 inches of rain.
9/8/2011	The combination of the remnants from Tropical Storm Lee and a frontal boundary draped over the region caused heavy rain which produced flash flooding across portions of central and eastern Virginia. In Westmoreland, many streets were closed by VDOT and the Fire Department. Many homes were flooded on Washington and Irving Streets. Flooding was also reported on Monticello Road.
10/29/2012	Superstorm Sandy which moved northward well off the Mid-Atlantic coast produced heavy rain which caused flooding across much of eastern and southeast Virginia. Numerous roads were closed due to flooding. Total rainfall ranged from three to ten inches across the Northern Neck. Total rainfall of 9.90 inches was reported at Reedville. Total rainfall of 6.77 inches was reported at Lottsburg.

4.5.4 Probability of Future Events

Riverine flood events will continue to occur frequently in the Northern Neck due to the location of the area between two major rivers and the Chesapeake Bay. The probability of future flood events is based on historic storm magnitude and best available data. Further, it is highly likely that the Northern Neck will continue to experience inland flooding as a result of tropical storms, hurricanes, and Nor’easters. Based on the annualized events from the NCEI database (Table 4-51) the Northern Neck can expect at least one riverine flooding event every two years and an average of $73,000 in property and crop damages.

It should also be noted that short duration high intensity rainfall events are increasing in the United States.[4] While annual rainfall has not increased dramatically during the last decade, the intensity and magnitude of storms has. As a result, a flood event that is currently a two percent annual probability (50-year) flood may become a 10 percent annual probability (10-year) flood.

4.5.5 FEMA National Flood Insurance Program Participation

The National Flood Insurance Program (NFIP) is a federal program that enables property owners in participating communities to purchase insurance for flood losses. For a community to participate in the NFIP they must adopt FEMA's flood risk maps and the Flood Insurance Study as well as floodplain management regulations that reduce future flood damages.

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. Nationally, flood damage is reduced by nearly $1 billion annually through community implementation of sound floodplain management requirements, and property owner purchase of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80% less damage annually than those which predate floodplain management regulations or are not built in compliance.

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the nation's floodplains. Mapping of flood hazards creates broad-based awareness of these hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance.

Floodplain management regulations are the cornerstone of NFIP participation. Communities that participate in the NFIP are expected to adopt and enforce floodplain management regulations. These regulations apply to all types of floodplain development and ensure that development activities will not cause an increase in future flood damages. Buildings are required to be elevated at or above the Base Flood Elevation which is the predicted level of the one-percent flood.

Communities that participate in the NFIP are required to adopt and enforce the minimum federal NFIP floodplain management regulations. These regulations apply to all types of floodplain development and ensure that development activities will not cause an increase in future flood damages. Buildings are required to be reasonably safe from flooding which usually requires the finished floor elevation at or above the site's Base Flood Elevation (BFE). The BFE is determined based on modeling and mapping detailed in the community's Flood Insurance Study (FIS). The FIS and its corresponding Flood Insurance Rate Maps (FIRMs) provide information on areas of flood risk per NFIP standards. FIRMs identify areas that have a one-percent annual chance of flooding as well as those areas with a 0.2%-annual chance of flooding. When new structures are built, or existing structures are improved at more than 50 percent of their market value, they are required to adhere to floodplain management regulations. If the structure is financed through a federally insured loan, there is a mandatory flood insurance purchase requirement. Many mortgage lenders in high hazard areas are now requiring flood insurance even for structures outside of the regulated floodplain. Insuring high risk structures is one method used by the NFIP to offset the escalating costs of flood disasters.

[4] Westra, S., H. J. Fowler, J. P. Evans, L. V. Alexander, P. Berg, F. Johnson, E. J. Kendon, G. Lenderink, and N. M. Roberts (2014), Future changes to the intensity and frequency of short-duration extreme rainfall, Rev. Geophys., 52, 522–555, doi:10.1002/2014RG000464.

The Towns of Irvington, Kilmarnock, White Stone, and Colonial Beach as well as the unincorporated parts of Lancaster, Northumberland, Richmond, and Westmoreland Counties participate in the NFIP but do not participate in the Community Rating System. The Town of Montross in Westmoreland County and the Town of Warsaw in Richmond County do not participate in the NFIP. NFIP participation and the current effective map dates of each county and town are listed in Table 4-8. The Reg-Emer Date is the date the community first joined the NFIP. All jurisdictions listed below participate in the "Regular" Program. The Town of Warsaw does not participate in the NFIP.

Table 4-8. FEMA NFIP Participation Dates[5]

County	Jurisdiction	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Reg-Emer Date
Lancaster	Irvington, Town of	10/18/74	8/4/87	10/2/14	08/04/87
	Kilmarnock, Town of	N/A	9/17/10	10/2/14	09/17/10
	Unincorporated County	1/24/75	3/4/88	10/2/14	03/04/88
	White Stone, Town of	8/30/74	9/24/84	10/02/14	09/24/84
Northumberland	Unincorporated County	12/13/74	7/4/89	2/18/15	07/04/89
Richmond	Unincorporated County	4/11/75	3/16/89	4/16/15	03/16/89
Westmoreland	Colonial Beach, Town of	8/9/74	9/18/87	4/16/15	09/18/87
	Unincorporated County	7/18/75	9/18/87	4/16/15	09/18/87

Table 4-9 shows the total policies in force in the Northern Neck, 1,942 policies, and their associated insurance value and premiums. Table 4-10 summarizes the NFIP policy and claim statistics for the counties and towns within the Northern Neck Planning District Commission. Reported losses include all flooding events. It should be emphasized that these numbers include only those losses to structures that were insured through the NFIP, and losses in which claims were sought and received except for those labeled as Closed Without Payment (CWOP). It is likely that there are additional instances of flood losses in the counties and towns that were uninsured, denied claims payment, or not reported.

Table 4-9. NFIP Policies in Force[6]

County	Jurisdiction	Policies In-Force	Insurance In-Force Whole $	Written Premium In-Force
Lancaster	Irvington, Town of	13	$3,585,900	$27,876

[5] FEMA. Community Status Book Report. Virginia. https://www.fema.gov/cis/VA.html

[6] FEMA. Policy Statistics as of 12/31/2016.

Table 4-9. NFIP Policies in Force[6]

County	Jurisdiction	Policies In-Force	Insurance In-Force Whole $	Written Premium In-Force
	Kilmarnock, Town of	2	$700,000	$830
	Unincorporated County	589	$164,332,200	$582,511
	White Stone, Town of	3	$721,200	$4,279
Northumberland	Unincorporated County	735	$220,102,400	$536,772
Richmond	Unincorporated County	84	$22,489,400	$82,130
Westmoreland	Colonial Beach, Town of	206	$53,226,100	$141,451
	Unincorporated County	310	$93,020,500	$224,566
Total	**Northern Neck**	**1942**	**$558,177,700**	**$1,600,415**

Table 4-10. NFIP Claims as of 31 January 2017[7]

County	Jurisdiction	Total Losses	Closed Losses	Open Losses	CWOP Losses	Total Payments
Lancaster	Irvington, Town of	15	12	0	3	$268,192.03
	Kilmarnock, Town of	N/A	N/A	N/A	N/A	N/A
	Unincorporated County	365	294	0	71	$5,656,672.35
	White Stone, Town of	11	5	0	6	$63,849.49
Northumberland	Unincorporated County	391	290	0	101	$6,934,255.31
Richmond	Unincorporated County	84	78	0	6	$1,764,532.32
Westmoreland	Colonial Beach, Town of	81	71	0	10	$3,585,030.95
	Unincorporated County	131	95	0	36	$2,738,975.05
Total	**Northern Neck**	**1,078**	**845**	**0**	**233**	**$21,011,508**

An NFIP survey was sent to the four Northern Neck Counties to document how each actively participates in the NFIP. These questions ask about floodplain identification and mapping, floodplain management, and flood insurance. The survey and answers for each County can be found in Appendix J.

4.5.6 FEMA Repetitive Loss and Severe Repetitive Loss Properties

FEMA defines a Repetitive Loss (RL) property as: "any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP"[8]. A Severe Repetitive Loss (SRL) property is any property that: "has four or more separate claim payments of more than $5,000 each; or has two or more separate claim

[7] FEMA. Loss Statistics Country Wide as of 01/31/2017.

[8] FEMA. National Flood Insurance Program: Frequently Asked Questions. https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt

payments where the total payments exceeds the current building value of the property"[9]. Nationwide, RL properties constitute two percent of all NFIP insured properties, but are responsible for 40% of all NFIP claims. Mitigation for RL and SRL properties is a high priority for FEMA.

The identification of RL and SRL properties is an important element to conducting a local flood risk assessment, as the inherent characteristics of properties with multiple flood losses strongly suggest that they are at a high risk of future flood losses. RL and SRL properties are also important to the NFIP, since structures that flood frequently put a strain on NFIP funds. A primary goal of FEMA is to reduce the numbers of structures that meet these criteria, whether through elevation, acquisition, relocation, or a flood control project that lessens the potential for future losses. Since FEMA's database tracks RL and SRL properties on a rolling ten-year basis, the number of properties fluctuates based on flooding events.

Using the redacted data provided by the Virginia Department of Conservation and Recreation State NFIP Coordinator, the Northern Neck has 189 RL properties and five SRL properties. The current RL and SRL list may not represent all properties that have been previously affected or could be affected by future flooding. Table 4-11 and Table 4-12 shows severe repetitive losses per each Northern Neck community. All of the severe repetitive loss properties in the Northern Neck are residential. There are no repetitive loss properties in Kilmarnock and White Stone when this plan was submitted for FEMA review in September 2017.

Figure 4-3 shows the general location of RL and SRL properties within the Northern Neck.[10]

Table 4-11. Repetitive Loss Structures in the Northern Neck

County	Jurisdiction Name	RL Buildings	RL Losses	Residences	Non-Residential	Condominiums	2 – 4 Family	Total Payments	Property value
Lancaster County	Unincorporated Areas, Lancaster County	67	152	64		2	1	$3,726,597	$30,012,6465B
Lancaster County	Town of Irvington	1	2		1			$75,789	$451,039
Northumberland County	Unincorporated Areas, Northumberland County	72	173	66	1	4		$4,495,717	$40,014,093B

[9] FEMA. Guidance for Severe Repetitive Loss Properties. https://www.fema.gov/pdf/nfip/manual201205/content/20_srl.pdf

[10] NFIP repetitive loss data is protected under the federal Privacy Act of 1974 (5 U.S.C. 552a) which prohibits personal identifiers (i.e., owner names, addresses, etc.) from being published in local mitigation plans.

Table 4-11. Repetitive Loss Structures in the Northern Neck

County	Jurisdiction Name	RL Buildings	RL Losses	Residences	Non-Residential	Condominiums	2 – 4 Family	Total Payments	Property value
Richmond County	Unincorporated Areas, Richmond County	16	51	8	8			$1,265,458	$3,784,628
Westmoreland County	Unincorporated Areas, Westmoreland County	20	43	18	2			$2,063,133	$3,563,409
Westmoreland County	Town of Colonial Beach	13	30	10	3			$1,452,579	$5,371,179
Total	**Northern Neck**	**189**	**451**	**173**	**11**	**6**	**1**	**$13,079,273**	**$70,039,909 B**

Table 4-12 shows severe repetitive losses per each Northern Neck community. All of the severe repetitive loss properties in the Northern Neck are residential.

Table 4-12. Severe Repetitive Loss Structures in the Northern Neck

County	Jurisdiction Name	SRL Buildings	Number of Claims	Building Payments	Average Claim	Property Value
Northumberland County	Unincorporated Areas, Northumberland County	4	18	$362,730	$22,144	$1,067,177
Richmond County	Unincorporated Areas, Richmond County	1	5	$97,464	$24,036	$89,604
Total	**Northern Neck**	**4**	**23**	**$460,194**	**$23,090**	**$1,156,781**

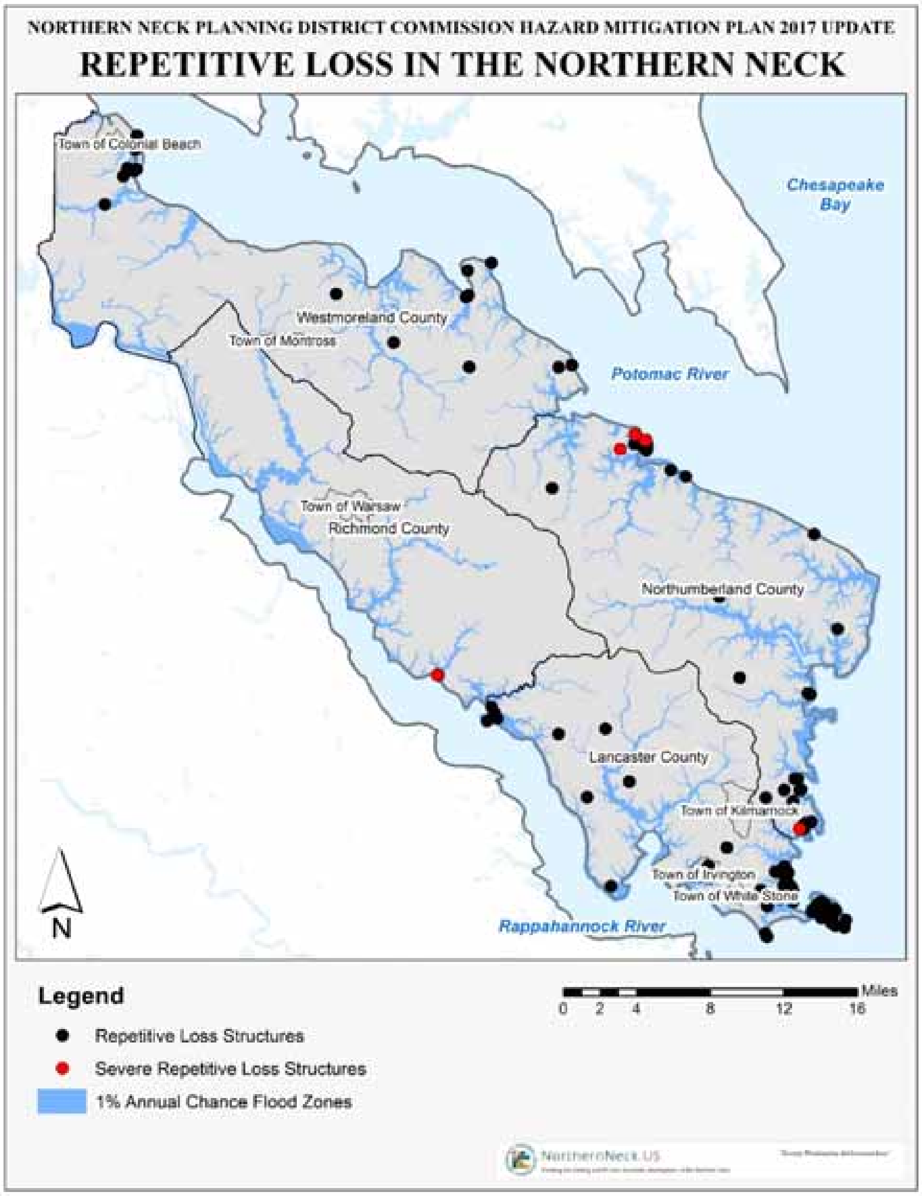

Figure 4-3. Repetitive Loss and Severe Repetitive Loss Properties

4.5.7 Vulnerability and Risk Assessment

Table 4-13 shows the annualized damages for riverine flooding in the Northern Neck. The NCEI Storm Events data was annualized by taking the total number of riverine flooding events and dividing by the length of record. Annualized values should only be used as an estimate of what can be expected during any year. Using historical records, individual counties can expect to experience one event every three to five years. The Northern Neck can expect to experience a riverine flooding event once every two years. Annual total damages (adjusted for inflation) from these events for each county was found to be between $0 and $56,671, though it is possible that actual annual damages in some counties could be higher due to unreported damages. There are no expected deaths or injuries from these events but nationally deaths due to vehicular accidents during floods is increasing.

Table 4-13. Annualized Damages from Riverine Flooding Events

Riverine Flooding	Annualized Events	Annualized Property Damages	Annualized Crop Damage	Annualized Total Damage	Annualized Deaths	Annualized Injuries
Lancaster	0.2	$0	$0	$0	0	0
Northumberland	0.2	$0	$0	$0	0	0
Richmond	0.3	$43,399	$13,272	$56,671	0	0
Westmoreland	0.4	$12,940	$3,650	$16,590	0	0

4.5.7.1 Vulnerability and Impact to People and Property

Flooding has the greatest effect on the people living in the area impacted. Flooding directly impacts a community's ability to function by damaging homes and businesses, disrupting community services, and interrupting utility service. Flooded roadways can increase congestion on alternative routes and lengthen travel times for emergency vehicles and school buses. Businesses that are flooded may sustain damage to the structure and its contents, resulting in economic losses to the business.

Riverine and flash floods have the potential to pick up chemicals, sewage, and toxins from roads, factories, and farms; therefore, any property affected by a flood may be contaminated with hazardous materials and present a health and safety risk to residents. Debris from vegetation and structures may also become hazardous following the occurrence of a flood. In addition, floods may threaten water supplies and water quality, and create health issues such as mold. Damages from storm water runoff events also includes wall damage due to "wicking", mildew damage, damages to building contents, minor foundation damage, damage to water distribution systems, and potable water contamination. Public related costs include debris clearance; equipment, material and labor expenses related to emergency response; and building or facility repair or replacement (county parks, utilities, communications, buildings, vehicles, etc.).

A number of factors contribute to the relative vulnerabilities of certain areas in the floodplain. Development, or the presence of people and property in the hazardous areas, is a critical factor in determining vulnerability to flooding. Additional factors that contribute to flood vulnerability range from specific characteristics of the floodplain to characteristics of the structures located within the floodplain. The following is a brief discussion of some of these factors and how they may relate to the area.

- *Flood depth*: The greater the depth of flooding, the higher the potential for significant damages.
- *Flood duration*: The longer duration of time that floodwaters are in contact with building components, such as structural members, interior finishes, and mechanical equipment, the greater the potential for damage. Floodwaters may linger because of the low relief of the area, but the degree varies.
- *Velocity*: Flowing water exerts force on the structural members of a building, increasing the likelihood of significant damage. A one-foot depth of water, flowing at a velocity of five feet per second or greater, can knock an adult over and cause significant scour around structures and roadways.

- *Elevation*: The lowest possible point where floodwaters may enter a structure is the most significant factor contributing to its vulnerability to damage due to flooding. Data on the specific elevations of structures in the Northern Neck has not been compiled for use in this analysis.
- *Construction type*: Certain types of construction are more resistant to the effects of floodwaters than others. Masonry buildings, constructed of brick or concrete blocks, are typically the most resistant to flood damages simply because masonry materials can be in contact with limited depths of water without sustaining significant damage. Wood frame structures are more susceptible to flood damage because the construction materials used are easily damaged when inundated with water. The type of construction throughout the Planning District varies.

4.5.7.2 Total Exposure in Floodplain (TEIF) Analysis

In support of FEMA's RiskMAP Program, FEMA endeavored to produce national-level flood risk analyses to estimate the potential losses from flooding across the nation. This effort occurred during 2009 and 2010 and produced a product known as the 2010 Hazus Average Annualized Loss (AAL) Study Results. The 2010 AAL Study and its associated results were intended to be a mechanism for FEMA - as well as local stakeholders - to assist in the prioritization of flood mitigation activities across the lower 48 states. Further information on the 2010 AAL Results and its use in RiskMAP Risk Assessments can be viewed in Guidance for Flood Risk Analysis and Mapping (May 2014). Notably, there were some areas in which the Hazus software was unable to produce valid results for the 2010 AAL Study in certain coastal areas. A lack of estimated flood damages limited the ability to assess potential damage across the entirety of the regional geography.

An analysis was performed in order to estimate the Total Exposure in the Floodplain (TEIF) of the building stock in the Virginia Northern Neck region. Building footprint polygons were available for Richmond and Westmoreland counties through the Virginia Geographic Information Network (VGIN) and were used for the TEIF analysis. For Lancaster and Northumberland Counties, the TEIF method was applied at the 1,000 square foot Census Block level. The subsequent section describes the methodology and vulnerability assessment as part of this analysis.

TEIF Methodology for Building Footprints: TEIF uses the 2010 Topologically Integrated Geographic Encoding and Referencing (TIGER) Census block level data to assume the total property value for each census block within the county. The analysis divides that total census tract property value by the number of buildings in the tract, proportional to the area of each of the building footprints[11]. For example, if the total value of one census block is $1,000,000 and there are 10 equally sized 1,000 square foot buildings within the block, each building would be assigned a value of $100,000. If the buildings were not equal in size, they would receive more or less value proportional to the size of the other buildings within that block.

The building footprints are then intersected with the FEMA effective 100-year and 500-year floodplain data. The proportion of how much of each building lies within each floodplain is then used to calculate the value of the building's exposure to the floodplain. Due to a combination of the low resolution of the property values from the Census block data, the high resolution of the

[11] Building footprints shape file provided by VGIN.

buildings, and the assumption of total exposure within the floodplain, the exposed property values are extrapolated to 1000 square foot grids. This resolution best summarizes the results of the TEIF analysis at a countywide scale, identifies areas that may be more affected by a flood, and represents the uncertainty within this method of extrapolating building values from Census block property values.

TEIF Methodology for Census Blocks: When building footprints are not available, the 2010 Census TIGER block data is intersected with the effective 100-year and 500-year floodplain data directly. This method is also extrapolated to 1000 square foot grids because of some uncertainty in this approach. On a countywide scale, this method helps summarize areas with high valued property at risk of flooding.

TEIF Vulnerability Analysis and Assessment: The results of the analysis identified areas within each of the four counties that have high levels of flood exposure. The Unincorporated Areas of Lancaster County, Northumberland County, Westmoreland County, and the Town of Colonial Beach account for the most property value exposed to the floodplain accounting for 39%, 27%, 16%, and 12%, respectively, of the total damage within the Northern Neck.

For the Northern Neck Planning District Commission, the TEIF analysis showed that there is an estimated $346.8 million worth of property exposed to losses in the 100 year floodplain, and $425 million exposed to losses in the 500 year floodplain. A summary of the flood exposure for the Planning District Commission can be found in Table 4-14. All values are rounded to three significant figures.

Figure 4-4 and

Figure 4-5 map the results of the TEIF analysis for the 100 and 500 year floodplains for the entire Northern Neck area. TEIF analysis maps for each county can be found in Appendix B.

Table 4-14. TEIF Summary for Northern Neck

County	Jurisdictions	100 Year Exposure	500 Year Exposure
Lancaster	County Total	$131,000,000	$176,000,000
	Town of Irvington	$3,610,000	$3,720,000
	Town of Kilmarnock	$531,000	$531,000
	Town of White Stone	$0	$0
	Unincorporated Areas	$127,000,000	$172,000,000
Northumberland	County Total	$98,800,000	$113,000,000
Richmond	County Total	$16,000,000	$21,000,000
	Town of Warsaw	$0	$0
	Unincorporated Areas	$16,000,000	$21,000,000
Westmoreland	County Total	$101,000,000	$115,000,000
	Town of Colonial Beach	$42,100,000	$50,400,000
	Town of Montross	$155,000	$155,000
	Unincorporated Areas	$59,000,000	$64,600,000
Total	**Northern Neck**	**$346,800,000**	**$425,000,000**

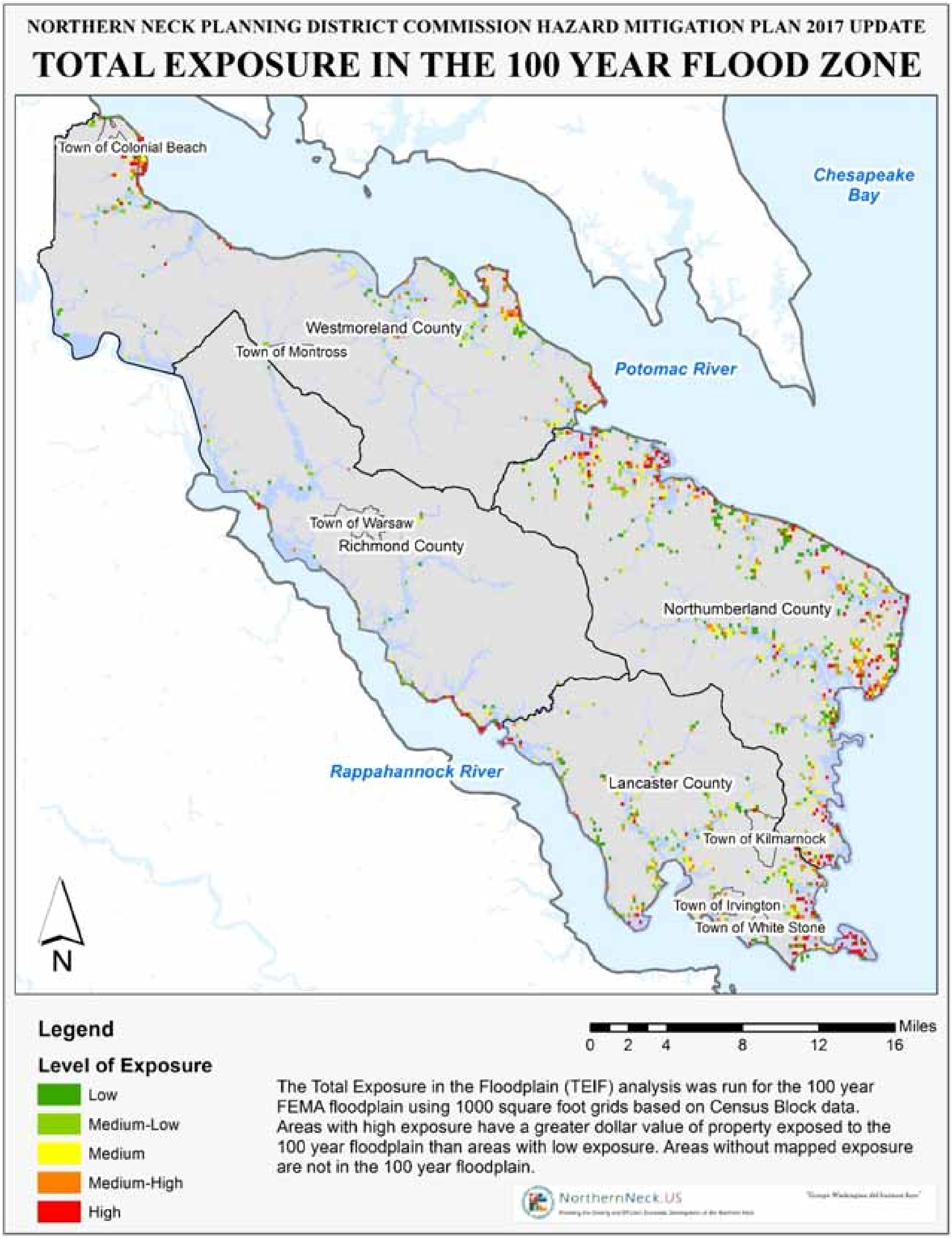

Figure 4-4. Total Exposure in the 100 Year Floodplain

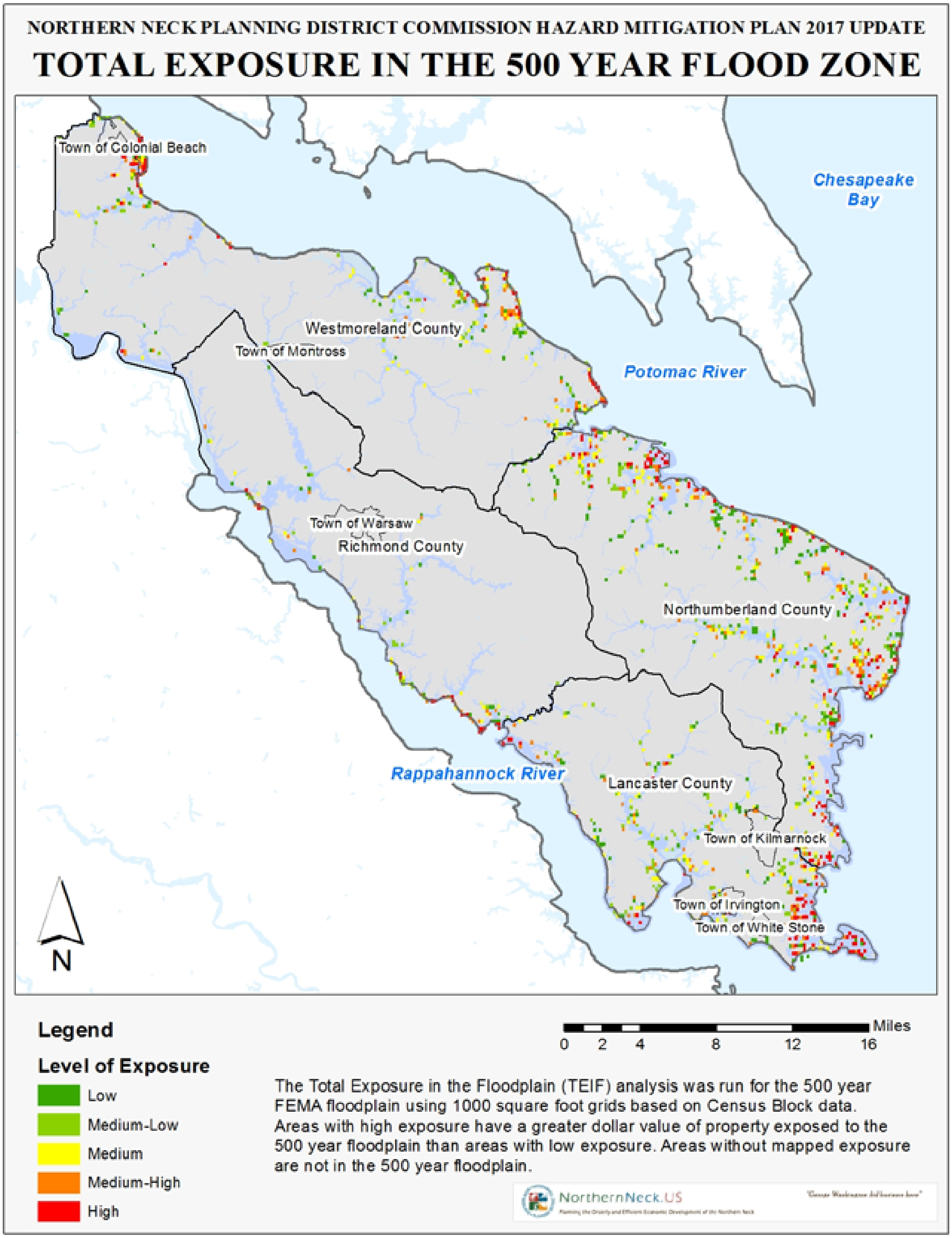

Figure 4-5. Total Exposure in the 500 Year Floodplain

4.5.7.3 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined riverine flooding to be a "significant" hazard in the Northern Neck. As described in the profile above, flood events within the region are likely events with between 1 and 3.9 events annually. Flood events have a "medium" range of impacts, accounting for annual property damages between $10,000 and $100,000 (adjusted for inflation). The potential exposure for flooding is "high" with $1 million or greater in potential damages. Warning time of at least one day is expected before an event. Table 4-15 outlines the hazard ranking for each of the hazard priority criteria related to riverine flooding.

Table 4-15. Riverine Flooding Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	Medium	Significant	Medium	Significant	Significant

4.6 Coastal Flooding

4.6.1 Description

Coastal flooding is the inundation of land areas along the coasts of oceans, bays, estuaries, coastal rivers by seawater that is greater than normal tide action. Coastal flooding is the result of storm surge caused by winds and forward motion associated with a storm that piles water up in front of it as it moves toward shore. This advancing surge combines with normal tides to create a storm tide that can increase the mean water level 15 feet or more. Severe storm surge is also frequently associated with nor'easters and hurricanes that impact the Northern Neck.

A nor'easter is a macro-scale cyclone that can form during the fall, winter, or early spring and produces heavy snow, high wind, and rain. The term "nor'easter" refers to the direction of the system's counter clockwise winds which usually manifests as an offshore air mass rotating counterclockwise northeast-to-southwest over the northwest quadrant of the cyclone or storm system. According to the National Weather Service, the U.S. East Coast provides an ideal breeding ground for nor'easters. During winter, the polar jet stream transports cold Arctic air southward across the plains of Canada and the United States, then eastward toward the Atlantic Ocean where warm air from the Gulf of Mexico and the Atlantic tries to move northward. The warm waters of the Gulf Stream help keep the coastal waters relatively mild during the winter, which in turn helps warm the cold winter air over the water. This difference in temperature between the warm air over the water and cold Arctic air over the land is the fuel that feeds nor'easters. High wind gusts, which can reach hurricane strength, are also associated with a nor'easter. The combination of high wind with heavy snow fall can result in blizzard conditions and can cause widespread power outages.

4.6.2 Location and Extent

The entirety of the Northern Neck is susceptible to the damaging effects of nor'easters due to its location adjacent to the Chesapeake Bay and near the Atlantic Ocean. Its low-lying coastal areas that are in close proximity to the shore, sounds, and estuaries are particularly exposed to the threat of flooding from storm surge and wind-drive waves that are associated with nor'easters.

Unlike a hurricane, a nor'easter can linger through several tides and cause more severe coastal flooding since each tide piles more water along shorelines and bays, becoming stationary or slow moving, continuing to spin and drench the impacted area. Nor'easters can also cause significant beach erosion that damages property and habitats.

Storm surge heights, wind speed, fetch length, pressure and associated waves are dependent upon the configuration of the continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). These as well as other factors can impact storm surge height and wave height. A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water in close proximity to the shoreline, tends to produce a lower surge but higher and more powerful storm waves. Table 4-16 highlights the general impacts of storm surge hazards.

Table 4-16. Storm Surge Impacts

Extent of Hazard (Storm Surge)	Impacts
High: 4-10 feet	Major structural flooding, loss of life, and major beach erosion
Medium: 3-4 feet	Flood damage to homes
Low: 0-3 feet	Damage to sea turtle nests, minor beach erosion

4.6.3 Previous Occurrences

The NCEI storm events database contains reports of 11 coastal flood events in the Northern Neck area totaling nearly $29 million in property damage. These events are primarily the result of storm surge associated with nor'easters and higher than average tidal flooding. Table 4-17 lists the notable coastal flood events that have affected the Northern Neck. When no community-specific description is given, the general description applies to the entire region.

Table 4-17. Notable Coastal Flooding Events

Event Date	Hazard History
January 27 – 28, 1998	A nor'easter battered eastern Virginia on Tuesday, January 27 and Wednesday, January 28. The slow movement of the storm combined with the highest astronomical tides of the month resulted in an extended period of gale to storm force onshore winds which drove tides to 6.44 feet above Mean Lower Low Water (MLLW) at Sewells Point in Norfolk. Locally moderate coastal flooding was reported across the Middle Peninsula and Northern Neck areas.
February 4 – 6, 1998	A nor'easter battered eastern Virginia from Tuesday, February 3rd through Thursday, February 5th. The slow movement of the storm resulted in an extended period of gale to storm force onshore winds which drove tides to 7.0 feet above Mean Lower Low Water (MLLW) at Sewells Point in Norfolk.
September 1, 2006	Tides of 4 to 5 feet above normal, combined with 6 to 8 foot waves caused significant damage to homes, piers, bulkheads, boats, and marinas across portions of the Virginia's Northern Neck and Eastern Shore. Some of the most significant damage occurred in the Lewisetta area of Northumberland County. More

Table 4-17. Notable Coastal Flooding Events

Event Date	Hazard History
	than $21 million in damage was reported in the Northern Neck from this event.
November 12 – 14, 2009	An intense Nor'easter produced moderate to severe coastal flooding across much of eastern and southeast Virginia and the Virginia Eastern Shore. Several streets, homes and businesses were flooded in low lying areas that are close to or directly exposed to the Chesapeake Bay. There were also damaged piers, bulkheads, and groins.
October 28 – 29, 2012	Superstorm Sandy moved northward well off the Mid-Atlantic Coast then northwest into extreme southern New Jersey produced very strong northeast winds followed by very strong west or northwest winds. Very strong winds caused moderate to severe coastal flooding across portions of eastern and southeast Virginia. Water levels reached 2.0 feet to 3.5 feet above normal adjacent to the Chesapeake Bay and Rappahannock River resulting in moderate to severe coastal flooding. Reported property damages totaled more than $600,000 in the Northern Neck.
October 2– 5, 2015	A combination of Hurricane Joaquin near the Bahamas and strong high pressure over New England produced strong onshore winds over the Mid-Atlantic. The strength and duration of the onshore winds produced moderate coastal flooding along the Atlantic Coast and Chesapeake Bay. A tidal departure of 2 to 3 feet resulted in moderate flooding along the Rappahannock River, Potomac River, and Chesapeake Bay. Several roads were closed, and a number of homes and other buildings sustained flood related damage. Hundreds of residents were evacuated from low-lying areas in Lancaster County on Virginia's Northern Neck. Reported property damages exceeded $1 million.
September 30, 2016	Prolonged east to northeast winds produced minor to moderate coastal flooding in parts of the Chesapeake Bay region. Water levels reached moderate flood levels on the Northern Neck. Tides of 2 feet above normal caused moderate flooding near the Potomac River and areas adjacent to the Chesapeake Bay. Water levels reached nearly 3.7 feet MLLW at Lewisetta VA. No damage was reported in the Northern Neck.

4.6.4 Probability of Future Events

The extensive coastal areas of the Northern Neck are considered equally at risk of experiencing the damaging effects of future Nor'easters. Coastal flooding is expected to occur in the Northern Neck once every two years and cause an average of $1.3 million in property and crop damages, based on past occurrences reported in the NCEI Storm Events Database. Nor'easters are expected to continue developing between the months of September and April, with the most powerful storms affecting the area in January, February, and March but they can occur at any time. It should also be noted that anticipated sea level rise will increase the probability and intensity of future tidal flooding events in years to come.

4.6.5 Vulnerability and Risk Assessment

Table 4-18 shows the annualized damages for coastal flooding in the Northern Neck. The NCEI Storm Events data was annualized by dividing the total number of coastal flooding events by the length of record. The annualized values should only be utilized as an estimate of what can be expected in a given year. Using historical records, individual counties can expect to experience one event every two to five years. The Northern Neck can expect to see one coastal flooding event every two years. Annual total damages (adjusted for inflation) from these events for each county was found to be between $11,396 and $1,117,120, though it is possible that actual annual damages in some counties could be higher due to unreported damages. There are no expected deaths or injuries from these events.

Table 4-18. Annualized Damages from Coastal Flooding

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	0.4	$91,330	$0	$91,330	0	0
Northumberland	0.5	$1,117,120	$0	$1,117,120	0	0
Richmond	0.1	$98,041	$0	$98,041	0	0
Westmoreland	0.2	$11,396	$0	$11,396	0	0

4.6.5.1 Vulnerability and Impact to People and Property

The low-lying coastal areas of the Northern Neck are most vulnerable to the damaging effects of storm surge due to nor'easters and Hurricanes as well as above average tidal flooding. Non-elevated structures built prior to the 1980s when National Flood Insurance Program (NFIP) building standards were adopted are especially vulnerable to damage. Storm surge has the potential to cause damage to foundations of structures, damage contents, cut off utilities such as power, damage infrastructure such as bridges and roads, and cause extensive beach erosion. Coastal erosion will be addressed as a separate hazard in Section 4.7. Many of the same vulnerabilities and impacts to people and property as described in the riverine flooding section apply also to coastal flooding.

4.6.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined coastal flooding to be a significant hazard. Coastal flood events within the Northern Neck are a likely event with between 1 and 3.9 events annually. Coastal storm events have a high range of impacts, accounting for more than $100,000 (adjusted for inflation) in annual property damages. The potential exposure for coastal storms is high with more than $1 million in potential damages. Coastal flooding is ranked medium for having a warning time of at least one day before an event. Table 4-19 outlines the hazard ranking for each of the hazard priority criteria related to coastal flooding.

Table 4-19. Coastal Flooding Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	High	High	Medium	Significant	Significant

4.7 Coastal Erosion

4.7.1 Description

Coastal erosion is the landward displacement of the shoreline caused by the forces of waves and currents. Sea level rise, land subsidence and increasing rates of shoreline development intensify tidal erosion, causing property loss and water quality degradation. Coastal erosion has a significant impact on water quality and natural resources. About 4.7 million cubic yards of Chesapeake Bay shoreline erode each year, adding sediments, toxins, and nutrients to the water[12].

Coastal erosion poses an increasingly serious threat to the region's local governments since each county features significant shoreline areas encompassing a large percentage of each communities' higher value residential building stock. Coastal erosion is wearing away the land exacerbating the removal of beach or dune sediments. Wind and fast moving motor craft can also cause coastal erosion, initiating temporary or long term loss of sediment, rocks and redistribution of coastal sediments. These processes often result in shoreline loss due to erosion in one location balanced by nearby accretion.

4.7.2 Location and Extent

Coastal erosion impacts the four counties in the Northern Neck in varying degrees. The two driving forces of coastal erosion in the Northern Neck are the slow rise in sea level that started about 15,000 years ago that has flooded the coastal plain watersheds, and wave action from hurricanes and nor'easters.[13] As the shorelines recede and erode, the bank material creates sandy beaches and is carried offshore to create sand bars.

Erosion rates and potential impacts are highly localized. Coastal erosion rates are determined by four principle factors: storm frequency; storm type and direction; resulting wind, tides, current, and waves; and storm intensity and duration. Other forces which cause increased levels of storm water runoff and coastal erosion are:

- human activity
- grading
- upland runoff
- vegetation removal

The beaches and dune system along the Chesapeake Bay are protected by the Coastal Primary Sand Dune Protection Act of 1980[14]. Research by Hardaway *et al.* (2001) located, classified, and

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[12] "Eroding shores reshape the Chesapeake", Blankenship, Karl, June 01, 1991, http://www.bayjournal.com/article/eroding_shores_reshape_the_chesapeake

[13] Shoreline Evolution Chesapeake Bay and Potomac River Shorelines Northumberland County, Virginia (2006), Hardaway et al.

[14] The General Assembly of Virginia enacted the Coastal Primary Sand Dune Protection Act (the Dune Act) in

counted the dune systems within the eight localities listed in the Act, including Northumberland and Lancaster Counties. Subsequently, the Northumberland County Dune Inventory was created by Hardaway *et al.* in 2003 to detail the location and nature of the jurisdictional primary dunes along the Northumberland County Chesapeake Bay shoreline. Figure 4-6 outlines an example of a typical Chesapeake Bay dune profile.[15]

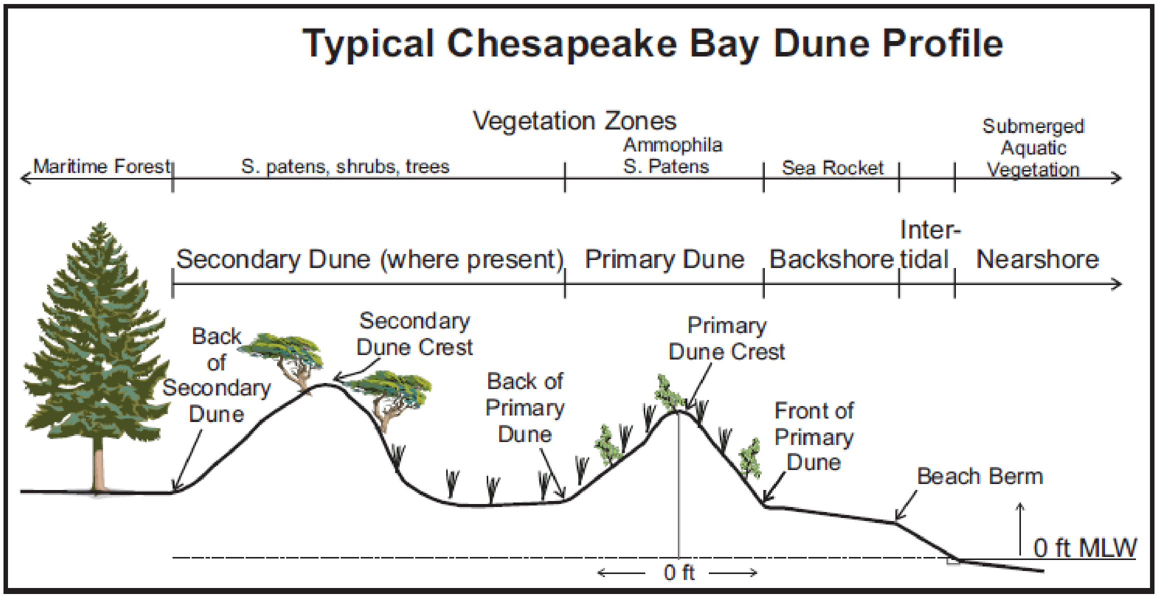

Figure 4-6. Typical Profile of a Chesapeake Bay Dune System

Shoreline evolution studies have been completed for Northumberland (2006), Lancaster (2006), Richmond (2011), and Westmoreland (2012) Counties by the Virginia Institute of Marine Science (VIMS) to document how these dune profiles have evolved since 1937 using aerial imagery. The results of these analyses can be found in Appendix B. Erosion extent is related to the following factors defined by the Virginia Department of Mines, Minerals and Energy (DMME):

- composition of the shoreline (rock, sand, clay, marsh, or man-made structures)
- fetch
- orientation to prevailing wind direction
- relative sea-level rise

Additionally, there is the localized effect of land subsidence, and flood heights that can vary by several feet over the tidal areas given basin shape, wind direction, and state of the tide. The effects of coastal erosion can be seen in

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1980. The Dune Act was originally codified in § 62.1-13.21 to -13.28. The Dune Act is now recodified as Coastal Primary Sand Dunes and Beaches in § 28.2-1400 to -1420.

[15] Hardaway, C.S., Jr., L.M. Varnell, D.A. Milligan, G.R. Thomas, and C.H. Hobbs, III, 2001. Chesapeake Bay Dune Systems: Evolution and Status. Technical Report. Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, Virginia.

Figure 4-7, an example of a major slump feature found at the Nomini Cliffs in Westmoreland County along a scarp.[16] A scarp is a steep slope along the coastline, often as part of a series of beach ridges that are produced by higher stands of sea level, or a low, steep beach slope caused by wave erosion. A slump is caused by the erosion of fine-grained silt and clay (basal clay layers) at the base of a scarp, giving way to the upper layer of sand.[17]

Figure 4-7. Major Slump Feature Along Nomini Cliffs in Westmoreland County

4.7.3 Previous Occurrences

The College of William and Mary's Virginia Institute of Marine Science published a series of Shoreline Evolution studies for Lancaster (2006), Northumberland (2006), Richmond (2011), and Westmoreland (2012) counties. Recent and historical aerial imagery was obtained to analyze the past shoreline positions and understand trends in shoreline evolution. The rate of change for each plate, which is a mosaic of aerial images, is an average across large sections of shoreline between 1937 and 2002 (Lancaster and Northumberland) and 1937 and 2009 (Richmond and Westmoreland).

For each county in the Northern Neck, the three plates with the highest rate of change were summarized in Table 4-20. The highest rate of change, -11.1 feet per year, was observed in Lancaster County along the shoreline between Mosquito Point and Windmill Point. The entire Windmill Point area experienced high rates of change. Northumberland County also experienced comparably high rates of change, especially at Jarvis and Bluff Points along the Chesapeake Bay.

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[16] Shoreline Management in Chesapeake Bay, Hardaway, C.S., and Byrne, R.J. October 1999, Virginia Sea Grant Publication

[17] Ibid.

Table 4-20. Northern Neck Top Areas of Coastal Erosion by County

County	Location	Rate of Change (ft/year)	Description
Lancaster	Plate 16A	-11.1	Shoreline between Mosquito Point and Windmill Point
Lancaster	Plate 17	-6.7	Windmill Point
Lancaster	Plate 18	-4.6	Shoreline outside of Little Bay
Northumberland	Plate 21	-8.8	Jarvis Point
Northumberland	Plate 5	-7.4	Great Point and Walnut Point
Northumberland	Plate 22	-6.9	Bluff Point and area fed by Henrys Creek
Richmond	~Plate 14	-3.1	L Rappahannock River - Richardson Creek
Richmond	~Plate 9	-2.1	G Rappahannock River - Shoreline just north of Totuskey Creek
Richmond	~Plate 10	-1.5	H Rappahannock River Shoreline just north of Totuskey Creek
Westmoreland	~Plate 12	-4	I Nomini Bay, Hollis Marsh
Westmoreland	~Plate 31	-2.2	P Potomac River, Jackson Creek to Sandy Point
Westmoreland	~Plate 36	-1.4	Q Potomac River, Sandy Point to Lynch Point

Source: Data obtained from the Virginia Institute of Marine Science's Shoreline Evolution studies for Lancaster, Northumberland, Richmond, and Westmoreland counties.

Note: For the Richmond and Westmoreland studies, the shoreline segments analyzed for the rate of change analysis were lettered. The lettered segments do no line up one-to-one with the numbered plates therefore the lettering was maintained in the Description column and a plate number was estimated for the Location column.

4.7.4 Probability of Future Events

The Northern Neck will continue to be impacted by hurricanes and nor'easters in the future. These severe storms will cause shoreline erosion from increased wave action that will exacerbate the rate of erosion that already occurs on the Northern Neck during normal tidal conditions. While there is no single continuous record of coastal erosion events for the Northern Neck, coastal erosion is a constant and pervasive issue that could cost the Northern Neck billions in future property damages. The Northern Neck includes more than 1,000 miles of shoreline that includes beaches, marinas, and historic towns that contain valuable waterfront property. With the increase in storm events and sea level rise in the future, coastal erosion will be an increasing threat to the region.

4.7.5 Vulnerability and Risk Assessment

4.7.5.1 Vulnerability and Impact to People and Property

Some of the assets most vulnerable to coastal erosion in the Northern Neck are infrastructure such as bridges and roads, personal property, public and private beaches, and the natural habitats of shorebirds and other wildlife. Severe storms such as hurricanes and nor'easters that impact the Northern Neck have the potential to exacerbate the coastal erosion due to the higher wave action and storm surge. Severe storms can remove wider beaches, along with substantial dunes, in a single event. In undeveloped areas, these recession rates are not likely to cause significant concern, but in more heavily populated locations, one or two feet of erosion may be considered catastrophic to beach and shore-front property.

Shoreline protection installations, such as bulkheads and seawalls, can have positive and negative effects on the surrounding area. Eroding sediment banks that once provided sands for beaches, spits and offshore bars no longer has a supply of natural sand input. In addition, these now-protected segments of shoreline will remain as hard points or headland features while adjacent unprotected properties will continue to erode, sometimes at an accelerated rate[18].

To understand the quantity of assets in the Northern Neck at risk of coastal erosion, an exposure analysis was performed using data from each county. For Richmond and Westmoreland counties, actual building footprints and tax assessment values were used to determine the value of coastal property exposed to the hazard. For Lancaster and Northumberland Counties, the FEMA 2010 TIGER Census block data was used to estimate property value exposed. Since rising sea level is a driving factor of coastal erosion, the USGS Climate Resilience Toolkit dataset that assesses the coastal vulnerability to sea level rise was used to estimate areas at high risk of erosion. This dataset includes a Coastal Vulnerability Index (CVI) that provided a subjective assessment of local risk along with sea level rise.[19] The dataset includes ranking values from very low, low, moderate, high, and very high. The entire Northern Neck's coastal areas were assessed at a "high" risk for coastal erosion compared to other national coastal areas.

To quantify the potential exposure and risk of the Northern Neck, a 500 foot buffer was created around the CVI shoreline and intersected with the building footprints or Census blocks of each county. The total risk exposure in Lancaster and Northumberland Counties was much higher because the Census blocks include a much larger area than individual buildings and therefore have a higher total value that could potentially be exposed. Since a national data set was used, shoreline resolution is also poor at the county level. With advances in climate change and sea level rise research, it is anticipated that some of these data gaps will be filled as more information becomes available to future hazard mitigation plan updates. However, at this time this analysis provides a reasonable estimate of the property, most of it residential, at risk to coastal erosion. A summary of the exposure within 500 feet of the CVI shoreline is shown in Table 4-21.

Table 4-21. Building Exposure to Coastal Erosion in Northern Neck

County	Number Affected	Exposure within 500 ft.	Percent Affected	Total Count	Total Value
Richmond	222 Buildings	$16,600,000	1.83%	9749	$906,014,000
Westmoreland	1550 Buildings	$209,000,000	8.04%	20963	$2,598,329,000
Lancaster	324 Census Blocks	$792,000,000	41.1%	1071	$1,928,632,000

18 Shoreline Management in Chesapeake Bay, Hardaway, C.S., and Byrne, R.J. October 1999, Virginia Sea Grant Publication

19 USGS. Coastal Vulnerability to Sea-Level Rise. https://pubs.usgs.gov/dds/dds68/htmldocs/data.htm

Table 4-21. Building Exposure to Coastal Erosion in Northern Neck

County	Number Affected	Exposure within 500 ft.	Percent Affected	Total Count	Total Value
Northumberland	651 Census Blocks	$1,130,000,000	51.7%	1603	$2,187,319,000
Northern Neck	**N/A**	**$2,147,600,000**	**25.67%**	**33386**	**$7,620,294,000**

4.7.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined coastal erosion to be a moderate hazard in the Northern Neck. Coastal erosion within the Northern Neck is a highly likely event with more than four predicted events annually. Coastal erosion events can have a wide range of impacts, however no recorded property damages were available to quantify that prior impact. Damages have been ranked "significant" because damages are reported as caused by hurricanes, tropical depressions, nor'easters, etc. However, the potential exposure for coastal erosion is "significant" based on a vulnerability analysis that estimated exposure exceeding $1.0 million. Coastal erosion is ranked very low for having a warning time of more than three days before an event. Table 4-22 outlines the hazard rankings for each of the hazard priority criteria related to coastal erosion. With ongoing climate change, sea level rise and coastal erosion research, it is highly likely that the coastal erosion ranking will grow to 'significant' in the next plan update HIRA.

Table 4-22. Coastal Erosion Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Significant	**Damages not reported as erosion**	**Medium**	**Low**	**Significant**	**Medium**

4.8 Hurricanes

4.8.1 Description

A tropical cyclone is defined by the NOAA's National Hurricane Center as a warm-core non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation about a well-defined center. Tropical cyclones are defined by atmospheric and hydrologic characteristics such as severe winds, storm surge flooding, high waves, coastal erosion, extreme rainfall, thunderstorms, lightning, and, in some cases, tornadoes. Tropical cyclones that impact the east coast of the United States originate in the Atlantic basin, which includes the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico.

Depending on strength, tropical cyclones are classified as hurricanes or tropical storms. The Saffir-Simpson Hurricane Wind Scale (Table 4-23) uses wind speed, central pressure, and damage potential to create storm classifications. This scale is the standard describing an event's disaster potential. The Scale uses a 1 to 5 categorization based on the hurricane's intensity at the indicated time. 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.

Table 4-23. Saffir-Simpson Hurricane Wind Scale and Typical Damages

Category	Sustained Wind Speeds (mph)	Surge (ft.)	Pressure (mb)	Typical Damage
Tropical Depression	<39	--	--	
Tropical Storm	39-73	--	--	
Hurricane 1	74-95	4-5	> 980	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
Hurricane 2	96-110	6-8	965-980	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. 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.
Hurricane 3	111-129	9-12	945-965	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
Hurricane 4	130-156	13-18	920-945	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Table 4-23. Saffir-Simpson Hurricane Wind Scale and Typical Damages

Category	Sustained Wind Speeds (mph)	Surge (ft.)	Pressure (mb)	Typical Damage
Hurricane 5	> 157	> 18	< 920	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: NOAA National Hurricane Center: http://www.nhc.noaa.gov/aboutsshws.php?

4.8.2 Location and Extent

All areas within the Northern Neck are equally at risk of being affected by a hurricane, but storm damage is dependent on the specific storm track, whether the storm hits the area at high tide, and many other localized factors. The hurricanes that affect Virginia typically form in the Atlantic or Gulf of Mexico during the months of June through November. These storms form from strong low-pressure systems originating in the tropics, which cause the updraft of warm ocean water. Typically, these systems result in strong damaging winds and high seas that can cause flooding and shoreline erosion. A storm originating in the Atlantic is defined as a hurricane when the maximum sustained winds reach 74 miles per hour. Below this level, it is defined as either a tropical storm or tropical depression.

A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. The average diameter of hurricane force winds is 100 miles, with tropical storm force winds extending out 300 – 400 miles. Figure 4-8 shows the distribution of the four wind zones in the United States that reflect the number and strength of extreme windstorms. The Northern Neck is located in a “Hurricane-Susceptible Region” of Zone II where damaging wind speeds of up to 160 mph can be experienced. Buildings should be built to withstand this “design” wind event.

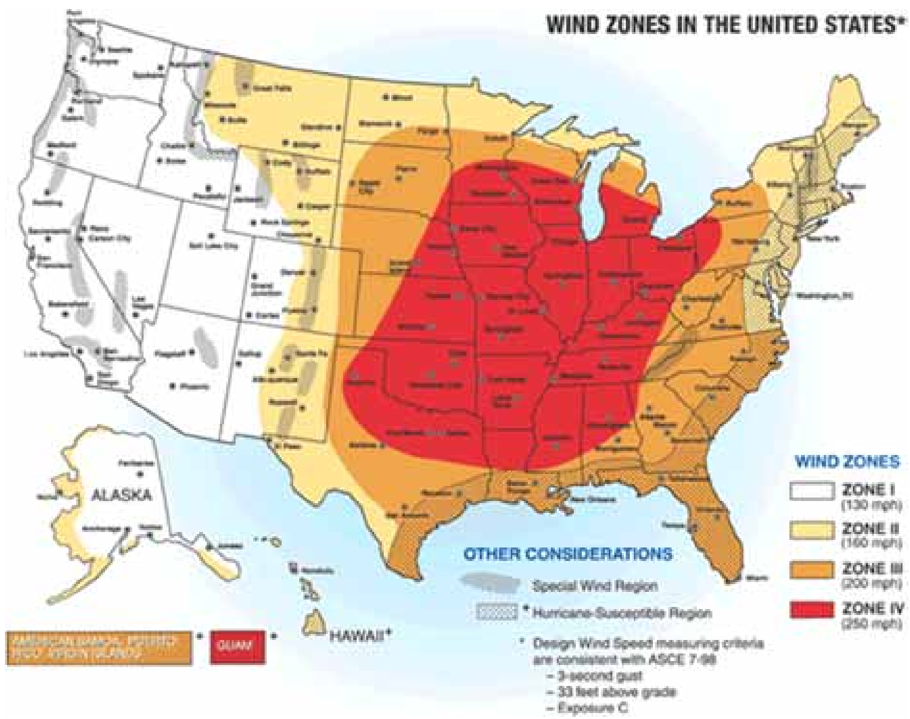

Figure 4-8. Wind Zones in the United States

Storm surge flooding can push inland, and riverine flooding associated with heavy inland rains can be extensive. High winds are associated with hurricanes, with two significant effects: widespread debris due to downed and damaged trees and building debris; and power outages. The Northern Neck is especially vulnerable to hurricanes and their impacts. A tropical cyclone or hurricane has the potential to affect the entire region demonstrated by many past topical depressions, tropical storms and hurricanes. As a storm moves into more shallow waters, wave heights may lessen, but water levels rise, bulging up on the storm's front right quadrant in what is called the "storm surge." This is the deadliest part of a hurricane. Storm surge and wind driven waves can devastate a coastline

4.8.3 Previous Occurrences

According to the NCEI database, three reported hurricanes have impacted the Northern Neck: Hurricanes Fran, Floyd and Isabel. While these storms did not directly track over the Northern Neck, damages were reported in the area due to coastal flooding and high wind associated with the storms because of their relative high strength in the storms' northeastern quadrant. There have also been four tropical storms that have impacted the Northern Neck. Table 4-24 summarizes the most significant hurricanes and tropical storm to impact the Northern Neck.

Table 4-24. Previous Occurrences of Hurricane

Event Date	Hazard History
September, 5, 1996	Hurricane Fran was a Category 3 hurricane that struck Virginia and North Carolina in September, 1996. In Virginia, winds between 39 and 73 mph lashed Chesapeake Bay and increased water levels in the

Table 4-24. Previous Occurrences of Hurricane

Event Date	Hazard History
	Potomac River around the nation's capital. There was severe damage to power lines that left 415,000 households in Virginia without electricity, making it the largest storm related power outage in history until Hurricane Isabel in 2003. Along the Rappahannock River, a storm surge of 5 foot damaged or sank several small boats and damaged wharfs and bulkheads. An F1 tornado touched down in Lancaster County on the Northern Neck, producing winds up to 90 mph that caused $2.5 million in residential damage to 45 structures and $200,000 in commercial damage.
September 15, 1999	Hurricane Floyd was a Category 1 hurricane as it entered Virginia on September 15, 1999. For the Northern Neck area, Hurricane Floyd brought very heavy rainfall due to the presence of a stalled frontal boundary. The rainfall led to overflowing rivers in the Chowan River Basin, some of which exceeded 500-year flood levels. Northumberland and Lancaster counties reported a total of $1.1 million in property damage and $147,000 in crop damage as result of this storm.
September 18, 2003	Hurricane Isabel was a Category 1 hurricane as it crossed the Virginia Beach area. Sustained tropical storm force winds with frequent gusts to hurricane force occurred over Eastern Virginia, along and near the Chesapeake Bay and Atlantic coastal waters. While Hurricane Isabel ultimately made landfall in Ocracoke Island, NC and tracked inland west of Richmond, Virginia, the high winds and storm surge greatly affected the Northern Neck region. The storm surge at Colonial Beach in Westmoreland County reached 6.5 feet. The storm caused widespread power outages, downed numerous trees and eroded beaches throughout the Northern Neck. Westmoreland County reported about $450,000 in crop damage as a result of the storm.
September 1, 2006	The remnants of Tropical Storm Ernesto interacted with an unusually strong high pressure over New England to generate strong winds, heavy rainfall, and storm surge-related tidal flooding and damage. Five to 8 inches of rainfall amounts were common across central and eastern Virginia. This rainfall caused flooding in many areas, although no substantial river flooding resulted from the heavy rain. Wind gusts of 60 to 70 mph occurred on the Eastern Shore of Virginia, as well as areas adjacent to the Chesapeake Bay from Yorktown northward. Tides were particularly high from communities adjacent to the York River, northward through the Rappahannock River to tidal portions of the Potomac River. Tides of 4 to 5 feet above normal, combined with 6 to 8 foot waves, caused significant damage to homes, piers, bulkheads, boats, and marinas across portions of the Peninsula and Middle Peninsula near the Chesapeake

Table 4-24. Previous Occurrences of Hurricane

Event Date	Hazard History
	Bay and adjacent tributaries. At some locations on the Middle Peninsula, Northern Neck and Eastern Shore, the tidal flooding and damage rivaled that from Hurricane Isabel in 2003. Power outages were widespread across the Virginia's Northern Neck and Middle Peninsula. Reported property damages in Northumberland county were over $23 million (2017$).
August 27, 2011	Hurricane Irene affected the Mid-Atlantic Region by bringing strong winds, storm surge flooding, and up to 12 inches of rain across eastern North Carolina, central and eastern Virginia, and the DELMARVA peninsula. Although Irene passed east of the Mid-Atlantic coast, the most substantial wind damage occurred in a swath from Caroline and Westmoreland counties (Northern Neck) southward into the Richmond metropolitan area, then southeastward into Surry, Sussex, James City, and Southampton counties. Winds estimated between 70 and 80 mph downed many trees, blocked roads and caused widespread power outages. The Richmond Times-Dispatch reported widespread downed trees, standing water, and minor damage to homes.
October 28, 2012	Hurricane Sandy was the deadliest and most destructive hurricane of the 2012 Atlantic hurricane season, and the second-costliest hurricane in United States history. On October 26, Governor of Virginia Bob McDonnell declared a state of emergency.
October 8, 2016	Hurricane Matthew was a powerful and devastating tropical cyclone which became the first Category 5 Atlantic hurricane since Hurricane Felix in 2007. While damage was primarily confined to the coast in Florida and Georgia, torrential rains spread inland in the Carolinas and Virginia, causing widespread flooding. Impacts to the Northern Neck were localized.

4.8.4 Probability of Future Events

Hurricanes are a low probability event that can greatly impact large areas. Based on the NCEI historic records of hurricane activity to the Northern Neck, it is estimated that the area will experience one hurricane or tropical storm every three to four years and an average of $292,000 in property and crop damages. Virginia's hurricane season is June 1 through November 30 but usually the most intensive hurricanes occur during August and September.

4.8.5 Vulnerability and Risk Assessment

Table 4-25 shows the annualized damages for hurricanes in the Northern Neck. The NCEI Storm Events data was annualized by dividing the total number of hurricane events by the length of record. The annualized values should only be utilized as an estimate of what can be expected annually. Using historical records, individual counties can expect to experience one hurricane or tropical storm every five to 10 years. The Northern Neck can expect to experience hurricanes and tropical storms in a similar frequency. Annual total damages (adjusted for inflation) from these events for each county was found to be between $46,249 and $106,248, though it is possible that actual annual damages in some counties could be higher due to unreported damages. There are no expected deaths or injuries from these events.

Table 4-25. Annualized Damages from Hurricanes

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	0.2	$39,482	$24,722	$64,204	0	0
Northumberland	0.2	$47,344	$58,904	$106,248	0	0
Richmond	0.1	$6,340	$39,909	$46,249	0	0
Westmoreland	0.1	$24,574	$51,612	$76,187	0	0

4.8.5.1 Vulnerability and Impact to People and Property

Secondary hazards from a hurricane often include high winds, flooding, heavy waves, and tornadoes. Hurricane force winds can easily destroy poorly constructed buildings and mobile homes. Once inland, the hurricane's band of thunderstorms produces torrential rains and, sometimes, tornadoes. A foot or more of rain may fall in less than a day causing flash floods and localized shoreline landslides. The rain eventually drains into the Potomac and Rappahannock Rivers and their tributaries which can exacerbate coastal flooding. Hurricane or tropical depression force winds damage and topple trees, impact utilities, and damage buildings. Utilities, including power, water and waste water treatment and communications can be impaired for days, or in the case of 2003's Hurricane Isabel, for weeks. Transportation networks can be impassable due to high standing water, debris on roadways, and damaged roads and bridges.

4.8.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined hurricane to be a "significant" hazard in Northern Neck. Hurricane events within the Northern Neck are somewhat likely events with less than one event annually. Hurricane events have a "high" range of impacts, accounting for over $100,000 (adjusted for inflation) in annualized property damages. The potential exposure for hurricane events is "high" with more than $1 million in potential damages. Hurricane is ranked low for having a warning time of at least two days before an event. Table 4-26 outlines the hazard ranking for each of the hazard priority criteria related to hurricane events.

Table 4-26. Hurricane Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	**Significant**	**Significant**	**Low**	**Significant**	**Significant**

4.9 Severe Weather (Thunderstorms, Severe Wind, Lightning, and Hail)

4.9.1 Description

For the purposes of the hazard mitigation plan update, severe weather includes thunderstorms, severe wind, lightning, and hail events. The National Weather Service (NWS) defines a thunderstorm as a localized storm produced by a cumulonimbus cloud and accompanied by lightning and thunder. Thunderstorms are typically the result of warm, moist air that is pushed upwards into the atmosphere where it cools and forms into cumulonimbus clouds. As the air continues to cool, it starts to form water droplets or ice. As these droplets or ice start to fall, they may collide and combine many times into larger forms before reaching the Earth's surface. These severe storms are associated with the presence of strong winds, thunder, and lightning. It is also possible to experience a thunderstorm with no precipitation which can cause wildfires to occur. Thunderstorms can form in any geographic region, and are sometimes the cause of other natural phenomena such as downburst winds, heavy rain, flash floods, large hailstones, tornadoes, and waterspouts.

A severe thunderstorm includes damaging winds greater than 58 mph (50 knots) or greater and hail one inch or larger in diameter. Severe winds have been further broken down into three categories by the NWS Storm Events database:

- *High Wind*: Sustained non-convective winds of 35 knots (40 mph) or greater lasting for one hour or longer or winds (sustained or gusts) of 50 knots (58 mph) for any duration (or otherwise locally/regionally defined), on a widespread or localized basis. In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.
- *Strong Wind*: Non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph) resulting in a fatality, injury, or damage.
- *Thunderstorm Wind*: Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage. Events with maximum sustained winds or wind gusts less than 50 knots (58 mph) should be entered as a Storm Data event only if they result in fatalities, injuries, or serious property damage.

Hail is precipitation in the form of ice pellets larger than five mm that forms in thunderstorms between currents of rising air (updrafts) and currents of descending air (downdrafts) as shown in Figure 4-9. These events typically occur in late spring and early summer. One criteria for severe thunderstorms, as defined by the NWS, is hail that is one inch in diameter (quarter-size) or larger.

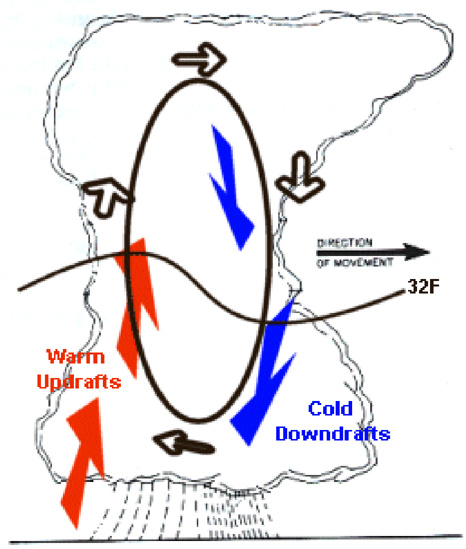

Figure 4-9. Formation of Hail (Source: NOAA)

Lightning is defined by the NWS as a visible electrical discharge (i.e. lightning bolt) produced by a thunderstorm. The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground or between the ground and a cloud. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes, but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes thunder.

4.9.2 Location and Extent

Since it is difficult to determine the probability of future occurrences in a specific area with any degree of accuracy, all areas within the Northern Neck are assumed to be equally at risk to the damaging effects of a thunderstorm that causes high wind, lightning, or hail. Therefore, all assets across the region should be considered vulnerable to these hazards and precautions should be taken to protect them.

Using the NWS definition for a severe thunderstorm, dime-sized hail is considered a minimum hazard and quarter-sized hail is considered a major hazard. Quarter-sized hail can cause significant damage to agricultural crops and livestock, as well as property such as automobiles, aircraft, and roofs. Although rare, large hailstones may even cause injury or death. The amount of cover obtained during a hail storm can greatly reduce the risk to human health during these events.

While there is no established index for lightning, a lightning strike is considered to be of minimum severity when it has limited impacts on infrastructure (ex. tree limbs) and major severity when it causes extensive damage (ex. loss of life, fire, structural damage). The potential damages resulting from lightning strikes are primarily injury, loss of life, power outages, business interruption, fire and minor structural damage. A false sense of security often leads people to believe that they are safe from a lightning strike because it may not appear to be near their location. However, lightning can strike 10 miles away from a rain column, which puts people that are still in clear weather at risk.

High wind events can occur for a variety of reasons: low and high pressure systems, isolated thunderstorms, tropical cyclones, and Nor'easters. Using the NWS severe wind categories listed above, sustained non-convective winds of 40 mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration, on a widespread or localized basis are considered a minimum severity event. A major severe event would be wind events of greater than 58 mph or a wind event resulting in death, injury or significant damage.

4.9.3 Previous Occurrences

There have been 254 severe wind events (including high wind, strong wind, and thunderstorm wind), four lightning strikes and 74 hail events recorded in the Northern Neck according to the NCEI Storm Events Database. Based on the NCEI Storm Events Database, the most significant severe weather events in the Northern Neck are extracted and summarized in Table 4-27. Significant events include any event that caused a death or injury (direct or indirect), as well as the top seven most costly events in terms of property damage. No direct deaths or indirect injuries were reported.

Table 4-27. Significant Severe Weather Events

Location	Event Date	Event Type	Wind Speed/Magnitude	Direct Injuries	Indirect Deaths	Property Damage ($2017)
Northumberland	9/1/2006	High Wind	37	0	0	$15,000,000
Lancaster	7/12/2009	Thunderstorm Wind	52	0	0	$1,000,000
Lancaster	7/12/2009	Thunderstorm Wind	52	0	0	$1,000,000
Lancaster	7/12/2009	Thunderstorm Wind	50	0	0	$1,000,000
Lancaster	9/1/2006	High Wind	35	0	0	$200,000
Lancaster	7/16/2000	Lightning		0	0	$50,000
Lancaster	8/6/2000	Lightning		0	0	$50,000
Lancaster	5/2/1989	Thunderstorm Wind	100	3	0	$0
Richmond	6/13/2013	Thunderstorm Wind	52	0	1	$5,000
Westmoreland	4/21/2017	High Wind, Hail	125	0	0	Reported damage to 170 residences; $8M in damages in Colonial Beach.

The likelihood and potential severity of thunderstorm wind/lightning/hail events can be assessed by reviewing the number and severity of thunderstorm events that have occurred in the period of history available for the Northern Neck. Of the 254 severe wind events, 76 did not have a recorded magnitude or had a magnitude of 0 within the NCEI database. Of the remaining 178 recorded events, the recorded wind speeds varied from 28 to 100 miles per hour (mph). There are a significant number of severe wind events reported because during the same incident, such as an isolated thunderstorm, it can result in multiple reports of thunderstorm wind (of various speeds) from different towns in the same county. Table 4-28 shows the distribution of events by recorded wind speed, where the maximum wind speeds for an average thunderstorm range from 50 to 55 mph. Similarly, Table 4-29 shows the distribution of hail events by recorded hail size, where a majority of reported hail events in the Northern Neck are one inch or less in size.

Table 4-28. Frequency of Severe Wind Events

Wind Speed (mph)	Number of Events
Not Recorded	43
0-30	33
31-35	1
36-40	3
41-45	0
46-50	150
51-55	10
56-60	7
61-65	3
66-70	2
71-75	0
76-80	1
81-85	0
86-90	0
91-95	0
96-100	1
Total	**254**

Table 4-29. Frequency of Hail Events

Hail Size (in.)	Object Analog Reported	Number of Events
0.5	Marble, moth ball	0
0.75	Penny	25
0.88	Nickel	11
1	Quarter	19
1.25	Half dollar	1
1.5	Walnut, ping pong	5
1.75	Golf ball	11
2	Hen egg	2
2.5	Tennis ball	0
2.75	Baseball	0
3	Tea cup	0
4	Softball	0
4.5	Grapefruit	0
	Total	**74**

4.9.4 Probability of Future Events

The chance of future occurrences of high wind, hail and lightning in the Northern Neck is high: between five and six events each year after annualizing reported events by the length of record from the NCEI database. Based on the frequency tables above, the average hail event is expected to produce hail sizes ranging from 0.75" and 1." Future severe wind events will likely cause 46 to 55 mph gusts and sustained winds.

4.9.5 Vulnerability and Risk Assessment

Table 4-30 shows the annualized damages for severe weather events in the Northern Neck. The NCEI Storm Events data was annualized by dividing the number of severe weather events by the length of record. The annualized values should only be used as an estimate of what can be expected each year. Using historical records, an individual county can expect to experience between one to two severe weather events annually. The Northern Neck can expect to see between five and six events annually. Annual total damages (adjusted for inflation) from these events for each county was found to be between $3,454 and $289,889, though it is possible that actual annual damages in some counties could be higher due to unreported damages. There was a reported injury in Lancaster County due to severe weather, however overall for the Northern Neck there are no expected deaths or injuries from these events.

Table 4-30. Annualized Damages from Severe Weather

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	1.2	$62,629	$0	$62,629	0	0.048
Northumberland	1.1	$289,889	$0	$289,889	0	0
Richmond	1.9	$3,349	$105	$3,454	0	0
Westmoreland	1.8	$4,303	$0	$4,303	0	0

4.9.5.1 Vulnerability and Impact to People and Property

High wind events pose a danger because they can result in localized or widespread power outages, property damage, and falling trees. Mobile homes are particularly vulnerable to high winds, especially if improperly anchored. Injury or death can result from falling objects, vehicle accidents, and flying debris. Most deaths associated with extreme wind events occur in cars, especially lightweight vehicles and high-profile tractor trailers.

Older critical facilities are vulnerable to wind damage due to the age of construction and possible poor condition. It is important to identify specific critical facilities and assets that are most vulnerable to the hazard. Evaluation criteria include the age of the building (and what building codes may have been in effect at the time of construction), type of construction, and condition of the structure (i.e., how well the structure has been maintained).

4.9.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined severe weather events to be a “moderate” hazard in Northern Neck. Severe weather events within the Northern Neck are highly likely events with more than four events annually. Severe weather events have a “high” range of impact, accounting for more than $100,000 (adjusted for inflation) in annual property damages. The potential exposure for severe weather events is “medium” with between $100,000 and $1.0 million in potential damages. Severe weather is ranked medium for having a warning time of at least one day before an event. Table 4-31 outlines the hazard rankings for each of the hazard priority criteria related to severe weather events.

Table 4-31. Severe Weather Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Significant	Significant	N/A – Did not rank	Medium	Medium	Medium

4.10 Tornado

4.10.1 Description

A tornado is described as a violently rotating column of air extending from a thunderstorm to the ground. The rotating column of air often resembles a funnel-shaped cloud. Winds are typically less than 100 mph, with the most violent tornado wind speeds exceeding 250 mph. The widths of most Virginia tornados are generally several yards across, but the path length can vary from a few hundred yards to dozens of miles long. A tornado moves at speeds between 30 and 125 miles per hour (mph), and can generate winds that reach 300 mph.

4.10.2 Location and Extent

In the United States, tornadoes have been classified on the Fujita Scale, assigning numeric scores from zero to five (or higher) based on the severity of observed damages. The traditional Fujita scale, introduced in 1971, was used to rate the intensity of tornadoes thereafter, and was also applied to previously documented tornadoes. The scale assigns numerical values for wind speeds inside the tornado according to the type of damage and degree of the tornado. Most tornadoes are F0 and F1, resulting in little widespread damage. Low-intensity tornadoes can also cause localized transportation route disruption due to debris from trees and impacted buildings, signs, etc. Utilities can also be out of service for several days due to downed power and phone lines. A tornado's intense power can destroy buildings, especially manufactured homes, downed power lines and can cause significant tree and crop damage.

In February, 2007, an "enhanced" Fujita scale was implemented with somewhat lower wind speeds at the higher F-numbers, and more thoroughly-refined structural damage indicator definitions. It was developed to better align tornado wind speeds with associated damages. Table 4-32 shows the differences between the old and new tornado intensity scales, wind speeds, typical damages, and frequency.

Table 4-32. Tornado Damage Scale

Derived EF Scale		Fujita Scale		Damage	Frequency
EF Number	3 Second Gust (mph)	F Number	3 Second Gust (mph)		
EF0	65 to 85	F0	40 to 72	Light Damage. Some damage to chimneys, TV antennas, roof shingles, trees, and windows	29%
EF1	86 to 110	F1	73 to 112	Moderate Damage. Automobiles overturned, carports destroyed, trees uprooted	40%
EF2	111 to 135	F2	113 to 157	Considerable Damage. Roofs blown off homes, sheds and outbuildings demolished, mobile homes overturned	24%
EF3	136 to 165	F3	158 to 206	Severe Damage. Exterior walls and roofs blown off homes. Metal buildings collapsed or severely damaged. Forests and farmland flattened.	6%

Table 4-32. Tornado Damage Scale

Derived EF Scale		Fujita Scale		Damage	Frequency
EF Number	3 Second Gust (mph)	F Number	3 Second Gust (mph)		
EF4	166 to 200	F4	207 to 260	Devastating Damage. Few walls, if any, standing in well-built homes. Large steel and concrete missiles thrown far distances.	2%
EF5	Over 200	F5	261 to 318	Incredible Damage. Homes leveled with all debris removed. Schools, motels, and other larger structures have considerable damage with exterior walls and roofs gone. Top stories demolished.	Less than 1%

Source: NOAA Storm Prediction Center http://www.spc.noaa.gov/efscale/ef-scale.html

Tornado season typically is March through August; however, tornados can occur in any month. In Virginia, peak tornado activity is in July since hot, humid conditions stimulate tornado growth. Strong tornadoes may be produced by thunderstorms and are often associated with the passage of hurricanes. The total number may be higher as incidents may occur over areas with sparse populations, or may not cause any property damage.

4.10.3 Previous Occurrences

According to the NCEI storm events database, there have been 26 recorded tornado events since 1950, which includes two funnel clouds and two water spouts. These tornado events have resulted in a total of $11.7 million in property damage. Figure 4-10 shows the location of historic tornado tracks and touch downs in the Northern Neck. Table 4-33 lists the most significant of these events along with recent events not recorded by the NCEI database.

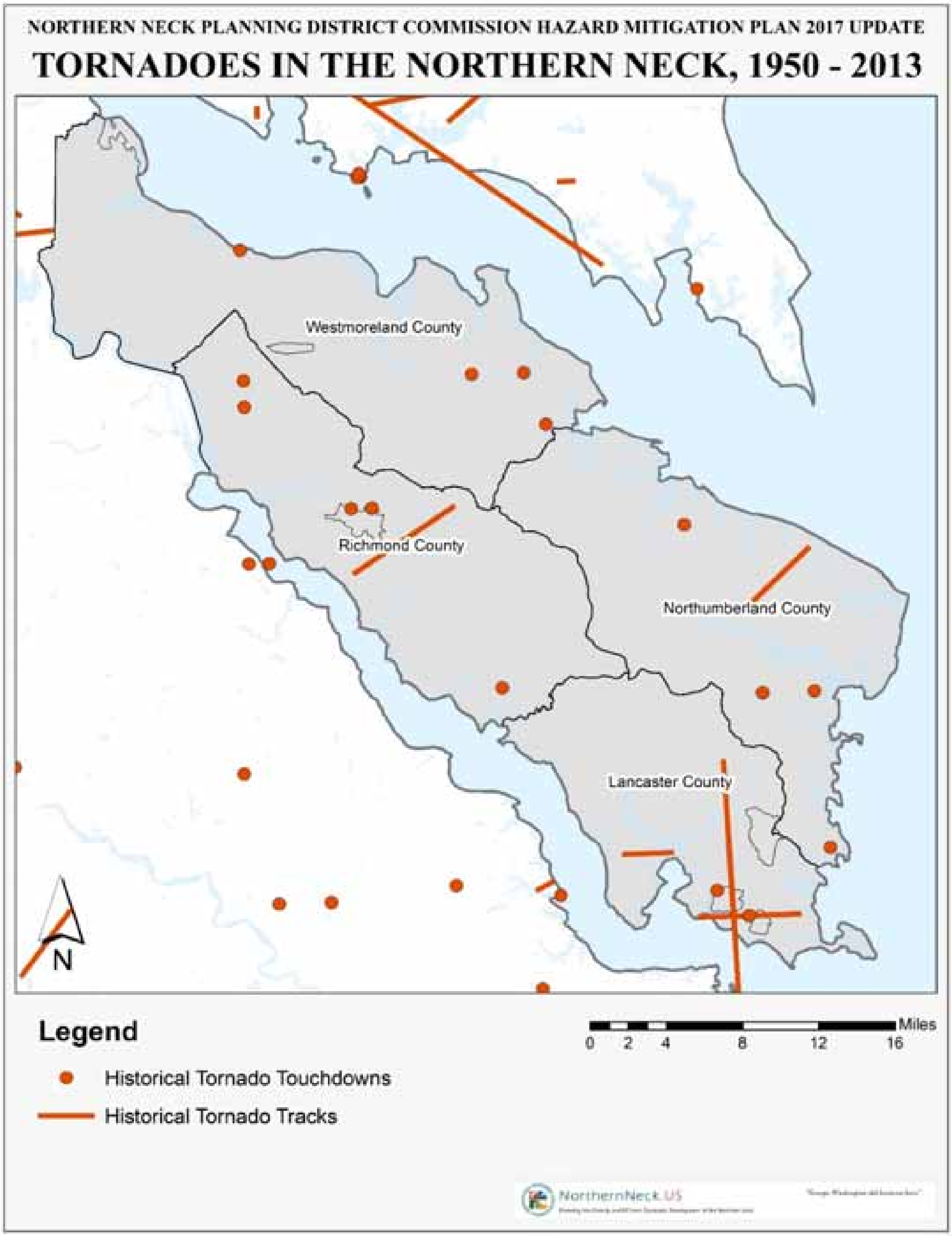

Figure 4-10. Historic Tornado Tracks and Touchdowns in the Northern Neck

Table 4-33. Previous Occurrences of Tornado Events

Event Date	Hazard History
5/10/1990	Lancaster County. This tornado traveled in an east-northeast direction from two miles southwest of White Stone, and ending about two miles east-northeast of White Stone. The path was just over four miles long and it was intermittent. The greatest damage occurred in the center of White Stone. In addition to considerable tree damage, three buildings were heavily damaged, five stores lost plate-glass windows, and a mobile home was destroyed by trees.
8/6/1993	White Stone. At 1515 EDT, a tornado moved northeast through White Stone. Tree were broken and knocked down damaging hones.
6/24/1996	Westmoreland County. Brief tornado touched down at Westmoreland State Park. Numerous trees and power lines were downed throughout the park. Roofs of three cabins were damaged by downed trees. One cabin suffered the most damage as a large tree trunk crashed through the roof, damaging the rafters and inside walls of the kitchen and a bedroom.
7/12/1996	Northumberland County. Tornado damage occurred from Burgess to Oyster Cove. The most significant damage was found in the Edwardsville area, where nearly 20 mobile homes were severely damaged or destroyed. Numerous trees were downed or suffered damage. Nine, mostly minor, injuries were reported.
	Westmoreland County. The same storm which produced the Edwardsville storm produced a second weaker tornado in Hague. One house sustained minor damage, and numerous trees were sheared off or uprooted.
9/10/1997	Northumberland County. A tornado damaged 5 homes, with a large porch on one home and a garage/breezeway on another home completely destroyed. Damage to 2 other homes was primarily incidental, and caused by flying debris. The fifth home sustained siding and substantial roof damage. Several boats were damaged/overturned at local marina. One row boat near the initial damage area was lifted up and tossed 300-400 yards from its tied-down position. Several other items were thrown distances of several hundred yards. Two cars were damaged, one severely. Several trees were severely damaged, one tree was uprooted by an airborne

Table 4-33. Previous Occurrences of Tornado Events

Event Date	Hazard History
	boat. There were no injuries or fatalities. Property damage totaled about $150,000.
5/25/2004	Lancaster County. A waterspout formed over Carters Creek and came ashore at Irvington Marina as a tornado. A boat house was blown over and numerous boats damaged. Several cars were also damaged.
6/18/2015	Scattered severe thunderstorms associated with a trough of low pressure produced damaging winds and three weak tornadoes across portions of central and eastern Virginia. Richmond County. The tornado began 2 miles west of German's Corner in Richmond County, tracking southeast for about 6 miles passing near Naylors Beach and crossing Highway 360. Peak winds were between 70 and 80 mph. Hardwood trees were uprooted and snapped off. Power lines were downed. Lancaster County. The tornado touched down in Lancaster County near Mollusk and tracked southeast to Ottoman. The tornado remained mostly in the tree tops and bounced as it tracked southeast for about 4 miles. The tornado paralleled River Road eventually crossing River Road near Ottoman. Peak. Winds were between 60 to 70 mph. Hardwood trees were uprooted and snapped off. Power lines were downed.
2/24/2016	Lancaster County. The tornado that began as an EF0 in Middlesex County, intensified briefly to an EF1 in the Norwood Church Road area near Flagstaff Road in Lancaster County. In this area, a brick wall on a garage was flattened, the roof was ripped off a house, and an outbuilding was destroyed. Numerous large trees were snapped including two foot diameter pine trees. The tornado continued north and northeast for a short distance before lifting.
	Richmond County. Tornado crossed the Rappahannock River from Essex County into Richmond county. The tornado struck Naylors Beach as an EF2 tornado removing significant portions of the upper floor of one two story home and destroying several other smaller homes. At this point, the tornado was 300 yards wide with winds around 120 mph. The tornado then crossed Newland Road, weakening slightly too low end EF1 with winds around 90 mph and continuing to Tallent Town Road and Piney Grove Road. The tornado then

Table 4-33. Previous Occurrences of Tornado Events

Event Date	Hazard History
	tracked into Westmoreland County. The tornado caused over $3.3 million in property damage.
2/24/2016 (continued)	Westmoreland County. The tornado re-intensified as it moved from Richmond County into Westmoreland county, crossing Kings Highway (Route 3) west of Naomi Grove as a high EF1 tornado. Tornadic winds increased to 100 mph, severely damaging two homes and destroying a mobile home along Kings Highway. It continued to Cople Highway near Mount Holly, severely damaging numerous homes. After crossing Nomini Creek, the tornado crossed Bushfield Road damaging several homes. The tornado then continued northeast along Mount Holly Road, uprooting and snapping trees before moving into the Potomac River toward Maryland. Reported property damages totaled over $900,000 in Westmoreland County, in addition to over $78,000 in crop damage.
4/6/2017	Town of Irvington. On April 6, an enhanced risk for severe weather was issued for parts of the Mid-Atlantic region. An EF1 touched down in the Town of Irvington in Lancaster County. Some windows were blown out at the local hospital, forcing the hospital to operate on emergency power for a couple hours. Homes in the town had their roofing material, gutters or awnings, and siding material damaged. Numerous trees were snapped or uprooted. According to VDEM records, one home was destroyed, seven suffered major damage, 22 experienced minor damage and an additional 19 were affected for a total loss of $2,707,180. Additionally, there was $10,000 in damage to parks and recreation facilities. Local governments were reimbursed $35,000 for debris removal and emergency protective measures.

4.10.4 Probability of Future Events

Tornadoes are considered to be low-frequency, high-impact events. The NWS advises that tornadoes strike randomly, so all areas within Northern Neck are equally at risk. Tornado and high-wind events can occur at any time of the year, but are more frequent in this area in the spring and summer. Based on the NCEI historic records of tornado activity in the Northern Neck, it is estimated that the region will experience about one tornado every three years. Due to the proximity of this area to open water, proper precautions should be taken to protect infrastructure from damaging wind events.

4.10.5 Vulnerability and Risk Assessment

Table 4-34 shows the annualized damages for tornado events in the Northern Neck. The NCEI Storm Events data was annualized by dividing the tornado events and by the length of record. The annualized values should only be utilized as an estimate of what can be expected each year. Using historical records, an individual county can expect to see one tornado every five to 10 years. The Northern Neck can expect to see one tornado every three to four years. It should be noted that tornado and high wind event frequencies have increased dramatically since the 2011 mitigation plan update. Annual total damages (adjusted for inflation) from these events for each county was found to be between $9,341 and $87,182, though it is possible that actual annual damages in some counties could be higher due to unreported damages. Overall, the region can expect to see at least one injury due to tornados every five years.

Table 4-34. Annualized Damages from Tornados

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	0.1	$87,182	$0	$87,182	0.0	0.0
Northumberland	0.1	$9,341	$0	$9,341	0.0	0.1
Richmond	0.2	$55,666	$0	$55,666	0.0	0.0
Westmoreland	0.1	$20,016	$1,162	$21,178	0.0	0.0

4.10.5.1 Vulnerability and Impact to People and Property

A structure's tornado vulnerability is the same as that for other types of extreme wind events and is based in large part on building construction and standards. Other factors such as location, condition, and maintenance of trees also play a significant role in determining vulnerability. A tornado will cause severe damage or destruction to any structure in its path. Clusters of mobile homes are more vulnerable to tornadoes. Proper anchoring can reduce damage exposure, but not entirely as these structures are extremely vulnerable to damage from downed trees and a tornado's effect on the structure of the manufactured home itself.

Human vulnerability is based on the availability, reception, and understanding of early warnings of tornadoes (e.g., tornado warnings issued by the NWS) and access to safe, substantial indoor shelter. Once warned of an impending tornado hazard, to seek shelter indoors on the lowest floor of a substantial building away from windows is recommended as the best protection.

Electrical utilities and communications infrastructure are also vulnerable to tornadoes. Damage to power lines or communication towers has the potential to cause power and communication outages for residents, businesses, and critical facilities. In addition to lost revenues, downed power lines present a threat to personal safety. Further, downed wires and lightning strikes have been known to spark fires.

4.10.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined tornado events to be a "significant" hazard in Northern Neck. Tornado events within the Northern Neck are somewhat likely events with less than one event annually. Tornado events have a "high" range of impacts, accounting for annual property damages exceeding $100,000 (adjusted for inflation). The potential exposure for tornado events is "medium" with between $100,000 and $1.0 million in potential damages. Tornado is ranked high for having a warning time of less than 24 hours before an event. Table 4-35 outlines the hazard rankings for each of the hazard priority criteria related to tornado events.

Table 4-35. Tornado Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	Significant	Significant	Significant	Medium	Significant

4.11 Winter Storm

4.11.1 Description

Winter storms are events in which varieties of precipitation are formed that only occur at low temperatures, such as snow or sleet, or a rainstorm where ground temperatures are low enough to form ice (i.e. freezing rain). The following are the National Weather Service's descriptions of various components of a winter storm:

- **Heavy snowfall** - the accumulation of six or more inches of snow in a 12 hour period or eight or more inches in a 24 hour period.
- **Blizzard** - the occurrence of sustained wind speeds over 35 mph accompanied by heavy snowfall or large amounts of blowing or drifting snow for more than three hours.
- **Freezing drizzle/freezing rain** - precipitation that falls as liquid, but freezes on contact with roads, trees, power lines and other surface structures that are below 32 degrees F, forming a dangerous glaze of ice.
- **Ice storm** - a type of winter storm characterized by freezing rain which results in a dangerous coating of ice on trees, power lines, and road surfaces.
- **Sleet** - solid grains or pellets of ice formed by the freezing of raindrops or the refreezing of largely melted snowflakes. Sleet does not cling to surfaces.
- **Wind chill** – a calculated temperature index that describes the combined effect of wind and low air temperatures on exposed skin.

Winter storms usually form along a stationary front. An area of lower pressure develops along the front as the atmosphere tries to even out the pressure difference. This pressure difference creates wind that blows from high pressure towards low pressure, in an attempt to move enough air to even out the pressure difference. As the air moves toward the low-pressure area, it has nowhere to go but up into the colder regions of the atmosphere. This causes water vapor in the air to condense. To the north of the storm, where temperatures are colder, this condensed water falls as snow. To the south, if the temperatures are warm enough, it can fall as heavy rain in within thunderstorms.

4.11.2 Location and Extent

Winter storms derive their energy when two air masses of substantially different temperatures and moisture levels meet. In Northeastern Virginia, winter storms usually form when an air mass of cold, dry, Canadian air moves south and interacts with a warm, moist air mass moving north from the Gulf of Mexico. The point where these two air masses meet is called a front. If cold air advances and pushes away the warm air, it forms a cold front. When warm air advances, it rides up over the denser, cold air mass to form a warm front. If neither air mass advances, it forms a stationary front.

In the temperate eastern Virginia climate, winter storms infrequently occur during late fall or spring but are largely contained to the winder season, particularly between January and early March. Winter storms can include heavy snow, freezing rain, and high winds that completely disrupt communities' transportation networks, cause power outages, close schools, and hamper communication.

4.11.3 Previous Occurrences

According to the NCEI storm events database, there have been 93 recorded winter storm events across the Northern Neck counties since 1996, including the following types of event: Winter Weather, Winter Storms, Ice Storms, Heavy Snow, and Frost/Freeze.

These severe winter weather events have resulted in a total of $42,373 in property damage. It should be noted that these numbers reflect only the reported damages. In addition, the Northern Neck has had four major disaster declarations and two emergency declarations related to winter storm weather. Table 4-36 lists some of the most significant of these events.

Table 4-36. Previous Occurrences of Winter Storm Events

Event Date	Hazard History
January 26, 1987	A record 17.0 inches of snow fell during a 24-hour period on January 26, 1987 in Richmond County.
March 13, 1993	The "Blizzard of '93", also known as the "Superstorm '93" and the first coined "Storm of the Century" during the 1990's, was an extremely intense nor'easter which impacted the entire East Coast of the U.S. An emergency declaration was made in the Northern Neck area.
January 6, 1996	The blizzard of 1996 was a strong winter storm that impacted the eastern United States, especially the metropolitan areas of Washington, DC, Philadelphia, New York City, and Boston. Three day snowfall totals ranged from 10-20 inches in the Northern Neck area. A presidential disaster was declared that included Northern Neck Counties.
December 23, 1998	A major ice storm affected central and eastern Virginia from Wednesday, December 23rd into Friday, December 25th, including all four counties on the Northern Neck. A prolonged period of freezing rain and some sleet resulted in ice accumulations of one half inch /0.50/ to one inch /1.00/ in many locations. The heavy ice accumulations on trees and power lines caused widespread power outages across the region. Approximately 400,000 customers were without power during the maximum outage period, Christmas Eve day. Some customers were without power for about ten days. Many accidents occurred due to slippery road conditions, especially bridges and overpasses. Secondary roads were impassable due to fallen tree limbs and in a few cases, whole trees.

Table 4-36. Previous Occurrences of Winter Storm Events

Event Date	Hazard History
January 25, 2000	A significant winter storm dumped more than one foot of snow across much of central and eastern Virginia, with isolated amounts of up to 19 inches reported. There was also significant blowing and drifting of snow as winds gusted over 30 mph during the storm. The Richmond International Airport was closed during this storm. A very cold air mass built into the region after the storm, preserving the snowpack for over a week in many areas. Snow totals on the Northern Neck included: Richmond county 11 to 12 inches, Westmoreland county 12 to 13 inches, and Northumberland county 12 inches.
January 30,2000	An ice storm affected a large portion of central and eastern Virginia with ice accumulations of up to one-half inch. Freezing rain mixed with sleet and snow spread over the area during the morning hours. Freezing rain then mixed with rain during the afternoon and evening along the eastern counties of Richmond, and Westmoreland Counties. More than $30,000 in property damage was reported.
April 7, 2007	Low pressure developed over southern Virginia and deepened as it moved offshore. A band of moderate to heavy snow fell over portions of eastern Virginia as the storm strengthened off the Atlantic seaboard. Heavy snow was reported in Richmond, Northumberland, and Lancaster Counties.
January 30, 2010	Low pressure moving off the coastal Carolinas produced between five and fifteen inches of snow across central and eastern Virginia from Friday night, January 29th, into Saturday night January 30th. Snowfall amounts reported in the Northern Neck counties ranged from as low as seven inches to thirteen inches of snow reported in Richmond County.
February 5, 2010	Low pressure moving off the coastal Carolinas produced between four and twelve inches of snow across central and eastern Virginia from Friday afternoon, February 5th, through Saturday afternoon February 6th. In the Northern Neck, some of the heaviest snow fell in Newland, Richmond County, where 11 inches was reported.
January 22,2016	Strong low pressure moving from the Southeast United States northeast and off the Mid-Atlantic Coast produced between five and thirteen inches of snow and strong winds across the Virginia Northern Neck and south central Virginia. Heathsville reported 11 inches of snow.
January 7, 2017	Low pressure tracking northeast just off the Southeast and Mid-Atlantic Coasts produced heavy snow and strong winds across eastern Virginia. In Northumberland and Lancaster Counties, snowfall totals were generally between 8 inches and 12 inches. Strong north winds affected the area, producing some blowing snow and reduced visibilities. Heathsville and Brook Vale reported 12 inches of snow.

4.11.4 Probability of Future Events

Based on the NCEI historic records of winter storm activity in the Northern Neck, it is estimated that the region will experience about between four and five reports of winter weather per year. This includes reports of freezing rain, ice, and small accumulations of snow typically found in the region. While this data includes weaknesses discussed previously, it is reasonable to conclude that severe winter weather events will likely continue to occur on at least an annual basis in the Northern Neck.

4.11.5 Vulnerability and Risk Assessment

Table 4-37 shows the annualized damages for winter storm events in the Northern Neck. The NCEI Storm Events data was annualized by taking the total number of winter storm events and dividing by the length of record. The annualized values should only be used to estimate what can be expected annually. Using historical records, the individual counties can expect to experience on average between two and four winter storm related events every year. The region can expect to see between 4 and 5 winter storm related events annually. The annual average for the region is higher than each individual county since it encompasses a larger area overall and some events were only reported in single counties whereas the annual average for the region accounts for storm events in all four counties. Total damages from winter storm events is expected to be very low on an annual basis for the region. There are no expected deaths or injuries from these events.

Table 4-37. Annualized Damages from Winter Storm Events

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	2.7	$0	$0	$0	0	0
Northumberland	3.0	$0	$0	$0	0	0
Richmond	3.1	$963	$0	$963	0	0
Westmoreland	3.2	$963	$0	$963	0	0

4.11.5.1 Vulnerability and Impact to People and Property

All critical facilities in the Northern Neck are considered vulnerable to the effects of severe winter storms due to the potential disruption of services and transportation systems as well as possible structure failure due to heavy snow loads. The level of vulnerability of a building depends on the age of the building (and the building codes in effect at the time of construction), type of construction, and condition of the structure (i.e., how well it has been maintained, materials used, etc.). FEMA Risk Management has published a Snow Load Safety Guide[20]. The guide states:

> *Most buildings are not at risk of snow induced failure More often than not, attempting to remove snow from a roof is more hazardous than beneficial, posing a risk to both personnel and the roofing structure. However, snow accumulation in excess of building design conditions can result in more than a temporary loss of electrical power and inaccessible roads. Buildings may be vulnerable to structural failure and possible*

[20] FEMA Risk Management Series: Snow Load Safety Guide. FEMA P-957 January 2013. https://www.fema.gov/media-library-data/7d8c55d1c4f815edf3d7e7d1c120383f/FEMA957_Snowload_508.pdf

collapse if basic preventative steps are not taken in advance of a snow event. Knowledge of the building roof framing system and proper preparation in advance of a snow event is instrumental in reducing risk to the structure.

Using the FEMA Snow Load Safety Guide, it can be assumed that certain roof types and materials are more susceptible to snow-induced collapse. Buildings vulnerable to increased snow accumulation and unbalanced loads include:

- Gable/multi-span gable roof
- Mono-slope roof
- Flat or low-slope roof with or without roof drains
- Stepped roof
- Saw-tooth roof

Even small accumulations of ice can cause a significant hazard, especially on power lines and trees. An ice storm occurs when freezing rain falls and freezes immediately upon impact. Communications and power can be disrupted for days, and even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Extended power outages from ice storms would require residents to look for supplemental heat sources; improper use of these sources could result in house fires. Injuries could result from slipping on ice if residents, especially elderly, were to leave their home.

4.11.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined winter storms to be a "limited" hazard in Northern Neck. Winter storm related events within the Northern Neck are likely events with between 4 and 5 events reported annually. Winter storm events have a "low" range of impacts, accounting for less than $10,000 (adjusted for inflation) in annual property damages. The potential exposure for winter storms is "low" with less than $100,000 in potential damages. Winter storms in the Northern Neck cause more problems with impacts to transportation networks and power outages. This leads to school, government and business closings. For these reasons, while annualized property losses are low and the hazard ranking is low, winter storms have serious impacts to the region. Winter storms are ranked low for having a warning time of at least two days before an event. Table 4-38 outlines the hazard rankings for each of the hazard priority criteria related to winter storms.

Table 4-38. Winter Storm Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	Low	Medium	Low	Low	Low

4.12 Drought

4.12.1 Description

A ***drought*** is a period in which an unusual scarcity of rain causes a serious hydrological imbalance in which water supply reservoirs empty, water wells dry up, and crop damage ensues. A prolonged period of drought may or may not accompany the periods of extreme heat. Drought is a complex physical and social process that can vary on a regional basis. Unlike floods, droughts are not a distinct event and typically do not have a well-defined start or end date.

A drought can last for months or years, or may be declared after as few as 15 days. Droughts are classified based on meteorological, agricultural, hydrological, and socioeconomic effects:

- Meteorological drought is an extended period of time (six or more months) with precipitation of less than 75% of normal. Meteorological drought usually precedes the other types of drought.
- Agricultural droughts are characterized by unusually dry conditions during the growing season. A traditional agricultural drought is caused by an extended period of below average precipitation.
- Hydrological drought occurs when water reserves available in aquifers, lakes and reservoirs fall below the statistical average. Hydrological drought tends to emerge more slowly because it involves stored water that is used but not replenished.
- Socio-economic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace.

4.12.2 Location and Extent

Agricultural droughts are the most common form of drought in the Northern Neck and pose the greatest threat to region's agricultural operations. High summer temperatures can exacerbate the severity of a drought. When soils are wet, a significant portion of the sun's energy goes toward evaporation of the ground moisture. However, when drought conditions eliminate soil moisture, the sun's energy heats the ground surface and temperatures can soar, further drying the soil. Table 4-39 summarizes the levels of drought severity and their possible impacts on a community or region[21].

Table 4-39. Drought Severity Classification and Possible Impacts

Category	Description	Possible Impacts
D0	Abnormally dry	Going into a drought: short-term dryness slows planting, growth of crops or pastures; fire risk above average. Coming out of a drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low; some water shortages develop or are imminent; voluntary water use restrictions requested.
D2	Severe drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.

[21] U.S. Drought Monitor.

Category	Description	Possible Impacts
D3	Extreme drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.

The Drought Monitoring Task Force (DMTF) is a Commonwealth of Virginia interagency group of technical representatives from state and federal agencies responsible for monitoring natural resource conditions and the effects of drought on people, business and natural resources. When activated, the Drought Task Force meets to assess conditions and make recommendations regarding drought status. The Task Force periodically releases Drought Status Reports summarizing drought conditions in the Commonwealth. Through the DMTF, the group can make recommendations for declaring four Drought Stages based on how the measured groundwater levels compare to historic levels: Normal, Watch, Warning, and Emergency. Each Drought Stage involves a list of response activities that are generally initiated when a specific Drought Stage declaration is made[22].

Table 4-40 summarizes the 2012 US Census of Agriculture information by county in the Northern Neck. As of 2012, there are a total of 401 farms that produce more than $77 million in regional agricultural production annually. The 2017 US Census of Agriculture is ongoing during the time of the 2017 plan update, therefore 2012 data was used (the most current information available).

Table 4-40. 2012 US Census of Agriculture General Information by County

Jurisdiction	Number of Farms	Land in Farms (Acres)	Average Size of Farm (Acres)	Market Value of Products	Average Value Per Farm
Lancaster	61	10,695	175	$4,864,000	$79,741
Northumberland	98	43,270	442	$21,357,000	$217,932
Richmond	90	32,373	360	$15,467,000	$171,858
Westmoreland	152	59,378	391	$35,758,000	$235,248
Northern Neck	**401**	**145,716**	**363**	**$77,446,000**	**$193,132**

Source: 2012 U.S. Census of Agriculture

4.12.3 Previous Occurrences

Historically, Virginia droughts have tracked somewhat consistently with precipitation levels, whether a limited drought or a longer term agricultural drought such as those during the 1930's, 1963 and during the late 1980's through early 1990's. During the past five years, drought on the Northern Neck has been localized and usually a result of low precipitation during July through September impacting crop revenue but not significantly harming aquifers or drinking water wells.

[22] National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center, Climate at a Glance

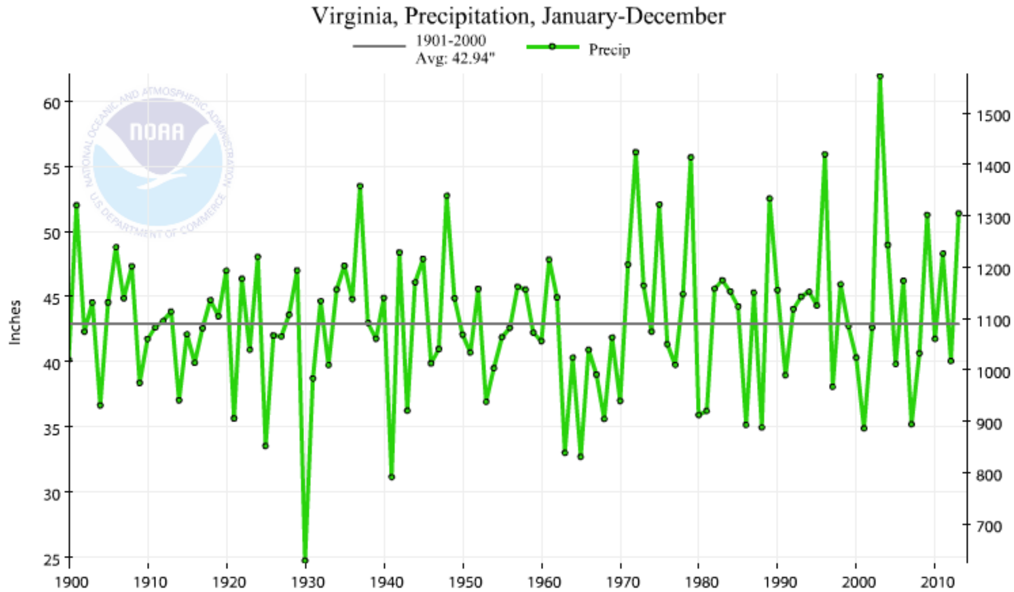

Figure 4-11. Virginia Precipitation since 1900

According to the NCEI database, there have been three recorded droughts since 1996 that have affected all of the Northern Neck counties. Table 4-41 lists the most significant droughts which impacted the Northern Neck, both of which occurred several decades ago. Drought is cyclical, severe droughts were experienced in the 1960's, 1970's and during 1988. In recent years, short-term droughts of several months impacted horticulture, lawns, and even crops but not aquifers. Severity was not extensive enough to activate the Commonwealth of Virginia Drought Monitoring Task Force.

Table 4-41. Previous Occurrences of Drought Events

Event Date	Hazard History
September 1, 1997	A very dry period from May through September resulted in drought-like conditions across much of central and eastern Virginia. Of the four Northern Neck counties, Lancaster reported $1,880,000 in crop damages as a result of this drought.
October 1, 1998	A very dry period from July through October resulted in drought-like conditions across much of the eastern piedmont and northern neck of Virginia. The four Northern Neck counties reported a total of $8 million in crop damage as a result of this drought.

Table 4-41. Previous Occurrences of Drought Events

Event Date	Hazard History
November 1, 1998	Drought-like conditions continued to affect much of the eastern Piedmont and Northern Neck through November. This was the fifth month in a row that drought conditions were seen across Northern Virginia. Persistent high pressure over the Southeast U.S. forced rain producing low pressure systems to steer north of the region. There was an additional $4 million in reported crop damage in the Northern Neck. This was the first year the USDA Farm Service Agency had to make direct payments for grazing losses. The extended drought damaged root systems of grass and was expected to have an effect on the 1999 hay crop. The drought also contributed to a high frequency of forest and brush fires.

Source: NCEI Storm Events Database

4.12.4 Probability of Future Events

Droughts are often unpredictable and may be localized, which makes it difficult to assess the probability. Historical records of drought shows that when droughts occur, they have a costly impact on agricultural production of the Northern Neck. According to the USGS analysis of droughts since 1930, on average they occur once every ten years with variation in duration and severity[23]. Most droughts in this area are shorter, multi-month droughts, while widespread multiyear droughts are much less common.

4.12.5 Vulnerability and Risk Assessment

Table 4-42 shows the annualized damages for drought events in the Northern Neck. The NCEI Storm Events data was annualized by dividing total drought events by the length of record. The annualized values should only be used to estimate what can be expected annually. Using historical records, individual counties can expect to experience a drought once every ten years and the region can expect to see a drought every five to ten years. However, lengthy, agricultural droughts have not been experienced in more than two decades. Annual total damages (adjusted for inflation) from these events for each county was found to be between $135,650 and $339,126, though it is possible that actual annual damages in some counties could be higher due to unreported damages. There are no expected deaths or injuries from these events.

[23] Virginia Floods and Droughts. https://md.water.usgs.gov/publications/wsp-2375/va/

Table 4-42. Annualized Damages from Drought

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	0.1	$0	$265,148	$265,148	0	0
Northumberland	0.1	$0	$203,475	$203,475	0	0
Richmond	0.1	$0	$135,650	$135,650	0	0
Westmoreland	0.1	$0	$339,126	$339,126	0	0

4.12.5.1 Vulnerability and Impact to People and Property

If a significant drought event were to occur, it could bring economic, social, and environmental impacts to the region. One of the most significant economic effects of a drought to a community is the agricultural impact that includes the undernourishment of livestock and crop damage. Droughts severely impact farm income and can increase the cost of potable water if water supplies have to be augmented.

High summer temperatures can exacerbate the severity of a drought. When soils are wet, a significant portion of the sun's energy goes toward evaporation of the ground moisture. However, when drought conditions eliminate soil moisture, the sun's energy heats the ground surface and temperatures can soar, further drying the soil. The impact of excessive heat is most prevalent in urban areas, where urban heat-island effects prevent inner-city buildings from releasing heat built up during the daylight hours. Secondary impacts of excessive heat are severe strain on the electrical power system and potential brownouts or blackouts.

Droughts can also create conditions that enable the occurrence of other natural hazard events such as wildfires or wind erosion. The likelihood of flash flooding is increased if a period of severe drought is followed by a period of extreme precipitation. Low-flow conditions also decrease the quantity and pressure of water available to fight fires, while the dry conditions increase the likelihood that fires will occur.

4.12.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined drought to be a moderate hazard in Northern Neck. Drought events within the region are a somewhat likely event with less than one event recorded annually. Drought events have a very low range of impacts with no reported annual property damages. The potential exposure for drought is "high" with over $1 million in reported crop damages. Drought is ranked low for having a warning time of more than three days. Table 4-43 outlines the hazard ranking for each of the hazard priority criteria related to drought.

Table 4-43. Drought Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	N/A No property damages were recorded	Medium	Medium	Significant	Low

4.13 Wildfire

4.13.1 Description

A wildfire is an undesirable fire occurring in a forest, brush land, or wooded development that is a serious and growing hazard over much of the United States. Fires within forested areas that are ignited by natural causes such as lightning or as part of a controlled burn process are part of the natural fire cycle and an important contributor to forest health.

Wildfires are classified as uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures for areas greater than one acre. Wildfires may create additional environmental concerns well after they are extinguished such as increased erosion and water quality concerns in storm water runoff. Three main factors influence wildfire behavior – topography, fuel, and weather. Other hazards can contribute to the potential for wildfires or can influence wildfire behavior. High winds can down power lines and lightning can spark fires. Lightning is a major cause of structural fires and wildfires.

Drought conditions also increase wildfire potential by decreasing fuel moisture. Warm winters, hot, dry summers, severe drought, insect and disease infestations, years of fire suppression, and growth in the wildland-urban interface (WUI) continue to increase wildfire risk and the potential for catastrophic wildland fires. Forest insect epidemics and forest parasites contribute to wildfire potential by increasing fuel loading.

4.13.2 Location and Extent

The Wildland Urban Interface (WUI) is the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuel.[24] The three types of communities that occur in or around the WUI are:

- **Interface Community** - The Interface Community exists where structures directly about wildland fuels. There is a clear line of demarcation between residential, business, and public structures and wildland fuels. The development density for an interface community is usually 3 or more structures per acre or a population density of 250 or more people per square mile, with shared municipal services.
- **Intermix Community** - The Intermix Community exists where structures are scattered throughout a wildland area. There is no clear line of demarcation; wildland fuels are continuous outside of and within the developed area. The development density in the

[24] Radeloff, V. C., R. B. Hammer, S. I Stewart, J. S. Fried, S. S. Holcomb, and J. F. McKeefry. 2005. The Wildland Urban Interface in the United States. Ecological Applications 15:799-805.

intermix ranges from structures very close together to one structure per 40 acres or a population density in between 28-250 people per square mile.

- **Occluded Community** - The Occluded Community generally exists in a situation, often within a city, where structures abut an island of wildland fuels (e.g., park or open space). There is a clear line of demarcation between structures and wildland fuels. The development density for an occluded community is usually similar to those found in the interface community, but the occluded area is usually less than 1,000 acres in size.

The areas where forested lands meet with urban areas (WUI) are considered most at risk to sustaining damages to property and structures as well as injuries and loss of life. Drought or near-drought conditions can significantly increase the potential for wildfires to spread. Figure 4-12 shows the location of the wildland-urban interface and intermix zones as well as other types of development zones. Because most densely settled areas are in towns or along the coast, the WUI risk is much lower than in more suburban areas of the Commonwealth but should be monitored in future plans if significant development occurs near or within forested areas.

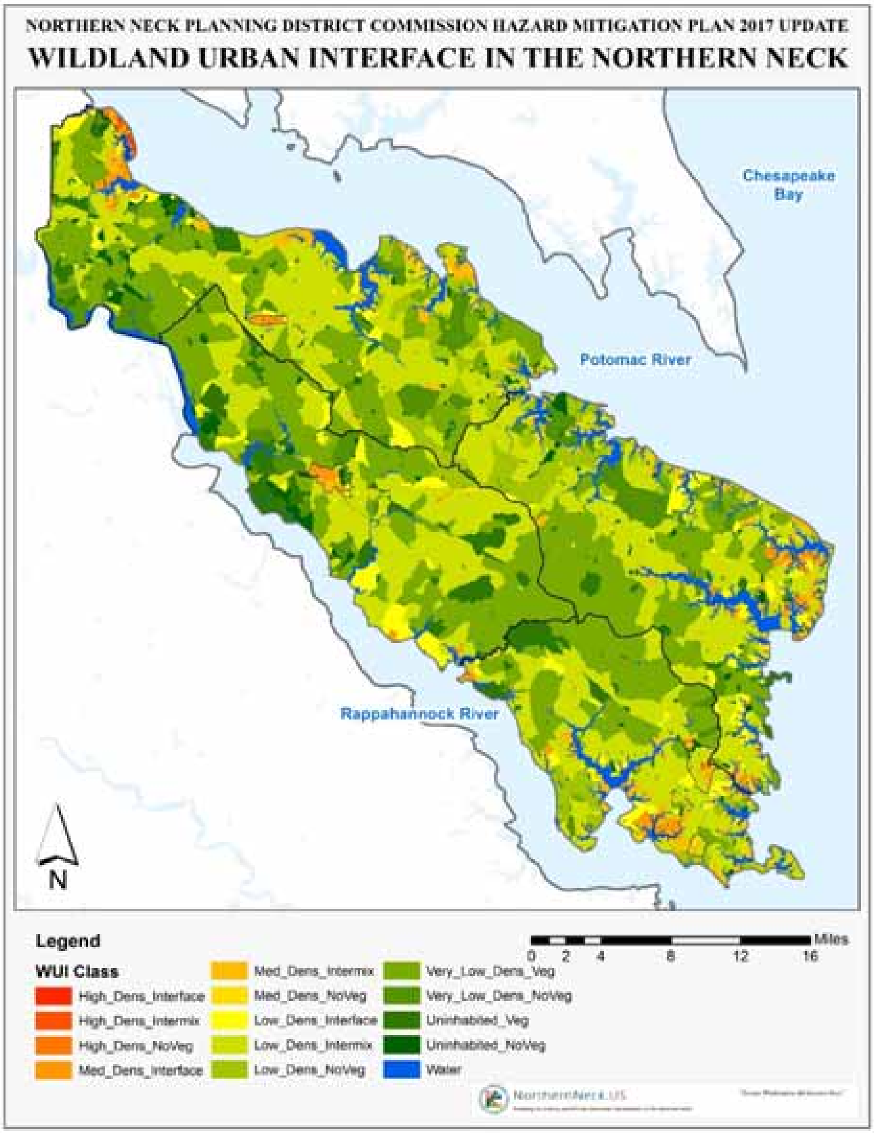

Figure 4-12. Wildland Urban Interface Areas in Northern Neck

4.13.3 Previous Occurrences

According to the Virginia Department of Forestry, formerly the Virginia Division of Forestry established in 1914, 1,460 wildfires have been reported since 1917[25]. Since 2000, there have been 279 recorded wildfires in the Northern Neck documented in a database obtained from Virginia Department of Forestry's GIS Data Portal. This geospatial database does not include earlier recorded wildfires due to data limitations, nor does it include wildfires reported during the spring 2017 season, where occurrence was rare due to sufficient rainfall. This database is updated on an annual basis in the fall for federal reporting purposes. Wildfire sizes range from less than a quarter of an acre (Class A) to larger than 5000 acres (Class G). Of the 279 wildfires in Northern Neck, 157 were one-fourth acre or less, 108 were more than one-fourth acre but less

[25] "Virginia's Fire History" http://www.dof.virginia.gov/fire/va-fire-history.htm

than 10 acres, and 14 were between 10 acres and 100 acres. Upon reviewing the data, no fire exceeded 31 acres in extent. Table 4-44 lists the fires specific to the counties in Northern Neck. Figure 4-13 shows the locations of historic wildfires in the Northern Neck.

Table 4-44. Fires in the Northern Neck (2000-2016)

Jurisdiction	One-fourth acre or less	More than one-fourth acre, but less than 10 acres	10 acres or more, but less than 100 acres	Total
Lancaster	79	33	3	115
Northumberland	8	11	1	20
Richmond	34	34	5	73
Westmoreland	36	30	5	71
Northern Neck	**157**	**108**	**14**	**279**

Source: Virginia Department of Forestry https://vdof.maps.arcgis.com/home/index.html

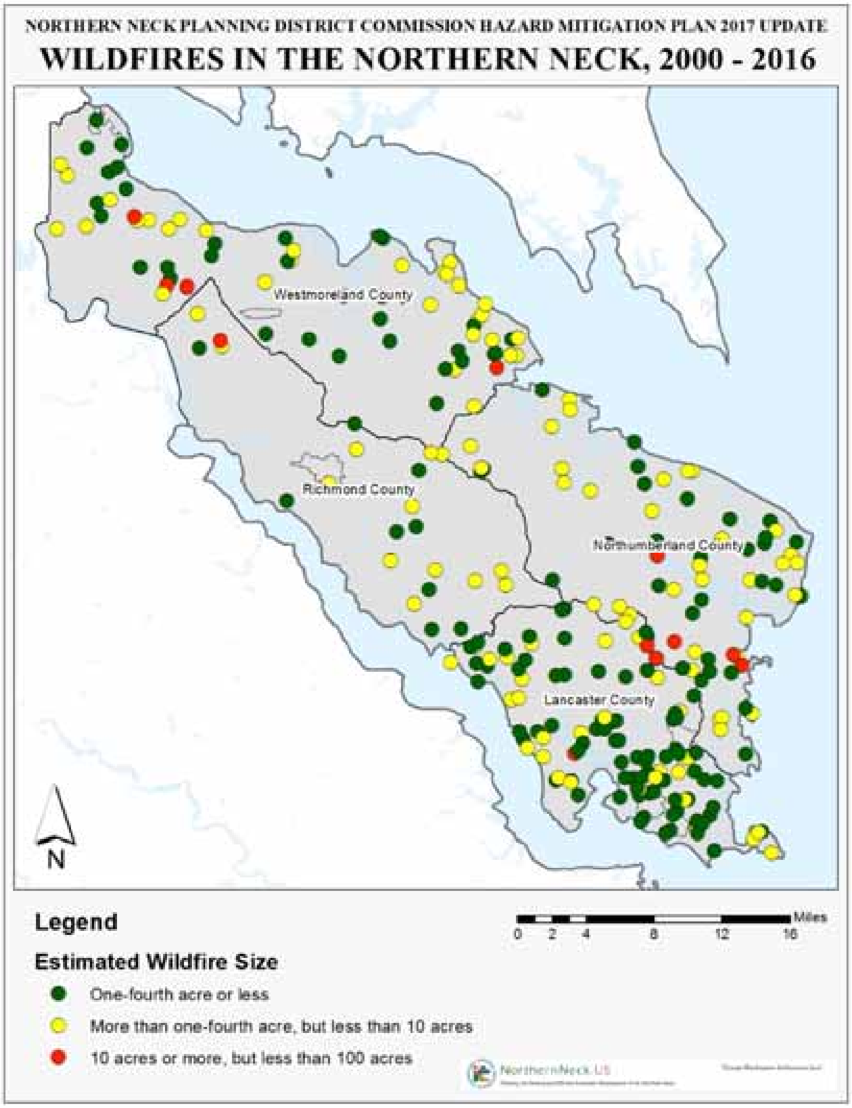

Figure 4-13. Historic Wildfires in the Northern Neck

4.13.4 Probability of Future Events

The probability of wildfires is difficult to predict and is dependent on many factors, including the type of vegetative cover in a particular area, and weather conditions, including humidity, wind, and temperature. There have been an average of 15 wildfires annually in the Northern Neck based on the VDOF historical wildfire data recorded since 2000. A similar number of fires would be expected to occur in the future, contingent on rainfall amount/drought levels, quantity of new development, and accuracy of reporting. A Wildfire Risk Assessment model was done by VDOF in 2003 that shows the potential for an area to burn during a wildfire. As seen in Figure 4-14, most of Lancaster County and the eastern part of Northumberland County have a high burn potential that is closely correlated with historical reported fires.

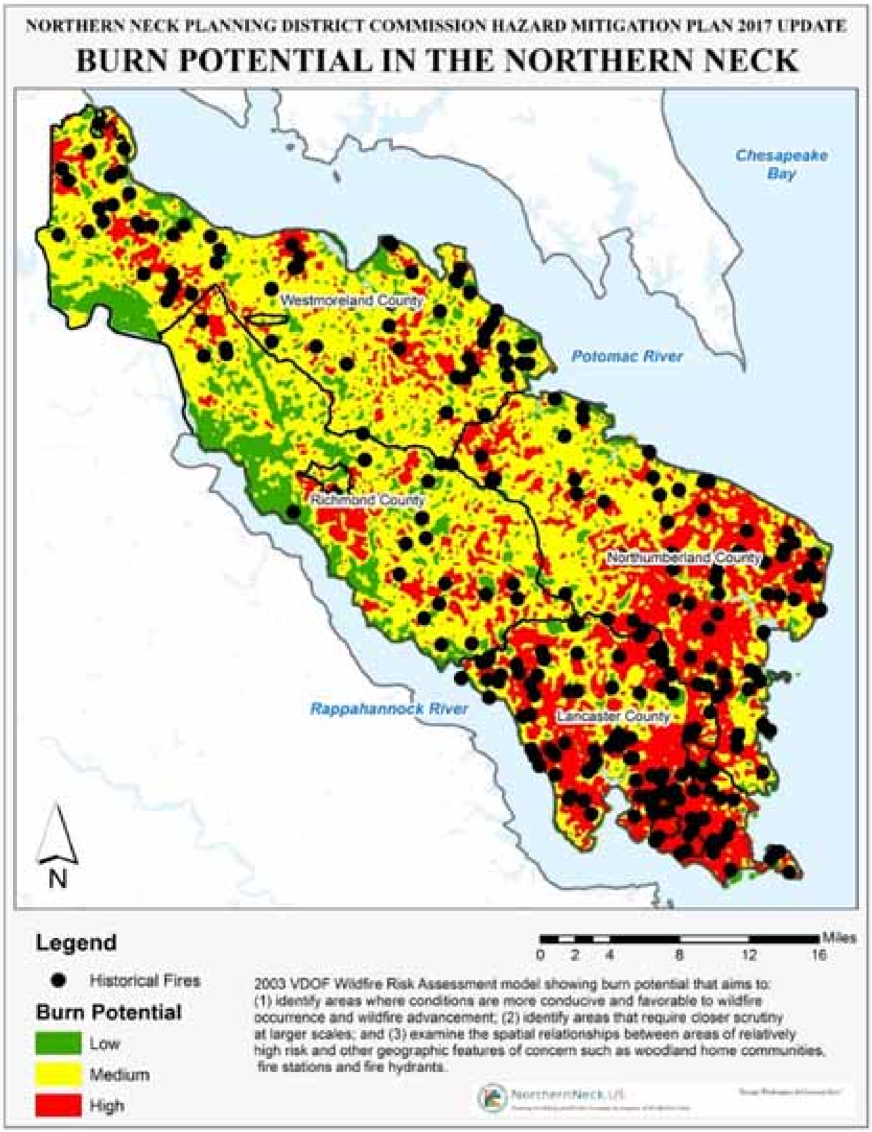

Figure 4-14. Wildfire Burn Potential in the Northern Neck

4.13.5 Vulnerability and Risk Assessment

4.13.5.1 Vulnerability and Impact to People and Property

Wildfires can have disastrous consequences causing damage to residences, commercial buildings, and to timber, grasslands and natural resources. Economic consequences include the cost of suppression, reduced property values, lost sales and business revenues, reduced tourism, and increased water treatment costs. Resources threatened include communities, homes, gas transmission lines, electrical facilities and lines, timber, watershed and recreation areas, and wildlife. Wildfires may create additional environmental concerns well after they are extinguished such as increased erosion and water quality concerns in storm water runoff.

Timber loss and environmental damage frequently result from wildfires. Wildfire poses a significant threat to nearby buildings and populations. Forest damage from thunderstorms may block interior access roads and fire breaks, pull down overhead power lines, or damage pavement and underground utilities, thereby creating heavy fire load and making suppression and response more difficult. While the risk is apparent with many Northern Neck second homes located in wooded areas, even with limited volunteer fire departments, wildfire size remains small. The lack of drought during the past two decades has greatly helped reduce wildfire occurrence and limit size.

4.13.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined wildfires to be a "limited" hazard in Northern Neck. Wildfire events within the region are highly likely with more than four events reported annually. Wildfire events have a "low" range of impacts, accounting for less than $10,000 (adjusted for inflation) in annual reported property damages. The potential exposure for wildfires is "low" with less than $100,000 in potential damages. Wildfire ranks high for having a warning time of less than 24 hours before an event. Table 4-45 outlines the hazard rankings for each of the hazard priority criteria related to wildfires.

Table 4-45. Wildfire Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Significant	Low	Low	Significant	Low	Low

4.14 Earthquakes

4.14.1 Description

The earth's surface is covered by solid rock approximately 50 miles thick, referred to as the lithosphere. The lithosphere is made up of the Earth's crust, which ranges in size from about 22 miles thick for continents to about five miles thick for the oceans, and the upper mantle which is composed of solidified magma. This lithosphere "floats" above a thick layer of molten rock known as the lower mantle. The lithosphere is divided into large and small sections that geologists call plates. Earthquakes occur when those geologic plates slide against each other, resulting from the sudden release of energy that creates seismic waves. Most movements between plates are extremely small, generating tiny earthquakes that cannot be sensed by people. Other less frequent movements between plates can be quite large, generating powerful earthquakes that can shake the ground surface and cause widespread damage. Earthquakes can be violent enough to destroy whole cities.

The term "earthquake" is used to describe any seismic event — whether natural or caused by humans — that generates seismic waves. Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An earthquake's point of initial rupture is called its focus or hypocenter. The epicenter is the point at ground level directly above the hypocenter.

Most earthquakes occur at weak points in the earth's crust along surfaces where two or more geologic plates meet, called faults. Large faults within the Earth's crust result from the action of plate tectonic forces, with the largest forming the boundaries between the plates. The location of faults can provide an indication of where future earthquakes are likely to occur. Some of the more active earthquake faults in the United States include the San Andreas Fault in California and the New Madrid Fault in the Midwest.

4.14.2 Location and Extent

Earthquakes in the United States occur most frequently along the West Coast, where both convergent and transform plate boundaries are present. Earthquakes also occur along the East Coast of the United States, but the mechanisms causing these earthquakes are not well understood, as these earthquakes occur within the plate rather than at plate boundaries (USGS, 2003).

The potential effects of an earthquake are dependent on the magnitude of the event, the intensity (distance from the epicenter), and the type of geologic material in the area:

- Magnitude is a measure of the strength of an earthquake or energy released by it. Magnitude is measured by a device known as a seismograph. The scale used to measure earthquake magnitude was originally defined by Charles Richter in the 1930s, and is commonly referred to as the Richter scale, which assigns a magnitude number to quantify the strength of an earthquake. Since January 2002, the Moment Magnitude Scale (MMS) has been used by seismologists in the USGS to calculate and report magnitudes for all modern large earthquakes. The MMS was developed in the 1970s and measures the size of earthquakes in terms of its energy released.
- Intensity is a measure of the effects of an earthquake at a particular place on people, structures, or the land itself. Earthquake intensity is most commonly measured in the United States using the Modified Mercalli (MMI) scale. The intensity at a point depends not only upon the strength of the earthquake, but also upon the distance from the earthquake to the point and the local geology at that point.
- Peak Ground Acceleration (PGA) is another common measure of earthquake shaking along the earth's surface. PGA expresses acceleration along the earth's surface as a percentage of g, the acceleration due to gravity (32.2 ft. /s^2). PGA varies significantly depending on the ground type and the geology of an area.

Table 4-46 summarizes the intensities typically observed at locations near the epicenter of earthquakes of different magnitudes and defines the intensity scale based on the effects on people, human structures, and the natural environment. Table 4-47 compares the PGA with earthquake intensities and the perceived damage and shaking expected.

Table 4-46. Modified Mercalli Intensity Scale for Earthquakes

Scale	Intensity	Effects	Richter Magnitude Scale
I	Instrumental	Detected only on seismographs	1.0 to 3.0
II	Feeble	Some people feel it	3.0 to 3.9
III	Slight	Felt by people resting; like a truck rumbling by	
IV	Moderate	Felt by people walking	4.0 to 4.9
V	Slightly Strong	Sleepers awake; church bells ring	

Table 4-46. Modified Mercalli Intensity Scale for Earthquakes

Scale	Intensity	Effects	Richter Magnitude Scale
VI	Strong	Trees sway; suspended objects swing; objects fall off shelves	5.0 to 5.9
VII	Very Strong	Mild alarm; walls crack; plaster falls	
VIII	Destructive	Moving cars uncontrollable; masonry fractures; poorly constructed buildings damaged	6.0 to 6.9
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	7.0 and Higher
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards	
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	

Table 4-47. Modified Mercalli Intensity (MMI) and PGA Equivalents

MMI	Acceleration (%g) (PGA)	Perceived Shaking	Potential Damage
I	<0.17	Not Felt	None
II	0.17 - 1.4	Weak	None
III	0.17 - 1.4	Weak	None
IV	1.4 - 3.9	Light	None
V	3.9 - 9.2	Moderate	Very Light
VI	9.2 - 18	Strong	Light
VII	18 - 34	Very Strong	Moderate
VIII	34 - 65	Severe	Moderate to Heavy
IX	65 - 124	Violent	Heavy
X	> 124	Extreme	Very Heavy
XI	> 124	Extreme	Very Heavy
XII	> 124	Extreme	Very Heavy

Source: Virginia State Hazard Mitigation Plan

4.14.3 Previous Occurrences

Since 1900, there is no record of an earthquake having its epicenter within the boundaries of the Northern Neck. The earthquake that occurred on August 23, 2011, with an epicenter in Louisa County, Virginia resulted in a Federal Disaster Declaration in nine jurisdictions, and was felt as far north as Vermont. Due to the orientation of the fault, this earthquake was felt in the Northern Neck, though not as strongly as in those nine jurisdictions. Figure 4-15 shows the location of past earthquakes in the Commonwealth relative to the Northern Neck Region.

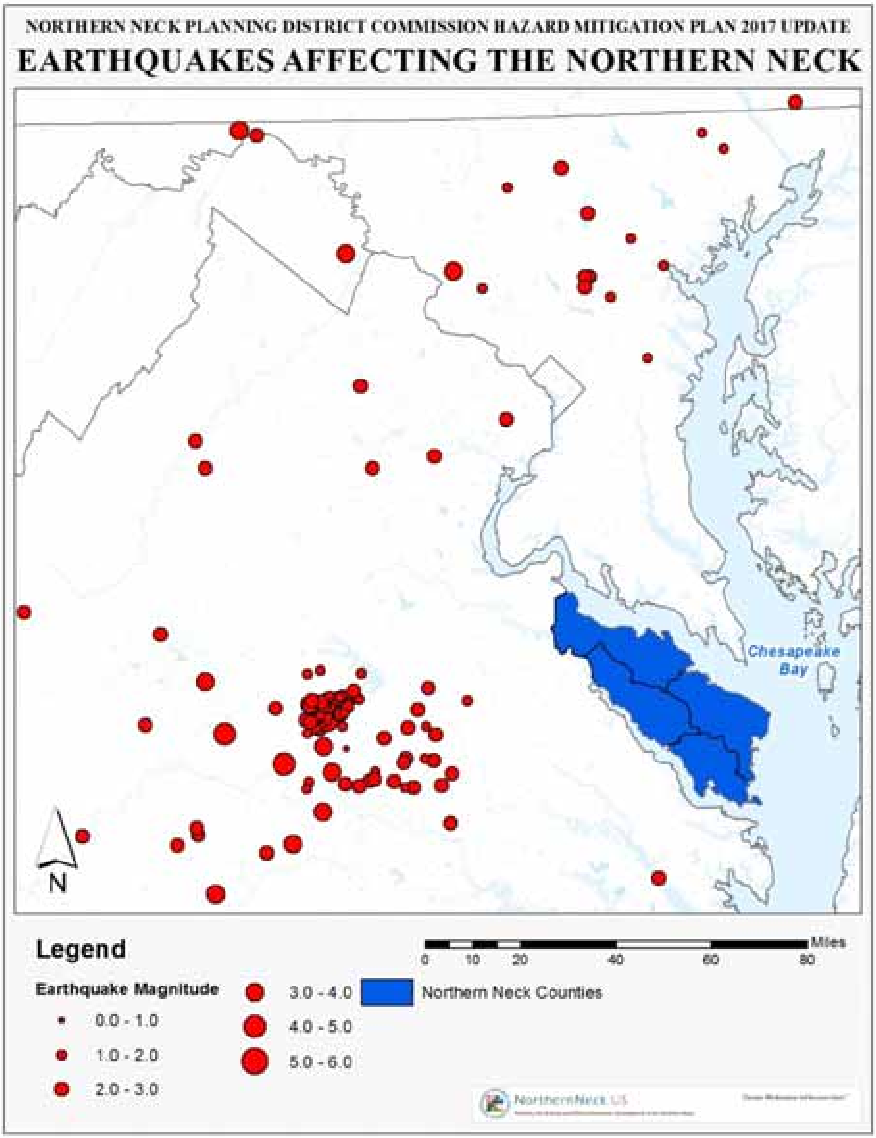

Figure 4-15 Historical Earthquakes in the Commonwealth of Virginia

4.14.4 Probability of Future Events

Earthquakes are low probability, high-consequence events. Earthquakes and tsunamis are not considered significant hazards in the Northern Neck, and the probability of these events occurring within the region is unlikely. The closest offshore fault lies east of Charleston, South

Carolina, and has the potential to impact the Northern Neck in the event of a moderate to severe earthquake event.

4.14.5 Vulnerability and Risk Assessment

4.14.5.1 Vulnerability and Impact to People and Property

Although earthquakes may occur infrequently they can have devastating impacts that affect entire communities and regions. The destructiveness of an earthquake depends on a number of factors, including the magnitude of the tremor, direction of the fault, distance from the epicenter, regional geology, and the design characteristics of buildings and infrastructure. Buildings in the Northern Neck are seldom designed to deal with an earthquake threat because of the very low likelihood of occurrence; therefore, they are extremely vulnerable to the impacts of moderate and large earthquakes.

Earthquake intensity is generally greater on soft soils than solid rock. Liquefaction can occur when loose sand and silt that is saturated with water behaves like a liquid when shaken by an earthquake[26] to the point where it can no longer support the weight of any object that is located on it. Areas in the Northern Neck that contain alluvial soils are more at risk of liquefaction occurring in the event of an earthquake. Other effects of a strong earthquake include landslides, fissuring and slumping at the ground surface, and even tsunamis. When the epicenter of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Tsunami waves can travel across the ocean at very high speeds, depending on the location and source of the seismic event.

4.14.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined earthquakes to be a limited hazard in the Northern Neck. As described in the profile above, earthquakes are unlikely events with no epicenters recorded in the Northern Neck. There are no recorded property damages as a result of earthquakes. The potential exposure for an earthquake event is “medium” with between $100,000 and $1 million in potential damages. Due to the infrequency of events in this area, infrastructure could sustain considerable damage in a medium strength earthquake. Earthquake is ranked high for having a warning time of less than 24 hours before the event. Table 4-48 outlines the hazard rankings for each of the hazard priority criteria related to earthquakes.

Table 4-48. Earthquake Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
N/A	N/A	Low	Significant	Medium	Low

4.15 Summary/Conclusions on Vulnerability Assessment

A variety of natural hazards have the potential to impact the Northern Neck. In addition to the potential for injury or loss of life and damage to property and crops, a hazard event can disrupt utilities, communication and transportation impacting the well-being of people and communities.

[26] “About Liquifaction” https://geomaps.wr.usgs.gov/sfgeo/liquefaction/aboutliq.html

Since so many residents are second-home owners along the Northern Neck's shores, full understanding of hazard potential and severity, along with recovery after an event, are a unique challenge to the area.

It is important to point out that data limitations for some hazards prevented a complete analysis of past occurrence and or potential future losses. The availability of more precise building footprint data for Lancaster and Northumberland County, more complete damage information on April and May, 2017, wind events, and expanded Department of Forestry wildfire occurrence data will improve future plan updates, reflecting a broader data set than just the NCEI and localized media reports. Increased research on sea-level rise and climate change will also be presented in future hazard vulnerability analysis. Also, the NOAA NCEI database recognizes that it may not contain every hazard event and complete damage statistics since a lot of storm damage is never reported. Additionally, new 2017 U.S. Agricultural Census data will help better characterize hazard risk to agricultural commodities. Thus, the information presented herein should be considered an "informed estimate."

4.15.1 Hazard Rankings

The purpose of the hazard ranking is to categorize and prioritize all potential hazards for the Northern Neck based on risk. Combined with the asset inventory and quantitative vulnerability assessment, the summary hazard classifications allow for the prioritization of those high hazard risks for mitigation planning purposes, and more specifically, the identification of hazard mitigation opportunities for the Northern Neck to consider as part of their proposed mitigation strategy. Each hazard was ranked by 0 (no data), 1 (low), 2 (medium), and 3 (high) in five categories, which were then weighted and averaged together to develop a Composite Hazard Index. This index was then used to rank the hazards to give the community some sense of how the hazards ranked in comparison to the others. Table 4-5 provides a summary of the categories used to rank the hazards and their weighted values for the Composite Hazard Index.

Table 4-49 contains a detailed accounting of the ranking for each of the ten hazards discussed in this section. The highest priority hazards were coastal flooding, riverine flooding, hurricanes, and tornados. Coastal erosion and severe weather were ranked as moderate hazards. The rest, ranked as Limited, were Wildfire, Winter Storm, Drought, and Earthquakes.

Table 4-49. Hazard Rankings and Risk Assessment

Hazard	Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Coastal Flooding	Medium	Significant	Significant	Medium	Significant	Significant
Riverine Flooding	Medium	Medium	Significant	Medium	Significant	Significant
Hurricane	Medium	Significant	Significant	Low	Significant	Significant
Tornado	Medium	Significant	Significant	Significant	Medium	Significant

Table 4-49. Hazard Rankings and Risk Assessment

Hazard	Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Coastal Erosion	Significant	Damages not reported as erosion	Medium	Low	Significant	Medium
Severe Weather	Significant	Significant	N/A Did not rank	Medium	Medium	Medium
Wildfire	Significant	Low	Low	Significant	Low	Low
Winter Storm	Medium	Low	Medium	Low	Low	Low
Drought	Medium	N/A - No property damages reported	Medium	Medium	Significant	Low
Earthquake	N/A	N/A	Low	Significant	Medium	Low

4.15.2 Summary of Loss Estimates

As described in the hazard-specific estimated loss sections, there have been a total of 352 storm events since 1950 reported across the Northern Neck, as recorded in the NOAA NCEI Storm Events database. This total accounts for any duplication in instances where the same storm event was reported in multiple counties of the Northern Neck. Total damages, which are also reported at a county level, are not duplicative since each county only reports their local damages. Similarly, deaths and injuries are not duplicative. The NOAA NCEI Storm Events Database data was annualized using the total years of record for each hazard category. Table 4-50 summarizes the estimated annualized events and damages for the Northern Neck. This information is additionally presented by county in Table 4-51 and Table 4-52. Reported damages for coastal erosion, wildfire, and earthquake hazards were not available NCEI Storm Events Database and are therefore not included in the table below. Historical wildfire data that was available from 2000 to 2016 averages out to about 15 wildfires annually. No property damage, deaths, or injuries were included in this dataset.

Table 4-50. Northern Neck Annualized Hazard Events, Damages, Deaths, and Injuries

Hazard	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Coastal Flooding	0.5	$1,317,887	$0	$1,317,887	0	0
Drought	0.1	$0	$943,399	$943,399	0	0
Hurricane	0.3	$117,741	$175,147	$292,888	0	0
Riverine Flooding	0.5	$56,339	$16,922	$73,261	0	0
Severe Weather	3.2	$360,170	$105	$360,275	0	0.0
Tornado	0.4	$172,204	$1,162	$173,367	0	0.2
Winter Storm	4.2	$1,926	$0	$1,926	0	0

Table 4-51. Annualized Hazard Events by County and the Northern Neck Region

Hazard	Lancaster	Northumberland	Richmond	Westmoreland	Region
Coastal Flooding	0.4	0.5	0.1	0.2	0.50
Drought	0.1	0.1	0.1	0.1	0.14
Hurricane	0.2	0.2	0.1	0.1	0.32
Riverine Flooding	0.2	0.2	0.3	0.4	0.55
Severe Weather	1.2	1.1	1.9	1.8	3.17
Tornado	0.1	0.1	0.2	0.1	0.38
Winter Storm	2.7	3.0	3.1	3.2	4.23

Table 4-52. Annualized Hazard Damages by Type and County

Hazard	Lancaster		Northumberland		Richmond		Westmoreland		REGION
	Property	Crop	Property	Crop	Property	Crop	Property	Crop	TOTAL
Coastal Flooding	$91,330.29	$0.00	$1,117,119.92	$0.00	$98,041.18	$0.00	$11,395.89	$0.00	$1,317,887.28
Drought	$0.00	$265,147.75	$0.00	$203,475.46	$0.00	$135,650.31	$0.00	$339,125.77	$943,399.29
Hurricane	$39,482.34	$24,721.89	$47,344.19	$58,903.73	$6,340.21	$39,908.89	$24,574.44	$51,612.35	$292,888.04
Riverine Flooding	$0.00	$0.00	$0.00	$0.00	$43,399.14	$13,271.91	$12,940.11	$3,649.77	$73,260.93
Severe Weather	$62,629.15	$0.00	$289,888.57	$0.00	$3,348.70	$104.91	$4,303.34	$0.00	$360,274.67
Tornado	$87,181.85	$0.00	$9,341.00	$0.00	$55,665.58	$0.00	$20,015.86	$1,162.42	$173,366.71
Winter Storm	$0.00	$0.00	$0.00	$0.00	$963.02	$0.00	$963.02	$0.00	$1926.04
Total	**$280,623.63**	**$289,869.64**	**$1,463,693.68**	**$262,379.19**	**$207,757.84**	**$188,936.02**	**$74,192.67**	**$395,550.31**	**$3,163,002.96**

5.0 Mitigation Strategy

5.1 Introduction

The hazard mitigation planning process conducted by the Northern Neck Planning District Commission used a typical problem-solving methodology:

- Describe the problem (Hazard Identification).
- Estimate the impacts the problem could cause (Risk Assessment).
- Assess what local programs, staff, and technical abilities are in place (or potentially could be in place) to lessen those impacts. Using this information, determine what, if anything, can be done to reduce hazard impacts and promote community resilience, and select those actions that are appropriate for the Northern Neck region (Mitigation Strategy).

The Mitigation Strategy section of the hazard mitigation plan update describes the development of the mitigation strategy. Through the process of reviewing and updating the 2011 plan update goals and debriefing the 2011 plan update objectives and mitigation strategies during the May 31, 2017, Mitigation Action Committee meeting, the updated 2017 mitigation plan goals were set. During this process Planning District Commission and local government 2017 to 2022 mitigation actions were developed (including re-prioritization of 2011 actions that were continued).

5.2 Existing Authorities, Policies, Programs, and Resources for Mitigation

Relevant authorities, policies, programs, and resources available to support the Northern Neck's hazard mitigation activities are outlined in Section 6.0 Capabilities, Plan Implementation and Maintenance. Northern Neck jurisdictions have long-established, experienced program administrators and staff who can work with the Local Emergency Planning Committee and Mitigation Advisory Committee to advance not only the 2017 to 2022 mitigation strategies herein but can also further facilitate a holistic, integrated mitigation program to reduce risk exposure and increase resilience of the region's population (described in Section 3.0 Community Profile).

5.3 Setting Mitigation Goals

When a community decides that certain risks are unacceptable and that certain mitigation actions may be achievable, the development of *goals* and *actions* takes place. *Goals* are long-term and general statements. *Actions* are detailed and specific strategies, actions, or projects that support accomplishment of the 2017 mitigation plan update goals as well as holistic hazard mitigation programs.

The Mitigation Advisory Committee (MAC) reviewed the goals from the 2011 Northern Neck Regional Hazard Mitigation Plan at the April 5, 2017, HIRA and Mitigation Goals review meeting conducted at the Northern Neck PDC office in Warsaw, Virginia. The goals were reviewed, discussed, and edited to better address hazards as profiled in Section 4.0 Hazard Identification and Risk Assessment, and to inject resilience concepts into the hazard mitigation plan update. The goals are broad and applicable to the jurisdictions served by the NNPDC. The goals were addressed a second time during the final MAC meeting conducted May 31, 2017, where they were slightly modified. A column on the 2017 to 2022 Mitigation Actions table (Appendix D) aligns each action to the revised mitigation goals.

2017 – 2022 Mitigation Goals

Goal 1: Promote new development that avoids undue risks posed by natural hazards and is resilient to natural disasters.

Goal 2: Address natural hazards and vulnerabilities that represent a threat to the community.

Goal 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents, property and critical infrastructure of the Northern Neck.

Goal 4: Enhance the capabilities of local government to address natural hazards to enhance the whole community for increased resilience.

Goal 5: Increase natural hazard awareness of our citizens. Educate Northern Neck citizens and part-time residents on citizen and community hazard resilience.

Goal 6: Participate and Comply with the National Flood Insurance Program (NFIP) through floodplain identification, mapping, and floodplain management.

5.4 Selecting Mitigation Actions

Actions are detailed and specific strategies, actions, and projects that help support regional natural hazard resilience and mitigation goal achievement. The actions from the 2011 plan formed a platform for discussion about mitigation actions for the 2017 plan. During the April 5, 2017, MAC Meeting, the group decided that it did not want objectives but wanted to go with a goal-action mitigation strategy structure. A lengthy discussion was held at that meeting on the 2011 plan mitigation actions and strategies to help frame which 2011 actions should be continued and what organizational form the 2017 – 2022 mitigation actions should take.

5.4.1 2011 Plan Mitigation Goals, Objectives, and Strategies Discussion Points

2011 GOAL 1: Promote new development that acknowledges the risks posed by natural hazards and is resilient to natural disasters.

2017 Comments

- Within the Chesapeake Bay coastal high hazard area are no build zones for Northumberland.
- The region has done a good job of not locating critical facilities in the floodplain?
- Westmoreland has a steep slope ordinance to address issues on high hazard Potomac River shorelines.
- Every jurisdiction adopted updated Flood Insurance Studies (FIS) and Flood Insurance Rate Maps (FIRMs) during the planning period along with updated floodplain management ordinances.
- PDC is working on shoreline management mechanisms through the “Living Shores” Program to promote better practices to manage coastal shoreline erosion. Specific county strategies will be included.

2011 GOAL 2: Address risks that threaten existing development.

2017 Comments

- Manufactured housing (trailers) and fuel tanks continue to be a danger. We can address them with new siting and VDEM elevation projects, but there are a lot of existing, non-compliant structures throughout the region.
- Some residents have self-financed building elevation in Northumberland County.

2011 GOAL 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents of the Northern Neck.

2017 Comments

- When asked about infrastructure performance during spring 2017 wind events, the MAC felt that response operations and critical infrastructure performed as designed.
- York county drone team came and flew over to do initial damage assessment. This is an emerging technology with great future potential.
- Town of Irvington – response time was incredible for the tornado. No injuries, no deaths. Trees fell on houses. One house shifted on the foundation. Windows were blown out in a hospital. Didn't stop servicing patients, but one person did get transferred to Walter Reed.
- Stormwater management systems are not common on the Northern Neck so heavy rainfall was either absorbed in the watershed or drained quickly. Standing floodwaters are generally not an issue but coastal surge and erosion are.
- Make sure your critical facilities can handle exposure to water.

2011 GOAL 4: Enhance the capabilities of local government to address natural hazards and potentially limit their impacts.

- No comments

2011 GOAL 5: Increase the awareness of our citizens regarding the natural hazards present in the Northern Neck. Educate them about how to prepare for and mitigate against these hazards.

2017 Comments

- Website information has increased and social media use will continue to grow during the next plan cycle.
- Counties have implemented Code Red which features notification messaging that raises an awareness among citizens.
- Use volunteers with drones for damage assessment if carefully trained.

2011 GOAL 6: Participate and Comply with the National Flood Insurance Program (NFIP) through Floodplain Identification and Mapping, Floodplain Management, and Flood Insurance.

- No comments.

The status of the 2011 plan update strategies and actions were discussed at the April 5 and May 31, 2017, MAC meetings. Status was obtained through return of MS Excel hard copy and digital worksheets developed for each county and town and the NNPDC. The summary workbook sheets for each community may be found in Appendix C.

In addition, a range of new action alternatives were identified by each jurisdiction in individual local government meetings. These alternatives are presented in Appendix D. Generally, the jurisdiction representatives evaluated the actions for inclusion in the plan with the following criteria:

- Time – Can the strategy be implemented quickly?
- Ease of implementation – How easy is the strategy to implement? Will it require many financial or staff resources?
- Effectiveness – Will the strategy be highly effective in reducing risk?
- Lifespan – How long will the effects of the strategy be in place?
- Hazards – Does the strategy address a high-priority hazard or does it address multiple hazards?

After the 2017 actions were selected, the STAPLEE (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) criteria (Table 5-1) were used to inform prioritization the most appropriate actions for the Northern Neck. This methodology requires that social, technical, administrative, political, legal, economic, and environmental considerations be taken into account when reviewing potential actions for the area's jurisdictions to undertake. This process was used to help ensure that the most equitable and feasible actions would be undertaken based on each County's capabilities.

Table 5-1. STAPLEE Project Evaluation Criteria

Social	• Is the proposed action socially acceptable to the community? • Are there equity issues involved that would mean that one segment of a community is treated unfairly? • Will the action cause social disruption?
Technical	• Will the proposed action work? • Will it create more problems than it solves? • Does it solve a problem or only a symptom? • Is it the most useful action in light of other community goals?
Administrative	• Can the community implement the action? • Is there someone to coordinate and lead the effort? • Is there sufficient funding, staff, and technical support available? • Are there ongoing administrative requirements that need to be met?
Political	• Is the action politically acceptable? • Is there public support both to implement and to maintain the project?

Table 5-1. STAPLEE Project Evaluation Criteria

Legal	• Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity? • Are there legal side effects? Could the activity be construed as a taking? • Is the proposed action allowed by a comprehensive plan, or must a comprehensive plan be amended to allow the proposed action? • Will the community be liable for action or lack of action? • Will the activity be challenged?
Economic	• What are the costs and benefits of this action? • Do the benefits exceed the costs? • Are initial, maintenance, and administrative costs taken into account? • Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)? • How will this action affect the fiscal capability of the community? • What burden will this action place on the tax base or local economy? • What are the budget and revenue effects of this activity? • Does the action contribute to other community goals, such as capital improvements or economic development? • What benefits will the action provide?
Environmental	• How will the action affect the environment? • Will the action need environmental regulatory approvals? • Will it meet local and state regulatory requirements? • Are endangered or threatened species likely to be affected

Each STAPLEE factor was of primary concern when selecting measures. For those measures, such as education and outreach, that do not result in a quantifiable reduction of damages, the relationship of the probable future benefits and the cost of each measure was considered when developing the mitigation actions. Action ideas were evaluated based on technical feasibility (i.e., whether they could be done and would solve the problem); cost-effectiveness (i.e., the benefits outweighed the costs); environmental and historic/cultural resource impacts; and political and social acceptance. A priority level was assigned to each project based on the potential for the projects to be completed given the existing and potential funding; this prioritization method was selected because the MAC believed it would foster a realistic expectation of what could be accomplished in the next five years. A priority level of High indicates that these projects are currently in progress and have designated funds for completion or require minimal funds to complete (resulting in a high return on investment or measure of cost-effectiveness). A priority level of Medium indicates that the community is likely to receive funding for these particular projects, and if funding is received, the projects will be completed. Lastly, a priority level of Low indicates that these actions will be complete only if outside funding becomes available.

Actions were developed for each community by creating a spreadsheet that carried forward each 2011 action that the community indicated it wished to “continue.” Then through hard copy and electronic correspondence and interviews, each community updated their 2017 to 2022 mitigation actions, as did the Northern Neck Planning District Commission.

The new 2017 to 2022 mitigation actions have been organized into six major categories of mitigation, as shown in Table 5-2.

Table 5-2. Hazard Mitigation Categories and Associated Projects

Mitigation Category	Project Type
Prevention	• Planning and zoning • Building codes • Open space preservation • Floodplain regulations • Stormwater management regulations • Drainage system maintenance • Capital improvements programming • Shoreline/riverine setbacks
Property Protection	• Acquisition/Demolition • Relocation • Building elevation • Critical facilities protection • Retrofitting (i.e., wind-proofing, floodproofing, seismic design) • Safe rooms, shutters, shatter-resistant glass • Insurance
Natural Resource Protection	• Land acquisition • Floodplain protection • Watershed management • Beach and dune preservation • Riparian buffers • Forest and vegetation management (i.e., fire resistant landscaping, fuel breaks)

Table 5-2. Hazard Mitigation Categories and Associated Projects

Mitigation Category	Project Type
	• Erosion and sediment control • Wetland preservation and restoration • Habitat preservation • Slope stabilization • Historic properties and archaeological site preservation
Structural Projects	• Reservoirs • Dams/levees/dikes/floodwalls/seawalls • Diversions/detention/retention • Channel modification • Beach nourishment • Storm sewers
Emergency Services	• Warning systems • Evacuation planning and management • Emergency response training and exercises • Sandbagging for flood protection • Installing temporary shutters for wind protection
Education & Awareness	• Outreach projects • Speaker series/demonstration events • Hazard mapping • Real estate disclosure • Library materials • School children educational programs • Hazard expositions

NOTES:

- Many 2011 floodplain management and NFIP-related actions were carried forward for each community but are listed independently for each community as priorities, staff responsibility and local implementation resources vary.
- A holistic mitigation project action was added for each community to fully insure project type for HMA grant eligibility. Again, these are listed on each community worksheet to allow community-specific prioritization, etc.
- A holistic plan integration action is also included for each community to better ensure plan coordination during the next hazard mitigation planning period. It should be noted that the current local comprehensive plans do a good job of hazard mitigation integration.

5.5 Developing a Mitigation Action Plan

Mitigation action plans were developed for all of the identified actions. Each mitigation action plan includes:

- the goal(s) it is intended to help achieve,
- the hazard(s) it is designed to mitigate,
- the agency assigned responsibility for carrying out the strategy,
- general resources needed,
- a timeframe for completion, and
- Priority level for its implementation (high, medium, or low).

The 2017 to 2022 Mitigation Action tables do include notation where the community did not provide all requested information. The following timeframes are defined in Table 5-3 for the completion of the identified mitigation actions.

Table 5-3. Timeframes Defined

Timeframe	Definition
Short-term	Less than three years
Long-term	More than three years
As funding becomes available	Project timeline is dependent on funding
Ongoing	Project is continuous with no designated end date

The mitigation action plans for each jurisdiction within the Northern Neck are listed in alphabetical order in Appendix D.

6.0 Capabilities, Plan Implementation, and Maintenance

6.1 Capability Assessment

This portion of the Plan assesses the current capacity of the communities of the Northern Neck Planning District to mitigate the effects of the natural hazards identified in Section 4 of the plan. This assessment includes a comprehensive examination of the following local government capabilities:

- *Administrative Capability* – describes the forms of government in the region, including the departments that may be involved in hazard mitigation.
- *Technical Capability* – addresses the technical expertise of local government staff.
- *Fiscal Capability* – examines budgets and currently used funding mechanisms.
- *Policy and Program Capability* – describes past, present, and future mitigation projects in the region and examines existing plans (e.g., emergency operations plan, comprehensive plan).
- *Legal Authority* – describes how jurisdictions in the region use the four broad government powers (i.e., regulation, acquisition, taxation, and spending) to influence hazard mitigation activities.

The purpose of conducting the capability assessment is to assess methods that the Northern Neck Regional Planning District's local governments, specifically Lancaster, Northumberland, Richmond, and Westmoreland Counties, have available to implement successful mitigation programs. Through careful analysis, any existing gaps, shortfalls, or weaknesses within existing governmental activities that could exacerbate a community's vulnerability were identified. The assessment also highlights the positive measures underway at the local level that will continue to be supported and enhanced through future mitigation efforts.

The capability assessment serves as the foundation for designing an effective hazard mitigation strategy. It not only helps inform plan goals to be both achievable but aspirational to reduce planning district regional exposure to natural hazards. A master capability assessment matrix table which summarizes each jurisdiction’s programs is located in Appendix I. Elements of the master table and a capability assessment survey completed by most of the participating local governments was used to inform this analysis.

6.1.1 Administrative Capability

As described previously, the planning area is comprised of four counties. The counties operate under a Board of Supervisors - County Administrator/Manager system. In this form of government, the elected Board of Supervisors hires a County Administrator who oversees daily operations of the County. In the Northern Neck, each of Board of Supervisors has five members.

The Northern Neck Emergency Operations Plan designates seven departments with specific responsibilities for hazard mitigation:

- Board of Supervisors, Town Councils and Local Government Administrators
- Emergency Management
- Department of Health
- Building/Planning/Zoning
- Law Enforcement

- Public Safety (including fire department and rescue squads)
- School systems

These major functions exist in each of the Northern Neck counties and to some extent the towns with similar responsibilities but sometimes varying local government organization to meet local needs. Additionally, Lancaster County and Northumberland County have identified responsibilities for the General Services Department (Public Works) and the Reedville Sanitary District. Implementation of Hazard Mitigation Assistance (HMA) grants to elevate residential buildings most recently segued to grant administration by the Northern Neck Planning District Commission with on-site supervision and code enforcement through the local building official. Most aspects of the floodplain management program lie within the planning or zoning office with final field enforcement through submission of completed Elevation or Floodproofing Certificates through the local building official. Outreach aspects of hazard mitigation are more holistically driven by local public information officers, emergency managers, planners and non-profit organizations.

Representatives of local governments supported the hazard mitigation plan update and, as part of the process, completed a capability assessment that helped identify local program strengths, gaps, and opportunities for existing or future emergency management, hazard mitigation, or resilience programs. This is especially timely as the region recovers from a sustained recession, has experienced increased severe weather events, and faces sea level rise and continued, accelerating coastal erosion. While exact responsibilities differ from jurisdiction to jurisdiction, general functions and responsibilities of Northern Neck local government departments are described in the sections which follow.

The responsibility to the public for effective hazard mitigation rests with the elected officials, which in the Northern Neck are the County Boards of Supervisors and the Town Councils. They enact the codes, regulations, and ordinances through the authorities granted them by the Commonwealth of Virginia under the Dillon Rule. Emergency management is directed through local emergency management or emergency services offices. County and Town leaders direct local hazard mitigation efforts and work cooperatively as appropriate on regional initiatives through the Northern Neck Local Emergency Planning Committee or with specific counties to provide FEMA-VDEM Hazard Mitigation Assistance (HMA) grant project administration and management. Many related regional plans and programs are administered by the Northern Neck PDC that directly inform and benefit its local governments related to natural resources, economic development, climate change and sea-level rise.

County and Town emergency management operations are focused in two areas. First responders, primarily volunteers (except for 911 dispatchers), sheriffs, and state police support immediate response to incidents such as building, brush and woodland fires, medical emergencies, accidents and hazardous materials spills. Virginia Department of Forestry staff aide response to brush and woodland fires. Several Counties are beginning to add professional emergency medical technicians to provide full-time emergency-medical-services-response capability for medical emergencies.

Additionally, emergency managers are responsible for the mitigation, preparedness, response, and recovery operations relative to natural and man-made disaster events. Specifically, County Administrators and Town Managers, in their roles as Coordinators of Emergency Services, have designated management responsibility for the floodplain management and emergency management programs, often including hazard mitigation program, and assigns program operations to appropriate departments or staff.

The Virginia Department of Health enforces ordinances related to the safe handling and the emergency distribution of water and food. In addition, the Department of Health is responsible for the prevention or spread of disease. The Northern Neck is served by the Three Rivers Health District. Ninety-six employees support the ten-county region of the Northern Neck and Middle Peninsula. An emergency planner and epidemiologist are on District staff.

Planning, zoning and site inspections are conducted by staff or departments that have responsibility for administering and enforcing existing building codes and zoning ordinances. Planning and code compliance staff also ensure that all new construction, repair and building additions or improvements comply with State and County building codes, zoning, and land-use regulations. While the Town of Colonial Beach also has its own building inspector, other small Northern Neck towns use County building officials to support building-code compliance and construction monitoring. Local compliance with the Chesapeake Bay Preservation Act, erosion and sediment control regulations, and stormwater management start with proposed development plan review by local planners, with additional technical and field inspection support provided by the Northern Neck Soil and Water Conservation District. In addition, these departments support project review and code enforcement for hazard mitigation such as elevation of flood-prone residential buildings, and ensure that FEMA Elevation Certificates and Floodproofing Certificates are properly completed for applicable projects.

The County Building Official is licensed by the Commonwealth of Virginia and locally enforces the Virginia Uniform Statewide Building Code (VUSBC). This code includes implications for floodplain management. Local Planning or Community Development departments address land-use planning and, in most cases, house the local floodplain management program enforcing local floodplain management regulations. Public Works departments have a role in hazard resilience through oversight and maintenance of local infrastructure, some critical, which varies amongst Northern Neck jurisdictions. While the responsibilities and infrastructure are varied, critical infrastructure includes wastewater treatment facilities, a few local water treatment systems, and several new local drainage systems. Primary and secondary road maintenance is largely the responsibility of the Virginia Department of Transportation, which coordinates closely with local emergency managers during and immediately after disaster events and storms to address road closures and detours, debris management, and messaging.

Other departments may have responsibilities for programs that could complement hazard mitigation activities. For instance, parks and recreation departments may be responsible for open space programs. If demolition/acquisition projects are undertaken, coordination to manage created open space may include the parks and recreation staff.

Table 6-1 summarizes the number of staff who perform key functions in Northern Neck County governments. For the most part, County self-evaluations determined that programs are adequately funded and staffed (with the exception of emergency medical and fire response), and staff are adequately trained to support government program mission functions.

Table 6-1. Staffing Levels

County	Emergency Services	Building/ Planning/ Zoning	Law Enforcement (local)	Fire Department	Public Works
Lancaster	2	4	24	125	12
Northumberland	1	6	28	60 Active 90 Total	2
Richmond	2	4	15	55	N/A
Westmoreland	2	7	41	96 Active 102 Total	N/A

6.1.2 Technical Capability

Mitigation is multi-disciplinary. For a successful mitigation program, it is necessary to have a broad range of people involved who can inform and contribute to holistic mitigation programs through diverse backgrounds and experience. Mitigation process participant diversity is reflected on the MAC but can further include additional local planners, engineers, building inspectors, emergency managers, floodplain managers, Geographic Information Systems (GIS) analysts, and grant writers.

GIS systems include the hardware, software, and technicians that collect, manage, analyze and display spatially-referenced data. Many local governments are now incorporating GIS systems into their existing planning and management operations. GIS is invaluable in identifying areas vulnerable to hazards. Improved online-archived technical information has greatly improved update processes and quality of emergency operations plans, continuity of operations plans, hazard mitigation plans and emergency management, resilience and mitigation messaging. This increases community resilience, especially outreach efforts using social media.

Table 6-2 summarizes the technical capabilities of the jurisdictions per their self-rated assessment. A summary capability assessment matrix table can be found in Appendix I. As demonstrated in the table, Northern Neck local governments do not have dedicated mitigation funding project sources to manage and administer HMP grant-funded projects so the Northern Neck PDC supports the administrative aspects of those projects. The Northern Neck PDC's website offers a central location to publicize information about a variety of different hazard mitigation and planning efforts throughout the region. Emergency managers devote staff time and use existing web sites, social media and events like tornado awareness month and hurricane preparedness month as a platform for mitigation messaging. Strong preparedness and mitigation messages, techniques, and program links are provided on local websites to enable residents and businesses to create disaster preparedness plans and carry adequate flood insurance on at-risk properties and property contents.

Northern Neck jurisdictions have dedicated emergency managers and floodplain managers with the exception of the Town of Colonial Beach where town managers often perform emergency management and floodplain management functions. The final mitigation measure for new or substantially improved building construction or critical facility installation is the final inspection performed by the local building official. Northern Neck counties and the Town of Colonial

Beach staff feature dedicated building inspectors while this function is performed for smaller towns by the county building official.

Table 6-2. Technical Capability Matrix by Jurisdiction

Jurisdiction	Mitigation Assigned to Specific Dept.	GIS	Adequate Zoning Staff	Dedicated Floodplain Mgmt. Staff	Building Inspectors	Overall Technical Capabilities
Lancaster	Yes	Yes (limited)	Yes	Yes	Yes (2)	Moderate
Northumberland	Yes	Yes	Yes	Yes	Yes	Moderate
Richmond	Yes	Yes	No	No	Yes	Moderate
Westmoreland	Yes	Yes	Yes	Yes	Yes	Moderate
NNPDC		Yes	N/A – localities staff	Yes	N/A – localities staff	High
Town of Colonial Beach	No	Yes	No	No	Yes (1)	Moderate
Town of White Stone	Yes	No	Yes	Yes	No (county)	High
Town of Kilmarnock	Yes	Yes (limited)	Yes	Yes	No	Low
Town of Montross	Yes	No (county)	Yes	No (county)	No (county)	Low

High: Higher standards, high program management.

Moderate: Adequate program management.

Limited: Increased capability desired.

Note: Towns of Warsaw and Irvington did not respond to 2017 capability assessment survey

6.1.3 Fiscal Capability

For Fiscal Year 2017, the budgets of the participating jurisdictions range from about $22 million (Richmond County) to $30 million (Westmoreland County) and smaller budgets for towns. Revenues which support local budgets come from property taxes, State and local sales taxes, local service fees, and through restricted intergovernmental contributions (federal and state pass through dollars). Mitigation projects have been funded through FEMA's post-disaster Hazard Mitigation Grant Program (HMGP). The Commonwealth of Virginia historically and presently provides 20 percent of the required non-federal project match, leaving only a required 5 percent local match, usually using property-owner resources. Considering current budget challenges combined with trends in reduced federal support to state and local governments, funding for future mitigation work could be a challenge.

FY 2017 budgets provided by local LEPC representatives (and internet search for some towns) are shown in Table 6-3. Northumberland County has created a development impact fee structure to supplement county income. Capital Improvement Plans (CIPs) and intergovernmental agreements are used by three of the four Northern Neck counties.

Table 6-3. Fiscal Capability Matrix by Jurisdiction

Jurisdiction	Total FY17 Budget	Public Safety FY17 Budget
Lancaster	$29 million	$5.5 million
Northumberland	$36.7 million	$4.3 million
Richmond	$21-22 million	$1 million
Westmoreland	$29.7 million	$5.9 million
NNPDC	$790,000	N/A
Town of Colonial Beach	$26 million	$1.3 million
Town of Irvington	$142,705	$2,100
Town of Kilmarnock		
Town of Montross	$388,225	$17,650
Town of Warsaw	$1.4 million	$332,510
Town of White Stone	$181,730	$46,614

N/A – not applicable

6.1.4 Policy and Program Capability

Local officials generally felt that their government capacity, through staffing, technical expertise and regulatory programs was at least moderate in most areas. Stormwater management is regulated by the Department of Environmental Quality's Chesapeake Bay Preservation Program but most Northern Neck communities are not experiencing the type and volume of development covered by these regulations, so a rating of "low" is not reflective of a program deficiency, but a reflection of low need.

Table 6-4. Local Planning Mechanisms and Their Relationship to Hazard Mitigation

Locality	Comp. Plan Adoption Date & Horizon	Floodplain Mgmt. Ordinance	Storm Water Mgmt. Plan	Emergency Operations Plan	Erosion and Sediment Control Ordinance
Lancaster	High Adopted: 10/31/13	Moderate	Low Need	Moderate/High	High

Table 6-4. Local Planning Mechanisms and Their Relationship to Hazard Mitigation

Locality	Comp. Plan Adoption Date & Horizon	Floodplain Mgmt. Ordinance	Storm Water Mgmt. Plan	Emergency Operations Plan	Erosion and Sediment Control Ordinance
Northumberland	High Adopted: 11/10/16	Moderate	Moderate	Moderate/High	High
Richmond	High Adopted: 7/11/2013	Moderate	Moderate	Moderate/High	High
Westmoreland	High Adopted: 12/13/2010	Moderate	Low Need	Moderate/High	High

6.1.4.1 Past Mitigation Efforts

A Community Development Block Grant (CDBG) was used in the past in Westmoreland County to make storm water improvements. Homeowners self-financed home elevations after Hurricane Floyd, but the region became more active in use of the HMGP program following 2003's Hurricane Isabel for residential elevation projects in Northumberland and Lancaster County. HMGP has supported further residential elevation projects. Grant management for these projects has shifted to the PDC, which is more experienced in grant management because of the variety of grants it supports throughout the region that benefit local governments.

One local frustration has been the eligibility challenge due to the required FEMA positive benefit-cost ratio for each project. Following severe impacts, several projects in the past seemed necessary and viable but did not achieve the required positive benefit-cost ratio (greater than 1.0) despite significant storm damage. This was a challenge after Tropical Depression Ernesto and continues to be an issue.

Elevation projects have moved forward to address properties listed on FEMA's Repetitive and Severe Repetitive Loss list. Due to continued flood damages and increased flood insurance claims, grant requirements for these properties are more relaxed so the Northern Neck has had some success in more recent residential elevation grant applications. Award for several projects are currently pending.

The Tidewater Resource Conservation and Development District, in coordination with the US Department of Agriculture and the Virginia Department of Forestry, implemented a FIREWISE program in the Northern Neck and Middle Peninsula regions. The project began in 2001 with a data collection and awareness phase. Areas of apparent risk were identified using GIS, followed by completion of field verification. A workshop for local planners was conducted introducing them to wildfire mitigation principles and ways to incorporate them into the local planning process. Demonstration projects have been conducted in several small communities to illustrate and promote mitigation practices. While wildfire occurrence in the Northern Neck is low, the risk is great due to numerous loblolly pine plantations interspersed with rural residences. This forest plantation type can be highly flammable in dry conditions.

6.1.4.2 Emergency Operations Plan

The Northern Neck Planning District Commission worked with Northern Neck communities to develop the 2011 Regional Emergency Operations Plan Update. The plan was originally developed in 2004. It consisted of a basic concept of operations, seven hazard-specific annexes, ten region-wide functional annexes, and community-specific functional annexes. This plan represented a full adoption of the operational Incident Command System during emergency events.

The 2011 regional plan update serves as a foundational plan for independent County Emergency Operations Plans (EOPs) which have been drafted and adopted by County Boards of Supervisors during the past several years. These plans, while not publically available for security reasons, generally provide the legal and organizational basis for operations in each specific county or community in response to any type of disaster or large-scale emergency situation. Local Northern Neck Emergency Operations Plans (EOPs) outline a set of assumptions, which include a statement that primary hazards in the Northern Neck are severe weather events and numerous man made hazards (e.g., hazardous material incidents). The hazard statement may be modified as informed by the 2017 hazard mitigation plan update, as local emergency operations plans are updated.

Each plan outlines roles and responsibilities for the various county departments and agencies, ranging from the County Administrator, Emergency Manager, public safety officials and other government functions ranging from planning to public works and the Virginia Department of Health. While EOPs focus on emergency response, most include the emergency functional annex that addresses disaster recovery and mitigation. They usually do not describe mitigation needs or planned actions but rather outlines responsibilities for various organizations including the County Administrator, Emergency Manager, county staff and volunteer organizations.

The 2010 regional EOP stated that mitigation measures should "include, but are not limited to, the development of zoning laws and land use ordinances, building codes, regulations, and licensing for handling and storage of hazardous materials, and the inspection and enforcement of such ordinances, codes, and regulations." This language should be maintained. Additionally, following a state or federal emergency and disaster declaration, VDEM coordinates recovery efforts with local governments through the LEPC, local emergency managers, and VDEM Regional Support teams.

The information that follows for each Northern Neck County is paraphrased from local emergency management websites.

Lancaster County Office of Emergency Services

The Lancaster County Office of Emergency Services maintains a separate web site. Please refer to www.ReadyLancaster.org for more comprehensive information on Emergency Services information and programs. The www.ReadyLancaster.org website is deep and provides diverse information directed at local citizens, businesses, and organizations providing advice on emergency and disaster preparedness planning, instructions for sheltering and other emergency and disaster needs, and post-event instructions. In accordance with state law, the Lancaster

County Board of Supervisors has adopted an Emergency Operations Plan which establishes the legal and organizational basis for operations in response to any type of disaster or large scale emergency situation. The Plan assigns broad responsibilities to local government agencies and support organizations for disaster mitigation, preparedness, response and recovery. These responsibilities are generally extensions of normal day-to-day functions involving the same personnel and material resources.

The types of disasters most likely to affect Lancaster County are weather-related occurrences such as hurricanes, coastal flooding, tornadoes, and severe thunderstorms that produce high winds and significant rainfall.

Northumberland County

Northumberland County is one of the few counties left in Virginia that has all-volunteer emergency services. The county is served by two fire departments, Callao Volunteer Fire Department, in Callao, and Fairfield Volunteer Fire Department, with buildings in Reedville and Burgess. There are three rescue squads that serve the county: Callao Volunteer Rescue Squad, in Callao; Mid-County Volunteer Rescue Squad, in Heathsville; and Northumberland County Rescue Squad, in Reedville and Burgess. The county also has a water rescue service, Smith Point Sea Rescue.

Richmond County Department of Emergency Services

The Richmond County Department of Emergency Services is organized into two functional areas: the Division of Emergency Medical Services and the Office of Emergency Management. The Division of Emergency Medical Services provides 24 hour-a-day, state of the art basic and advanced life support emergency medical services to Richmond County residents and visitors.

The Office of Emergency Management writes and maintains the Richmond County Emergency Operations Plan, manages the County's Emergency Operations Center, and coordinates post-disaster recovery activities. OEM also provides emergency planning in such areas as special needs, continuity of operations, and emergency operations. OEM staff members are available to give presentations on emergency preparedness to homeowners' associations, civic groups, businesses, or faith community members.

Westmoreland Public Safety

Westmoreland County's public safety personnel are trained and ready to prevent harm to citizens and property and to respond effectively to routine matters, emergencies and disasters when they occur. Instructions on dialing 911 to report fires, crime, life-threatening situations or other emergencies is given along with detailed instructions on how to communicate the situation with the 911 dispatcher.

The Westmoreland County All Hazards Preparedness Brochure and the Ready Virginia Emergency Brochure are linked to the website. Highlights of information available to residents from Ready Virginia, VDEM, and FEMA are highlighted. Evacuation and sheltering information is also highlighted on the website with instructions to contact the Sheriff's Office or County Administrator's Office for assistance when evacuation transportation is needed.

6.1.4.3 Floodplain Management

Communities that regulate development in floodplains participate in the National Flood Insurance Program (NFIP). In return, the NFIP makes federally-backed flood insurance policies available for properties in the community. Table 6-5 shows the effective Flood Insurance Rate

Map (FIRM) dates for each NFIP participating Northern Neck community as well as other applicable historic information about the community's participation. FIRMs and Flood Insurance Studies (FIS) were developed by FEMA to show the boundaries of the one-percent and 0.2 percent annual chance floodplain. As the table shows, FEMA's recent investment in updating flood risk hazard maps, especially in high risk coastal areas, has resulted in revision of the Northern Neck community flood hazard risk maps. Following lengthy local and public citizen review of draft FIRMs and FIS reports, each jurisdiction's elected officials adopted the FIRMs, FIS, and an updated floodplain management ordinance or zoning ordinance section with an embedded floodplain management ordinance.

Despite new flood risk mapping, local landscape features such as increased frequency of coastal storms, sea-level rise, and coastal erosion rates are taken into consideration by local governments reviewing requests for development or construction within the regulated floodplain called the Special Flood Hazard Area (SFHA).

Statutes of the Commonwealth of Virginia provide cities and counties land use authority. Floodwater control is empowered through §15.2-2223 and §15.2-2280 of the Code of the Commonwealth of Virginia. Each Northern Neck jurisdiction with land use authority has adopted a local floodplain ordinance as a requirement of participation in the NFIP.

Table 6-5. NFIP Entry and FIRM Date

County	Jurisdiction	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Reg-Emer Date
Lancaster	Irvington, Town of	10/18/74	8/4/87	10/2/14	08/04/87
	Kilmarnock, Town of	N/A	9/17/10	10/2/14	09/17/10
	Unincorporated County	1/24/75	3/4/88	10/2/14	03/04/88
	White Stone, Town of	8/30/74	9/24/84	10/02/14	09/24/84
Northumberland	Unincorporated County	12/13/74	7/4/89	2/18/15	07/04/89
Richmond	Unincorporated County	4/11/75	3/16/89	4/16/15	03/16/89
Westmoreland	Colonial Beach, Town of	8/9/74	9/18/87	4/16/15	09/18/87
	Unincorporated County	7/18/75	9/18/87	4/16/15	09/18/87

Source: FEMA. Community Status Book Report. Virginia. https://www.fema.gov/cis/VA.html

Each community has designated staff who enforce their floodplain management ordinance, which is included, in some cases, in the zoning ordinance. The Department of Conservation and Recreation's Floodplain Management Program, including their NFIP Coordinator and his staff, conduct Community Assistance Visits or Community Assistance Calls (CACs) to review program administration locally, on about a two-year rotation

Local floodplain management ordinances often feature more restrictive measures than the required FEMA model ordinance. "Higher Standards" such as "freeboard" require a higher first-floor elevation than that depicted on the FIRMs and FIS report's data tables. For example, Northumberland County requires 12" of additional freeboard above Base Flood Elevation (BFE) for substantial improvements in an AE Zones and 24" of freeboard in VE Zones. Westmoreland County requires 18" of additional freeboard above the Base Flood Elevation.

The Community Rating System (CRS) was created by FEMA during 1990 as an incentive program to recognize and encourage community floodplain management activities that exceed the minimum NFIP standards. Residents of CRS participating communities receive a reduction in their flood insurance annual premiums. These are awarded in five percent increments following a rigorous community floodplain management program review. There are ten CRS classes: Class 1 requires the most credit points and gives a 50-percent premium reduction; Class 10 communities' NFIP policy holders do not receive a premium reduction. None of the communities in the Northern Neck currently participate in the CRS.

One of the CRS requirements is a community floodplain management plan. The Northern Neck hazard mitigation plan update is intended to fulfill the CRS planning requirement should any NFIP participating communities wish to pursue CRS program participation.

Local emergency managers who responded to the capability assessment were not well-versed on how the NFIP is administered locally. In the next plan update, the plan should include more in-depth information on how the NFIP is managed in each of the jurisdictions. Examples could include: process to ensure new construction is compliant with the local floodplain ordinances; how residents are assisted in mapping issues and how substantially damaged structures are managed to ensure compliance with the latest floodplain ordinance.

6.1.4.4 Comprehensive Plans

A community's comprehensive plan provides the future vision for the community regarding growth and development. However, many of the plans include land use or environmental protection goals that could support future mitigation efforts. For example, limiting development in the floodplain (which is considered mitigation) may also help meet open-space goals laid out in a comprehensive plan. Several comprehensive plans address mitigation, resilience and long-term community sustainability. These are new inclusions, and, as communities continue to update their comprehensive plans, it is anticipated that mitigation and resiliency issues will be more comprehensively addressed. Virginia comprehensive plans are usually updated on a five-year cycle.

For the most part, the region's comprehensive plans includes strategies that address development in the floodplain or otherwise flood-prone areas. In addition, the comprehensive plans indicate that communities in the Northern Neck use zoning and subdivision regulations to retain the rural character of their areas while they preserve traditional livelihoods like agriculture, forestry, fishing and aquaculture. A significant focus is recession recovery and protection of coastal resources.

Table 6-4 shows the comprehensive plan adoption status for each comprehensive plan. Demographic information is from the U.S. Census. Some plans use growth projections from either the Virginia Employment Commission or the University of Virginia's Weldon Cooper Center. The Weldon Cooper Center's population projection data was also used to inform Section 3.0 Community Profile in the 2017 hazard mitigation plan update. Population projects in the

Northern Neck are generally flat for the next two decades due to an aging population, limited new development and an overabundance of housing stock due to the lingering effects of the recession.

Lancaster County

Hazard mitigation concepts are found throughout the Lancaster County Comprehensive Plan, adopted October 31, 2013. The first goal derived from the land suitability study is "to encourage new and orderly development in areas of the County most suitable for growth." One of the means that the plan recommends to achieve this goal is to develop amendments to the zoning ordinance that help protect property owners from potential hazards of shrink-swell soil and high water tables. The second goal is to "ensure that new development is designed in a manner that provides for continued protection of the surface and groundwater resources in Lancaster County and the State of Virginia." Furthermore, Chapter 3 is dedicated to discussing the protection of the Lancaster County potable water supply. Chapter 4 of the comprehensive plan is devoted to shoreline protection and includes a shoreline protection study and plan to address shoreline erosion. The plan advocates for the use of vegetative methods as opposed to structural solutions such as rip rap and groins on individual parcels. The plan also encourages a coordinated approach to shoreline protection suggesting that density credits and other innovative techniques could be used to encourage such actions.

The plan notes that a variety of growth tools may be appropriate for Lancaster County, including performance standards, conservation easements, use valuation taxation, overlay zones, and open space provisions that prioritize flood control.

Northumberland County

The opening goal for the 2016 Northumberland County Comprehensive Plan is similar to Lancaster County: "To provide a framework for managing future development of the County in a way that promotes opportunity for its citizens while directing growth to areas best able to accommodate growth."

Another plan goal is to "reduce soil erosion on steep slopes particularly along creek and stream banks." The steep slopes and unstable soils impact development in the area by increasing project costs. These conditions cause serious soil erosion and can increase sediment and other pollutants entering local streams, estuaries, rivers, and bays.

The plan includes a section on flood-prone areas and delineates numerous goals and strategies directed toward protection of life and property from floods. These strategies include public education, performance standards, enforcement of existing ordinances, and utility-siting criteria. The plan also highlights that the current County regulations require that any building constructed within the floodplain have a finished floor elevation two feet above the base flood elevation.

As with Lancaster County, shoreline erosion is of concern for Northumberland. The plan includes numerous strategies designed to protect shorelines. These include use of vegetation for shoreline protection and performance standards for structures that modify the shoreline. The plan also recognizes the need for coordinated or subdivision-wide actions.

Richmond County

Like its neighboring counties, Richmond County's Comprehensive Plan (adopted July 11, 2013) calls for accommodating future growth while maintaining the rural character of the County. The recommendations in the plan also recognize that growth cannot occur unchecked but should be guided away from environmentally-sensitive areas such as floodplains. For instance, the plan calls for the use of cluster design techniques to allow for environmentally-sensitive areas to remain undeveloped.

Shoreline erosion is featured in the Richmond County Comprehensive Plan. One recommendation calls for promoting the use of natural shoreline protection strategies.

Recommendations include establishing setbacks in known erosion areas, the use of vegetation and other natural features to protect the shoreline, enforcement of existing ordinances and facility sitting requirements.

The plan also recommends that the County develop programs to encourage maintenance of existing properties. Hazard mitigation principles could be incorporated into such a program.

Westmoreland County

Flood is a primary concern in the Westmoreland County 2010 Comprehensive Plan as well as the draft 2016 plan. Both plans suggest that appropriate development practices, land use controls and protection of vulnerable shoreline and drainage should be improved to minimize the effects of flooding. One of the goals to address flooding is to follow proper design practices including community retention ponds and other measures to improve flood-insurance ratings for the county. These recommendations were informed by the *Westmoreland County Shoreline Management Plan, 2013,* which was prepared for the county and the Virginia Coastal Zone Management Program by the Virginia Marine Institute of Marine Science, College of William and Mary.

The comprehensive plan recommends a variety of studies to address shoreline erosion and storm water drainage. The future land use plan also includes a conservation designation that incorporates areas of the floodplain and calls for limited to no future development. The plan recommends that Westmoreland County pursue measures to reduce facilitate entry into the Community Rating System.

It is clear from the plan that the County is willing to use easements to protect land. While floodplains and other high risk areas are not specifically mentioned, the use of easements and coordination with the Virginia Department of Conservation and Recreation, the Northern Neck Chesapeake Bay Public Access Authority, and other public agencies may provide an opportunity to protect property and achieve open space goals. The plan also recommends the underground placement of utilities in new development.

6.1.5 Legal Authority

Local governments in Virginia, including those in the Northern Neck region, have a wide range of tools available to them for implementing mitigation programs, policies, and actions. A hazard mitigation program can use any or all of the four broad types of government powers granted by the State of Virginia, which are (a) regulation, (b) acquisition, (c) taxation, and (d) spending. The scope of this local authority is subject to constraints; however, as all of Virginia's political subdivisions must not act without proper delegation from the state. All power is vested in the state and can only be exercised by local governments to the extent it is delegated (in accordance with Dillon's Rule). Thus, this portion of the capabilities assessment will summarize Virginia's enabling legislation that grants the four types of government powers within the context of available hazard mitigation tools and techniques.

6.1.5.1 Regulation

General Police Power

Virginia's local governments have been granted broad regulatory powers in their jurisdictions. The statutes of the Commonwealth of Virginia bestow the general police power on local governments, allowing them to enact and enforce ordinances which define, prohibit, regulate or abate acts, omissions, or conditions detrimental to the health, safety, and welfare of the people, and to define and abate nuisances (including public health nuisances). Since hazard mitigation can be included under the police power (as protection of public health, safety and welfare), towns, cities, and counties may include requirements for hazard mitigation in local ordinances. Local governments also may use their ordinance-making power to abate "nuisances," which could include, by local definition, any activity or condition making people or property more vulnerable to any hazard.

All of the jurisdictions in the Northern Neck planning area have enacted and enforce regulatory ordinances designed to promote the public health, safety, and general welfare of its citizenry.

6.1.5.2 Land Use

Regulatory powers granted by the state to local governments are the most basic manner in which a local government can control the use of land within its jurisdiction. Through various land use regulatory powers, a local government can control the amount, timing, density, quality, and location of new development. All these characteristics of growth can determine the level of vulnerability of the community in the event of a natural hazard. Land use regulatory powers include the power to engage in planning, and to enact and enforce zoning ordinances, floodplain ordinances, and subdivision controls. Each local community possesses great power to prevent unsuitable development in hazard-prone areas.

6.1.5.3 Planning

According to State Statutes, local governments in Virginia may create or designate a planning agency. The planning agency may perform a number of duties, including:

- Make studies of the area;
- Determine objectives;
- Prepare and adopt plans for achieving those objectives;
- Develop and recommend policies, ordinances, and administrative means to implement plans;
- Perform other related duties.

The importance of the planning powers of local governments is illustrated by the requirement that zoning regulations be made in accordance with a comprehensive plan. While the ordinance itself may provide evidence that zoning is being conducted "in accordance with a plan," the existence of a separate planning document ensures that the government is developing regulations and ordinances that are consistent with the overall goals of the community.

Each Northern Neck county and the Town of Colonial Beach have dedicated planning staff, zoning regulations and comprehensive plans. Town managers with assistance from counties perform planning and floodplain management functions. The towns in the study area all have planning commissions that meet regularly, receiving support as necessary from county planning departments.

6.1.5.4 Zoning

Zoning is the traditional and most common tool available to local governments to control the use of land. Broad enabling authority is granted for municipalities and counties in Virginia to engage in zoning. Land "uses" controlled by zoning include the type of use (e.g., residential, commercial, and industrial) as well as minimum specifications that control height and bulk such as lot size, building height and setbacks, and density of population. Local governments are authorized to divide their territorial jurisdiction into districts, and to regulate and restrict the erection, construction, reconstruction, alteration, repair or use of buildings, structures, or land within those districts. Districts may include general use districts, overlay districts, and special use or conditional use districts. Zoning ordinances consist of maps and written text.

Only Lancaster County implements floodplain regulations via the zoning ordinance. An overlay district is used to impose additional requirements on properties within the designated floodplain area.

6.1.5.5 Subdivision Regulations

Subdivision regulations control the division of land into parcels for the purpose of building development or sale. Flood-related subdivision regulations are included in the floodplain management ordinance, requiring developers to install adequate drainage facilities and design water and sewer systems to minimize flood damage and contamination. They also may prohibit the subdivision of land subject to flooding unless flood hazards are mitigated through filling or other measures, and they prohibit filling of floodway areas.

All of the jurisdictions in Northern Neck have adopted a subdivision ordinance. Some of the ordinances contain floodplain-specific provisions. For instance, Lancaster, Richmond, and Westmoreland Counties require that sufficient buildable land exist for each lot to ensure that the site is free of flood danger.

6.1.5.6 Floodplain Management Regulations

Each Northern Neck community with land use authority has adopted floodplain management regulations. As noted previously, only Lancaster County has done so specifically through the zoning ordinance. Northumberland, Richmond, and Westmoreland counties have adopted floodplain management ordinances into various locations in their municipal code.

Generally, the regulations adopted by the study communities do not go beyond the minimum standards of the NFIP. Several Northern Neck localities have adopted “freeboard” requirements, which require that first floors of new or substantially improved buildings exceed the base flood elevation (BFE) to provide extra flood risk exposure mitigation. Buildings built to this higher standard usually are eligible for a “preferred risk” flood insurance policy with lower annual premiums. Each NFIP participating local government that allows development in the regulated floodplain require at least 1-foot of freeboard, with Northumberland and Westmoreland counties requiring greater flood protection levels. Each county floodplain management ordinance establishes design criteria requiring elevation and flood resistant construction of utility equipment. Three of the four Northern Neck counties also have higher standard design criteria for coastal high-hazard buildings. None of the communities prohibit manufactured homes in the floodplain, however all ordinances require proper elevation and foundation anchoring.

Local floodplain management programs are supported by the Virginia Department of Conservation and Recreation's National Floodplain Management Program Coordinator and his staff. Technical assistance is provided by in-person Community Assistance Visits (CAVs), check in phone interviews called Community Assistance Contacts (CACs) which consists of a program "check-in" or address specific technical issues or situations. CAVs are performed on a two to three year rotation. All Northern Neck communities are in good standing with the NFIP and the state NFIP Coordinator's office, continuing property owner and renter eligibility for flood insurance purchase and FEMA HMA grant program participation.

6.1.5.7 Chesapeake Bay Protection Regulations

The Chesapeake Bay Preservation Act (Bay Act) was enacted by the Virginia General Assembly in 1988 as a critical element of Virginia's non-point source management program. The Bay Act program is designed to improve water quality in the Chesapeake Bay and other waters of the State by requiring the use of effective land management and land use planning.

Virginia designed the Bay Act to enhance water quality with continued reasonable development. The Bay Act balances state and local economic interests and water quality improvement by creating a unique cooperative partnership between state and Tidewater local governments to reduce and prevent nonpoint source pollution. Local governments retain the primary responsibility for land use decisions, expanding local government authority to manage water quality, and establishing a more specific relationship between water quality protection and local land use decision-making.

The Bay Act Program is the only program in Virginia state government that deals comprehensively with the relationships between water quality, and land use planning and development. It is also the only program that assists local governments with land use planning needs to meet water quality goals: the development of land use regulations, ordinances and comprehensive plans.

Virginia is a signatory to the Chesapeake Bay Agreement, a unique regional partnership aimed at restoration of the Chesapeake Bay. Communities in certain parts of the state are required to implement local land use controls to minimize runoff and other adverse impacts to the water quality of the Bay. Each PDC jurisdiction is part of the Tidewater area and therefore required to enforce Bay Act provisions locally. The program's agricultural non-point source pollution reduction efforts have been led by the Northern Neck Soil and Water Conservation District. Prevention of sediment, nutrient and other pollution from land development is directed through erosion and sediment control and stormwater management ordinances. The local Bay Act program has three phases: Phase I program elements include the designation of local Chesapeake Bay Preservation Areas (including Resource Protection Areas and Resource Management Areas that often include floodplains) and adoption of local ordinances that include the required performance criteria. Phase II required local governments to adopt a comprehensive plan or plan element that addresses the protection of water quality through the discussion of a number of policy areas. Phase III requires an assessment during 2017 to review progress toward meeting the nutrient and sediment pollutant load reductions necessary for Bay restoration.

6.1.5.8 Other Ordinances

Northern Neck communities have adopted Erosion and Sediment Control ordinances compliant with Chesapeake Preservation Area Program regulations as well as those of the Department of Environmental Quality. Stormwater management is also managed through the Chesapeake Bay

Preservation Area Program for projects meeting specific criteria. Lancaster County has enacted a dune protection ordinance that authorizes specific uses and requires use and alteration permits.

6.1.5.9 Building Codes and Building Inspection

Mitigation measures which involve elevation or building and infrastructure retrofit are required to be compliant with not only local floodplain management standards but flood risk reduction design standards outlined in building codes.

Northern Neck jurisdictions have adopted the Uniform Virginia Building Code. While municipalities and counties may adopt codes for their respective areas if approved by the state as providing "adequate minimum standards," none of the participating jurisdictions have chosen to do so.

Local governments in the Commonwealth perform building inspections. The state empowers cities and counties to create an inspection department, and enumerates their duties and responsibilities, which include enforcing state and local laws relating to the construction of buildings; installation of plumbing, electrical, and heating systems; building maintenance; and other matters. Northern Neck counties and the Town of Colonial Beach have appointed a specific individual or established an office to carry out building inspections. Westmoreland County has adopted a minimal building maintenance ordinance. Enforcement is focused on vacant unoccupied buildings. Table 6-6 summarizes the various ordinances that are in effect in the jurisdictions in the study area.

Table 6-6. Availability of Ordinances and their Support for Hazard Mitigation

Ordinance Type	Lancaster	Northumberland	Richmond	Westmoreland
Building Code	Yes	Yes	Yes	Yes
Floodplain Management	Yes	Yes	Yes	Yes
Historic Preservation	Yes	Yes	Yes	No*
Subdivision	Yes	Yes	Yes	Yes
Unified Development	Yes	No	No	No
Zoning	Yes	Yes	Yes	Yes

*Consideration to historic properties is integrated through Westmoreland’s zoning ordinance.

6.1.5.10 Fire Codes

Virginia has a statewide fire code. The code establishes statewide standards to safeguard life and property from the hazards of fire or explosion arising from the improper maintenance of life safety, and fire prevention and protection of materials, devices, systems, and structures. The Virginia State Fire Marshal’s Office is charged with enforcement of the code statewide except in those localities that choose to enforce the code locally. Localities that choose to enforce the code locally must employ their own certified fire official.

6.1.5.11 Taxation

The power to levy taxes and special assessments is an important tool delegated to local governments by Virginia's law. The power of taxation extends beyond merely the collection of revenue, and can have a profound impact on the pattern of development in the community. Communities have the power to set preferential tax rates for areas which are more suitable for development in order to discourage development in otherwise hazardous areas. Local units of government also have the authority to levy special assessments on property owners for all or part of the costs of acquiring, constructing, reconstructing, extending or otherwise building or improving flood protection works within a designated area. This can serve to increase the cost of building in such areas, thereby discouraging development.

Because the usual methods of apportionment seem mechanical and arbitrary, and because the tax burden on a particular piece of property is often quite large, the major constraint in using special assessments is political. Special assessments seem to offer little in terms of control over land use in developing areas. They can, however, be used to finance the provision of necessary services within municipal or county boundaries. In addition, they are useful in distributing the costs of the infrastructure required by new development to the new property owners.

Localities in Virginia collect a one-percent sales tax. In addition, all of the counties in the Northern Neck levy property taxes.

6.1.5.12 Spending

The fourth major power that has been delegated from the Virginia General Assembly to local governments is the power to make expenditures in the public interest. Hazard mitigation principles can be made a routine element of all spending decisions made by local governments, including during adoption of annual budgets and the Capital Improvement Plan (CIP) for protection of critical facilities.

A CIP is a schedule for provision of town or county services over a specified period of time. By tentatively committing itself to a timetable for the provision of capital to extend services, a community can control growth in areas where the provision of on-site sewage disposal and water supply are unusually expensive.

In addition to forming a timetable for provision of services, a local community can regulate the extension of and access to services. A CIP that is coordinated with extension and access policies can provide a significant degree of control over the location and timing of growth. These tools also can influence the cost of growth. If the CIP is effective in directing growth away from environmentally sensitive or high hazard areas, for example, it can reduce environmental costs.

The majority of counties in the Northern Neck have a capital improvements program. The construction or renovation of capital facilities, such as schools, municipal offices, and police/fire stations are often highlighted in capital improvements programs. Investments in water treatment, wastewater treatment, drainage improvements and critical facility hardening are priority mitigation improvements which can be included in a capital improvements program.

6.1.6 Other Relevant Plans and Studies

Northern Neck citizens, local and regional government officials, elected officials and non-governmental organizations have seen increased vulnerability along the region's coasts. Several relevant studies have supported an evolving understanding of coastal shoreline processes.

A series of county coastal erosion evaluations was performed by the Virginia Institute of Marine Sciences at the College of William and Mary. These were used to inform the Section 4.0 Hazard Identification and Risk Assessment coastal hazard analysis and are referenced in Appendix B.

6.1.6.1 Changing Flood Risk

The *North Atlantic Coast Comprehensive Study* was conducted by the U.S. Army Corps of Engineers. The results of the study were published in a report detailing the two year study to address coastal storm and flood risk to vulnerable populations, property, ecosystems, and infrastructure affected by Hurricane Sandy in the United States' North Atlantic region. This study is designed to help communities better understand how flood risk is changing as a result of climate change and to provide tools to help communities better prepare for future flood risk. The study builds on lessons learned from Hurricane Sandy and attempts to bring to bear the latest scientific information available for state, local, and tribal planners. The Northern Neck communities are a part of the study area and the results of the study should be consulted when developing climate change adaptation measures based on future flood risk.

The *Costs of Doing Nothing: A Sea Level Rise Synopsis for the Hampton Roads Region* study (November 2016) was conducted by the Research Triangle Institute and estimated the annualized economic impacts of future sea level rise for the Hampton Roads region. The results show a negative impact on local economies that will increase as sea levels rise. While the study only extended to the south shore of the Rappahannock River, information and holistic messaging can be interpreted even conservatively to a conclusion that sea level rise will significantly impact the Northern Neck, especially eastern areas of the region, within the next 25 years.

6.1.6.2 Economic and Business Development

The Stronger Economics Together: Strategies for Building New Economic Development Northern Neck Economic Development Plan 2013 – 2018 (SET) was collaboratively prepared with the USDA Regional Rural Development Center and local governments to strengthen local community capacity to work together to create a blueprint to capture clusters of emerging economic advantages. The effort served as a catalyst for regional thinking and included SET training for participating communities. Hazard mitigation principles can be interwoven into the SET plan's four goal and opportunity centers, especially as the SET plan enters its fifth year with the availability of the updated hazard mitigation plan:

1) Infrastructure to facilitate expansion of existing businesses and attraction of new, higher wage jobs;
2) Workforce preparedness to succeed in a technology-based economy;
3) Creation of a business-friendly atmosphere for the region; and
4) Effective and sustainable use of the regional's natural beauty.

Several towns have developed business revitalization plans during 2017, in addition to a plan developed by the Town of Colonial Beach in 2012. While these plans do not directly address hazard mitigation, the Northern Neck has suffered continued, localized flood and wind events during 2017, providing an opportunity to work with small business to promote emergency and storm preparedness and resilience to reduce losses. The following plans were developed:

- Callao Business District Revitalization Plan
- Warsaw Business District Revitalization Plan
- White Stone Business District Revitalization Plan

- Town of Colonial Beach Business District Revitalization Plan (2012)

6.1.6.3 Coastline Protection

Since throughout the Northern Neck and coastal plain, homes and businesses are experiencing increased erosion from winds, waves, currents, tides and recreational activities making homes and businesses more vulnerable, the region has embarked on a “living shorelines” initiative. This is informed, in part, due to continued research that has demonstrated the harm to the immediate shoreline and bathymetric processes which occur from of lot-specific shoreline hardening like riprap, sea walls and groins. *Living Shorelines* is a shoreline management system designed to protect or restore the natural shoreline ecosystem from powerful storms, accelerated sea level rise, and landward erosion through the use of natural elements, sometimes combining them with structural components if necessary.

There are two categories for living shorelines: Nonstructural and Combined structural/non-structural. Each uses vegetation to protect the shoreline from erosion, flooding, and storm surges. The type of living shoreline application depends on the amount of erosion, wave energy, and size. Depending on the scope of the living shoreline, landowners can apply for a free *Living Shoreline Group 1 General Permit* through the Virginia Marine Resources Commission and local Wetlands Board. Program partners include:

- Friends of the Rappahannock
- Science Education at Sea (SEAS) Program
- Virginia Marine Resources Commission
- Local Wetlands Boards
- Northern Neck Master Gardeners
- NNKgreen
- The Wetlands Project
- Virginia Institute of Marine Science

6.2 Implementation

Upon adoption, the plan faces the biggest test: implementation. While the 2017 plan update outlines many aspirational "High" priority recommendations, the decision of which actions to address first will be a continued implementation challenge.

Each participating jurisdiction is responsible for integrating its mitigation actions into various planning documents, processes and budgets pursuant to locally-administered governing policies and procedures. Each action is assigned a responsible department or departments that will work together to implement designated actions.

Funding is always an important and critical issue when it comes to implementing mitigation actions. While several Northern Neck counties have been active in pursuing and implementing mitigation projects funded by FEMA/VDEM Hazard Mitigation Assistance programs, low or no-cost high-priority strategies broaden the region's approach to mitigation and long-term resilience. The Planning District Commission and its local governments will still pursue grant funding to implement more challenging actions. While resources remain limited, some counties in the Northern Neck have received funding to elevate homes. An example of a low-cost, high-priority recommendation would be to install flood level markers on bridges to warn motorists, pedestrians and cyclists of high water levels or to expand green shores programs to stabilize eroding shorelines.

In the past five years, four mitigation projects within the Northern Neck have been funded through FEMA hazard mitigation grants:

- DR-1905 in Northumberland County to raise the elevation of one of their residential properties;
- DR-4042 in Lancaster County to raise the elevation of five of their residential properties;
- FMA-2014 in Northumberland County to raise the elevation of one of their severe repetitive loss properties; and
- FMA-2016 in Richmond and Northumberland to raise the elevation of one repetitive loss property and one severe repetitive loss property, a project that was just approved in early September 2017.

Another implementation approach is to prioritize actions that can be completed in a short amount of time. Being able to publicize a successful project can build momentum to implement other mitigation actions.

It is important to long-term implementation of the plan update that the underlying principles of the hazard mitigation plan update are incorporated into other community plans and mechanisms, such as:

- comprehensive plans
- development ordinances (Zoning Ordinance, Subdivision Ordinance, or Building Code)
- resilience planning
- disaster recovery planning
- economic development plans
- natural resource protection and shoreline protection plans, and
- Capital Improvement Program (CIP) budgeting

Section 3.0 Community Profile provides insight into the current comprehensive plans for each community. Communities should work to ensure that the appropriate information from this plan is incorporated into the next update of their comprehensive plan. Information from the hazard identification and risk assessment as well as mitigation goals and strategies can be directly included as a comprehensive plan element. Projects that require large investments, such as at-risk property acquisition or infrastructure hardening are candidates for inclusion in capital improvement plans. Hazard vulnerability analysis can be incorporated into local emergency operations plans, debris management, coastal protection and disaster recovery plans. Floodplain management data and mitigation actions can be used to leverage Community Rating System (CRS) program participation. Mitigation is most successful when it is included within day-to-day functions and priorities of government. Integration is accomplished by a constant effort to network and to identify and highlight multi-objective, benefits to each program, the communities and their constituents. This effort is achieved through constant communication, messaging, monitoring agendas, attending meetings, and sending memos.

Simultaneous to these efforts, it will be important to constantly monitor funding opportunities that can be used to implement high priority, high cost mitigation actions. Funding opportunities that can be monitored include special pre- and post-disaster funds, special district budgeted funds, state or federal ear-marked funds, and grant programs, including those that can serve or support multi-objective applications.

With adoption of the 2017 plan update, the Northern Neck communities commit to:

- Pursuing the implementation of the high-priority, low/no-cost recommended actions.
- Keeping the concept of mitigation in the forefront of community decision-making by identifying and stressing the recommendations of the Hazard Mitigation Plan when other community goals, plans and activities are discussed and decided upon.
- Maintaining a constant monitoring of multi-objective, cost-share opportunities to assist the participating communities in implementing the recommended actions of this plan for which no current regular funding or support exists.
- Incorporate hazard risk information, and priority mitigation actions into appropriate local initiatives and programs through collaborative interaction between all related community departments and staff; and
- Evaluating and assessing regional mitigation plan goal and local jurisdiction action effectiveness to reduce hazard risk exposure.

In addition, the communities of the Northern Neck region remain committed to the NFIP. They will continue to enforce floodplain regulations and undertake other actions to remain in compliance with the program such as continued flood hazard risk evaluation, participation in Community Assistance Visits (CAV's) with the Commonwealth of Virginia NFIP staff, and education and outreach activities directed at flood-prone residents and businesses.

6.3 Maintenance

Plan maintenance requires an ongoing effort to monitor and evaluate the implementation of the plan, and to update the plan as progress, roadblocks, or changing circumstances are recognized. The Executive Director and Northern Neck PDC staff will be responsible for monitoring the plan. The Mitigation Advisory Committee representative from each jurisdiction will make annual updates to the Northern Neck Planning District on progress of their Mitigation Actions. Timing of annual reports can coincide with either the anniversary of the approval date of this plan or another date chosen by the committee in consultation with VDEM, such as the anniversary of a significant event (e.g., Tropical Depression Ernesto). The annual progress reports will be evaluated by the Mitigation Advisory Committee who will determine if corrective actions are needed. Figure 6-1 shows a sample update form.

This monitoring and updating will take place through:

- Annual progress reports from each jurisdiction on Mitigation Action Plan,
- An annual review by the Mitigation Advisory Committee, and
- Annual updates submitted to VDEM and FEMA Region III, unless a disaster or other circumstances (e.g., changing regulations) lead to a revised time frame.

Jurisdiction:		
Updated through:		
Action number:	Status: Not started In progress (percent complete___) Completed for purposes of this plan Ongoing Activities Successes Effectiveness	Notes (e.g., changes in action/funding/responsible department/timeframe):
Action number:	Status: Not started In progress (percent complete___) Completed for purposes of this plan Ongoing Activities Successes Effectiveness	Notes (e.g., changes in action/funding/responsible department/timeframe):

Figure 6-1. Sample Update Form

The Mitigation Advisory Committee will be responsible for setting annual measures of success and a five-year measure of success for each strategy. These indicators can be used to measure the progress and success of implementation of the mitigation plan during the 2021 update process. The Mitigation Advisory Committee can use this information to determine if corrective action needed or if the action should be continued or discontinued. In addition, the Mitigation Advisory Committee should review the composition of the committee annually and add members if needed.

In evaluating the plan, the Mitigation Advisory Committee should assess:

- The goals and objectives addressed in the current plan and any expected conditions
- The nature, magnitude, and/or types of risk present in the region and assess if
- those risks have changed
- The current resources that are required and appropriate for implementing the plan
- Issues with implementation, (ex. technical, political, legal, or coordinating with state and federal agencies)
- The outcome of mitigation strategies, and evaluate their success
- The agencies and partners and their level of participation as originally proposed
- The Mitigation Advisory Committee will determine at the annual meeting, if an update of the plan is needed. At a minimum, the plan will be updated every five years. Factors to consider when determining if an update is necessary include:
- Lessened vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions, and/or,
- Increased vulnerability as a result of new development (and/or annexation).
- New state/federal laws, policies, or programs
- Changes in resource availability

Ongoing public outreach will continue and public participation will be encouraged through available web postings, social media and press releases to local media outlets, primarily weekly community newspapers and radio stations. As with the previous plan, the Local Emergency Planning Committee (serving as the MAC) shall be charged with maintaining public outreach through reporting back to government officials.

Table 6-7. Northern Neck Hazard Mitigation Plan Update Maintenance Schedule

Timeframe	Activity	Leadership
2017	Jurisdictions Adoption	Local jurisdictions; Northern Neck PDC submittal to FEMA
2018	Annual implementation review	MAC/LEPC
2019	Annual implementation review	MAC/LEPC
2020	Annual implementation review; seek FEMA HMA funding for 2022 plan update	MAC/LEPC
2021	Annual implementation review initiate 2022 Plan update process;	MAC/LEPC

Table 6-7. Northern Neck Hazard Mitigation Plan Update Maintenance Schedule

Timeframe	Activity	Leadership
2022	Continue 2022 Plan update process	MAC/LEPC

A major event, such as a Presidentially-declared disaster, may trigger a need to review the plan. If such an event occurs in the Northern Neck, the Mitigation Advisory Committee will coordinate to determine how best to review and update the plan. The updating of the plan will be through written changes and submissions, as the Northern Neck communities and Mitigation Advisory Committee deem appropriate and necessary. Major changes to the plan will be submitted to the state and to FEMA Region III.

Public notice will be given and public participation will be invited, at a minimum, through available web postings and press releases to the local media outlets, primarily newspapers and radio stations. In addition, an annual event will be held to publicize progress on implementing the mitigation plan. This event could be timed to coincide with the anniversary of a significant event or annual awareness event (i.e., Hurricane Preparedness Week). Jurisdictions also should provide annual updates to the governing body to keep them informed about plan implementation.

7.0 Plan Adoption

Four counties and their incorporated towns in eastern Virginia participated in the planning process and will formally adopt this plan by resolution of their governing board. These local governments are the counties of Lancaster, Northumberland, Richmond, and Westmoreland Counties and the Towns of Colonial Beach, Irvington, Kilmarnock, Montross, Warsaw, and White Stone. The plan was completed through leadership of the Mitigation Advisory Committee that was led by the Northern Neck Planning District Commission and the Local Emergency Planning Committee (LEPC). Sample adoption language will be provided to the participating jurisdictions to facilitate the adoption process after FEMA conditionally approved the plan Draft (Appendix F).

The adoption process will take several months, as significant coordination by the Mitigation Advisory Committee with their governing bodies is required to:

1) Place the plan review and adoption on the appropriate meeting agendas in each jurisdiction;
2) Advertise the review process and provide copies in the County Board of Supervisors and Town County members' adoption meeting packets;
3) Facilitate the actual adoption;
4) Collect the adoption resolutions; and
5) Incorporate the adopted resolutions into the final hazard mitigation plan.

The Northern Neck Planning District appreciates the willingness that both Virginia Department of Emergency Management and FEMA Region III demonstrated by reviewing this plan concurrently and providing comments for revision prior to the adoption process. Not having done so would clearly have added more months to the adoption process.

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2016 Northumberland County Comprehensive Plan

2013 Richmond County Comprehensive Plan

2010 Westmoreland County Comprehensive Plan (also referenced draft 2016 plan, adopted May, 2017)

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9.0 Appendices

Appendix A - Meetings and Outreach

Meetings Contents:

The Northern Neck, VA Multi-Jurisdictional HMP Update Kick-off Meeting February 27, 2017 – Presentation

The Northern Neck, VA Multi-Jurisdictional HMP Update Kick-off Meeting February 27, 2017 – Sign-in Sheet

The Northern Neck, VA Multi-Jurisdictional HMP Update HIRA Results Meeting April 5, 2017 – Presentation

The Northern Neck, VA Multi-Jurisdictional HMP Update HIRA Results Meeting April 5, 2017 – Sign-in Sheet

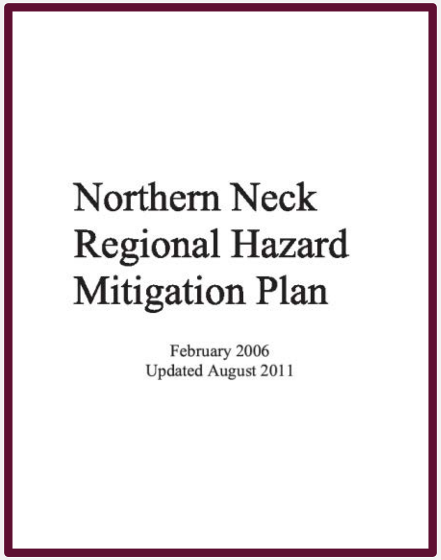
The Northern Neck, VA Multi-Jurisdictional HMP Update Final Meeting May 31, 2017 – Presentation

The Northern Neck, VA Multi-Jurisdictional HMP Update Final Meeting May 31, 2017 – Sign-in Sheet

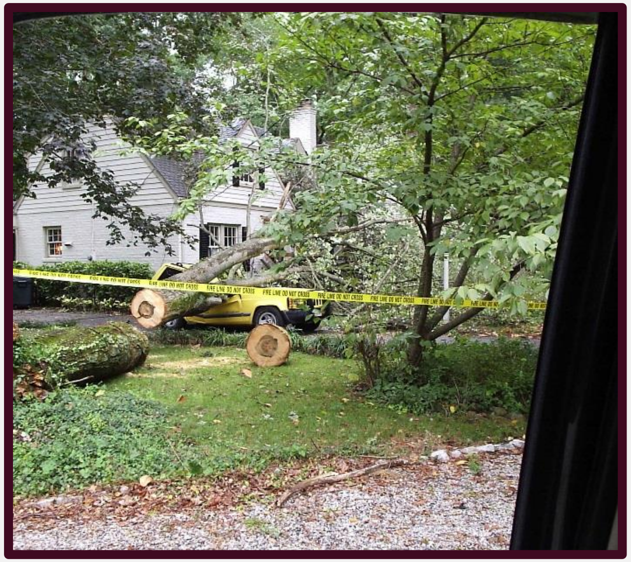
The Northern Neck, VA Multi-Jurisdictional HMP Update Final Meeting May 31, 2017 – Mitigation Strategy, Action & Project Types, and Regional Goals Handout

Outreach Contents:

The Northern Neck Planning District Commission – Hazard Mitigation Planning Update Web-Announcement


Northern Neck
Regional Hazard
Mitigation Plan

February 2006
Updated August 2011



Northern Neck Multi-Jurisdictional Hazard Mitigation Plan Update

Kick-off Meeting

February 27, 2017

Agenda

1. Welcome & Introductions
2. Schedule and Plan Update Process
3. Hazard Prioritization
4. Data Needs
5. Committee Member Responsibilities
6. HMP Update Aspirations
7. Next Steps
8. Wrap Up & Future Meetings

Introductions

- **Name**
- **Jurisdiction/Department/Role**

Hazard Mitigation Plan Update

Project Scope:

Update the *Northern Neck Regional Hazard Mitigation Plan 2011 Update* to remain compliant with Virginia Department of Emergency Management and FEMA requirements

LEPC, Northern Neck PDC, VDEM and Dewberry roles

Committee members need to: ensure that this is your plan through Local Emergency Planning Committee (LEPC) which serves as this project's "Mitigation Advisory Committee (MAC) through your engagement with the Northern Neck PDC, VDEM and Dewberry

- Critical facilities update to Dewberry
- Capacity assessment survey and 2011 mitigation actions update to Dewberry
- 2017 new mitigation actions (in-person meetings/calls)
- Support draft review and outreach
- Participate & make the final decisions

Northern Neck PDC Project Role:

- Organize dates and host LEPC meetings
- Coordinate Public Outreach and participation (social media emphasis)
- Facilitate communication and project scheduling/reporting with Virginia Department of Emergency Management and Dewberry

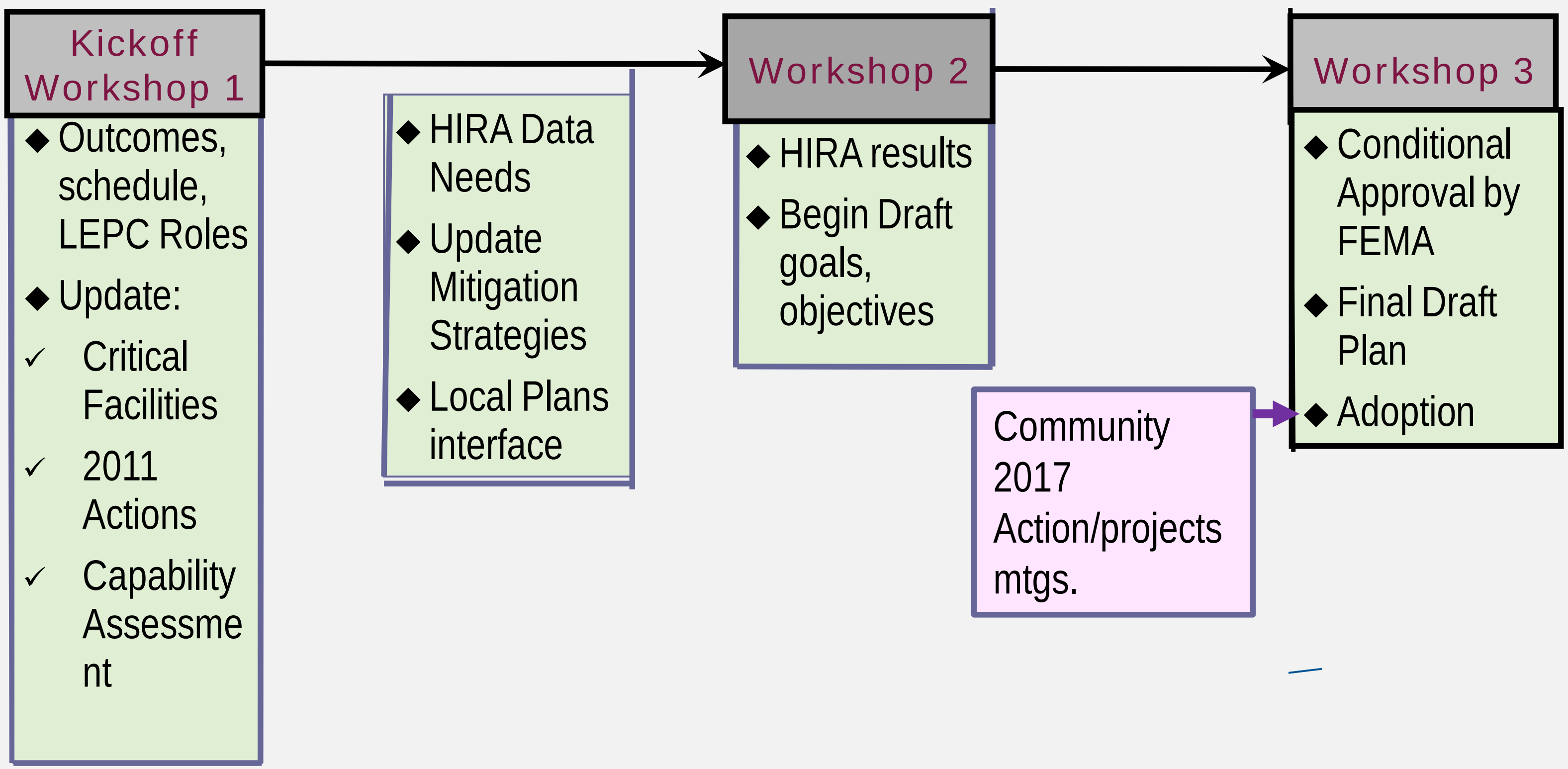
LEPC and Dewberry

Dewberry is here to:

- Lend technical expertise and consultation
- Partner with NNPDC and local government staff to update all required sections of the plan
- Prepare and check the plan against FEMA mitigation plan update requirements.
- Draft and final plan sections

We will do the heavy lifting to assure you receive a compliant, relatable plan that positions your region to become more resilient.

Project Approach: Planning Process



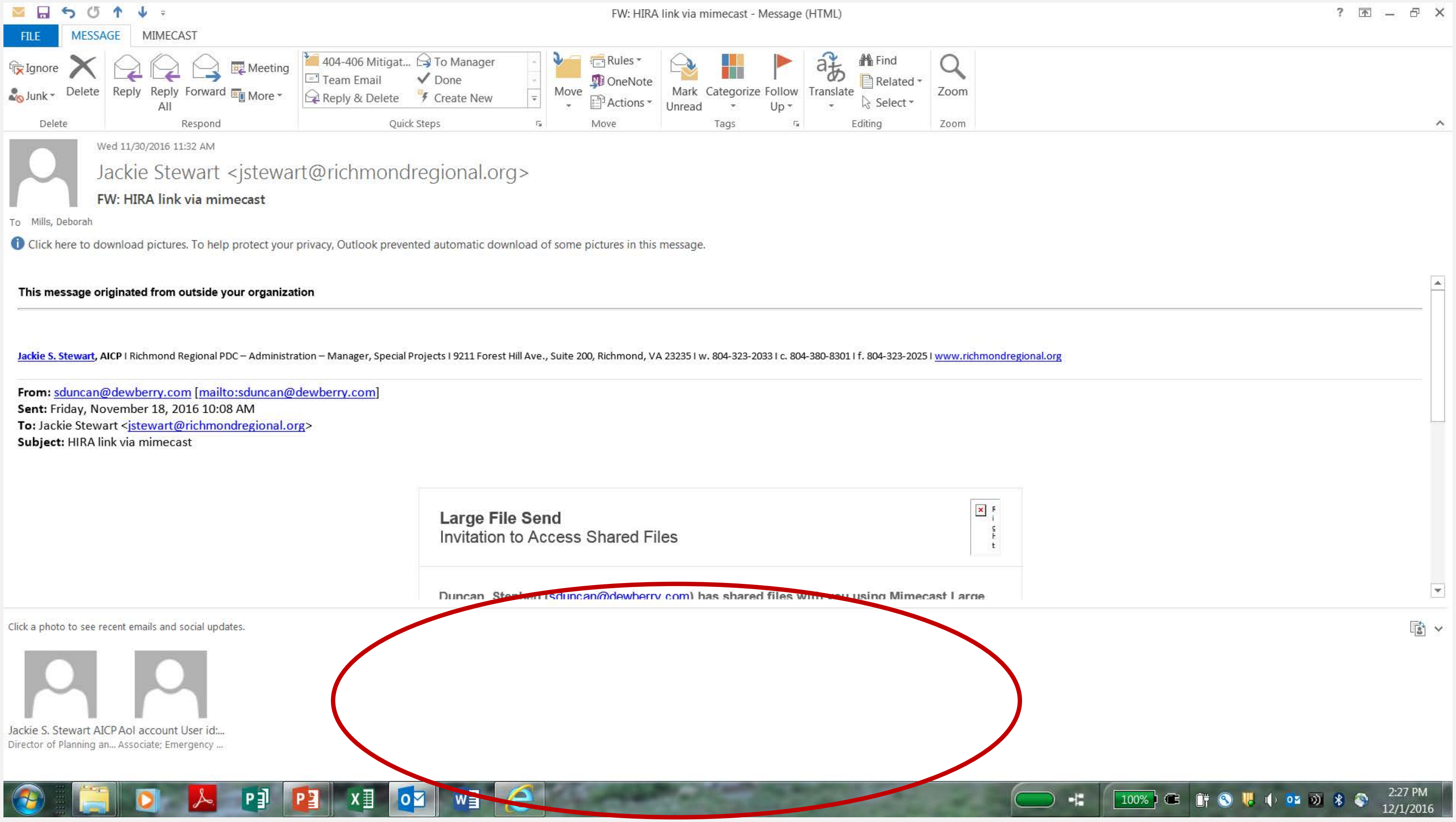
Schedule

Task	Feb	Mar	April	May	June	Jul
Kick-off Meeting	1					
HIRA Update/Development						
Capability Assessment			2			
Draft Plan/ Mitigation Strategies						
Final Meeting & Implementation Kick-off				3		
VDEM/FEMA Review			✪	✪		
Plan Submittal/Adoption Support/Close Out						

1 – 3 **LEPC** Workshops – HIRA Results/Mitigation workshop

✪ Draft Plan review submittal and meeting with VDEM if needed

Mime Cast Large File Submittal



Why does hazard mitigation matter?

Hazard Mitigation

…is a sustainable action that will reduce or eliminate injury to citizens, damages to structures and allow continuity of critical society functions…

Resiliency Definition

…capacity to maintain/regain functionality &vitality from natural, climate-induced, or man-made stressors and disturbances. Resiliency strategies can provide communities with tools for bouncing back more quickly from extreme weather or other high-impact events.

Resiliency planning provides communities with the ability to adapt and thrive despite changing environmental, social, and economic conditions.

BREAK - Hazard Rankings

Hazard Type	2011 HMP Planning Consideration Level		2017 Northern Neck Regional Hazard Mitigation Plan Update LEPC Kick-off Meeting
Natural			
Hurricane	Significant		
Flooding (river, stream, coast)	Moderate		
Winter Storm	Moderate		
Coastal Erosion	Moderate		
Drought	Limited		
Coastal Storm (Nor'easter)	Limited		
Tornado	Limited		
Wildfire	Limited		
Earthquake	None		

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Hazard Identification, Risk Assessement and Vulnerabilty Analysis Update

- **What natural hazard events have occurred since 2010?**
- **What specific vulnerabilities exist in the Counties and Towns which may not have been captured in the previous plan?**
- **Please provide any updates to areas of concern noted in HIRA narrative.**

Critical Facilities

- Critical facilities include public safety, buildings used for sheltering, schools, health care (hospitals and long-term care), correctional facilities, utilities and other vital to community continuity of services after a disaster.
- Other “critical facilities” of concern can be added to this list – transportation, drainage, shelters, etc.
- Existing list will be emailed next week. Please review and provide deletions/modifications/additions by March 14, 2017.

Capability Assessment

- Increased emphasis on melding the mitigation plan with other local and regional planning and program initiatives
- Update information provided in tables and text in Hazard Identification, Risk Assessment and Vulnerability (HIRA) Chapter
- Develop a master table for summary program/plan initiative data customized to 2010 HMP actions included in the Appendix.
- We will reach out to you with specifics for your locality and departments in early March.
- Target completion late-March.
- Many programs or functions are performed for towns by counties – example: building inspections.

Mitigation Actions Status

- ID completed, deleted, or deferred actions or activities from the 2010 plan as a benchmark for progress.
- Existing list will be distributed by early March.
- Please review and provide deletions/modifications/additions by March 24, 2017 to Jillian Browning jbrowning@dewberry.com copied to Deborah Mills at dmills@dewberry.com.
- We will call you to follow-up over the phone.

Public Involvement in Plan Update

- **Document how the community was kept involved during the plan maintenance process over the previous five years.**
  - **What has been done since 2011?**

LEPC Hazard Mitigation Plan Update Aspirations

- What keeps you up at night?
- What do you like about current plan?
- To enable cross-cutting mitigation themes and actions/projects are the necessary people/departments ready to participate?
- Are there other efforts currently going on in your community that we should be aware of?
- What would some positive outcomes be?
- What information/expertise can you contribute?

What's Next?

- Data gathering for HIRA (VDEM, NNPDC, open data sources)
- Data gathering for Capability Assessment
- Initiation of Public Outreach
- Reporting and updates to 2011 Plan Strategy/Action Accomplishments
- Vulnerability analysis Update and Kick-off for Goals, Objectives and Mitigation actions Workshop (early April)

Questions, Comments, Discussion

Deborah G. Mills, C.F.M.

Associate

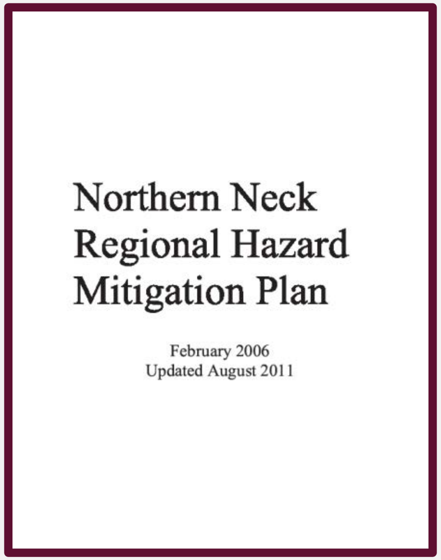
Dewberry

804.823.6971 Desk

804.335.9946 Mobile

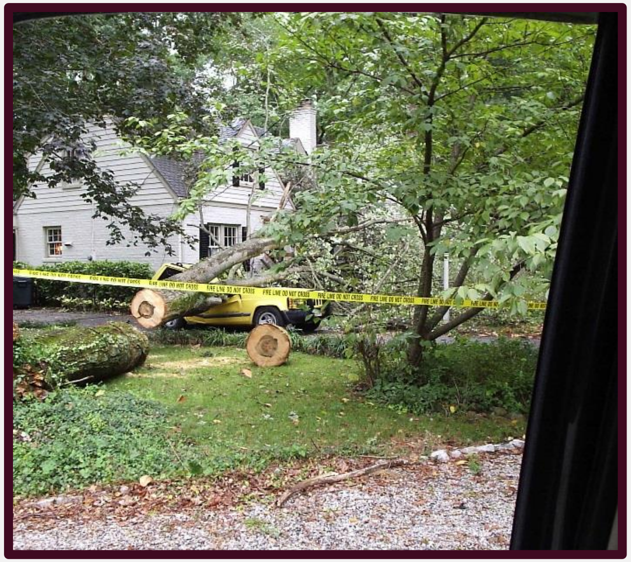
dmills@dewberry.com

Northen Neck PDC Hazard Mitigation Plan Update Kick Off Meeting February 27, 2017 Sign-In Sheet				
Jurisdiction	**Name**	**Position**	**Email**	**Phone**
Colonial Beach, Town	Val Foulds	Town Manager	vfoulds@colonialbeachva.net	804-224-7181/540-848-4517
Town of White Stone	Patrick Frere	Town Manager	frere37@yahoo.com	804-436-4935
Town of Irvington	Bob Hardesty	Town Administrator	info@irvingtonva.org	804-438-6230
County of Lancaster	Terrence McGregor	Chief of Emergency Services	tmcgregor@lancova.com	804-436-3553
County of Lancaster	Frank Pleva	County Administrator	fpleva@lancova.com	804-462-5129
County of Northumberland	Luttrell Tadlock	County Administrator	ltadlock@co.northumberland.va.us	804-580-7666
Lancaster Co.	Wally Beauchamp	Bd. of Supervisors	wbeauchamp@lancova.com	804-436-3605
Northumberland County	Rick McClure	Emergency Services Chief	rmcclure@co.northumberland.va.us	804-580-5221
~~Greg~~ Richmond Co	Greg Baker	Chief	gbaker@co.richmond.va.us	804-761-8485
Richmond Co.	Mitch Paulette	Captain	mpaulette@co.richmond.va.us	804-313-1332
Richmond Co.	Morgan Quicke	County Administrator	rmquicke@co.richmond.va.us	804-333-3415
Westmoreland Co.	Beth McDowell	planner	bmcdowell@westmoreland-county.org	804-493-0120
Westmoreland Co.	Darrin Lee	planner	dlee@westmoreland-county.org	804-493-0120
Westmoreland Co	Jeff Beasley	Emergency Services	jbeasley@westmoreland-county.org	804 456 1777
Westmoreland Co.	David Farmer	Asst chief Emergency Services	dfarmer@westmoreland-county.org	804-456-7925
Westmoreland Cnty	Bill Cease	IT Director	bcease@westmoreland-county.org	804-456-6268
Town of Montross	Patricia Lewis	Town Manager	townofmontross@verizon.net	804-493-9623
Northumberland County	Stuart McKenzie	County Planner	smckenzie@co.northumberland.va.us	804 580-8910
NNPDC	Alex Eguiguren	Technical Assistant	aeguiguren@nnpdc17.state.va.us	804-333-1900
Town of Kilmarnock	Marshall Sebra	Planning/Zoning Administrator	msebra@kilmarnockva.com	804-435-1552 x 32
VDEM	Amy S. Howard	Grant Administrator	amy.howard@vdem.virginia.gov	804-897-9974
VDEM	Tricia Chappell	VDEM Region V	patricia.chappell@vdem.virginia.gov	(804)516-5983
County of Lancaster	Heather Brown	Dep. Coordinator	hbrown@lancova.com	(804) 238-8302



Northern Neck
Regional Hazard
Mitigation Plan

February 2006
Updated August 2011



Northern Neck Multi-Jurisdictional Hazard Mitigation Plan Update

HIRA, Goals and Mitigation Actions Meeting

April 5, 2017 – as modified during

Agenda

1. Welcome
2. Project Schedule
3. Risk Assessment
4. Mitigation Goal Refresh and Strategies
5. PDC, County & Town Mitigation Action Update
6. Outreach Brainstorming
7. Next Steps

Major HIRA Components

Identify and profile hazards affecting the region:

Vulnerability to critical facilities and estimate losses

Vulnerability for current and future land use and development

Plan Update Requirements

- **Hazard Identification and Risk Assessment**
  - Describe all hazards that affect the region; rationale for omitting recognized hazards from analysis
    - Hazard Profiles
    - Location
    - Extent
    - Previous occurrences
    - Probability of future events
  - Vulnerability Assessment
    - Summary of the Counties and Towns vulnerability to each hazard
    - Summary of potential hazard impacts

Schedule

Task	Feb	Mar	April	May	June	Jul
Kick-off Meeting	1					
HIRA Update/Development						
Capability Assessment			2			
Draft Plan/ Mitigation Strategies						
Final Meeting & Implementation Kick-off				3		
VDEM/FEMA Review			✪	✪		
Plan Submittal/Adoption Support/Close Out						

1 – 3 **LEPC** Workshops – HIRA Results/Mitigation workshop

✪ Draft Plan review submittal and meeting with VDEM if needed

2017 Plan Update Changes

New analyses and updates: Updated each hazard profile

- Hazard profile
- NCEI storm events data
- 2010 – present storm/disaster occurrences
- Summary risk by jurisdiction using new data

New maps based on updated data

- HIRA summary that includes overall relative risk comparison by hazard.

Flood Risk

FEMA NFIP Participation Dates

County	Jurisdiction	Init FHBM Identified	Init FIRM Identified	Curr Eff Map Date
Lancaster	Irvington, Town of	10/18/74	8/4/87	10/2/14
	Kilmarnock, Town of	N/A	9/17/10	10/02/14(M)
	Unincorporated County	1/24/75	3/4/88	10/2/14
	White Stone, Town of	8/30/74	9/24/84	10/02/14(M)
Northumberland	Unincorporated County	12/13/74	7/4/89	2/18/15
Richmond	Unincorporated County	4/11/75	3/16/89	4/16/15
Westmoreland	Colonial Beach, Town of	8/9/74	9/18/87	4/16/15
	Unincorporated County	7/18/75	9/18/87	4/16/15

NFIP Policies in Force

County	Jurisdiction	Policies In-Force	Insurance In-Force Whole $	Written Premium In-Force
Lancaster	Irvington, Town of	13	$3,585,900	$27,876
	Kilmarnock, Town of	2	$700,000	$830
	Unincorporated County	589	$164,332,200	$582,511
	White Stone, Town of	3	$721,200	$4,279
Northumberland	Unincorporated County	735	$220,102,400	$536,772
Richmond	Unincorporated County	84	$22,489,400	$82,130
Westmoreland	Colonial Beach, Town of	206	$53,226,100	$141,451
	Unincorporated County	310	$93,020,500	$224,566

NFIP Claims as of 31 Jan 2017

County name	Jurisdiction	Total Losses	Closed Losses	Open Losses	CWOP Losses	Total Payments
Lancaster	Irvington	15	12	0	3	$268,000
	Kilmarnock	N/A	N/A	N/A	N/A	N/A
	Unincorporated	365	294	0	71	$5,660,000
	White Stone	11	5	0	6	$63,800
Northumberland	Unincorporated	391	290	0	101	$6,930,000
Richmond	Unincorporated	84	78	0	6	$1,760,000
Westmoreland	Colonial Beach	81	71	0	10	$3,590,000
	Unincorporated	131	95	0	36	$2,740,000

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

FLOOD HAZARD AREAS IN NORTHERN NECK, VIRGINIA

Flood Zones in Northern Neck

- A - 1% APPROXIMATE FLOOD HAZARD
- AE - 1% DETAILED FLOOD HAZARD
- AO - 1% SHALLOW DETAILED (SLOPING TERRAIN)
- VE - 1% COASTAL DETAILED

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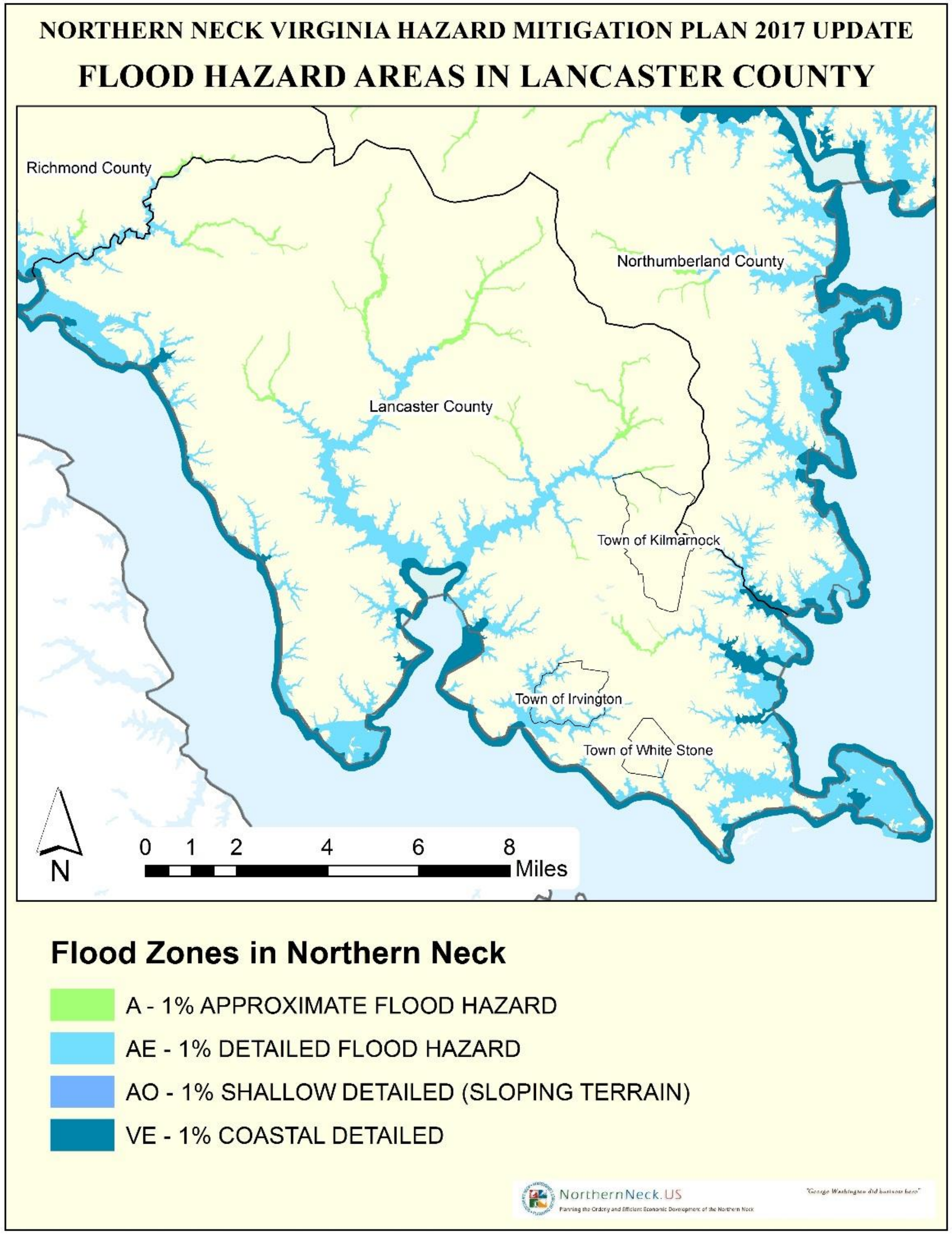

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
FLOOD HAZARD AREAS IN LANCASTER COUNTY
Richmond County
Northumberland County
Lancaster County
Town of Kilmarnock
Town of Irvington
Town of White Stone
N
0 1 2 4 6 8
Miles
Flood Zones in Northern Neck
A - 1% APPROXIMATE FLOOD HAZARD
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AO - 1% SHALLOW DETAILED (SLOPING TERRAIN)
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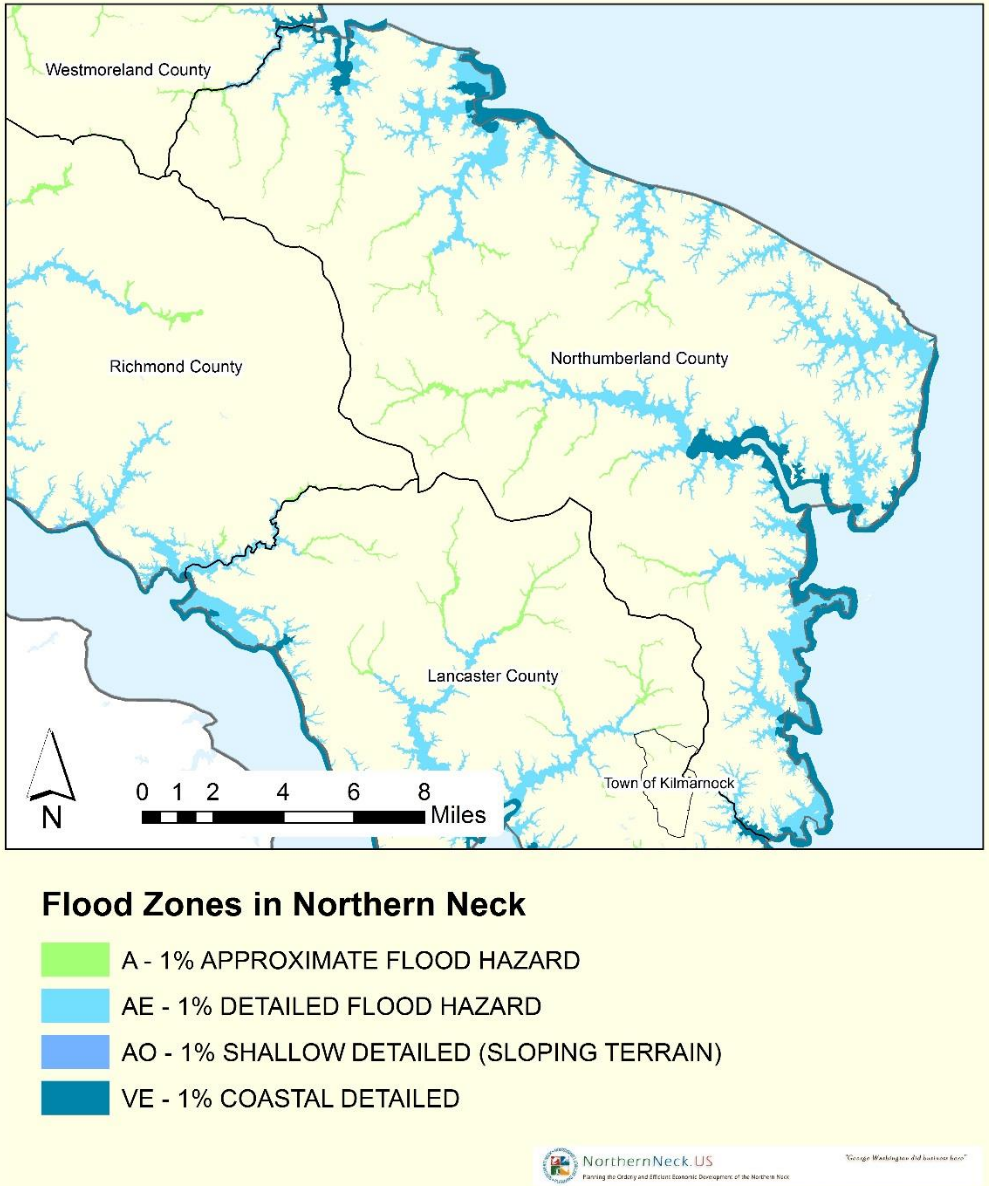
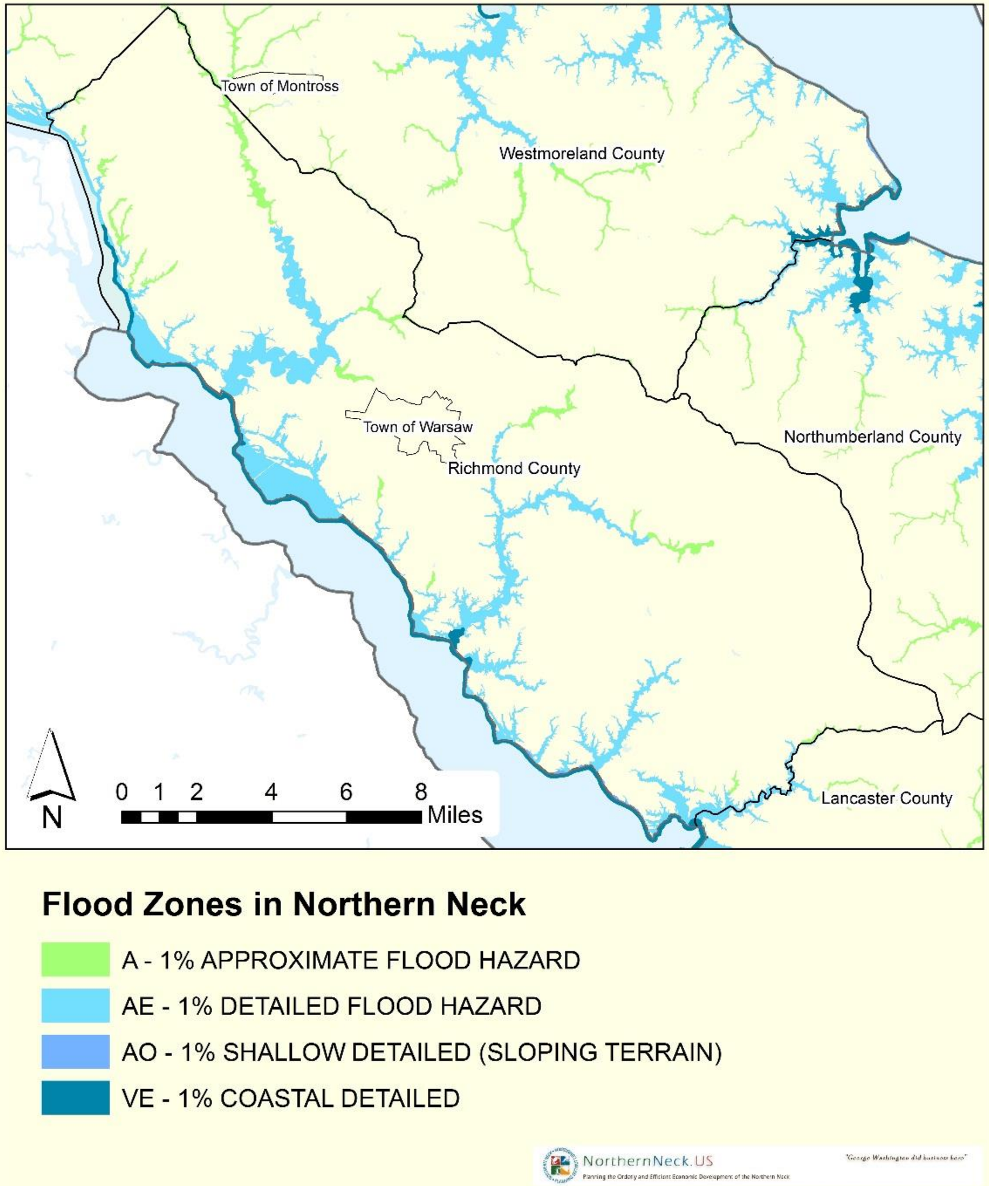
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

FLOOD HAZARD AREAS IN NORTHUMBERLAND COUNTY



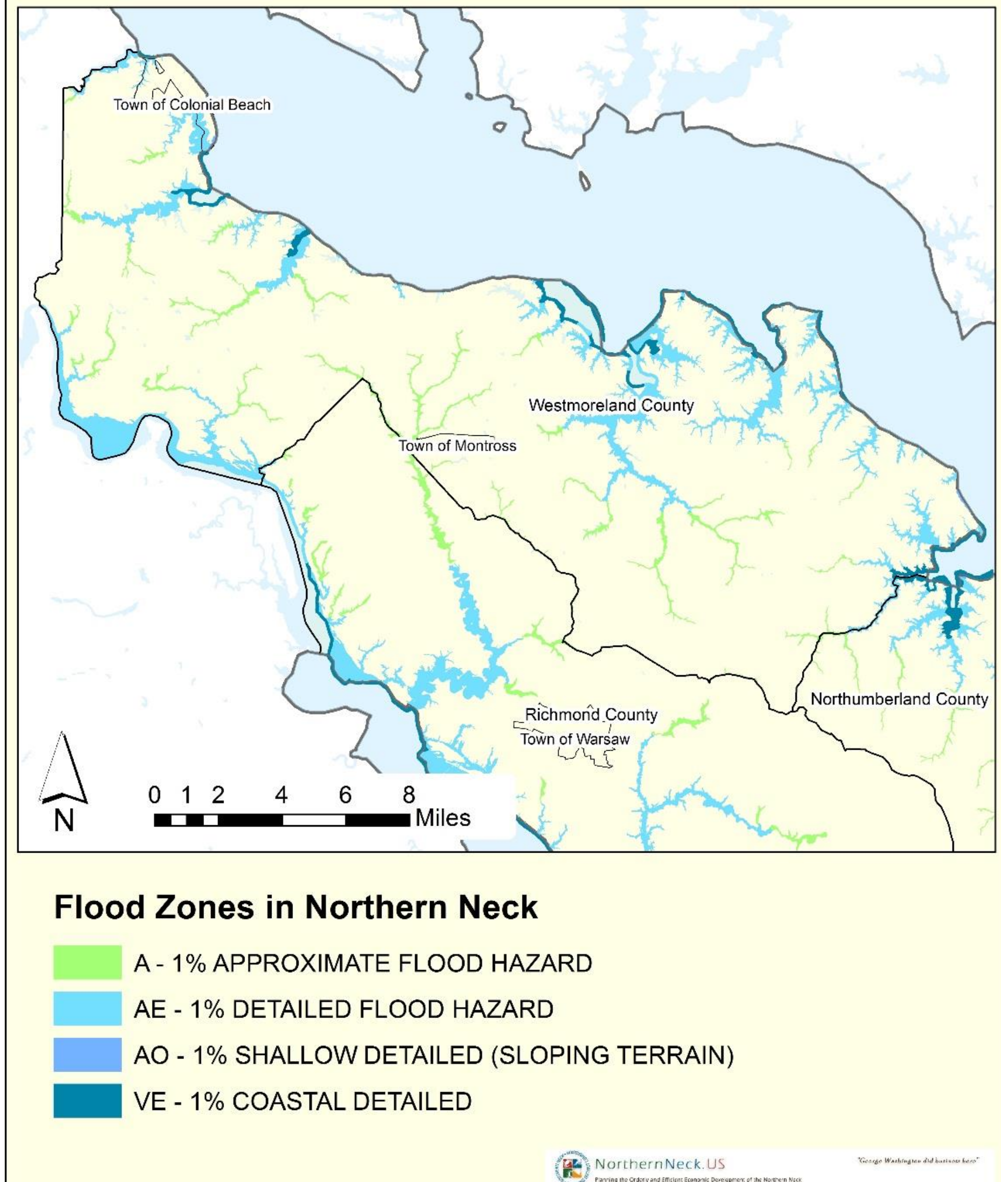
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

FLOOD HAZARD AREAS IN RICHMOND COUNTY



NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

FLOOD HAZARD AREAS IN WESTMORELAND COUNTY



NCEI Flooding Damages

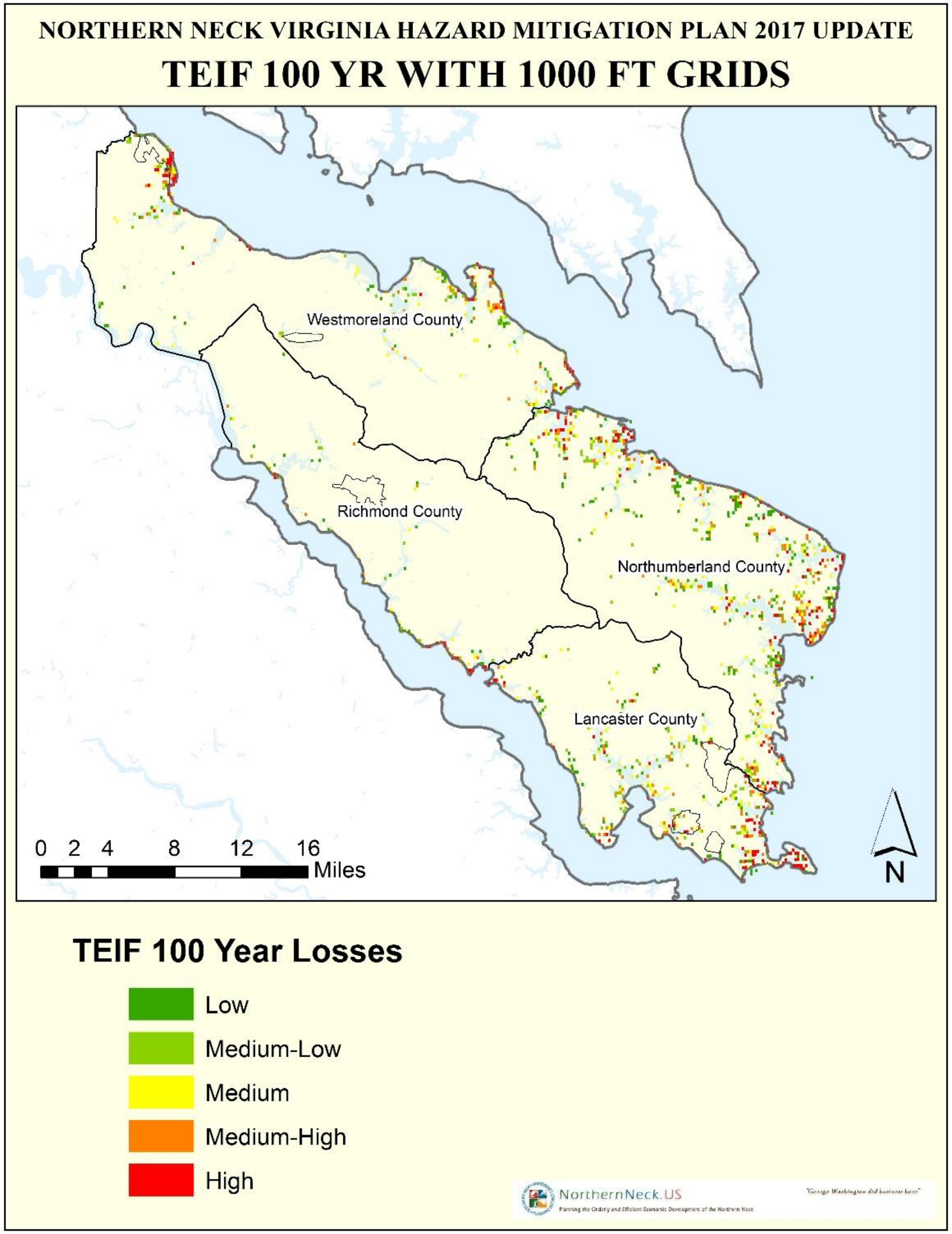
County	Events	Number of Events	Original Paid Damage	Adjusted 2017 Property Damage	Adjusted 2017 Crop Damage	Adjusted 2017 Total Damage
Lancaster	Coastal Flood	9	$1,870,000	$2,010,000	$0	$2,010,000
	Flash Flood	2	$0	$0	$0	$0
	Riverine Flood	3	$0	$0	$0	$0
Northumberland	Coastal Flood	10	$20,400,000	$24,600,000	$0	$24,600,000
	Flash Flood	3	$0	$0	$0	$0
	Riverine Flood	2	$0	$0	$0	$0
Richmond	Coastal Flood	3	$1,800,000	$2,160,000	$0	$2,160,000
	Flash Flood	2	$854,000	$955,000	$292,000	$1,250,000
	Riverine Flood	4	$0	$0	$0	$0
Westmoreland	Coastal Flood	5	$220,000	$251,000	$0	$251,000
	Flash Flood	6	$250,000	$285,000	$80,300	$365,000
	Riverine Flood	2	$0	$0	$0	$0

Total Exposure In Floodplain (TEIF)

- Analysis to estimate the Total Exposure in the Floodplain of the building stock in the NNPDC.
- TEIF performed for Richmond and Westmoreland Counties and Towns using building footprint polygons from the Virginia Geographic Information Network (VGIN).
- Lancaster and Northumberland Counties and Towns analysis used the TEIF method applied at a census block level.

TEIF Exposure by Political Area

County	Jurisdictions	100 Year Exposure	500 Year Exposure
Lancaster	Town of Irvington	$3,610,000	$3,720,000
	Town of Kilmarnock	$531,000	$531,000
	Town of White Stone	$0	$0
	Unincorporated Areas	$127,000,000	$172,000,000
	Total Lancaster County	**$131,000,000**	**$176,000,000**
Northumberland	**Northumberland County**	**$98,800,000**	**$113,000,000**
Richmond	Town of Warsaw	$0	$0
	Unincorporated Areas	$16,000,000	$21,000,000
	Total Richmond County	**$16,000,000**	**$21,000,000**
Westmoreland	Town of Colonial Beach	$42,100,000	$50,400,000
	Town of Montross	$155,000	$155,000
	Unincorporated Areas	$59,000,000	$64,600,000
	Total Westmoreland County	**$101,000,000**	**$115,000,000**
Total	**Northern Neck PDC**	**$348,000,000**	**$425,000,000**


NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
TEIF 100 YR WITH 1000 FT GRIDS
Westmoreland County
Richmond County
Northumberland County
Lancaster County
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Miles
N
TEIF 100 Year Losses
Low
Medium-Low
Medium
Medium-High
High
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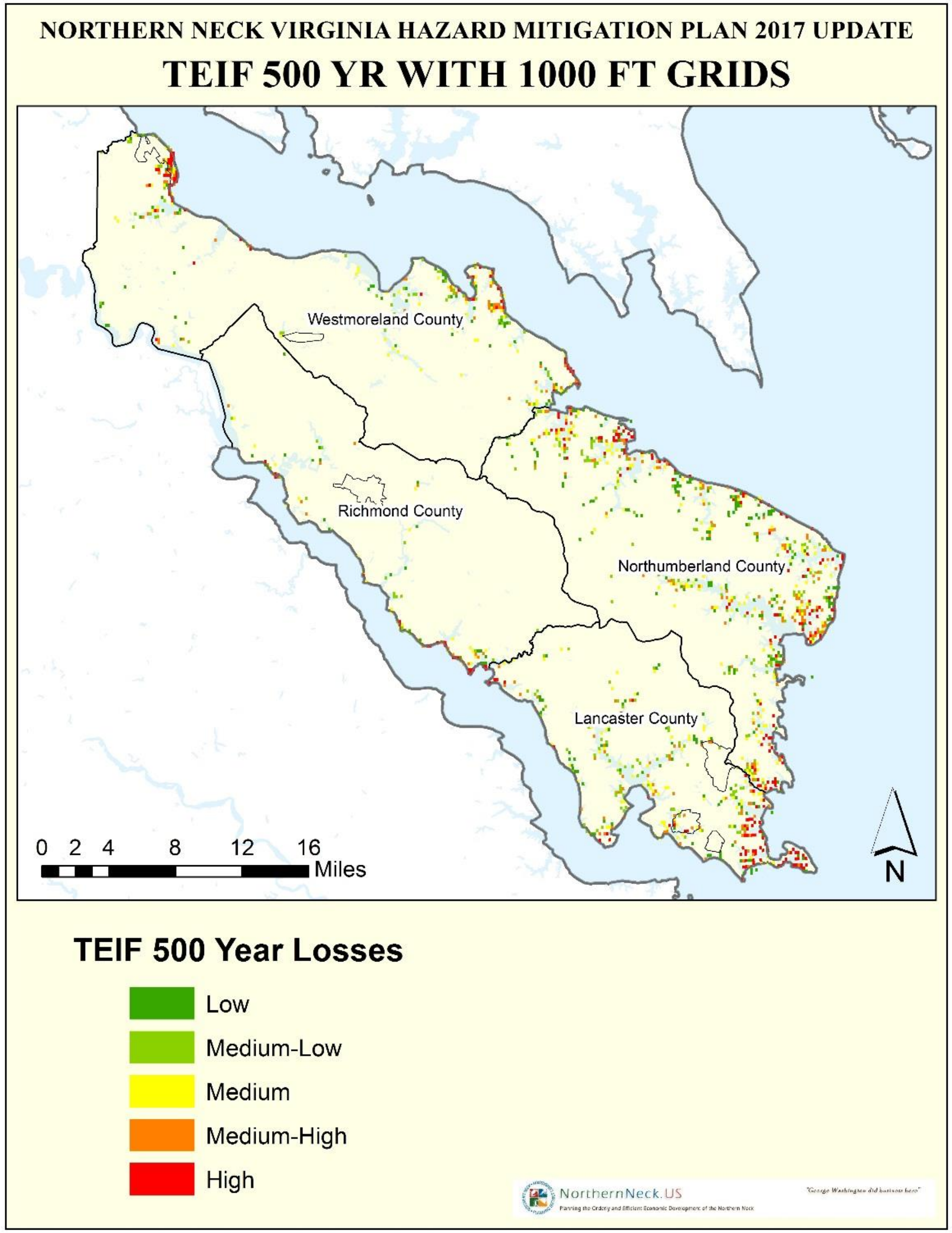
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
TEIF 500 YR WITH 1000 FT GRIDS
Westmoreland County
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Northumberland County
Lancaster County
0 2 4 8 12 16
Miles
N
TEIF 500 Year Losses
Low
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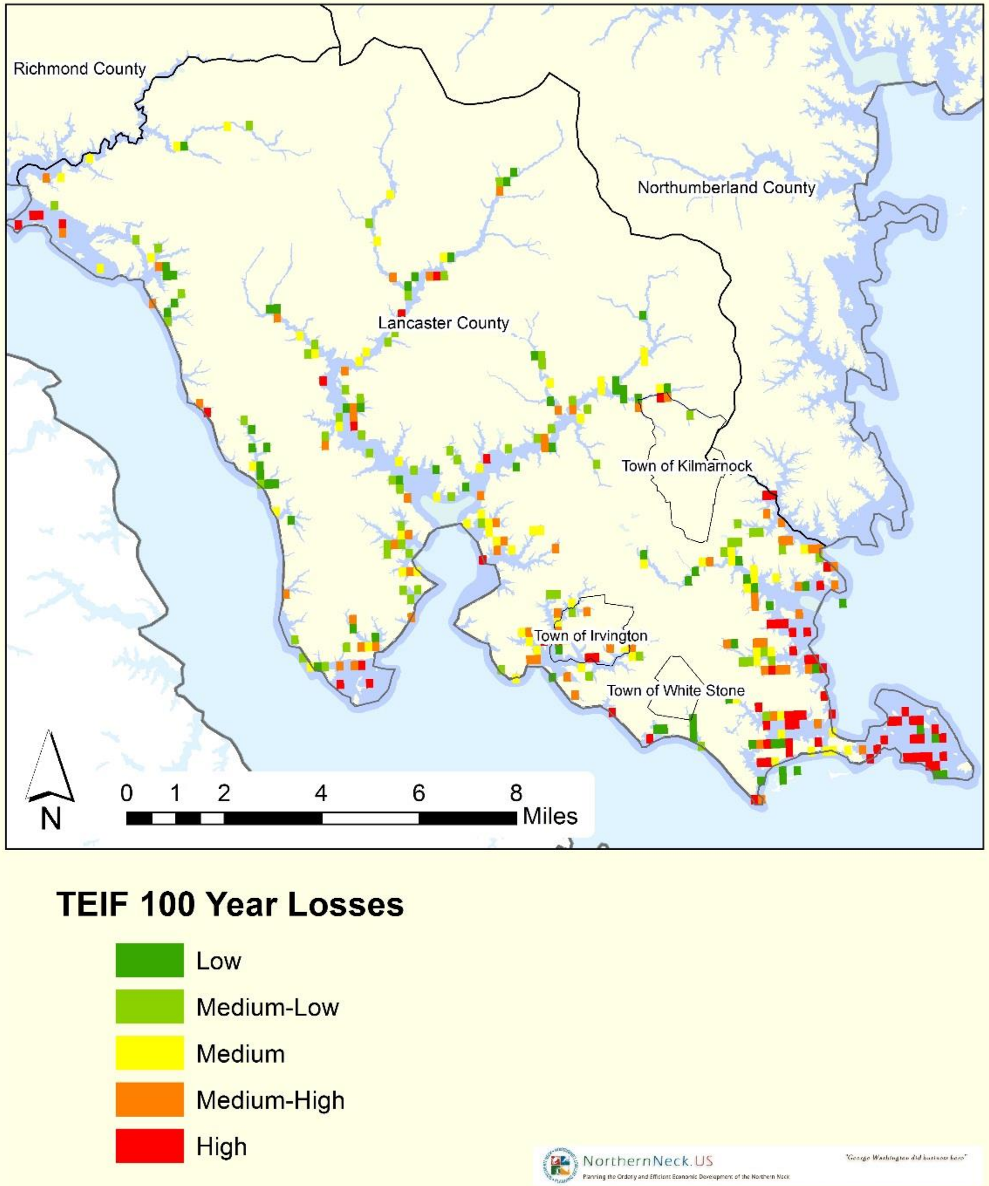
NorthernNeck.US

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 100 YR WITH 1000 FT GRIDS, LANCASTER COUNTY



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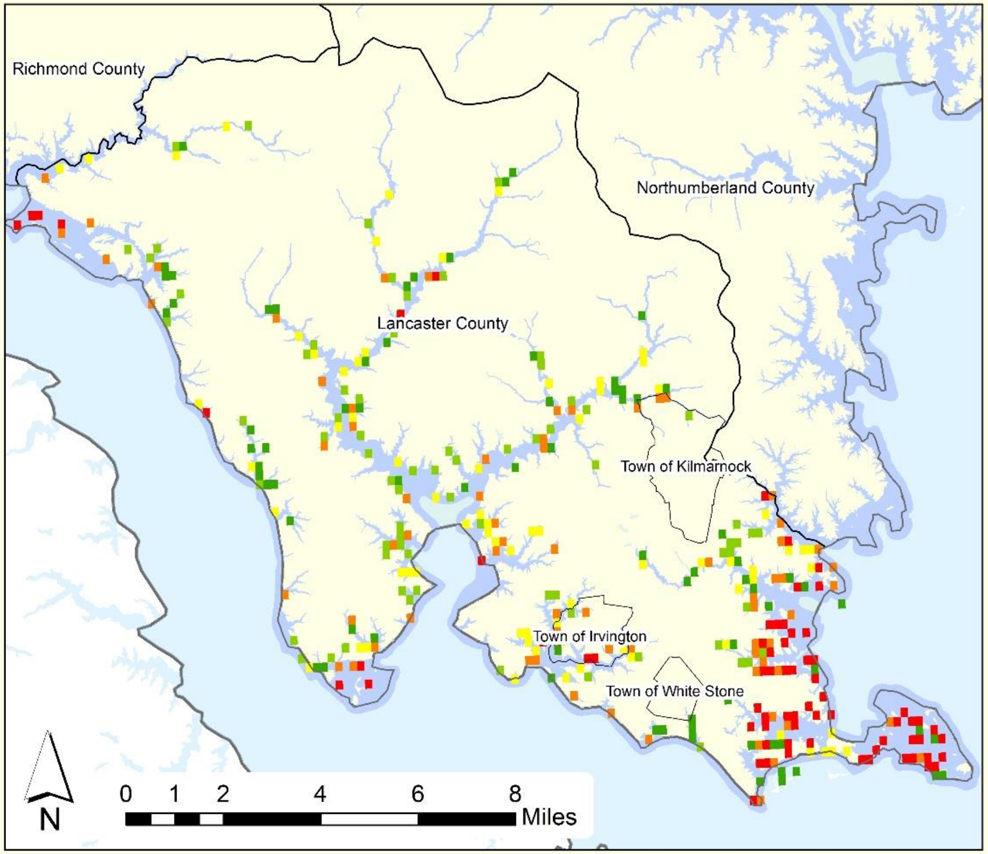
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 500 YR WITH 1000 FT GRIDS, LANCASTER COUNTY



TEIF 500 Year Losses

- Low
- Medium-Low
- Medium
- Medium-High
- High

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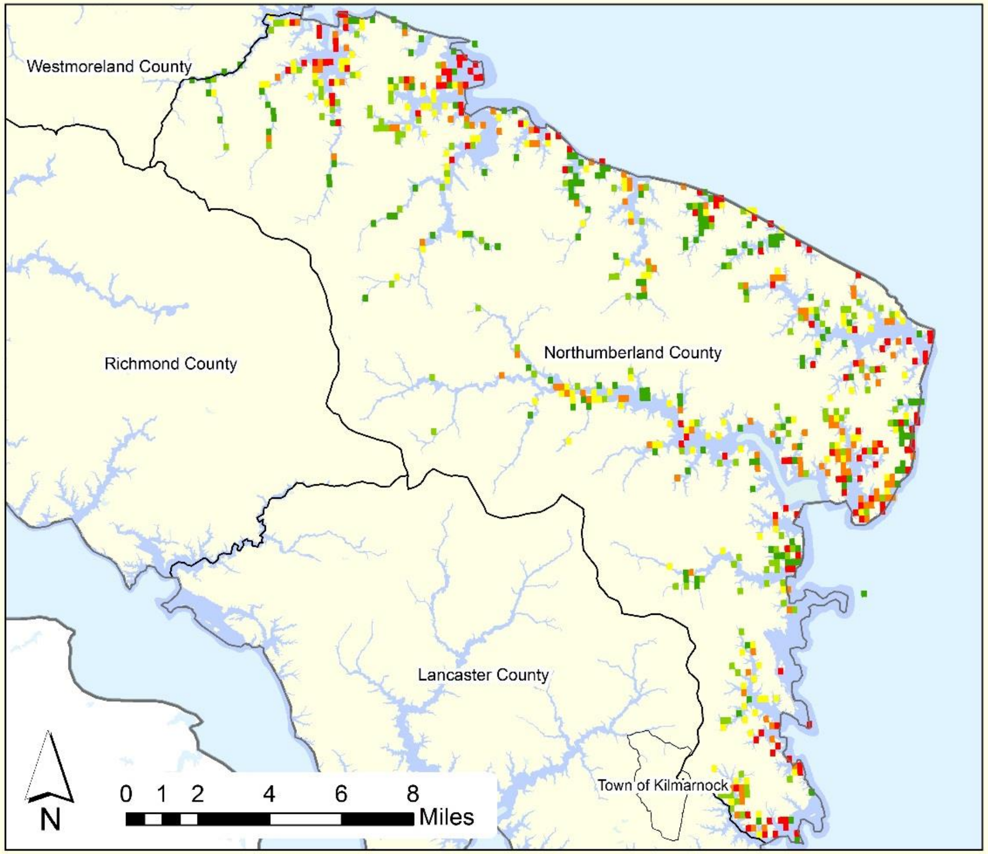
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 100 YR WITH 1000 FT GRIDS, NORTHUMBERLAND COUNTY



TEIF 100 Year Losses

- Low
- Medium-Low
- Medium
- Medium-High
- High

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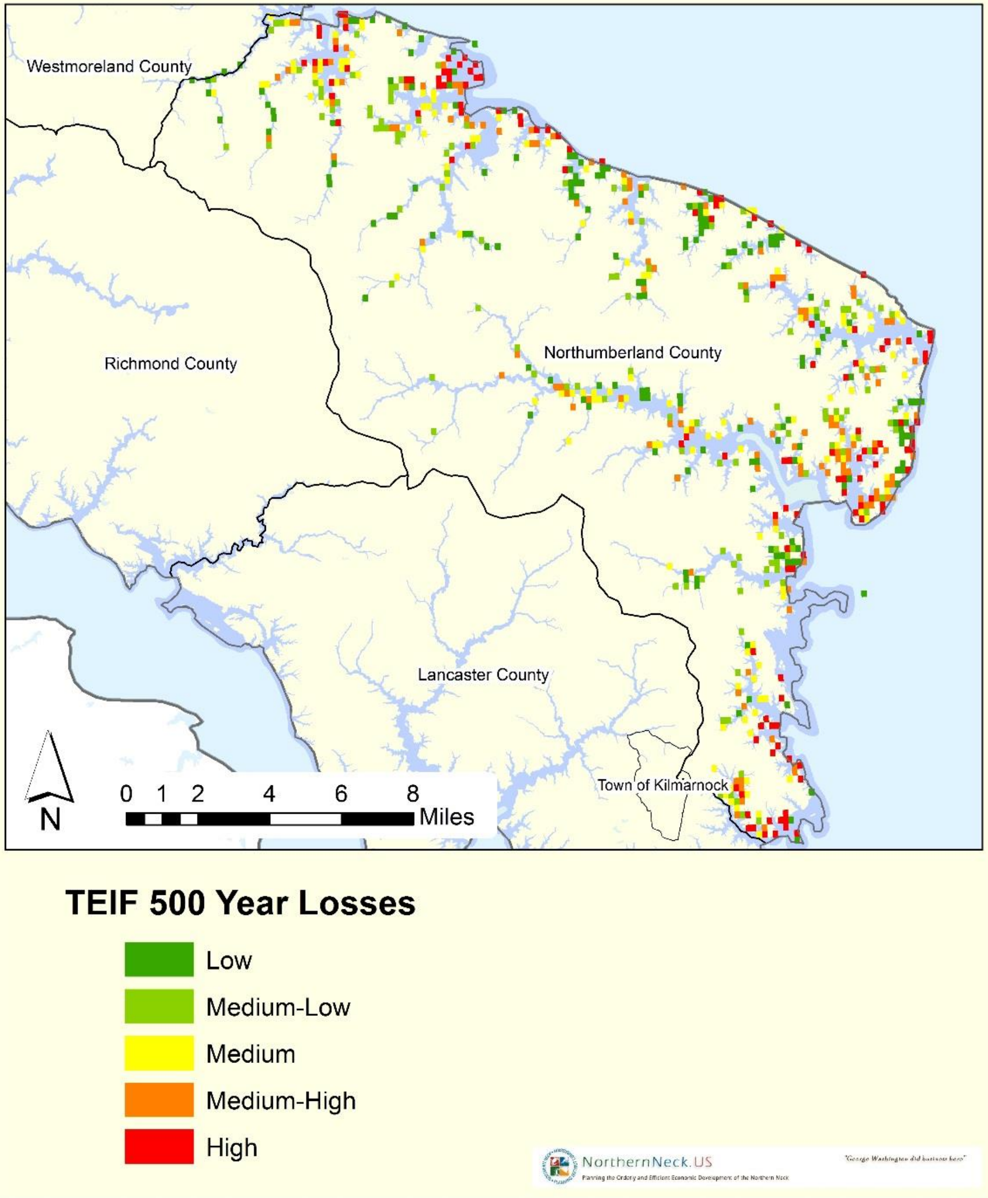
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 500 YR WITH 1000 FT GRIDS, NORTHUMBERLAND COUNTY



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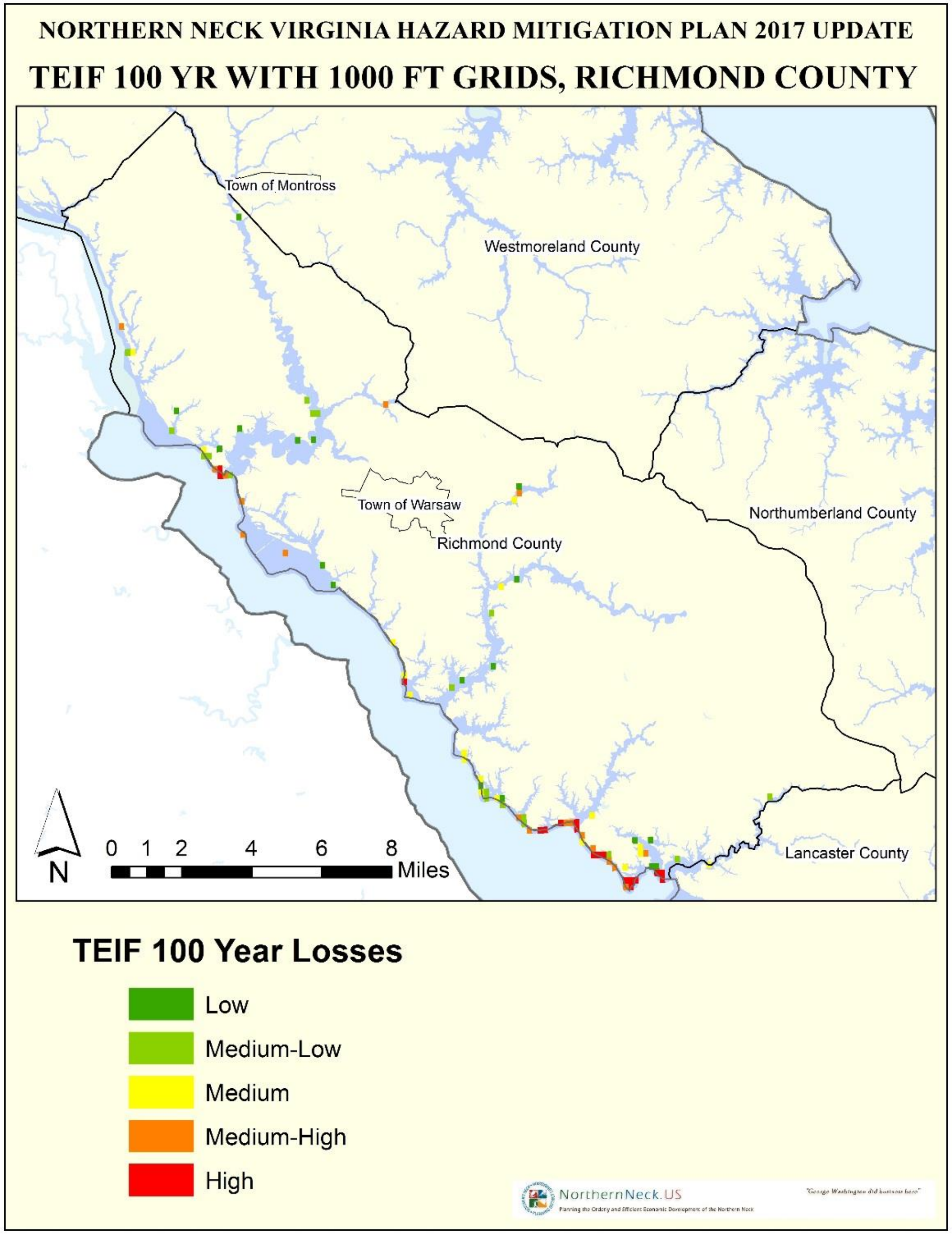

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
TEIF 100 YR WITH 1000 FT GRIDS, RICHMOND COUNTY
Town of Montross
Westmoreland County
Town of Warsaw
Richmond County
Northumberland County
Lancaster County
N
0 1 2 4 6 8
Miles
TEIF 100 Year Losses
Low
Medium-Low
Medium
Medium-High
High
NorthernNeck.US

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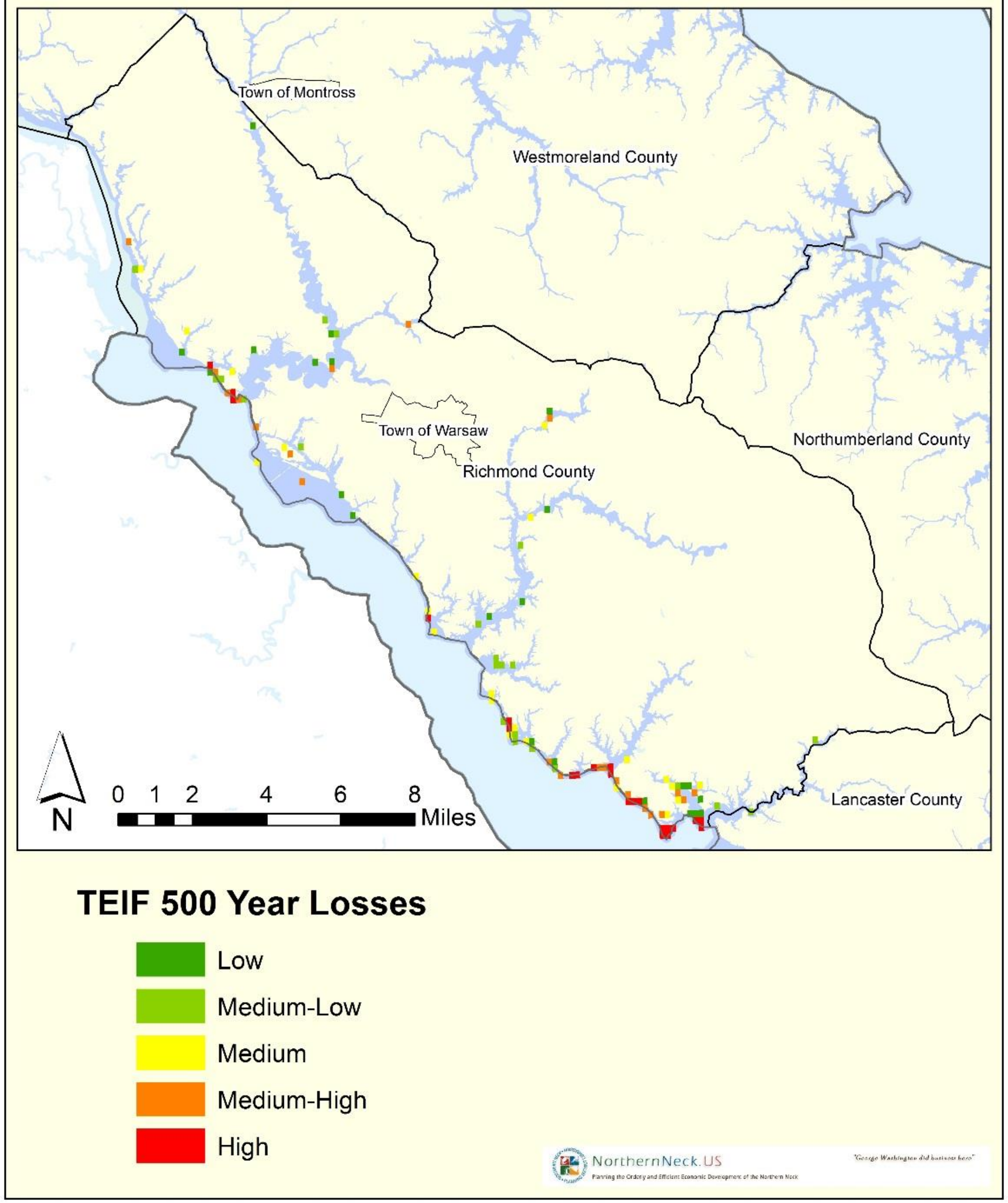
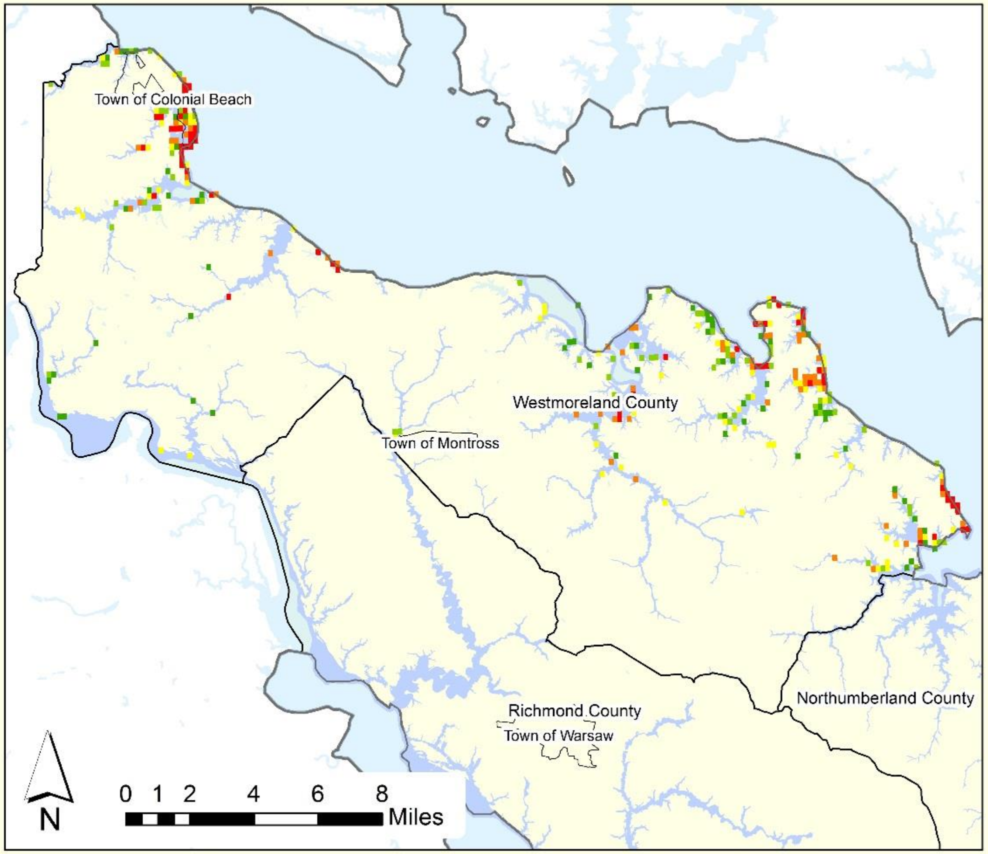
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 500 YR WITH 1000 FT GRIDS, RICHMOND COUNTY



NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 100 YR WITH 1000 FT GRIDS, WESTMORELAND COUNTY



TEIF 100 Year Losses

- Low
- Medium-Low
- Medium
- Medium-High
- High

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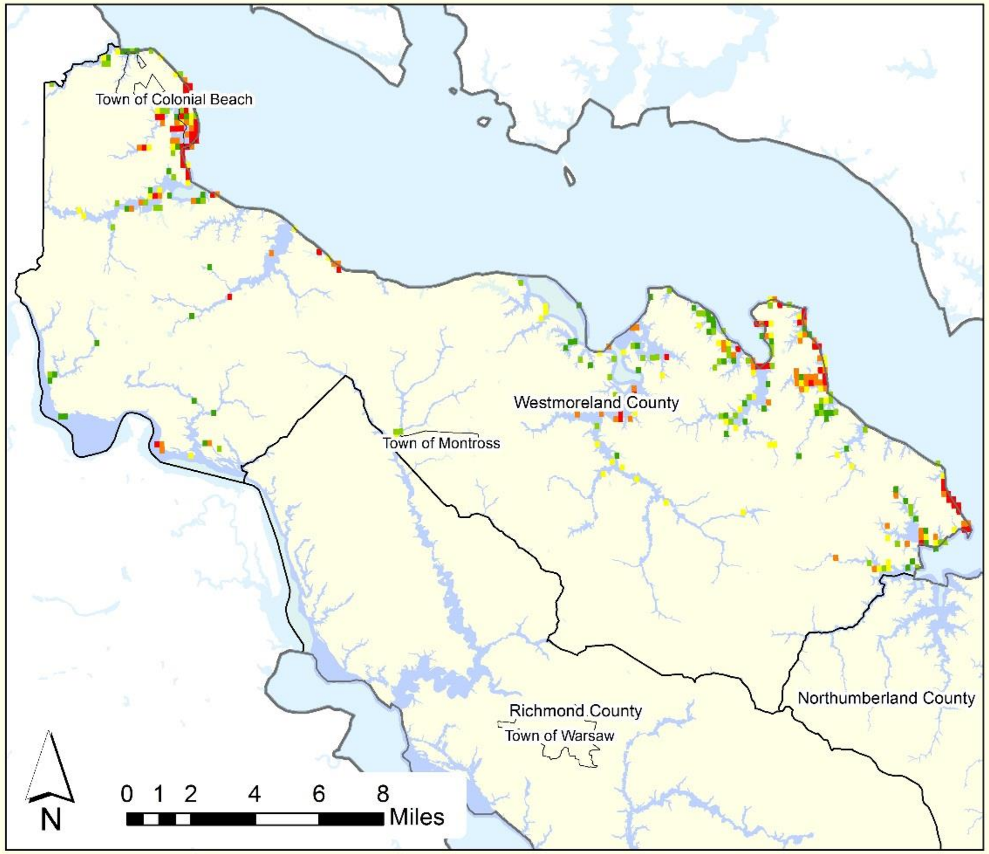
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 500 YR WITH 1000 FT GRIDS, WESTMORELAND COUNTY



TEIF 500 Year Losses

- Low
- Medium-Low
- Medium
- Medium-High
- High

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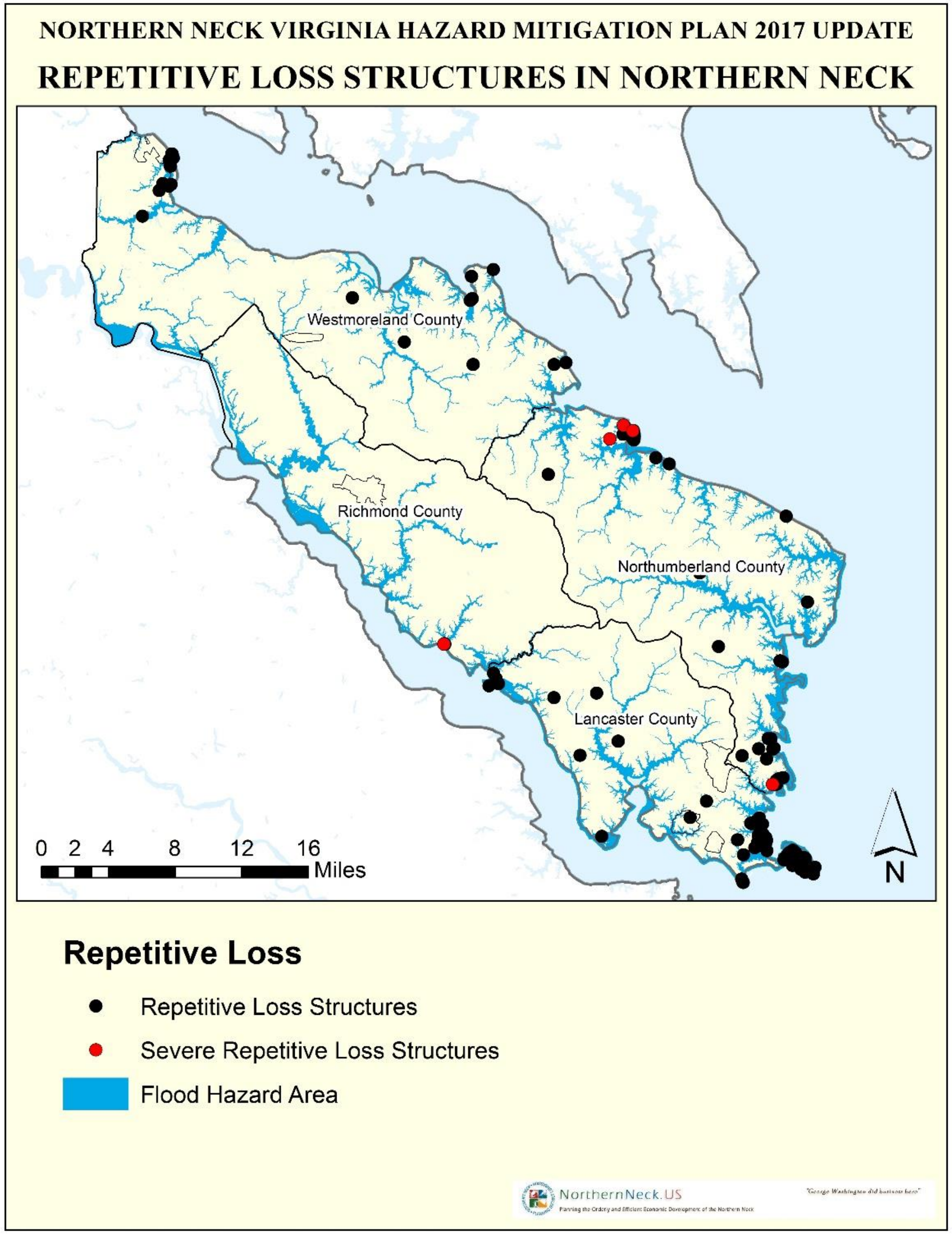
Repetitive Loss

- Repetitive Loss (RL) property: any insurable building w/ 2 or more claims >/= $1,000 paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

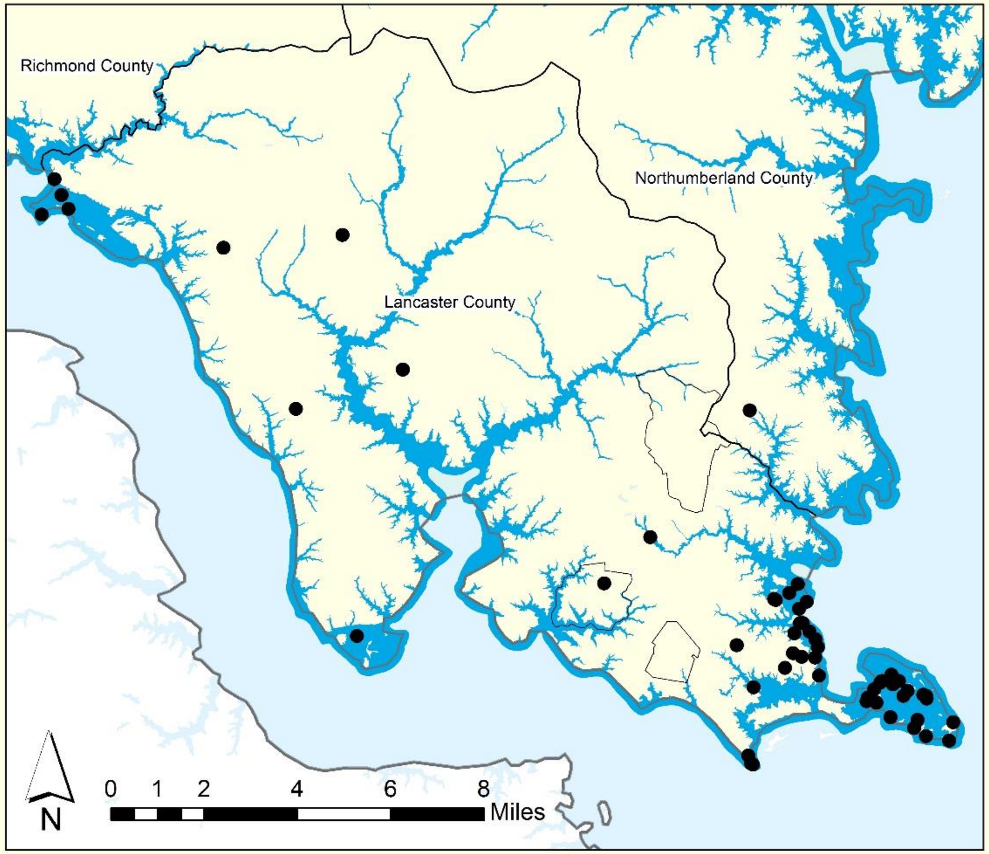
- A Severe Repetitive Loss (SRL) property: any property with 4 or more separate claim payments >$5,000 each; or 2 or more separate claim payments where the total payments > the current building value of the property.

- Nationwide, RL properties constitute 2% of all NFIP insured properties, but are responsible for 40% of all NFIP claims


NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
REPETITIVE LOSS STRUCTURES IN NORTHERN NECK
Westmoreland County
Richmond County
Northumberland County
Lancaster County
0 2 4 8 12 16
Miles
N
Repetitive Loss
Repetitive Loss Structures
Severe Repetitive Loss Structures
Flood Hazard Area
NorthernNeck.US

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS STRUCTURES IN LANCASTER COUNTY



Repetitive Loss

- Repetitive Loss Structures
- Severe Repetitive Loss Structures
- Flood Hazard Area

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NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
REPETITIVE LOSS STRUCTURES IN NORTHUMBERLAND COUNTY

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NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS STRUCTURES IN RICHMOND COUNTY

Repetitive Loss

- Repetitive Loss Structures
- Severe Repetitive Loss Structures
- Flood Hazard Area

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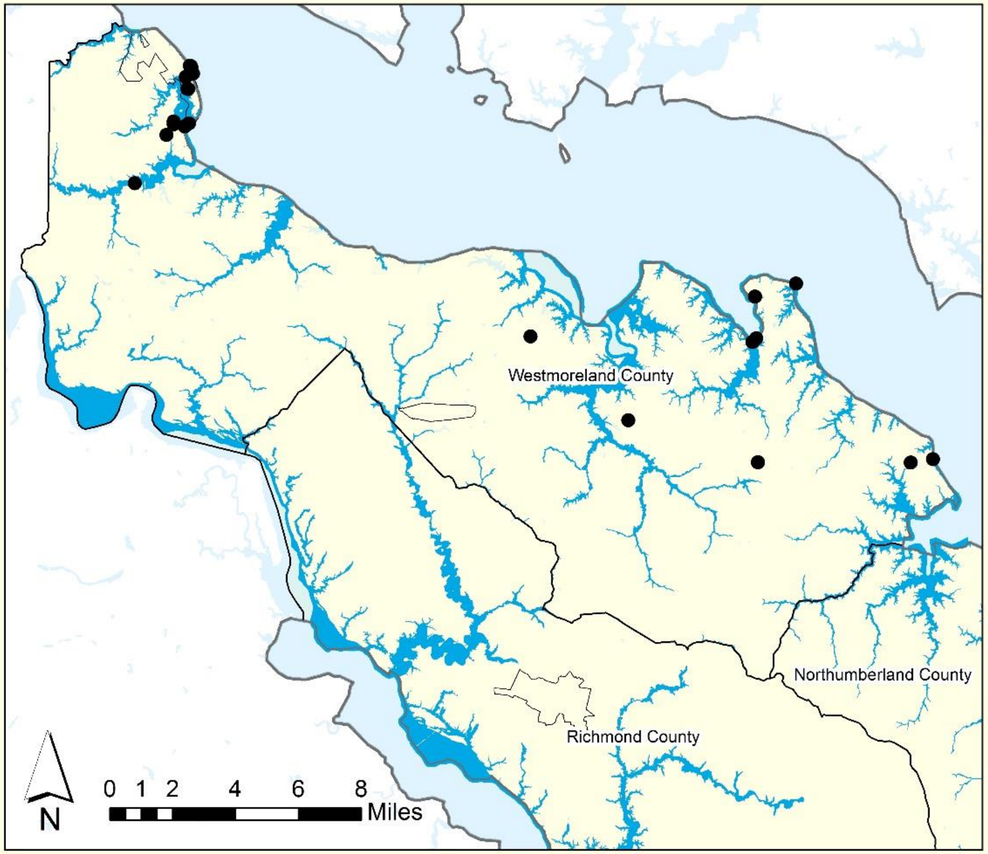
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS STRUCTURES IN WESTMORELAND COUNTY



Repetitive Loss

- Repetitive Loss Structures
- Severe Repetitive Loss Structures
- Flood Hazard Area

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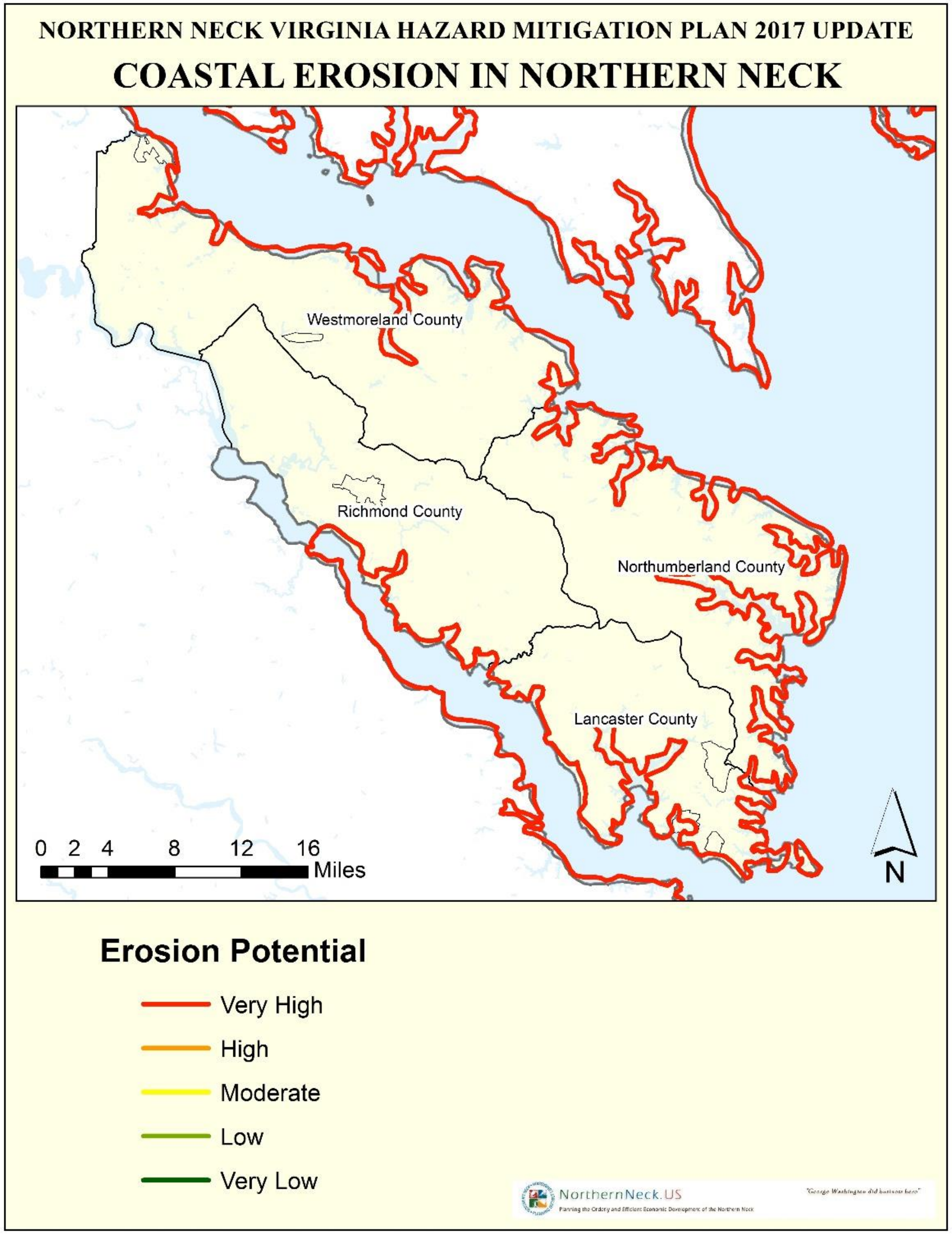
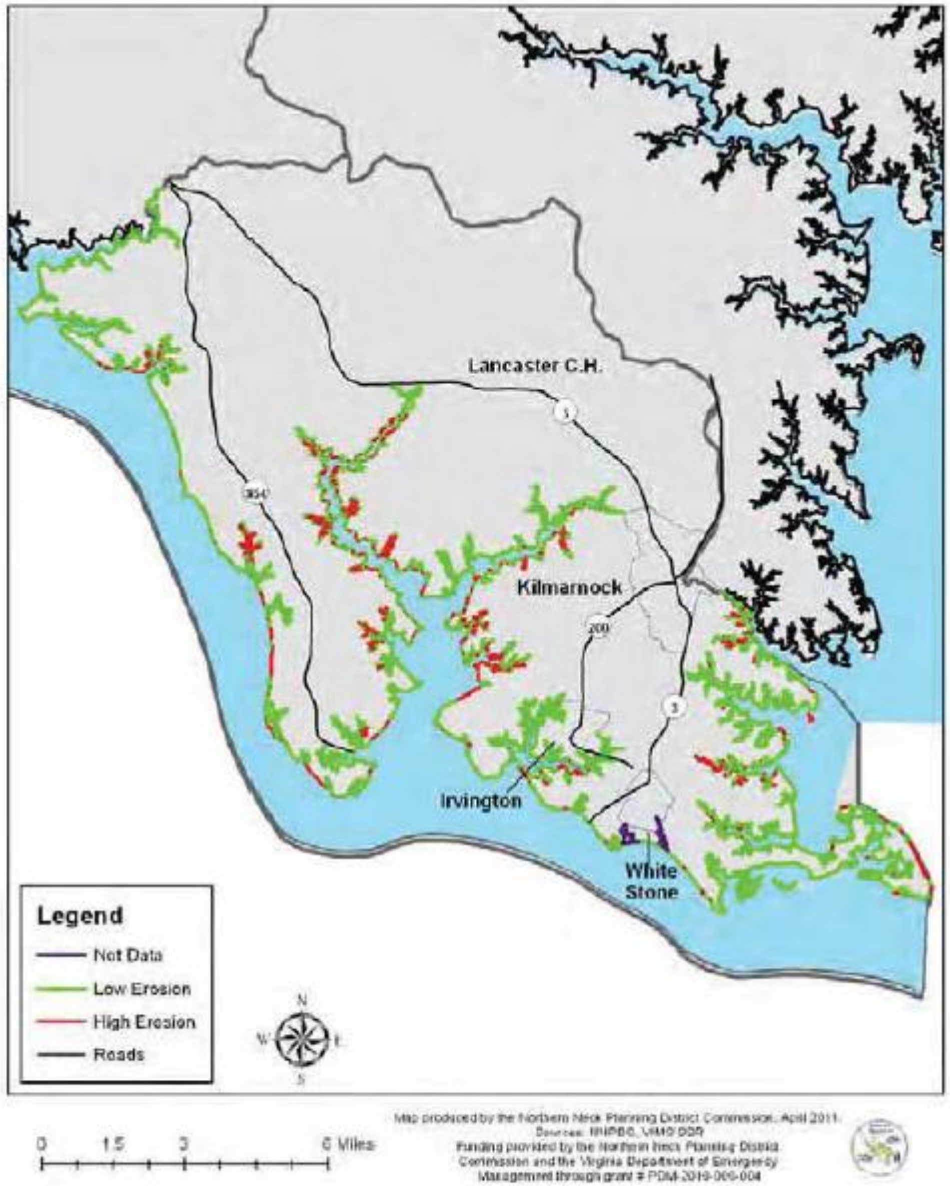
Coastal Erosion Risk

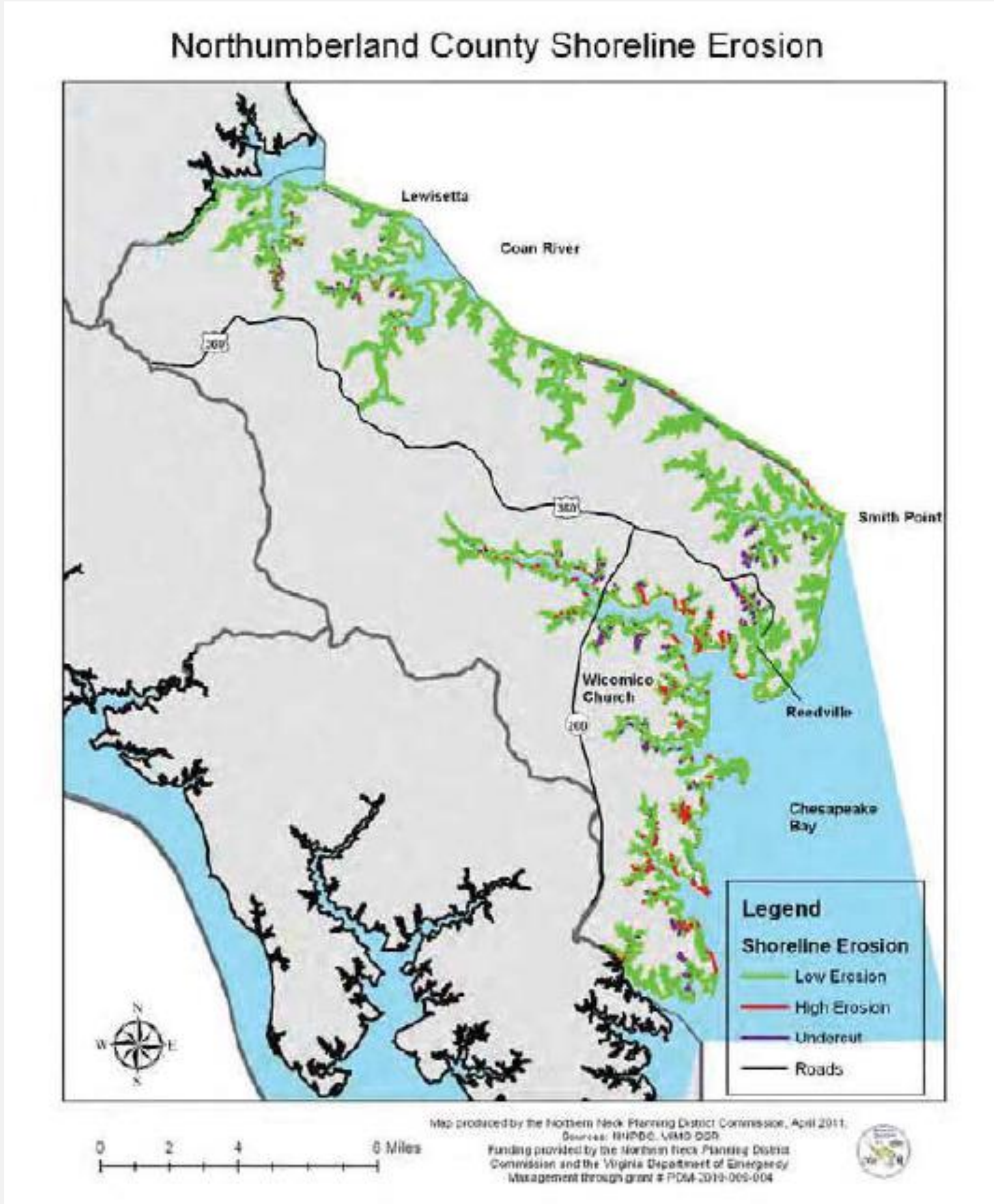


- USGS Climate Resilience Toolkit provides a coastal dataset showing vulnerability to sea level rise and erosion.
- Includes the Coastal Vulnerability Index (CVI) to give subjective assessment of risk to sea level rise and erosion.
- Ranking values range from very low, low, moderate, high, to very high.
- **NNPDC ranked mostly very high.**

Lancaster County Shoreline Erosion



* From 2011 Plan



* From 2011 Plan

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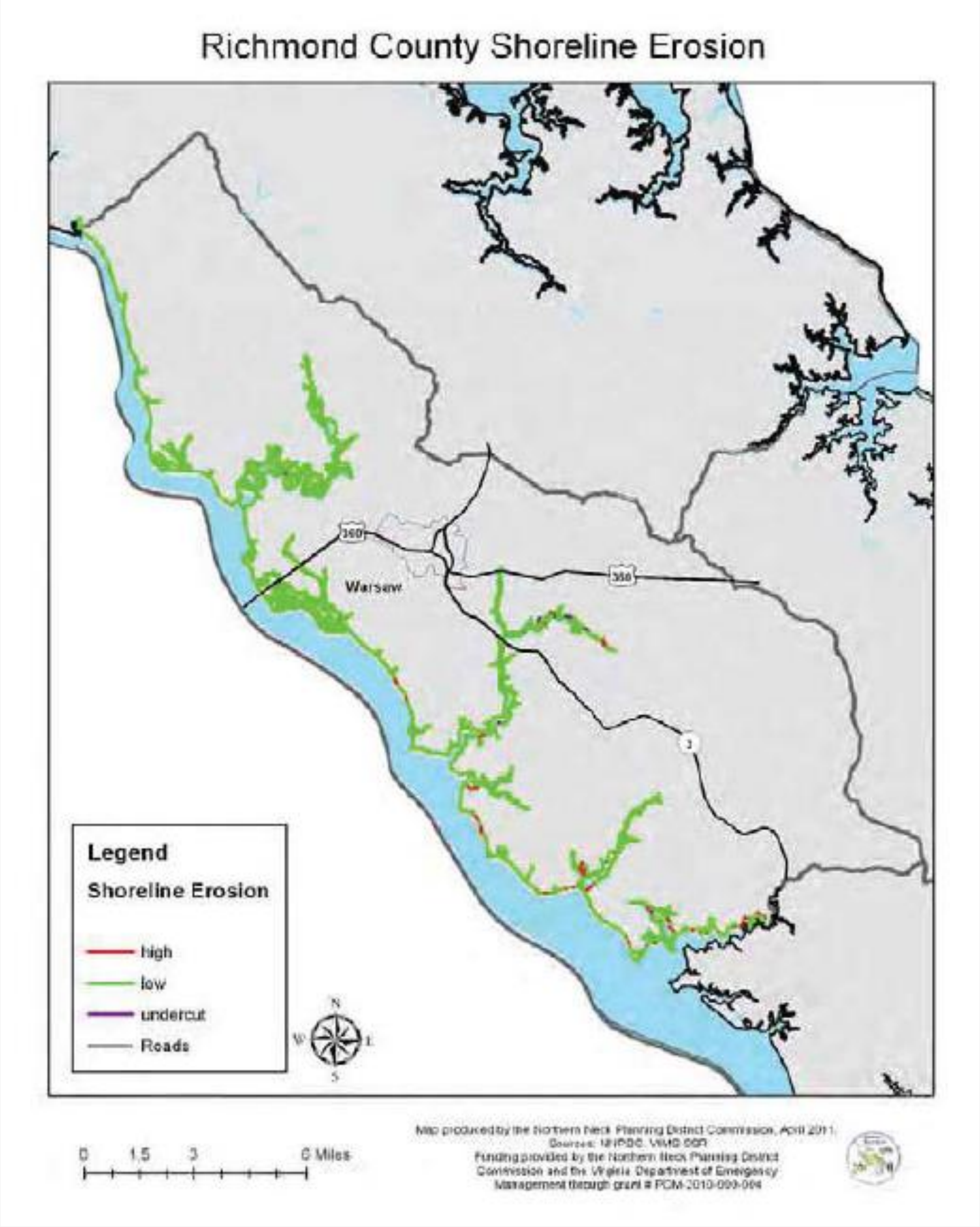

* From 2011 Plan

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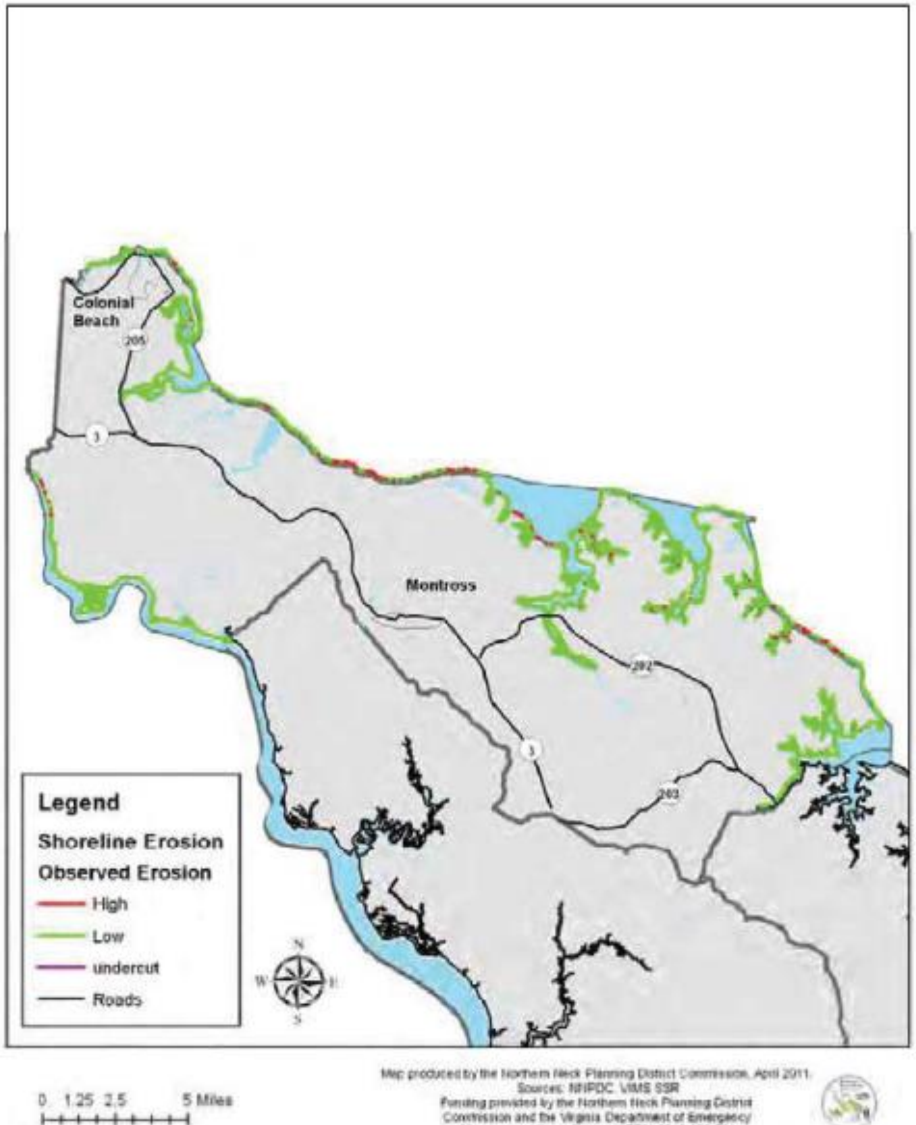
Westmoreland County Shoreline Erosion



Map produced by the Northern Neck Planning District Commission, April 2011.
Sources: NNPDC, VIMS SSR
Funding provided by the Northern Neck Planning District Commission and the Virginia Department of Emergency Management through grant # PDM-2010-000-004

* From 2011 Plan

Shoreline Studies Program, Virginia Institute of Marine Science, September 2012

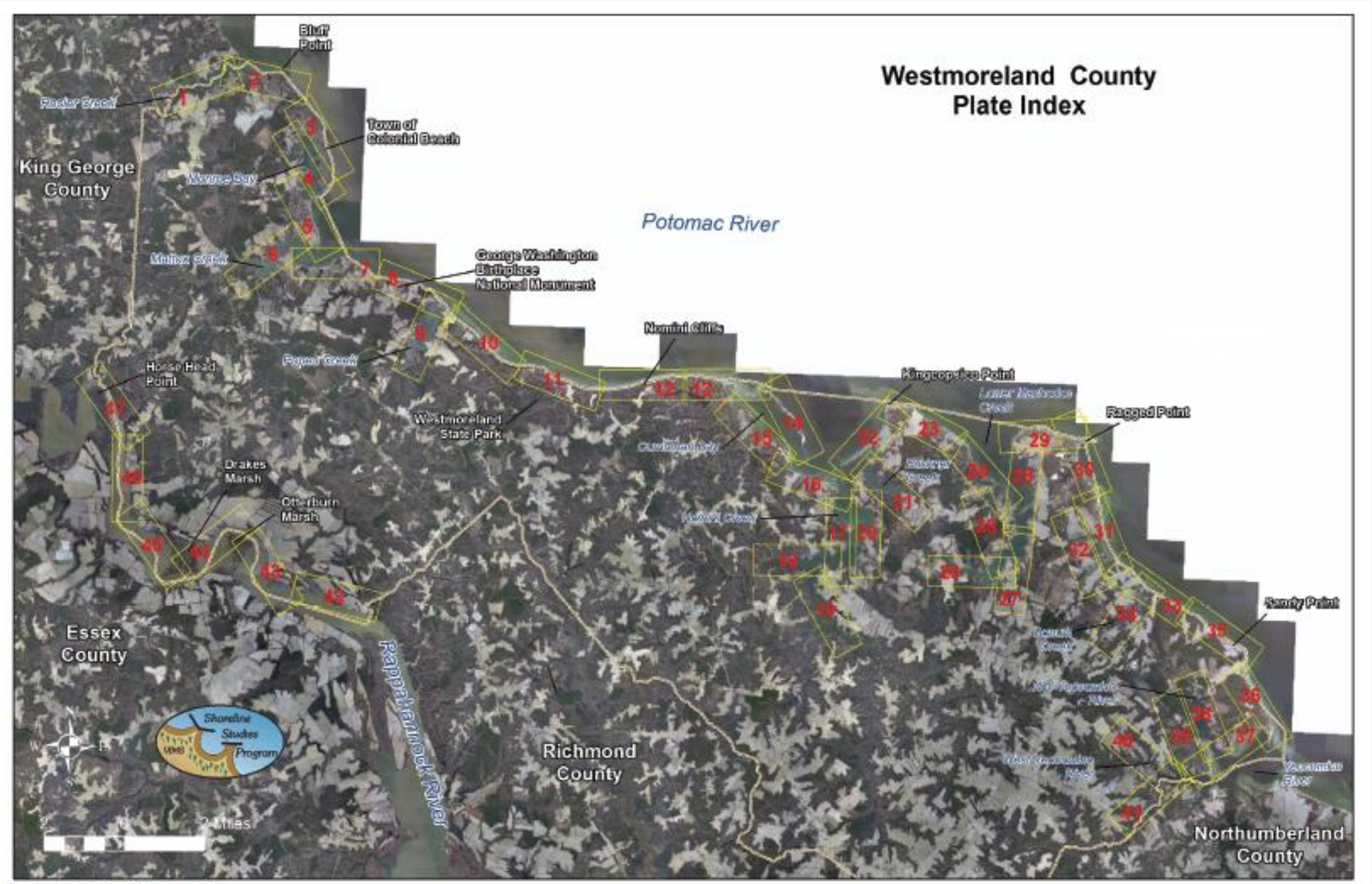


Figure 2. Index of shoreline plates.

Segments of the shoreline where shoreline erosion was calculated

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Shoreline Studies Program, Virginia Institute of Marine Science, September 2012

Table 1. Average end point rate of change (ft/yr) between 1937 an d2009 for segments along Westmoreland County's shoreline. Segment locations are show on maps in Appendix A.

Segment Name	Location	Average Rate of Change (ft/yr)
A	Rosier Creek	-0.7
B	Potomac River, Mouth of Rosier Creek to Bluff Point	-0.1
C	Potomac River, Town of Colonial Beach	0.1
D	Monroe Bay	-0.2
E	Potomac River, Sebastian Point to Paynes Point	-0.7
F	Mouth of Mattox Creek, Wirt Wharf	-0.1
G	Potomac River, Church Point to Westmoreland State Park	-1.1
H	Potomac River, Westmoreland State Park to Haulover Inlet	-0.8
I	Nomini Bay, Hollis Marsh	-4.0
J	Currioman Bay, Haulover Inlet to Nomini Creek	-0.6
K	Nomini Creek including Buckner Creek	-0.3
L	Nomini Bay, White Point to Kingcopsico Point	-0.3
M	Lower Machodoc Creek	-0.8
N	Potomac River, Grapevine Point to Ragged Point	-1.1
O	Potomac River, Ragged Point to Jackson Creek	-0.9
P	Potomac River, Jackson Creek to Sandy Point	-2.2
Q	Potomac River, Sandy Point to Lynch Point	-1.4
R	Yeocomico River	-0.5
S	Rappahannock River, Richmond County Line to Layton Landing Rd.	-0.4
T	Rappahannock River, Layton Landing Rd. to Blind Point	-1.2
U	Rappahannock River, Blind Point to King George County Line	-0.4

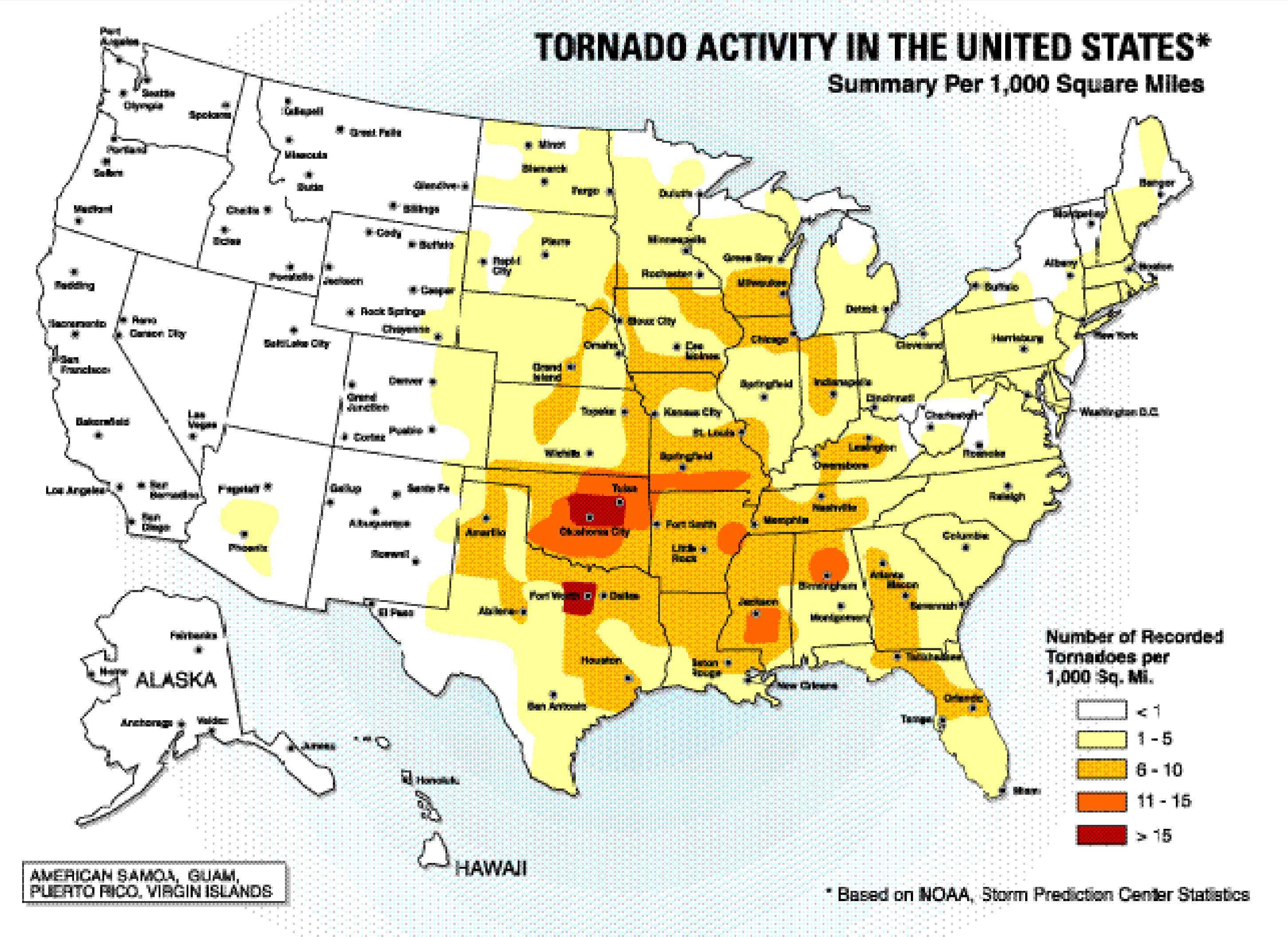
- Segments of the shoreline and their calculated shoreline erosion rate of change
- Annual losses predicted losses from -0.1 to -4.0 ft./yr.

Tornado Hazard Risk

Tornado Damage Scale

Enhanced Fujita Scale	Wind Speeds (mph)	F-Scale	Wind Speeds (mph)	Damage	Frequency
EF0	65 to 85	F0	40 to 72	Light Damage. Some damage to chimneys, TV antennas, roof shingles, trees, and windows	29%
EF1	86 to 110	F1	73 to 112	Moderate Damage. Automobiles overturned, carports destroyed, trees uprooted	40%
EF2	111 to 135	F2	113 to 157	Considerable Damage. Roofs blown off homes, sheds and outbuildings demolished, mobile homes overturned	24%
EF3	136 to 165	F3	158 to 206	Severe Damage. Exterior walls and roofs blown off homes. Metal buildings collapsed or severely damaged. Forests and farmland flattened.	6%
EF4	166 to 200	F4	207 to 260	Devastating Damage. Few walls, if any, standing in well-built homes. Large steel and concrete missiles thrown far distances.	2%
EF5	Over 200	F5	261 to 318	Incredible Damage. Homes leveled with all debris removed. Schools, motels, and other larger structures have considerable damage with exterior walls and roofs gone. Top stories demolished.	Less than 1%

National Tornado Risk



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Tornado History 1965-2016

Fujita Scale	Date	Counties Affected	Deaths	Injuries	2017 Property Damages	2017 Crop Damages	2017 Total Damages
EF1	**2/24/2016**	**Lancaster, Westmoreland**	**0**	**0**	**$1,299,168**	**$79,045**	**$1,378,212**
EF2	**2/24/2016**	**Richmond**	**0**	**0**	**$3,344,191**	**$0**	**$3,344,191**
EF0	6/18/2015	Lancaster, Richmond	0	0	$46,178	$0	$46,178
EF0	2/21/2014	Westmoreland	0	0	$15,411	$0	$15,411
F1	1/14/2005	Northumberland, Richmond	0	0	$37,361	$0	$37,361
F1	5/25/2004	Lancaster	0	0	$25,751	$0	$25,751
F0	8/26/2003	Richmond	0	0	$6,609	$0	$6,609
F0	4/4/1999	Westmoreland	0	0	$36,498	$0	$36,498
F1	9/10/1997	Northumberland	0	0	$227,309	$0	$227,309
F0	7/13/1996	Westmoreland	0	0	$15,502	$0	$15,502
F1	7/12/1996	Northumberland	0	0	$387,541	$0	$387,541
F0	6/24/1996	Westmoreland	0	0	$263,528	$0	$263,528
F0	1/19/1996	Richmond	0	0	$23,252	$0	$23,252
F0	8/6/1993	Lancaster	0	0	$841,595	$0	$841,595
F1	**5/10/1990**	**Lancaster**	**0**	**0**	**$4,652,276**	**$0**	**$4,652,276**
F1	5/2/1989	Northumberland	0	0	$0	$0	$0
F2	5/2/1989	Northumberland	0	0	$0	$0	$0
F2	8/31/1983	Richmond	0	0	$61,049	$0	$61,049
F1	9/6/1975	Lancaster	0	0	$11,302	$0	$11,302
F2	4/25/1975	Richmond	0	0	$113,021	$0	$113,021
F0	8/10/1969	Northumberland	0	0	$1,657	$0	$1,657
F3	11/2/1966	Richmond	0	0	$187,671	$0	$187,671

Local Tornado Risk

EF Scale Rating	Estimated Tornado Counts Northern Neck (1965-2016)
EF0	4
EF1	2
EF2	1
F0	7
F1	8
F2	2
F3	1

Source: NCEI Database for 2016.

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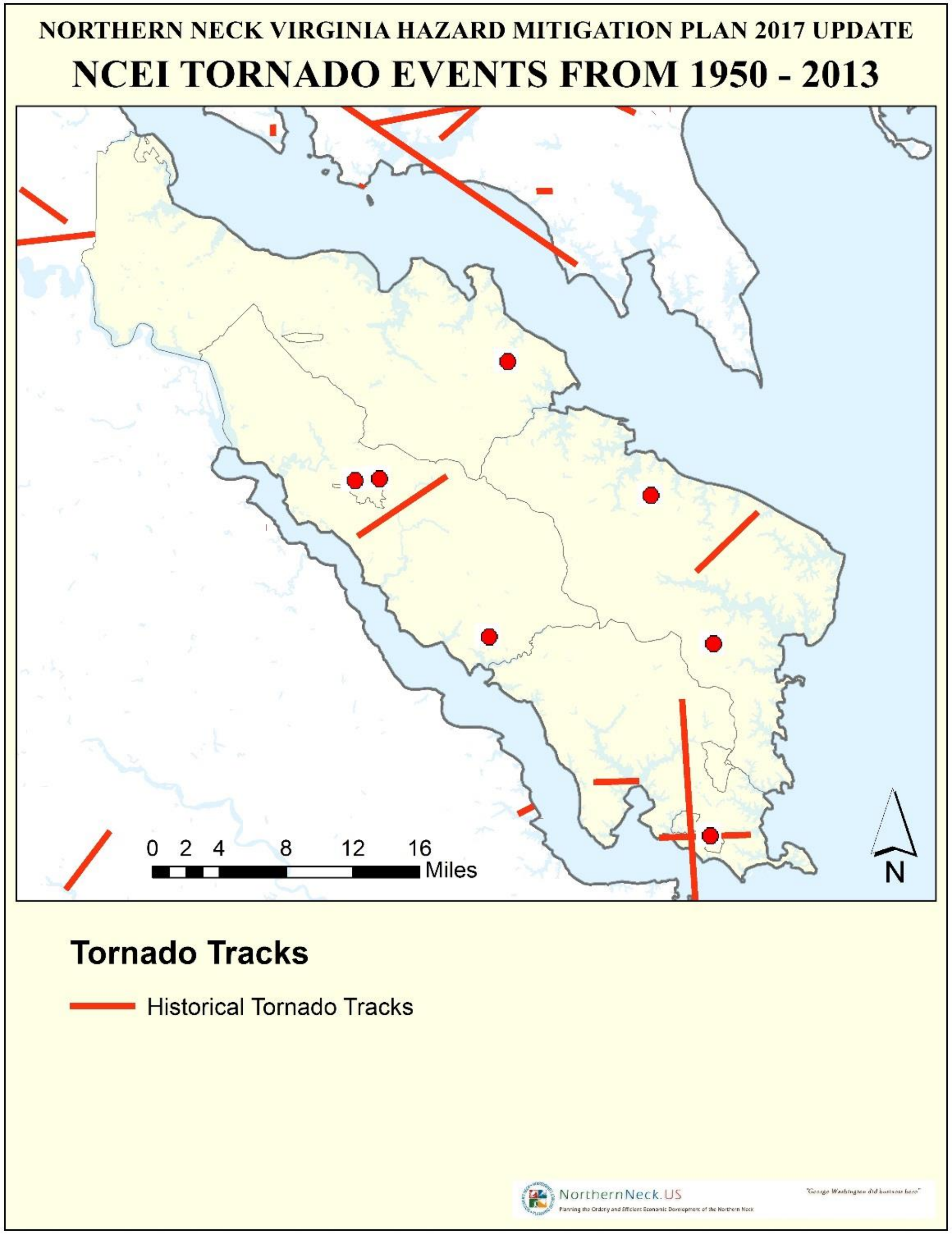
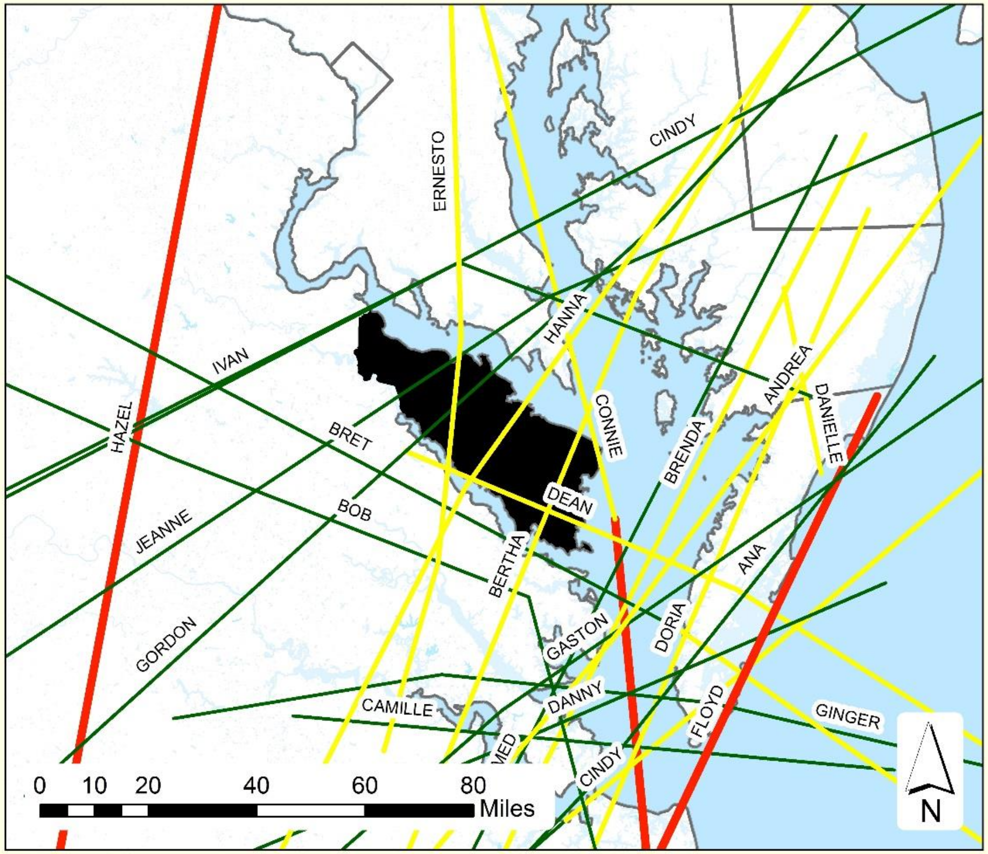

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
NCEI TORNADO EVENTS FROM 1950 - 2013
0 2 4 8 12 16
Miles
N
Tornado Tracks
Historical Tornado Tracks
NorthernNeck.US

Hurricanes and Tropical Storm Risk

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

STORM TRACKS IN NORTHERN NECK FROM 1950 - 2015



Saffir–Simpson Scale Classifications

- Tropical Depression
- Tropical Storm
- Category One Hurricane
- Norther Neck Counties

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Coastal Storm (Nor'easter) Risk

Coastal Storm Hazard Risk

Coastal storms (Nor'easters) are a persistent problem for Northern Neck. Recent notable storms include:

- February 2017 – On February 9 the system reached the East Coast and rapidly grew into a powerful nor'easter. Blizzard from Philadelphia north; precipitation on the Northern Neck was fortunately rainfall accompanied with high winds. Prior to the storm, unprecedented and record-breaking warmth had enveloped the region, with record highs of above 60 °F.
- January 2016 - Winter Storm Jonas. Between January 23 and 24, a very severe Nor'easter dumped 2 to 3 feet of snow in the East Coast of the United States. Sustained damaging winds over 50 mph were recorded in many coastal communities, with a maximum gust to 85 mph on Assateague Island, Virginia. Snow and high wind on the Northern Neck.
- October 2015 - Early October Atlantic low pressure system tapped into moisture from Hurricane Joaquin; the storm resulted in heavy rains and flooding in the mid-Atlantic.

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Winter Storm Risk

Winter Storm Hazard Risk

Winter storms are a persistent problem for Northern Neck.

Recent notable storms (excluding Nor'easters) include:

- January 2017 – Southern system resulted in snow from central to northern and northeastern VA – school closings, limited power outages.
- January 2016 – Low pressure from the south resulted in snow throughout central and northern Virginia and the Northern Neck resulting in limited power outages, school closings.
- March 2015 - Low pressure moving northeast produced freezing rain and freezing drizzle across portions of the Virginia Northern Neck. Ice accumulations ranged from a trace to 0.12 inch.
- Winter 2010 – Three significant winter storms severely affected northern Virginia and the Northern Neck resulting in road closures, extened power outages and periods of schools closings.
- December 2009 – A blizzard originating in the mid-west left the Northern Neck with 18-24 inches of snow, causing road closures, school closings and power outages.

Wildfire Risk

Wildfires 2002-2016

County	Size Class	Fire Description	Numbers of Fires
Lancaster	**A**	**One-fourth acre or less**	**79**
	B	**More than one-fourth acre, but less than 10 acres**	**33**
	C	10 acres or more, but less than 100 acres	3
Richmond	A	**One-fourth acre or less**	**34**
	B	**More than one-fourth acre, but less than 10 acres**	**34**
	C	10 acres or more, but less than 100 acres	5
Northumberland	A	One-fourth acre or less	8
	B	**More than one-fourth acre, but less than 10 acres**	**11**
	C	10 acres or more, but less than 100 acres	1
Westmoreland	A	**One-fourth acre or less**	**36**
	B	**More than one-fourth acre, but less than 10 acres**	**30**
	C	10 acres or more, but less than 100 acres	5

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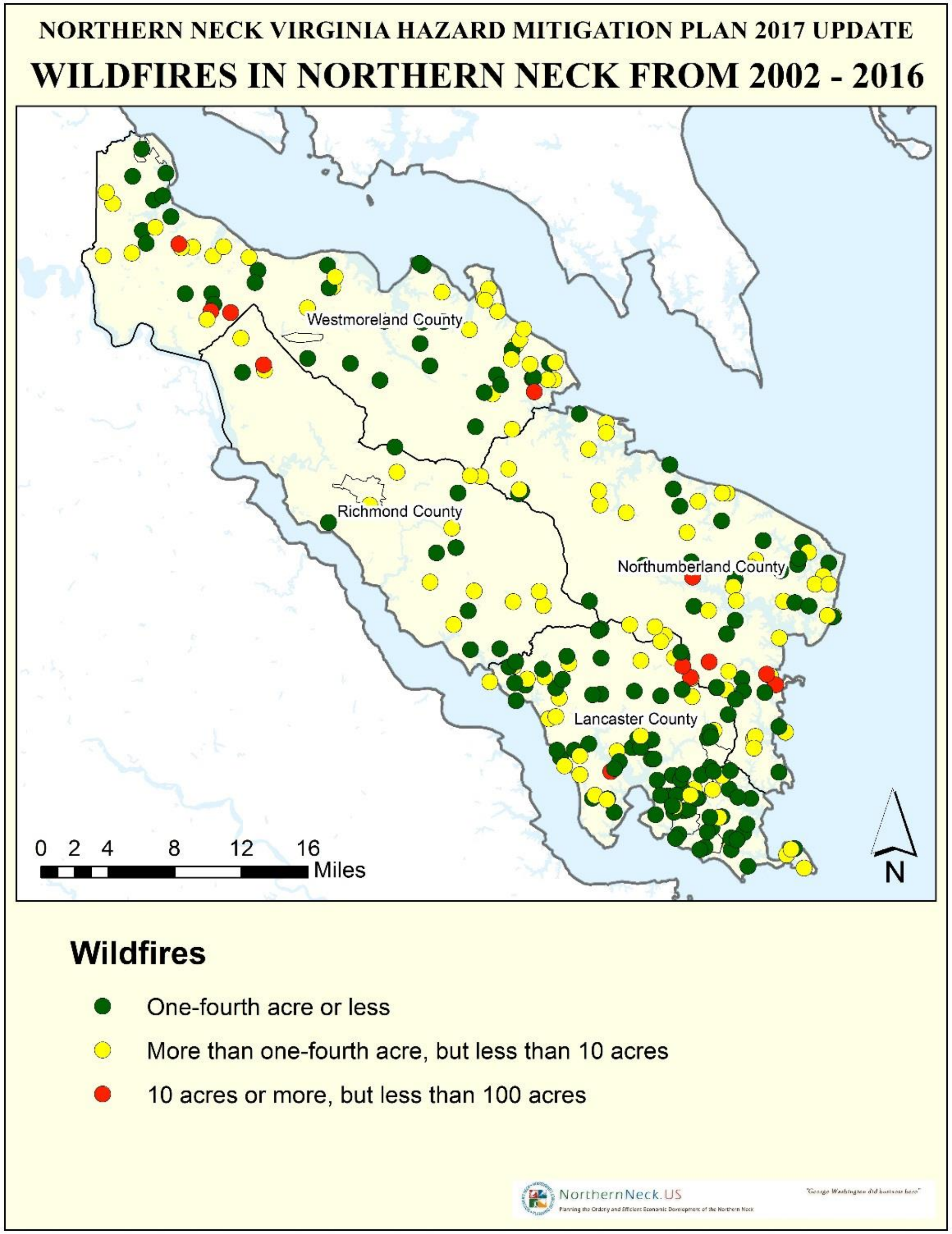
Wildfire Risk

- Northern Neck has on average 19 wildfire events per year
- However, as shown in the map on the right, most wildfires are small and are quickly extinguished



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Drought Risk

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Drought Categories

Category	Description	Possible Impacts
D0	Abnormally dry	Going into a drought: short-term dryness slows planting, growth of crops or pastures; fire risk above average. Coming out of a drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low; some water shortages develop or are imminent; voluntary water use restrictions requested.
D2	Severe drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.
D3	Extreme drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.

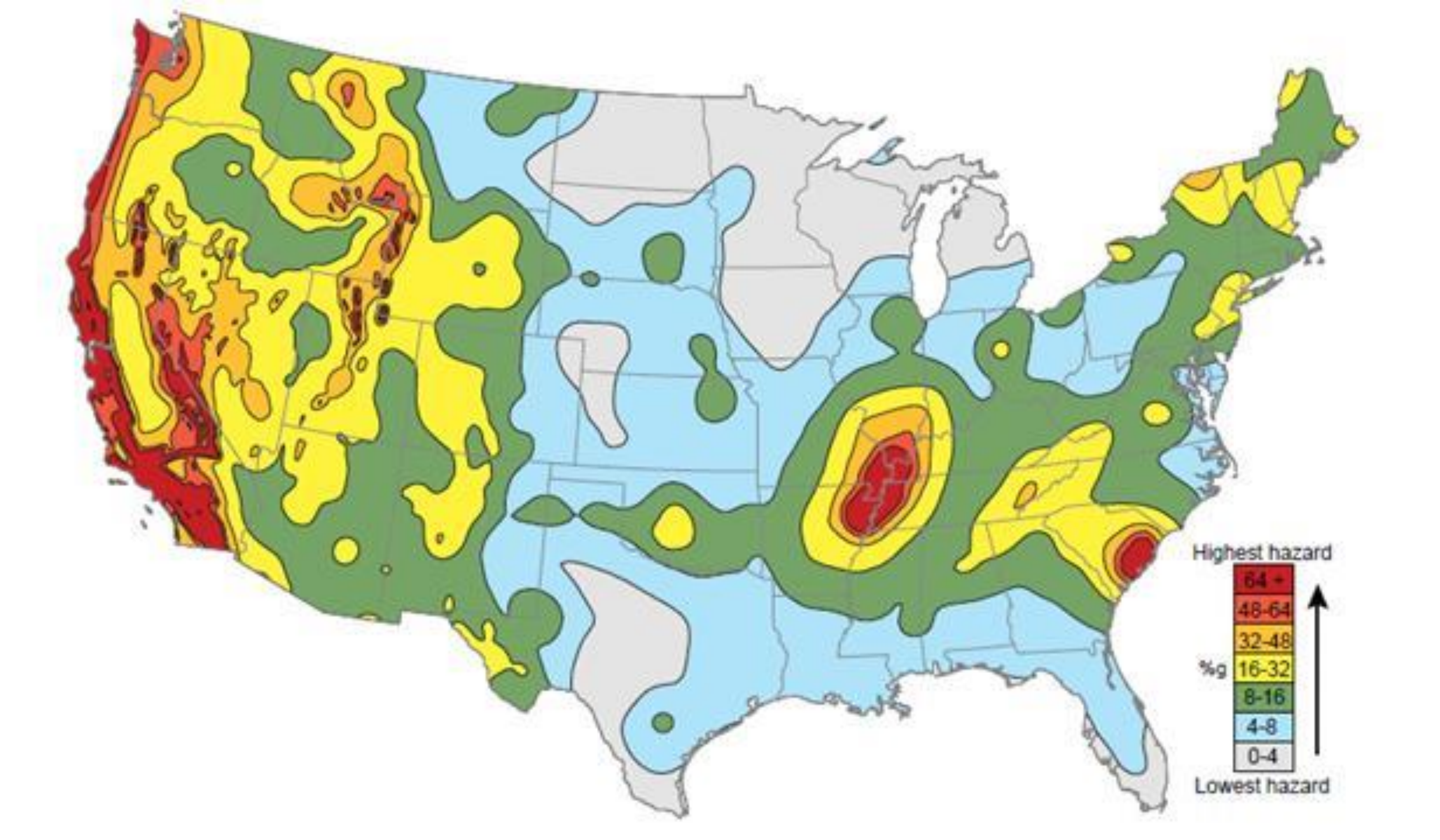
US Census of Agriculture General Information by County

(areas at risk of Drought Impacts)

County	Farms	Total Acres	Average Acres/Farm	Market Value of Products	Average Farm Value
Lancaster County	61	10,695	175	$4,864,000	$79,741
Northumberland County	566	79,107	140	$16,485,000	$29,125
Richmond County	90	32,373	360	$15,467,000	$171,858
Westmoreland County	152	59,378	391	$35,758,000	$235,248

Earthquake Hazard Risk

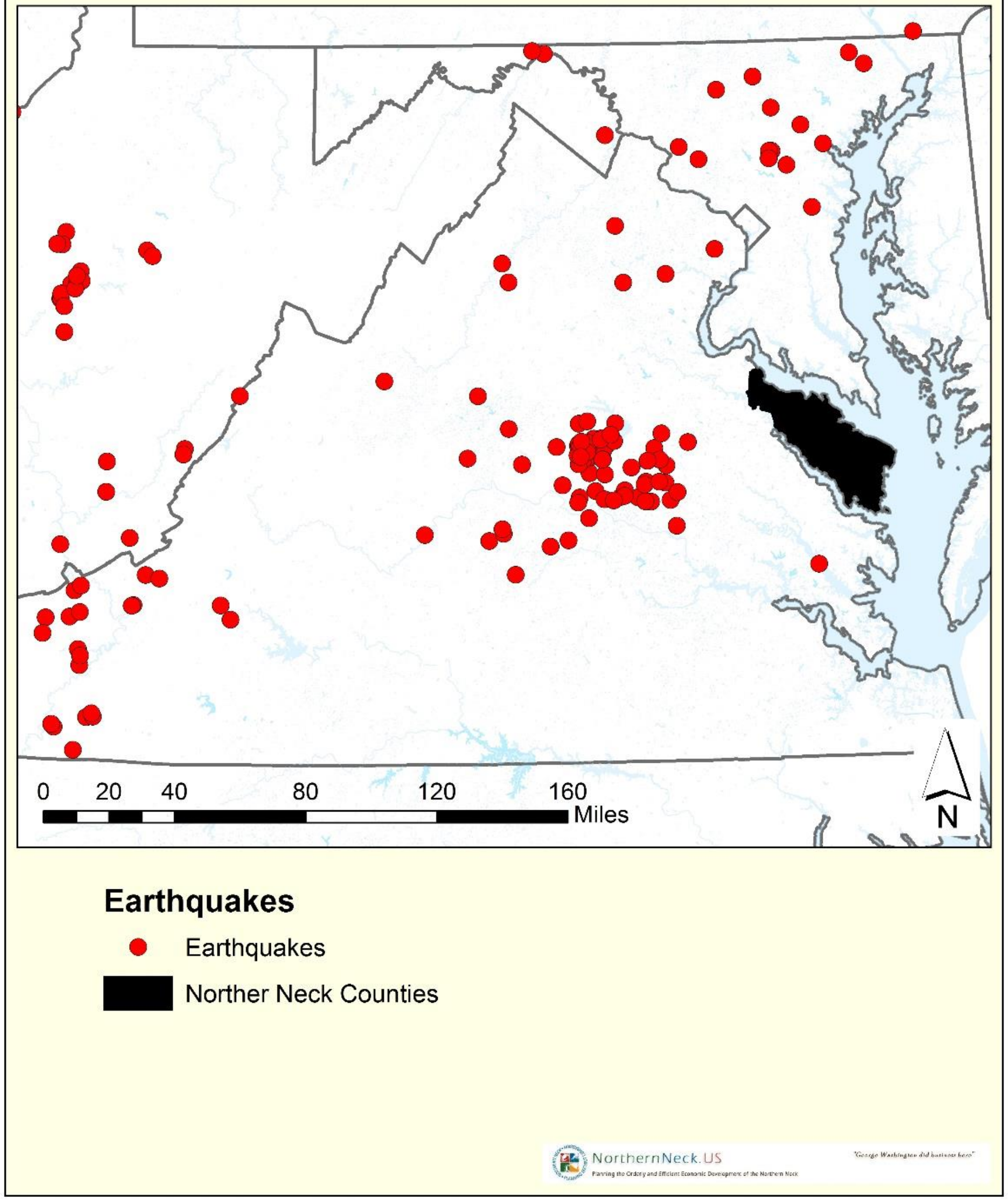
National Earthquake Risk



Source: United States Geological Survey (USGS) Earthquake Map (based on peak ground accelerations for a 2% probability event in the next 50 years), with earthquake ground accelerations expressed as a percentage of gravity, g (32.2 ft/s^2)

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

EARTHQUAKES AFFECTING NORTHERN NECK



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Northern Neck Hazard Rankings

Hazard Rankings

Hazard Type	2011 HMP Planning Consideration Level		2017 LEPC Kick-Off Meeting	2017 Draft HIRA Update
Hurricane	Significant		Significant	Significant
Flooding (river, stream, inc. coastal flooding)	Moderate		Moderate	Significant
Winter Storm	Moderate		Moderate	Moderate
Coastal Erosion	Moderate		Moderate	Moderate
Drought	Limited		Moderate	Moderate
Coastal Storm (Nor'easter)	Limited		Significant	Significant
Tornado	Limited		Significant	Significant
Wildfire	Limited		Limited	Limited
Earthquake	None		Limited	Limited

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Mitigation Actions and Goals

- Committee chose to eliminate objectives underneath 2011 plan goals.
- 2011 plan goals were modified to reflect resiliency and “whole community” concepts.
- The goals which follow reflect edited, new 2017 hazard mitigation plan goals.

2011 Northern Neck PDC 2011 HMP Goals

- Goal 1: Promote new development by avoiding undue risks posed by natural hazards and is resilient to natural disasters.

- Goal 2: Address natural hazards and vulnerability that represent a threat to the community.

2011 Northern Neck PDC Revised HMP Goals

- Goal 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents, property and critical infrastructure of the Northern Neck.

- Goal 4: Enhance the capabilities of local government to address natural hazards to enhance the whole community for increased resilience.

2011 Northern Neck PDC Revised HMP Goals

- Goal 5: Increase natural hazard awareness of our citizens. Educate Northern Neck citizens and part-time residents on citizen and community hazard resiliency.

- Goal 6: Participate and Comply with the National Flood Insurance Program (NFIP) through Floodplain Identification, Mapping and Floodplain Management.

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LEPC Hazard Mitigation Plan Update Actions

- Do you want to retain Objectives?
- What keeps you up at night?
- To enable cross-cutting mitigation themes and actions/projects are the necessary people/departments ready to participate?
- Must address as many hazards through actions as possible.
- Are there other efforts currently going on in your community that we should be aware of?
- What would some positive outcomes be?

2011 Mitigation Actions Status Review

Number in 2011 Plan	Strategy	Responsible Department	Priority	2016 Update	Notes - If cancelled, discontinued or no action, please state why?
Regional-1 (Richmond Regional PDC)	Leverage regional partnerships (e.g., law enforcement) to better use their data to inform mitigation planning and project development.	Local Emergency Managers	High	Continue	This strategy is an ongoing practice that PDCs continue to perform. Most PDC work involves relationships and partnerships with varied entities.

- Any strategy revisions
- Responsible party department
- Priority
- Complete, Continue, Delete, Other
- Notes

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Mitigation Actions

- Preventative Measures
- Property Protection
- Emergency Services
- Structural Projects
- Natural Resources Protection
- Public Information Programs

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2017 – 2022 Actions

- Include 2011 “Carry-forward” actions
- Actions must include:
  - Strategy/action statement
  - Responsible Department
  - Priority
  - Goals supported
  - Hazard Addressed
  - Timeframe
  - Resources – funding source, staff, etc.

2017 – 2022 Mitigation Actions

2017 - 2022 Mitigation Actions							
Number	**Strategy**	**Responsible Department**	**Priority**	**Goals**	**Hazards**	**Time**	**Resources**
Regional - 1 (RR PDC)	Leverage regional partnerships (e.g., law enforcement) to better use their data to inform mitigation planning and project development.	Local Emergency Managers	High	1, 2, 3,	All	ongoing	staff
Regional - 2 (RR PDC)	Work with state partners and neighboring regions to expand planning efforts regarding regional strategy for incoming evacuees (topics to include traffic management, shelters, information sharing, etc.).	Local Emergency Managers	Low	1, 2, 3, 4, 5	All	ongoing	staff, CVEMA
Regional - 3 (RRl PDC)	Continue to refine improve the quality and detail of data to prepare usable and effective hazard assessments and vulnerability analysis	PDC, Local GIS Managers		1, 2, 3	All	ongoing	staff, grants

Outreach Brainstorming

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Next Steps

- Draft HIRA chapter comments to Deborah Mills (dmills@dewberry.com) or Jillian by April 21, 2017
- 2011 Mitigation Action Status to Jillian Browning (jbrowning@dewberry.com) by April 28, 2017
- 2017 – 2022 Mitigation Actions to Jillian Browning by May 5, 2017
- Draft Plan to Northern Neck PDC and LEP/MAC by mid-May.

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LEPC Hazard Mitigation Plan Update Aspirations

- What keeps you up at night?
- What do you like about current plan?
- To enable cross-cutting mitigation themes and actions/projects are the necessary people/departments ready to participate?
- Are there other efforts currently going on in your community that we should be aware of?
- What would some positive outcomes be?
- What information/expertise can you contribute?

Questions, Comments, Discussion

Deborah G. Mills, C.F.M.

Associate

Dewberry

804.823.6971 Desk

804.335.9946 Mobile

dmills@dewberry.com

Northen Neck PDC Hazard Mitigation Plan Update HIRA, Goals and Objectives Meeting April 5, 2017 Sign-In Sheet				
Jurisdiction	**Name**	**Position**	**Email**	**Phone**
Westmoreland Co.	Beth McDowell	planner	BMcdowell@westmoreland-county.org	804-493-~~8~~0120
Westmoreland CO.	Darrin Lee	planner	dlee@westmoreland-county.org	(804)493-0120
Virginia Dept. of EM	Andy John	Response + Recovery	Andy.John@vdem.virginia.gov	804-624-8327
VA Dept. of Emerg. Mgt.	Tricia Chappell	Response Recovery - East	patricia.Chappell@vdem.virginia.gov	(804) 516-5783
Lancaster County	Terrence McGregor	Emergency Coordinator	tmcgregor@lancova.com	(804) 436-3553
Lancaster Co.	Wally Beauchamp	Supervisor	wbeauchamp@lancova.com	804-436-3605
Town of Irvington	R.A. Hardesty	Town Administrator	info@irvingtonva.org	804-438-6230
Northumberland County	Rick McClure	Emergency Services Chief	rmcclure@co.northumberland.va.us	804-761-3250
Westmoreland County	Jeff Beasley	Emergency Services	jbeasley@westmoreland-county.org	804 456 1777
Town of Montross	Patricia Lewis	Town Manager	townofmontross@verizon.net	804-493-9623
NNPDC	Jerry W Davis	Executive Director	jdavis@nnpdc17.state.va.us	804 333 1900 ex22
NNPDC	John Bateman	Regional Planner	jbateman@nnpdc17.state.va.us	804-313-8478
NNPDC	Alex Eguiguren	Technical Assistant	aeguiguren@nnpdc17.state.va.us	804-333-1900

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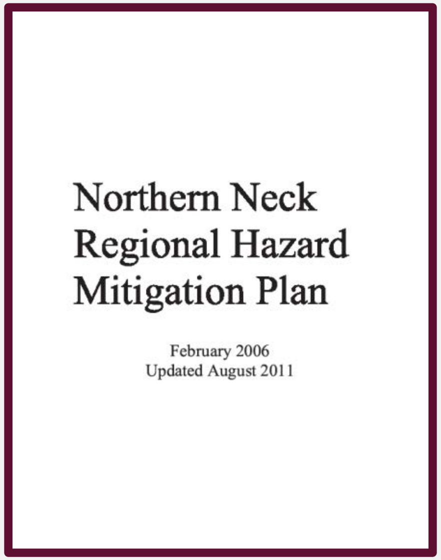
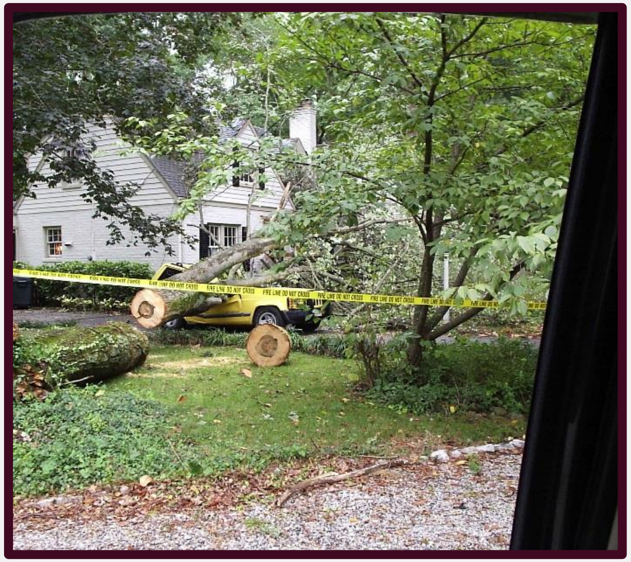

Northern Neck
Regional Hazard
Mitigation Plan

February 2006
Updated August 2011



Northern Neck Multi-Jurisdictional Hazard Mitigation Plan Update

Hazard Vulnerability Review, Mitigation Actions & Next Steps Meeting

May 30, 2017 – as modified during meeting

NORTHERN NECK PLANNING DISTRICT COMMISSION

Agenda

1. Welcome
2. Hazard Vulnerability Review
3. 2011 Mitigation Strategies Update
4. Mitigation Goal Refresh
5. Develop 2017 – 2022 Mitigation Strategies, actions and projects
6. Outreach Brainstorming
7. Next Steps

2017 Plan Update Changes

New analyses and updates: Updated each hazard profile

- Hazard profile
- NCEI storm events data
- 2010 – present storm/disaster occurrences
- Summary risk by jurisdiction using new data

New maps based on updated data

- HIRA summary that includes overall relative risk comparison by hazard.

Flood Risk

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NFIP Claims as of 31 Jan 2017

County name	Jurisdiction	Total Losses	Closed Losses	Open Losses	CWOP Losses	Total Payments
Lancaster	Irvington	15	12	0	3	$268,000
	Kilmarnock	N/A	N/A	N/A	N/A	N/A
	Unincorporated	365	294	0	71	$5,660,000
	White Stone	11	5	0	6	$63,800
Northumberland	Unincorporated	391	290	0	101	$6,930,000
Richmond	Unincorporated	84	78	0	6	$1,760,000
Westmoreland	Colonial Beach	81	71	0	10	$3,590,000
	Unincorporated	131	95	0	36	$2,740,000

National Flood Insurance Policies-in-Force cover about $400 M in structure and contents value on the Northern Neck

Total Exposure In Floodplain (TEIF)

- Analysis to estimate the Total Exposure in the Floodplain of the building stock in the NNPDC.
- TEIF performed for Richmond and Westmoreland Counties and Towns using building footprint polygons from the Virginia Geographic Information Network (VGIN).
- Lancaster and Northumberland Counties and Towns analysis used the TEIF method applied at a census block level.

TEIF Exposure by Community

County	Jurisdictions	100 Year Exposure	500 Year Exposure
Lancaster	Town of Irvington	$3,610,000	$3,720,000
	Town of Kilmarnock	$531,000	$531,000
	Town of White Stone	$0	$0
	Unincorporated Areas	$127,000,000	$172,000,000
	Total Lancaster County	**$131,000,000**	**$176,000,000**
Northumberland	**Northumberland County**	**$98,800,000**	**$113,000,000**
Richmond	Town of Warsaw	$0	$0
	Unincorporated Areas	$16,000,000	$21,000,000
	Total Richmond County	**$16,000,000**	**$21,000,000**
Westmoreland	Town of Colonial Beach	$42,100,000	$50,400,000
	Town of Montross	$155,000	$155,000
	Unincorporated Areas	$59,000,000	$64,600,000
	Total Westmoreland County	**$101,000,000**	**$115,000,000**
Total	**Northern Neck PDC**	**$348,000,000**	**$425,000,000**

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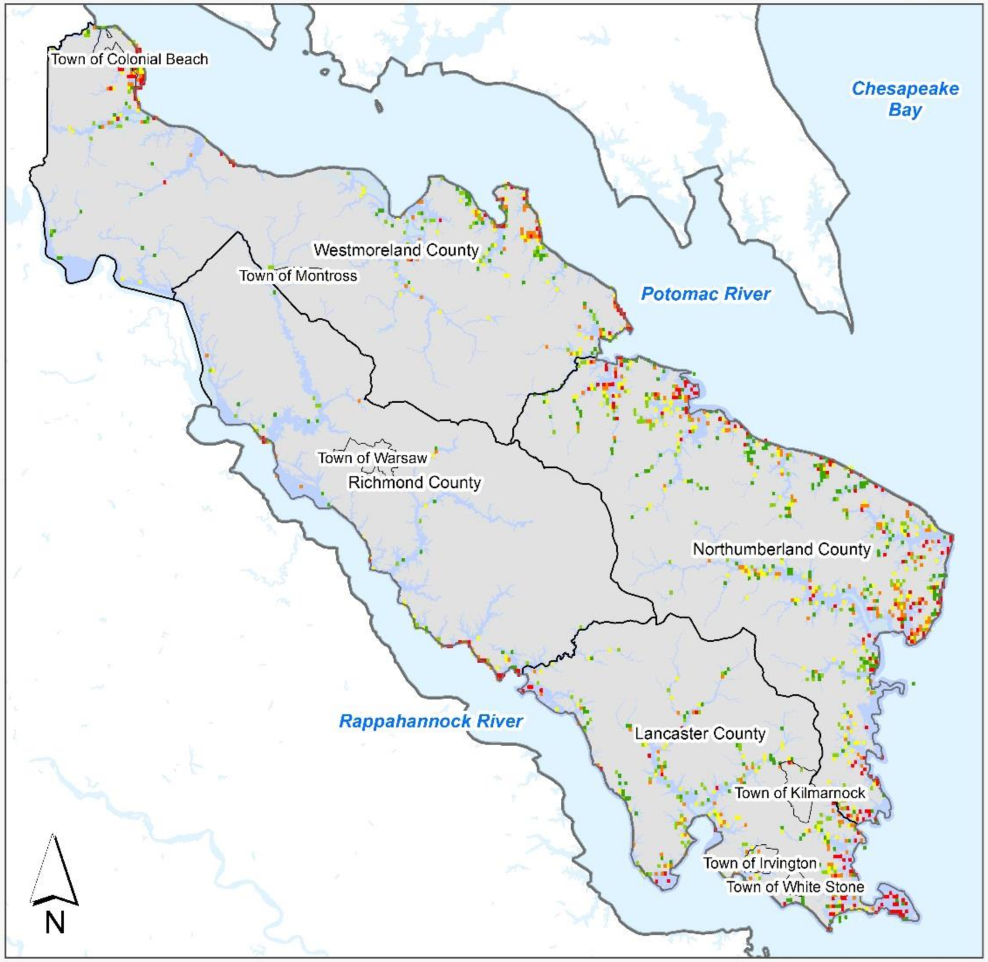
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

TOTAL EXPOSURE IN THE 100 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles: 0 2 4 8 12 16

The Total Exposure in the Floodplain (TEIF) analysis was run for the 100 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 100 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 100 year floodplain.

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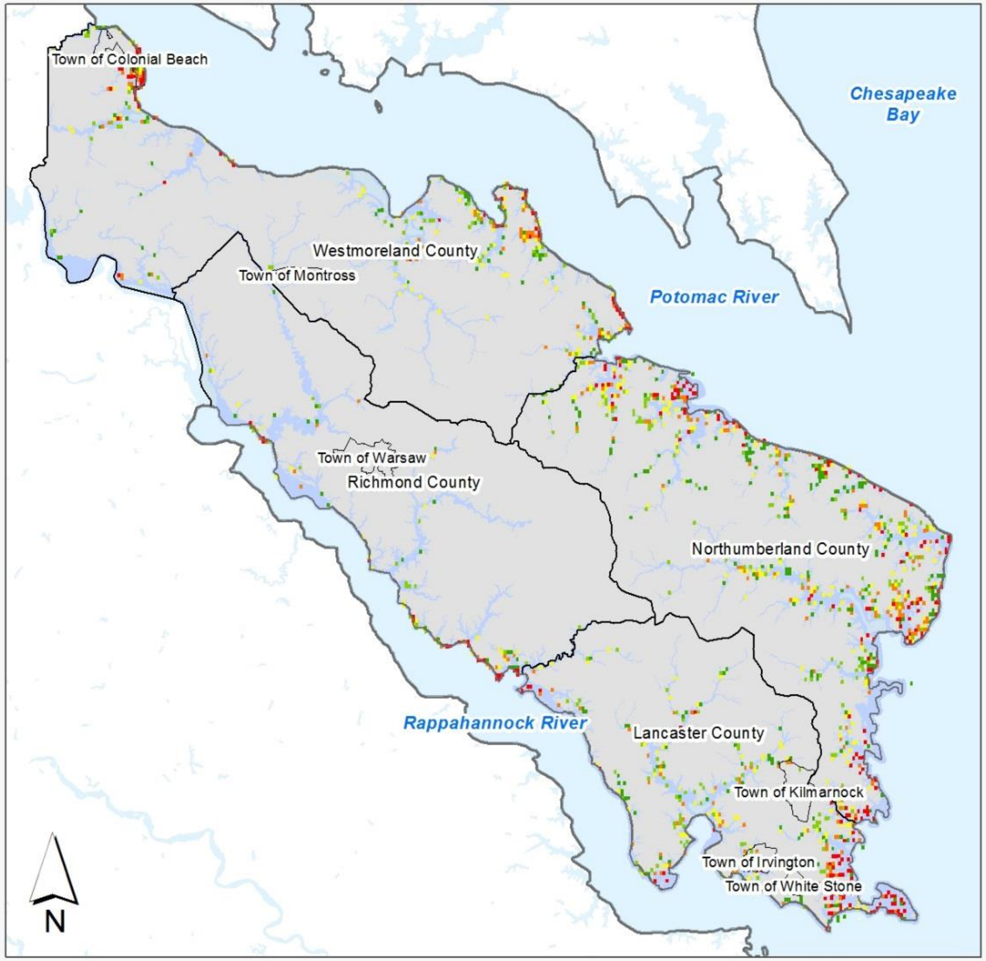
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

TOTAL EXPOSURE IN THE 500 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles: 0 2 4 8 12 16

The Total Exposure in the Floodplain (TEIF) analysis was run for the 500 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 500 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 500 year floodplain.

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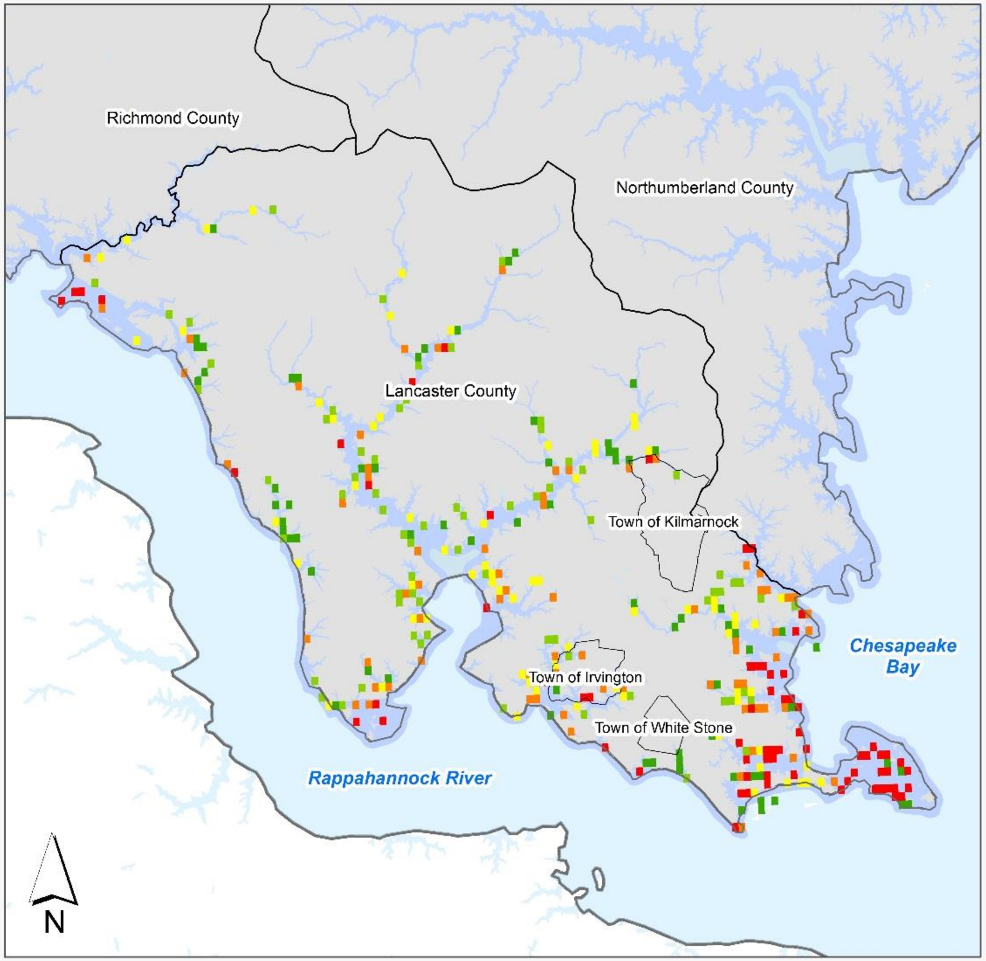
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

LANCASTER TOTAL EXPOSURE IN THE 100 YEAR FLOOD ZONE



Legend

Miles 0 1 2 4 6 8

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

The Total Exposure in the Floodplain (TEIF) analysis was run for the 100 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 100 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 100 year floodplain.

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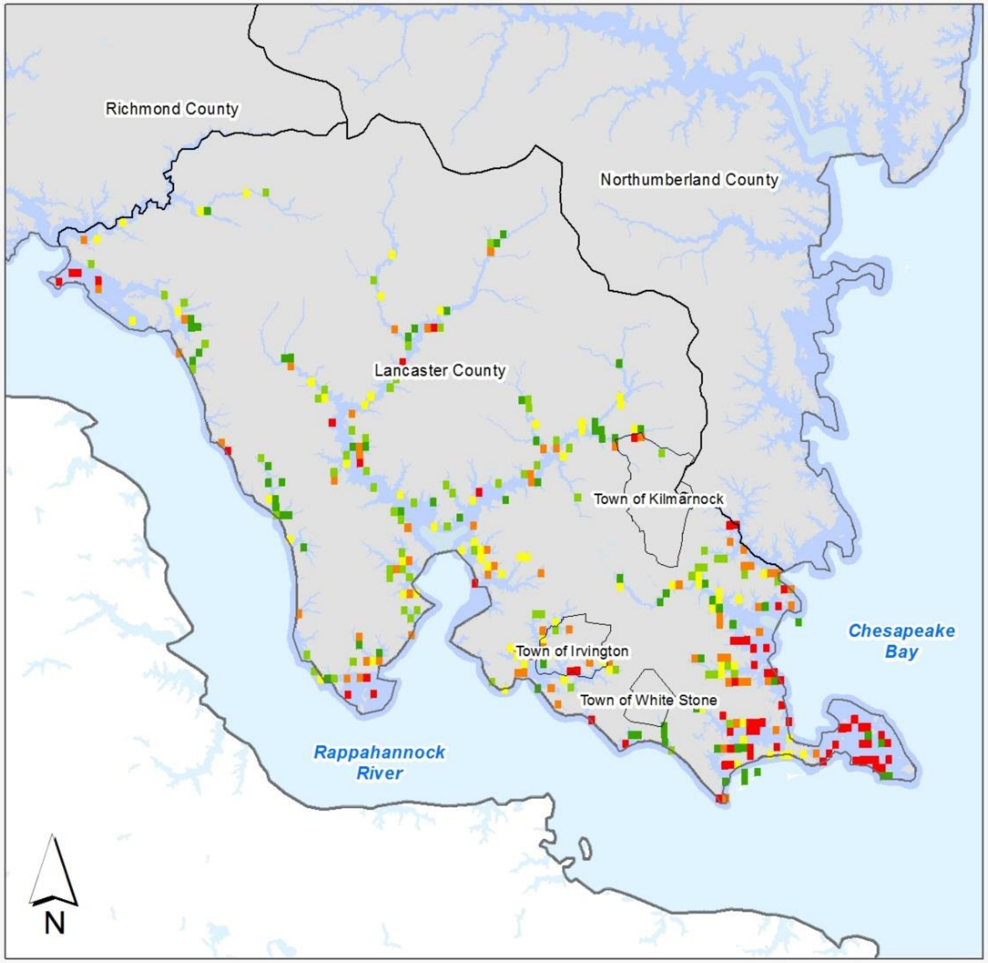
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

LANCASTER TOTAL EXPOSURE IN THE 500 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles: 0, 1.25, 2.5, 5, 7.5, 10

The Total Exposure in the Floodplain (TEIF) analysis was run for the 500 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 500 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 500 year floodplain.

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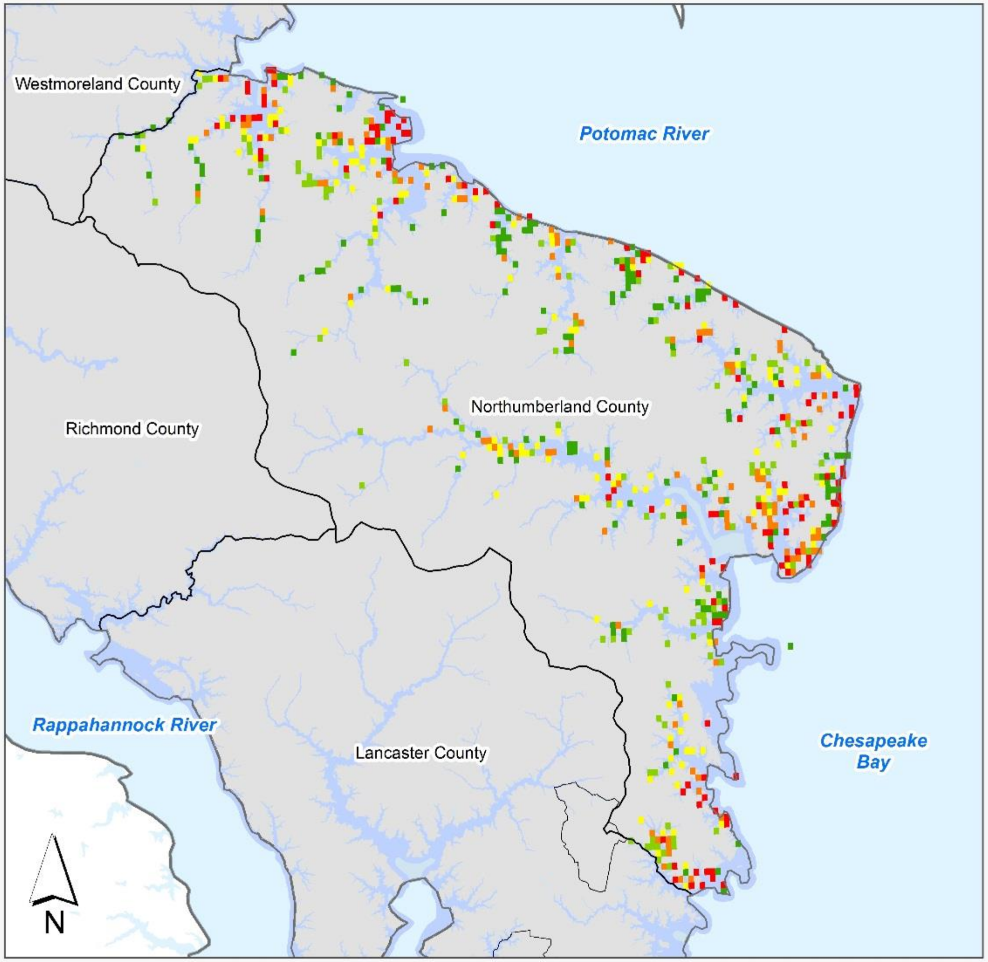
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

NORTHUMBERLAND TOTAL EXPOSURE IN THE 100 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

0 1 2 4 6 8 Miles

The Total Exposure in the Floodplain (TEIF) analysis was run for the 100 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 100 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 100 year floodplain.

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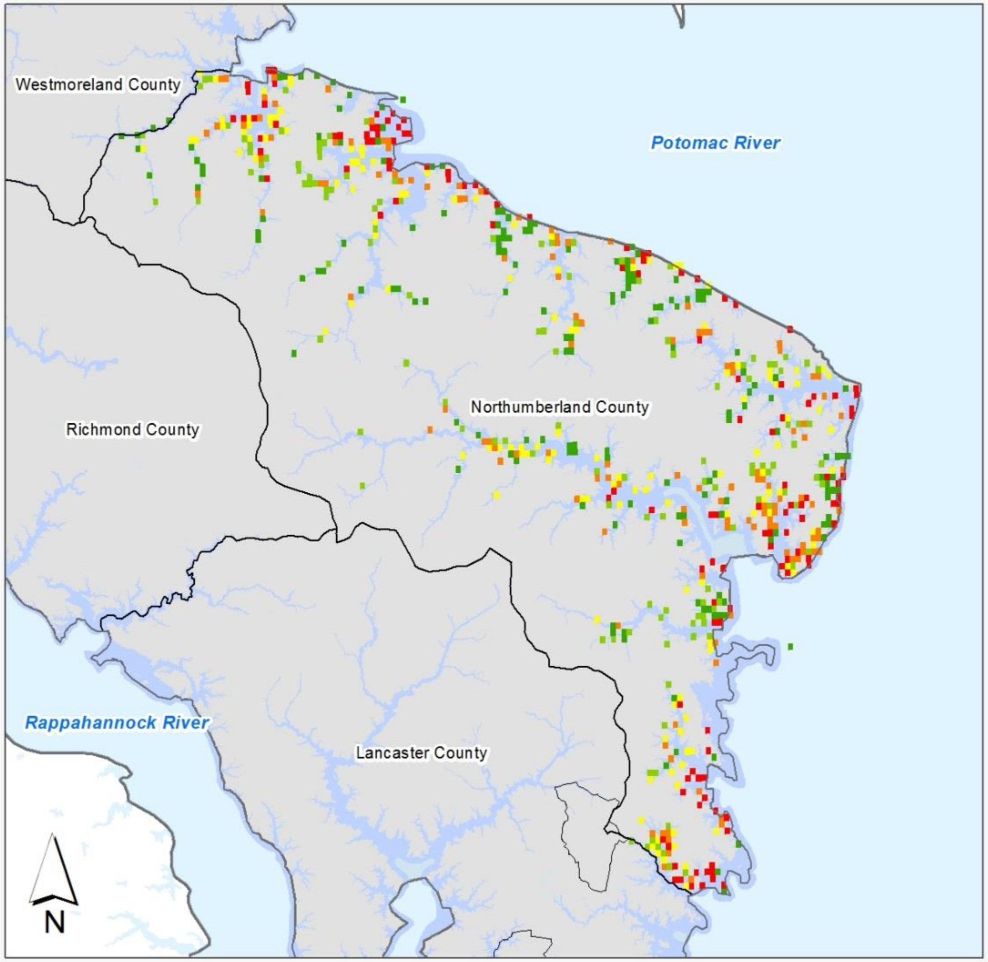
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

NORTHUMBERLAND TOTAL EXPOSURE IN THE 500 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles 0 1 2 4 6 8

The Total Exposure in the Floodplain (TEIF) analysis was run for the 500 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 500 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 500 year floodplain.

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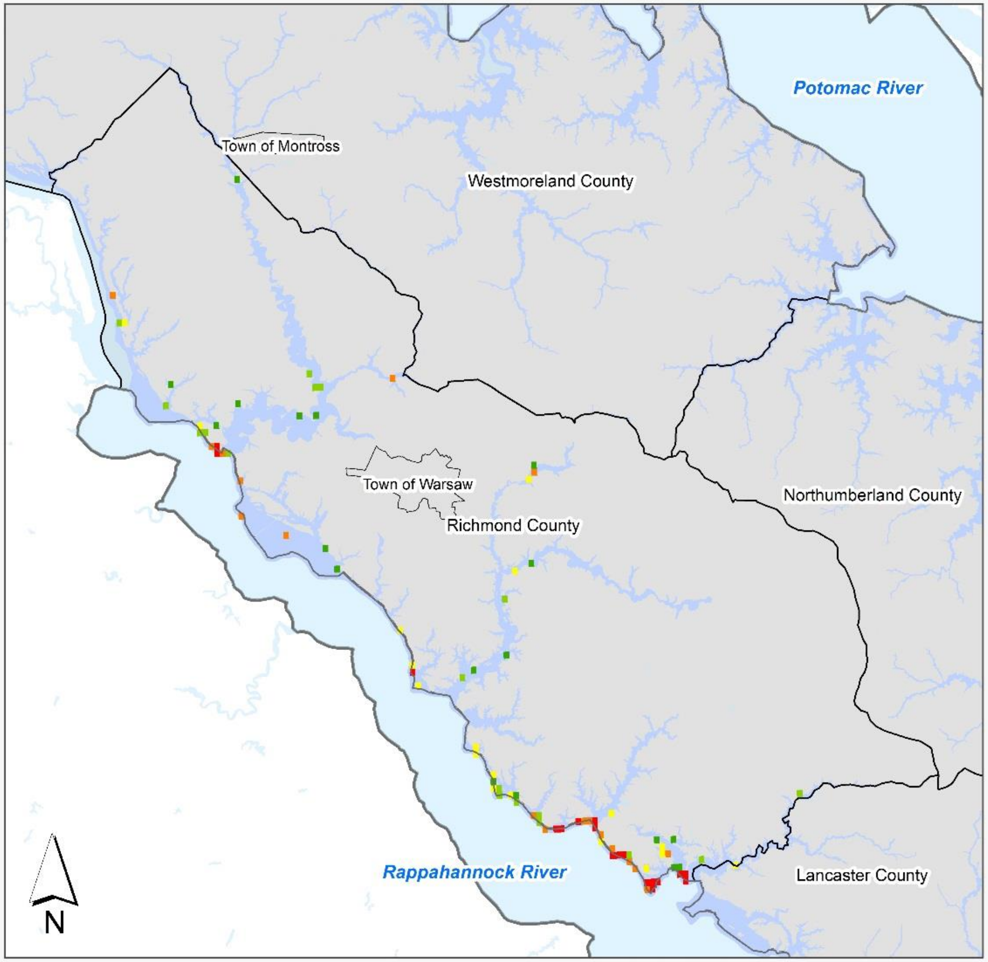
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

RICHMOND TOTAL EXPOSURE IN THE 100 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles 0 1 2 4 6 8

The Total Exposure in the Floodplain (TEIF) analysis was run for the 100 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 100 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 100 year floodplain.

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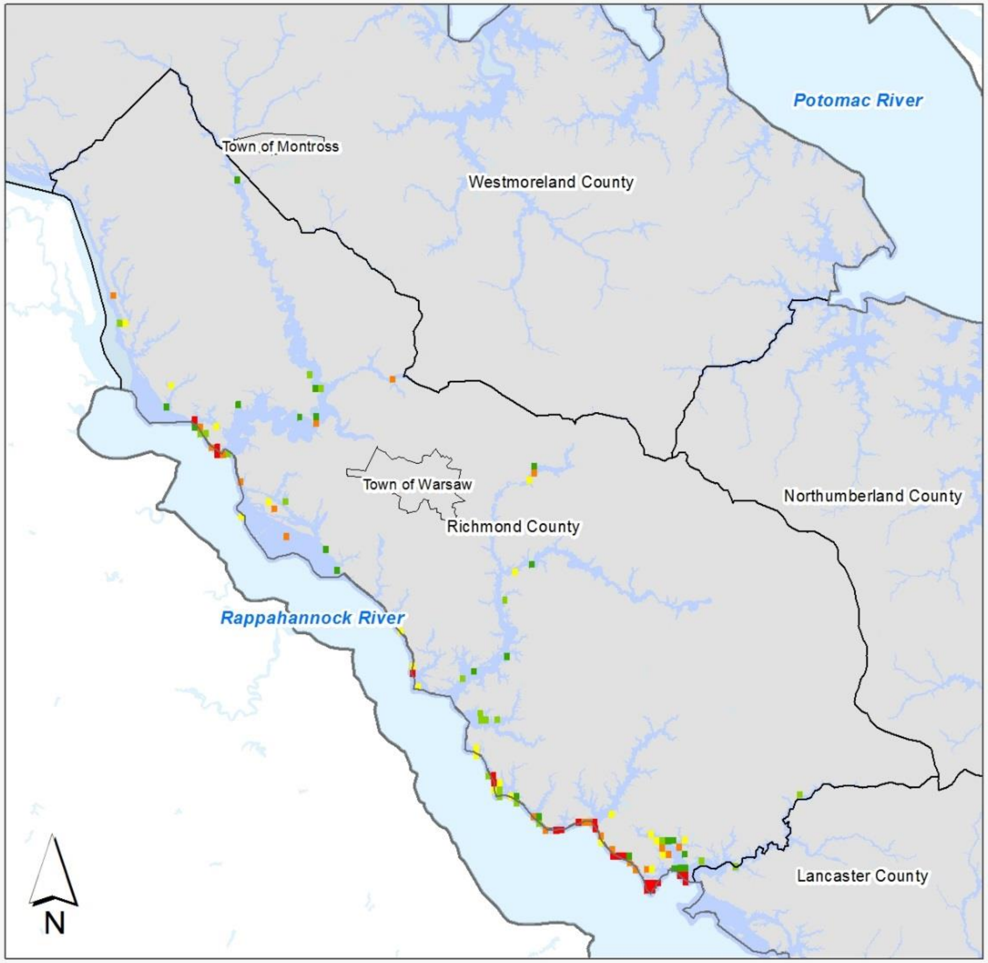
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

RICHMOND TOTAL EXPOSURE IN THE 500 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles 0 1 2 4 6 8

The Total Exposure in the Floodplain (TEIF) analysis was run for the 500 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 500 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 500 year floodplain.

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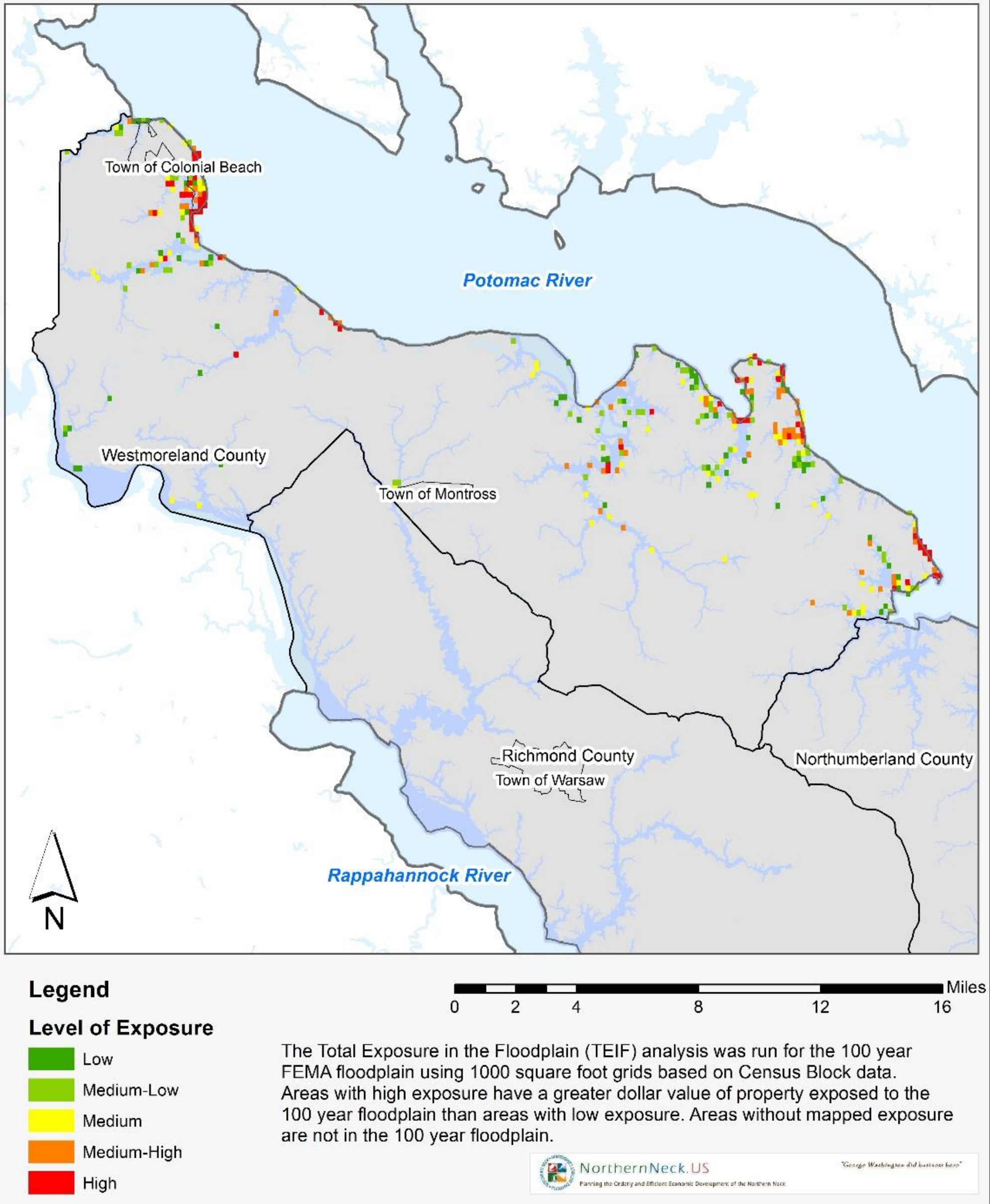
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

WESTMORELAND TOTAL EXPOSURE IN THE 100 YEAR FLOOD ZONE



The Total Exposure in the Floodplain (TEIF) analysis was run for the 100 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 100 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 100 year floodplain.

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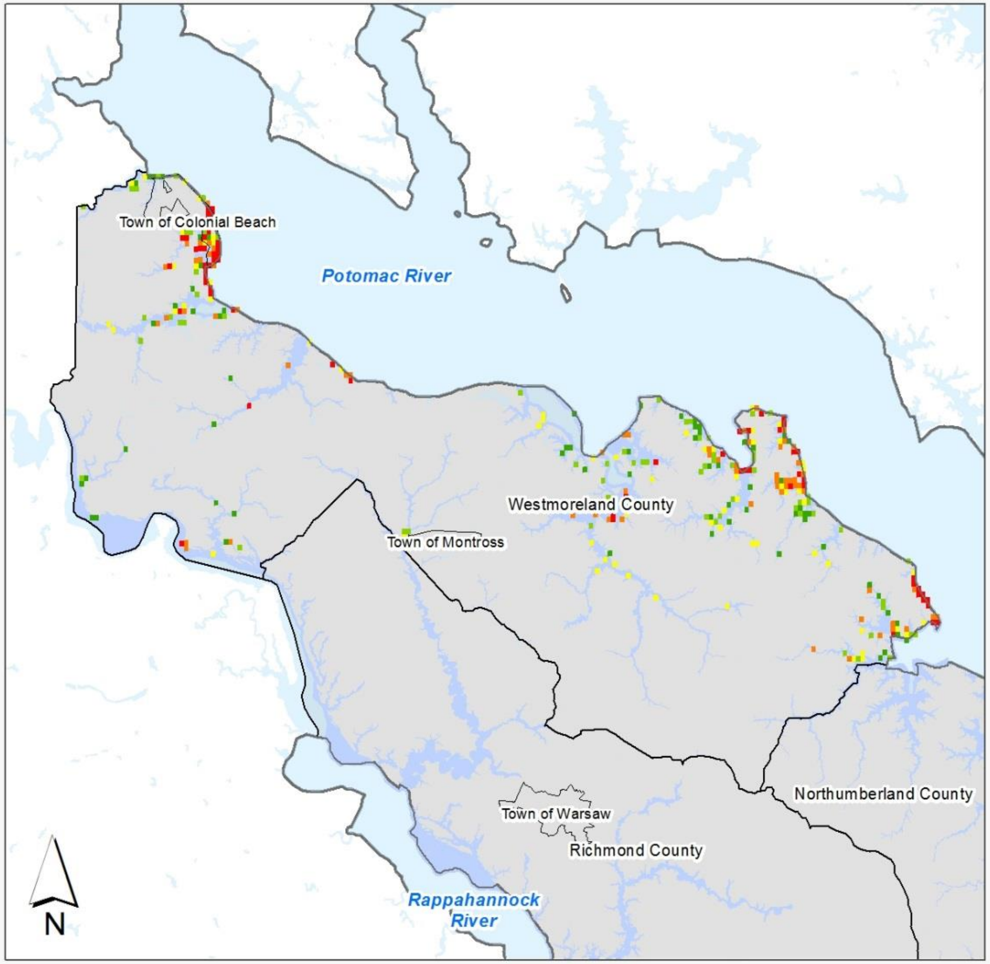
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

WESTMORELAND TOTAL EXPOSURE IN THE 500 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

0 2 4 8 12 16 Miles

The Total Exposure in the Floodplain (TEIF) analysis was run for the 500 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 500 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 500 year floodplain.

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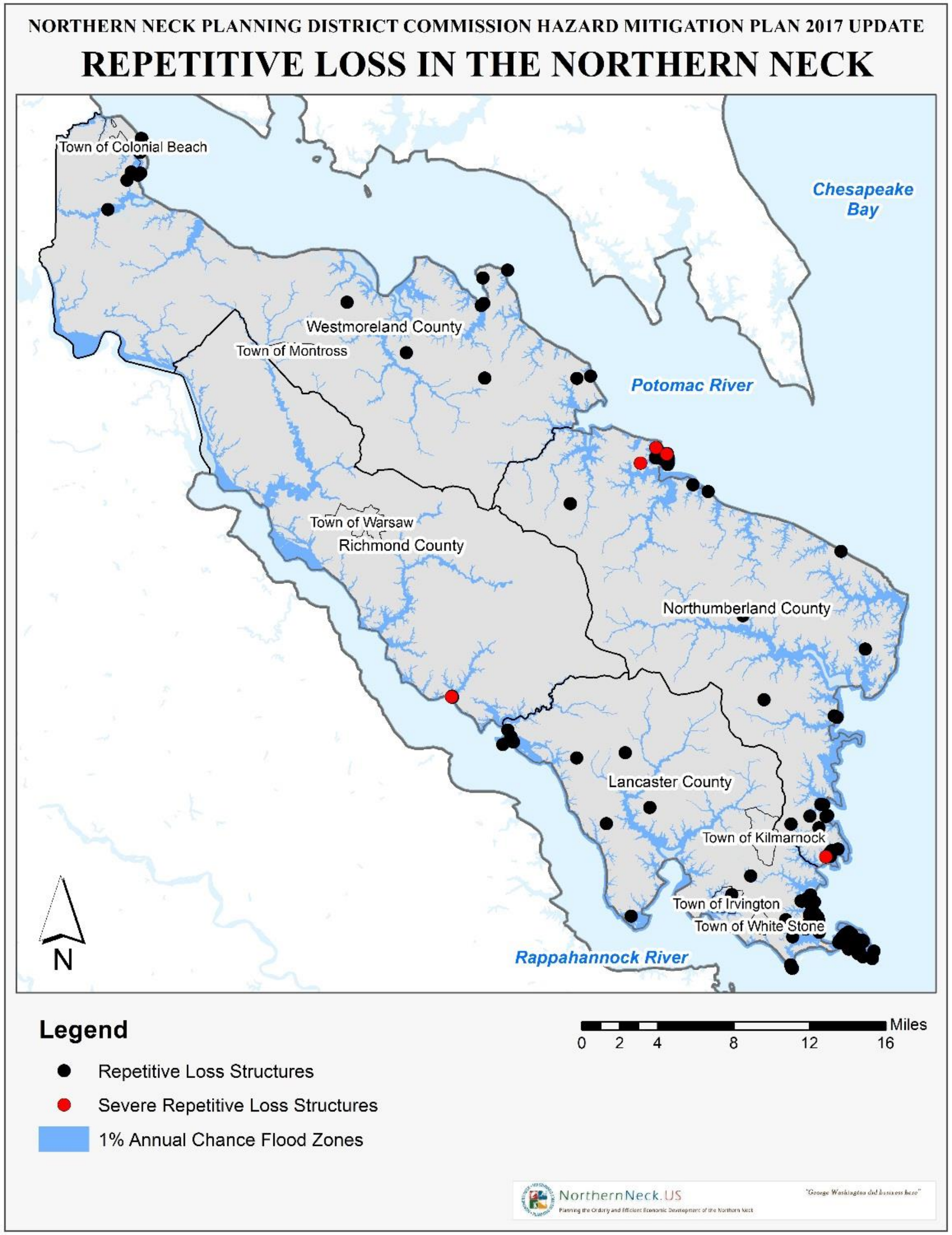
Repetitive Loss

- Repetitive Loss (RL) property: any insurable building w/ 2 or more claims >/= $1,000 paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. May or may not be currently insured by the NFIP.
- A Severe Repetitive Loss (SRL) property: any property with 4 or more separate claim payments >$5,000 each; or 2 or more separate claim payments where the total payments > the current building value of the property.
- Nationwide, RL properties constitute 2% of all NFIP insured properties, but are responsible for 40% of all NFIP claims


NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE
REPETITIVE LOSS IN THE NORTHERN NECK
Town of Colonial Beach
Chesapeake Bay
Westmoreland County
Town of Montross
Potomac River
Town of Warsaw
Richmond County
Northumberland County
Lancaster County
Town of Kilmarnock
Town of Irvington
Town of White Stone
Rappahannock River
N
Legend
Repetitive Loss Structures
Severe Repetitive Loss Structures
1% Annual Chance Flood Zones
Miles
0 2 4 8 12 16
NorthernNeck.US

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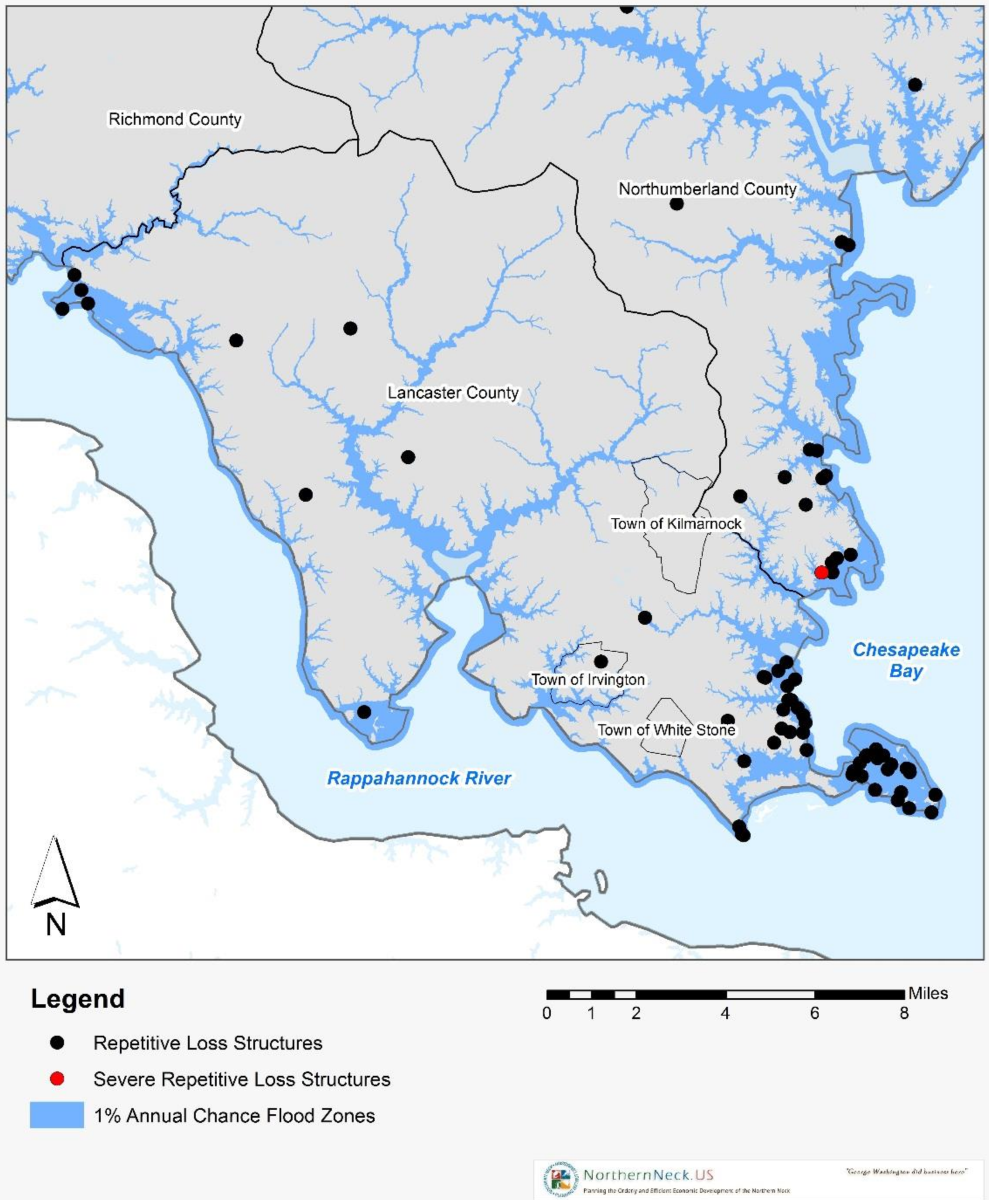
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS IN LANCASTER COUNTY



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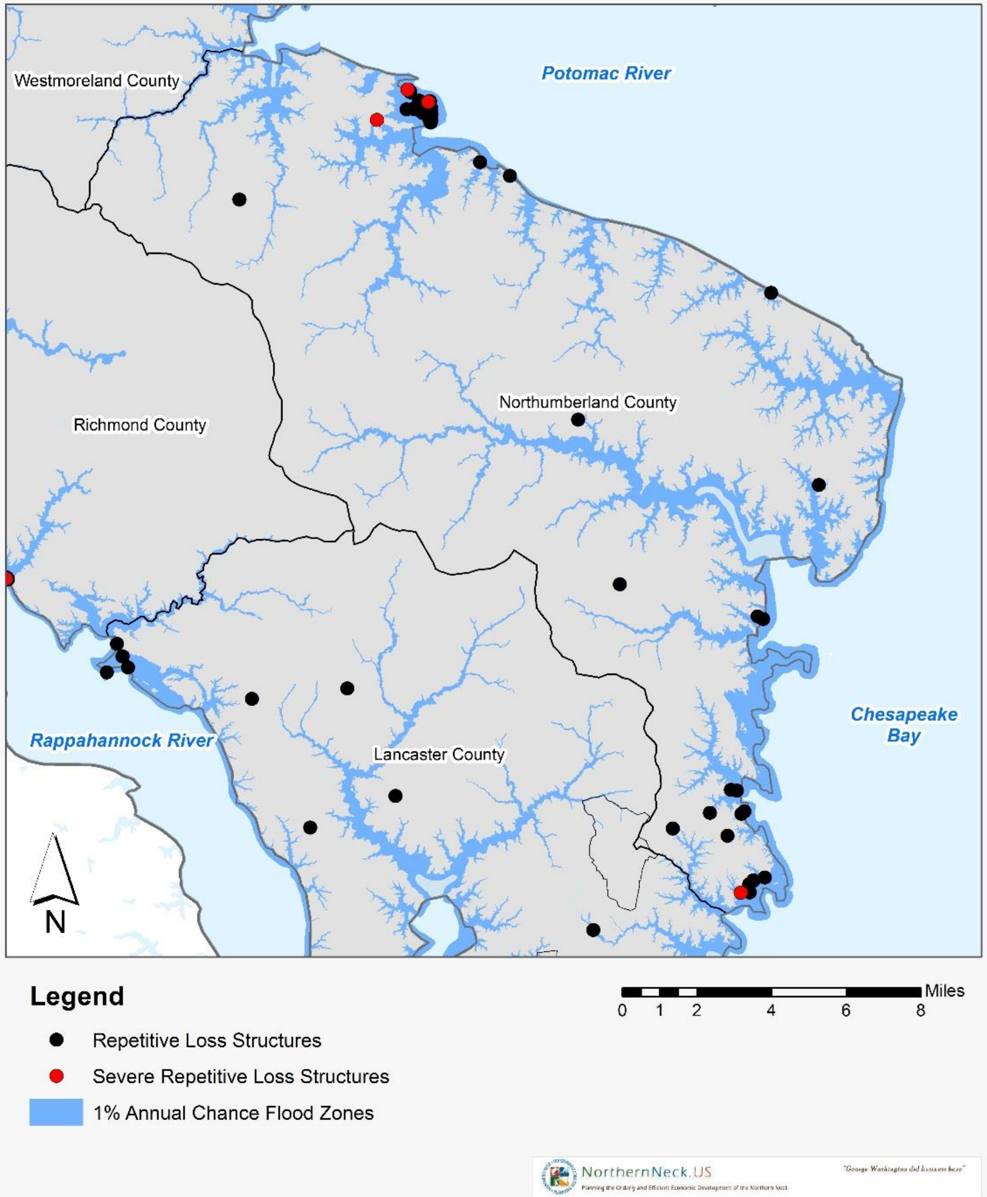
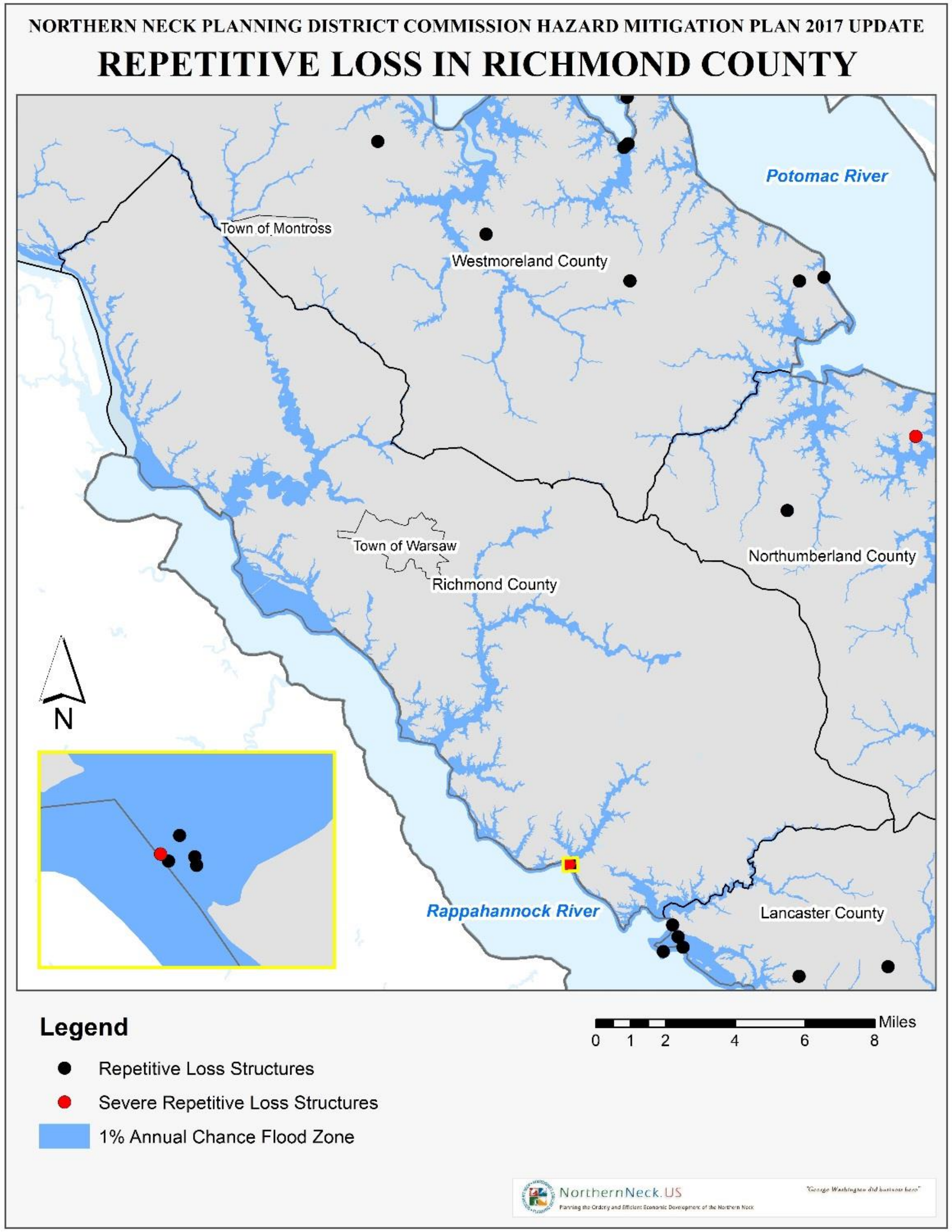
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS IN NORTHUMBERLAND COUNTY



Dewberry



NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE
REPETITIVE LOSS IN RICHMOND COUNTY
Potomac River
Town of Montross
Westmoreland County
Northumberland County
Town of Warsaw
Richmond County
Rappahannock River
Lancaster County
N
Legend
Repetitive Loss Structures
Severe Repetitive Loss Structures
1% Annual Chance Flood Zone
0 1 2 4 6 8
Miles
NorthernNeck.US

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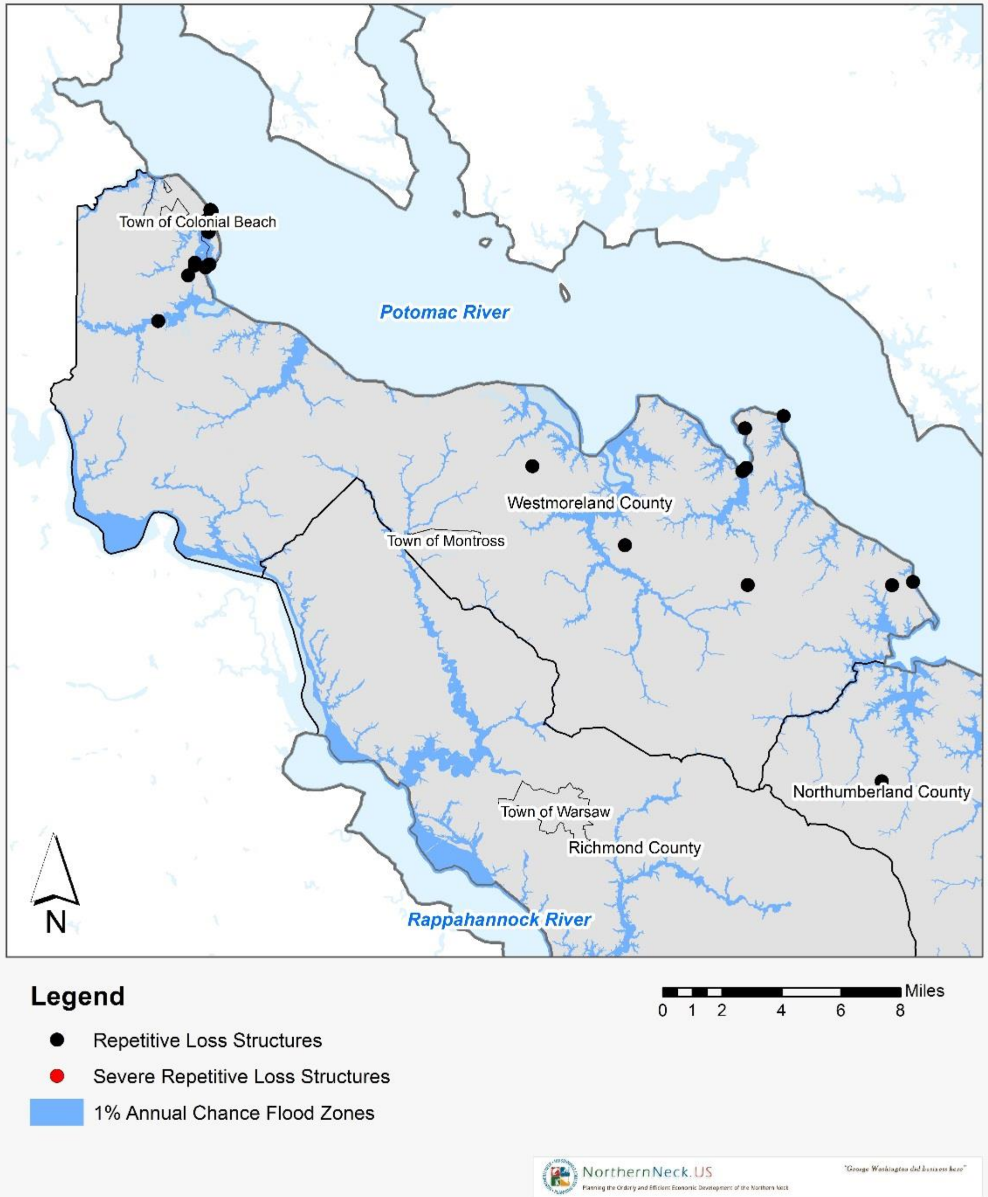
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS IN WESTMORELAND COUNTY



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Coastal Erosion Risk

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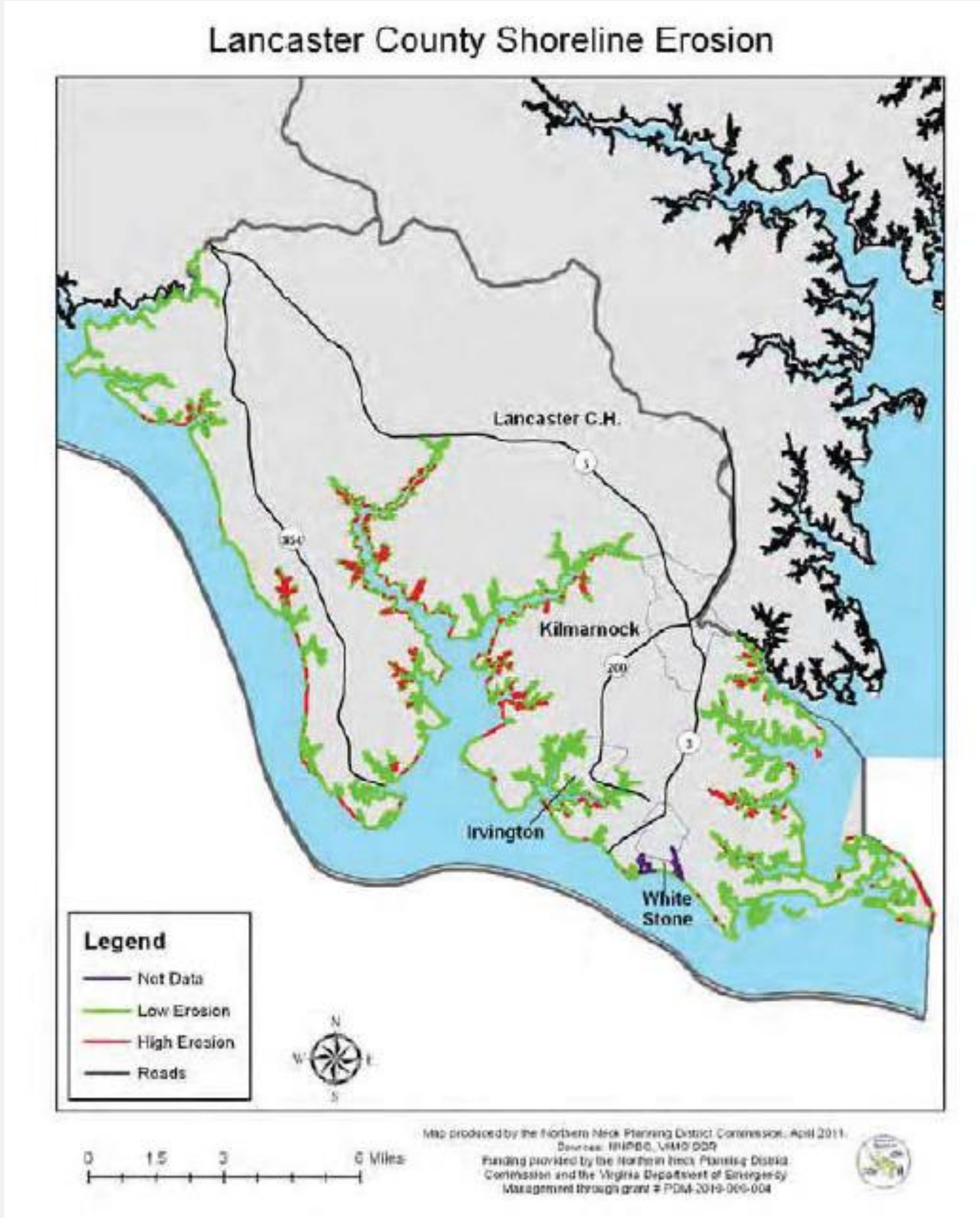
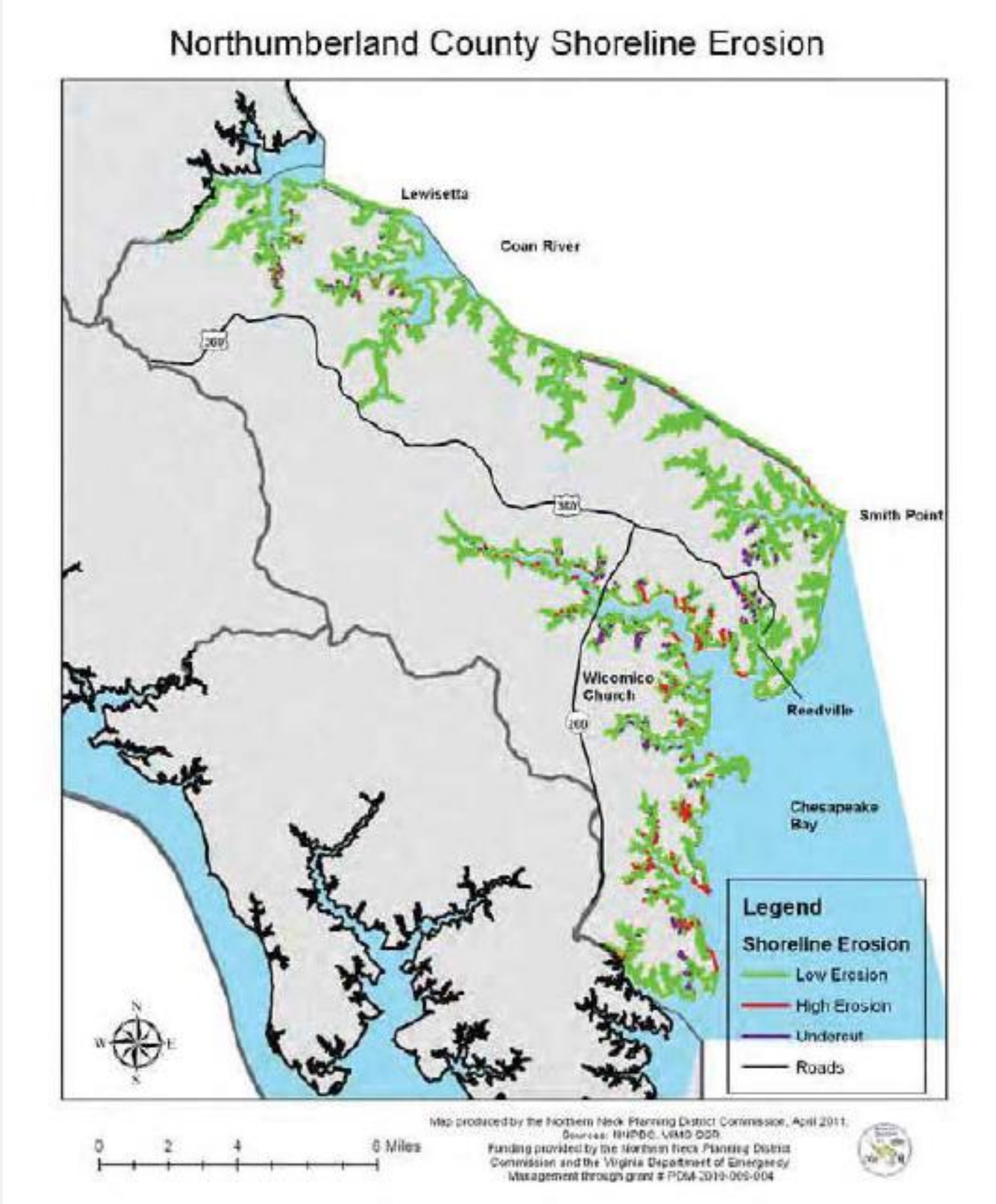
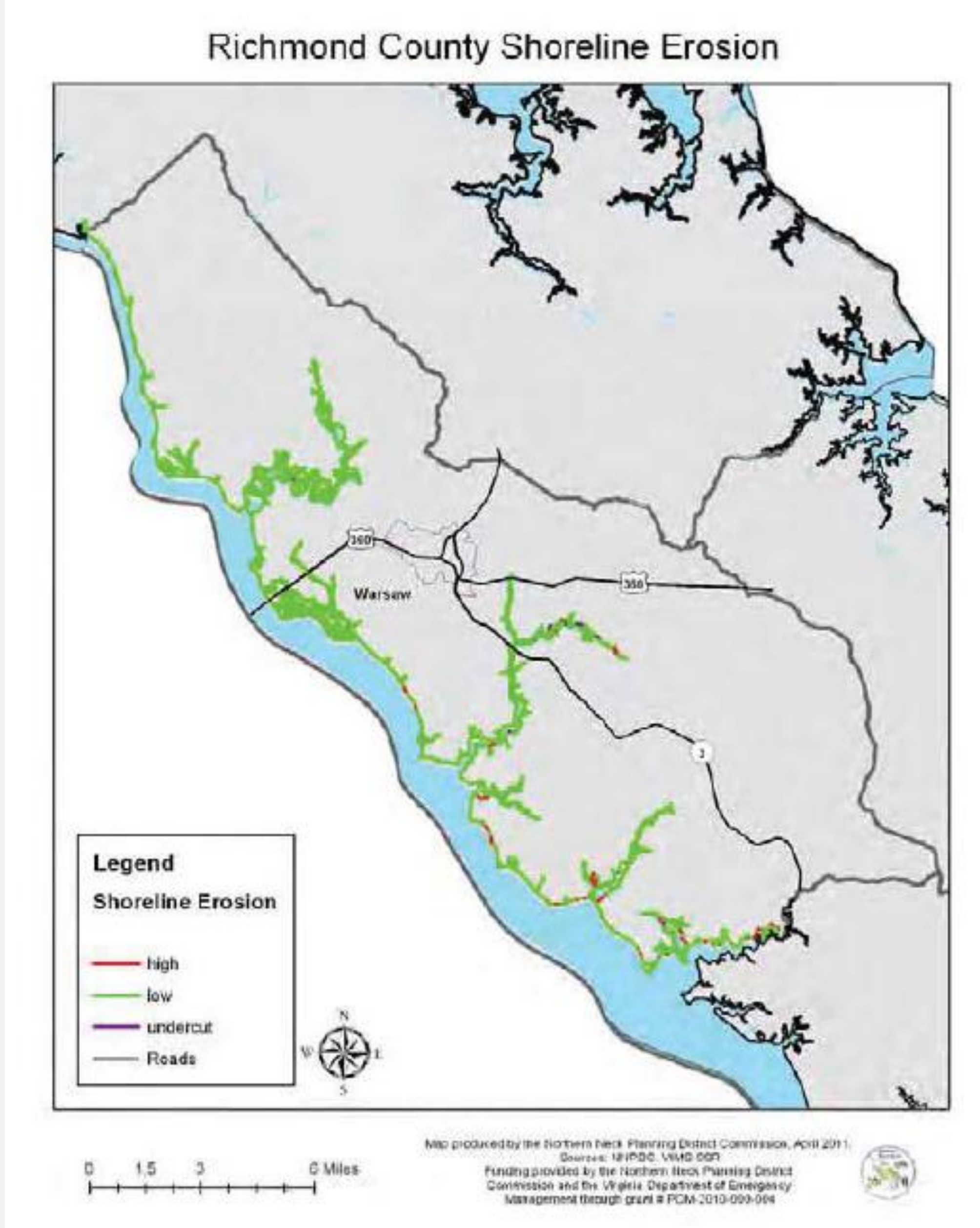


* From 2011 Plan



* From 2011 Plan



* From 2011 Plan

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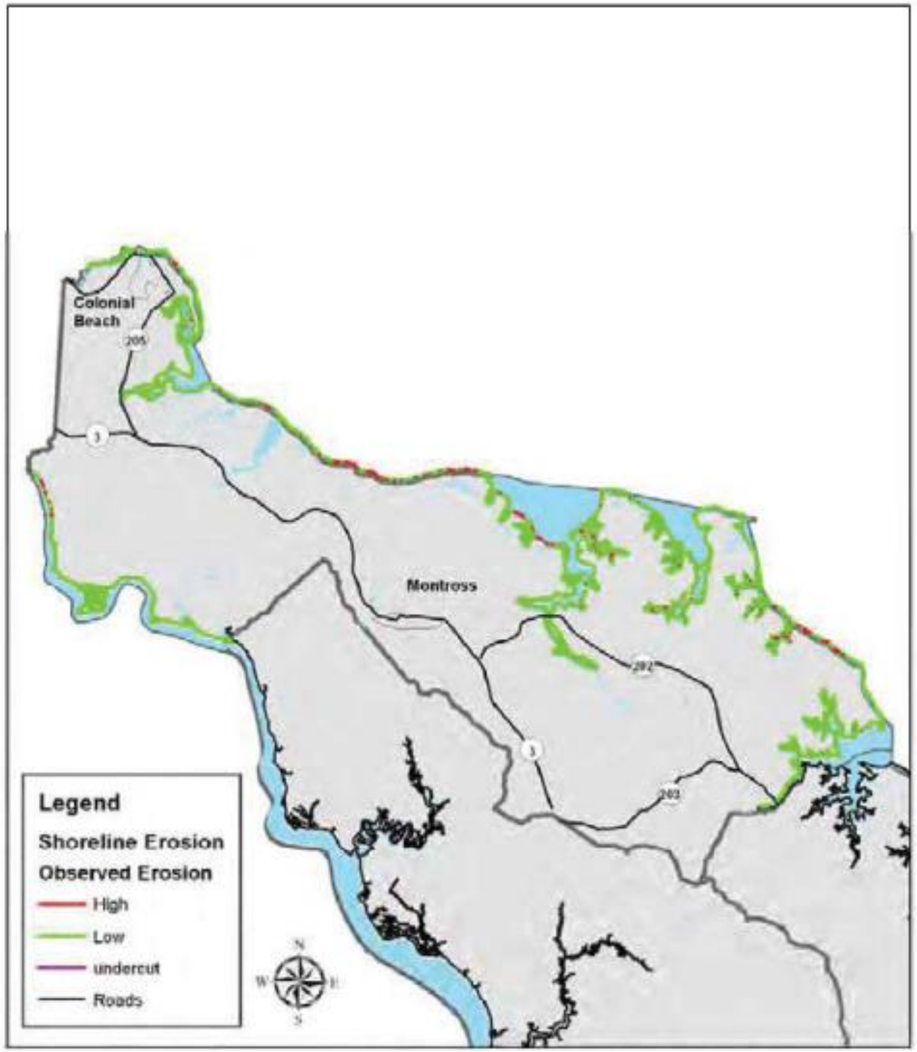
Westmoreland County Shoreline Erosion



0 1.25 2.5 5 Miles

Map produced by the Northern Neck Planning District Commission, April 2011.
Sources: NNPDC, VIMS SSR
Funding provided by the Northern Neck Planning District Commission and the Virginia Department of Emergency Management through grant # PDM-2010-000-004

* From 2011 Plan

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Shoreline Studies Program, Virginia Institute of Marine Science, September 2012

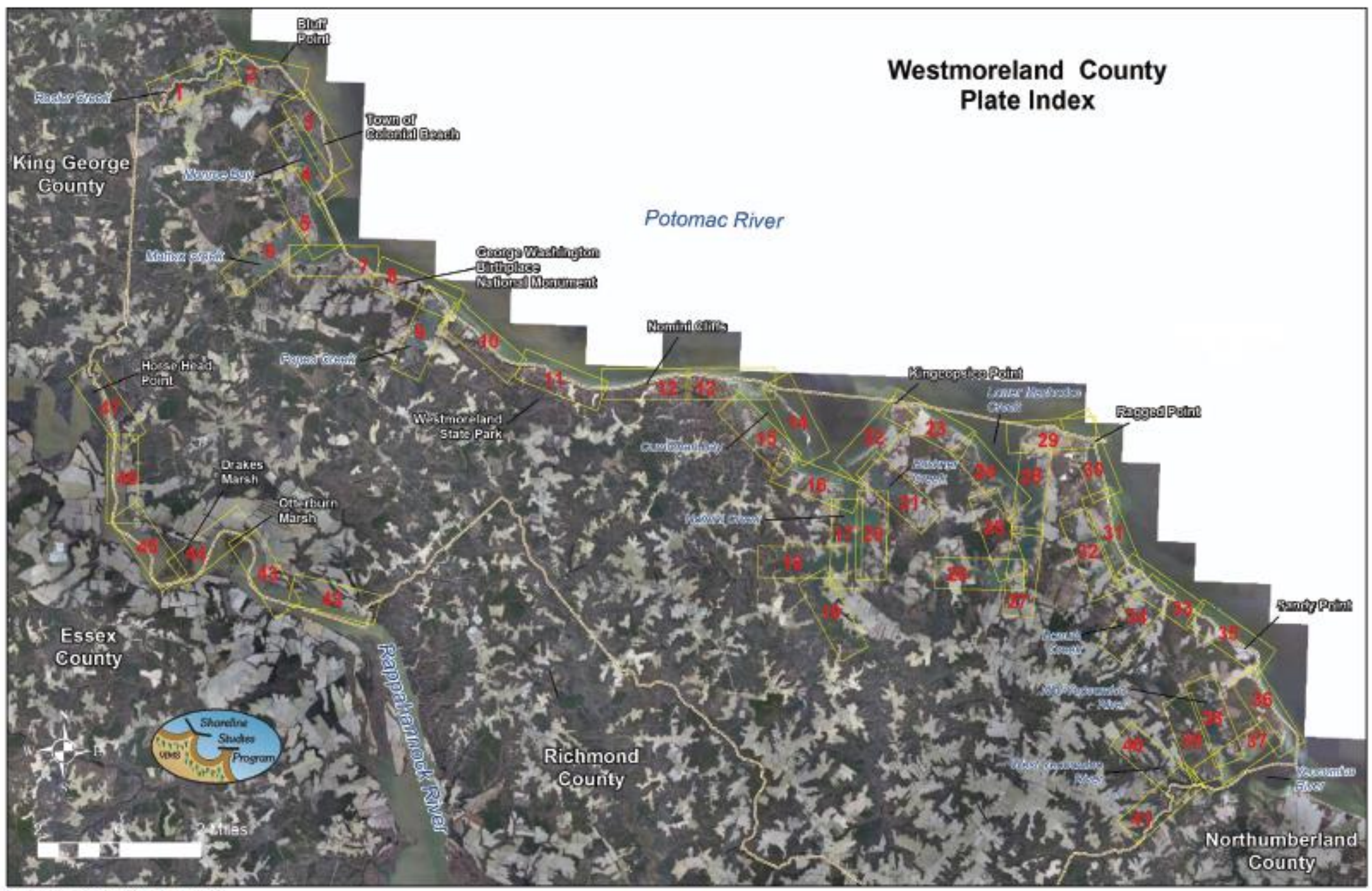


Figure 2. Index of shoreline plates.

Segments of the shoreline where shoreline erosion was calculated

Shoreline Studies Program, Virginia Institute of Marine Science, September 2012

Table 1. Average end point rate of change (ft/yr) between 1937 an d2009 for segments along Westmoreland County's shoreline. Segment locations are show on maps in Appendix A.

Segment Name	Location	Average Rate of Change (ft/yr)
A	Rosier Creek	-0.7
B	Potomac River, Mouth of Rosier Creek to Bluff Point	-0.1
C	Potomac River, Town of Colonial Beach	0.1
D	Monroe Bay	-0.2
E	Potomac River, Sebastian Point to Paynes Point	-0.7
F	Mouth of Mattox Creek, Wirt Wharf	-0.1
G	Potomac River, Church Point to Westmoreland State Park	-1.1
H	Potomac River, Westmoreland State Park to Haulover Inlet	-0.8
I	Nomini Bay, Hollis Marsh	-4.0
J	Currioman Bay, Haulover Inlet to Nomini Creek	-0.6
K	Nomini Creek including Buckner Creek	-0.3
L	Nomini Bay, White Point to Kingcopsico Point	-0.3
M	Lower Machodoc Creek	-0.8
N	Potomac River, Grapevine Point to Ragged Point	-1.1
O	Potomac River, Ragged Point to Jackson Creek	-0.9
P	Potomac River, Jackson Creek to Sandy Point	-2.2
Q	Potomac River, Sandy Point to Lynch Point	-1.4
R	Yeocomico River	-0.5
S	Rappahannock River, Richmond County Line to Layton Landing Rd.	-0.4
T	Rappahannock River, Layton Landing Rd. to Blind Point	-1.2
U	Rappahannock River, Blind Point to King George County Line	-0.4

- Segments of the shoreline and their calculated shoreline erosion rate of change
- Annual losses predicted losses from -0.1 to -4.0 ft./yr.

Tornado Hazard Risk

Tornado History 1965-2016

Fujita Scale	Date	Counties Affected	Deaths	Injuries	2017 Property Damages	2017 Crop Damages	2017 Total Damages
EF1	**2/24/2016**	**Lancaster, Westmoreland**	**0**	**0**	**$1,299,168**	**$79,045**	**$1,378,212**
EF2	**2/24/2016**	**Richmond**	**0**	**0**	**$3,344,191**	**$0**	**$3,344,191**
EF0	6/18/2015	Lancaster, Richmond	0	0	$46,178	$0	$46,178
EF0	2/21/2014	Westmoreland	0	0	$15,411	$0	$15,411
F1	1/14/2005	Northumberland, Richmond	0	0	$37,361	$0	$37,361
F1	5/25/2004	Lancaster	0	0	$25,751	$0	$25,751
F0	8/26/2003	Richmond	0	0	$6,609	$0	$6,609
F0	4/4/1999	Westmoreland	0	0	$36,498	$0	$36,498
F1	9/10/1997	Northumberland	0	0	$227,309	$0	$227,309
F0	7/13/1996	Westmoreland	0	0	$15,502	$0	$15,502
F1	7/12/1996	Northumberland	0	0	$387,541	$0	$387,541
F0	6/24/1996	Westmoreland	0	0	$263,528	$0	$263,528
F0	1/19/1996	Richmond	0	0	$23,252	$0	$23,252
F0	8/6/1993	Lancaster	0	0	$841,595	$0	$841,595
F1	**5/10/1990**	**Lancaster**	**0**	**0**	**$4,652,276**	**$0**	**$4,652,276**
F1	5/2/1989	Northumberland	0	0	$0	$0	$0
F2	5/2/1989	Northumberland	0	0	$0	$0	$0
F2	8/31/1983	Richmond	0	0	$61,049	$0	$61,049
F1	9/6/1975	Lancaster	0	0	$11,302	$0	$11,302
F2	4/25/1975	Richmond	0	0	$113,021	$0	$113,021
F0	8/10/1969	Northumberland	0	0	$1,657	$0	$1,657
F3	11/2/1966	Richmond	0	0	$187,671	$0	$187,671

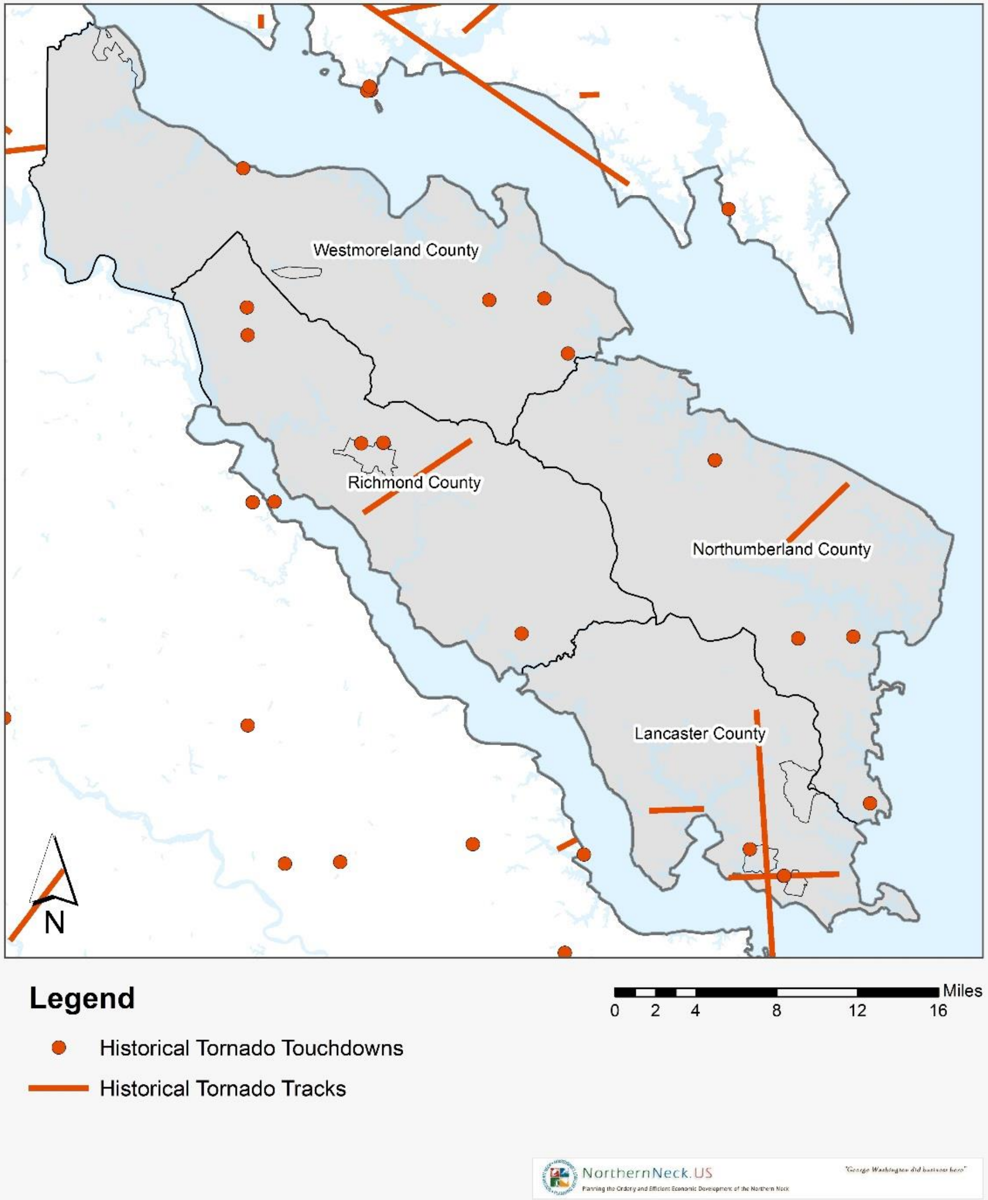
Local Tornado Risk

EF Scale Rating	Estimated Tornado Counts Northern Neck (1965-2016)
EF0	4
EF1	2
EF2	1
F0	7
F1	8
F2	2
F3	1

Source: NCEI Database for 2016.

NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

TORNADOES IN THE NORTHERN NECK, 1950 - 2013



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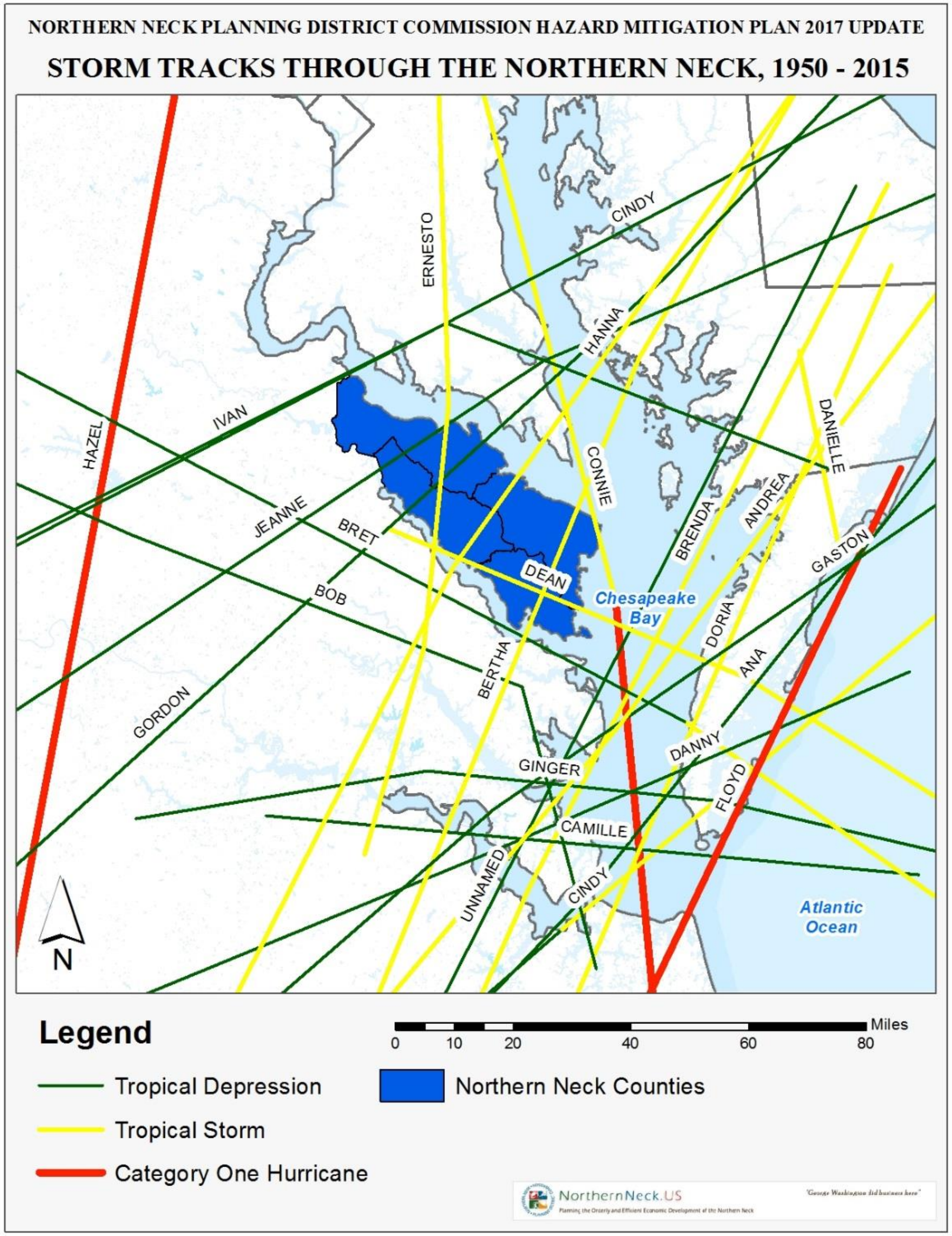
Hurricanes and Tropical Storm Risk

Note: While the PDC experienced significant damage from Fran and Isabel, the tracts were west of the PDC.



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Winter Storm Risk

Winter Storm Hazard Risk

Winter storms are a persistent problem for Northern Neck.

Recent notable storms (excluding Nor'easters) include:

- January 2017 – Southern system resulted in snow from central to northern and northeastern VA – school closings, limited power outages.
- January 2016 – Low pressure from the south resulted in snow throughout central and northern Virginia and the Northern Neck resulting in limited power outages, school closings.
- March 2015 - Low pressure moving northeast produced freezing rain and freezing drizzle across portions of the Virginia Northern Neck. Ice accumulations ranged from a trace to 0.12 inch.
- Winter 2010 – Three significant winter storms severely affected northern Virginia and the Northern Neck resulting in road closures, extended power outages and periods of schools closings.
- December 2009 – A blizzard originating in the mid-west left the Northern Neck with 18-24 inches of snow, causing road closures, school closings and power outages.

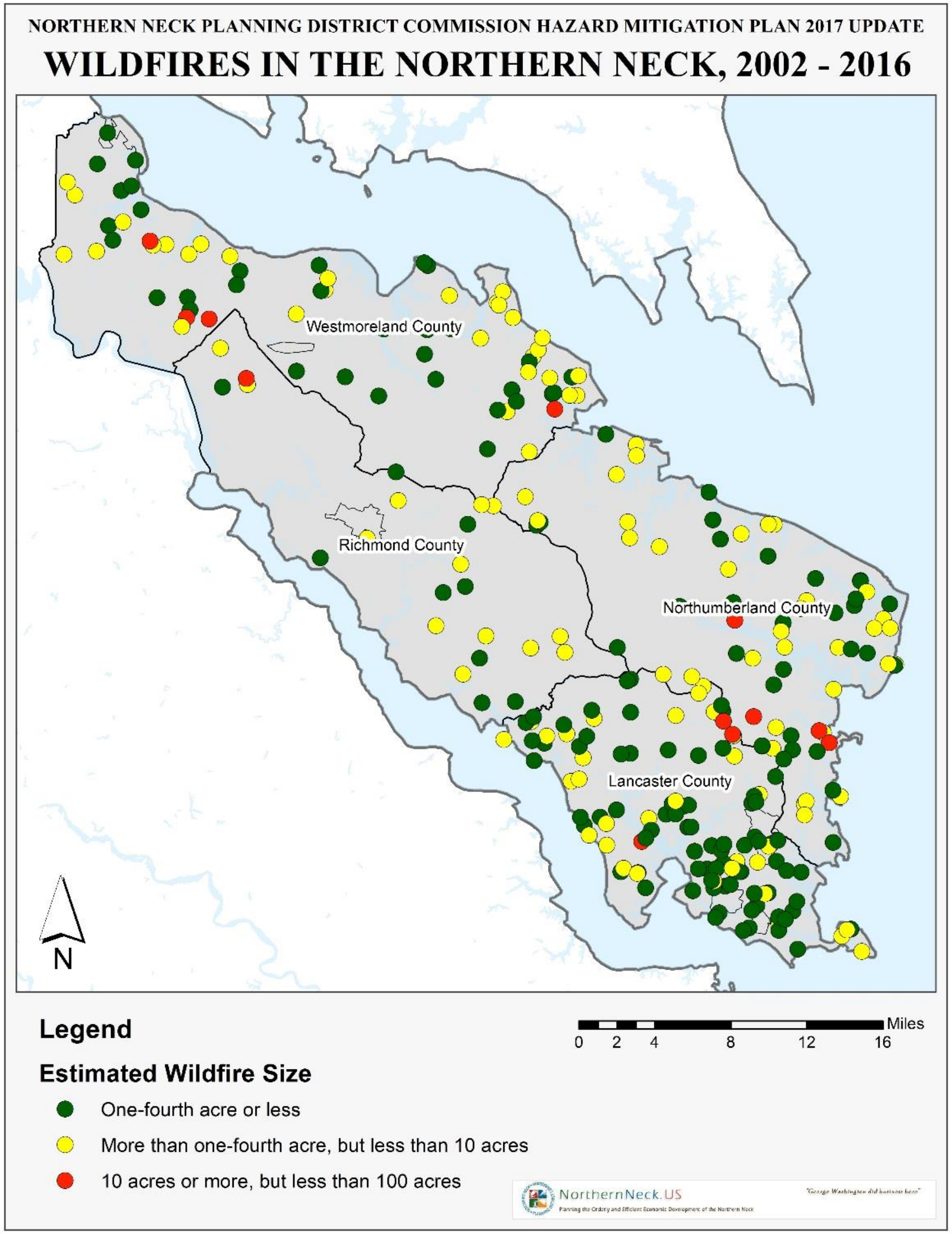
Wildfire Risk

Wildfires 2002-2016

County	Size Class	Fire Description	Numbers of Fires
Lancaster	**A**	**One-fourth acre or less**	**79**
	B	**More than one-fourth acre, but less than 10 acres**	**33**
	C	**10 acres or more, but less than 100 acres**	**3**
Richmond	A	**One-fourth acre or less**	**34**
	B	**More than one-fourth acre, but less than 10 acres**	**34**
	C	**10 acres or more, but less than 100 acres**	**5**
Northumberland	A	**One-fourth acre or less**	8
	B	**More than one-fourth acre, but less than 10 acres**	**11**
	C	**10 acres or more, but less than 100 acres**	1
Westmoreland	A	**One-fourth acre or less**	**36**
	B	**More than one-fourth acre, but less than 10 acres**	**30**
	C	**10 acres or more, but less than 100 acres**	**5**

Wildfire Risk

- Northern Neck has on average 19 wildfire events per year
- However, as shown in the map on the right, most wildfires are small and are quickly extinguished



Drought Risk

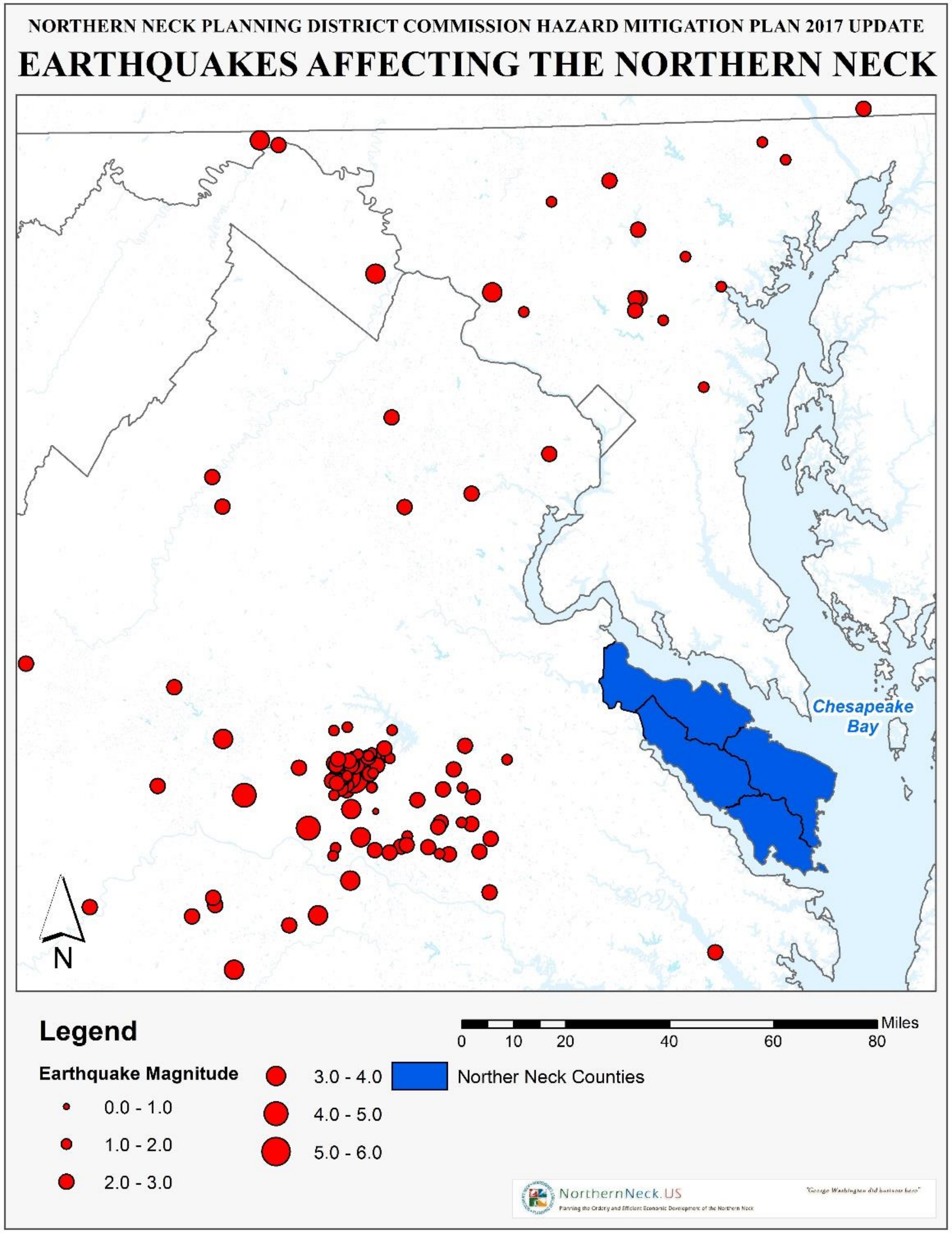
Drought Categories

Category	Description	Possible Impacts
D0	Abnormally dry	Going into a drought: short-term dryness slows planting, growth of crops or pastures; fire risk above average. Coming out of a drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low; some water shortages develop or are imminent; voluntary water use restrictions requested.
D2	Severe drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.
D3	Extreme drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.

US Census of Agriculture General Information by County

(areas at risk of Drought Impacts)

County	Farms	Total Acres	Average Acres/Farm	Market Value of Products	Average Farm Value
Lancaster County	61	10,695	175	$4,864,000	$79,741
Northumberland County	566	79,107	140	$16,485,000	$29,125
Richmond County	90	32,373	360	$15,467,000	$171,858
Westmoreland County	152	59,378	391	$35,758,000	$235,248



NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE
EARTHQUAKES AFFECTING THE NORTHERN NECK
Chesapeake Bay
N
Legend
Earthquake Magnitude
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
Norther Neck Counties
0 10 20 40 60 80 Miles
NorthernNeck.US

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Northern Neck Hazard Rankings

Hazard Rankings

Hazard Type	2011 HMP Planning Consideration Level		2017 LEPC Kick-Off Meeting	2017 Draft HIRA Update
Hurricane	Significant		Significant	Significant
Flooding (river, stream, inc. coastal flooding)	Moderate		Moderate	Significant
Winter Storm	Moderate		Moderate	Limited
Coastal Erosion	Moderate		Moderate	Moderate
Drought	Limited		Moderate	Limited
Coastal Storm (Nor'easter)	Limited		Significant	Significant
Tornado	Limited		Significant	Significant
Wildfire	Limited		Limited	Limited
Earthquake	None		Limited	Limited
Severe Weather (Lightening, Wind, Hail)	None		None	Moderate

Mitigation Actions and Goals

- Committee chose to eliminate objectives underneath 2011 plan goals.
- 2011 plan goals were modified to reflect resiliency and “whole community” concepts.
- The goals which follow reflect edited, new 2017 hazard mitigation plan goals.
- Let’s talk through each goal’s actions and how mitigation success stories, gaps, new approaches.

2011 Northern Neck PDC 2011 HMP Goals

- Goal 1: Promote new development that avoids undue risks posed by natural hazards and is resilient to natural disasters.
- Goal 2: Address natural hazards and vulnerabilities that represent a threat to the community.

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2011 Northern Neck PDC Revised HMP Goals

- Goal 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents, property and critical infrastructure of the Northern Neck.

- Goal 4: Enhance the capabilities of local government to address natural hazards to enhance the whole community for increased resilience.

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2011 Northern Neck PDC Revised HMP Goals

- Goal 5: Increase natural hazard awareness of our citizens. Educate Northern Neck citizens and part-time residents on citizen and community hazard resiliency.

- Goal 6: Participate and Comply with the National Flood Insurance Program (NFIP) through Floodplain Identification, Mapping and Floodplain Management.

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2011 Mitigation Actions Status Review

Number in 2011 Plan	Strategy	Responsible Department	Priority	2016 Update	Notes - If cancelled, discontinued or no action, please state why?
Regional-1 (Richmond Regional PDC)	Leverage regional partnerships (e.g., law enforcement) to better use their data to inform mitigation planning and project development.	Local Emergency Managers	High	Continue	This strategy is an ongoing practice that PDCs continue to perform. Most PDC work involves relationships and partnerships with varied entities.

- Assignment: Look these over; amend, correct and complete.
- Add an explanation in the Notes column of why any "high" priority strategy was not completed or was "discontinued."

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Mitigation Actions

- Preventative Measures
- Property Protection
- Emergency Services
- Structural Projects
- Natural Resources Protection
- Public Information Programs

2017 – 2022 Actions

- 2011 “Carry-forward” actions pre-populated
- Two actions pre-populated to cover HMA grant eligibility and plan integration
- Actions must include:
  - **Strategy/action statement**
  - **Responsible Department**
  - **Priority**
  - **Goals supported (Dewberry will align to Goals)**
  - **Hazard Addressed**
  - **Timeframe**
  - **Resources – funding source, staff, etc.**
  - **Check the project category box (or Dewberry will complete)**

2017 – 2022 Mitigation Actions

2017 - 2022 Mitigation Actions							
Number	**Strategy**	**Responsible Department**	**Priority**	**Goals**	**Hazards**	**Time**	**Resources**
Regional - 1 (RR PDC)	Leverage regional partnerships (e.g., law enforcement) to better use their data to inform mitigation planning and project development.	Local Emergency Managers	High	1, 2, 3,	All	ongoing	staff
Regional - 2 (RR PDC)	Work with state partners and neighboring regions to expand planning efforts regarding regional strategy for incoming evacuees (topics to include traffic management, shelters, information sharing, etc.).	Local Emergency Managers	Low	1, 2, 3, 4, 5	All	ongoing	staff, CVEMA
Regional - 3 (RR PDC)	Continue to refine improve the quality and detail of data to prepare usable and effective hazard assessments and vulnerability analysis	PDC, Local GIS Managers		1, 2, 3	All	ongoing	staff, grants

Outreach

- PDC and local government initiated
- Send copies/scans/web postings, tweets and Facebook screen captures to: jbrowning@dewberry.com


Northern Neck News

FOOD LION

Groundwater withdrawal requirements

Tree climbing as an international sport

Town Hall meeting sponsored by Indivisible Essex chapter

Prescription drug take-back

Severe storm crushes Colonial Beach

Inside this edition

facebook

twitter

Fed up with big banks that don't follow through?

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Next Steps

- Draft HIRA chapter comments to Deborah Mills (dmills@dewberry.com) or Jillian by June 23, 2017
- 2011 Mitigation Action Status to Jillian Browning (jbrowning@dewberry.com) NLT June 2, 2017
- 2017 – 2022 Mitigation Actions to Jillian Browning by June 9, 2017
- Draft Plan to Northern Neck PDC and LEP/MAC by July 1, 2017

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Questions, Comments, Discussion

Deborah G. Mills, C.F.M.

Associate

Dewberry

804.823.6971 Desk

804.335.9946 Mobile

dmills@dewberry.com

Northern Neck PDC Hazard Mitigation Plan Update FINAL Meeting May 31, 2017 Sign-In Sheet				
Jurisdiction	**Name**	**Position**	**Email**	**Phone**
NNPDC	Alex Eguiguren	Technical Assisstant	aeguiguren@nnpdc17.state.va.us	804.333.1900
NNPDC	Jerry Davis	Executive Director	jdavis@nnpdc17.state.va.us	804.516.5783
NNPDC	John Bateman	Regional Planner	jbateman@nnpdc17.state.va.us	804.313.8478
Westmoreland	Jeff Beasley	Emergency Services Chief	jbeasley@westmoreland-county.org	804.456.1777
Westmoreland	Bill Cease	IT Director	bcease@westmoreland-county.org	804.456.6268
Colonial Beach	Val Foulds	Town Manager	vfoulds@colonialbeachva.net	804.224.7181/590.848.4577
Westmoreland	Beth McDowell	Planner	bmcdowell@westmoreland-county.org	804.493.0120
"	"	"	bamst41@msn.com	"
Westmoreland	Darrin Lee	Planner	dlee@westmoreland-county.org	804.493.0120
Irvington	Bob Harresty	Town Administrator	info@irvingtonva.org	804.438.6230
Whitestone	Patrick Freve	Patrick Freve	frere37@yahoo.com	804.436.4935
Lancaster	Heather Brown	Dept. Coordinator	hbrown@lancova.com	804.238.8302
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Northumberland	Rick McClure	Emergency Services Chief	rmcclure@co.northumberland.va.us	804.580.5221
VDEM	Andy John	Response & Recovery VDEM Region V	andy.john@vdem.virginia.gov	804.624.8327
VDEM	Amy Howard	Grant Administrator	amy.howard@vdem.virginia.gov	804.897.9974

Mitigation Strategy, Action & Project Types

Northern Neck PDC 2017 Regional Goals

Mitigation Project Type and Project Types	
Prevention	• Planning and zoning • Building codes • Open space preservation • Floodplain regulations • Stormwater management regulations • Drainage system maintenance • Capital improvements programming • Shoreline/riverine setbacks
Property Protection	• Acquisition/Demolition • Relocation • Building elevation • Critical facilities protection • Retrofitting (i.e., wind-proofing, floodproofing, seismic design) • Safe rooms, shutters, shatter-resistant glass • Insurance
Natural Resource Protection	• Land acquisition • Floodplain protection • Watershed management • Beach and dune preservation • Riparian buffers • Forest and vegetation management (i.e., fire resistant landscaping, fuel breaks) • Erosion and sediment control • Wetland preservation and restoration • Habitat preservation • Slope stabilization • Historic properties and archaeological site preservation
Structural Projects	• Reservoirs • Dams/levees/dikes/floodwalls/seawalls • Diversions/detention/retention • Channel modification • Beach nourishment • Storm sewers
Emergency Services	• Warning systems • Evacuation planning and management • Emergency response training and exercises • Sandbagging for flood protection • Installing temporary shutters for wind protection
Education & Awareness	• Outreach projects • Speaker series/demonstration events • Hazard mapping • Real estate disclosure • Library materials • School children educational programs • Hazard expositions

2017 – 2022 Mitigation Goals:

Goal 1: Promote new development by avoiding undue risks posed by natural hazards and is resilient to natural disasters.

Goal 2: Address natural hazards and vulnerability that represent a threat to the community.

Goal 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents, property and critical infrastructure of the Northern Neck.

Goal 4: Enhance the capabilities of local government to address natural hazards to enhance the whole community for increased resilience.

Goal 5: Increase natural hazard awareness of our citizens. Educate Northern Neck citizens and part-time residents on citizen and community hazard resiliency.

Goal 6: Participate and Comply with the National Flood Insurance Program (NFIP) through Floodplain Identification, Mapping and Floodplain Management.

Hazard Mitigation Planning

The Hazard Mitigation Plan for the Northern Neck was last updated in 2011. FEMA and the Virginia Department of Emergency Management have provided funding to hire a consultant to update the plan and thus remain compliant with VDEM and FEMA requirements. The update process consists of a series of meetings with the region's stakeholders and the consultants:

02/27/17 – Kick-off Meeting – Presentation

04/05/17 – HIRA, Goals, and Mitigation Actions Meeting – Presentation

Appendix B: Additional Risk Assessment Information

B.1 Flood Zones

B.2 TEIF Analysis Results

B.3 Virginia Institute of Marine Science (VIMS) Shoreline Erosion Reports

B.1 Flood Zones

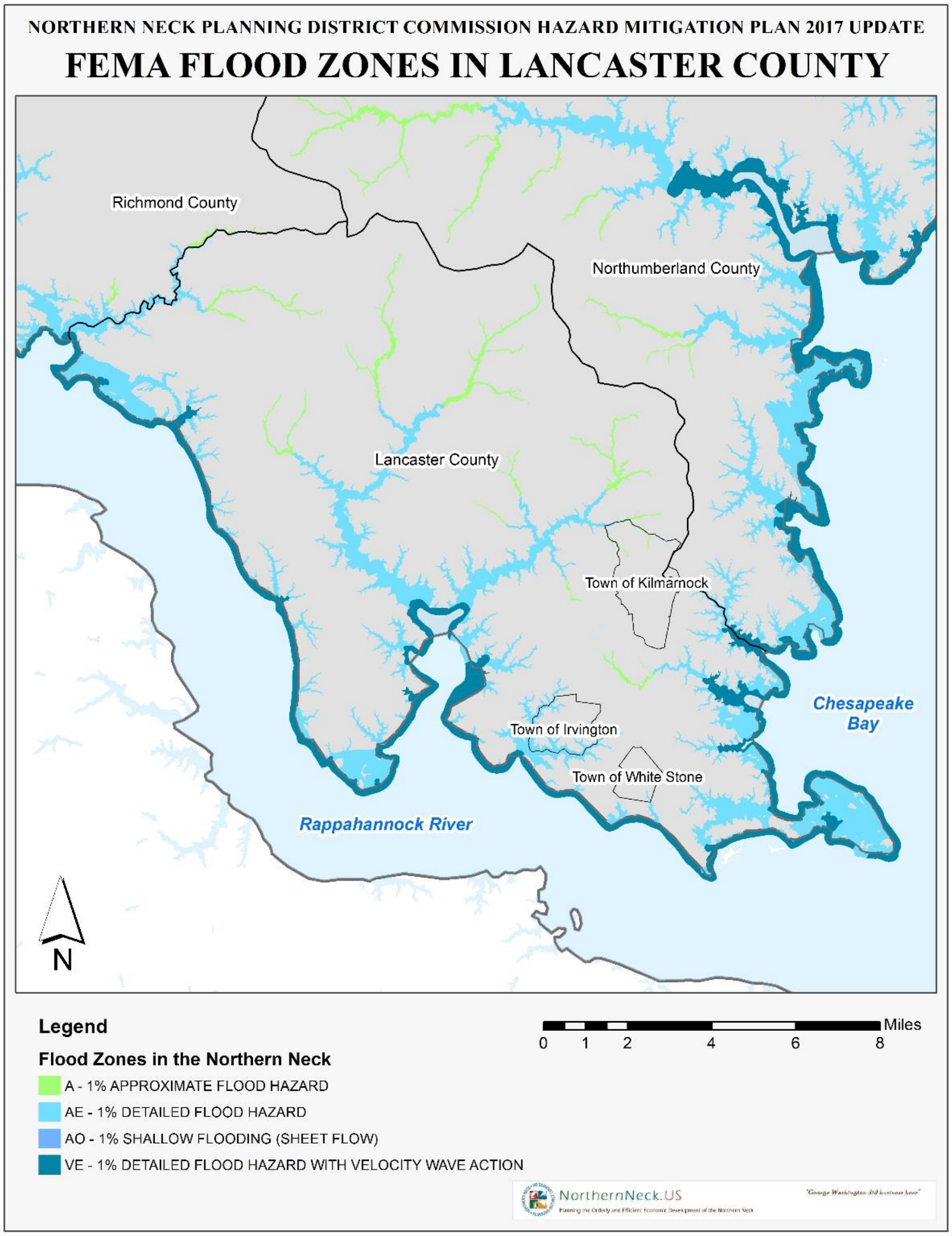

Figure 1. FEMA Flood Zones in Lancaster County

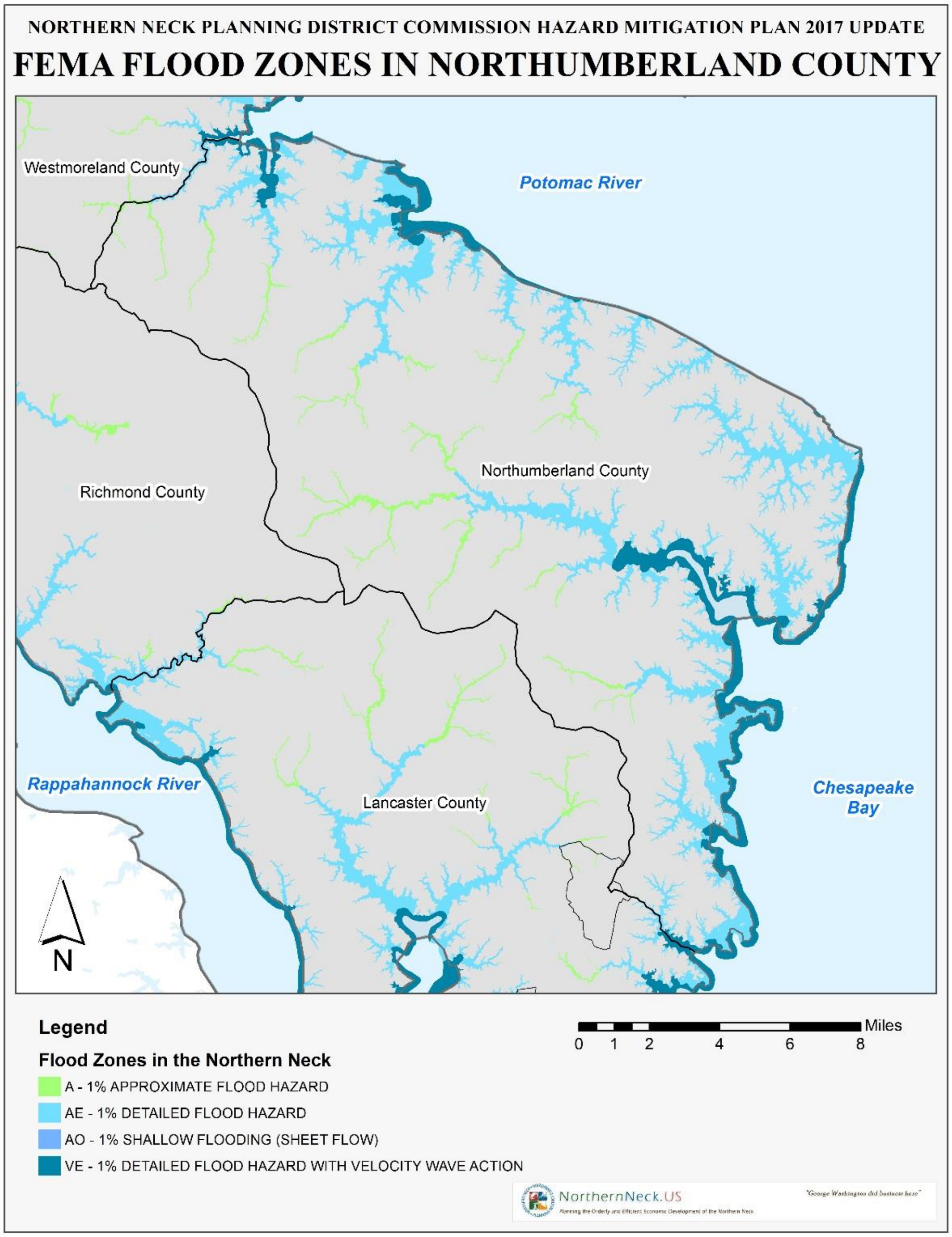

Figure 2. FEMA Flood Zones in Northumberland County

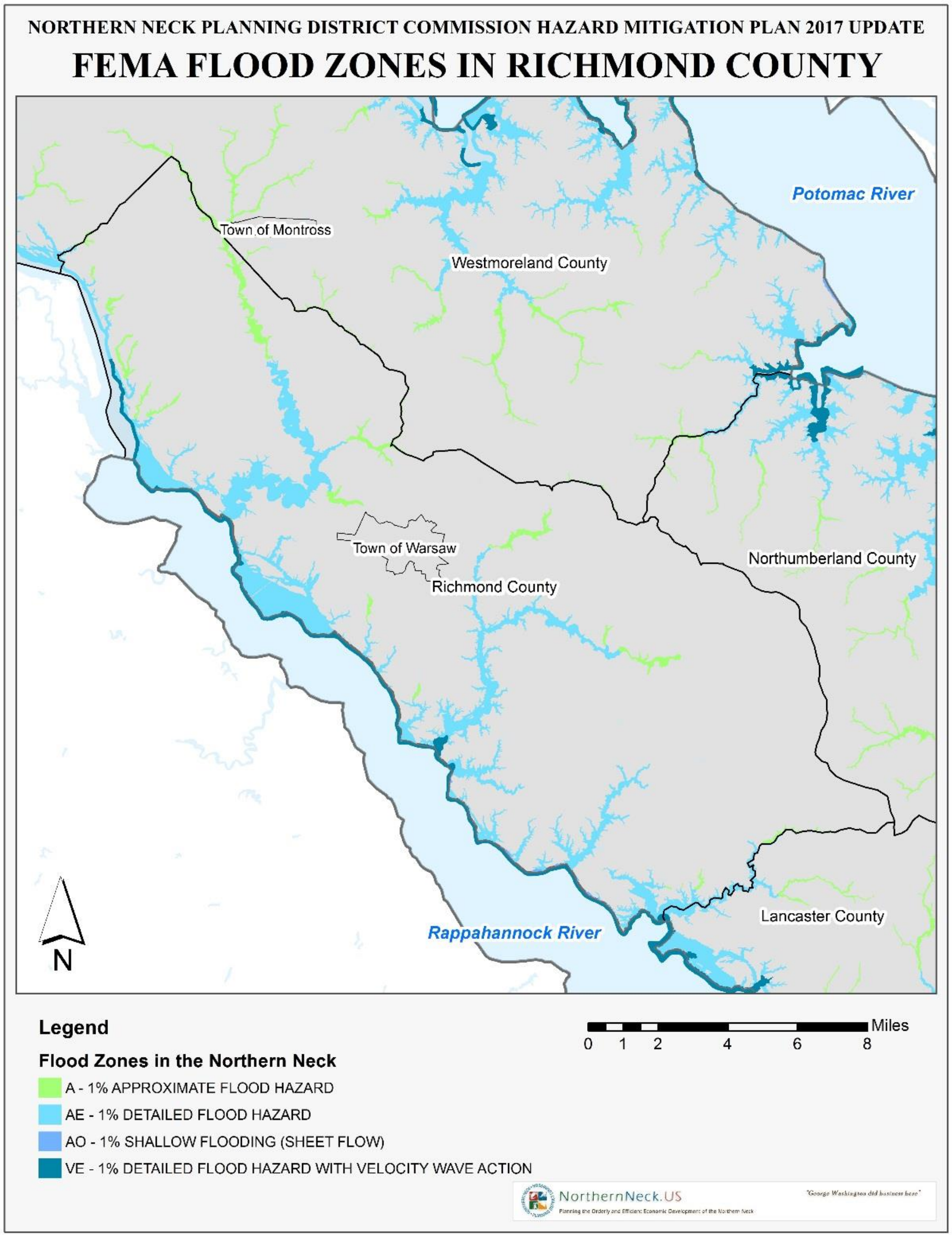

Figure 3. FEMA Flood Zones in Richmond County

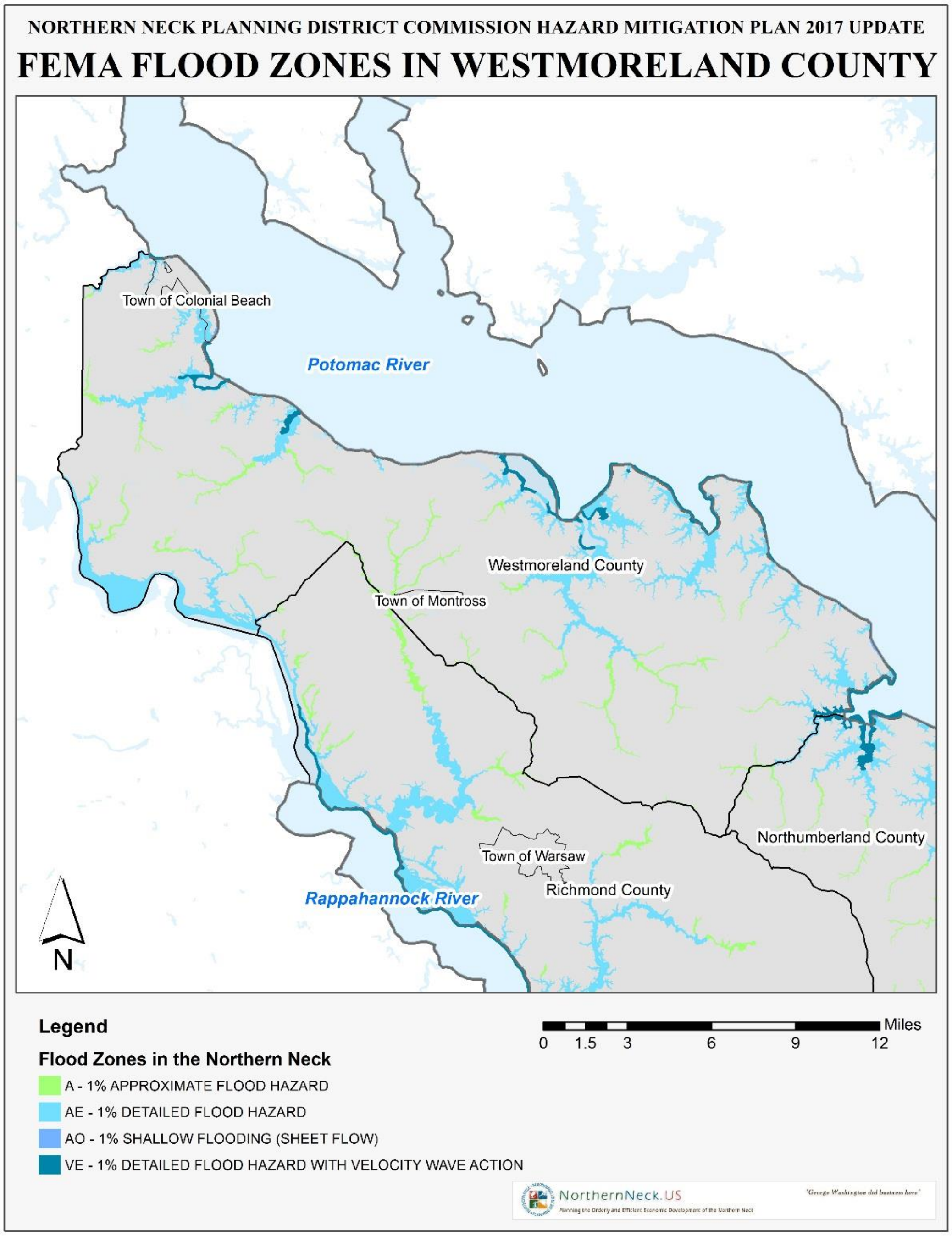

Figure 4. FEMA Flood Zones in Westmoreland County

B.2 TEIF Analysis Results

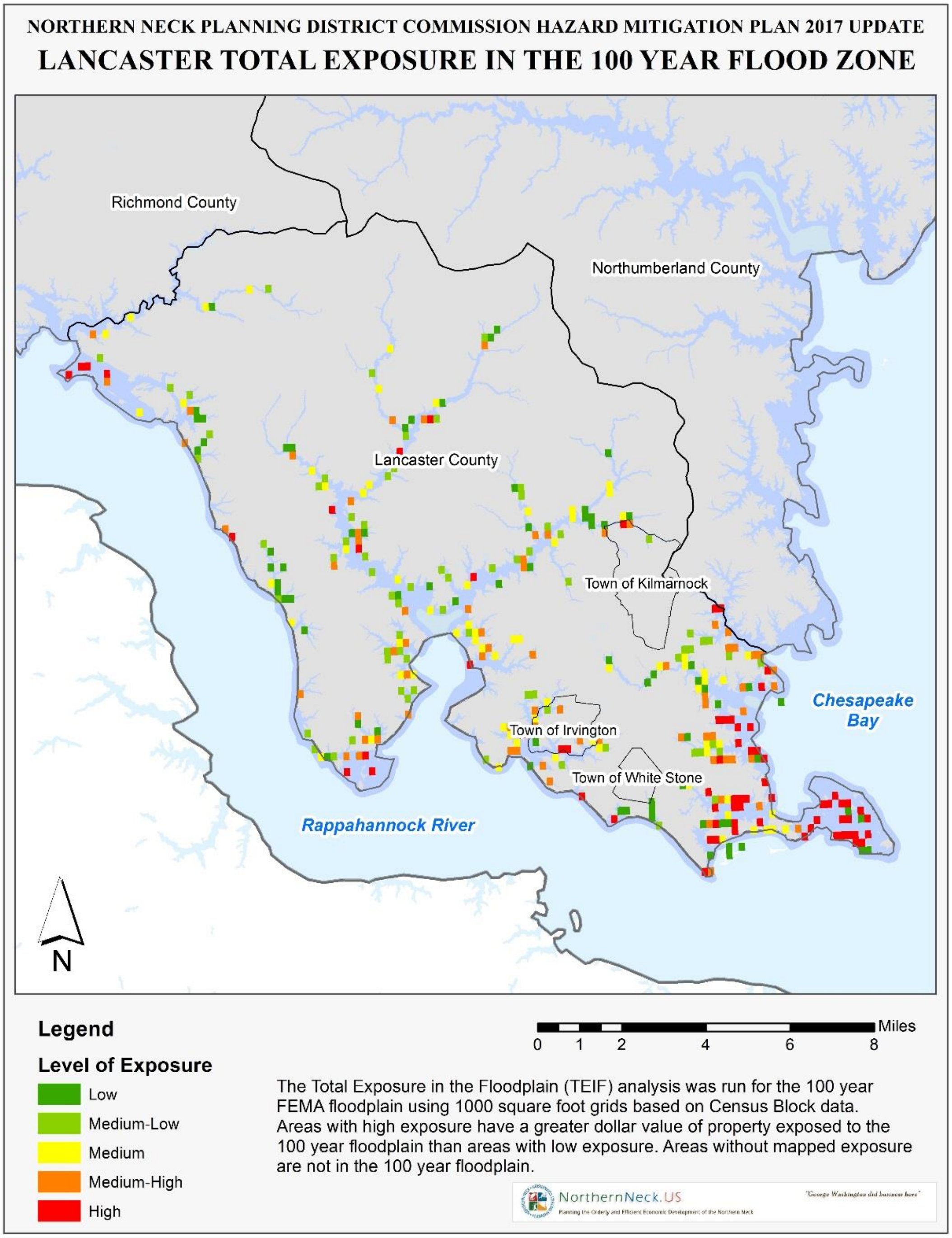

Figure 5. Lancaster Total Exposure in the 100 Year Flood Zone

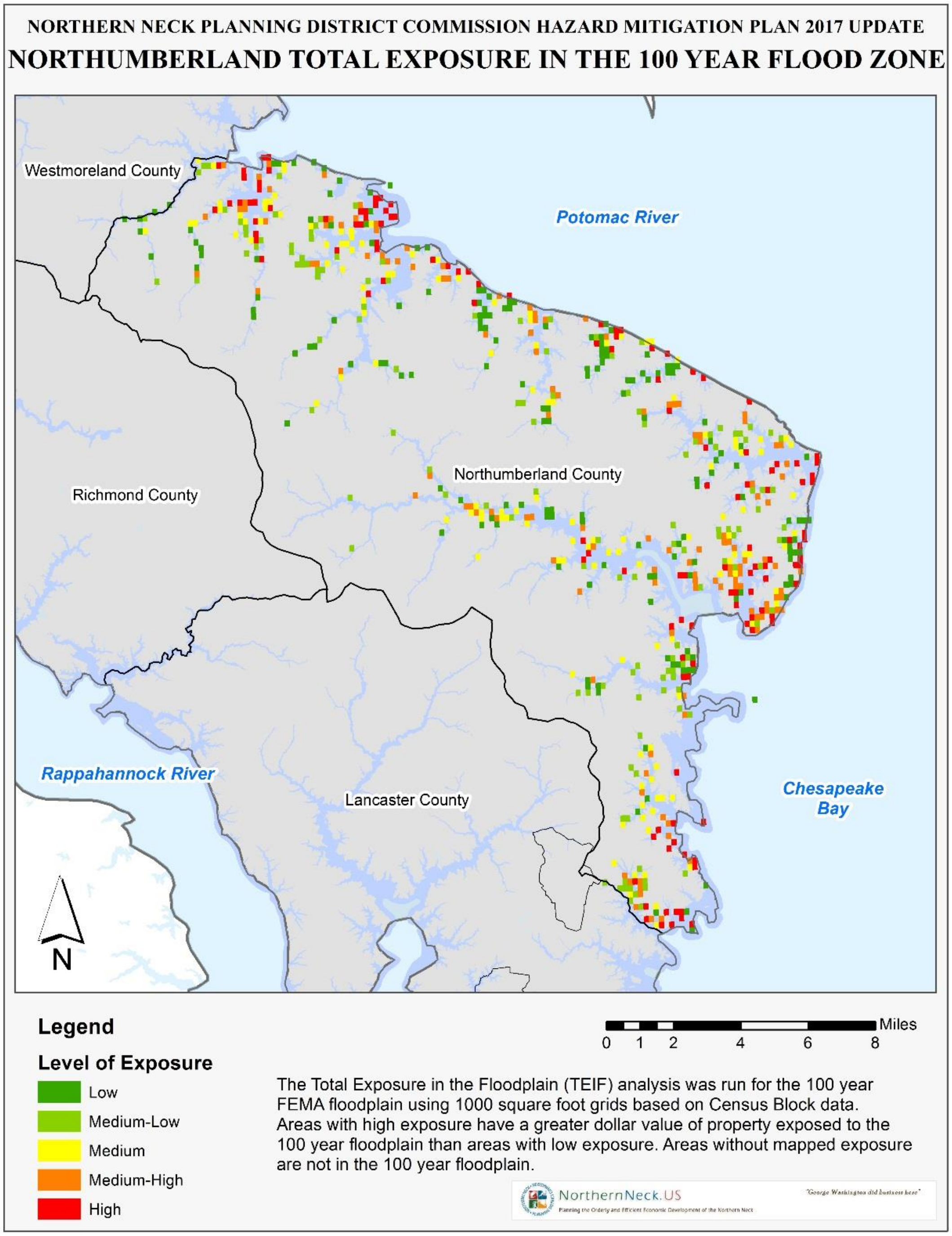

Figure 6. Northumberland Total Exposure in the 100 Year Flood Zone

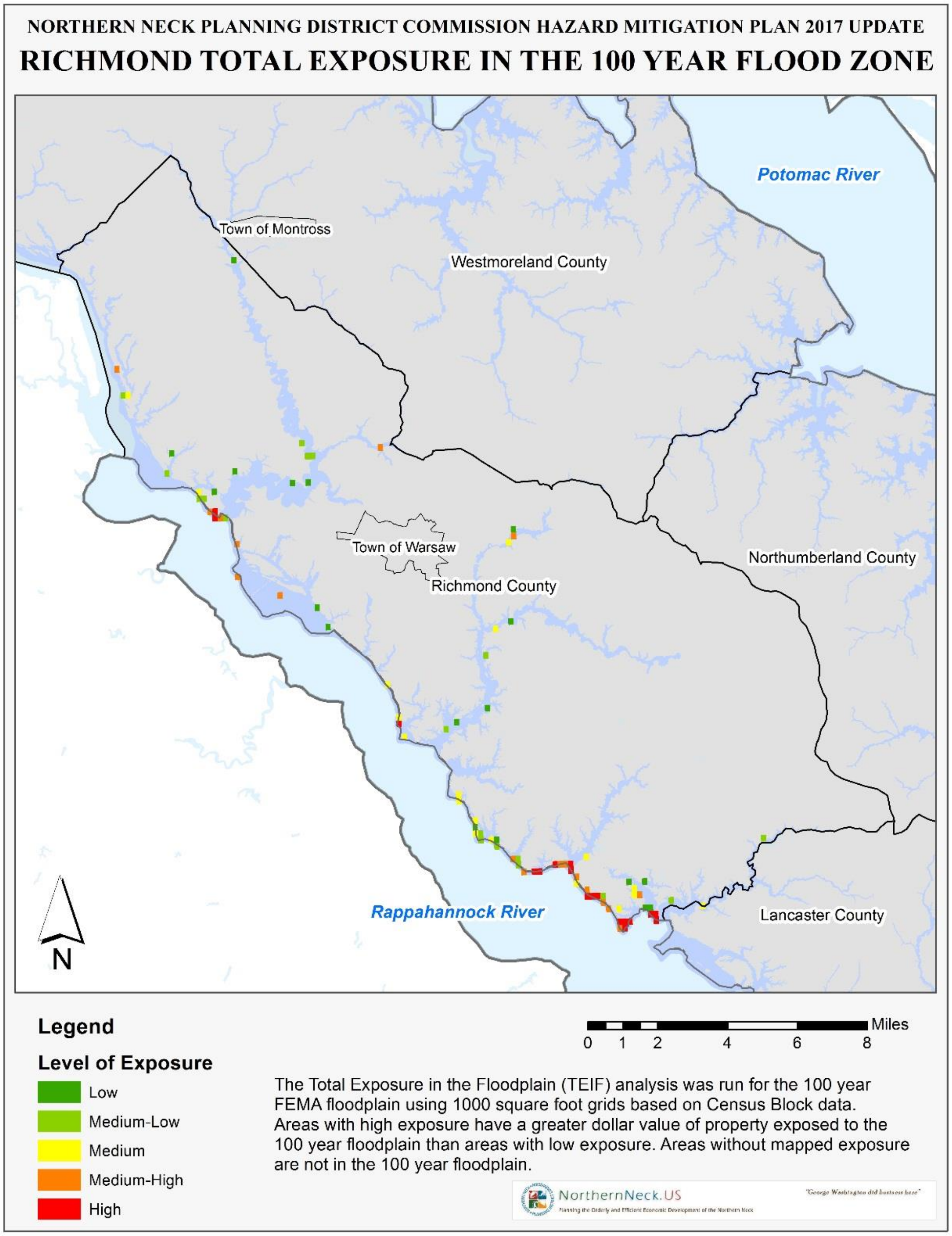

Figure 7. Richmond Total Exposure in the 100 Year Flood Zone

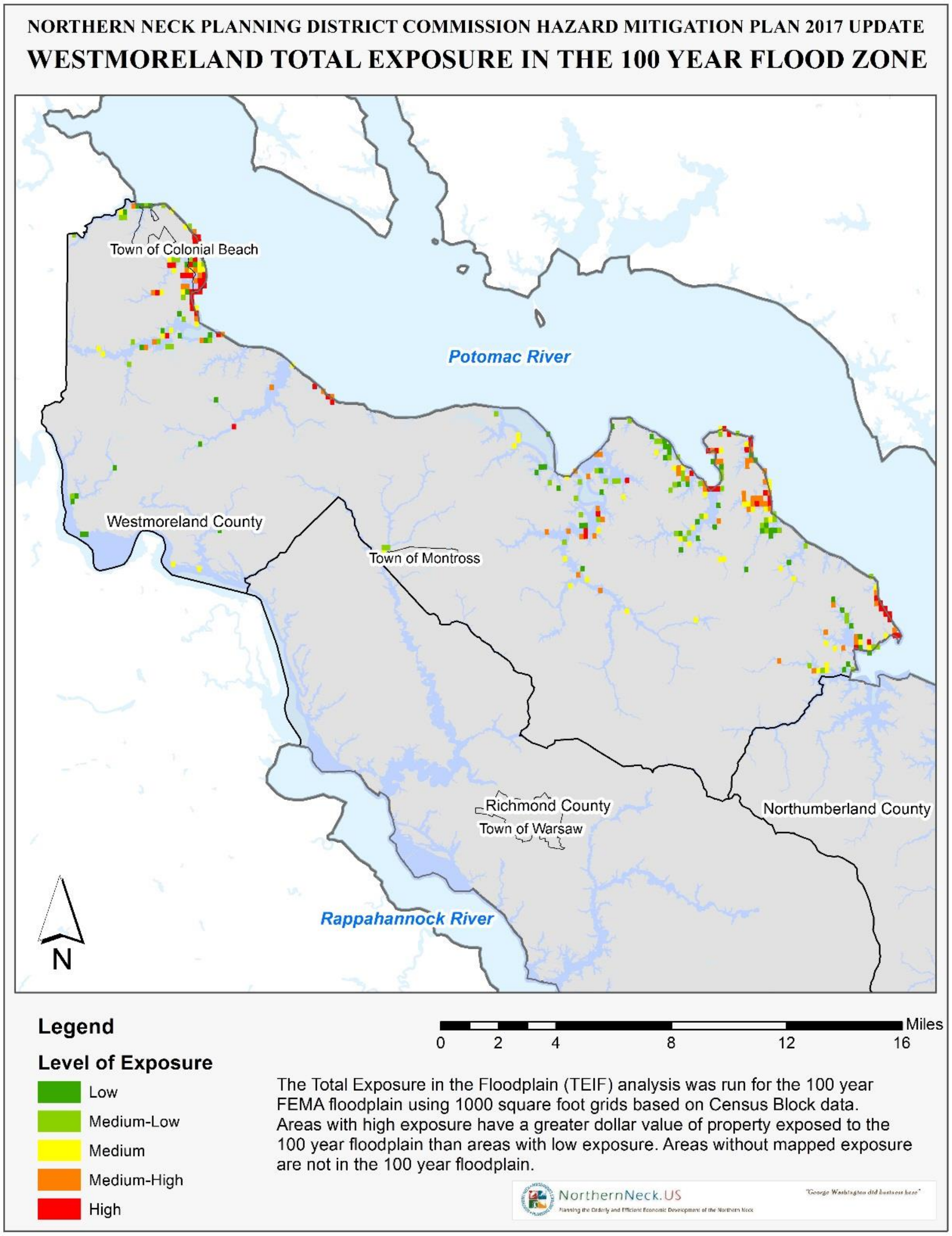

Figure 8. Westmoreland Total Exposure in the 100 Year Flood Zone

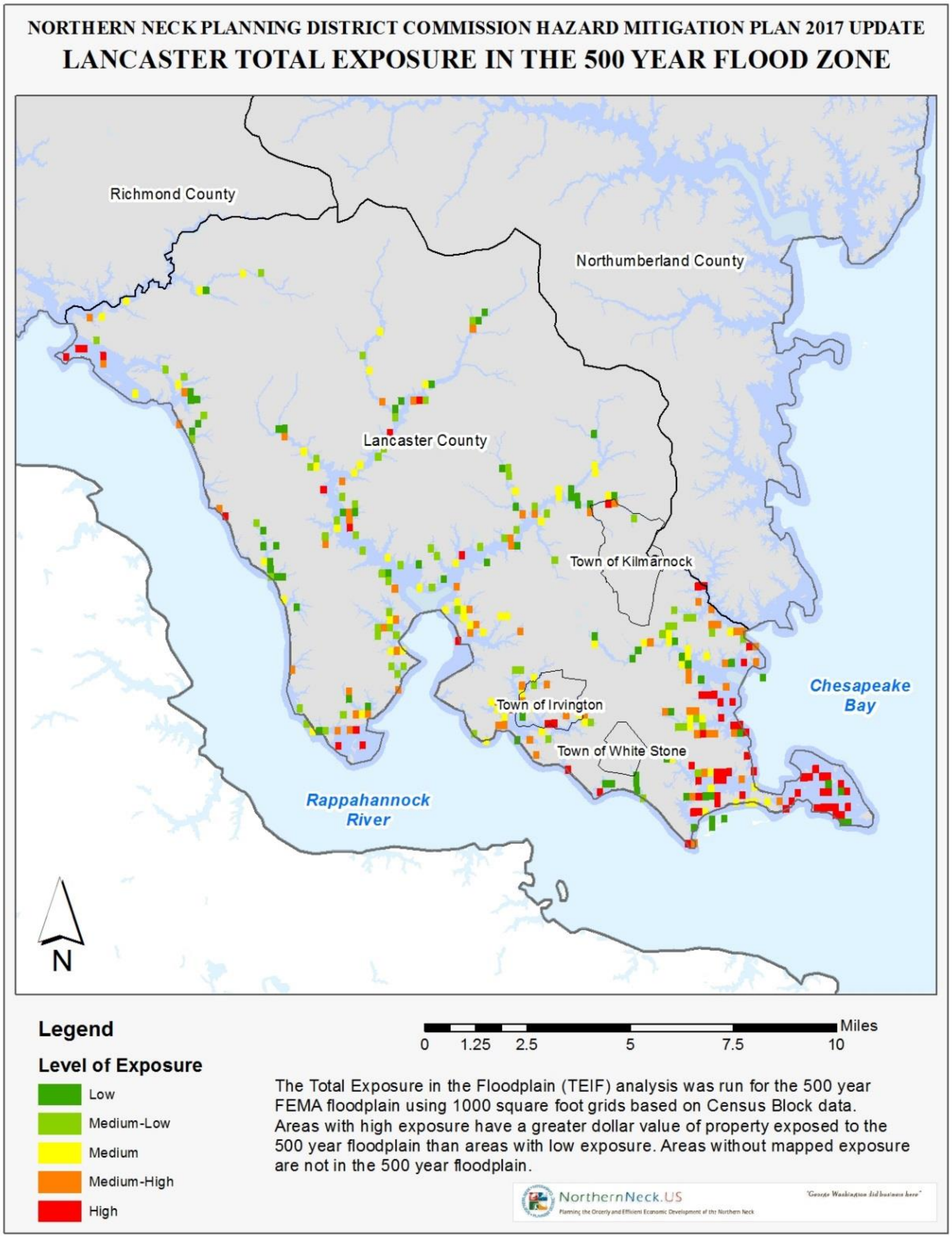

Figure 9. Lancaster Total Exposure in the 500 Year Flood Zone

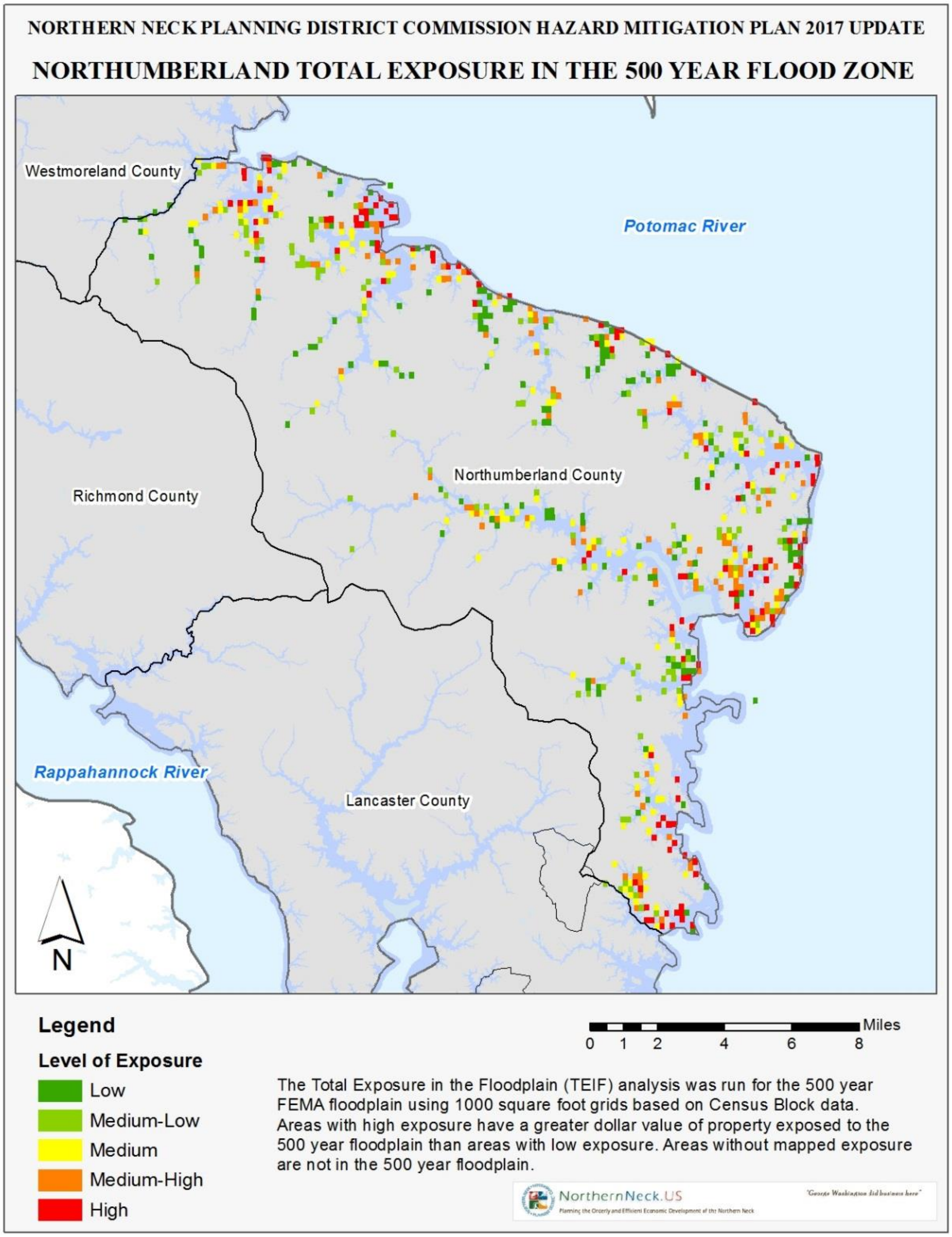

Figure 10. Northumberland Total Exposure in the 500 Year Flood Zone

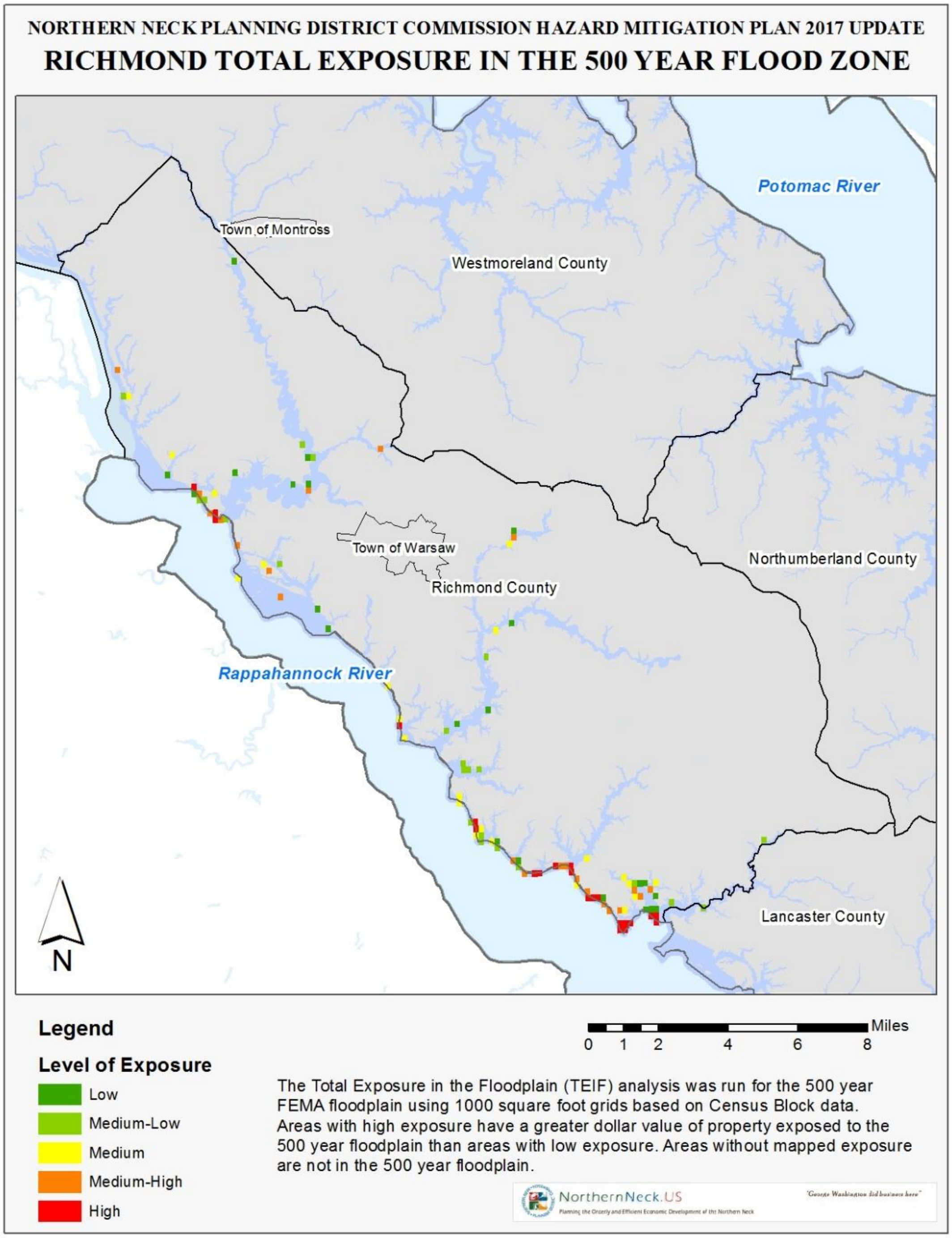

Figure 11. Richmond Total Exposure in the 500 Year Flood Zone

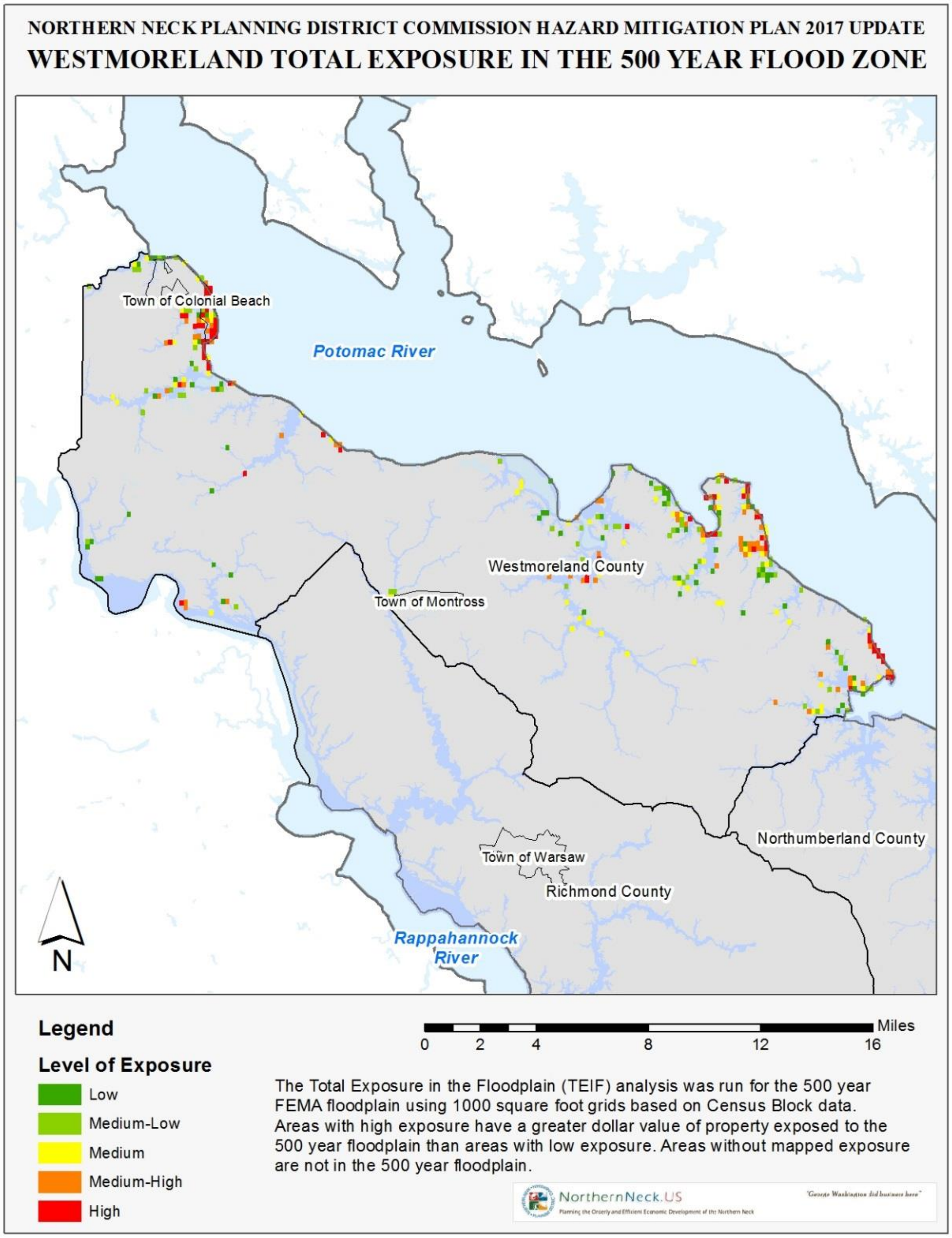

Figure 12. Westmoreland Total Exposure in the 500 Year Flood Zone

B.3 Virginia Institute of Marine Science (VIMS) Shoreline Erosion Reports

The Virginia Institute of Marine Science published Shoreline Evolution reports for Lancaster, Northumberland, Richmond, and Westmoreland Counties. These reports were referenced for the Coastal Erosion section of the HIRA chapter in this hazard mitigation plan update. Copies of these reports are attached for reference.

Shoreline Evolution
Lancaster County, Virginia
Chesapeake Bay and Rappahannock River Shorelines

2006

Shoreline Evolution
Lancaster County, Virginia
Chesapeake Bay and Rappahannock River Shorelines

C. Scott Hardaway, Jr. [1]
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Shoreline Studies Program [1]
Department of Physical Sciences
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Office of Research and Advisory Services[2]

Virginia Institute of Marine Science
College of William & Mary
Gloucester Point, Virginia

2006

This project was funded by the Virginia Department of Environmental Quality's Coastal Resources Management Program through Grants NA17OZ2355, NA17OZ1142,and NA04NOS4190060 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended.

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Cover Photo: Photograph of Mosquito Point in Lancaster County. Photo taken by Shoreline Studies Program on 15 August 2003.

I. INTRODUCTION

A. General Information

Shoreline evolution is the change in shore position through time. In fact, it is the material resistance of the coastal geologic underpinnings against the impinging hydrodynamic (and aerodynamic) forces. Along the shores of Chesapeake Bay and Rappahannock River, it is a process-response system. The processes at work include winds, waves, tides and currents, which shape and modify coastlines by eroding, transporting and depositing sediments. The shore line is commonly plotted and measured to provide a rate of change but it is as important to understand the geomorphic patterns of change. Shore analysis provides the basis to know how a particular coast has changed through time and how it might proceed in the future.

The purpose of this report is to document how the dunes along the Bay and river shores of Lancaster (Figure 1) have evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year, and it is this imagery that allows one to assess the geomorphic nature of shore change. Aerial imagery shows how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man through shore hardening or inlet stabilization come to dominate a given shore reach. Most of the change in shore positions will be quantified in this report. Others, particularly very irregular coasts, around inlets, and other complicated areas will be subject to interpretation.

B. Chesapeake Bay Dunes

The primary reason for developing this Shoreline Evolution report is to be able to determine how dunes and beaches along the Bay and river coast of Lancaster have and will evolve through time. The premise is that, in order to determine future trends of these important shore features, one must understand how they got to their present state. Beaches and dunes are protected by the Coastal Primary Sand Dune Protection Act of 1980 (Act)[1]. Research by Hardaway *et al.* (2001) located, classified and enumerated jurisdictional dunes and dune fields within the eight localities listed in the Act. These include the counties of Accomack, Lancaster, Mathews, Northampton and Northumberland and the cities of Hampton, Norfolk and Virginia Beach (Figure 2). Only Chesapeake Bay and river sites were considered in that study.

In 2004, Hardaway *et al*. created the Lancaster County Dune Inventory. That report detailed the location and nature of the jurisdictional primary dunes along the Bay shore of Lancaster County and those results appear in Appendix B. For this study, the positions of the dune sites are presented using the latest imagery in order to see how the sites sit in the context of past shoreline positions. The dune location information has not been field verified since the original visits in 2000. This information is not intended to be used for jurisdictional determinations regarding dunes.

[1]The General Assembly of Virginia enacted the Coastal Primary Sand Dune Protection Act (the Dune Act) in 1980. The Dune Act was originally codified in § 62.1-13.21 to -13.28. The Dune Act is now recodified as Coastal Primary Sand Dunes and Beaches in § 28.2-1400 to -1420.

II. SHORE SETTING

A. Physical Setting

The Bay shoreline of the Lancaster includes about 12 miles of shoreline from Windmill Point to Indian Creek which is the border with Northumberland County. The Rappahannock River shoreline extends from Windmill Point to Morattico Creek which is the border with Richmond County. This includes about 40 miles of tidal shoreline on the Rappahannock River and Corrotoman River. The shorelines along Chesapeake Bay are mostly low sandy banks and marsh. Historic shore change rates vary from 0 ft/yr (inside Little Bay) to -8 ft/yr (Windmill Point) for shore recession along the Bay coast (Byrne and Anderson, 1978). The open Bay coasts have the highest erosion rates. Up the Rappahannock River, shore erosion and accretion rates are highly variable. The point at Morrattico Creek had an erosion rate of -3.1 ft/yr. The shore along the Corrotoman River has erosion and accretion rates between -5 ft/yr and +2 ft/yr. Between the Corrotoman River and Mosquito Point, erosion and accretion occurred between +2.4 ft/yr (Mosquito Point) and -1.6 ft/yr (farther upriver). Some areas showed no change (Byrne and Anderson, 1978). The shore along the Rappahannock River includes high and low sandy banks and occasional marshes.

The coastal geomorphology of the County is a function of the underlying geology and the hydrodynamic forces operating across the land/water interface, the shoreline. The Chesapeake Bay coast of Lancaster County varies between Holocene marsh and Holocene beach sands (Figure 3). Both sediment types overlie the Lynnhaven Member of the Tabb Formation (Late Pleistocene). Along the Rappahannock River, the Sedgefield Member, Shirley Formation and Lynnhaven Member outcrop along the shoreline. In addition, Quaternary alluvium was deposited at Towles Point. The Atlantic Ocean has come and gone numerous times over the Virginia coastal plain over the past million years or so. The effect has been to rework older deposits into beach and lagoonal deposits at the time of the transgressions. The last low stand found the ocean coast about 60 miles to the east when sea level about 300 feet lower than today and the coastal plain was broad and low. The current estuarine system was a meandering series of rivers working their way to the coast. About 15,000 years ago, sea level began to rise and the coastal plain watersheds began to flood. Shorelines began to recede. The slow rise in sea level is one of two primary long-term processes which cause the shoreline to recede; the other is wave action, particularly during storms. As shorelines recede or erode the bank material provides the sands for the offshore bars, beaches and dunes.

Sea level is continuing to rise in the Chesapeake Bay Region. Tide data collected at Gloucester Point on the York River showed that sea level has risen 3.95 mm/yr or 1.3 ft/century (http://www.co-ops.nos.noaa.gov/). Lewisetta on the Potomac River rose 4.85 mm/yr or 1.59 ft/century. Windmill Point and the Rappahannock River are between these two guages. The amount of sea level rise directly effects the reach of storms and their impact on shorelines. Anecdotal evidence of storm surge during Hurricane Isabel, which impacted North Carolina and Virginia on September 18, 2003, put it on par with the storm surge from the "storm of the century" which impacted the lower Chesapeake Bay in August 1933. Boon (2003) showed that even though the tides during the storms were very similar, the difference being only 4 cm or about an inch and a half, the amount of surge was different. The 1933 storm produced a storm surge that was greater than Isabel's by slightly more than a foot. However, analysis of the mean water levels for the months of both August 1933 and September 2003 showed that sea level has risen by 41 cm (1.35 ft) at Hampton Roads in the seventy years between these two storms (Boon, 2003). This is the approximate time span between our earliest aerial imagery (1937) and our most recent (2002), which means the impact of sea level rise to shore change is significant. The beaches, dunes, and nearshore sand bars try to keep pace with the rising sea levels. Five shore reaches are described along the coast of Lancaster County (Figure 4). Reaches I, III, and IV are on the north shore of the Rappahannock River. Reach II is on the Corrotoman River, and Reach V is on the open Chesapeake Bay.

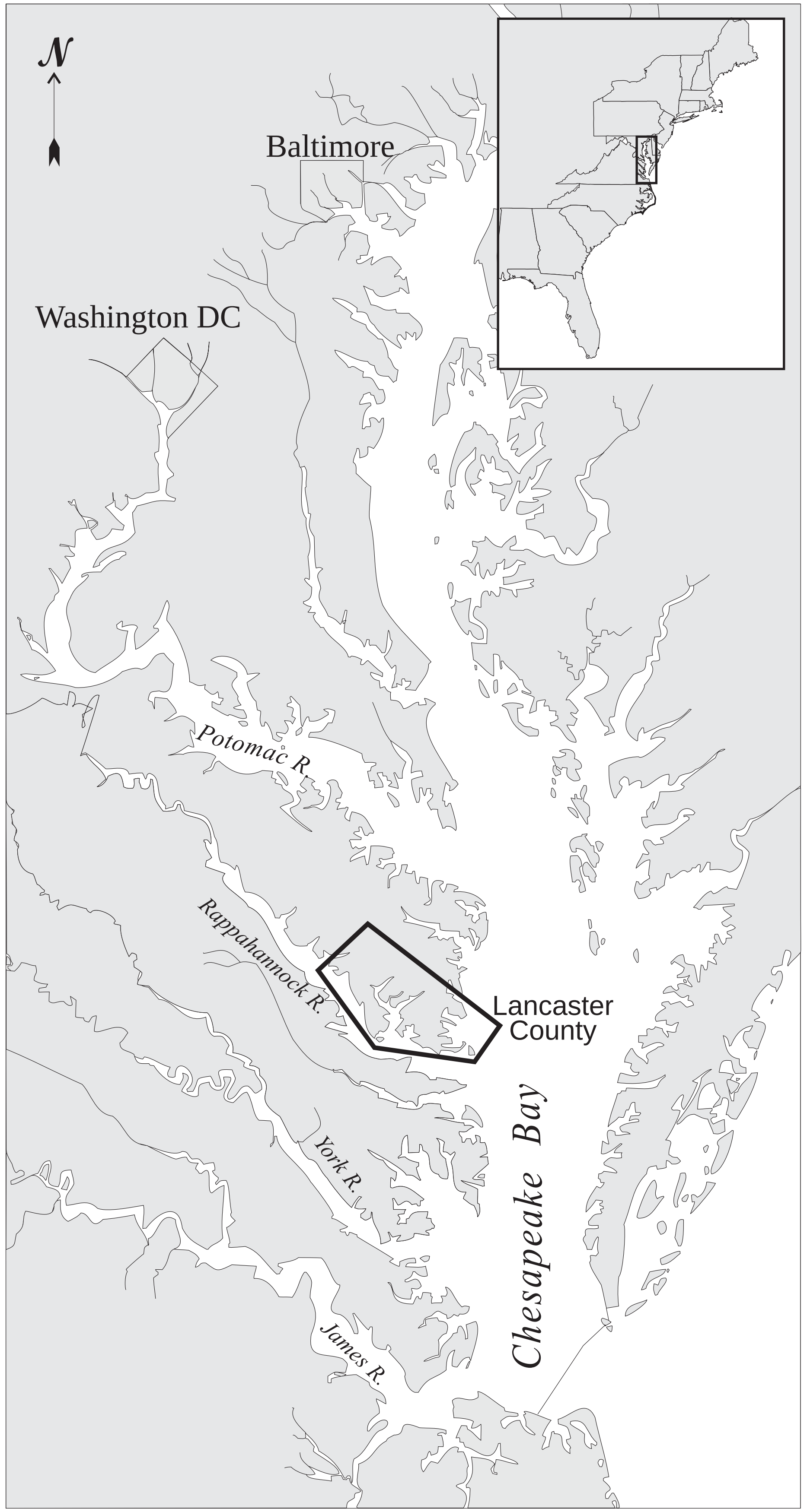


Figure 1. Location of Lancester County within the Chesapeake Bay estuarine system.

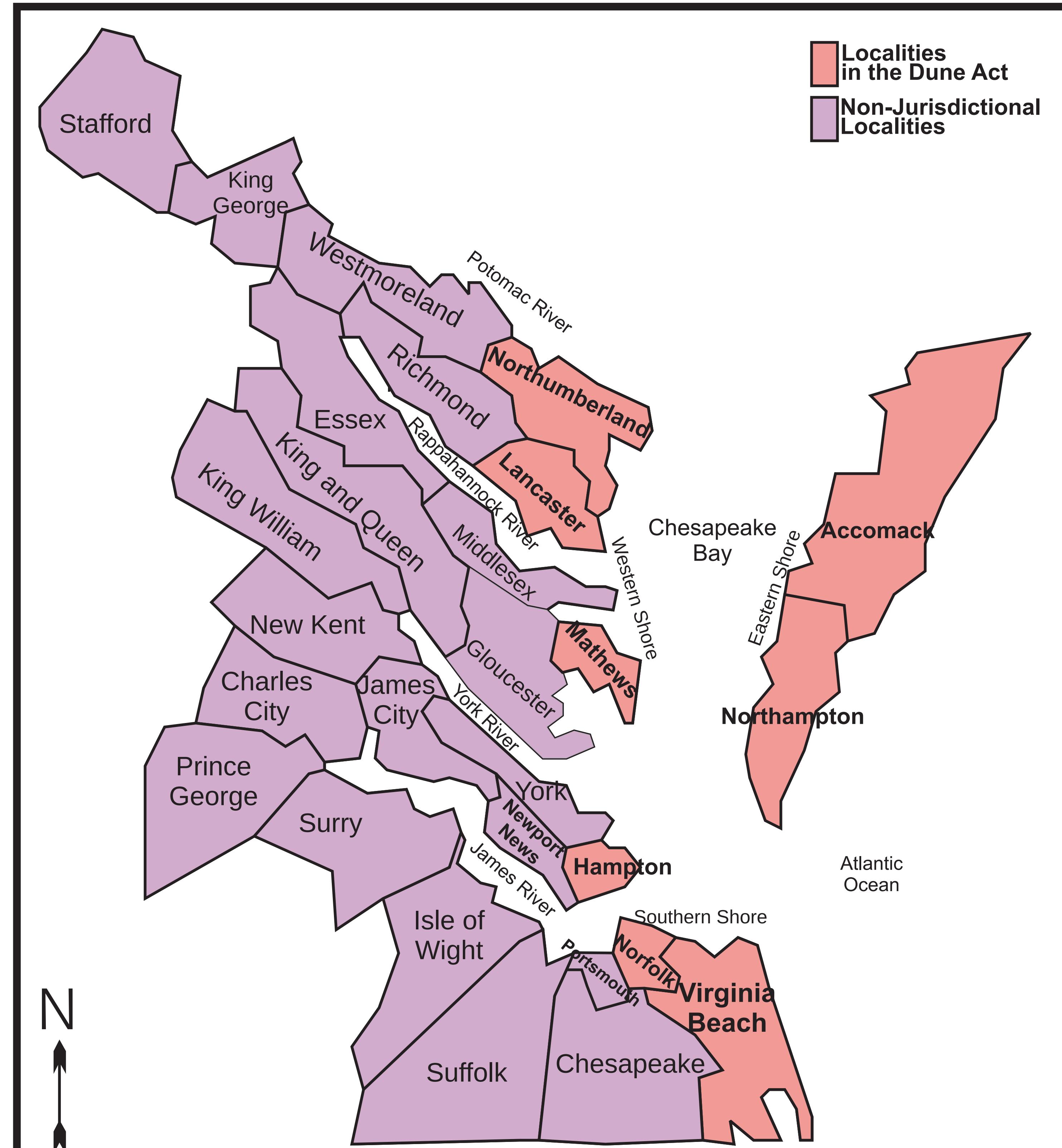
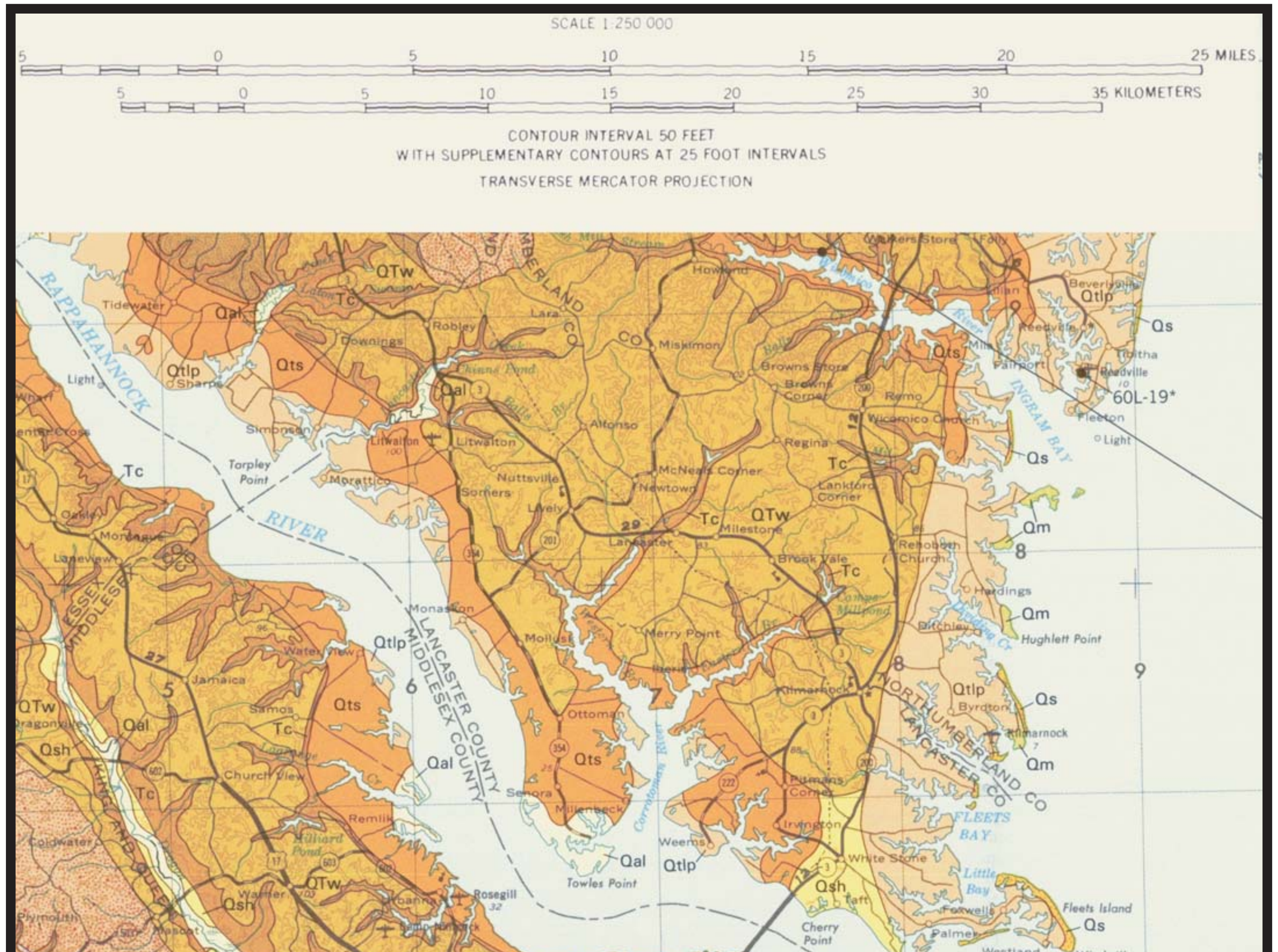


Figure 2. Location of localities in the Dune Act with jurisdictional and non-jurisdictional localities noted.



Qm **Holocene Soft Mud** - Medium to dark-gray, and peat, grayish brown. Comprises sediment of marshes in coastal areas and Chesapeake Bay. Thickness is 0-10 ft.

Qs **Holocene Sand** - Pale gray to light-yellowish gray, fine to coarse, poorly sorted to well sorted, shelly in part; contains angular to rounded fragments and whole valves of mollusks. Comprises deposits of coastal barrier islands and narrow beach-dune ridges bordering brackish-water marshes of Chesapeake Bay. As much as 40 ft in thickness.

Qtlp **Lynnhaven and Poquoson Members, undifferentiated**.

Qts **Sedgefield Member** - Pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt; locally, channel fill at base of unit includes as much as 50 ft of fine to coarse, crossbedded sand and clayey silt and peat containing in situ tree stumps. Sandy bay facies commonly contains Crassostrea biostromes, Mercenaria, Anadara, Polynices, Ensis, and other mollusks. Specimes of the coral Astrangia have yielded estimated uranium-series ages averaging 71,000 +/- 7,000 yrs B.P. (Mixon and others, 1982). Unit constitutes surficial deposit of river- and coast-parallel plains (alt. 20-30 ft) bounded on landward side by Suffolk and Harpersville scarps. Thickness is 0-50 ft.

Qal **Alluvium -** Fine to coarse gravelly sand and sandy gravel, silt, and clay, light- to medium- gray and yellowish-gray. Deposited mainly in channel, point-bar, and flood-plain environments; includes sandy deposits of narrow estuarine beaches, and mud, muddy sand, and peat in swamps and in fresh- and brackish-water marshes bordering tide-water rivers. Grades into colluvium along steeper valley walls at margins of unit. Mostly Holocene but, locally, includes low-lying Pleistocene(?) Terrace deposits. As much as 80 ft thick along major streams.

QTw **Windsor Formation (lower Pleistocene or upper Pliocene) -** Gray and yellow to reddish-brown sand, gravel, silt, and clay. Constitutes surficial deposits if extensive plain (alt. 85-95 ft) seaward of Surry scarp and coeval, fluvial-estuarine terrace west of scarp. Fining-upward sequence beneath plain consists of basal pebbly sand grading upward into crossbedded, quartzose Sand and massive, clayey silt and silty clay; lower and upper parts of sequence were deposited, repectively, in shallow-marine or open-bay and restricted-bay or lagoonal environments. In terraces west of Surry scarp, fluvial-estuarine deposit comprise muddy, coarse, trough-crossbedded sand and gravel grading upward to sandy silt and clay. Unit is 0-40 ft thick.

Qsh **Shirley Formation (middle Pleistocene)** - Light-to dark-gray and brown sand, gravel, silt, clay, and peat. Constitutes surficial deposits of riverine terraces and relict baymouth barriers and bay-floor plains (alt. 35-45 ft) inset below depositional surfaces of the Chuckatuck Formation (Johnson and Peebles, 1984). Upper part of unit is truncated on the east by the Suffolk and Harpersville scarps; locally, lower part extends east of scarps. Fluvial-estuarine facies comprises (1) a lower pebble to boulder sand overlain by (2) fine to coarse sand interbedded with peat and clayey silt rich in organic material, including in situ tree stumps and leaves and seeds of cypress, oak, and hickory, which grades upward to (3) medium- to thick-bedded, clayey and sandy silt and silty clay. Marginal-marine facies in lower James River and lowermost Rappahannock River areas is silty fine sand and sandy silt containing *Crassostrea virginica*, *Mulinia*, *Noetia*, *Mercenaria*, and other mollusks. *Astrangia* from lower Rappahannock River area has yielded a uranium-series age of 184,000 +/- 20,000 years B.P. (Mixon and other, 1982). Thickness is 0-80 ft.

Tc **Chesapeake Group (upper Pliocene to lower Miocene) -** Fine to coarse, quartzose sand, silt, and clay; variably shelly and diatomaceous, deposited mainly in shallow, inner- and middle-shelf waters. Ages of units based in studies of foraminiferal, nannofossil, diatom, and molluscan assemblages in Virginia and adjacent states (Andrews, 1988; Gibson, 1983; Gibson and others, 1980; Poag, 1989; Ward and Blackwelder, 1980; Ward and Krafft, 1984), Includes the following formations (see also sheet 2, figure 1), from youngest to oldest; Chowan River Formation (upper Pliocene), Yorktown Formation (lower upper and lower Pliocene), Eastover Formation (upper Miocene), St. Mary's Formation (upper and middle Miocene), Choptank Formation (middle Miocene), and Calvert Formation (middle and lower Miocene).

Figure 3. Geologic map of Lancaster County (from Mixon *et al*., 1989).

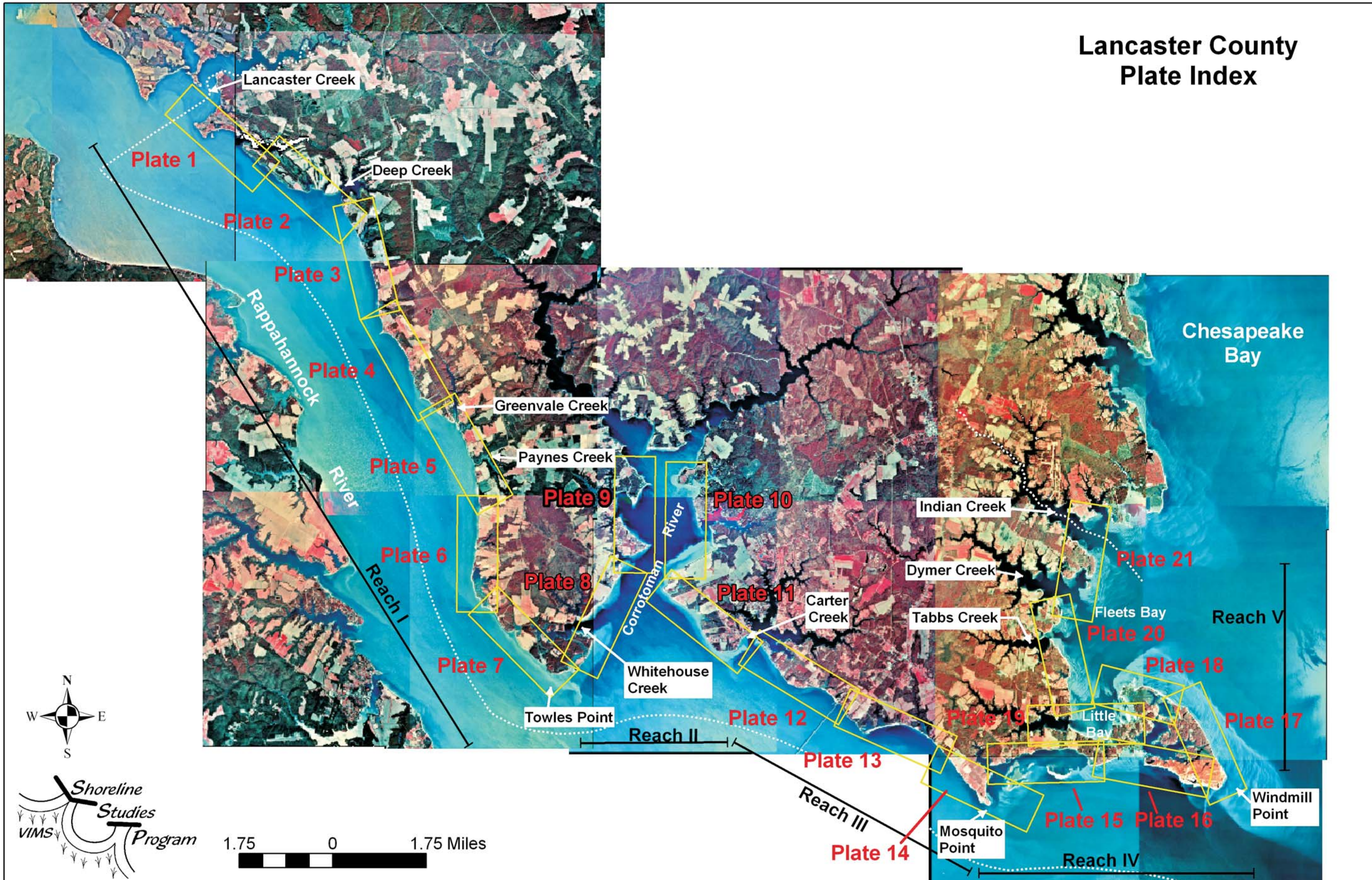


Figure 4. Index of shoreline plates.

B. Hydrodynamic Setting

Mean tide range at Windmill Point in Lancaster County is 1.2 ft (1983-2001). Up the Rappahannock River, mean tide range is 1.3 ft on the Corrotoman River, and 1.6 ft at Bayport which is across the river from Morattico Creek. The wind/wave climate impacting the Bay coast is defined by large fetch exposures to the northeast, east and southeast across Chesapeake Bay. Wind data from Norfolk International Airport reflect the frequency and speeds of wind occurrences from 1960 to 1990 (Table 1). Northeasters can be particularly significant in terms of the impacts of storm surge and waves on beach and dune erosion. The Rappahannock River is more fetch-limited. With the exception of the shore between Mosquito Point and Windmill Point, the coast is impacted by waves from the southwest, south, and southeast across limited open water.

Hurricanes, depending on their proximity and path can also have an impact to the Lancaster County Bay coast. On September 18, 2003, Hurricane Isabel passed through the Virginia coastal plain. The main damaging winds began from the north and shifted to the east then south. Beach and dune erosion were significant. Storm surge and wave action combined to create wrack lines measuring up to 8 ft above MLW around much of the Bay and up the rivers.

Table 1. Summary wind conditions at Norfolk International Airport from 1960-1990.

		WIND DIRECTION								
Wind Speed (mph)	**Mid Range (mph)**	**South**	**South west**	**West**	**North west**	**North**	**North east**	**East**	**South east**	**Total**
< 5	3	5497* 2.12+	3316 1.28	2156 0.83	1221 0.47	35748 13.78	2050 0.79	3611 1.39	2995 1.15	56594 21.81
5-11	8	21083 8.13	15229 5.87	9260 3.57	6432 2.48	11019 4.25	13139 5.06	9957 3.84	9195 3.54	95314 36.74
11-21	16	14790 5.70	17834 6.87	10966 4.23	8404 3.24	21816 8.41	16736 6.45	5720 2.20	4306 1.66	100572 38.77
21-31	26	594 0.23	994 0.38	896 0.35	751 0.29	1941 0.75	1103 0.43	148 0.06	60 0.02	6487 2.5
31-41	36	25 0.01	73 0.03	46 0.02	25 0.01	162 0.06	101 0.04	10 0.00	8 0.00	450 0.17
41-51	46	0 0.00	0 0.00	0 0.00	1 0.00	4 0.00	4 0.00	1 0.00	0 0.00	10 0.00
Total		41989 16.19	37446 14.43	23324 8.99	16834 6.49	70690 27.25	33133 12.77	19447 7.50	16564 6.38	259427 100.00

*Number of occurrences +Percent

III. METHODS

A. Photo Rectification and Shoreline Digitizing

Recent and historic aerial photography was used to estimate, observe, and analyze past shoreline positions and trends involving shore evolution for Lancaster County. Some of the photographs were available in fully geographically referenced (georeferenced) digital form, but most were scanned and orthorectified for this project.

Aerial photos from VIMS Shoreline Studies and Submerged Aquatic Vegetation (SAV) Programs, as well as from United States Geological Survey (USGS) archives were acquired. The years used for the shoreline change analysis included 1937, 1959, 1982, 1994, and 2002. Color aerials were obtained for 1982 and 1994. The 1994 imagery was processed and mosaicked by USGS, while the imagery from 2002 was mosaicked by the Submerged Aquatic Vegetation Program. The aerial photography for the remaining years were mosaicked by the VIMS Shoreline Study Program.

The images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. They were orthorectified to a reference mosaic, the 1994 Digital Orthophoto Quarterquadrangles (DOQQ) from USGS. The original DOQQs were in MrSid format but were converted into .img format as well. ERDAS Orthobase image processing software was used to orthographically correct the individual flightlines using a bundle block solution. Camera lens calibration data was matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. A minimum of four ground control points were used per image, allowing two points per overlap area. The exterior and interior models were combined with a 30-meter resolution digital elevation model (DEM) from the USGS National Elevation Dataset (NED) to produce an orthophoto for each aerial photograph. The orthophotographs that cover each USGS 7.5 minute quadrangle area were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic also in an .img format.

To maintain an accurate match with the reference images, it was necessary to distribute the control points evenly. This can be challenging in areas with little development. Good examples of control points are permanent features such as manmade features and stable natural landmarks. The maximum root mean square (RMS) error allowed is 3 for each block.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background to help delineate and locate the shoreline. For Lancaster' coast, an approximation to mean low water (MLW) was digitized. This often was defined as the "wetted perimeter" on the beach sand as the last high water location. In areas where the shoreline was not clearly delineated on the aerial photography, the location was estimated based on the experience of the digitizer. Digitizing the shoreline brings in, perhaps, the greatest amount of potential error because of the problems of image clarity and definition of shore features. A series of Lancaster dune site profiles are displayed in Figure 5 which shows beach/dune variability. Figure 6 shows the relationship of MHW, MLW and beach/dune system components.

B. Rate of Change Analysis

A custom Arcview extension called "shoreline" was used to analyze shoreline rate of change. A straight, approximately shore parallel baseline is drawn landward of the shoreline. The extension creates equally-spaced transects along the baseline and calculates distance from the baseline at that location to each year's shoreline. The output from the extension are perpendicular transects of a length and interval specified by the user. The extension provides the transect number, the distance from beginning baseline to each transect, and the distance from the baseline to each digitized shoreline in an attribute table. The attribute table is exported to a spreadsheet, and the distances of the digitized shoreline from the baseline are used to determine the rates of change. The rates of change are summarized as mean or average rates and standard deviations for each Plate.

It is very important to note that this extension is only useful on relatively straight shorelines. In areas that have unique shoreline morphology, such as creek mouths and spits, the data collected by this extension may not provide an accurate representation of true shoreline change. The shore change data was manually checked for accuracy. However, where the shoreline and baseline are not parallel, the rates may not give a true indication of the rate of shoreline change.

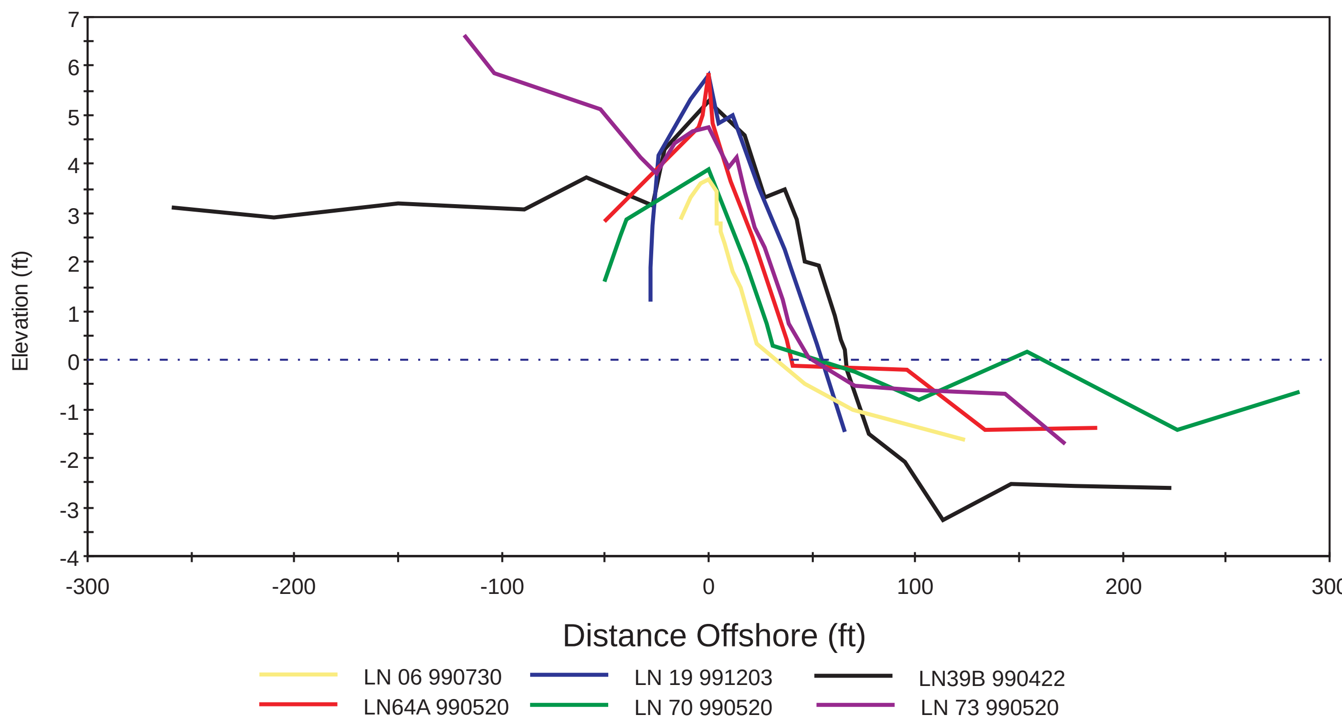


Figure 5. Variability of dune and beach profiles in Lancaster County.

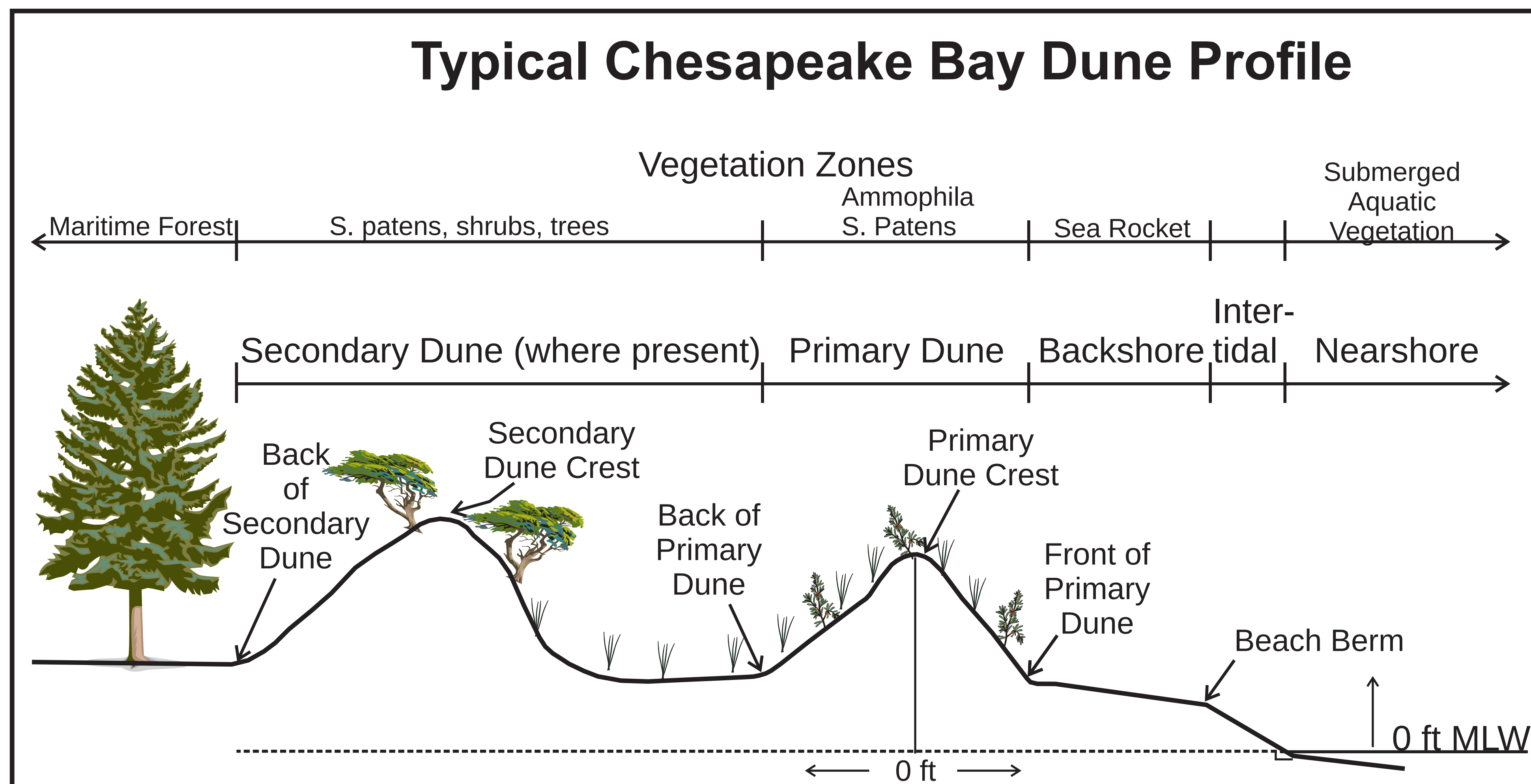


Figure 6. Typical profile of a Chesapeake Bay dune system (from Hardaway *et al.*, 2001).

IV. RESULTS

The Plates referenced in the following sections are in Appendix A. Dune locations are shown on all photo dates for reference only. Dune sites and lengths are positioned accurately on the 2002 photo. Because of changes in coastal morphology, the actual dune site might not have existed earlier. Site information tables are in Appendix B. More detailed information about Chesapeake Bay dunes and individual dune sites in Lancaster County can be found in Hardaway *et al.* (2001) and Hardaway *et al.* (2004). Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits. Some Plates did not have dunes identified on them, but the shore change information can still be valuable from a shoreline management perspective.

A. Reach I

Reach I occurs along the Rappahanock River and extends from the upriver county line at Lancaster Creek down to Towles Point and includes Plates 1 thru 7. The dune sites along Reach I are riverine dunes and generally face southwest. Plates 1 and 2 have no identified dune sites. The long-term trend for shore change (1937-2002) is negative on all three baselines on Plate 1. Baseline 1C has the highest due to its open exposure along the Rappahannock River. Shore trend is erosional along the single baseline on Plate 2.

Plate 3 contains dune sites LN3, LN4 and LN5. Site LN3 came into its present day form by 1994 and is maintained by a series of low groins. Sites LN4 and LN5 have evolved around respective small creek inlets since 1937 and are likely to continue change as the inlet spits and shoals do but stay in the same geomorphic setting. The overall shore change for Plate 3 is slightly erosional.

Plate 4 contains dune sites LN6, LN7, LN8, LN10 and LN11. Sites LN6, LN7 and LN8 reside along a relatively stable curvilinear coast protected on the upriver end by an unnamed point at Monaskon where the remains of an old pier help hold the headland. The sites are separated by breaks in the semi-continuos beach/dune system. Site LN10 and LN11 sit on either side of a man-made point (fill) that has eroded back over the years. Site LN11 has a secondary dune. The advance of these points can be seen in the shore change rates from 1937 to 1959. The long-term shore change trend along Plate 4 is slightly erosional.

Dune sites LN12, LN13, LN15 and LN16 are shown on Plate 5. Site LN12 is very small and developed as an overwash into a small tidal pond. Site LN 13 has been some type of beach feature since 1937 as it resides just upriver of Greenvale Creek. Dredging of Greenvale Creek was first performed in 1965 and sporadically since. Much of the material was placed just downstream of the entrance where it formed a large sandy headland. This headland has eroded away, but it has provided material for a small spit dune site, LN15, at its distal end. Dune site LN16 is a small dune on a spit across the mouth of Payne's Creek. The shoreline along Plate 5 has been relatively stable over time except for an advance and subsequent recession spike at the mouth of Greenvale Creek associated with dredge material disposal.

Plate 6 is the home of nine isolated dune sites labeled LN17 thru LN25. Sites LN17 and LN18 sit on either side of Bulls Creek as creek mouth dunes. Dune sites LN19 to LN24 are erosional remnants of a once more continuous beach/dune shoreline that fronts a marsh spit separating Beach Creek from the Rappahannock River. Most likely this is why this creek got its name. Dune site LN25 was formed as the distal end of the spit as it continued to lengthen. Channel dredging can be seen at the distal end of the spit since 1937 just downriver of LN24. The material was placed downriver which sealed up the natural channel. Site LN25 is attached to land on its downriver end. Grass became established, and a riverine dune developed. The shoreline rates of change are quite variable but show a long-term erosional trend for the baseline shown. The high variability of shore change along the Beach Creek spit is not quantified but can be seen pictorially.

Dune sites LN24 and LN25 also are shown on Plate 7, but no other sites occur. Shoreline change is minimal but slightly erosional. The shore attachment of the Beach Creek spit and its subsequent accretion is reflected between stations 0 and 1000.

B. Reach II

Reach II includes Plates 8, 9 and 10; no identified dune sites exist along this reach. These plates cover the main trunk of the Corrotoman River. Plate 8 has two baselines both showing erosional trends. Baseline 9A on Plate 9 shows a stable coast while baseline 9B is slightly erosional. The short single baseline on Plate 10 is also erosional.

C. Reach III

Reach III extends from the downstream side of the entrance to the Corrotoman River to Mosquito Point. This coast is a series of headland and embayments where the subreaches alternate riverine fetch exposures from the southwest then south. Reach III includes Plates 11 thru 14.

Plate 11 had dune site LN28 and LN29 (discussed in next plate). Site LN28 is a small isolated dune that resides in a small coastal embayment. This embayment can be seen in the imagery as early as 1937. The overall long-term shore trend from Corrotoman Point to Orchard Point has been stable.

Plate 12 has dune sites LN29 and LN32. Site LN29 has resided against the jetty at Crab Point since at least 1959. Site LN32 has developed on the upstream side of the Norris Bridge approach abutment since it was installed in the 1950s. It has developed a series of secondary dune ridges. Long-term shoreline trends along the Plate 12 coast are erosional becoming stable to accretional toward the Norris Bridge, then erosional on the downriver side.

Two dune sites occur along the Plate 13 shoreline, LN34 and LN36. They are the dune segments of a long curvilinear sandy embayment on the downstream side of Cherry Point. Portions of the beach are known locally as White Stone Beach. This is a relatively stable coast as reflected in the near zero net shore change rate for that shore segment. The Plate 13 shoreline is the upsteam, spiral bay section of a larger embayment that extends from Cherry Point downriver to Mosquito Point. Site LN34 is the longer site on Plate 13 and has had a tidal creek near its center breach intermittently over the years. This would cause an ebb shoal to form at its exit. The inlet's position can be seen in 1937 and 1959 imagery, but then the shoal moves downriver forcing the channel alongshore where it exits again and shoals as seen in 1982, 1994 and 2002.

The Plate 14 shoreline is the dowriver extension of the Plate 13 shoreline; it is the tangential section of the embayed shoreline from Cherry Point to Mosquito Point. It has one continuous dune site but with two wind/wave fetch exposures. Site LN39A faces west-southwest up the Rappahannock River while LN39B faces the open Bay. The dune crests vary accordingly with the higher one on LN39B (Bay Influenced) and the lower

one along LN39A (Riverine). Mosquito Point dunes are also a VIMS monitoring site (http://www.vims.edu/physical/research/shoreline). They have evolved over time as Mosquito Point has moved upriver. Most of the Plate 14 shoreline on the Rappahannock River has been slightly erosional over time.

D. Reach IV

Reach IV includes Plate 15 and 16 and extends from Mosquito Point to Windmill Point. The coast includes several island complexes and faces generally southerly. Plate 15 includes the small isolated dune site LN40A along the sheltered mainland coast. LN40A resides against a protruding bulkhead and has been there since 1937. A long spit ending at Deep Hole Point with dune signature existed until 1982. This spit was actually an island in 1937 which became shore connected in 1959 and 1982. The spit was significantly breached by 1994 leaving the distal end an island that has advanced upriver into Deep Hole. Shoreline change rates are for the sheltered embayed coast showing it to be very stable.

The Deep Hole Island spit extended to Windmill Point Creek in 1937 and was an island (Plate 16). The island attached by 1959 creating two spits with one going to Deep Hole Point and the other ending at Windmill Point Creek. This spit receded landward and connected to the mainland by 1982 creating the foundation for site LN43 and has persisted since. Other dune sites along the Plate 16 coast include LN47, LN50, LN51 and LN52. These are all isolated erosional remnants that were once part of a continuous beach/dune system along the south side of Fleet's Island from Windmill Point Creek to Windmill Point (Plate 17). Numerous groins, large and small have been installed over the years, and each of the dune sites resides within a groin field.

E. Reach V

From Windmill Point north to the county line is designated Reach V and includes Plates 17, 18, 19, 20 and 21. This is mostly open bay shoreline that is broken by four smaller tidal creeks including Little Bay, Tabbs Creek, Dymer Creek and Indian Creek. Plate 17 includes Fleets Island with no identified dune sites. Historical erosion is significant at an average of 7 ft/yr. In order to abate erosion, a series of breakwaters were placed along the shoreline between 1994 and 2002. Plate 18 has no dune sites identified either and is also very erosive at about 5 ft/yr. The erosion of Fleets Island has provided sediments to upriver shorelines, particularly the Rappahannock River coast, where spits, islands, beach and dune have evolved and decayed over time. Plate 19 has no dune sites identified and was too irregular to apply the straight line shore change model.

Plate 20 contains dune sites LN64A, LN65, LN66 LN67 and LN68 which all occur along the distal end of Poplar Neck between Dymer Creek and Poplar Creek. These sites evolved and were created as the Bay-exposed end of Poplar Neck eroded. Dune sites LN64A and LN65 were not in existence in 1937. Site LN64 evolved by 1982 between two groins. A pond existed in 1937 and 1959, but it had completely breached by 1982. By 1959, LN65 had found a niche at a small washover into the pond and stabilized. Dune sites LN66 and LN67 evolved as isolated dunes on the mainland side of the old pond shoreline after the pond was breached as seen in 1982 imagery. Site LN68 resides as a small pocket beach bounded by a marsh headland and stone revetment.

Plate 21 shows the end of Fleets Neck which lies between Rones Bay and Indian Creek. Five dune sites occur on Fleets Neck including LN69, LN70, LN71, LN72 and LN73. They were all part of more extensive dune/beach coast in 1937. Over time, shore recession and development fragmented the coast. Each site settled into its own isolated geomorphic setting. Erosion has been most severe on the distal end on the Neck, and Grogg Island has been reduced to almost non-existence.

V. DISCUSSION: NEAR FUTURE TRENDS OF DUNE SITES

The following discussion is a delineation of shoreline trends based on past performance. Ongoing shore development, shore stabilization and/or beach fill, and storms will have local impacts on the near term. "Near Future" is quite subjective and only implies a reasonable expectation for a given shore reach to continue on its historic course for the next 10 to 20 years. In addition, the basis for the predictions are the shorelines digitized on geo-rectified aerial photography which have an error associated with them (see Methods, Section III). Each site's long-term and recent stability as well as a near future prediction are shown in a table in Appendix B. **This data is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.**

A. Reach I

Dune site LN3 has been stable for the last 30 years or so and should remain so for the near term (Figure 7). Site LN4 that occurs across a creek mouth has advanced and receded over time and will most likely continue that trend so it might be deemed erosional in that regard. Site LN5 appears stable as long as the bounding marsh headlands remain intact.

Site LN6 has lost much of its beach and the *Spartina patens* is eroding. The upriver headland also is eroding so this site will continue to recede. Site LN7 resides in a relatively stable coastal setting (Figure 7), and LN8 is reasonably secure within its groinfield. Site LN10 is in an erosional trend, and LN11 appears stable as it resides on the "sheltered" side of the adjacent upriver headland.

Dune site LN12 appears to be in a stable setting with the potential to advance and recede as the creek mouth opens and closes (Figure 7). Site LN13 is fairly stable within the existing groinfield. Although relatively stable now, LN15 may face potential long-term impacts as the bounding marsh headland recede. Site LN16 will most likely continue to recede.

Dune sites LN17 and LN18 are generally receding while LN19 resides in a relatively stable groinfield. Dune sites LN20, LN21, LN22 and LN23 are isolated dune features along a decaying shoreline while LN24 might be stable against the old jetty for the near term. Dune site LN25 will probably maintain its existence as the spit recedes to the mainland.

B. Reach II

No dune sites exist along this reach.

C. Reach III

Site LN28 and LN29 appear stable for the near term in their isolated geomorphic settings. The Norris bridge has provided a stable coastal setting for LN32 (Figure 8). Dune sites LN34 and LN36 also occur along a stable beach planform though their vegetative extent may transition alongshore (Figure 8). The Mosquito Point dunes, LN39A and LN39B will continue to exist as mobile features an the point migrates upriver (Figure 8).

D. Reach IV

Site LN40A is in a stable setting. Dune site LN43 is transgressing landward while LN47 is stable within its groinfield (Figure 9). Site LN50 is stable to accretionary, and LN51 and LN52 appear stable on either side of the old wharf/groin (Figure 9).

E. Reach V

Along the end of Poplar Neck, LN64A and LN65 appear to be in an erosional/transgressive state while LN66 is stable if not advancing. Site LN67 is presently in a stable configuration but will recede as the adjacent headland erodes, and LN68 appears stable to accretionary for the near term (Figure 9).

Site LN69 is stable between groins, and LN70 is still mobile between a revetment and breakwater but might become stable over time as it evolves between these man-made headlands. A groinfield helps maintain the stability of LN71 and LN72 in a stable embayment. Site LN73 also appears stable between a jetty and groin (Figure 9).

Figure 7. Selected dune site ground photos in Reach I.

Figure 8. Selected dune site ground photos in Reach III.

Figure 9. Selected dune site ground photos in Reach IV and V.

VI. SUMMARY

Shoreline change rates are based on aerial imagery taken at a particular point in time. We have attempted to portray the same shoreline feature for each date along the coast of Lancaster County. Every 500 feet along each baseline on each plate, the rate of change was calculated. The mean or average rate for each plate is shown in Table 2 for five time periods with the long-term rate determined between 1937 and 2002. The total average and standard deviation (Std Dev) for the entire data set of individual rates is also given. The standard deviation shows the relative spread of values about the mean or average. Larger standard deviation values relative to the mean indicates a wider scatter of erosion rates about the mean while lower standard deviation values indicates erosion rates are concentrated near the mean (*i.e*. all the rates calculated for the entire plate were similar).

The largest variability in mean shore change rates and standard deviations were recorded for the shoreline described by baseline 16A. For instance, between 1982 and 1994, the standard deviation was larger than the average rate of change indicating that the overall rate is probably not indicative of the change which occurred on this section of shore. However, not all of the dates for this section of shore had mean shore change rates with large standard deviations. In fact, many standard deviations were equal to or significantly less than the average rate of change, indicating that the shore change rates were relatively consistent for those time periods. In general, the plates influenced by the Chesapeake Bay wave climate (Plates 16-21) had the largest rates of change.

When short time frames are used to determine rates of shoreline change, shore alterations may seem amplified. The rates based on short-time frames can modify the overall net rates of change. Hopefully, the shore change patterns shown in this report along with the aerial imagery will indicate how the coast will evolve based on past trends and can be used to provide the basis for appropriate shoreline management plans and strategies. Dunes and beaches are a valuable resource that should be either maintained, enhanced or created in order to abate shoreline erosion and provide sandy habitat.

Table 2. Summary average shoreline rates of change and their standard deviation for Lancaster County.

	Plate 1A		Plate 1B		Plate 1C		Plate 2		Plate 3		Plate 4		Plate 5		Plate 6	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	-0.3	0.7	0.3	0.7	-0.5	1.4	-0.4	0.9	-0.2	2.8	0.2	4.4	-0.8	1.9	-0.5	1.6
1959-1982	-1.0	0.7	-0.4	0.6	-2.6	1.3	-2.3	1.3	-1.0	1.4	0.1	2.3	1.2	5.9	0.0	1.4
1982-1994	-0.1	0.7	-0.6	0.8	-5.0	3.7	-2.8	1.2	-1.5	2.6	-0.7	2.7	-1.6	2.1	-0.4	2.2
1994-2002	-3.8	1.3	-0.4	0.8	-4.3	4.8	-3.3	2.8	-0.6	3.7	-1.9	4.8	-1.8	4.9	-3.3	1.9
1937-2002	**-0.9**	**0.4**	**-0.2**	**0.3**	**-2.6**	**0.8**	**-1.9**	**0.8**	**-0.8**	**1.0**	**-0.7**	**2.0**	**-0.3**	**1.3**	**-0.9**	**1.4**

	Plate 7		Plate 8A		Plate 8B		Plate 9A		Plate 9B		Plate 10		Plate 11		Plate 12	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	0.3	1.7	-3.4	3.4	-3.0	2.2	0.9	0.6	4.5	1.1	-0.7	1.5	-1.2	1.7	0.0	2.4
1959-1982	-1.8	1.6	-0.7	0.9	-0.7	1.1	-1.9	0.7	-5.9	2.3	-1.3	0.4	-0.4	0.9	-1.2	2.1
1982-1994	1.2	9.7	-1.3	1.5	0.0	1.6	0.1	0.3	3.3	2.6	-0.4	0.7	-0.8	1.4	-0.6	3.5
1994-2002	-3.7	5.6	-1.7	0.9	-1.6	1.7	-0.5	0.6	-4.8	3.1	-1.6	2.6	-0.6	2.4	0.1	1.7
1937-2002	**-0.7**	**1.7**	**-1.9**	**1.3**	**-1.4**	**1.0**	**-0.4**	**0.3**	**-0.6**	**0.5**	**-1.0**	**0.5**	**-0.8**	**0.6**	**-0.5**	**1.0**

	Plate 13		Plate 14		Plate 15		Plate 16A		Plate 16B		Plate 17		Plate 18		Plate 20	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	-0.7	1.0	-0.2	5.5	0.5	0.9	-5.7	8.6	-2.1	5.0	-9.6	1.3	-3.3	4.3	-2.9	2.8
1959-1982	-1.2	1.6	-0.4	3.5	-0.6	0.9	-14.4	7.4	-0.7	3.4	-6.8	3.6	-4.3	3.6	-3.0	2.4
1982-1994	-1.8	2.4	-2.0	4.8	-0.9	1.7	-20.1	27.7	-1.0	2.1	-4.3	7.1	-9.3	11.7	-1.4	3.9
1994-2002	0.9	2.6	2.7	4.1	1.1	3.4	-3.0	1.8	-0.4	2.3	-1.8	5.2	-1.6	9.9	-1.8	2.5
1937-2002	**-0.9**	**1.0**	**-0.3**	**1.7**	**-0.1**	**0.6**	**-11.1**	**4.5**	**-1.2**	**1.5**	**-6.7**	**2.0**	**-4.6**	**2.4**	**-2.5**	**1.8**

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APPENDIX A

For each Plate shown on Figure 4 (Page 4), Appendix A contains orthorectified aerial photography flown in 1937, 1959, 1982, 1994, and 2002. Also shown are the digitized shorelines, identified dune sites, and an arbitrarily created baseline. A plot shows only the relative locations of the shorelines while another one depicts the rate of shore change between dates. A summary of the average Plate rate of change in ft/yr as well as the standard deviation for each rate is also shown.

This data is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

APPENDIX B

The data shown in the following tables were primarily collected as part of the Chesapeake Bay Dune: Evolution and Status report and presented in Hardaway *et al.* (2001) and Hardaway *et al.* (2004). Individual site characteristics may now be different due to natural or man-induced shoreline change.

An additional table presents the results of this analysis and describes each dune site's relative long-term, recent, and near-future predicted stability. This data results from the position of the digitized shorelines which have an error associated with them (see Methods, Section III).

Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001).
Site characteristics may now be different due to natural or man-influenced shoreline change.

Identified dune sites in Lancaster County as of 2000.

Dune Site No.	Location^ Easting (Feet)	Northing (Feet)	Date Visited	Dune Shore Length (feet)	Primary Dune Site?	Secondary Dune Site?	*Public Ownership?
3	2,555,400	525,350	30-Jul-1999	250	Yes	No	No
4	2,555,750	524,600	30-Jul-1999	210	Yes	No	No
5	2,557,700	518,400	30-Jul-1999	130	Yes	No	No
6	2,558,750	515,750	30-Jul-1999	670	Yes	No	No
7	2,559,900	514,900	30-Jul-1999	1,025	Yes	No	No
8	2,560,450	514,150	30-Jul-1999	580	Yes	No	No
10	2,562,200	509,650	30-Jul-1999	110	Yes	No	No
11	2,562,800	509,450	30-Jul-1999	990	Yes	Yes	No
12	2,564,500	507,800	30-Jul-1999	190	Yes	No	No
13	2,565,400	507,250	30-Jul-1999	300	Yes	No	No
15	2,566,000	507,200	30-Jul-1999	150	Yes	No	No
16	2,567,750	503,350	30-Jul-1999	125	Yes	No	No
17'	2,568,300	495,050	30-Jul-1999	120	Yes	No	No
18	2,568,350	494,750	30-Jul-1999	310	Yes	No	No
19	2,568,050	492,350	30-Jul-1999	200	Yes	No	No
20'	2,568,150	491,450	03-Dec-1999	140	Yes	No	No
21'	2,568,200	491,200	03-Dec-1999	160	Yes	No	No
22'	2,568,550	490,250	03-Dec-1999	100	Yes	No	No
23'	2,568,950	489,800	03-Dec-1999	170	Yes	No	No
24'	2,569,200	489,150	03-Dec-1999	240	Yes	No	No
25	2,570,000	488,750	03-Dec-1999	420	Yes	No	No
28'	2,593,600	485,650	03-Dec-1999	120	Yes	No	No
29'	2,596,400	486,600	03-Dec-1999	150	Yes	No	No
32	2,604,050	481,450	22-Apr-1999	900	Yes	Yes	No
34	2,608,900	478,650	22-Apr-1999	1,200	Yes	No	No
36	2,610,700	479,100	22-Apr-1999	140	Yes	No	No
39A	2,619,050	471,800	22-Apr-1999	850	Yes	Yes	No
39B	2,619,050	471,800	22-Apr-1999	600	Yes	No	No
40A	2,623,930	476,750	22-Apr-1999	320	Yes	No	No
43	2,631,650	476,200	22-Apr-1999	820	Yes	No	No
47	2,636,250	475,750	22-Apr-1999	360	Yes	No	No
50	2,638,500	474,850	22-Apr-1999	580	Yes	No	No
51	2,638,750	747,350	22-Apr-1999	250	Yes	No	No
52	2,639,000	474,150	22-Apr-1999	100	Yes	No	No
64A	2,626,220	489,950	20-May-1999	200	Yes	No	No
65	2,626,300	490,350	20-May-1999	150	Yes	No	No
66	2,626,100	490,600	20-May-1999	170	Yes	No	No
67	2,625,750	491,250	20-May-1999	140	Yes	No	No
68	2,625,350	491,900	20-May-1999	250	Yes	Yes	No
69	2,628,800	494,300	20-May-1999	100	Yes	No	No
70	2,628,550	496,450	20-May-1999	100	Yes	No	No
71	2,628,250	496,850	20-May-1999	300	Yes	No	No
72	2,627,400	497,650	20-May-1999	570	Yes	Yes	No
73	2,626,700	498,050	20-May-1999	300	Yes	Yes	No

*Public ownership includes governmental entities including local, state, and federal; otherwise ownership is by the private individual.
^Location is in Virginia State Plane South, NAD 1927
'Sites were noted as dunes but were not photographed or surveyed

Dune site measurements in Lancaster County as of 2000.

Dune Site Measurements							
Primary Dune			Secondary Dunes				
Crest Elev	Distance from Crest landward to back base	To MLW	2nd Dune Site	Crest Elev	Distance From Primary Crest to 2nd Crest	2ndCrest landward	2nd Crest seaward to 1st back base
(ftMLW)	(feet)	(feet)		(ftMLW)	(feet)	(feet)	(feet)
5	18	35					
3.94	21	44					
3.44	32	45					
3.67	14	33					
5	6	53					
4.81	39	40					
4.06	12	32					
3.53	3	28	Yes	3.27	29	3	26
3.87	9	47					
4.58	23	28					
3.75	19	35					
2.77	13	23					
5.09	18	27					
5.83	24	54					
4.59	15	50					
4.52	18	45	Yes	4.41	61	29	43
5.54	28	60					
3.7	32	61	Yes	3.44	143	86	25
5.28	27	65					
5.5	20	45					
5	20	30					
5	50	41					
4.34	15	60					
5	40	28					
7.15	32	63					
5.84	50	40					
4.86	44	48					
3.74	7	42					
5.13	63	50					
3.63	18	79	Yes	3.42	60	13	42
5.41	25	65					
3.91	50	52					
5.25	4	44					
3.39	18	29	Yes	3.03	40	18	4
4.74	25	50	Yes	5.11	104	52	27

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

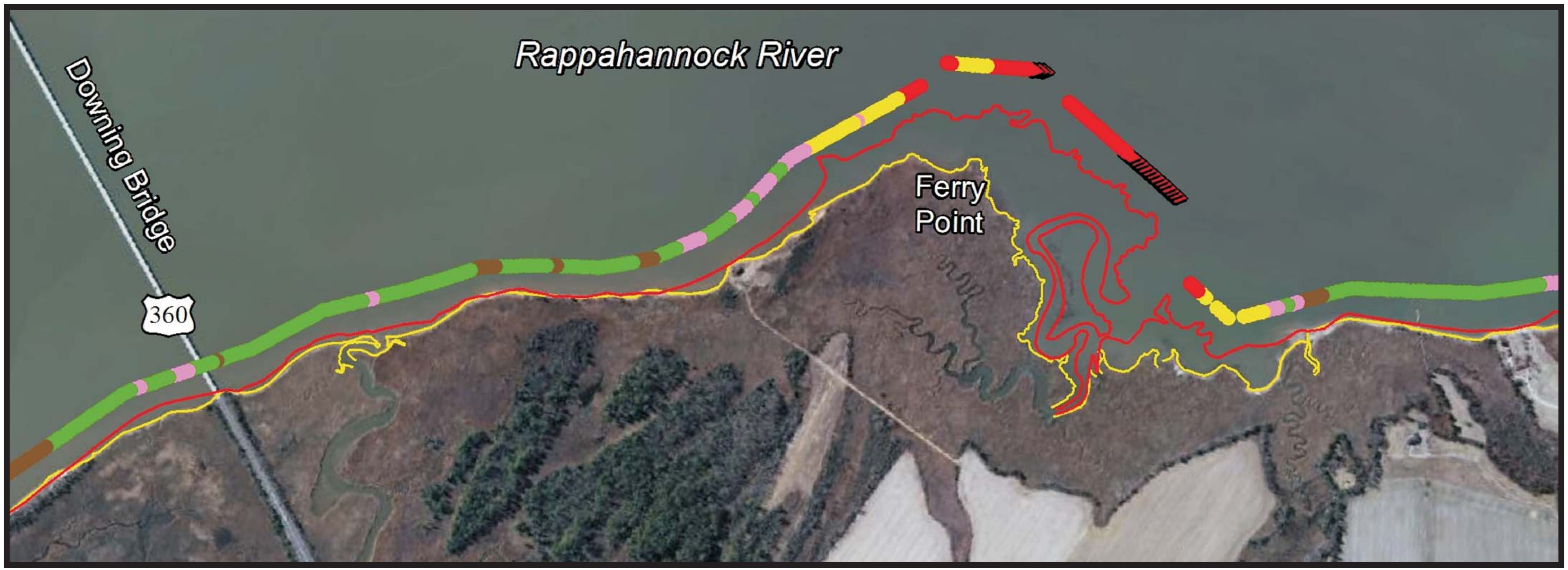
Dune site parameters in Lancaster County as of 2000.

Site No.	Type	Fetch Exposure A	Shoreline Direction of Face B	Nearshore Gradient C		Morphologic Setting D	Relative Stability E	Underlying Substrate F	Structure or Fill G
3	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Pocket	Stable	Upland	Groin
4	Natural	Riverine	Southwest	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	
5	Natural	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	
6	Natural	Riverine	South	Steep	No Bars	Isolated, Shallow Bay	Erosional	Upland	
7	Natural	Riverine	Southwest	Steep	No Bars	Dune Field, Linear	Stable	Upland	
8	Man Inf	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
10	Natural	Riverine	West	Steep	No Bars	Isolated, Linear	Erosional	Upland	
11	Natural	Riverine	Southwest	Medium	No Bars	Dune Field, Shallow Bay	Stable	Upland	
12	Man Inf	Riverine	Southwest	Medium	No Bars	Ck Mouth Barrier/Spit	Accretionary	Marsh	Revet/Bulkhead
13	Man Inf	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
15	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Linear	Erosional	Marsh	Beach Fill
16	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
17	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
18	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
19	Man Inf	Riverine	West	Medium	No Bars	Isolated, Linear	Stable	Upland	Groin
20	Man Inf	Riverine	West	Medium	No Bars	Isolated, Linear	Erosional	Marsh	Groin
21	Natural	Riverine	West	Medium	No Bars	Isolated, Linear	Erosional	Marsh	
22	Natural	Riverine	Southwest	Steep	No Bars	Isolated, Pocket	Erosional	Marsh	
23	Natural	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Erosional	Marsh	
24	Man Inf	Riverine	West	Steep	No Bars	Ck Mouth Barrier/Spit	Accretionary	Marsh	Jetty
25	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Linear	Stable	Marsh	Beach Fill
26	Natural	Riverine	Southwest	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	
27	Man Inf	Riverine	Southeast	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
28	Natural	Riverine	South	Steep	No Bars	Isolated, Pocket	Stable	Marsh	
29	Man Inf	Riverine	Southwest	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Upland	Jetty
32	Man Inf	Riverine	Southwest	Steep	No Bars	Dune Field, Linear	Stable	Upland	Jetty
34	Man Inf	Riverine	South	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	Groin
36	Man Inf	Riverine	South	Steep	No Bars	Isolated, Shallow Bay	Stable	Upland	Groin
39A	Natural	Riverine	West	Steep	No Bars	Dune Field, Salient	Accretionary	Upland	
39B	Natural	River, Bay Inf	South	Steep	No Bars	Dune Field, Salient	Erosional	Upland	
40A	Man Inf	River, Bay Inf	Southeast	Shallow	No Bars	Isolated, Shallow Bay	Stable	Upland	Revet/Bulkhead
43	Natural	River, Bay Inf	Southeast	Medium	Bars	Dune Field, Linear	Erosional	Upland	
47	Man Inf	River, Bay Inf	South	Medium	Bars	Isolated, Linear	Stable	Upland	Groin
50	Man Inf	River, Bay Inf	Southwest	Medium	No Bars	Dune Field, Shallow Bay	Stable	Upland	Groin
51	Man Inf	River, Bay Inf	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
52	Man Inf	River, Bay Inf	South	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
64A	Man Inf	Open Bay	East	Medium	Bars	Isolated, Linear	Erosional	Upland	Beach Fill
65	Man Inf	Open Bay	East	Medium	Bars	Isolated, Pocket	Erosional	Upland	Revet/Bulkhead
66	Natural	Riverine	Northeast	Shallow	No Bars	Isolated, Salient	Accretionary	Upland	
67	Natural	River, Bay Inf	East	Medium	Bars	Isolated, Pocket	Erosional	Marsh	
68	Natural	River, Bay Inf	North	Steep	No Bars	Isolated, Salient	Accretionary	Upland	
69	Man Inf	River, Bay Inf	South	Steep	Bars	Isolated, Pocket	Erosional	Upland	Groin
70	Man Inf	River, Bay Inf	Northeast	Steep	Bars	Isolated, Linear	Erosional	Marsh	Breakwaters
71	Man Inf	River, Bay Inf	Northeast	Steep	Bars	Isolated, Linear	Stable	Upland	Groin
72	Natural	River, Bay Inf	North	Steep	No Bars	Dune Field, Shallow Bay	Stable	Upland	
73	Man Inf	River, Bay Inf	Northeast	Steep	No Bars	Isolated, Salient	Stable	Upland	Jetty

Long-term, recent stability and future predictions of shore erosion and accretion rates for dune sites in Lancaster County.

	Site No.	Long-Term Stability 1937-2002	Recent Stability 1994-2002	Near Future Prediction
LN	3	Erosional	Stable	Stable
LN	4	Stable	Erosional	Erosional
LN	5	Erosional	Erosional	Stable
LN	6	Erosional	Erosional	Erosional
LN	7	Accretionary	Erosional	Stable
LN	8	Accretionary	Stable	Stable
LN	10	Accretionary	Erosional	Erosional
LN	11	Accretionary	Stable	Stable
LN	12	Erosional	Accretionary	Stable
LN	13	Stable	Stable	Stable
LN	15	Erosional	Stable	Erosional
LN	16	Erosional	Erosional	Erosional
LN	17	Erosional	Erosional	Erosional
LN	18	Accretionary	Erosional	Erosional
LN	19	Accretionary	Stable	Stable
LN	20	Erosional	Erosional	Erosional
LN	21	Erosional	Erosional	Erosional
LN	22	Erosional	Erosional	Erosional
LN	23	Erosional	Erosional	Erosional
LN	24	Accretionary	Erosional	Stable
LN	25	Accretionary	Erosional	Erosional
LN	28	Erosional	Stable	Stable
LN	29	Stable	Stable	Stable
LN	32	Accretionary	Stable	Stable
LN	34	Erosional	Stable	Stable
LN	36	Erosional	stable	Stable
LN	39A	Accretionary	Accretionary	Accretionary
LN	39B	Accretionary	Erosional	Erosional
LN	40A	Accretionary	Accretionary	Stable
LN	43	Accretionary	Erosional	Erosional
LN	47	Erosional	Stable	Stable
LN	50	stable	Stable	Stable
LN	51	Erosional	stable	Stable
LN	52	Erosional	Stable	Stable
LN	64A	Erosional	Erosional	Erosional
LN	65	Erosional	Erosional	Erosional
LN	66	Erosional	stable	Accretionary
LN	67	Erosional	Accretionary	Stable
LN	68	Accretionary	Stable	Stable
LN	69	Stable	Stable	Stable
LN	70	Erosional	Erosional	Erosional
LN	71	Erosional	Stable	Stable
LN	72	Accretionary	Stable	Stable
LN	73	Accretionary	Stable	Stable

Shoreline Evolution:
Richmond County, Virginia
Rappahannock River Shorelines



Virginia Institute of Marine Science
College of William & Mary
Gloucester Point, Virginia

September 2011

Shoreline Evolution:
Richmond County, Virginia
Rappahannock River Shorelines

Data Summary Report

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Shoreline Studies
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Gloucester Point, Virginia

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September 2011

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1 Introduction

Richmond County is situated on the Northern Neck Peninsula in the eastern portion of Virginia (Figure 1). The Rappahannock River forms the southern boundary of this 192 square mile community. The County has 149 miles of shoreline on the Rappahannock River and Cat Point and Totuskey Creeks. Through time, the County's shoreline has evolved, and determining the rates and patterns of shore change provides the basis to know how a particular coast has changed through time and how it might proceed in the future. Along Chesapeake Bay's estuarine shores, winds, waves, tides and currents shape and modify coastlines by eroding, transporting and depositing sediments.

The purpose of this report is to document how the shore zone of Richmond County has evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year and can be used to assess the geomorphic nature of shore change. Aerial photos show how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man, through shore hardening or inlet stabilization, come to dominate a given shore reach. In addition to documenting historical shorelines, the change in shore positions along the rivers and larger creeks in Richmond County will be quantified in this report. The shorelines of very irregular coasts, small creeks around inlets, and other complicated areas, will be shown but not quantified.

2 Methods

2.1 Photo Rectification and Shoreline Digitizing

An analysis of aerial photographs provides the historical data necessary to understand the suite of processes that work to alter a shoreline. Images of the Richmond County Shoreline from 1937, 1953, 1969, 1994, 2002, 2007 and 2009 were used in the analysis. The 1994, 2002, 2007 and 2009 images were available from other sources. The 1994 imagery was orthorectified by the U.S. Geological Survey (USGS) and the 2002, 2007 and 2009 imagery was orthorectified by the Virginia Base Mapping Program (VBMP). The 1937, 1953, and 1969 photos were a part of the VIMS Shoreline Studies Program archives. The historical aerial images acquired to cover the entire shoreline were not always flown on the same day. The dates for each year are: *1937* - April 1, 6,7 and 17; *1953* - October 2, 3, and November 27; *1969* - December 5 and 11. The exact dates the 1994 images were flown could not be determined, and the 2002, 2007, and 2009 were all flown in February and March of their respective years.

The 1937, 1953, and 1969 images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. These aerial photographs were orthographically corrected to produce a seamless series of aerial mosaics following a set of standard operating procedures. The 1994 Digital Orthophoto Quarter Quadrangles (DOQQ) from USGS were used as the reference images. The 1994 photos are used rather than higher quality, more recent aerials because of the difficulty in finding control points that match the earliest 1937 and 1953 images.

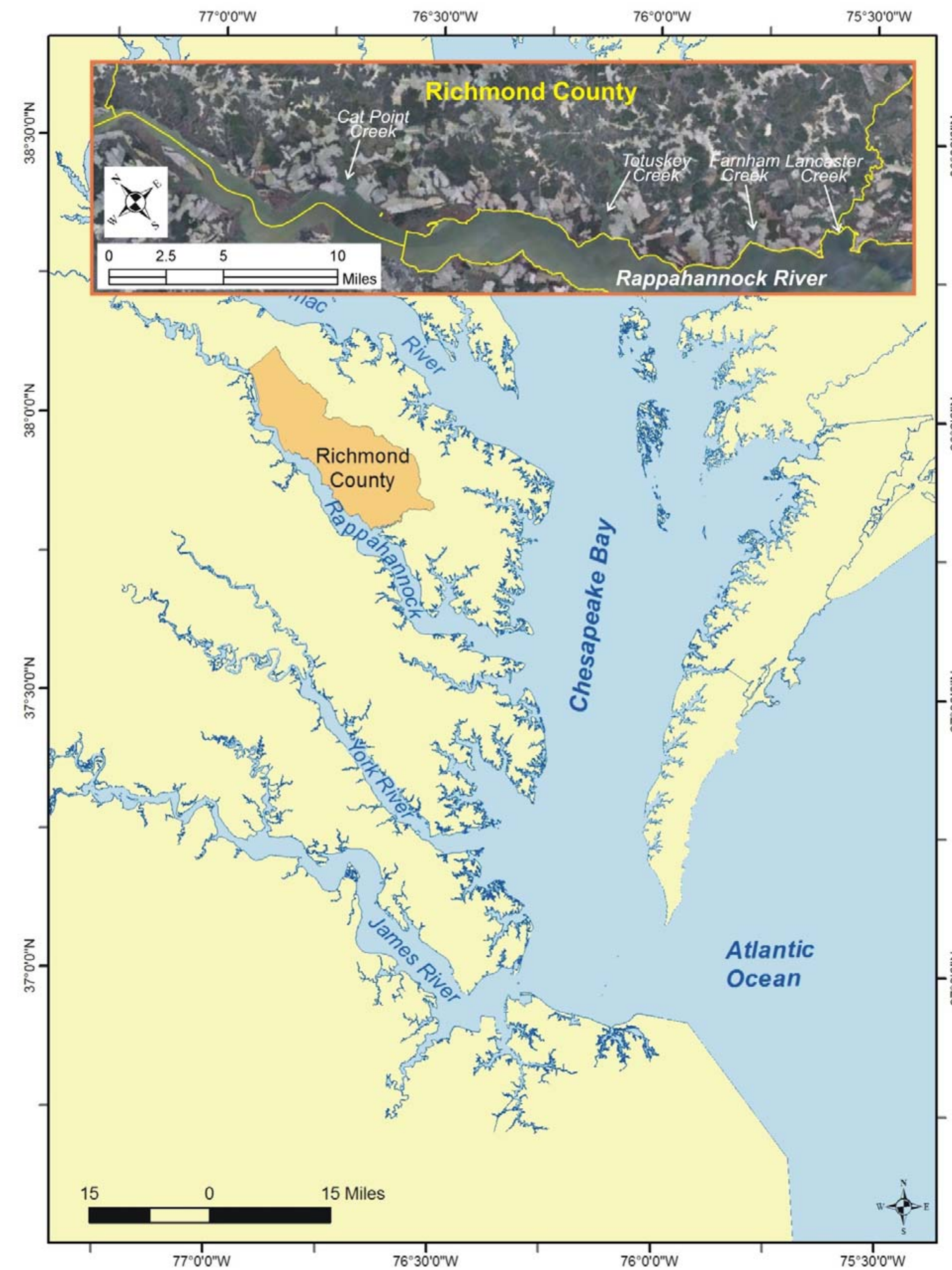

Figure 1. Location of Richmond County within the Chesapeake Bay estuarine system.

ERDAS Orthobase image processing software was used to orthographically correct the individual flight lines using a bundle block solution. Camera lens calibration data were matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. The exterior and interior models were combined with a digital elevation model (DEM) from the USGS National Elevation Dataset to produce an orthophoto for each aerial photograph. The orthophotographs were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic .img format. To maintain an accurate match with the reference images, it is necessary to distribute the control points evenly, when possible. This can be challenging in areas with lack of ground features, poor photo quality and lack of control points. Good examples of control points were manmade features such as road intersections and stable natural landmarks such as ponds and creeks that have not changed much over time. The base of tall features such as buildings, poles. or trees can be used, but the base can be obscured by other features or shadows making these locations difficult to use accurately. Most areas of the county were particularly difficult to rectify, either due to the lack of development when compared to the reference images or due to no development in the historical and the reference images.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background. The morphologic toe of the beach or edge of marsh was used to approximate low water. High water limit of runup can be difficult to determine on the shoreline due to narrow or non-existent beaches against upland banks or vegetated cover. In areas where the shoreline was not clearly identifiable on the aerial photography, the location was estimated based on the experience of the digitizer. The displayed shorelines are in shapefile format. One shapefile was produced for each year that was mosaicked.

Horizontal positional accuracy is based upon orthorectification of scanned aerial photography against the USGS digital orthophoto quadrangles. To get vertical control, the USGS 30m DEM data was used. The 1994 USGS reference images were developed in accordance with National Map Accuracy Standards (NMAS) for Spatial Data Accuracy at the 1:12,000 scale. The 2002, 2007, and 2009 Virginia Base Mapping Program's orthophotography were developed in accordance with the National Standard for Spatial Data Accuracy (NSSDA). Horizontal root mean square error (RMSE) for historical mosaics was held to less than 20 ft.

Using methodology reported in Morton *et al.* (2004) and National Spatial Data Infrastructure (1998), estimates of error in orthorectification, control source, DEM and digitizing were combined to provide an estimate of total maximum shoreline position error. The data sets that were orthorectified (1937, 1953, and 1969) have an estimated total maximum shoreline position error of $\pm$20.0 ft, while the total maximum shoreline error for the four existing datasets are estimated at 18.3 ft for USGS and 10.2 ft for VBMP. The maximum annualized error for the shoreline data is $\pm$0.7 ft/yr. The smaller rivers and creeks are more prone to error due to their lack of good control points for photo rectification, narrower shore features, tree and ground cover and overall smaller rates of change. These areas are digitized but due to the higher potential for error, rates of change analyses are not calculated.

The Richmond County shoreline was divided into 21 plates (Figure 2) in order to display that data in Appendices A and B. In Appendix A, all of the digtized shorelines are shown, and the 2009 image is shown with only the 1937 and 2009 shorelines to show the long-term trends. In Appendix B, two photo dates and their associated shoreline are shown on each plate.

2.2 Rate of Change Analysis

The Digital Shoreline Analysis System (DSAS) was used to determine the rate of change for the County's shoreline (Himmelstoss, 2009). All DSAS input data must be managed within a personal geodatabase, which includes all the baselines created for Richmond County and the digitized shorelines for 1937, 1953, 1969, 1994, 2002, 2007, and 2009. Baselines were created about 200 feet seaward of the 1937 shoreline and encompassed most of the County's main shorelines but generally did not include the smaller creeks. It also did not include areas that have unique shoreline morphology such as creek mouths and spits. DSAS generated transects perpendicular to the baseline about 33 ft apart , which were manually checked and cleaned up. For Richmond County, this method represented about 43 miles of shoreline along 6937 transects. The End Point Rate (EPR) is calculated by determining the distance between the oldest and most recent shoreline in the data and dividing it by the number of years between them. This method provides an accurate net rate of change over the long term and is relatively easy to apply to most shorelines since it only requires two dates. This method does not use the intervening shorelines so it may not account for changes in accretion or erosion rates that may occur through time. However, Milligan *et al.* (2010a, 2010b, 2010c, 2010d) found that in several localities within the bay, EPR is a reliable indicator of shore change even when intermediate dates exist. Average rates were calculated along selected areas of the shore; segments are labeled in Appendix A and shown in Table 1.

3 Summary

The rates of change shown in Table 1 are averaged across large sections of shoreline and may not be indicative of rates at specific sites within the reach. Along many segments, rate of change is very low. Most change occurs at headlands, marshes or southwest or southeast-facing shorelines. The largest average rates occur on the Rappahannock River while the more fetch limited creeks have smaller average erosion rates. Segment L has the highest rate of change due to the loss of land at Waverly Point at the mouthof Totusky Creek and the barrier across Richardson Creek.

Table 1. Average end point rate of change (ft/yr) between 1937 and 2009 for segments along Richmond's shoreline. Segment locations are shown on maps in Appendix A.

Segment Name	Location	Average Rate of Change (ft/yr)
A	Rappahannock River	-0.4
B	Rappahannock River	-0.7
C	Rappahannock River - Mulberry Island	-0.6
D	Rappahannock River	-0.5
E	Cat Point Creek	-0.6
F	Rappahannock River	-0.5
G	Rappahannock River	-2.1
H	Rappahannock River	-1.5
I	Rappahannock River	-0.7
J	Rappahannock River	-0.8
K	Totuskey Creek	-0.5
L	Rappahannock River - Richardson Creek	-3.1
M	Rappahannock River	-0.4
N	Rappahannock River	-0.4
O	Farnham Creek	-0.4
P	Rappahannock River	-1.0
Q	Lancaster Creek	-0.8
R	Morattico Creek	-0.4

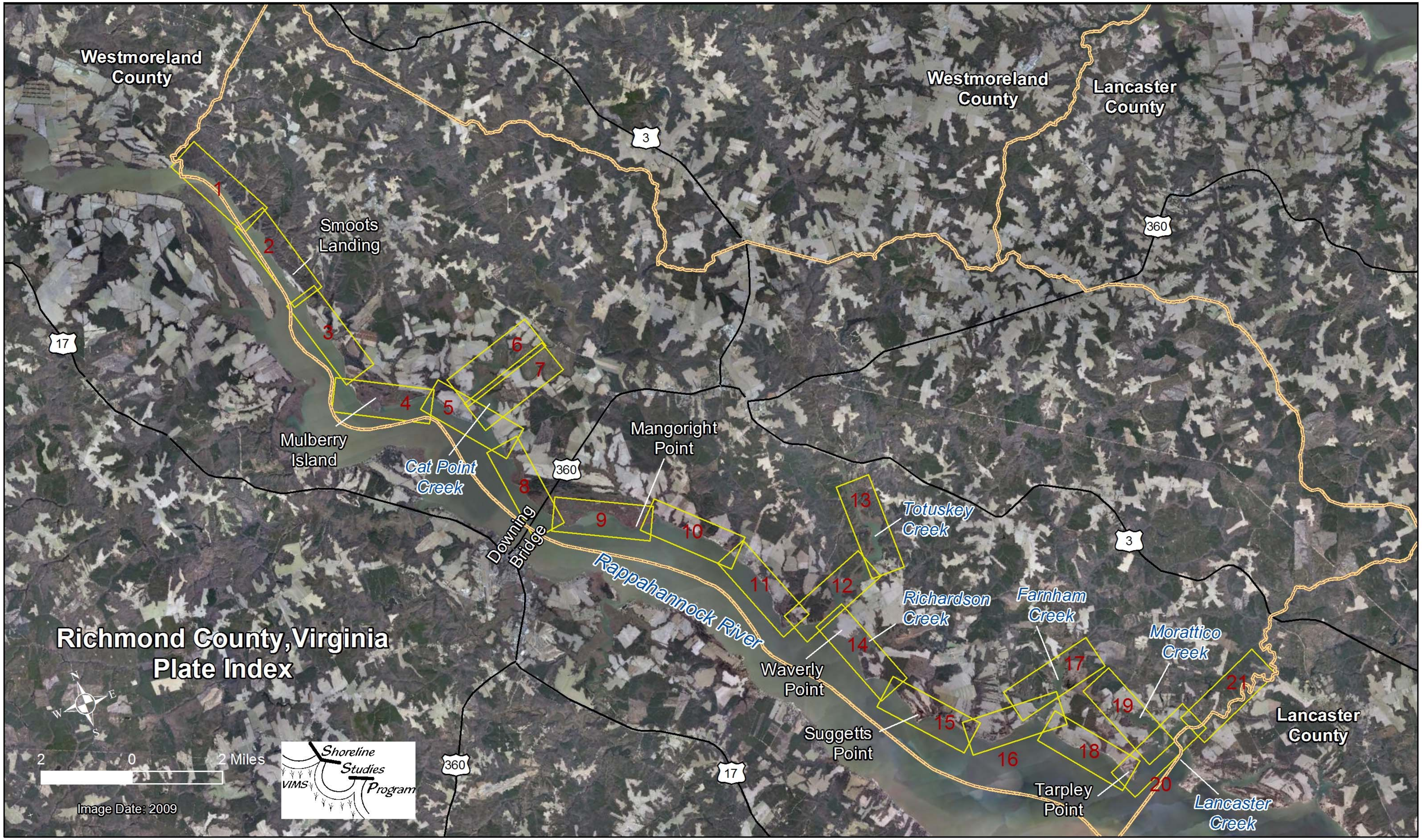

Figure 2. Index of shoreline plates.

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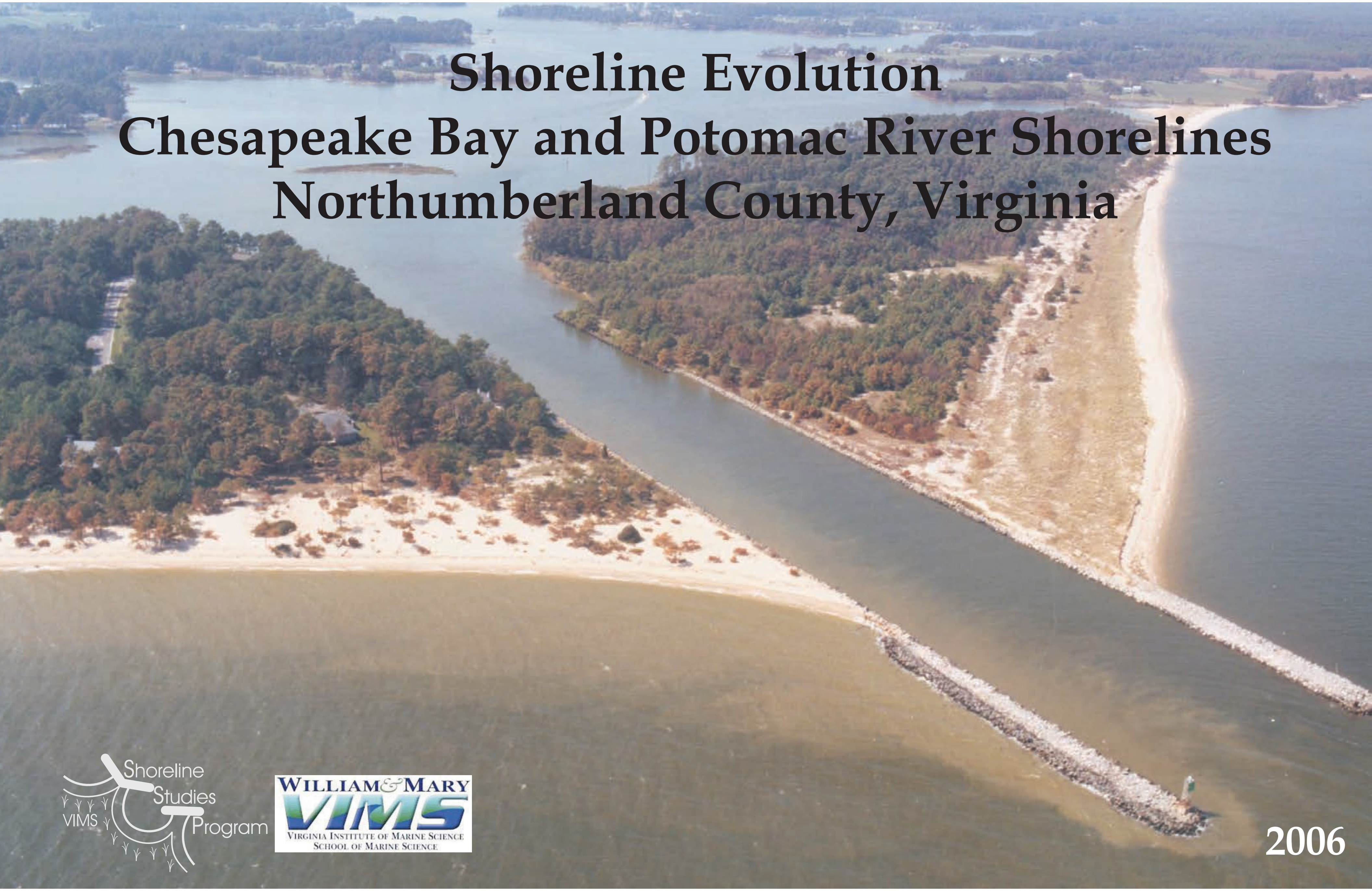
Shoreline Evolution
Chesapeake Bay and Potomac River Shorelines
Northumberland County, Virginia



Shoreline Evolution
Chesapeake Bay and Potomac River Shorelines
Northumberland County, Virginia

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2006

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Cover Photo: Photograph of Smith Point jetties and the Little Wicomico River. Photo taken by Shoreline Studies Program on 25 September 2003 .

I. INTRODUCTION

A. General Information

Shoreline evolution is the change in shore position through time. In fact, it is the material resistance of the coastal geologic underpinnings against the impinging hydrodynamic (and aerodynamic) forces. Along the shores of Chesapeake Bay, it is a process-response system. The processes at work include winds, waves, tides and currents, which shape and modify coastlines by eroding, transporting and depositing sediments. The shore line is commonly plotted and measured to provide a rate of change but it is as important to understand the geomorphic patterns of change. Shore analysis provides the basis to know how a particular coast has changed through time and how it might proceed in the future.

The purpose of this report is to document how dunes on the Potomac River and Chesapeake Bay shores of Northumberland (Figure 1) has evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year, and it is this imagery that allows one to assess the geomorphic nature of shore change. Aerial imagery shows how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man through shore hardening or inlet stabilization come to dominate a given shore reach. Most of the change in shore positions will be quantified in this report. Others, particularly very irregular coasts, around inlets, and other complicated areas will be subject to interpretation.

B. Chesapeake Bay Dunes

The primary reason for developing this Shoreline Evolution report is to be able to determine how dunes and beaches along the River and Bay coasts of Northumberland have and will evolve through time. The premise is that, in order to determine future trends of these important shore features, one must understand how they got to their present state. Beaches and dunes are protected by the Coastal Primary Sand Dune Protection Act of 1980 (Act)[1]. Research by Hardaway *et al.* (2001) located, classified and enumerated jurisdictional dunes and dune fields within the eight localities listed in the Act. These include the counties of Accomack, Lancaster, Mathews, Northampton and Northumberland and the cities of Hampton, Norfolk and Virginia Beach (Figure 2). Only Chesapeake Bay and river sites were considered in that study.

In 2003, Hardaway *et al*. created the Northumberland County Dune Inventory. That report detailed the location and nature of the jurisdictional primary dunes along the Bay shore of Northumberland and those results appear in Appendix B. For this study, the positions of the dune sites are presented using the latest imagery in order to see how the sites sit in the context of past shoreline positions. The dune location information has not been field verified since the original visits in 1999. This information is not intended to be used for jurisdictional determinations regarding dunes.

[1]The General Assembly of Virginia enacted the Coastal Primary Sand Dune Protection Act (the Dune Act) in 1980. The Dune Act was originally codified in § 62.1-13.21 to -13.28. The Dune Act is now recodified as Coastal Primary Sand Dunes and Beaches in § 28.2-1400 to -1420.

II. SHORE SETTING

A. Physical Setting

The Potomac River and Chesapeake Bay shoreline of Northumberland County extends from the county line with Westmoreland at the Yeocomico River down river to Smith Point and southward to the Lancaster County line at Indian Creek. This includes about 17 miles of tidal shoreline along the Potomac River and 18 miles along Chesapeake Bay. Additional shoreline is included in the tributaries. Historic shore erosion rates vary from 0 ft/yr to over 7 ft/yr along the Bay coast with several areas of localized accretion. The Potomac River shoreline change rates varied between +1 ft/yr to -10 ft/yr (Byrne and Anderson, 1978).

The coastal geomorphology of the County is a function of the underlying geology and the hydrodynamic forces operating across the land/water interface, the shoreline. The Chesapeake Bay and Potomac River coasts of Northumberland are almost exclusively Upper Pliestocene undifferentiated members of the Tabb Formation. Several areas of Holocene beach sands and muds occur along the Chesapeake Bay shore (Figure 3). The Atlantic Ocean has come and gone numerous times over the Virginia coastal plain over the past million years or so. The effect has been to rework older deposits into beach and lagoonal deposits at time of the transgressions. The last low stand found the ocean coast about 60 miles to the east when sea level about 300 feet lower than today and the coastal plain was broad and low. The current estuarine system was a meandering series of rivers working their way to the coast. About 15,000 years ago, sea level began to rise and the coastal plain watersheds began to flood. Shorelines began to recede. The slow rise in sea level is one of two primary long-term processes which cause the shoreline to recede; the other is wave action, particularly during storms. As shorelines recede or erode, the bank material provides the sands for the offshore bars, beaches and dunes. Parts of Northumberland's littoral system is sand rich from erosion over time of the sandy, sometimes high, upland banks and the nearshore substrate. Many sand beaches occur along the coast and an extensive system of offshore sand bars exist along both the Potomac and Chesapeake shores. These sand bars greatly influenced and are themselves influenced by the impinging wave climate.

Sea level is continuing to rise in Chesapeake Bay. Tide data collected at Sewells Point in Norfolk show that sea level has risen 4.42 mm/yr (0.17 inches/yr) or 1.45 ft/century (http://www.co-ops.nos.noaa.gov/). Lewisetta on the Potomac River in Northumberland County rose 4.85 mm/yr or 1.59 ft/century. Increased water levels directly effect the reach of storms and their impact on shorelines. Anecdotal evidence of storm surge during Hurricane Isabel, which impacted North Carolina and Virginia on September 18, 2003, put it on par with the storm surge from the "storm of the century" which impacted the lower Chesapeake Bay in August 1933. Boon (2003) showed that even though the tides during the storms were very similar, the difference being only 4 cm (~0.5 in), the amount of surge was different. The 1933 storm produced a storm surge that was greater than Isabel's by slightly more than a foot. However, analysis of the mean water levels for the months of both August 1933 and September 2003 showed that sea level has risen by 41 cm (1.35 ft) at Hampton Roads in the seventy years between these two storms (Boon, 2003). This is the approximate time span between our earliest aerial imagery (1937) and our most recent (2002), which means the impact of sea level rise to shore change is significant. The beaches, dunes, and nearshore sand bars try to keep pace with the rising sea levels.

Four shore reaches are considered in this report along the shoreline of Northumberland (Figure 4). Reach I extends along the Yeocomico River and Potomac River from the boundary with Westmoreland County to Lewisetta. Reach II goes from the Coan River to the jetties at Smith Point. Reach III picks up at the jetties and heads south to the Wicomico River. Reach IV occurs on Chesapeake Bay from the Wicomico River to the boundary with Lancaster County at Indian Creek.

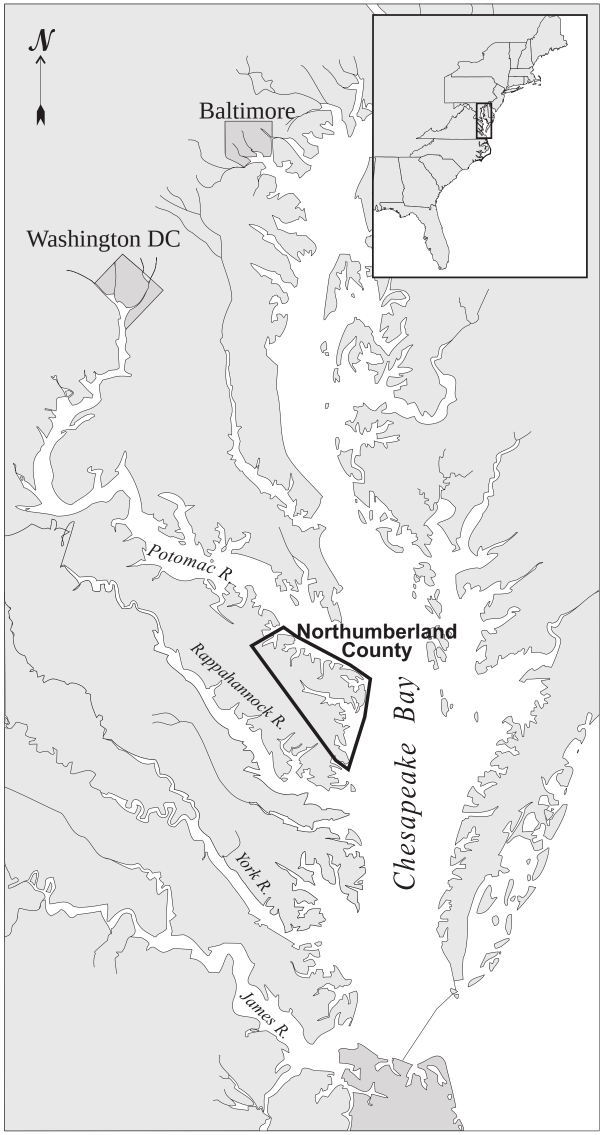


Figure 1. Location of Northumberland County within the Chesapeake Bay estuarine system.

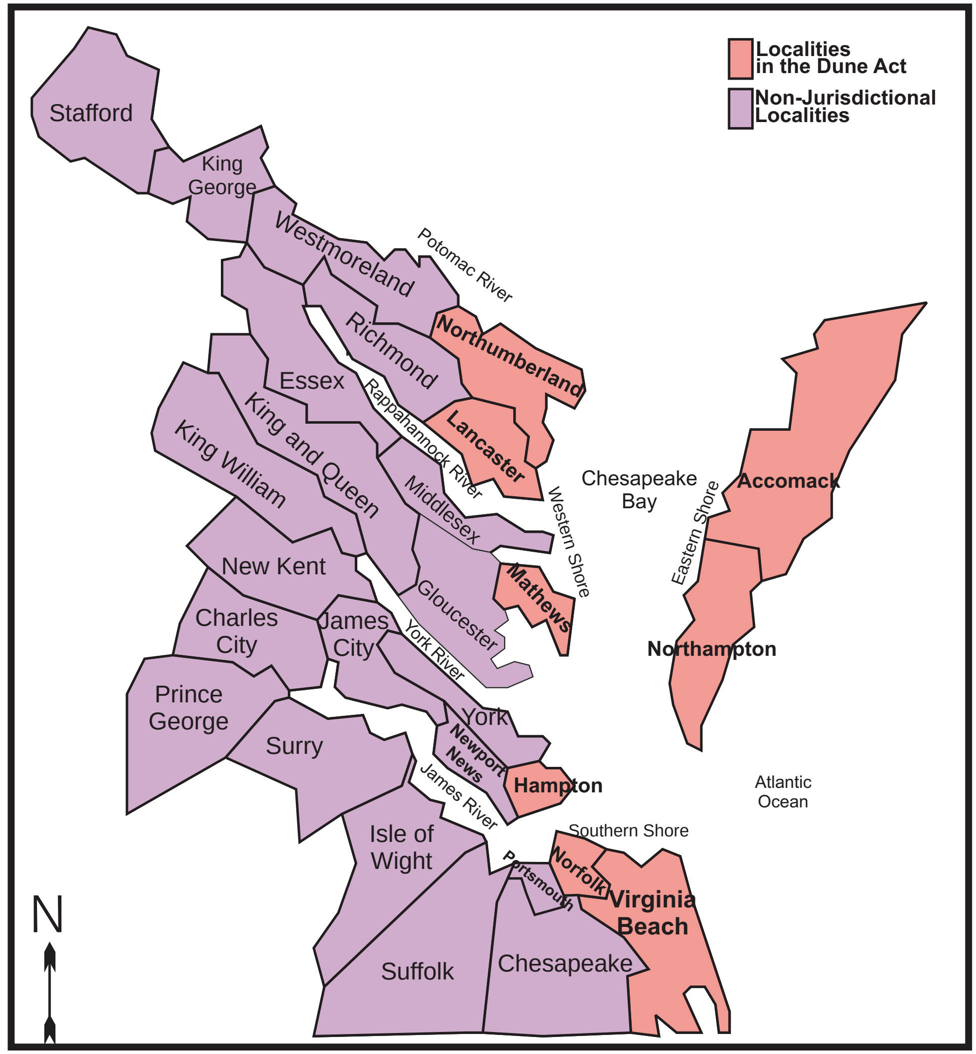
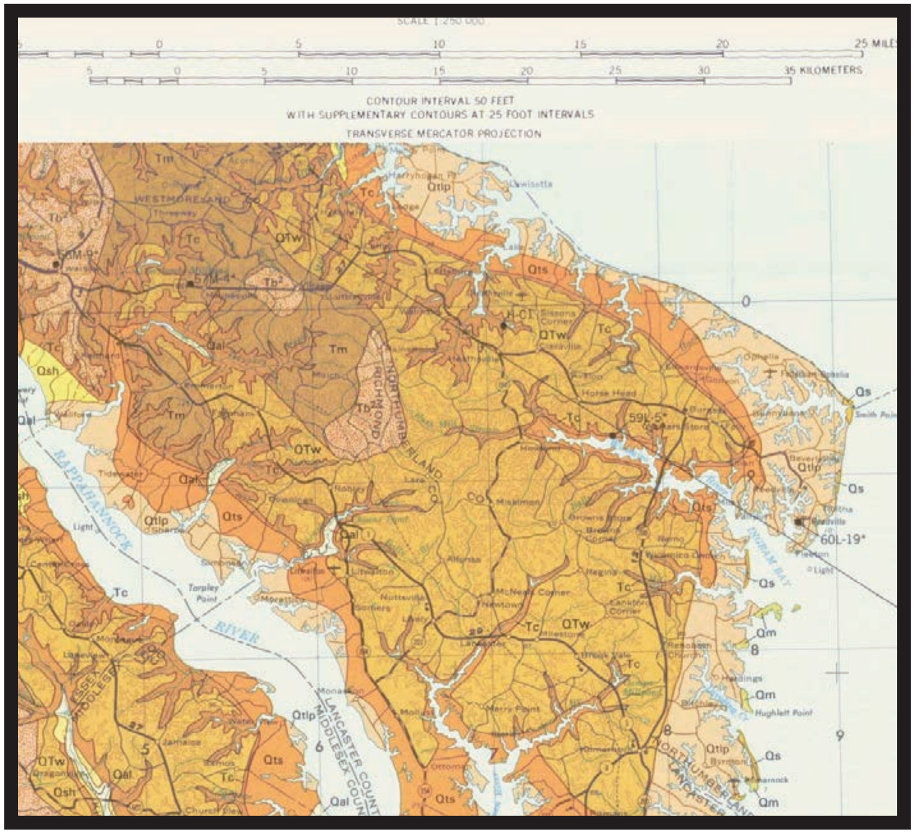


Figure 2. Location of localities in the Dune Act with jurisdictional and non-jurisdictional localities noted.



Qm **Holocene Soft Mud** - Medium to dark-gray, and peat, grayish brown. Comprises sediment of marshes in coastal areas and Chesapeake Bay. Thickness is 0-10 ft.

Qs **Holocene Sand** - Pale gray to light-yellowish gray, fine to coarse, poorly sorted to well sorted, shelly in part; contains angular to rounded fragments and whole valves of mollusks. Comprises deposits of coastal barrier islands and narrow beach-dune ridges bordering brackish-water marshes of Chesapeake Bay. As much as 40 ft in thickness.

Qtlp **Lynnhaven and Poquoson Members, undifferentiated (Upper Pleistocene)**.

Qts **Sedgefield Member (Upper Pleistocene)** - Pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt; locally, channel fill at base of unit includes as much as 50 ft of fine to coarse, crossbedded sand and clayey silt and peat containing in situ tree stumps. Sandy bay facies commonly contains Crassostrea biostromes, Mercenaria, Anadara, Polynices, Ensis, and other mollusks. Specimes of the coral Astrangia have yielded estimated uranium-series ages averaging 71,000 +/- 7,000 yrs B.P. (Mixon and others, 1982). Unit constitutes surficial deposit of river- and coast-parallel plains (alt. 20-30 ft) bounded on landward side by Suffolk and Harpersville scarps. Thickness is 0-50 ft.

Qsh **Shirley Formation (middle Pleistocene)** - Light-to dark-gray and brown sand, gravel, silt, clay, and peat. Constitutes surficial deposits of riverine terraces and relict baymouth barriers and bay-floor plains (alt. 35-45 ft) inset below depositional surfaces of the Chuckatuck Formation (Johnson and Peebles, 1984). Upper part of unit is truncated on the east by the Suffolk and Harpersville scarps; locally, lower part extends east of scarps. Fluvial-estuarine facies comprises (1) a lower pebble to boulder sand overlain by (2) fine to coarse sand interbedded with peat and clayey silt rich in organic material, including in situ tree stumps and leaves and seeds of cypress, oak, and hickory, which grades upward to (3) medium- to thick-bedded, clayey and sandy silt and silty clay. Marginal-marine facies in lower James River and lowermost Rappahannock River areas is silty fine sand and sandy silt containing *Crassostrea virginica*, *Mulinia*, *Noetia*, *Mercenaria*, and other mollusks. *Astrangia* from lower Rappahannock River area has yielded a uranium-series age of 184,000 +/- 20,000 years B.P. (Mixon and other, 1982). Thickness is 0-80 ft.

QTw **Windsor Formation (lower Pleistocene or upper Pliocene) -** Gray and yellow to reddish-brown sand, gravel, silt, and clay. Constitutes surficial deposits if extensive plain (alt. 85-95 ft) seaward of Surry scarp and coeval, fluvial-estuarine terrace west of scarp. Fining-upward sequence beneath plain consists of basal pebbly sand grading upward into crossbedded, quartzose Sand and massive, clayey silt and silty clay; lower and upper parts of sequence were deposited, repetively, in shallow-marine or open-bay and restricted-bay or lagoonal environments. In terraces west of Surry scarp, fluvial-estuarine deposit comprise muddy, coarse, trough-crossbedded sand and gravel grading upward to sandy silt and clay. Unit is 0-40 ft thick.

Tc **Chesapeake Group (upper Pliocene to lower Miocene) -** Fine to coarse, quartzose sand, silt, and clay; variably shelly and diatomaceous, deposited mainly in shallow, inner- and middle-shelf waters. Ages of units based in studies of foraminiferal, nannofossil, diatom, and molluscan assemblages in Virginia and adjacent states (Andrews, 1988; Gibson, 1983; Gibson and others, 1980; Poag, 1989; Ward and Blackwelder, 1980; Ward and Krafft, 1984), Includes the following formations (see also sheet 2, figure 1), from youngest to oldest; Chowan River Formation (upper Pliocene), Yorktown Formation (lower upper and lower Pliocene), Eastover Formation (upper Miocene), St. Mary's Formation (upper and middle Miocene), Choptank Formation (middle Miocene), and Calvert Formation (middle and lower Miocene).

Tm **Moorings unit of Oaks and Coch (1973) (upper Pliocene) -** White, light-gray, and grayish-yellow quartzose sand and gray to grayish-brown clayed silt and silty clay. Constitutes discontinuous linear body along and just west of Surry scrap; depositional surfaces range in altitude from 130 ft along slightly higher, ridge-like topography at scarp to about 110 ft west of scarp. Eastern facies of unit is unfossiliferous, massive to cross-laminated, moderately well-sorted, fine sand believed to have been deposited in beach and near shore environments. Upper part of fine sand facies interfingers westward with massive, bioturbated clay and slit deposited in a lagoon or shallow bay. Unit is as much as 30 ft thick.

Tb^1 Tb^2 **Bacons Castle Formation (upper Pliocene) -** Gray, yellowish-orange, and reddish-brown sand, gravel, silt, and clay; Constitutes surficial deposits of high plain extending from Richmond, VA., Eastward to Surry Scrap. Unit is subdivided into two members: Tb^1 and Tb^2. Tb^2 predominantly thin-bedded and laminated clayey silt and silty fine sand. TB^2 is characterized by flaser, wayy, and lenticular bedding and rare to common clay-lined burrows including *Ophiomorpha nodosa.* Unit is 0-70 ft thick.

Figure 3. Geologic map of Northumberland County (from Mixon *et al*., 1989).

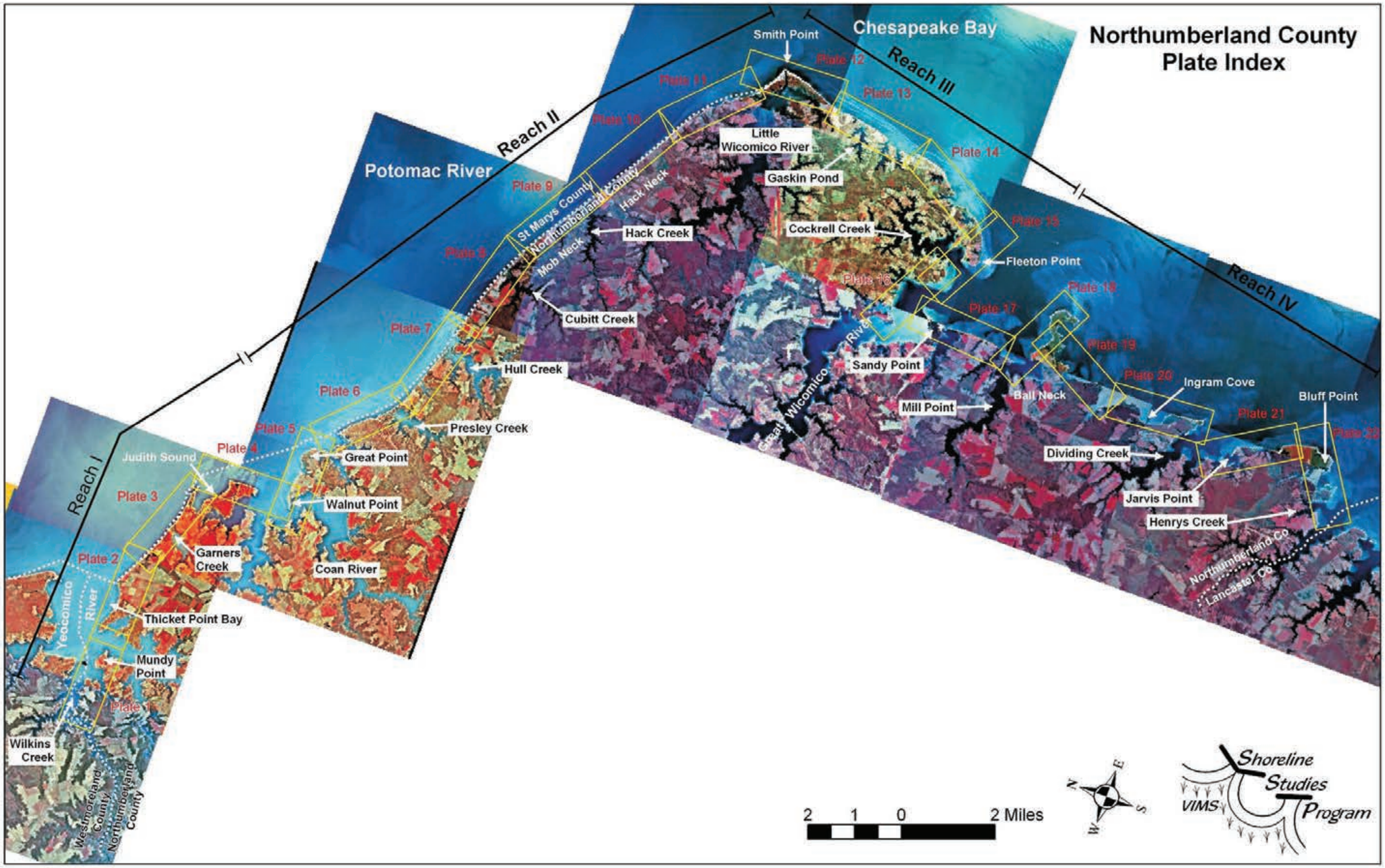


Figure 4. Index of shoreline plates.

B. Hydrodynamic Setting

Mean tide range along the upper Potomac River coast of Northumberland is about 1.2 ft (1983-2001 Tidal Epoch at Lewisetta). Spring tide range is 1.5 ft. The Chesapeake Bay shoreline in Northumberland has similar tide ranges. The wind/wave climate impacting the Northumberland Bay coast is defined by large fetch exposures to the northeast, east, and spoutheast across Chesapeake Bay and fetch exposures to the northwest, north, and northeast along Potomac River. Wind data from Quantico Marine Corps Base upriver reflect the frequency and speeds of wind occurrences from 1973 to 2001 (Table 1) which characterize the locally-generated Bay waves.

Northeasters are particularly significant in terms of the impacts of storm surge and waves on beach and dune erosion. Hurricanes, depending on their proximity and path can also have an impact to the Virginia Beach coast. On September 18, 2003, Hurricane Isabel passed through the Virginia coastal plain. The main damaging winds began from the north and shifted to the east then south. Beach erosion and dune scarping were significant but areas with wide beaches offered more protection to the adjacent dunes.

Table 1. Summary wind conditions at Quantico Marine Corps Base from 1973-2001.

		WIND DIRECTION								
Wind Speed (mph)	**Mid Range (mph)**	**North**	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**	**Total**
< 5	3	5703* 3.21+	3330 1.87	3868 2.18	4792 2.70	12257 6.90	4291 2.42	7070 3.98	15437 8.69	56748 31.95
5-11	8	17454 9.82	10087 5.68	6504 3.66	8117 4.57	22593 12.72	8515 4.79	13391 7.54	18453 10.39	105114 59.17
11-21	16	3698 2.08	1460 0.82	386 0.22	517 0.29	2030 1.14	1156 0.65	1129 0.64	4601 2.59	14977 8.43
21-31	26	165 0.09	64 0.04	34 0.02	21 0.01	60 0.03	64 0.04	102 0.06	274 0.15	784 0.44
31-41	36	7 0	1 0	2 0	0 0	1 0	1 0	7 0	7 0	26 0.01
41-50	46	0 0	0 0	0 0	0 0	1 0	0 0	0 0	0 0	1 0
>50		1 0	3 0	3 0	3 0	4 0	0 0	7 0	5 0	26 0.01
Total		27028 15.20	14945 8.41	10797 6.08	13450 7.57	36946 20.79	14027 7.9	21706 12.22	38777 21.82	177676 100.00

*Number of occurrences +Percent

III. METHODS

A. Photo Rectification and Shoreline Digitizing

Recent and historic aerial photography was used to estimate, observe, and analyze past shoreline positions and trends involving shore evolution for Northumberland. Some of the photographs were available in fully geographically referenced (georeferenced) digital form, but most were scanned and orthorectified for this project.

Aerial photos from VIMS Shoreline Studies and Submerged Aquatic Vegetation (SAV) Programs, as well as from United States Geological Survey (USGS) archives were acquired. The years used for the shoreline change analysis included 1937, 1953, 1969, 1994, and 2002. Color aerials were obtained for 1994 and 2002. The 1994 imagery was processed and mosaicked by USGS, while the imagery from 2002 was mosaicked by the Virginia Base Mapping Program (VBMP). The aerial photography for the remaining years were mosaicked by the VIMS Shoreline Study Program.

The images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. They were orthorectified to a reference mosaic, the 1994 Digital Orthophoto Quarterquadrangles (DOQQ) from USGS. The original DOQQs were in MrSid format but were converted into .img format as well. ERDAS Orthobase image processing software was used to orthographically correct the individual flightlines using a bundle block solution. Camera lens calibration data was matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. A minimum of four ground control points were used per image, allowing two points per overlap area. The exterior and interior models were combined with a 30-meter resolution digital elevation model (DEM) from the USGS National Elevation Dataset (NED) to produce an orthophoto for each aerial photograph. The orthophotographs that cover each USGS 7.5 minute quadrangle area were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic also in an .img format.

To maintain an accurate match with the reference images, it was necessary to distribute the control points evenly. This can be challenging in areas with little development. Good examples of control points are permanent features such as manmade features and stable natural landmarks. The maximum root mean square (RMS) error allowed is 3 for each block.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background to help delineate and locate the shoreline. For Northumberland's coast, an approximation to mean low water (MLW) was digitized. This often was defined as the “wetted perimeter” on the beach sand as the last high water location. In areas where the shoreline was not clearly delineated on the aerial photography, the location was estimated based on the experience of the digitizer. Digitizing the shoreline brings in, perhaps, the greatest amount of potential error because of the problems of image clarity and definition of shore features. A series of Northumberland dune site profiles are displayed in Figure 5 which shows beach/dune variability. Figure 6 shows the relationship of MHW, MLW and beach/dune system components.

B. Rate of Change Analysis

A custom Arcview extension called "shoreline" was used to analyze shoreline rate of change. A straight, approximately shore parallel baseline is drawn landward of the shoreline. The extension creates equally-spaced transects along the baseline and calculates distance from the baseline at that location to each year's shoreline. The output from the extension are perpendicular transects of a length and interval specified by the user. The extension provides the transect number, the distance from beginning baseline to each transect, and the distance from the baseline to each digitized shoreline in an attribute table. The attribute table is exported to a spreadsheet, and the distances of the digitized shoreline from the baseline are used to determine the rates of change. The rates of change are summarized as mean or average rates and standard deviations for each Plate.

It is very important to note that this extension is only useful on relatively straight shorelines. In areas that have unique shoreline morphology, such as creek mouths and spits, the data collected by this extension may not provide an accurate representation of true shoreline change. The shore change data was manually checked for accuracy. However, where the shoreline and baseline are not parallel, the rates may not give a true indication of the rate of shoreline change.

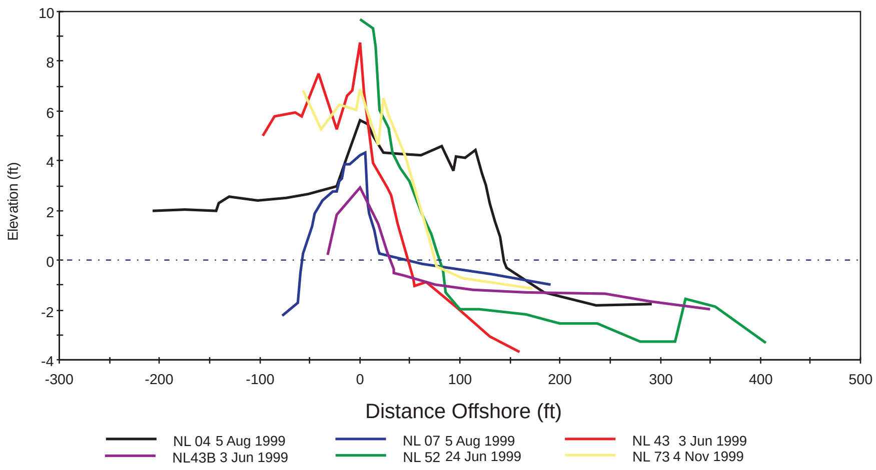


Figure 5. Variability of dune and beach profiles in Northumberland County.

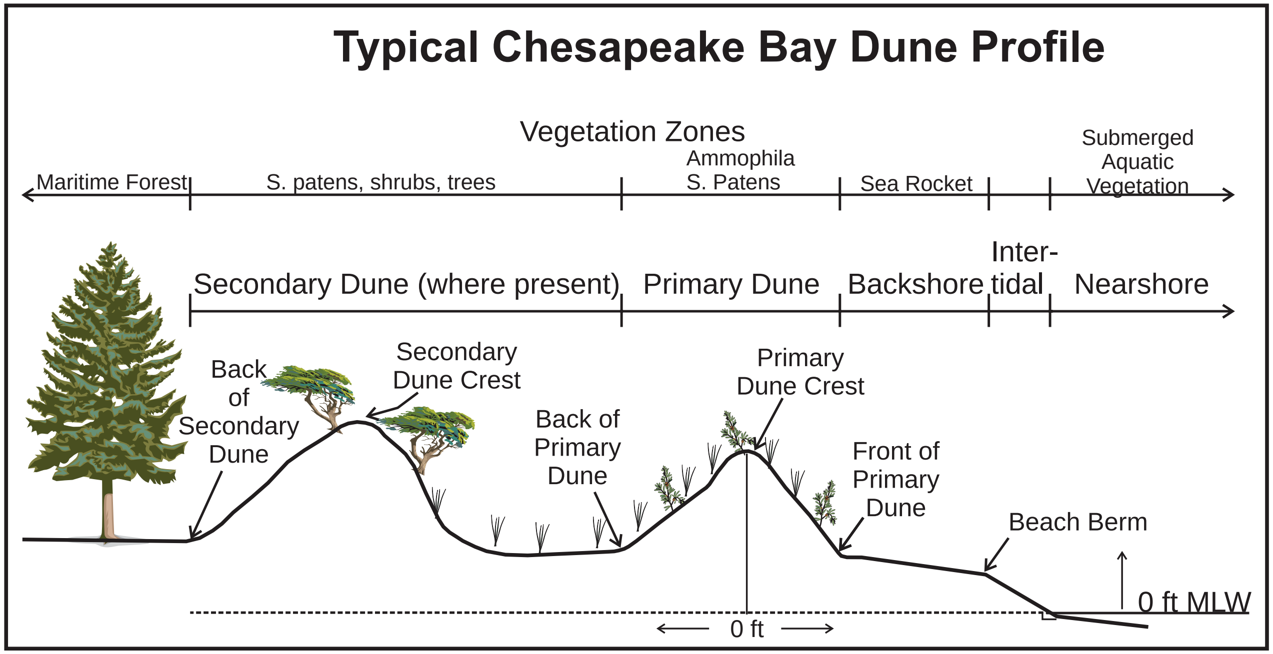


Figure 6. Typical profile of a Chesapeake Bay dune system (from Hardaway *et al.*, 2001).

IV. RESULTS

The Plates referenced in the following sections are in Appendix A. Dune locations are shown on all photo dates for reference only. Dune sites and lengths are positioned accurately on the 2002 photo. Because of changes in coastal morphology, the actual dune site might not have existed earlier. Site information tables are in Appendix B. More detailed information about Chesapeake Bay dunes and individual dune sites in Northumberland can be found in Hardaway *et al.* (2001) and Hardaway *et al.* (2003). Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

A. Reach I

Reach I begins on the upriver side of the Potomac River coast at the Yeocomico River and extends downriver to Lewisetta. It includes Plates 1 through 5. Only Plate 4 has a dune site, NL78. Plate 1 shows the convoluted coast of Yeocomico River where shore change is minimal, and no erosion rate baselines were created. Plate 2 has two baselines, 2A and 2B which indicate a net long term (1937-2002) shore change rate of -1.3 and -1.1 ft/yr respectively. Long-term erosion rates of over -8 ft/yr occur at and adjacent to Thicket Point. Plate 3 has a long-term erosional trend of -2.6 ft/yr with significant recession of -5 ft/yr along the Potomac River side of the peninsula to Judith Sound.

Plate 4 highlights the Travis Point/Lewisetta Neck and dune site NL78 which can be seen evolving between two groins in the 1969 imagery. The embayment has become relatively stable. This evolution is reflected in shore change at station 500. The long-term trend for the subreach is -0.5 ft/yr. Plate 5 has no dune sites and has a significant long-term erosional trend of -7.3 ft/yr. Great Point has had some of the severest erosion along the Potomac River due to its low bank with rates greater than -25 ft/yr for the time period 1953-1969.

B. Reach II

Reach II is extends from the Coan River to Smith Point, approximately 14 miles. Most of the coast is relatively straight and is included in Plates 6 through 12. Plate 6 has dune site NL73 which can be seen forming at the mouth of Presley Creek in 1969 and has remained in place even though the inlet channel has moved upriver over the years. The overall long-term erosion rate along the Plate 6 shorelines is -2.6 ft/yr. Plate 7 also has one dune site, NL70, that has evolved over time as an erosional remnant of a once more extensive dunal spit across the mouth of Hull Creek. Average long-term erosion rates along the Plate 7 coast is -3.5 ft/yr.

Plate 8 has three dune sites, NL62, NL63, and NL67. All three sites are isolated erosional remnants of a once more extensive dune fields. Dune site NL67 resides in front of a pond that was once an intermittent drainage and is controlled by a groin field. Dune sites NL63 and NL62 are creek mouth dunes lying on either side of Cubitt Creek. The average long-term erosion rate along the Plate 8 coast is -1.4 ft/yr.

Plate 9 includes dune sites NL61, NL59, and NL58. All sites are remnants of a more extensive beach/dune system which existed in 1937. Site NL61 resides in front of Condit Pond while NL59 is controlled by a groin field that was installed in the 1970s. Site NL58 lies on a broad spit feature that crosses the mouth of Hack Creek and has a secondary dune. A few groins and a wood jetty help stabilize this site. The Plate 9 coast has a long-term erosion rate of only -0.3 ft/yr due, in part, to shore stabilization efforts.

Five dune sites exist along Plate 10 including NL55, NL54, NL52, NL51, and NL50. They are all isolated remnants of a once continuous beach/dune system. Site NL55 developed on the old (1937) flood shoal of Flag Pond. The other four have been maintained and controlled by a long groin field. Long-term average erosion rate for Plate 10 is 0.9 ft/yr, but with a high degree of variability between interim years.

Plate 11 has eight dune sites, all are located well landward from the 1937 shoreline. Shoreline evolution and intermittent shoreline hardening by bulkheads and groins created an irregular set of headlands and embayments where sand accumulated, and beaches and dunes developed. Isolated dune sites NL50, NL49, and NL48 developed within an extensive groin field that created enough backshore to allow dunes to grow. Site NL47 developed in a large shoreline offset and embayment between adjacent man-made headlands (groins) by 1969. Sites NL46 and NL45 came into being as the uplands evolved between headlands. By 1994, enough backshore had accumulated to allow dune development. Dune sites 43B and 43A developed on beach fill placed there over the years from maintenance dredging of the Little Wicomico River. Constant erosion and deposition keeps these sites very mobile. Long-term shore change is erosional at -4.1 ft/yr. Shorelines on both sides of Smith Point have been influenced by the channel jetties at the mouth of the Little Wicomico River. The dunes sites on the Potomac River shore of Plate 12, NL43A and NL43 are segments of a semi-continuos beach/dune system separated by a short wooded area. Over time, major accretion against the northwest jetty has allow these systems to evolve and are maintained, in part, by the jetty and ongoing dredging and subsequent fill at dune site NL43B (Plate 11). Net shore change has been positive along this subreach.

C. Reach III

Reach III extends from Smith Point to the Great Wicomico River and includes Plates 12, 13, 14, 15, and 16. This is a fairly continuous coast interrupted by a several small tidal creeks. It has long fetch exposures up, across, and down Chesapeake Bay to the north, east and southeast.

Reach III on Plate 12 encompasses the shoreline on the Chesapeake Bay side of Smith Point and includes dune site NL42. Shorelines on both sides of Smith Point have been influenced by the channel jetties at the mouth of the Little Wicomico River. Site NL42, on the Chesapeake Bay side of Smith Point is a long low beach/dune system that is beginning to be impacted by the northward encroaching construction of groins. The shoreline along this subreach has experienced long-term accretion near the jetties and general recession toward the south end of the plate boundary. Long-term shore change is -1.5 ft/yr.

The shoreline along the Plate 13 coast was once a continuous beach/dune system that has significantly eroded with time, breached Owens Pond and left a string of isolated dunes sites. Site NL40 has evolved on an over wash into an adjacent unnamed pond between to groin fields. Dune site NL38 has developed at the mouth of Gaskin Pond that is controlled by wood jetties. Sites NL37and NL36 developed in small, low overwashes into adjacent small ponds. Dune sites NL35, NL34, and NL33 are small isolated pockets that developed after the breach into Owens Pond and the subsequent transport of sand onto the mainland coast. The erosion rates are quite variable as a result of the breach, but the net change rate was -5.9 ft/yr.

Plate 14 includes the shorelines in and adjacent to Taskmakers Creek. Dune sites NL32, NL31, and NL30 presently occur along a long low beach/dune coast that receded into its present day location. They are separated by short areas without dune features. In 1937, a long spit protected the present dune sites from direct bay wave attack. By 1953, the spit was gone, sand entered the newly created embayment, and the foundation for the dune sites was created. The long-term shoreline change patterns are therefore complex but yield a net average of -4.2 ft for the Plate 14 shorelines.

Three isolated dune sites occur on the Plate 15 including NL28, NL27, and NL26. Site NL28 is an erosional remnant of a spit feature that had developed in 1953 but only occurs as salient feature by 2002. Site NL27 evolved in a small embayment, and NL26 developed in a small protected washover. Shore change was variable along the Potomac River shoreline with mostly erosion along most of Bull Neck except for accretion at Fleeton Point. The overall net change for that subreach was -2.1 ft/yr.

Plate 16 depicts shorelines at the entrance to the Great Wicomico River. Sites NL27 and NL26 were discussed previously in Plate 15. Dune sites NL23A and NL23B on Hayne Point have been around since 1953 on a spit that has moved back and forth over the years.

D. Reach IV

Reach IV extends form The Great Wicomico River to Indian Creek and the county line with Lancaster County. It is a very convoluted and complex coast dissected by many modest sized tidal creeks and rivers. Much of the Bay fronting coast is low and marshy.

Ingram Bay shorelines are shown in Plate 17 and include dune sites NL22A, NL22, NL21, NL20 and NL19. Site NL22A was once part of a large sandy spit feature (1937) but is now a small isolated remnant. Dune site NL22 evolved on a washover into an unnamed pond on the south side of Sandy Point. Towles Creek had a narrow inlet and associated sandy dune shorelines on either side until it was dredged and stabilized with jetties sometime before 1969. Site NL20 now resides on the south side of the inlet. Dune site NL19 has resided in about the same place since 1937, in a small curvilinear embayment. Long-term average erosion for Plate 17 is -2.3 ft/yr.

Plate 18 includes two sites along the Dameron Marsh peninsula. Site NL17 did not come into existence until just before 1994 and occurs as a spit dune feature that continues to evolve. Dune site NL15 also became more prominent by 1994 in a long shallow embayment. It appears to have reached a state of dynamic equilibrium and will migrate as the adjacent headland coasts erode.

Four dune sites are shown on Plate 19. Dune site NL14 came into existence sometime before 1994 in a shallow cove. Site NL12 evolved across a small pond and can be seen as early as 1937. Sites NL11A and NL11 reside in two adjacent bays created by three marshy headlands. Erosion patterns are complex but headland and bay features tend to persist over time.

Plate 20 has three dune sites. Site NL10 was part of small spit feature in 1953 and 1969. The small tidal creek was all but closed off by 1994, more sand came into the embayment, and the site expanded alongshore. Site NL9 has been part of long curvilinear embayment on the north side of Hughlett Point since 1937, and today represents a significant dune field. A spit evolved up Dividing Creek as seen in 1994 imagery and became home for NL8. Site NL7 is also located on Dividing Creek. However, it is not shown on the plates. It is a delta-shaped spit that is exposed to a bimodel wind/wave climate along the north shore of Dividing Creek. Long-term shore change along the Chesapeake Bay coast of Plate 20 was -2.9 ft/yr.

Dune site NL6 on Plate 21 is an erosional remnant of a longer beach/dune feature seen in 1937 imagery. The shoreline from Jarvis Point to Bluff Point (plate 22) has had siginificant erosion with a long term rate of -8.8 ft/yr. Site NL4A is a small remainder of what was once a long barrier dune beach system about 1mile in length up until 1969. Then the barrier broke through leaving NL4 as a large washover into a large tidal pond.

Three isolated dune sites occur on Plate 22. Site NL3 evolved on a washover in 1969 and 1994 and is now a cove feature. Site NL2 was part of long spit but now resides as an erosional remnant. As Barnes Creek was opened up, NL1 evolved by 1994 on the south flank of the creek shore. Long-term erosion along the Bay coast of Plate 22 is -6.9 ft/yr.

V. DISCUSSION: NEAR FUTURE TRENDS OF DUNE SITES

The following discussion is a delineation of shoreline trends based on past performance. Ongoing shore development, shore stabilization and/or beach fill, and storms will have local impacts on the near term. "Near Future" is quite subjective and only implies a reasonable expectation for a given shore reach to continue on its historic course for the next 10 to 20 years. In addition, the basis for the predictions are the shorelines digitized on geo-rectified aerial photography which have an error associated with them (see Methods, Section III). Each site's long-term and recent stability as well as a near future prediction are shown in a table in Appendix B. **This data is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.**

A. Reach I

Site NL78, the only dune site in Reach I, should remain stable as long as the supporting groinfield remains intact (Figure 7).

B. Reach II

Although located at the mouth of Presley Creek, an historically mobile inlet, the site NL73 may shift in response but should keep its general dimensions and integrity(Figure 8). Site NL70 at the mouth of Hull Creek has been in a state of decay for years and will most likely continue that trend. Site NL67 should remain stable as long as the groinfield is intact (Figure 8). Like other creek mouth dune sites, NL63 will remain a dune entity but may move in response to inlet dynamics (Figure 8). Site NL62 has been modified with beach fill and offshore breakwaters so the nature of the site has changed, but the beach and associated future dune should be relatively stable.

Even after Hurricane Isabel, sites NL61, NL59 and NL58 should be relatively stable in the near term (Figure 8). A slight erosional tendency occurs on the downriver end of NL58. Site NL55 should continue to evolve toward stability between the revetment boundaries (Figure 8). Sites NL54, NL52, and NL51 all lie within the confines of extensive groinfields and should be stable for the near term (Figure 8). Site NL 50 is eroding as the groinfield fails and the beach face retreats.

Dune sites NL49 and NL48 occur within old deteriorating wood groin field. The primary dune faces are often steep and slumping but the overall dune appears relatively stable for the near term. Further loss of groin structures may cause a recessional trend. Site NL47 is on the tangential section of spiral embayment bounded by groins and appears relatively stable. The large embayment where NL46 sits is also a stable beach shore planform (Figure 8). Site NL45 is a sparsely vegetated low dune that is receding into an adjacent pond. Sites 43B and 43A are, by nature, erosional as they are dredge disposal for material from the Little Wicomico River. Site 43, on the other hand, is the recipient of that material and will erode and accrete as a function of beach fill periodicity but will always retain a minimum shore position (Figure 8).

C. Reach III

Site NL42 has been historically accretionary and mobile, but the south boundary continues to be impacted by groin construction toward the jetties which may be causing localized erosion. Site NL40 has evolved into a relatively stable embayment. North of Gaskin Pond lies NL38 bounded by the channel jetty and a revetment (Figure 9). It should be stable for the near term as long as the north wood jetty remains intact. A small groin field has helped create and stabilize NL37 but NL36 is decaying as the low bank headland to the north erodes (Figure 9). Dune sites NL35, NL34 and NL33 are stable isolated pocket dunes on the mainland coast of Owens Pond (Figure 9).

Sites NL32, NL31 and NL30 share the same stable subreach north of Taskmakers Creek (Figure 9). Site NL28 is an erosional salient while NL27 and NL26 are small stable isolated features (Figure 9). Sites NL23A and 23B share and accreting sand spit that should continue grow and provide dune growth elements as long as sand is available within the littoral system (Figure 9).

D. Reach IV

Dune site NL22A is a small, relatively stable dune on the Great Wicomico River side of Sandy Point while NL22 resides in a groin field on the Ingram Bay side (Figure 10). Site NL21 is a small stable dune at the mouth of Cranes Creek. The south channel jetty into Towles Creek creates a stable north boundary for site NL20, and a revetment creates the south boundary. The dune at NL19 is a mostly erosional feature open to the Bay. Site NL17 is on a mobile spit that cannot be called stable while NL15 occupies a long, stable bay on the north side of Dameron Marsh.

Dune sties NL14 and NL12 are linear isolated dune features that are relatively stable but will migrate as the controlling marsh headland erode. Currently those marsh headlands appear relatively stable unlike the controlling marsh headlands bounding NL11A and NL11 (Figure 10). These marsh headlands are more erosive as they and sites NL11A and NL11 are on the exposed distal end of Ball Neck (Figure 10).

Site NL10 had evolved in a deep stable bay called Ingram Cove and NL9 although currently relatively stable as the bounding headland erode it will leave the site more exposed and erosive (Figure 10). Site NL8 resides on a mobile but stabilizing spit feature. Site NL7 is a small erosional isolated dune and NL6 has resides on stable coast bounded by revetments. Sites NL4A and NL4 are long low stable slightly embayed dune sites but subject to storm overwash (Figure 10). Sites NL3 and NL2 are isolated dunes that will migrate as the bounding peat substrate erodes and NL1 is on an accreting spit that goes into Barnes Creek.

Figure 7. Dune site NL78 in Reach I on Potomac River on 4 Nov 1999.

Figure 8. Photos of Northumberland's shoreline showing dune sites in Reach II.

Figure 9. Photos of Northumberland's shoreline showing dune sites in Reach III.

Figure 10. Photos of Northumberland's shoreline showing dune sites in Reach IV.

VI. SUMMARY

Shoreline change rates are based on aerial imagery taken at a particular point in time. We have attempted to portray the same shoreline feature for each date along the coast of Northumberland County. Every 500 feet along each baseline on each plate, the rate of change was calculated. The mean or average rate for each plate is shown in Table 2 for five time periods with the long-term rate determined between 1937 and 2002. The total average and standard deviation (Std Dev) for the entire data set of individual rates is also given. The standard deviation shows the relative spread of values about the mean or average. Larger standard deviation values relative to the mean indicates a wider scatter of erosion rates about the mean while lower standard deviation values indicates erosion rates are concentrated near the mean (*i.e.* all the rates calculated for the entire plate were similar).

The largest variability in mean shore change rates and standard deviations were recorded for the shoreline on Plate 21 with the rates of change and standard deviation reaching over 20 ft/yr. Plate 12A had standard deviations that were much larger than the average rate of change indicating that the overall rate is probably not indicative of the change which occurred on this section of shore. However, not all dates for this section of shore had mean shore change rates with large standard deviations. For 1959-1982, the standard deviation was half the mean shore change rate indicating that the shore change rates were relatively consistent for that time period.

When short time frames are used to determine rates of shoreline change, shore alterations may seem amplified. The rates based on short-time frames can modify the overall net rates of change. Hopefully, the shore change patterns shown in this report along with the aerial imagery will indicate how the coast will evolve based on past trends and can be used to provide the basis for appropriate shoreline management plans and strategies. Dunes and beaches are a valuable resource that should be either maintained, enhanced or created in order to abate shoreline erosion and provide sandy habitat.

Table 2. Summary shoreline rates of change and their standard deviation.

	Plate 2A		Plate 2B		Plate 3		Plate 4		Plate 5		Plate 6	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1953	-0.3	0.6	-0.2	0.6	-3.6	3.4	-0.6	1.9	-7.2	8.4	-5.2	2.7
1953-1969	-2.1	3.9	-4.7	3.5	-5.4	6.7	-1.4	2.1	-5.5	8.1	-4.8	3.8
1969-1994	-1.6	3.0	-0.3	0.8	-0.5	1.8	-0.3	0.7	-8.3	3.4	-0.5	3.0
1994-2002	-1.0	4.9	1.6	1.0	-1.1	4.1	1.1	1.0	-8.7	3.7	0.2	3.0
1937-2002	**-1.3**	**2.7**	**-1.1**	**1.0**	**-2.6**	**2.7**	**-0.5**	**0.7**	**-7.4**	**5.0**	**-2.6**	**1.9**

	Plate 7		Plate 8		Plate 9		Plate 10		Plate 11		Plate 12A		Plate 12B	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1953	-4.1	1.5	-1.0	2.3	0.2	1.5	-2.4	2.8	-4.1	8.0	2.2	13.6	0.4	3.9
1953-1969	-5.6	1.7	-2.7	1.4	-1.5	1.4	-1.1	1.7	-4.6	8.1	4.1	1.3	-4.2	4.2
1969-1994	-2.0	1.9	-0.6	1.4	0.4	1.1	0.0	1.2	-3.5	5.6	4.6	3.0	-1.2	3.4
1994-2002	-3.2	3.7	-1.9	2.1	-1.1	2.0	-0.7	1.8	-5.0	7.6	0.2	4.8	-1.0	5.8
1937-2002	**-3.6**	**1.2**	**-1.4**	**0.9**	**-0.3**	**0.4**	**-0.9**	**0.6**	**-4.1**	**2.8**	**3.4**	**4.8**	**-1.5**	**2.2**

	Plate 13		Plate 14		Plate 15		Plate 17		Plate 20		Plate 21		Plate 22	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1953	-2.5	1.9	-9.4	17.0	-0.3	10.7	-1.6	5.4	-2.4	3.9	-7.7	2.1	-11.0	3.2
1953-1969	-5.9	1.8	-4.4	5.8	-3.6	3.8	-2.4	3.6	-3.2	2.0	12.2	5.7	-7.6	4.4
1969-1994	-9.4	11.0	-1.4	4.2	-3.7	3.6	-2.5	6.6	-2.6	3.7	-18.5	7.7	-3.0	1.8
1994-2002	-1.6	3.9	-2.1	7.3	2.7	6.9	-3.5	2.8	-4.5	3.4	-22.3	23.2	-9.7	6.0
1937-2002	**-5.9**	**4.6**	**-4.2**	**3.7**	**-2.1**	**2.7**	**-2.3**	**2.9**	**-2.9**	**2.2**	**-8.8**	**3.0**	**-6.9**	**2.2**

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APPENDIX A

For each Plate shown on Figure 4, Appendix A contains orthorectified aerial photography flown in 1937, 1953, 1969, 1994, and 2002.
Also shown are the digitized shorelines, identified dune sites, and an arbitrarily created baseline.
A plot shows only the relative locations of the shorelines while another one depicts the rate of shore change between dates.
A summary of the average Plate rate of change in ft/yr as well as the standard deviation for each rate is also shown.

This data is intended as a resource for coastal zone managers and homeowners;
it is not intended for use in determining legal jurisdictional limits.

APPENDIX B

The data shown in the following tables were primarily collected as part of the Chesapeake Bay Dune: Evolution and Status report and presented in Hardaway *et al.* (2001) and Hardaway *et al.* (2003). Individual site characteristics may now be different due to natural or man-induced shoreline change.

An additional table presents the results of this analysis and describes each dune site's relative long-term, recent, and near-future predicted stability. This data results from the position of the digitized shorelines which have an error associated with them (see Methods, Section III).

Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001).
Site characteristics may now be different due to natural or man-influenced shoreline change.

. Identified dune sites in Northumberland County as of 1999.

Dune Site No.	Location^ Easting (Feet)	Location^ Northing (Feet)	Date Visited	Dune Shore Length (Feet)	Primary Dune Site?	Secondary Dune Site?	*Public Ownership?
1	2,630,850	499,900	8/5/99	140	Yes		
2	2,634,800	501,100	8/5/99	210	Yes		
3	2,635,950	503,000	8/5/99	250	Yes		
4	2,634,300	507,000	8/5/99	710	Yes	Yes	
4A	2,633,300	509,700	8/5/99	580	Yes		
6	2,630,400	511,700	8/5/99	180	Yes		
7	2,629,500	518,750	8/5/99	320	Yes		
8	2,632,050	517,350	8/5/99	270	Yes		
9	2,633,700	518,350	8/5/99	2,200	Yes		
10	2,631,350	522,300	8/5/99	1,360	Yes		
11	2,633,300	528,200	9/14/99	200	Yes		
11A	2,633,500	528,550	9/14/99	400	Yes		
14	2,634,150	533,150	9/14/99	510	Yes		
15	2,635,750	535,500	9/14/99	1,360	Yes		Yes
17	2,633,200	536,200	9/14/99	250	Yes		Yes
19	2,632,200	538,900	9/14/99	1,050	Yes		
20	2,633,400	542,150	9/14/99	290	Yes		
21	2,632,250	547,380	4/29/99	170	Yes		
22	2,633,150	548,600	4/29/99	390	Yes		
22A	2,632,950	548,900	4/29/99	160	Yes		
23A	2,631,050	552,600	5/13/99	300	Yes		
23B	2,631,050	552,600	5/13/99	140	Yes		
26	2,637,150	550,000	5/13/99	120	Yes		
27	2,637,950	549,300	5/13/99	180	Yes		
28	2,641,050	546,150	5/13/99	480	Yes		
30	2,647,600	552,200	5/13/99	250	Yes		
31	2,648,100	552,850	4/29/99	620	Yes		
32	2,648,700	553,400	5/13/99	360	Yes		
33	2,649,300	558,000	5/13/99	180	Yes		
34	2,649,500	558,500	5/13/99	180	Yes		
35	2,649,600	560,100	5/13/99	280	Yes		
36	2,650,450	561,600	5/13/99	120	Yes		
37	2,650,550	562,300	5/13/99	240	Yes		
38	2,650,800	564,350	5/13/99	230	Yes		

Dune Site No.	Location^ Easting (Feet)	Location^ Northing (Feet)	Date Visited	Dune Shore Length (Feet)	Primary Dune Site?	Secondary Dune Site?	*Public Ownership?
40	2,650,900	566,800	4/29/99	600	Yes		
42	2,652,500	572,400	4/29/99	3,690	Yes	Yes	
43	2,651,150	575,100	6/3/99	2,750	Yes	Yes	
43A	2,650,000	575,950	6/3/99	870	Yes	Yes	
43B	2,649,100	576,650	6/3/99	400	Yes		
45	2,648,100	577,750	6/3/99	220	Yes		
46	2,647,500	578,750	6/3/99	650	Yes		
47	2,646,800	579,500	6/3/99	320	Yes		
48	2,643,500	582,450	6/3/99	200	Yes		
49	2,642,500	583,000	6/3/99	470	Yes		
50	2,641,700	583,450	6/3/99	160	Yes		
51	2,640,850	583,800	6/24/99	190	Yes		
52	2,640,150	584,150	6/24/99	300	Yes		
54	2,637,750	585,400	6/24/99	240	Yes		
55	2,633,700	587,700	6/24/99	250	Yes		
58	2,630,450	589,550	6/24/99	900	Yes	Yes	
59	2,629,200	590,300	6/24/99	1,680	Yes	Yes	
61	2,626,900	591,750	6/24/99	400	Yes		
62	2,620,600	594,850	11/4/99	970	Yes		
63	2,619,800	595,250	11/4/99	250	Yes		
67	2,615,150	596,750	11/4/99	90	Yes		
70	2,608,500	598,300	11/4/99	670	Yes		
73	2,599,600	601,950	11/4/99	750	Yes		
78	2,586,800	614,250	11/4/99	540	Yes		

*Public ownership includes governmental entities including local, state, and federal; otherwise ownership is by the private individual.
^Location is in Virginia State Plane South, NAD 1927
‘One site with variable alongshore dune conditions

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

Dune site measurements in Northumberland County as of 1999.

Dune Site Measurements

Site	No.	Dune Shore Length (Feet)	Primary Dune Crest Elev (ft MLW)	Primary Dune Distance from Crest landward to back base (Feet)	Primary Dune Distance from Crest To MLW (Feet)	Secondary Dune 2nd Dune Site	Secondary Dune Crest Elev (ft MLW)	Secondary Dune Distance From Primary Crest to 2nd Crest (Feet)	Secondary Dune Distance From 2nd Crest landward (Feet)	Secondary Dune Distance From 2nd Crest seaward to 1st back base (Feet)
NL	1	140	3.9	25	86					
NL	2	210	5.1	45	36					
NL	3	250	4.5	44	71					
NL	4	710	5.6	23	144	Yes	2.6	130	77	107
NL	4A	580	4.4	69	36					
NL	6	180	5.5	6	71					
NL	7	320	4.2	23	45					
NL	8	270	4.8	19	18					
NL	9	2,200	6.3	31	40					
NL	10	1,360	5.7	40	52					
NL	11	200	3.3	47	39					
NL	11A	400	4.3	22	66					
NL	12	450	6.8	17	56					
NL	14	510	5.5	37	41					
NL	15	1,360	6.1	44	38					
NL	17	250	3.5	81	20					
NL	19	1,050	5.4	33	39					
NL	20	290	5.8	50	38					
NL	21*	170								
NL	22	390	4.0	35	27					
NL	22A	160	3.5	10	35					
NL	23A	300	4.3	13	52					
NL	23B	140	4.1	16	51					
NL	26	120	5.0	16	45					
NL	27	180	4.6	14	34					
NL	28	480	4.5	15	30					
NL	30	250	5.6	45	85					
NL	31	620	4.5	39	48					
NL	32*	360								
NL	33	180	4.9	31	63					
NL	34	180	5.4	77	61					
NL	35	280	5.3	38	75					
NL	36	120	5.0	14	43					
NL	37	240	6.3	5	66					
NL	38	230	3.5	45	40					
NL	40	600	4.5	25	50					
NL	42	3,690	5.6	69	40	Yes	9.8	125	21	56
NL	43	2,750	8.8	23	48	Yes	7.5	41	56	18
NL	43a	870	8.2	29	34	Yes	6.0	54	26	25
NL	43b	400	2.9	32	28					
NL	45	220	3.2	36	35					

*Not profiled

Dune Site Measurements

Site	No.	Dune Shore Length (Feet)	Primary Dune Crest Elev (ft MLW)	Primary Dune Distance from Crest landward to back base (Feet)	Primary Dune Distance from Crest To MLW (Feet)	Secondary Dune 2nd Dune Site	Secondary Dune Crest Elev (ft MLW)	Secondary Dune Distance From Primary crest to 2nd Crest (Feet)	Secondary Dune Distance From 2nd Crest landward (Feet)	Secondary Dune Distance From 2nd Crest seaward to 1st back base (Feet)
NL	46	650	5.5	10	52					
NL	47	320	6.2	60	35					
NL	48	200	9.9	14	58					
NL	49	470	9.6	3	51					
NL	50	160	12.7	4	56					
NL	51	190	6.7	4	44					
NL	52	300	9.7	15	77					
NL	54	240	6.1	10	40					
NL	55	250	4.9	7	50					
NL	58	900	6.6	8	49	Yes	9.0	19	92	11
NL	59	1,680	8.2	7	52	Yes	11.3	40	6	33
NL	61	400	7.5	18	52					
NL	62	970	6.5	52	49					
NL	63	250	5.7	19	77					
NL	67	90	7.7	13	62					
NL	70	670	5.9	5	78					
NL	73	750	6.9	4	75					
NL	78	540	6.5	10	62					

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001).
Site characteristics may now be different due to natural or man-influenced shoreline change.

Dune site parameters in Northumberland County as of 1999.

Dune Site Parameters

	Site No.	Type	Fetch Exposure A	Shoreline Direction of Face B	Nearshore Gradient C		Morphologic Setting D	Relative Stability E	Underlying Substrate F
NL	1	Natural	Open Bay	East	Shallow		Isolated, linear	Accretion	Marsh/CB
NL	2	Natural	Open Bay	South	Shallow	Bars	Isolated, pocket	Stable	Marsh/CB
NL	3	Natural	Open Bay	Southeast	Shallow		Ck Mouth	Stable	Marsh/CB
NL	4	Natural	Open Bay	Northeast	Medium		Ck Mouth	Stable	Marsh/CB
NL	4A	Natural	Open Bay	Northeast	Medium		Spit	Stable	Marsh/CB
NL	6	Man Inf	Open Bay	Northeast	Steep		Isolated, bay	Stable	Upland
NL	7	Natural	Riverine	Southeast	Steep		Spit	Stable	Marsh/CB
NL	8	Natural	Riv-Bay	South	Steep		Spit	Accretion	Upland
NL	9	Natural	Open Bay	East	Medium		Dune Field, linear	Stable	Marsh/CB
NL	10	Natural	Open Bay	Northeast	Medium	Bars	Dune Field, bay	Erosional	Marsh/CB
NL	11	Natural	Open Bay	East	Medium		Isolated, pocket	Erosional	Marsh/CB
NL	11A	Natural	Open Bay	East	Medium		Isolated, pocket	Erosional	Marsh/CB
NL	12	Natural	Open Bay	East	Medium		Ck Mouth	Stable	Marsh/CB
NL	14	Natural	Open Bay	East	Shallow		Isolated, pocket	Stable	Marsh/CB
NL	15	Natural	Open Bay	Northeast	Medium		Dune Field, bay	Stable	Marsh/CB
NL	17	Natural	Riv-Bay	Northwest	Steep		Spit	Erosional	Upland
NL	19	Natural	Open Bay	East	Steep		Dune Field, linear	Erosional	Upland
NL	20	Man Inf	Open Bay	East	Medium		Isolated, linear	Accretion	Upland
NL	21	Natural	Riv-Bay	East	Steep		Isolated, linear	Stable	Upland
NL	22	Man Inf	Riv-Bay	East	Medium		Ck Mouth	Stable	Marsh/CB
NL	22A	Natural	Riverine	Northwest	Steep		Spit	Stable	Upland
NL	23A	Natural	Riv-Bay	West	Steep		Spit	Accretion	Upland
NL	23B	Natural	Riverine	Southeast	Steep		Spit	Accretion	Upland
NL	26	Man Inf	Riverine	Southwest	Medium		Ck Mouth	Stable	Marsh/CB
NL	27	Natural	Riv-Bay	South	Shallow		Isolated, pocket	Stable	Upland
NL	28	Man Inf	Open Bay	South	Medium		Isolated, salient	Accretion	Upland
NL	30	Man Inf	Open Bay	Southeast	Shallow		Isolated, pocket	Stable	Upland
NL	31	Natural	Open Bay	Southeast	Shallow		Ck Mouth	Stable	Upland
NL	32	Man Inf	Open Bay	Southeast	Shallow		Ck Mouth	Stable	Upland
NL	33	Man Inf	Open Bay	East	Shallow	Bars	Isolated, pocket	Stable	Upland
NL	34	Natural	Open Bay	East	Medium	Bars	Isolated, pocket	Stable	Upland
NL	35	Man Inf	Open Bay	East	Medium	Bars	Isolated, pocket	Stable	Upland
NL	36	Man Inf	Open Bay	East	Medium	Bars	Isolated, pocket	Erosional	Marsh/CB

Dune Site Parameters

	Site No.	Type	Fetch Exposure A	Shoreline Direction of Face B	Nearshore Gradient C		Morphologic Setting D	Relative Stability E	Underlying Substrate F
NL	37	Man Inf	Open Bay	East	Medium	Bars	Isolated, pocket	Accretion	Upland
NL	38	Man Inf	Open Bay	East	Medium	Bars	Ck Mouth	Stable	Marsh/CB
NL	40	Natural	Open Bay	East	Medium	Bars	Ck Mouth	Stable	Marsh/CB
NL	42	Man Inf	Open Bay	East	Medium		Dune Field, linear	Stable	Upland
NL	43	Man Inf	Open Bay	Northeast	Medium	No Bars	Dune Field, linear	Stable	Marsh/CB
NL	43A	Man Inf	Open Bay	Northeast	Medium		Dune Field, linear	Erosional	Marsh/CB
NL	43B	Man Inf	Open Bay	Northeast	Medium		Ck Mouth	Erosional	Marsh/CB
NL	45	Man Inf	Open Bay	Northeast	Medium	Bars	Ck Mouth	Erosional	Marsh/CB
NL	46	Man Inf	Open Bay	Northeast	Medium	Bars	Dune Field, bay	Erosional	Upland
NL	47	Man Inf	Open Bay	Northeast	Medium	Bars	Isolated, linear	Stable	Marsh/CB
NL	48	Man Inf	Open Bay	Northeast	Medium	Bars	Isolated, linear	Stable	Upland
NL	49	Man Inf	Open Bay	Northeast	Medium	Bars	Isolated, linear	Stable	Upland
NL	50	Man Inf	Open Bay	Northeast	Medium	Bars	Isolated, linear	Erosional	Upland
NL	51	Man Inf	Open Bay	Northeast	Medium	Bars	Isolated, linear	Stable	Upland
NL	52	Man Inf	Open Bay	Northeast	Medium	Bars	Isolated, linear	Stable	Upland
NL	54	Man Inf	Open Bay	Northeast	Medium	Bars	Isolated, linear	Stable	Upland
NL	55	Man Inf	Open Bay	Northeast	Medium	Bars	Ck Mouth	Stable	Marsh/CB
NL	58	Man Inf	Open Bay	Northeast	Medium	Bars	Dune Field, linear	Stable	Upland
NL	59	Man Inf	Open Bay	Northeast	Medium	Bars	Dune Field, linear	Stable	Upland
NL	61	Man Inf	Open Bay	Northeast	Medium	Bars	Isolated, linear	Stable	Upland
NL	62	Man Inf	Open Bay	Northeast	Shallow	Bars	Ck Mouth	Erosional	Upland
NL	63	Man Inf	Open Bay	Northeast	Shallow	Bars	Ck Mouth	Erosional	Marsh/CB
NL	67	Man Inf	Open Bay	North	Medium	Bars	Ck Mouth	Erosional	Marsh/CB
NL	70	Man Inf	Riv-Bay	North	Medium	Bars	Ck Mouth	Erosional	Marsh/CB
NL	73	Man Inf	Riv-Bay	Northeast	Medium	Bars	Spit	Stable	Marsh/CB
NL	78	Man Inf	Riv-Bay	East	Medium	No Bars	Isolated, linear	Erosional	Marsh/CB

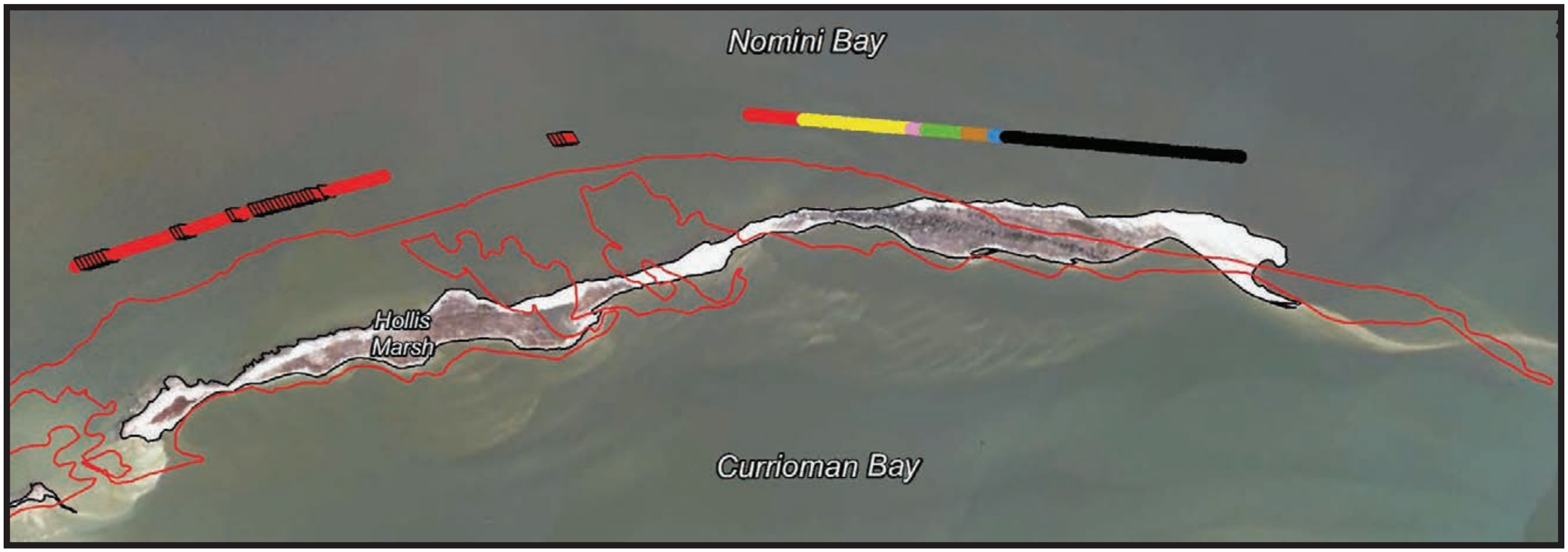
These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

Long-term, recent stability and future predictions of shore erosion and accretion rates for dune sites in Northumberland County.

Site	No.	Long-Term Stability 1937-2002	Recent Stability 1994-2002	Near Future Prediction
NL	1	Erosional	Stable	Accretionary
NL	2	Erosional	Stable	Erosional
NL	3	Erosional	Erosional	Erosional
NL	4	Erosional	Accretionary	Stable
NL	4A	Erosional	Erosional	Stable
NL	6	Stable	Stable	Stable
NL	7	Accretionary	Erosional	Erosional
NL	8	Accretionary	Erosional	Stable/Accrete
NL	9	Stable	Stable	Erosional
NL	10	Accretionary	Stable	Stable
NL	11	Erosional	Erosional	Erosional
NL	11A	Erosional	Erosional	Erosional
NL	12	Stable	Stable	Stable
NL	14	Erosional	Erosional	Stable
NL	15	Erosional	Stable	Stable
NL	17	Accretionary	Erosional	Erosional
NL	19	Stable	Stable	Erosional
NL	20	Erosional	Stable	Stable
NL	21	Stable	Stable	Stable
NL	22	Erosional	Stable	Stable
NL	22A	Accretionary	Stable	Stable
NL	23A	No Data	Stable	Accretionary
NL	23B	No Data	Stable	Accretionary
NL	26	Erosional	Stable	Stable
NL	27	Erosional	Stable	Stable
NL	28	Accretionary	Accretionary	Erosional
NL	30	Erosional	Stable	Stable
NL	31	Accretionary	Accretionary	Stable
NL	32	Accretionary	Stable	Stable
NL	33	Erosional	Stable	Stable
NL	34	Erosional	Stable	Stable
NL	35	Erosional	Stable	Stable
NL	36	Erosional	Stable	Erosional
NL	37	Erosional	Stable	Stable
NL	38	Erosional	Stable	Stable
NL	40	Erosional	Stable	Stable
NL	42	Eros/Accete	Stable	Eros/Accete

Site	No.	Long-Term Stability 1937-2002	Recent Stability 1994-2002	Near Future Prediction
NL	43	Accretionary	Stable	Eros/Accete
NL	43A	Erosional	Erosional	Erosional
NL	43B	Erosional	Erosional	Erosional
NL	45	Erosional	Erosional	Erosional
NL	46	Erosional	Accretionary	Stable
NL	47	Erosional	Erosional	Stable
NL	48	Erosional	Stable	Stable
NL	49	Erosional	Stable	Stable
NL	50	Erosional	Stable	Erosional
NL	51	Erosional	Erosional	Stable
NL	52	Erosional	Stable	Stable
NL	54	Erosional	Stable	Stable
NL	55	Erosional	Stable	Stable
NL	58	Erosional	Stable	Stable
NL	59	Stable	Stable	Stable
NL	61	Stable	Stable	Stable
NL	62	Erosional	Erosional	Stable
NL	63	Erosional	Erosional	Stable
NL	67	Erosional	Stable	Stable
NL	70	Erosional	Erosional	Erosional
NL	73	Erosional	Accretionary	Stable
NL	78	Erosional	Accretionary	Stable

Shoreline Evolution:
Westmoreland County, Virginia
Potomac River and Rappahannock River Shorelines



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Gloucester Point, Virginia

September 2012

Shoreline Evolution:
Westmoreland County, Virginia
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Data Summary Report

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September 2012

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1 Introduction

Westmoreland County is situated along the Potomac River and Rappahannock River (Figure 1). Through time, the County's shoreline has evolved, and determining the rates and patterns of shore change provides the basis to know how a particular coast has changed through time and how it might proceed in the future. Along Chesapeake Bay's estuarine shores, winds, waves, tides and currents shape and modify coastlines by eroding, transporting and depositing sediments.

The purpose of this report is to document how the shore zone of Westmoreland County has evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year and can be used to assess the geomorphic nature of shore change. Aerial photos show how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man, through shore hardening or inlet stabilization, come to dominate a given shore reach. In addition to documenting historical shorelines, the change in shore positions along the rivers and larger creeks in Westmoreland County will be quantified in this report. The shorelines of very irregular coasts, small creeks around inlets, and other complicated areas will be shown but not quantified.

2 Methods

2.1 Photo Rectification and Shoreline Digitizing

An analysis of aerial photographs provides the historical data necessary to understand the suite of processes that work to alter a shoreline. Images of the Westmoreland County Shoreline from 1937, 1953, 1969, 1994, 2002 and 2009 were used in the analysis. The 1994, 2002 and 2009 images were available from other sources. The 1994 imagery was orthorectified by the U.S. Geological Survey (USGS) and the 2002 and 2009 imagery was orthorectified by the Virginia Base Mapping Program (VBMP). The 1937, 1953 and 1969 photos are part of the VIMS Shoreline Studies Program archives. The historical aerial images acquired to cover the entire shoreline were not always flown on the same day. The dates for each year are:
1937 - March 4, April 4, 7, and 17; May 7 and 31;
1953 - October 2, 3, 11, and 26; November 2 and 27
1969 - December 5 and 11;
The 2002 and 2009 were all flown in February, March, and April of their respective years. We could not ascertain the exact dates the 1994 images were flown.

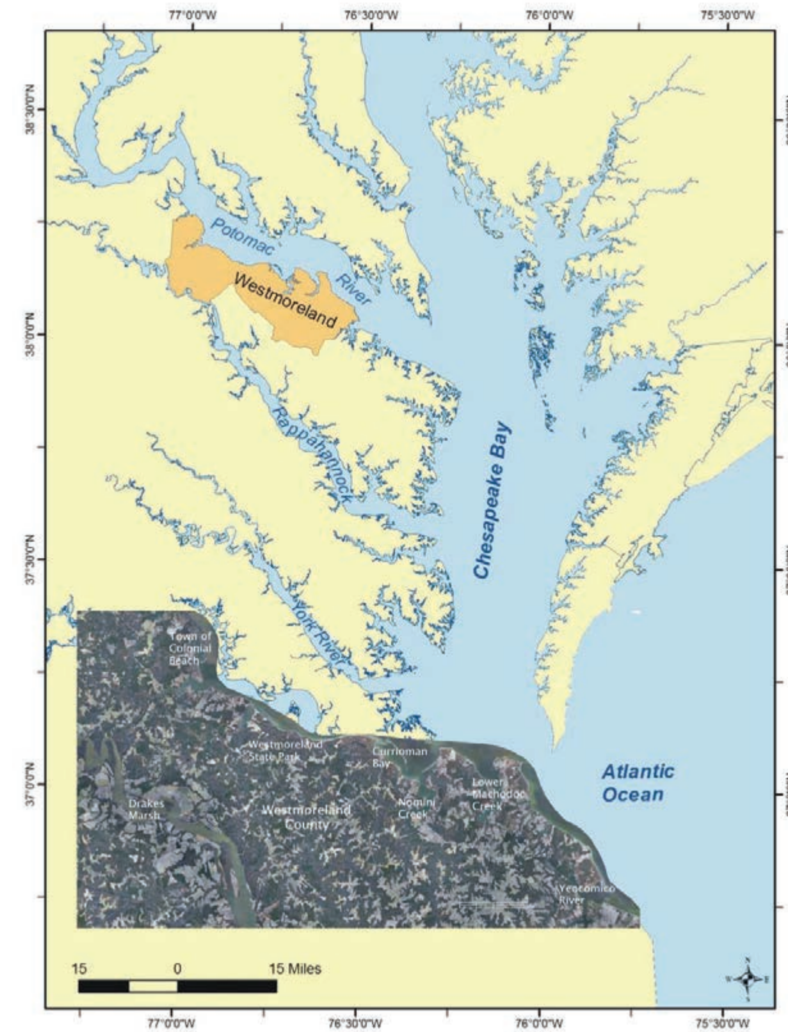

Figure 1. Location of Westmoreland County within the Chesapeake Bay estuarine system.

The 1937, 1953 and 1969 images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. These aerial photographs were orthographically corrected to produce a seamless series of aerial mosaics following a set of standard operating procedures. The 1994 Digital Orthophoto Quarter Quadrangles (DOQQ) from USGS were used as the reference images. The 1994 photos are used rather than higher quality, more recent aerials because of the difficulty in finding control points that match the earliest 1937 images.

ERDAS Orthobase image processing software was used to orthographically correct the individual flight lines using a bundle block solution. Camera lens calibration data were matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. The exterior and interior models were combined with a digital elevation model (DEM) from the USGS National Elevation Dataset to produce an orthophoto for each aerial photograph. The orthophotographs were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic .img format. To maintain an accurate match with the reference images, it is necessary to distribute the control points evenly, when possible. This can be challenging in areas given the lack of ground features and poor photo quality on the earliest photos. Good examples of control points were manmade features such as road intersections and stable natural landmarks such as ponds and creeks that have not changed much over time. The base of tall features such as buildings, poles, or trees can be used, but the base can be obscured by other features or shadows making these locations difficult to use accurately. Most areas of the County were particularly difficult to rectify, either due to the lack of development when compared to the reference images or due to no development in the historical and the reference images.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background. The morphologic toe of the beach or edge of marsh was used to approximate low water. High water limit of runup can be difficult to determine on the shoreline due to narrow or non-existent beaches against upland banks or vegetated cover. In areas where the shoreline was not clearly identifiable on the aerial photography, the location was estimated based on the experience of the digitizer. The displayed shorelines are in shapefile format. One shapefile was produced for each year that was mosaicked.

Horizontal positional accuracy is based upon orthorectification of scanned aerial photography against the USGS digital orthothophoto quadrangles. For vertical control, the USGS 30m DEM data was used. The 1994 USGS reference images were developed in accordance with National Map Accuracy Standards (NMAS) for Spatial Data Accuracy at the 1:12,000 scale. The 2002 and 2009 Virginia Base Mapping Program's orthophotography were developed in accordance with the National Standard for Spatial Data Accuracy (NSSDA). Horizontal root mean square error (RMSE) for historical mosaics was held to less than 20 ft.

2.2 Rate of Change Analysis

The Digital Shoreline Analysis System (DSAS) was used to determine the rate of change for the County's shoreline (Himmelstoss, 2009). All DSAS input data must be managed within a personal geodatabase, which includes all the baselines created for Westmoreland County and the digitized shorelines for 1937, 1953, 1969, 1994, 2002 and 2009. Baselines were digitized about 200 feet, more or less, depending on features and space, seaward of the 1937 shoreline and encompassed most of the County's main shorelines but generally did not include the smaller creeks. It also did not include areas that have unique shoreline morphology such as creek mouths and spits. DSAS generated transects perpendicular to the baseline about 33 ft apart, which were manually checked and cleaned up. For Westmoreland County, this method represented about 70 miles of shoreline along 11310 transects.

The End Point Rate (EPR) is calculated by determining the distance between the oldest and most recent shoreline in the data and dividing it by the number of years between them. This method provides an accurate net rate of change over the long term and is relatively easy to apply to most shorelines since it only requires two dates. This method does not use the intervening shorelines so it may not account for changes in accretion or erosion rates that may occur through time. However, Milligan *et al.* (2010a, 2010b, 2010c, 2010d) found that in several localities within the bay, EPR is a reliable indicator of shore change even when intermediate dates exist. Average rates were calculated along selected areas of the shore; segments are labeled in Appendix A and shown in Table 1.

Using methodology reported in Morton *et al.* (2004) and National Spatial Data Infrastructure (1998), estimates of error in orthorectification, control source, DEM and digitizing were combined to provide an estimate of total maximum shoreline position error. The data sets that were orthorectified (1937, 1959, and 1969) have an estimated total maximum shoreline position error of 20.0 ft, while the total maximum shoreline error for the four existing datasets are estimated at 18.3 ft for USGS and 10.2 ft for VBMP. The maximum annualized error for the shoreline data is $\pm$0.7 ft/yr. The smaller rivers and creeks are more prone to error due to their lack of good control points for photo rectification, narrower shore features, tree and ground cover and overall smaller rates of change. These areas are digitized but due to the higher potential for error, rates of change analysis are not calculated. Many areas of Westmoreland County have shore change rates that fall within the calculated error. Some of the areas that show very low accretion can be due to errors within the method described above.

The Westmoreland County shoreline was divided into 47 plates (Figure 2) in order to display that data in Appendices A and B. In Appendix A, the 2009 image is shown with only the 1937 and 2009 shorelines to show the long-term trends along. In Appendix B, one photo date and the associated shoreline is shown on each. These include the photos taken in 1937, 1953, 1969, 1994, 2002 and 2009.

3 Summary

The rates of change shown in Table 1 are averaged across large sections of shoreline and may not be indicative of rates at specific sites within the reach. Some areas of the County, where the shoreline change rates are categorized as accretion, have structures along the shoreline which results in a positive long-term rate of change due to the structures themselves. Some of the areas with very low accretion, particularly in the smaller creeks and rivers, may be the result of errors within photo rectification and digitizing wooded shorelines.

Hollis Marsh has the largest erosion rate in Westmoreland County. Other Potomac River shoreline is eroding, but much more slowly. This is likely do to the nature of the material. Hollis Marsh is a low, marsh and sand island that is easily overwashed in storms. Much of the main Potomac River shoreline which is exposed to the same wave climate consists of high, consolidated banks that slump when their base of ban erodes providing material to the shoreline. This results in a lower erosion rate because the shoreline accretes and the slump material must erode away before base of bank erosion occurs again.

This also occurs along Westmoreland's Rappahannock River shoreline. The relatively lower bank shorelines and marshes in segment T erode more quickly than the high banks in sections of shoreline.

Table 1. Average end point rate of change (ft/yr) between 1937 an d2009 for segments along Westmoreland County's shoreline. Segment locations are show on maps in Appendix A.

Segment Name	Location	Average Rate of Change (ft/yr)
A	Rosier Creek	-0.7
B	Potomac River, Mouth of Rosier Creek to Bluff Point	-0.1
C	Potomac River, Town of Colonial Beach	0.1
D	Monroe Bay	-0.2
E	Potomac River, Sebastian Point to Paynes Point	-0.7
F	Mouth of Mattox Creek, Wirt Wharf	-0.1
G	Potomac River, Church Point to Westmoreland State Park	-1.1
H	Potomac River, Westmoreland State Park to Haulover Inlet	-0.8
I	Nomini Bay, Hollis Marsh	-4.0
J	Currioman Bay, Haulover Inlet to Nomini Creek	-0.6
K	Nomini Creek including Buckner Creek	-0.3
L	Nomini Bay, White Point to Kingcopsico Point	-0.3
M	Lower Machodoc Creek	-0.8
N	Potomac River, Grapevine Point to Ragged Point	-1.1
O	Potomac River, Ragged Point to Jackson Creek	-0.9
P	Potomac River, Jackson Creek to Sandy Point	-2.2
Q	Potomac River, Sandy Point to Lynch Point	-1.4
R	Yeocomico River	-0.5
S	Rappahannock River, Richmond County Line to Layton Landing Rd.	-0.4
T	Rappahannock River, Layton Landing Rd. to Blind Point	-1.2
U	Rappahannock River, Blind Point to King George County Line	-0.4

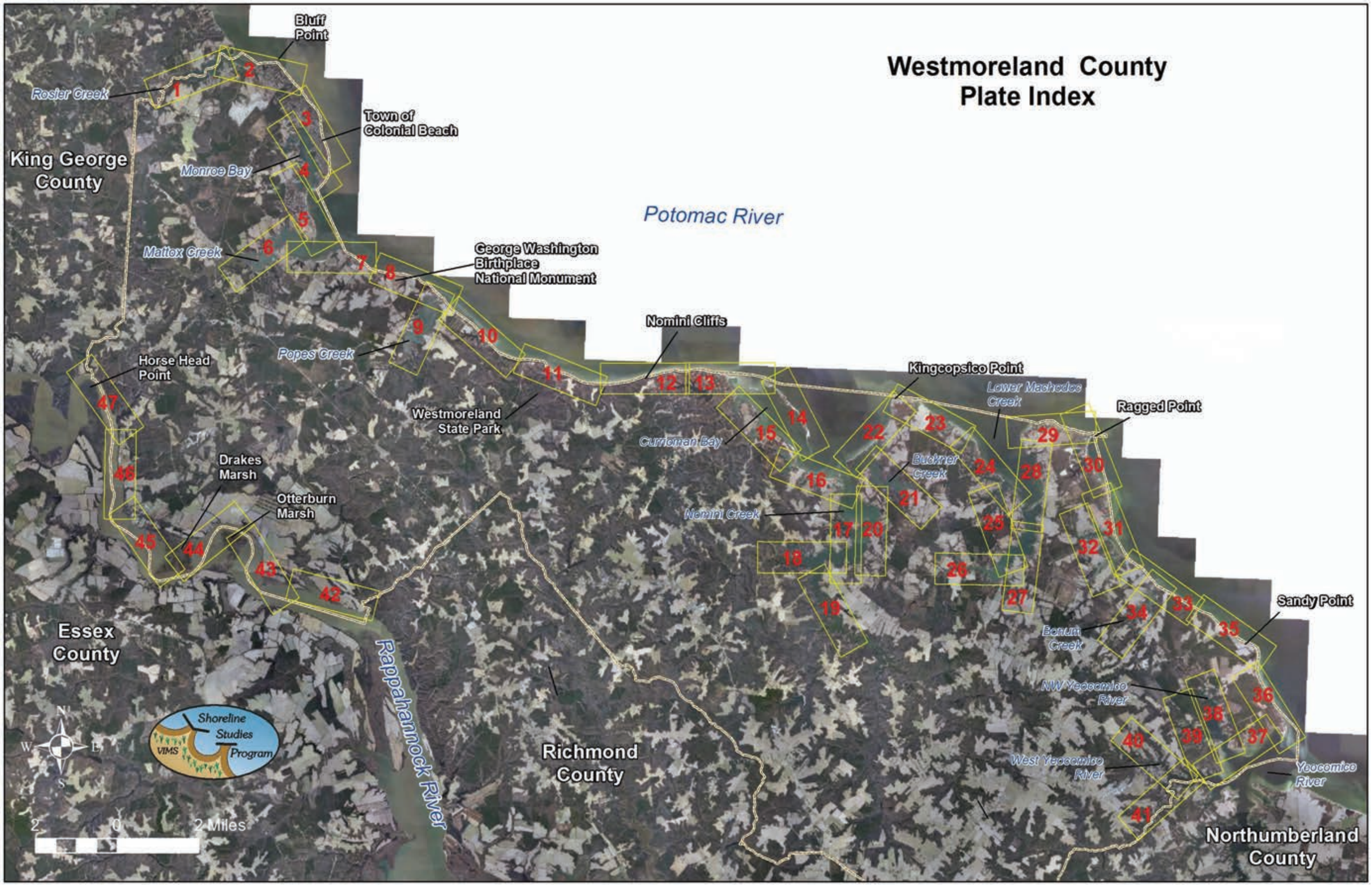

Figure 2. Index of shoreline plates.

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Appendix C: 2011 Mitigation Actions Update

The following tables provide detailed updates to the actions committed to by the participating jurisdictions in the 2011 Northern Neck PDC Hazard Mitigation Plan. The updates are provided by county in alphabetical order. Towns are included with their respective counties, also in alphabetical order.

Northern Neck PDC 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
PDC - 1	Strategy 4.1.1	Officially recognize the dual purpose of the Local Emergency Planning Committee as the Mitigation Advisory Committee. Use the Committee to review mitigation projects and coordinate multijurisdictional grant applications.	Localities	All		Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 2	Strategy 4.1.2	Develop recommendations for short-term and long-term revenue sources for mitigation, planning, and projects. These options could include grants and private sources.	Localities	All	High	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 3	Strategy 4.1.3	Incorporate mitigation principals into local comprehensive, emergency management, and recovery plans.	Localities	All	High	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 4	Strategy 4.2.1	Provide training opportunities to county/municipal enforcement staff. Educate them on GIS, damage assessment, mitigation techniques, and other related topics. Explore short term training opportunities (e.g., one day) that could be delivered in the region.	Localities	All		Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 5	Strategy 4.6.1	Provide information for citizenry about the SRL program.	Localities	Flood, Coastal	High	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 6	Strategy 4.6.2	Work in partnership with local, state, and federal agencies to implement SRL projects were appropriate.	Localities	Flood, Coastal	High	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC

Northern Neck PDC 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
							will provide support in achieving action.
PDC - 7	Strategy 5.1.1	Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day.)	Localities	All	Medium	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 8	Strategy 5.1.2	Partner with Parent Teacher Associations and local schools to implement seasonal hazard awareness weeks or days (e.g., Masters of Disaster, Risk Watch)	Localities	All	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 9	Strategy 5.1.3	Distribute packets to new residents to raise awareness regarding hazard risks in the Northern Neck.	Localities	All	Medium	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 10	Strategy 5.2.4	Work with the National Weather Service to promote the "Turn Around, Don't Drown" public education campaign.	Localities	Flood	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 11	Strategy 5.3.2	Investigate flood warning capabilities, including the identification of alternative safe routes.	Localities	Flood, Coastal	Medium	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.

Northern Neck PDC 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
PDC - 12	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 13	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 14	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 15	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 16	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.

Northern Neck PDC 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
PDC - 17	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 18	Strategy 6.3.2	Enforce the floodplain management ordinance by monitoring compliance and taking remedial action to correct violations.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.

Northern Neck PDC 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
PDC - 19	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 20	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 21	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 22	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.

Lancaster County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Lancaster - 1	Strategy 1.2.1	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Planning	Flood	High	Continued	Hazards continue, ordinances and policed updated to reflect new information
Lancaster - 2	Strategy 1.2.3	Encourage use of vegetation and revetments to reduce shoreline erosion.	Planning	Flood	High	Continued	Mandated by Chesapeake Bay Act
Lancaster - 3	Strategy 1.2.4	Require coordinated shoreline protection plans in new waterfront subdivisions.	Planning	Flood	Low	Continued	Not required, but encouraged
Lancaster - 4	Strategy 1.3.1	Consider using fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	Planning	Flood	Low	Continued	Conservation easement ordinance encourages this action
Lancaster - 5	Strategy 2.2.1	Identify existing flood prone structures that may benefit from mitigation measures such as elevation.	Planning	Flood	Low	Continued	Provide support for homeowners interested in the projects
Lancaster - 6	Strategy 2.2.3	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Planning	Flood	Med	Continued	Adjacent property owners are notified and actions encouraged
Lancaster - 7	Strategy 3.3.1	Identify funding opportunities to replace vulnerable or undersized culvert stream crossing with bridges or larger culverts to reduce flood hazards.	Not provided	Flood, Coastal		Canceled	No jurisdiction program support.
Lancaster - 8	Strategy 3.3.2	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	Planning	Flood	Med	Continued	BOS makes recommendations through the six year secondary road plan
Lancaster - 9	Strategy 3 .3. 7	Work with private property owners, VDOT, and private utilities to trim or remove trees that could down power lines.	Planning	Severe weather	Low	Continued	Ongoing efforts to communicate with VDOT, utilities and property owners

Lancaster County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Lancaster - 10	Strategy 4.2.2	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	IT	All	Med	Continued	As technology and resources allow, new opportunities are made available to staff to more effectively utilize GIS in emergency management planning, response and recovery
Lancaster - 11	Strategy 4.3.2	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	Emergency Services	All	High	Continued	Use of crisis track has been adopted and implemented
Lancaster - 12	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	Building Official	Flood	Low	Continued	Optional program, considering capabilities to support
Lancaster - 13	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Planning / Building Official	Flood	Med	Continued	Floodplain requirements must be met for building in the floodplain
Lancaster - 14	Strategy 5.1.5	Develop vegetative planting programs for public shoreline property to serve as a model for public education purposes.	Building and Grounds	Flood	Med	Continued	Placed vegetation in new public access projects
Lancaster - 15	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	Emergency Services	Flood	Med	Continued	Information provided to residents through outreach activities
Lancaster - 16	Strategy 5.2.2	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Emergency Services	Flood	Med	Continued	Information provided to residents through outreach activities
Lancaster - 17	Strategy 5.2.3	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	Emergency Services	Flood	Med	Continued	Information provided to residents through outreach activities

Lancaster County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Lancaster - 18	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities.	Emergency Services	Severe weather	High	Continued	All public facilities are so equipped; public encouraged through outreach activities
Lancaster - 19	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Building Official	Flood	High	Continued	Ordinances remain updated to maintain compliance
Lancaster - 20	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	IT / Planning	Flood	Med	Continued	Maps maintained by planning office and made available on County GIS website
Lancaster - 21	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Planning	Flood	High	Continued	Ordinances remain updated to maintain compliance
Lancaster - 22	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Planning	Flood	Med	Continued	Information is submitted to FEMA for review in a timely manner, as received
Lancaster - 23	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Planning	Flood	High	Continued	Required by ordinance
Lancaster - 24	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the	Planning	Flood	High	Continued	Required by ordinance, updated regularly as new information becomes available

Lancaster County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.					
Lancaster - 25	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Planning	Flood	High	Continued	Required by ordinance
Lancaster - 26	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning	Flood	High	Continued	Regulations meet or exceed minimum requirements
Lancaster - 27	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Emergency Services	Flood	Med	Continued	Information provided to residents through outreach activities
Lancaster - 28	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Emergency Services	Flood	Med	Continued	Information provided to residents through outreach activities

Lancaster County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Lancaster - 29	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Emergency Services	Flood	Low	Continued	Staff available to assist residents upon request

Town of Irvington 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Irvington - 1	Strategy 1.2.3	Encourage use of vegetation and revetments to reduce shoreline erosion. (also Goal #2)	Town Administrator	flood	medium	continue	Chesapeake Bay Restoration Act Requirements
Irvington - 2	Strategy 1.2.4	Require coordinated shoreline protection plans in new waterfront subdivisions.	Town Administrator	flood	low	continue	no new waterfront subdivisions
Irvington - 3	Strategy 2.2.3	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Town Administrator	flood	low	continue	as permits are requested
Irvington - 4	Strategy 3.2.1	Identify need for backup generators, communications and/or vehicles at critical public facilities. Develop means to address shortfall identified. (also Goal #4)	Town Administrator	all	low	continue	very limited facilities and funds
Irvington - 5	Strategy 3.2.2	Consider providing necessary electrical hook-up, wiring, and switches to allow readily accessible connections to emergency generators at selected critical public facilities.	Town Administrator	all	low	continue	very limited facilities and funds
Irvington - 6	Strategy 3.3.4	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	Town Administrator	all	medium	continue	continuing discussions with Aqua VA and Dominion power
Irvington - 7	Strategy 3.4.1	Initiate road clearing efforts early in wind and winter storms. Develop plan for quick deployment of road clearing support.	Town Administrator	all	medium	continue	VADOT responsible for road clearing and maintenance
Irvington - 8	Strategy 4.1.4	Develop a Continuity of Operations Plan.	town Administrator	all	low	continue	limited staff to coordinate
Irvington - 9	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	Town Administrator	flood	low	continue	already participate in FEMA floor Insurance and mapping plans
Irvington - 10	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Town Administrator	flood	medium	continue	done on an ongoing basis

Town of Irvington 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Irvington - 11	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	Town Administrator	flood	low	continue	limited flood plane properties
Irvington - 12	Strategy 5.2.2	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Town Administrator	flood	low	continue	limited properties in flood plane
Irvington - 13	Strategy 5.2.3	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	town Administrator	flood	low	continue	limited properties in flood plane
Irvington - 14	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	Town Administrator	flood /all	low	continue	only public facility is town hall and we have a NOAA radio
Irvington - 15	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Town Administrator	all	low	continue	we are involved in NFIP
Irvington - 16	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Town Administrator	flood	low	continue	we have copies of floodplain maps at town hall for public inspection
Irvington - 17	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Town Administrator	flood	low	continue	will do as items developed
Irvington - 18	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Town Administrator	flood /all	low	continue	will do as developed
Irvington - 19	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Town Administrator	flood	low	continue	will do as developed

Town of Irvington 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Irvington - 20	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	town Administrator	flood	low	continue	have town ordinance which adopts and incorporates Chesapeake Bay Restoration Act
Irvington - 21	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Town Administrator	flood	medium	continue	done on a regular basis
Irvington - 22	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that	Town Administrator	all	low	continue	We have very limited facilities with hazardous materials and building and zoning code takes care of residential housing.

Town of Irvington 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		prohibit any new residential or non-residential structures in the SFHA.					
Irvington - 23	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Town Administrator	flood	low	continue	we have very limited properties in flood planes
Irvington - 24	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Town Administrator	flood	low	continue	done on an as needed basis
Irvington - 25	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Town Administrator	all	low	continue	On all types of insurance?

Town of Kilmarnock 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Kilmarnock - 1	Strategy 1.1.1	Avoid establishing public service facilities and utilities, such as wastewater disposal facilities, within or near the floodplain where they might create a hazard if damaged during a storm.	Planning Department/ Public Works	flooding, water pollution	moderate	continued	continued avoidance
Kilmarnock - 2	Strategy 1.2.1	Incorporate hazard mitigation techniques into new community facilities to minimize damages. (See Goal #3)	Planning Department/ Public Works	all	moderate	continued	will continue to incorporate
Kilmarnock - 3	Strategy 3.1.1	Investigate all critical community facilities, such as county administrative offices, shelters (non-school buildings), fire stations, and police stations, to evaluate their resistance to flood and wind hazards. Particular attention will be given to the HY AC systems and structural integrity of the buildings. Prioritize facilities in known hazard areas (e.g., floodplains)	Planning Department/ Public Works	all	moderate	continued	town facilities are continually accessed
Kilmarnock - 4	Strategy 3.3.3	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Planning Department/ Public Works	flooding	moderate	continued	the town works with landowners and helps vdot keep streets clean
Kilmarnock - 5	Strategy 3.3.4	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	Planning Department/ Public Works	all	moderate	continued	discuss when possible
Kilmarnock - 6	Strategy 3.3.5	Replace traffic lights hung from wires with traffic lights hung from mast arms. Install all new traffic lights on mast arms. Ensure traffic light mechanisms are weather proof.	Planning Department/ Public Works	wind	moderate	continued	rely on vdot
Kilmarnock - 7	Strategy 3.3.6	Identify program of corrective actions to improve stormwater systems capacity to handle major rain events.	Planning Department/ Public Works	flooding	moderate	continued	need state cooperation
Kilmarnock - 8	Strategy 4.1.4	Develop a Continuity of Operations Plan.	Planning Department/ Public Works	all	low	continued	will consider

Town of Kilmarnock 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Kilmarnock - 9	Strategy 4.2.2	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	Planning Department/ Public Works	all	low	cancelled	rely on county
Kilmarnock - 10	Strategy 4.3.1	Develop a detailed building inventory for all structures in the jurisdiction, which catalogues information such as value of the structure, contents, age, location (latitude and longitude), etc.	Planning Department/ Public Works	all	low	cancelled	rely on county
Kilmarnock - 11	Strategy 4.3.2	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	Planning Department/ Public Works	all	low	cancelled	rely on county
Kilmarnock - 12	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	Planning Department/ Public Works	all	low	continued	considering
Kilmarnock - 13	Strategy 4.5.6	Include an assessment and associated mapping of the jurisdiction's vulnerability to location specific hazards, and make appropriate recommendations for the use of these hazard areas in the next comprehensive plan.	Planning Department/ Public Works	all	moderate	continued	considered during comp plan review
Kilmarnock - 14	Strategy 4.5.7	Investigate using non-conforming or substantial damage provision to require hazard retrofitting of existing development.	Planning Department/ Public Works	all	low	continued	will investigate
Kilmarnock - 15	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	Planning Department/ Public Works	all	moderate	continued	town will encourage
Kilmarnock - 16	Strategy 5.2.2	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Planning Department/ Public Works	all	moderate	continued	town will educate
Kilmarnock - 17	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	Planning Department/ Public Works	all	low	continued	town will encourage

Town of Kilmarnock 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Kilmarnock - 18	Strategy 5.3.3	Investigate, develop, or enhance a regional public notification system such as low power FM or AM radio.	Planning Department/ Public Works	all	low	cancelled	needs to be county wide not just town. Town has its own code red in place now but rely as well.
Kilmarnock - 19	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Planning Department/ Public Works	flooding	low	cancelled	town participates in the NFIP
Kilmarnock - 20	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Planning Department/ Public Works	flooding	low	continued	town does this
Kilmarnock - 21	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Planning Department/ Public Works	flooding	low	continued	town does this
Kilmarnock - 22	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Planning Department/ Public Works	flooding	low	continued	town does this
Kilmarnock - 23	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Planning Department/ Public Works	flooding	low	continued	town does this
Kilmarnock - 24	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres;	Planning Department/ Public Works	flooding	low	continued	Ordinance adopted and maintained

Town of Kilmarnock 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.					
Kilmarnock - 25	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Planning Department/ Public Works	flooding	low	continued	town does this now
Kilmarnock - 26	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning Department/ Public Works	flooding	low	continued	considered
Kilmarnock - 27	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Planning Department/ Public Works	flooding	low	continued	town does this
Kilmarnock - 28	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Planning Department/ Public Works	flooding	low	continued	town does this

Town of Kilmarnock 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Kilmarnock - 29	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Planning Department/ Public Works	flooding	low	continued	town provides when needed

Northumberland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Northumberland - 1	Strategy 1.1.2	Established special setback regulations where shoreline erosion has been documented, and due to periodic storms, represents a future threat to life and property.	Building and Zoning	Flood, Coastal Erosion	Low	cancelled	100 Foot CBPA RPA is considered an adequate hazard boundary
Northumberland - 2	Strategy 1.1.3	Established standards for construction which modify the shoreline, such as: bulkheads, piers, and boat house.	Building and Zoning	Flood, Coastal Erosion	Low	cancelled	Adjoining localities may have conflicting standards
Northumberland - 3	Strategy 1.2.1	Incorporate hazard mitigation techniques into new community facilities to minimize damages. (See Goal #3)	Building and Zoning	All	Med	continued	
Northumberland - 4	Strategy 1.2.2	Provide incentives for property owners to implement mitigation measures. (also Goals #2 & #5)	Building and Zoning	Flood, Coastal Erosion	Low	cancelled	Providing incentives is not possible at this time
Northumberland - 5	Strategy 1.2.3	Encourage use of vegetation and revetments to reduce shoreline erosion. (also Goal #2)	Building and Zoning	Coastal Erosion	Low	continued	Not appropriate everywhere
Northumberland - 6	Strategy 1.3.1	Consider using fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	Building and Zoning	Flood	Low	continued	
Northumberland - 7	Strategy 1.3.2	Consider implementing a wetlands acquisition and /or restoration program.	Building and Zoning	Flood	Low	continued	
Northumberland - 8	Strategy 2.1.1	Increase enforcement and education regarding the tie down of propane and other fuel tanks (also Goal # 1)	Building and Zoning	Flood, Wind	Low	continued	
Northumberland - 9	Strategy 2.2.1	Identify existing flood prone structures that may benefit from mitigation measures such as elevation.	Building and Zoning	Flood	Low	continued	
Northumberland - 10	Strategy 2.2.2	Investigate all manufactured homes and trailers to evaluate their resistance to winds and flood hazards.	Building and Zoning	Flood, Wind	Low	cancelled	Inadequate staffing levels to complete task

Northumberland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Northumberland - 11	Strategy 2.2.3	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Building and Zoning	Coastal Erosion	Med	continued	
Northumberland - 12	Strategy 3.1.1	Investigate all critical community facilities, such as county administrative offices, shelters (non-school buildings), fire stations, and police stations, to evaluate their resistance to flood and wind hazards. Particular attention will be given to the HY AC systems and structural integrity of the buildings. Prioritize facilities in known hazard areas (e.g., floodplains)	Building and Zoning; Admin. Office	All	Med	completed	We have identified our at risk critical community facilities
Northumberland - 13	Strategy 3.3.2	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	Building and Zoning	Flood	High	continued	Working with VDOT now
Northumberland - 14	Strategy 3.3.3	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Building and Zoning	Flood	Low	cancelled	This is VDOT's responsibility
Northumberland - 15	Strategy 4.3.1	Develop a detailed building inventory for all structures in the jurisdiction, which catalogues information such as value of the structure, contents, age, location (latitude and longitude), etc.	Building and Zoning	All	Low	cancelled	Inadequate staffing levels to complete task
Northumberland - 16	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Building and Zoning	Flood, Wind	Med	cancelled	County policy allows development in the floodplain provided the structure meets freeboard requirements

Northumberland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
							and /or foundation reinforcement
Northumberland - 17	Strategy 4.5.8	Investigate implementation of cumulative damage provision as part of floodplain ordinance.	Building and Zoning	Flood	Low	continued	
Northumberland - 18	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	Building and Zoning	Flood	Low	continued	
Northumberland - 19	Strategy 5.2.2	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Building and Zoning	Flood	Med	continued	
Northumberland - 20	Strategy 5.2.3	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	OEMS	Flood	Low	continued	Investigate adding to county website
Northumberland - 21	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	OEMS	All	Low	cancelled	NOAA Radios analog old school technology. Replace with automated phone call warning system - Code Red (see added strategy)
Northumberland - 22	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Building and Zoning	Flood	High	continued	
Northumberland - 23	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Building and Zoning	Flood	High	continued	
Northumberland - 24	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Building and Zoning	Flood	High	continued	

Northumberland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Northumberland - 25	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Building and Zoning	Flood	Med	continued	LOMA's sent to FEMA by individual
Northumberland - 26	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Building and Zoning	Flood	Low	continued	Assist surveyors, as county staff can't make official determination
Northumberland - 27	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Building and Zoning	Flood	Med	continued	
Northumberland - 28	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Building and Zoning	Flood	High	continued	

Northumberland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Northumberland - 29	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Building and Zoning	Flood	High	continued	Have flood ordinance that requires an extra 24 inches of freeboard
Northumberland - 30	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Building and Zoning	Flood	Med	continued	
Northumberland - 31	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Building and Zoning	Flood	Med	continued	Have held public meetings win conjunction with FEMA
Northumberland - 32	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Building and Zoning	All	High	continued	

Richmond County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Richmond - 1	Strategy 1.1.1	Avoid establishing public service facilities and utilities, such as wastewater disposal facilities, within or near the floodplain where they might create a hazard if damaged during a storm.	health department	Flood	Low	completed	state health department takes care of this
Richmond - 2	Strategy 1.1.2	Established special setback regulations where shoreline erosion has been documented, and due to periodic storms, represents a future threat to life and property.	land use	Flood, Coastal	Low	cancelled	not addressed
Richmond - 3	Strategy 1.1.3	Established standards for construction which modify the shoreline, such as: bulkheads, piers, and boat house.	VMRC	Coastal	Low	cancelled	handled by VMRC
Richmond - 4	Strategy 1.2.1	Incorporate hazard mitigation techniques into new community facilities to minimize damages. (See Goal #3)	land use	All	High	completed	
Richmond - 5	Strategy 1.2.3	Encourage use of vegetation and revetments to reduce shoreline erosion. (also Goal #2)	land use	Coastal	High	completed	
Richmond - 6	Strategy 1.2.4	Require coordinated shoreline protection plans in new waterfront subdivisions.	land use	Coastal	High	completed	
Richmond - 7	Strategy 1.3.1	Consider using fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	land use	Flood, Coastal	Low	completed	would be submitted by builder for profers to by approved by county
Richmond - 8	Strategy 1.3.2	Consider implementing a wetlands acquisition and /or restoration program.	NN Soil and Water Conservation District	Coastal	Moderate	continued	
Richmond - 9	Strategy 2.1.1	Increase enforcement and education regarding the tie down of propane and other fuel tanks (also Goal # 1)	land use	Wind, Flood	High	completed	

Richmond County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Richmond - 10	Strategy 2.2.3	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	land use	Coastal	High	continued	
Richmond - 11	Strategy 3.3.2	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	county administrator	Flood	Low	continued	
Richmond - 12	Strategy 3.3.4	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	Information not provided	Wind, Flood	Information not provided	cancelled	Information not provided
Richmond - 13	Strategy 4.2.2	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	IT	All	High	continued	
Richmond - 14	Strategy 4.2.3	Evaluate the floodplain manager's roles and responsibilities in each local jurisdiction.	land use	Flood, Coastal	High	continued	
Richmond - 15	Strategy 4.3.2	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	Emergency Management /IT	All	Low	continued	
Richmond - 16	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	land use	Flood, Coastal	Low	completed	
Richmond - 17	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	land use	Flood, Coastal	High	completed	
Richmond - 18	Strategy 4.5.4	Evaluate the potential costs versus benefits of implementing a freeboard requirement for all new structures within the 100 year floodplain.	land use	Flood, Coastal	Low	continued	
Richmond - 19	Strategy 4.5.8	Investigate implementation of cumulative damage provision as part of floodplain ordinance.	Emergency Management /IT	Flood, Coastal	Low	continued	

Richmond County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Richmond - 20	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	county administrator	All	High	completed	
Richmond - 21	Strategy 5.3.4	Work with VDOT to establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood prone areas.	land use	Flood, Coastal	Low	cancelled	
Richmond - 22	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	land use	Flood, Coastal	Low	completed	
Richmond - 23	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	land use	Flood, Coastal	Low	completed	
Richmond - 24	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	land use	Flood, Coastal	High	completed	
Richmond - 25	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	land use	Flood, Coastal	Low	continued	when new information is available
Richmond - 26	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	land use	Flood, Coastal	Low	completed	
Richmond - 27	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and	land use	Flood, Coastal	High	continued	

Richmond County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.					
Richmond - 28	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	land use	yes	yes	continued	
Richmond - 29	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	land use	Flood, Coastal	Low	completed	
Richmond - 30	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	land use	Flood, Coastal	Low	cancelled	up to FEMA

Richmond County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Richmond - 31	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	land use	Flood, Coastal	High	continued	
Richmond - 32	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	land use	Flood, Coastal	High	continued	

Westmoreland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Westmoreland - 1	Strategy 1.2.1	Incorporate hazard mitigation techniques into new community facilities to minimize damages. (See Goal #3)	planning	all	Not provided	continued	facilities are built to commercial standards
Westmoreland - 2	Strategy 1.3.1	Consider using fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	planning	flood	Not provided	continued	encourage for new development
Westmoreland - 3	Strategy 2.2.1	Identify existing flood prone structures that may benefit from mitigation measures such as elevation.	planning	flood	Not provided	continued	identified and some have been mitigated
Westmoreland - 4	Strategy 2.3.1	Evaluate built-upon areas within the floodplain or along the high erosion risk shoreline for possible relocation and/or buy-out. In particular, target FEMA's Repetitive Loss Properties throughout the Northern Neck for possible relocation and/or buy-out.	planning	flood	Not provided	continued	repitive loss properties have been identified through FEMA
Westmoreland - 5	Strategy 3.3.1	Identify funding opportunities to replace vulnerable or undersized culvert stream crossing with bridges or larger culverts to reduce flood hazards.	VDOT	flood	Not provided	continued	the county doesn't maintain any roads
Westmoreland - 6	Strategy 3.3.2	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	VDOT	flood	Not provided	continued	The county will bring potential issues or concerns to the attention of VDOT.

Westmoreland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Westmoreland - 7	Strategy 3.3.4	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	planning	flood an wind events	Not provided	continued	all subdivisions are sent to electric utilitilies for their review prior to our approval planning, Other State Agencies are invited to attend meetings for some commercial projects.
Westmoreland - 8	Strategy 4.2.2	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	EM	all hazards	Not provided	continued	Emergency Management coordiantes training for staff.
Westmoreland - 9	Strategy 4.3.2	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	County Admin	all hazards	Not provided	continued	County Administration tracks and keeps file per FEMA Guidelines.
Westmoreland - 10	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	planning	flood	Not provided	continued	Planning staff has attended training on the CRS Program
Westmoreland - 11	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 12	Strategy 4.5.2	Review and revise, if required, existing Subdivision Ordinances to include hazard mitigation-related development criteria in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 13	Strategy 4.5.4	Evaluate the potential costs versus benefits of implementing a freeboard requirement for all new structures within the 100 year floodplain.	planning	flood	Not provided	continued	Freeboard was increased to 18 inches last spring
Westmoreland - 14	Strategy 4.5.5	Review and revise, if required the existing zoning ordinance to include separate zones or districts with appropriate development criteria for known hazard areas.	planning	All	Not provided	cancelled	

Westmoreland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Westmoreland - 15	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	planning	flood	Not provided	continued	this is discussed with landowners along with floodplain issues
Westmoreland - 16	Strategy 5.2.2	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	planning	flood	Not provided	continued	this is discussed with landowners along with floodplain issues
Westmoreland - 17	Strategy 5.2.3	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	planning	flood	Not provided	continued	Follow FEMA guidelines
Westmoreland - 18	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	planning	flood	Not provided	continued	ongoing process
Westmoreland - 19	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	planning	flood	Not provided	continued	citizens request copies of applicable floodplain maps
Westmoreland - 20	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 21	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 22	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 23	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development	planning	flood	Not provided	continued	ongoing process

Westmoreland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.					
Westmoreland - 24	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 25	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 26	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	planning	flood	Not provided	continued	ongoing process

Westmoreland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Westmoreland - 27	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 28	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	planning	flood	Not provided	cancelled	citizens are encouraged to speak with their insurance carrier

Town of Colonial Beach 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Colonial Beach - 1	Strategy 2.1.1	Increase enforcement and education regarding the tie down of propane and other fuel tanks (also Goal # 1)	Planning	wind, flood	Not provided	continued	creating brochure to give to homeowners concerning flood hazards
Colonial Beach - 2	Strategy 3.1.2	Evaluate exiting storm water system to determine if it is adequate for existing (or future) flood hazards.	Planning	flood	Not provided	continued	researching grants to develop a town-wide stormwater management plan
Colonial Beach - 3	Strategy 3.3.3	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Public Works	flood, wind	Not provided	continued	continual maintenance performed by Public Works
Colonial Beach - 4	Strategy 3.3.6	Identify program of corrective actions to improve stormwater systems capacity to handle major rain events.	Planning	flood	Not provided	continued	researching grants to develop a town-wide stormwater management plan
Colonial Beach - 5	Strategy 4.3.1	Develop a detailed building inventory for all structures in the jurisdiction, which catalogues information such as value of the structure, contents, age, location (latitude and longitude), etc.	Planning	all	Not provided	continued	General Zoning Log contains this information
Colonial Beach - 6	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Planning	Flood	Not provided	continued	continual enforcement of Flood Plain Ordinance
Colonial Beach - 7	Strategy 4.5.2	Review and revise, if required, existing Subdivision Ordinances to include hazard mitigation-related development criteria in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.	Planning	flood	Not provided	completed	Floodplain Ordinance covers regulations in hazard areas
Colonial Beach - 8	Strategy 4.5.5	Review and revise, if required the existing zoning ordinance to include separate zones or districts with appropriate development criteria for known hazard areas.	Planning	all	Not provided	completed	Flood Plain ordinance and accomanied Flood Plain map
Colonial Beach - 9	Strategy 4.5.6	Include an assessment and associated mapping of the jurisdiction's vulnerability to location specific hazards, and make appropriate	Planning	all	Not provided	continued	2015 Flood maps adopted but not

Town of Colonial Beach 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		recommendations for the use of these hazard areas in the next comprehensive plan.					included in current comprehensive plan
Colonial Beach - 10	Strategy 4.5.7	Investigate using non-conforming or substantial damage provision to require hazard retrofitting of existing development.	Planning	flood, coastal	Not provided	continued	any improvements to existing non conforming structures will need to be conforming according to hazard mitigation techniques
Colonial Beach - 11	Strategy 5.1.4	Publicize the location of local shelters and emergency phone numbers. Include a map of shelters in local phonebooks or on county websites.	Planning	all	Not provided	continued	need to develop list
Colonial Beach - 12	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	Planning	all	Not provided	continued	
Colonial Beach - 13	Strategy 5.3.3	Investigate, develop, or enhance a regional public notification system such as low power FM or AM radio.	Planning	all	Not provided	continued	
Colonial Beach - 14	Strategy 5.3.4	Work with VDOT to establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood prone areas.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 15	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 16	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 17	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Planning	flood, coastal	Not provided	continued	

Town of Colonial Beach 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Colonial Beach - 18	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 19	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 20	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 21	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Planning	flood, coastal	Not provided	continued	

Town of Colonial Beach 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Colonial Beach - 22	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 23	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Planning	flood, coastal	Not provided	continued	creating brochure to give to homeowners concerning flood hazards
Colonial Beach - 24	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 25	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Planning	flood, coastal	Not provided	continued	

Town of Montross 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Montross - 1	Strategy 4.1.4	Develop a Continuity of Operations Plan.	Westmoreland County	All	Medium	Continued	The Town does not have a formal continuity of operations plan, but does participate with the county in planning for emergencies
Montross - 2	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	Town Manager	Flood, Coastal	Not provided	Continued	The Town of Montross partners with the County of Westmoreland in the development of FEMA's Community Rating System
Montross - 3	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	Town Manager	Flood, Coastal	Not provided	Continued	The Town works with interested property owners to make recommendations and stresses the importance of proper insurance.
Montross - 4	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	Town Manager	All	Not provided	Continued	The Town purchased three NOAA radios. These radios are accessible to key personnel.
Montross - 5	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Westmoreland County	Flood, Coastal	Not provided	Continued	Town of Montross partners with Westmoreland County
Montross - 6	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Town Manager	Flood, Coastal	High	Continued	Town of Montross will coordinate with Westmoreland County and assistance
Montross - 7	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Westmoreland County	Flood, Coastal	Not provided	Continued	Town of Montross will coordinate with Westmoreland County

Town of Montross 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Montross - 8	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Westmoreland County	Flood, Coastal	Not provided	Continued	Town of Montross partners with Westmoreland County
Montross - 9	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Westmoreland County	Flood, Coastal	Not provided	Continued	Town of Montross partners with Westmoreland County
Montross - 10	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Westmoreland County	Flood, Coastal	Not provided	Continued	Town of Montross will review with Westmoreland County as the County would issue the permits
Montross - 11	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Westmoreland County	Flood, Coastal	Not provided	Continued	The Westmoreland County would enforce this

Town of Montross 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Montross - 12	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Town Manager	Flood, Coastal	Medium	Continued	Town of Montross will review with Westmoreland County as the County does
Montross - 13	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Town Manager	Flood, Coastal	Not provided	Continued	The Town works with interested property owners to make recommendations and stresses the importance of proper insurance.
Montross - 14	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Town Manager	Flood, Coastal	High	Continued	Town will follow-up with Westmoreland County to see if they have anything in place
Montross - 15	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Town Manager	Flood, Coastal	Not provided	Continued	The Town works with interested property owners to make recommendations and stresses the importance of proper insurance.

Appendix D: 2017-2022 Mitigation Actions

The following tables provide detailed actions committed to by the participating jurisdictions in the 2017-2022 Northern Neck PDC Hazard Mitigation Plan. The actions are provided by county in alphabetical order. Towns are included with their respective counties, also in alphabetical order.

The Northern Neck PDC 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northern Neck - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Agency-wide	High	X	**X**	X	X	X	X	Hurricane, Flood, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	Staff, FEMA HMA Grants
Northern Neck - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Agency-wide	High	**X**	X	X	X	X	X	Hurricane, Flood, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	Staff, Member jurisdictions

The Northern Neck PDC 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northern Neck - 3	Promotion, education and implementation of nature-based resiliency practices. Eligible projects include but are not limited to: 1. Ecosystem restoration approaches such as ecological restoration or forest and wetland landscape restoration. 2. Issue-specific ecosystem related approaches such as ecosystem-based adaptation and mitigation, climate adaptation and ecosystem-based disaster risk reduction. 3. Infrastructure related approaches such as green and blue infrastructure. 4. Ecosystem-based management approaches such as integrated coastal zone and water resources management. 5. Ecosystem protection approaches such as area-based conservation and protected area management.	Agency-wide	High	X	**X**	X	X	X	X	Hurricane, Flood, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	Staff, State Agencies, Non-governmental Organizations
Northern Neck - 4	Promote and grow the Living Shoreline Initiative in both its Non-structural and Combined structural/non-structural aspects. Actions taken may include, but are not limited to, grading land away from eroding shoreline, maintain riparian bugger adjacent to shorelines, and complement with other stormwater management (rain barrels, rain garden, conservation landscaping).	Agency-wide	High	X	X	**X**	X	X	X	Flood, Coastal Erosion	Ongoing	Staff, Member jurisdictions, State Agencies, Non-governmental Organizations

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Lancaster - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Planning	Medium	X	**X**	X	X	X	X	Hurricane, Flood, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	County Staff
Lancaster - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Planning	Medium	**X**	X	X				Flood, Drought	Ongoing	County Staff
Lancaster - 3	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Planning	High	X	**X**		X			Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Lancaster - 4	Encourage use of vegetation and revetments to reduce shoreline erosion.	Planning	High		X	**X**	X			Flood	Ongoing	County Staff
Lancaster - 5	Require coordinated shoreline protection plans in new waterfront subdivisions.	Planning	Low	X	**X**	X	X		X	Flood	Ongoing	County Staff
Lancaster - 6	Consider using free, simple, and/or permanent easement to prevent development in the highest priority undeveloped Floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	Planning	Low	X	X	**X**				Flood	Ongoing	County Staff
Lancaster - 7	Identify existing flood prone structures that may benefit from mitigation measures such as elevation.	Planning	Low	X	**X**			X	X	Flood	Ongoing	County Staff
Lancaster - 8	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Planning	Medium	X	X	**X**				Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Lancaster - 9	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	Planning	Medium	X	X		**X**			Flood	Ongoing	County Staff
Lancaster - 10	Work with private property owners, VDOT, and private utilities to trim or remove trees that could down power lines.	Planning	Low	X	**X**	X	X			Severe weather	Ongoing	County Staff
Lancaster - 11	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	IT	Medium					**X**		All	Ongoing	County Staff
Lancaster - 12	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	Emergency Services	High		X	**X**		X		All	Ongoing	County Staff
Lancaster - 13	Consider participating in FEMA's Community Rating System (CRS).	Building Official	Low	**X**				X	X	Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Lancaster - 14	Continue to enforce zoning and building codes to prevent construction within the Floodplain.	Planning / Building Official	Medium	**X**	X					Flood	Ongoing	County Staff
Lancaster - 15	Develop vegetative planting programs for public shoreline property to serve as a model for public education purposes.	Building and Grounds	Medium			**X**				Flood	Ongoing	County Staff
Lancaster - 16	Encourage the purchase of flood and/or sewer back-up insurance.	Emergency Services	Medium	**X**					X	Flood	Ongoing	County Staff
Lancaster - 17	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Emergency Services	Medium	X					**X**	Flood	Ongoing	County Staff
Lancaster - 18	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	Emergency Services	Medium	X	X			X	**X**	Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Lancaster - 19	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities.	Emergency Services	High	X				**X**	X	Severe weather	Ongoing	County Staff
Lancaster - 20	Maintain a voluntary agreement with FEMA to participate in the NFIP	Building Official	High	**X**						Flood	Ongoing	County Staff
Lancaster - 21	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	IT / Planning	Medium	**X**					X	Flood	Ongoing	County Staff
Lancaster - 22	Adopt the most current DFIRM or FIRM and FIS as they become available.	Planning	High	**X**						Flood	Ongoing	County Staff
Lancaster - 23	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Planning	Medium	**X**						Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Lancaster - 24	Assist with local floodplain determinations and maintain a record of approved changes to the local Floodplain.	Planning	High	**X**						Flood	Ongoing	County Staff
Lancaster - 25	Adopt or maintain a Floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from Flood to or above the Base Flood Elevation (BFE), including anchoring , using Flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Planning	High	**X**						Flood	Ongoing	County Staff
Lancaster - 26	Enforce the floodplain management ordinance by monitoring compliance and taking remedial action to correct violations.	Planning	High	**X**						Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Lancaster - 27	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally Floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning	High	**X**						Flood	Ongoing	County Staff
Lancaster - 28	Educate community members about the availability and value of Flood insurance.	Emergency Services	Medium	X					**X**	Flood	Ongoing	County Staff
Lancaster - 29	Inform community property owners about changes to the DFIRM/FIRM that may impact their insurance rates.	Emergency Services	Medium						**X**	Flood	Ongoing	County Staff
Lancaster - 30	Provide general assistance to community members relating to insurance issues.	Emergency Services	Low						**X**	Flood	Ongoing	County Staff

Town of Irvington 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Irvington - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Not Provided	Not Provided	X	**X**	X	X		X	Hurricane, Flood, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Not Provided	Not Provided
Irvington - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Not Provided	Not Provided	**X**	X	X	X	X	X	All	Not Provided	Not Provided

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Kilmarnock - 1	Avoid establishing public service facilities and utilities, such as wastewater disposal facilities, within or near the Floodplain where they might create a hazard if damaged during a storm.	Public Works/ Planning Department	Medium	**X**	X					Flood, Water pollution	ongoing	Town Admin
Kilmarnock - 2	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Public Works/ Planning Department	Medium	**X**	X	X	X			All	ongoing	Town Admin
Kilmarnock - 3	Investigate all critical community facilities, such as county administrative offices, shelters (non-school buildings), fire stations, and police stations, to evaluate their resistance to flood and wind hazards. Particular attention will be given to the HY AC systems and structural integrity of the buildings. Prioritize facilities in known hazard areas (e.g., floodplains)	Public Works/ Planning Department	Medium	X	**X**					All	ongoing	Town Admin
Kilmarnock - 4	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Public Works/ Planning Department	Medium	**X**						Flood	ongoing	Town Admin, State

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Kilmarnock - 5	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	Public Works/ Planning Department	Medium	X	**X**					All	ongoing	Town Admin
Kilmarnock - 6	Replace traffic lights hung from wires with traffic lights hung from mast arms. Install all new traffic lights on mast arms. Ensure traffic light mechanisms are weather proof.	VDOT	Medium	**X**	X					Wind	0-5 years	VDOT
Kilmarnock - 7	Identify program of corrective actions to improve stormwater systems capacity to handle major rain events.	VDOT	Medium	X	X		**X**			Flood	ongoing	VDOT, Town Admin
Kilmarnock - 8	Develop a Continuity of Operations Plan.	Public Works/ Planning Department	Low				**X**	**X**		All	ongoing	Town Admin
Kilmarnock - 9	Consider participating in FEMA's Community Rating System (CRS).	Public Works/ Planning Department	Low	**X**				X	X	All	ongoing	Town Admin
Kilmarnock - 10	Include an assessment and associated mapping of the jurisdiction's vulnerability to location specific hazards, and make appropriate recommendations for the use of these hazard areas in the next comprehensive plan.	Public Works/ Planning Department	Medium	**X**						All	0-3 year	Town Admin

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Kilmarnock - 11	Investigate using non-conforming or substantial damage provision to require hazard retrofitting of existing development.	Public Works/ Planning Department	Low	**X**						All	ongoing	Town Staff
Kilmarnock - 12	Encourage the purchase of flood and/or sewer back-up insurance.	Public Works/ Planning Department	Medium						**X**	All	ongoing	Town Staff
Kilmarnock - 13	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Public Works/ Planning Department	Medium						**X**	All	ongoing	Town Staff
Kilmarnock - 14	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities.	Public Works/ Planning Department	Low					**X**	X	All	5 years	Town Admin
Kilmarnock - 15	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Public Works/ Planning Department	Low						**X**	Flood	ongoing	Town Staff
Kilmarnock - 16	Adopt the most current DFIRM or FIRM and FIS as they become available.	Public Works/ Planning Department	Low	**X**						Flood	ongoing	Town Staff
Kilmarnock - 17	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Public Works/ Planning Department	Low	**X**						Flood	ongoing	Town Staff

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Kilmarnock - 18	Assist with local floodplain determinations and maintain a record of approved changes to the local Floodplain.	Public Works/ Planning Department	Low	**X**						Flood	ongoing	Town Staff
Kilmarnock - 19	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base Flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from flood to or above the Base Flood Elevation (BFE), including anchoring , using Flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Public Works/ Planning Department	Low	**X**						Flood	5 years	Town Staff
Kilmarnock - 20	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Public Works/ Planning Department	Low	**X**						Flood	ongoing	Town Staff, Lancaster County

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Kilmarnock - 21	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Public Works/ Planning Department	Low	**X**				X		Flood	ongoing	Town Staff
Kilmarnock - 22	Educate community members about the availability and value of flood insurance.	Public Works/ Planning Department	Low						**X**	Flood	ongoing	Town Staff
Kilmarnock - 23	Inform community property owners about changes to the DFIRM/FIRM that may impact their insurance rates.	Public Works/ Planning Department	Low						**X**	Flood	ongoing	Town Staff
Kilmarnock - 24	Provide general assistance to community members relating to insurance issues.	Public Works/ Planning Department	Low						**X**	Flood	ongoing	Town Staff

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Kilmarnock - 25	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Public Works/Planning Department	Low	X	**X**	X	X	X	X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	ongoing	Town Staff
Kilmarnock - 26	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Public Works/ Planning Department	Medium	**X**	X	X		X		All hazards	ongoing	Town Staff

Town of White Stone 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
White Stone -1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Town Manager with Town Council	Medium/ Medium High	X	**X**	X	X		X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	3-5 Years	Staff FEMA Grants Other Grants
White Stone -2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Town Manager with Town Council	Medium	**X**	X	X		X		All Hazards	3-5 Years	Staff FEMA Grants Other Grants
White Stone -3	Avoid establishing public service facilities and utilities, such as wastewater disposal facilities, within or near the floodplain where they might create a hazard if damaged during a storm.	Town Manager with Town Council	Medium/ Medium High	**X**	X					Flood	3-5 Years	Staff FEMA Grants Other Grants

Town of White Stone 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
White Stone -4	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Town Manager with Town Council	Medium/ Medium High	**X**	X					All	3-5 Years	Staff FEMA Grants Other Grants
White Stone -5	Investigate All critical community facilities, such as county administrative offices, shelters (non-school buildings), fire stations, and police stations, to evaluate their resistance to Flood and wind hazards. Particular attention will be given to the HVAC systems and structural integrity of the buildings. Prioritize facilities in known hazard areas (e.g., floodplains)	Town Manager with Town Council	Medium/ Medium High	X	**X**					All	3-5 Years	Staff FEMA Grants Other Grants
White Stone -6	Evaluate exiting storm water system to determine if it is adequate for existing (or future) flood hazards.	Town Manager with Town Council	Medium/ Medium High	**X**	X		X			Flood	3-5 Years	Staff FEMA Grants Other Grants
White Stone -7	Identify need for backup generators, communications and/or vehicles at critical public facilities. Develop means to address shortfalls identified.	Town Manager with Town Council	Medium/ Medium High	**X**	X		X	X		All	3-5 Years	Staff FEMA Grants Other Grants
White Stone -8	Consider providing necessary electrical hook-up, wiring, and switches to allow readily accessible connections to emergency generators at selected critical public facilities.	Town Manager with Town Council	Medium/ Medium High	**X**	X					All	3-5 Years	Staff FEMA Grants Other Grants
White Stone -9	Encourage the purchase of flood and/or sewer back-up insurance.	Town Manager with Town Council	Medium/ Medium High	X	**X**					Flood, Coastal	3-5 Years	Staff FEMA Grants Other Grants

Town of White Stone 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
White Stone -10	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Town Manager with Town Council	Medium	**X**	X		X			Flood, Coastal	3-5 Years	Staff FEMA Grants Other Grants
White Stone -11	Identify program of corrective actions to improve stormwater systems capacity to handle major rain events.	Town Manager with Town Council	Medium	**X**	X		X			Flood, Coastal	3-5 Years	Staff FEMA Grants Other Grants
White Stone -12	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Town Manager with Town Council	Medium	**X**	X					Flood, Coastal	3-5 Years	Staff FEMA Grants Other Grants

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northumberland - 1	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Building and Zoning	High	**X**	X					All	5 years	County Staff
Northumberland - 2	Encourage use of vegetation and revetments to reduce shoreline erosion.	Building and Zoning	Low			**X**				Coastal Erosion	5 years	County Staff
Northumberland - 3	Consider using fee simple and/or permanent easements to prevent development in the highest priority undeveloped Floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	Building and Zoning	Low	X	**X**	X			X	Flood	5 years	County Staff
Northumberland - 4	Consider implementing a wetlands acquisition and /or restoration program.	Building and Zoning	Low		X	**X**				Flood	5 years	County Staff
Northumberland - 5	Increase enforcement and education regarding the tie down of propane and other fuel tanks	Building and Zoning	Low	X	X				**X**	Flood, Wind	5 years	County Staff
Northumberland - 6	Identify existing flood prone structures that may benefit from mitigation measures such as elevation.	Building and Zoning	Low	X	**X**			X	X	Flood	5 years	County Staff
Northumberland - 7	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Building and Zoning	Medium	X		**X**			X	Coastal Erosion	5 years	County Staff

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northumberland - 8	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	Building and Zoning	High		**X**		X			Flood	5 years	County Staff
Northumberland - 9	Investigate implementation of cumulative damage provision as part of floodplain ordinance.	Building and Zoning	Medium	**X**						Flood	5 years	County Staff
Northumberland - 10	Encourage the purchase of flood and/or sewer back-up insurance.	Building and Zoning	Low	X			X		**X**	Flood	5 years	County Staff
Northumberland - 11	Educate residents about Flood insurance and ICC (Increased Cost of Compliance) Coverage.	Building and Zoning	Medium						**X**	Flood	5 years	County Staff
Northumberland - 12	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	Office of Emergency Services	Low					X	**X**	Flood	5 years	County Staff
Northumberland - 13	Maintain a voluntary agreement with FEMA to participate in the NFIP	Building and Zoning	High	**X**						Flood	5 years	County Staff
Northumberland - 14	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Building and Zoning	High	X					X	Flood	5 years	County Staff
Northumberland - 15	Adopt the most current FIRM maps and FIS as they become available.	Building and Zoning	High	**X**						Flood	5 years	County Staff

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northumberland - 16	Share with FEMA any new technical or scientific data that may result in map revisions within six months of creation or identification of new data.	Building and Zoning	Medium	**X**						Flood	5 years	County Staff
Northumberland - 17	Assist with local floodplain determinations and maintain a record of approved changes to the local Floodplain.	Building and Zoning	High	**X**					X	Flood	5 years	County Staff
Northumberland - 18	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from Flood to or above the Base Flood Elevation (BFE), including anchoring , using Flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Building and Zoning	High	**X**						Flood	5 years	County Staff
Northumberland - 19	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Building and Zoning	High	**X**						Flood	5 years	County Staff

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Northumberland - 20	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally Floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Building and Zoning	High	**X**						Flood	5 years	County Staff
Northumberland - 21	Educate community members about the availability and value of Flood insurance.	Building and Zoning	High						**X**	Flood	5 years	County Staff
Northumberland - 22	Provide general assistance to community members relating to insurance issues.	Building and Zoning	High						**X**	All	5 years	County Staff

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Northumberland - 23	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Administrator's Office	Low	X	**X**	X	X	X	X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	5 years	County Staff
Northumberland - 24	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Administrator's Office	Low	**X**	X	X	X	X	X	All	5 years	County Staff

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northumberland - 25	Maintain an Emergency Notification System for citizens (Code Red) which upon voluntary subscription, will notify if a NWS severe weather alert is activated within the County.	Administrator's Office	High	X	X				**X**	Flood, Wind	5 years	County Staff

Richmond County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Richmond - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Land Use, Admin.	High	X	**X**	X	X		X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	
Richmond - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Land Use, Admin.	High	**X**	X	X		X		All	2018-2019	
Richmond - 3	Consider implementing a wetlands acquisition and /or restoration program.	Soil & Water Conservation District	Low			**X**				Coastal, Flood		

Richmond County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Richmond - 4	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Land use	High	**X**		X	X		X	Coastal, Flood	Ongoing	
Richmond - 5	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	County Admin.	High	X			**X**			Flood, Coastal	Ongoing	
Richmond - 6	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	IT	High	**X**						All	Ongoing	
Richmond - 7	Evaluate the floodplain manager's roles and responsibilities in each local jurisdiction.	land use	High	**X**							Ongoing	
Richmond - 8	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	Emergency Management/ IT	Low	**X**						All		
Richmond - 9	Evaluate the potential costs versus benefits of implementing a freeboard requirement for all new structures within the 100 year floodplain.	Land use	Low	**X**	X					Flood, Coastal		
Richmond - 10	Investigate implementation of cumulative damage provision as part of Floodplain ordinance.	Emergency Management/ IT	Low	**X**						Flood, Costal		
Richmond - 11	Share with FEMA any new technical or scientific data that may result in map revisions within six months of creation or identification of new data.	Land use	Low	**X**						Flood, Coastal		

Richmond County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Richmond - 12	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base Flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from Flood to or above the Base Flood Elevation (BFE), including anchoring , using Flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Land use	High	**X**						Flood, Coastal	Ongoing	
Richmond - 13	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Land use	High	**X**						Flood, Coastal	Ongoing	
Richmond - 14	Inform community property owners about changes to the FIRM that may impact their insurance rates.	Land use	High						**X**	Flood, Coastal	Ongoing	

Richmond County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Richmond - 15	Provide general assistance to community members relating to insurance issues.	Land use	High						**X**	Flood, Coastal	Ongoing	

Town of Warsaw 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Warsaw - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Not Provided	Not Provided	X	**X**	X	X		X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Not Provided	Not Provided
Warsaw - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Not Provided		**X**	X	X		X		All	Not Provided	Not Provided

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Westmoreland - 1	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Planning	High	**X**	X		X			All	Ongoing	Staff
Westmoreland - 2	Consider using fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	Planning	Medium	**X**		X				Flood	Ongoing	Staff
Westmoreland - 3	Identify existing floodprone structures that may benefit from mitigation measures such as elevation.	Planning	Medium	X	**X**				X	Flood	Ongoing	Staff
Westmoreland - 4	Evaluate built-upon areas within the floodplain or along the high erosion risk shoreline for possible relocation and/or buy-out. In particular, target FEMA's Repetitive Loss Properties throughout the Northern Neck for possible relocation and/or buy-out.	Planning	Medium	X	**X**	X				Flood	Ongoing	Staff
Westmoreland - 5	Identify funding opportunities to replace vulnerable or undersized culvert stream crossing with bridges or larger culverts to reduce food hazards.	VDOT	Medium		X		**X**			Flood	Ongoing	VDOT

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Westmoreland - 6	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	VDOT	Medium	X	X		**X**			Flood	Ongoing	Staff - VDOT
Westmoreland - 7	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	Planning	Low	X	X		**X**			Flood, Wind	Ongoing	Staff
Westmoreland - 8	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	Emergency Management	High	X				**X**		All	1-3 years	Staff
Westmoreland - 9	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	County Admin.	High	X				**X**		All	1-3 years	Staff - VDEM
Westmoreland - 10	Consider participating in FEMA's Community Rating System (CRS).	Planning	High	**X**						Flood, Coasta	1-3 Years	Staff - VDEM
Westmoreland - 11	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Planning	Medium	**X**						Flood, Coastal	Ongoing	Staff
Westmoreland - 12	Review and revise, if required, existing Subdivision Ordinances to include hazard mitigation-related development criteria in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.	Planning	Medium	**X**						Flood, Coastal	Ongoing	Staff

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Westmoreland - 13	Evaluate the potential costs versus benefits of continuing the freeboard requirement for all new structures within the 100 year floodplain.	Planning	Low	**X**						Flood, Coastal	Ongoing	Staff
Westmoreland - 14	Encourage the purchase of flood and/or sewer back-up insurance.	Planning	Medium	**X**	X				X	Flood	Ongoing	Staff - Grants
Westmoreland - 15	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Planning	Medium						**X**	Flood	Ongoing	Staff
Westmoreland - 16	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	Planning	Low					X	**X**	Flood	Ongoing	Staff
Westmoreland - 17	Maintain a voluntary agreement with FEMA to participate in the NFIP	Planning	High	**X**						Flood	Ongoing	Staff
Westmoreland - 18	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Planning	Low	**X**					X	Flood	1-3 years	Staff
Westmoreland - 19	Adopt the most current DFIRM or FIRM and FIS as they become available.	Planning	Low	**X**						Flood	1-3 Years	Staff

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Westmoreland - 20	Share with FEMA any new technical or scientific data that may result in map revisions within six months of creation or identification of new data.	Planning	Medium	**X**						Flood	Ongoing	Staff
Westmoreland - 21	Assist with local floodplain determinations and maintain a record of approved changes to the local Floodplain.	Planning	Low	**X**					X	Flood	Ongoing	Staff
Westmoreland - 22	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base Flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from Flood to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Planning	Medium	**X**						Flood	Ongoing	Staff

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Westmoreland - 23	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Planning	Medium	**X**						Flood	Ongoing	Staff
Westmoreland - 24	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning	Low	**X**						Flood	Ongoing	Staff
Westmoreland - 25	Educate community members about the availability and value of flood insurance.	Planning	Medium						**X**	Flood	Ongoing	Staff
Westmoreland - 26	Inform community property owners about changes to the DFIRM/FIRM that may impact their insurance rates.	Planning	Medium						**X**	Flood	Ongoing	Staff

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Westmoreland - 27	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. Wastewater and water supply system hardening and mitigation.	Planning	High	X	**X**	X	X	X	X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	Staff
Westmoreland - 28	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Planning	Medium	**X**	X	X		X		All	Ongoing	Staff

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Westmoreland – 29	Evaluate mitigation funding programs to seek a solution to and funding sources to address Stratford Hall area erosion and cliff failure issues.	Planning; Emergency Management	High		**X**					Hurricane, Flooding, Coastal Erosion	Ongoing	Staff
Westmoreland – 30	Work with VDOT and the Town of Colonial Beach to seek ingress and egress access issue solutions.	Planning, Emergency Management; Town of Colonial Beach; VDOT	High	**X**			X	X		Hurricane, Flooding	Ongoing	Staff

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	**Property Protection**	**Natural Resource Protection**	**Structural**	**Emergency Services**	**Education & Outreach**			
Colonial Beach - 1	Increase enforcement and education regarding the tie down of propane and other fuel tanks	Planning Department	High	X	X				**X**	Flood, Coastal, Wind	0-3 years	Staff
Colonial Beach - 2	Evaluate exiting storm water system to determine if it is adequate for existing (or future) flood Hazards.	Planning Department	Medium	**X**						Flood, Coastal	3-5 years	Staff
Colonial Beach - 3	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Public Works Department	High	**X**	X					Flood, Coastal	Ongoing	Staff
Colonial Beach - 4	Identify program of corrective actions to improve stormwater systems capacity to handle major rain events.	Planning Department	Medium	**X**						Flood, Coastal	2-3 years	FEMA Grant or similar
Colonial Beach - 5	Develop a detailed building inventory for all structures in the jurisdiction, which catalogues information such as value of the structure, contents, age, location (latitude and longitude), etc.	Planning Department	High	**X**						All	Ongoing	Staff
Colonial Beach - 6	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 7	Include an assessment and associated mapping of the jurisdiction's vulnerability to location specific hazards, and make appropriate recommendations for the use of these hazard areas in the next comprehensive plan.	Planning Department	Medium	**X**						All	3 years	Technical Consulting

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 8	Investigate using non-conforming or substantial damage provision to require hazard retrofitting of existing development.	Planning Department	Medium	X	**X**					Flood, Coastal	Ongoing	Staff
Colonial Beach - 9	Publicize the location of local shelters and emergency phone numbers. Include a map of shelters in local phonebooks or on county websites.	Planning Department	Low						**X**	All	Ongoing	Staff
Colonial Beach - 10	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities.	Planning Department	Low					**X**	X	All	5 years	Regional Collaboration
Colonial Beach - 11	Investigate, develop, or enhance a regional public notification system such as low power FM or AM radio.	Planning Department	Low	X				X	**X**	All	5 years	Regional Collaboration
Colonial Beach - 12	Work with VDOT to establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood prone areas.	Planning Department	Low	X					X	Flood, Coastal	Ongoing	Staff
Colonial Beach - 13	Maintain a voluntary agreement with FEMA to participate in the NFIP	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 14	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Planning Department	Low	**X**					X	Flood, Coastal	Ongoing	Staff

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 15	Adopt the most current FIRM or FIRM and FIS as they become available.	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 16	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 17	Assist with local floodplain determinations and maintain a record of approved changes to the local Floodplain.	Planning Department	High	**X**					X	Flood, Coastal	Ongoing	Staff, Appropriate Agencies

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 18	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base Flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from flood to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 19	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 20	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally Floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning Department	Low	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 21	Educate community members about the availability and value of flood insurance.	Planning Department	High						**X**	Flood, Coastal	Ongoing	Staff
Colonial Beach - 22	Inform community property owners about changes to the FIRM that may impact their insurance rates.	Planning Department	High						**X**	Flood, Coastal	Ongoing	Staff
Colonial Beach - 23	Provide general assistance to community members relating to insurance issues.	Planning Department	Medium						**X**	Flood, Coastal	Ongoing	Staff

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 24	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Planning Department, Admin.	High	X	**X**	X	X		X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	Staff
Colonial Beach - 25	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Planning Department, Admin.	High	**X**	X	X		X		All	Ongoing	Staff

Town of Montross 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Montross - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Town Manager	Medium	X	**X**	X	X		X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	0-5 years	Town Staff
Montross - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Town Manager	Medium	**X**	X	X		X		All	Ongoing	Town Staff
Montross - 3	Develop a Continuity of Operations Plan.	Westmoreland County	Medium					**X**		All	0-5 years	Town Staff
Montross - 4	Consider participating in FEMA's Community Rating System (CRS).	Town Manager	Low	**X**						Flood, Coastal	0-5 years	Town Staff

Town of Montross 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Montross - 5	Encourage the purchase of flood and/or sewer back-up insurance.	Town Manager	Medium	X					**X**	Flood, Coastal	0-5 years	Town Staff
Montross - 6	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities.	Town Manager	High					**X**	X	All	0-5 years	Town Staff
Montross - 7	Maintain a voluntary agreement with FEMA to participate in the NFIP	Westmoreland County	High	**X**						All	0-5 years	Town Staff
Montross - 8	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Town Manager	High	**X**					X	Flood, Coastal	0-5 years	Town Staff
Montross - 9	Adopt the most current DFIRM or FIRM and FIS as they become available.	Westmoreland County	Low	**X**						Flood, Coastal	0-5 years	Town Staff
Montross - 10	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Westmoreland County	Low	**X**						Flood, Coastal	0-5 years	Town Staff
Montross - 11	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Westmoreland County	Low	**X**						Flood, Coastal	0-5 years	Town Staff

Town of Montross 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Montross - 12	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from Flood to or above the base flood elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Westmoreland County	Medium	X						Flood, Coastal	0-5 years	Town Staff
Montross - 13	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Westmoreland County	Medium	X						Flood, Coastal	0-5 years	Town Staff

Town of Montross 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Montross - 14	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Town Manager	Medium	X						Flood, Coastal	0-5 years	Town Staff
Montross - 15	Educate community members about the availability and value of flood insurance.	Town Manager	Medium						X	Flood, Coastal	0-5 years	Town Staff
Montross - 16	Inform community property owners about changes to the DFIRM/FIRM that may impact their insurance rates.	Town Manager	High						X	Flood, Coastal	0-5 years	Town Staff
Montross - 17	Provide general assistance to community members relating to insurance issues.	Town Manager	Medium						X	Flood, Coastal	0-5 years	Town Staff

Appendix E: Record of Changes

Record of Changes

2017 Plan Section	Heading Section	Changes Made
SECTION I. EXECUTIVE SUMMARY	1.1 Hazard Mitigation	Expanded narrative to discuss the background about hazard mitigation.
	1.2 Authority	Expanded narrative to discuss the authority for this hazard mitigation plan update.
	1.3 Planning Area	Added section to highlight the planning area.
	1.4 Planning Committee Membership	Added section to summarize the planning committee membership.
	1.5 Hazard Identification and Risk Assessment	Updates and edits to section, including Table 1-2. Northern Neck Hazard Planning Consideration Levels to summarize 2017 plan update hazard rankings.
	1.6 Mitigation Goals and Strategies	Updates and edits to revise goals and describe new mitigation strategy groupings.
	1.7 Capability, Implementation, and Maintenance	Updates and edits to expand narrative about community capabilities in Table 1-3 and update how HMP will be implemented and maintained.
	1.8 Acknowledgements	Updated
	1.9 Conclusion	Updated
	1.10 Plan Organization	Added section
SECTION II. INTRODUCTION and PLANNING PROCESS	2.1 Introduction	Combined previous plan sections 2.0 and 3.0 into one section. Updating introduction narrative.
	2.1.1. The Local Mitigation Planning Impetus	Expanded history of legislative and regulatory federal mitigation planning requirements to include discussion of the 2013 Local Hazard Mitigation Plan Review Tool.
	2.2. Planning Process	Updated to include all participating jurisdictions.
	2.2.1. The Hazard Mitigation Technical Advisory Committee (HMTAC)	Updated to explain organization of the LEPC and updated Table 2-1 Northern Neck Mitigation Advisory Committee.
	2.2.2. Documentation of the Planning Process	Expanded discussion of planning process and updated Table 2-2 Mitigation Advisory Committee Meeting Dates.
	2.2.3. Public Participation and Stakeholder Input	Updated
	2.2.4. Incorporation of Existing Plans and Studies	Updated to list major plans and datasets used in update. Specific information references Sections 3.0, 4.0, and 6.0 and are documented in Section 9.0.
SECTION III. COMMUNITY PROFILE	4.1 Introduction	No Change
	4.2 Physiography	No Change
	4.3 Hydrology	No Change
	4.4 Climate	No Change
	4.5 Land Use and Development Trends	Updated to reflect land use as of the publication date of each community's Comprehensive Plan.

Record of Changes

2017 Plan Section	Heading Section	Changes Made
SECTION III. COMMUNITY PROFILE	4.6 Population	Updated sections and tables to reflect new 2015/2016 U.S. Census Bureau QuickFacts data based on the Population Estimates Program (PEP)
	4.7 Housing	Updated sections and tables to reflect new 2015/2016 U.S. Census Bureau QuickFacts data based on the Population Estimates Program (PEP)
	4.8 Business and Labor	Updated sections based on 2017 Virginia Community Profiles for each county, from the Virginia Employment Commission (VEC). Updated agriculture data based on the 2012 Agricultural U.S. Census data.
	4.9 Transportation	Updated Section with edits.
	4.10 Infrastructure	Updated Section with edits.
SECTION IV. HAZARD IDENTIFICATION AND RISK ASSESSMENT	5.1 Introduction	Minor Edits
	5.2 Hazard Identification	Hazards types updated. Information about the NCEI Storm Events database added. A NCEI Events table for the Northern Neck was created listing property damage, crop damage, deaths, and injuries. Presidential Disaster Declarations section and table updated. Data Limitation section changed to Hazard-Specific Datasets, with a table listing source material.
	5.3 Risk Assessment	Section added. Explanation for how each hazard was ranked.
	5.4 Vulnerability Assessment Overview	Critical Facilities data redacted.
	5.5 Riverine Flooding	Sub-sections standardized, and text updated to reflect new and expanded information. Maps updated. Hazard History tables updated. Repetitive Loss tables updated and simplified. Added annualized Damages table. New analysis for exposure generated.
	5.6 Coastal Flooding	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.
	5.7 Coastal Erosion	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added. Updated section to include information from coastal erosion shoreline studies for each county.
	5.8 Hurricanes	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.
	5.9 Severe Weather	Hazard added. Sub-sections standardized. Maps created. Hazard History tables added. Annualized Damages table added.
	5.10 Tornado	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.
	5.11 Winter Storm	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.

Record of Changes

2017 Plan Section	Heading Section	Changes Made
SECTION IV. HAZARD IDENTIFICATION AND RISK ASSESSMENT	5.12 Drought	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.
	5.13 Wildfire	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.
	5.14 Earthquakes	Hazard added. Sub-sections standardized. Data, text, and maps added.
	5.15 Summary/Conclusions on Vulnerability Assessment	Updated based on new calculated risk assessment matrix.
SECTION V. MULTIPLE HAZARD MITIGATION STRATEGY	4.1 Introduction	Updated
	4.2 Existing Authorities, Policies, Programs and Resources for Mitigation	Updated
	4.3 Selecting Mitigation Goals	Updated with revised 2017-2022 goals; resiliency added
	4.4 Selecting Mitigation Actions	Updated to a goal-action mitigation strategy structure. Review of 2011 mitigation goals, objectives, and strategies May 31, 2017 MAC meeting discussion. 2017 - 2022 actions per six broad mitigation categories.
	4.5 Developing a Mitigation Action Plan	Minor Edits
SECTION VII. CAPABILITIES, PLAN IMPLEMENTATION AND MAINTENANCE PROCESS	5.1 Capability Assessment Introduction	Minor Edits
	5.1.1 Administrative Capability	Updated
	5.1.2 Technical Capability	Updated Table 5-2 Technical Capability Matrix by Jurisdiction; added PDC-wide programs, studies and initiatives. Completed expanded capability matrix table in new Appendix I - Capability Assessment matrix table format including the NNPDC, four participating counties and the Town of Colonial Beach.
	5.1.3 Fiscal Capability	Updated Table 5-3 Fiscal Capability Matrix by Jurisdiction.
	5.1.4 Policy and Program Capability	Updated Table 5-4 Local Planning Mechanisms and Their Relationship to Hazard Mitigation. Updated sections with new policy and program capability information.
	5.1.5 Legal Authority	Updated Table 5-6 Availability of Ordinances and their Support for Hazard Mitigation. Updated sections with new legal authority information.
	5.1.6 Other Relevant Plans and Studies	Integrated NNPDC SLR study, USACE Atlantic Coastal Study, and other local business revitalization plans.
	5.2 Implementation	Minor Edits
	5.3 Maintenance	Added Table 8-1 Plan Update Maintenance Schedule

Record of Changes

2017 Plan Section	Heading Section	Changes Made
SECTION VIII. PLAN ADOPTION	6.0 Plan Adoption	Minor Edits

Appendix F: Sample Adoption Resolution

The following resolution can be used by local jurisdictions to adopt the regional hazard mitigation plan per FEMA requirements.

Contents:

Northern Neck Regional Hazard Mitigation Plan 2017 Update

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop, adopt, and update natural hazard mitigation plans to receive certain federal assistance, and

WHEREAS, a Mitigation Advisory Committee (“MAC”), a subcommittee of the Northern Neck Local Emergency Planning Committee comprised of representatives from the Counties of Lancaster, Northumberland, Richmond, and Westmoreland, and the Towns of Colonial Beach, Irvington, Kilmarnock, Montross, Warsaw, and White Stone was convened to study the Northern Neck Planning District Commission region’s risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on this region; and

WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the HMTAC to update the *Northern Neck Regional Hazard Mitigation Plan 2011 Update* for the Northern Neck Planning District Commission and it’s jurisdictions; and

WHEREAS, the efforts of the MAC members and the consulting firm Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in an update of the *Northern Neck Regional Hazard Mitigation Plan 2011 Update*, including (*local jurisdiction name*) during the planning process.

NOW THEREFORE, BE IT RESOLVED by the (*governing body name*) that the *Northern Neck Multi-Jurisdictional Hazard Mitigation Plan 2017 Update* dated (   ) is hereby approved and adopted for (*jurisdiction name*).

ADOPTED by the (jurisdiction) this ___ day of ___________________, 2017.

APPROVED:

____
(Jurisdiction head of governing body)

ATTEST:

____
(Jurisdiction Clerk)

Affix Clerk’s Seal

Appendix G: Redacted Materials

G.1 Repetitive Loss Properties

G.2 Critical Facilities Maps by Type

G.3 Critical Facilities Maps by County

G.4 Critical Facilities Maps by Summary

G.1 Repetitive Loss Properties

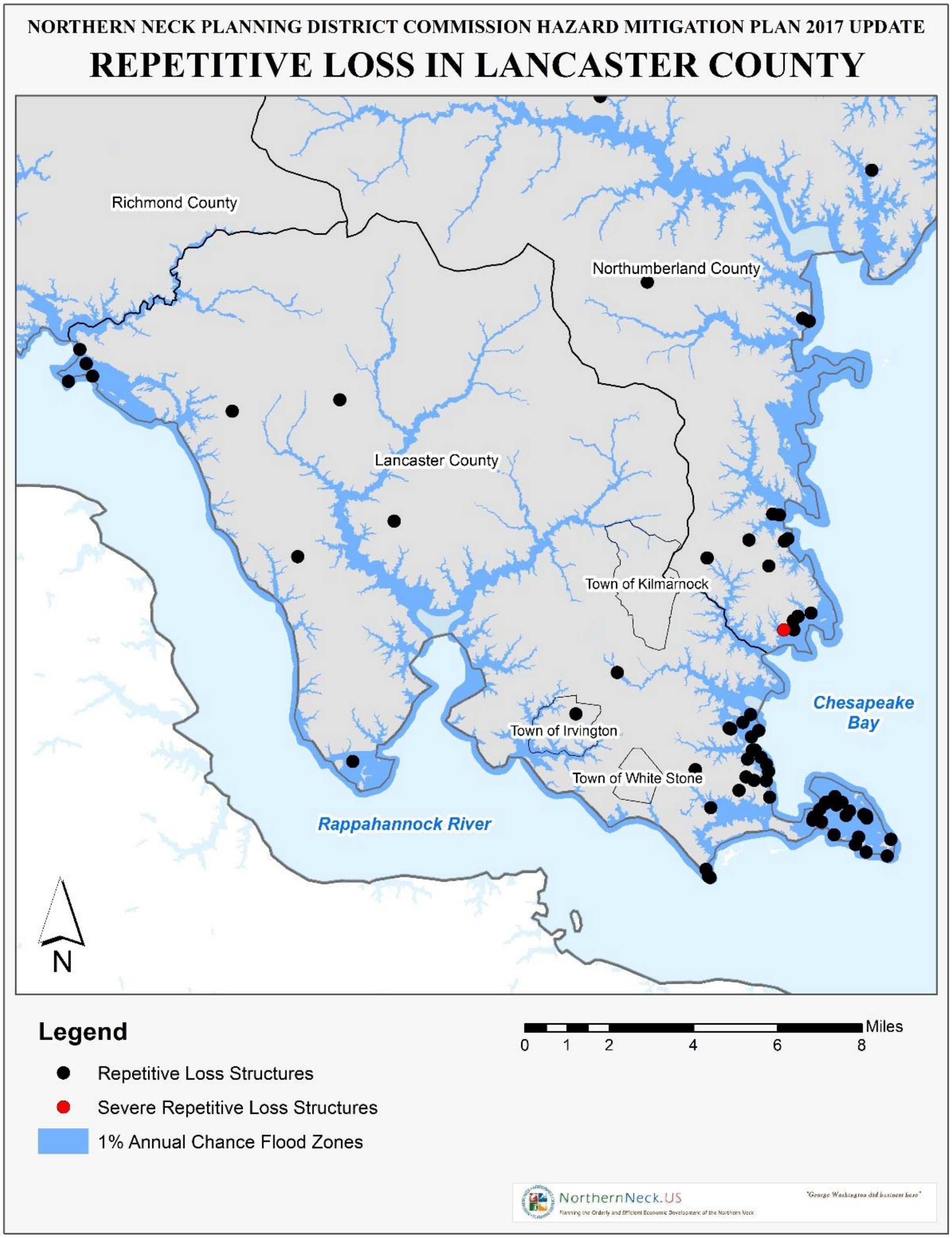


Figure Error! No text of specified style in document.**-1. Repetitive Loss Properties in Lancaster County**

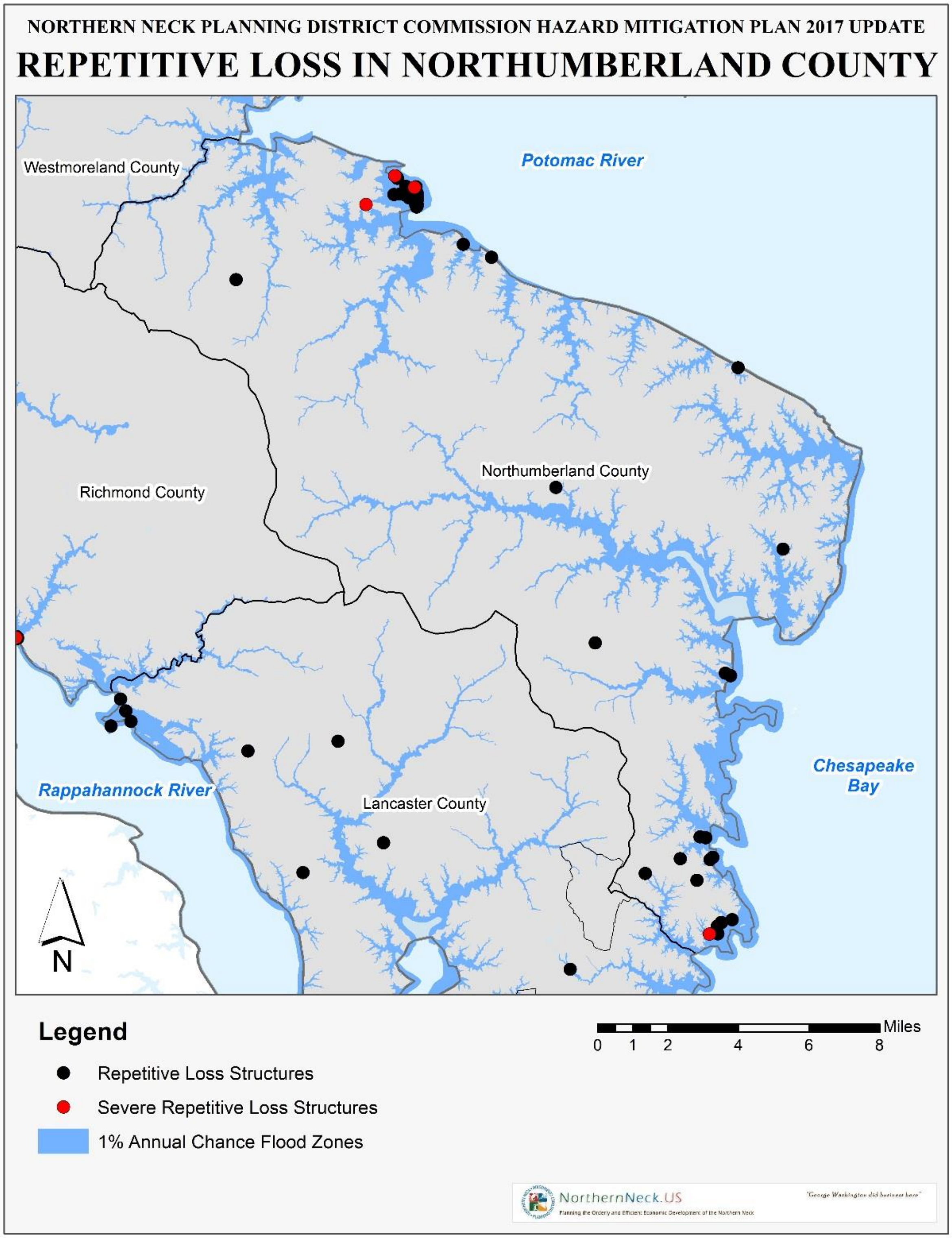


Figure Error! No text of specified style in document.**-2. Repetitive Loss Properties in Northumberland County**

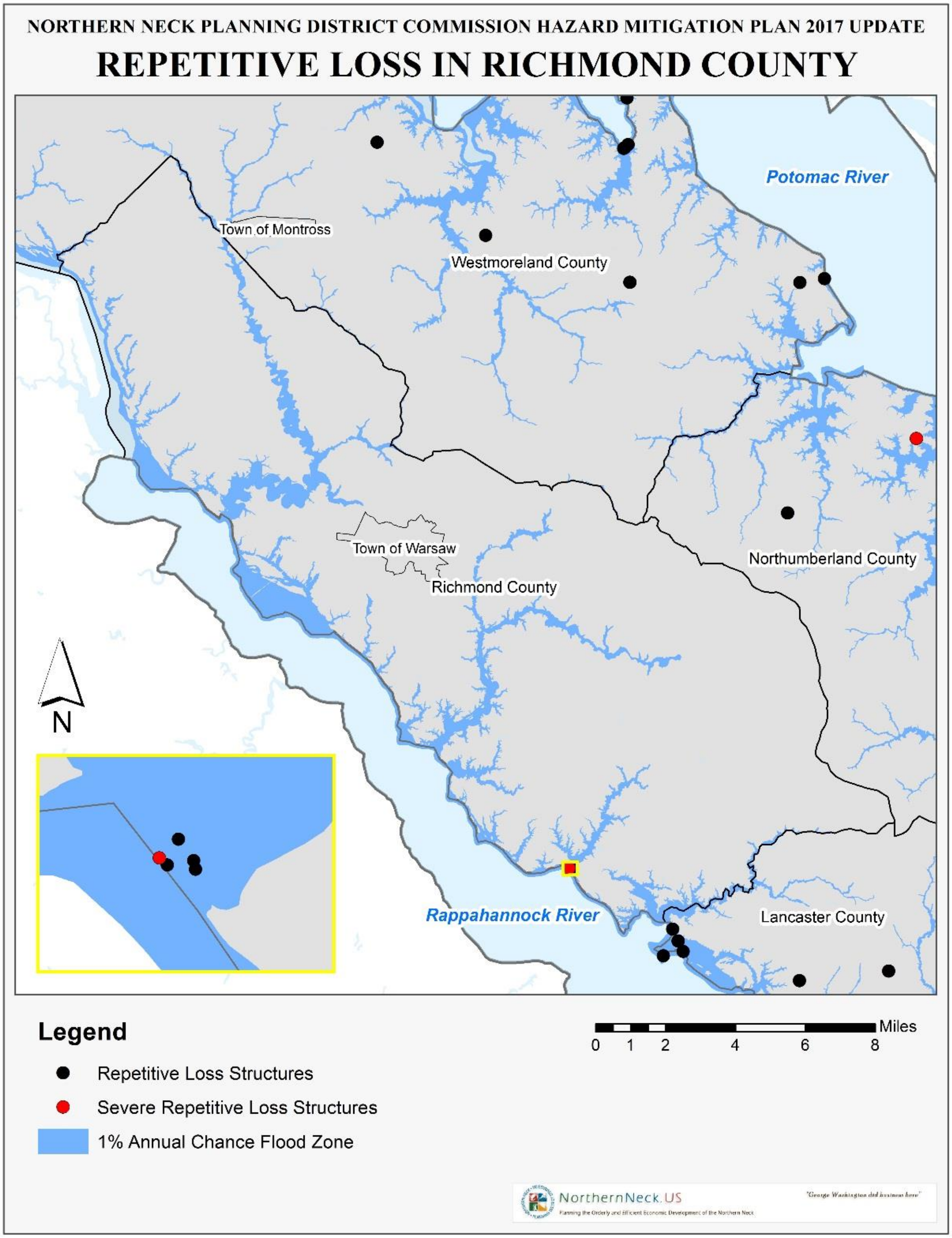


Figure Error! No text of specified style in document.**-3. Repetitive Loss Properties in Richmond County**

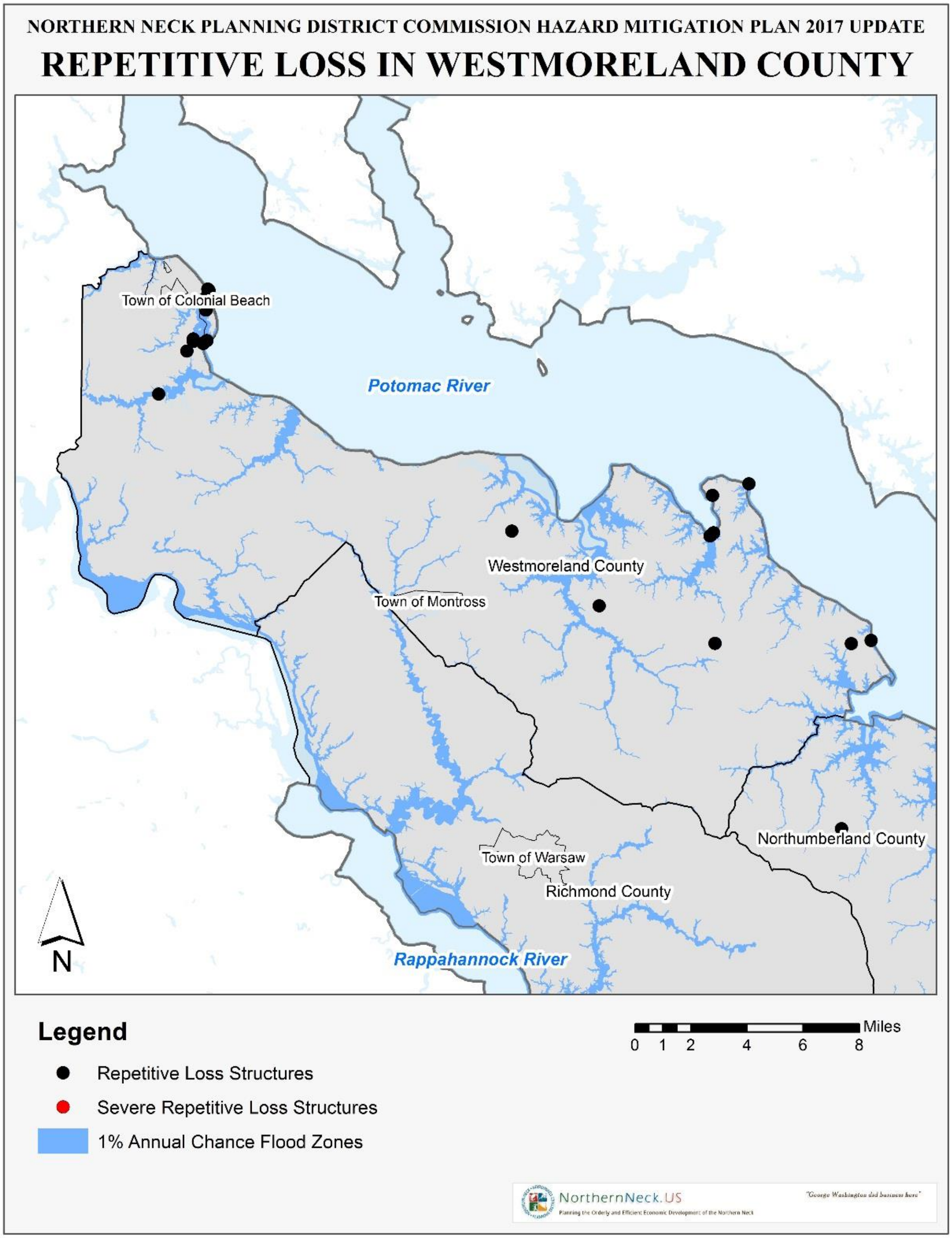


Figure Error! No text of specified style in document.**-4. Repetitive Loss Properties in Westmoreland County**

G.2 Critical Facilities Maps by Type

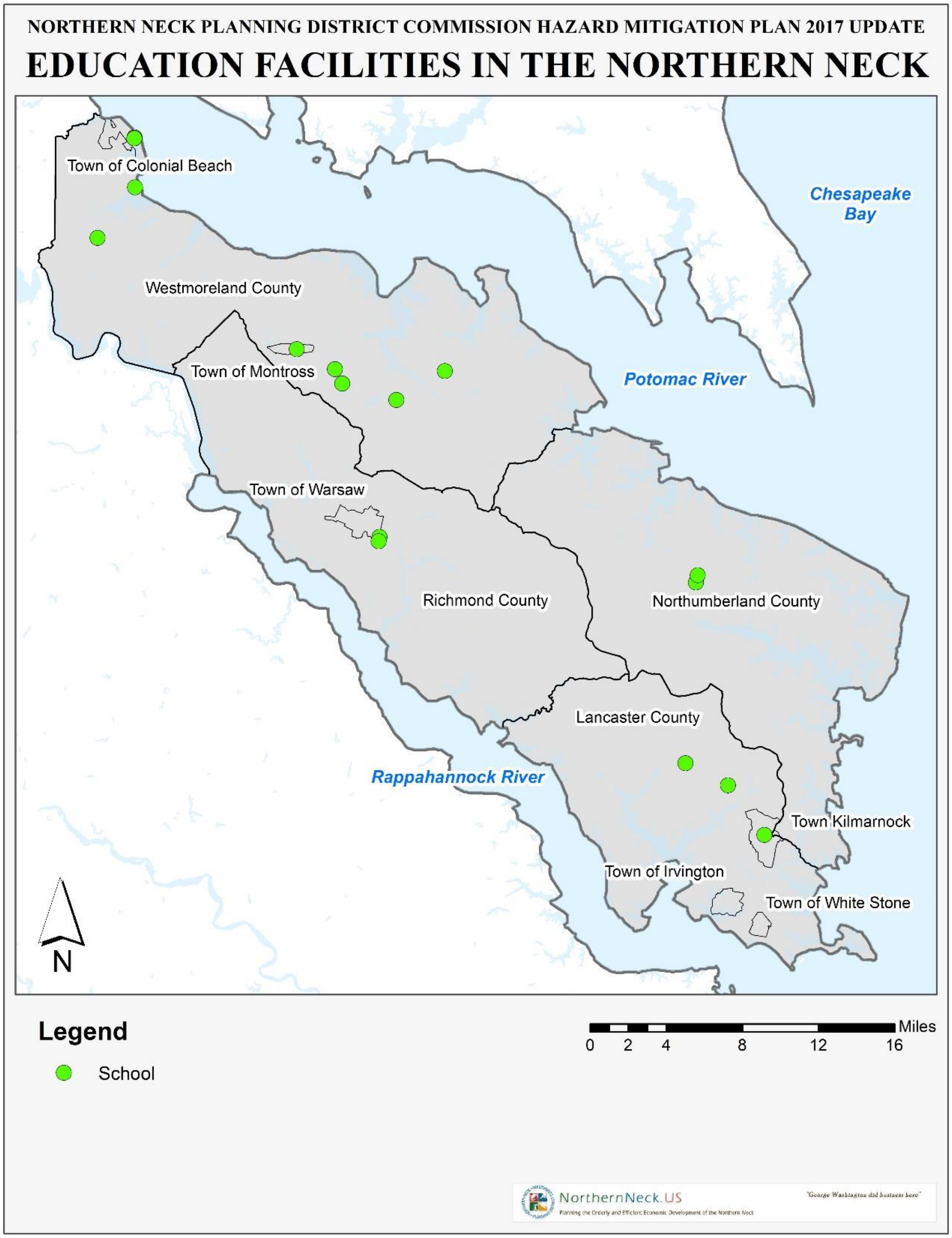


Figure Error! No text of specified style in document.**-5. Education Facilities in the Northern Neck**

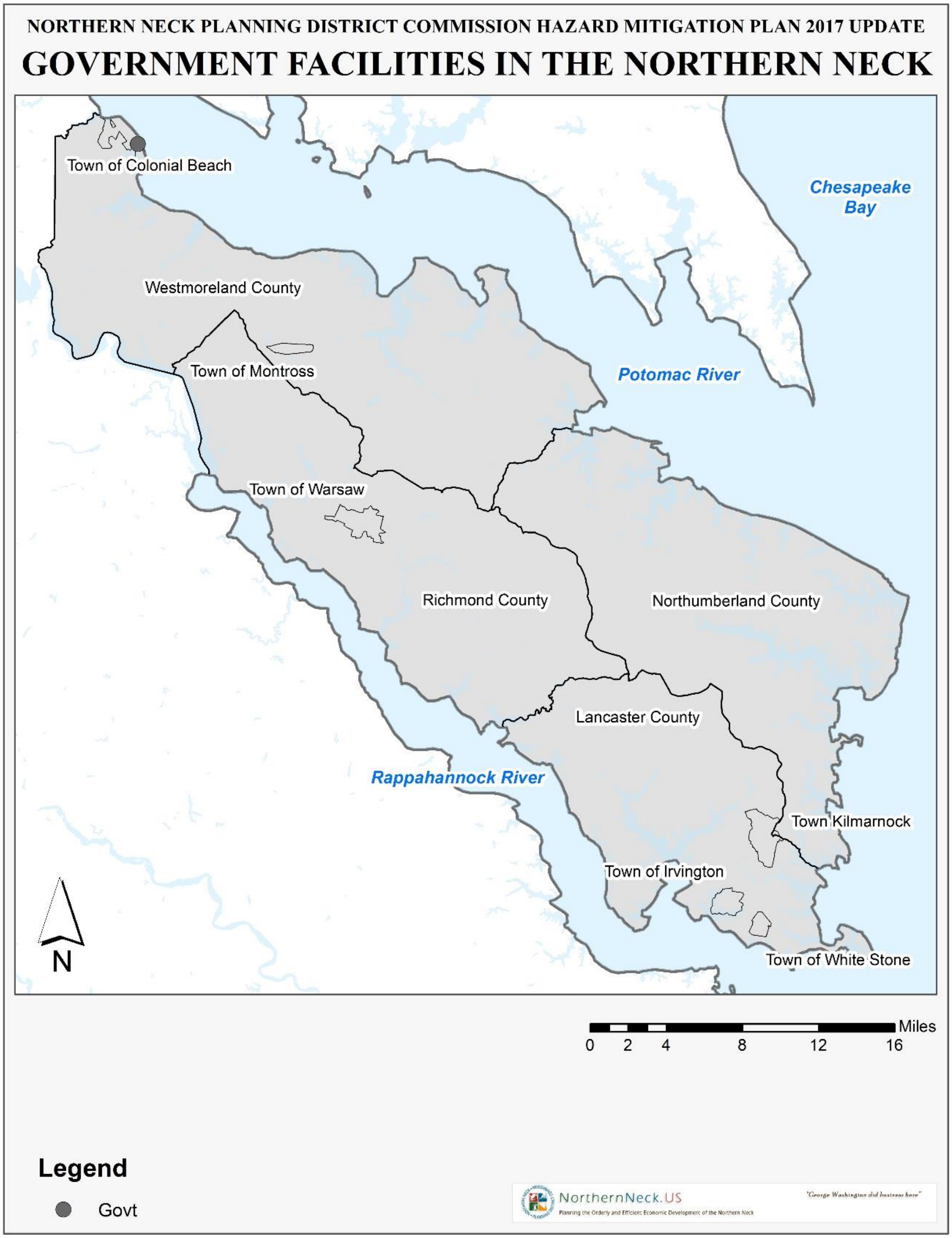


Figure Error! No text of specified style in document.**-6. Government Facilities in the Northern Neck**

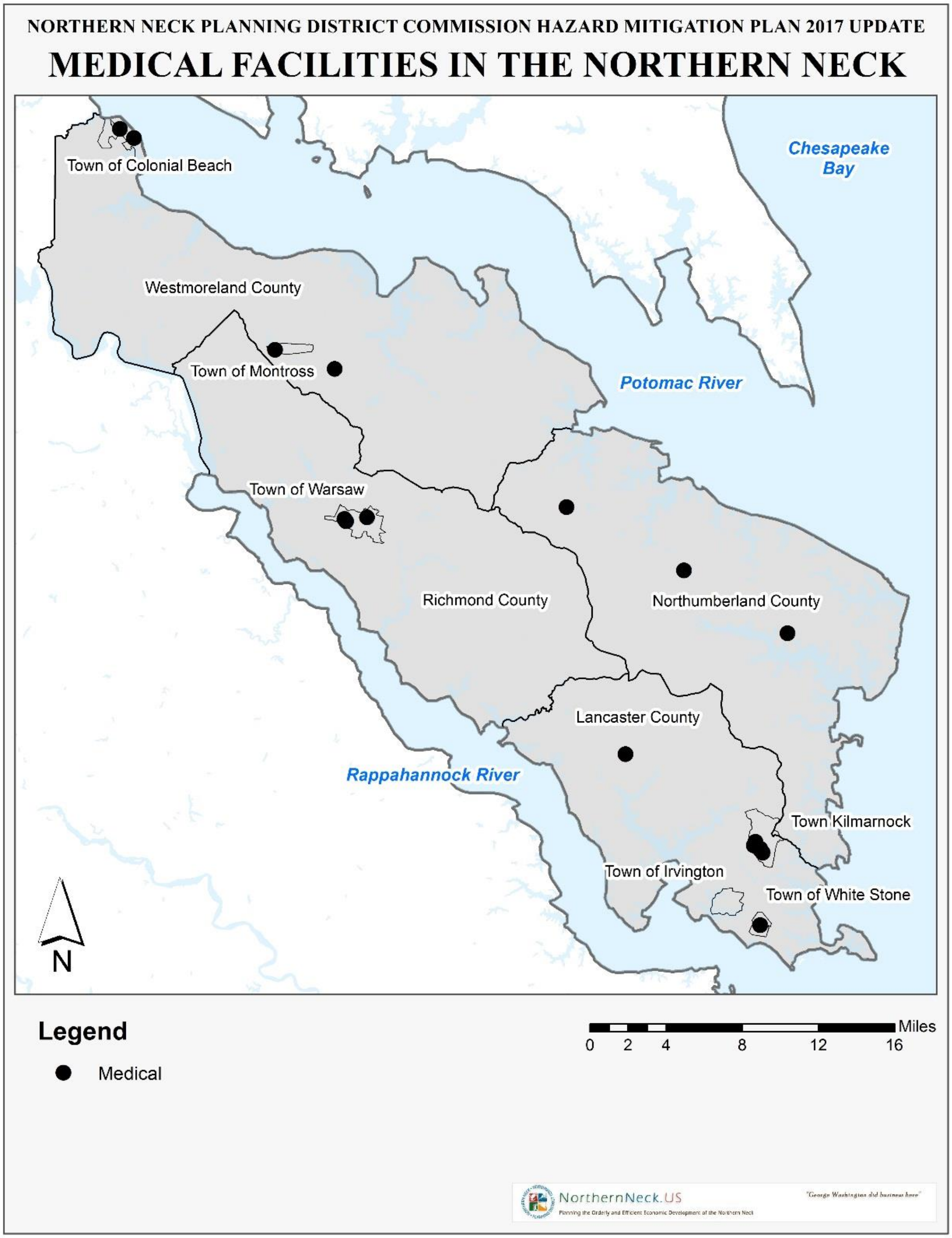


Figure Error! No text of specified style in document.**-7. Medical Facilities in the Northern Neck**

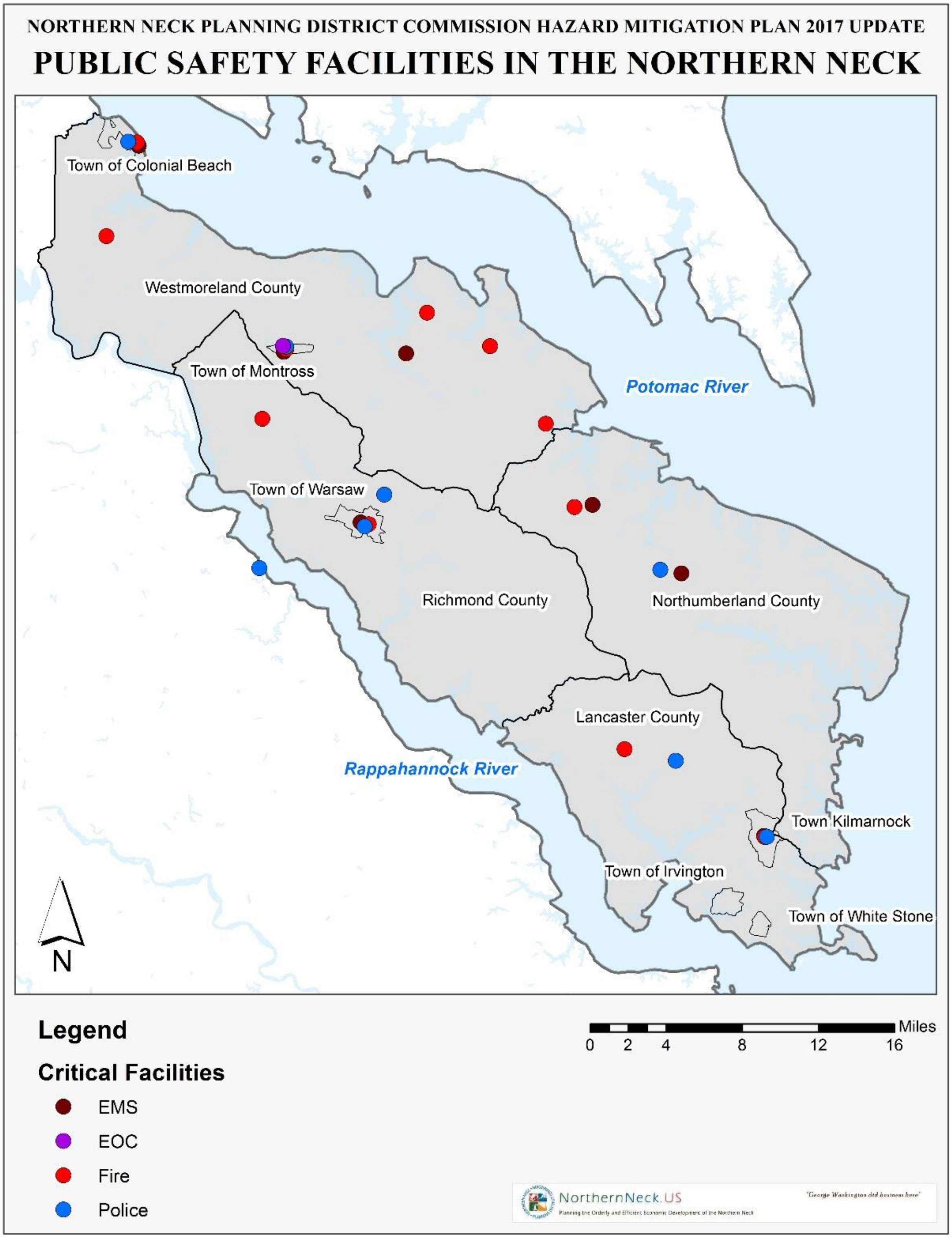


Figure Error! No text of specified style in document.**-8. Public Safety Facilities in the Northern Neck**

Figure Error! No text of specified style in document.**-9. Utility Facilities in the Northern Neck**

G.3 Critical Facilities Maps by County

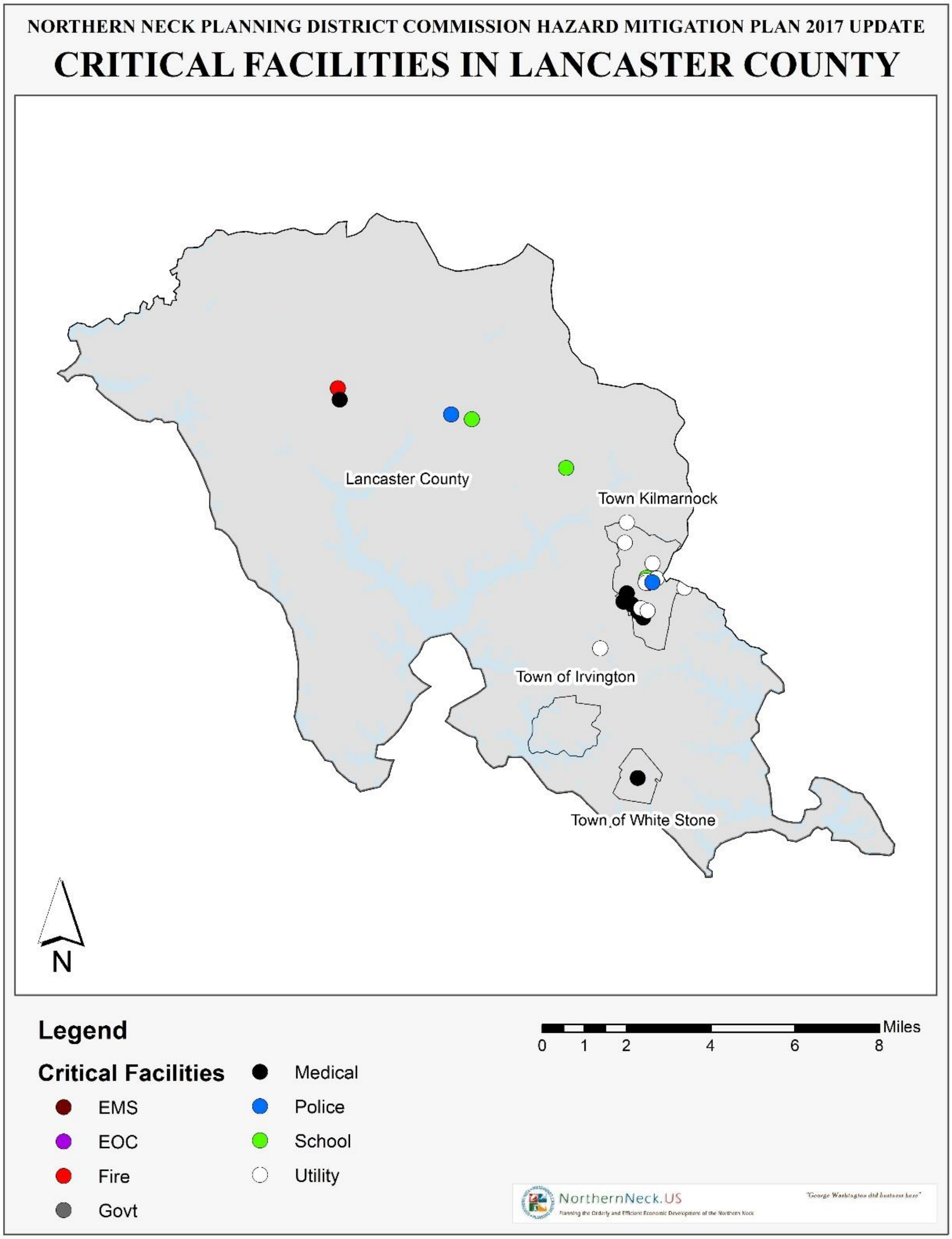


Figure Error! No text of specified style in document.**-10. Critical Facilities in Lancaster County**

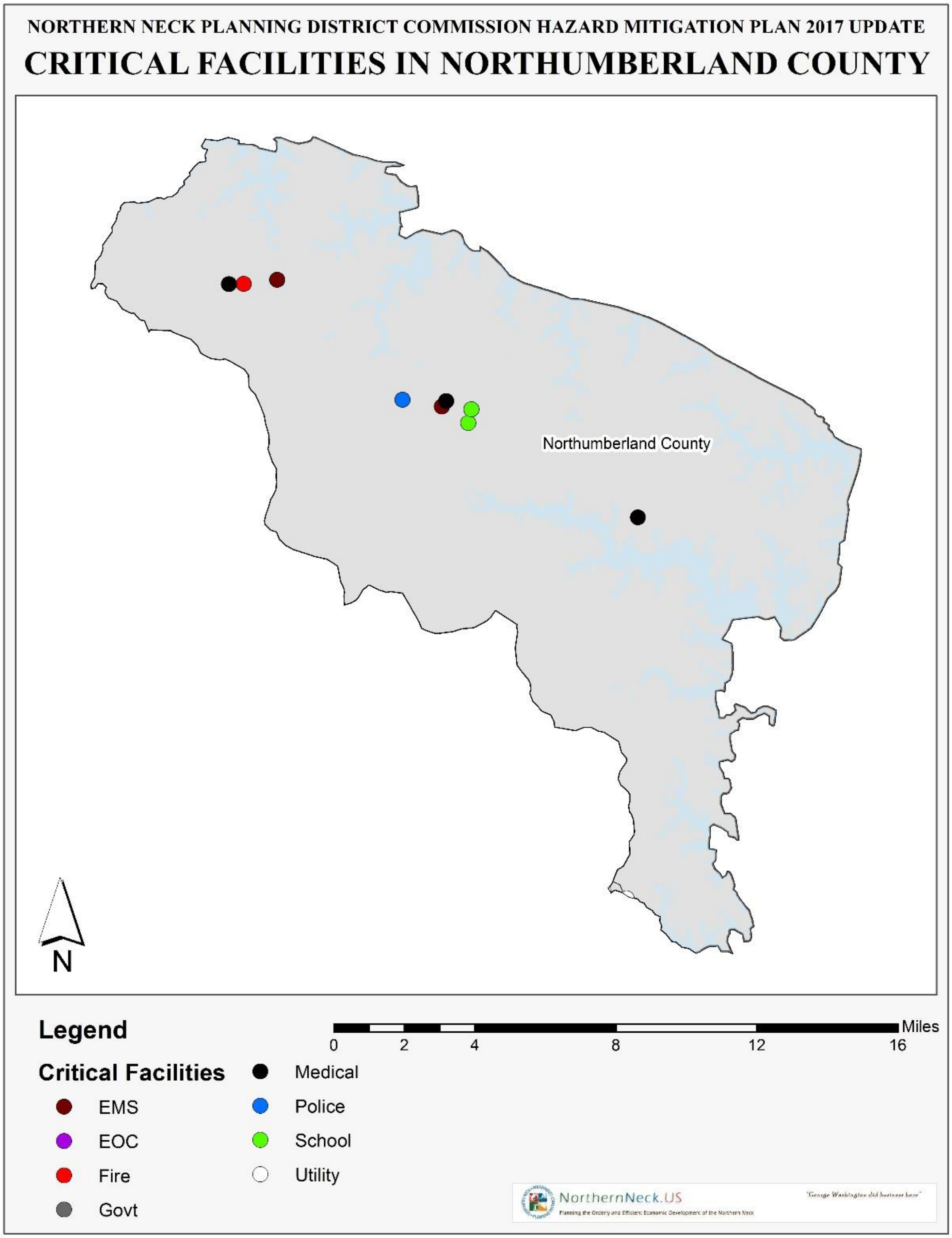


Figure Error! No text of specified style in document.**-11. Critical Facilities in Northumberland County**

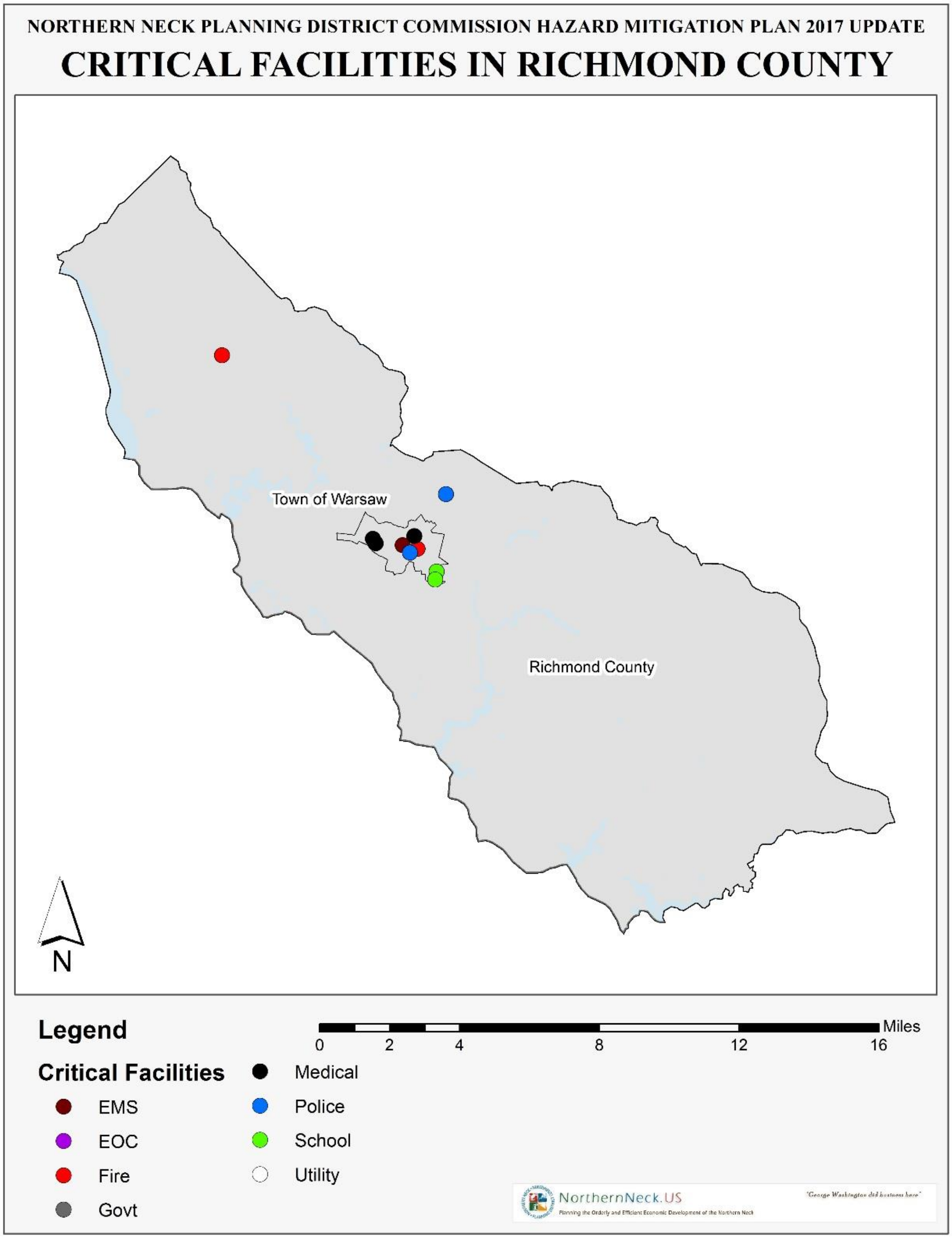


Figure Error! No text of specified style in document.**-12. Critical Facilities in Richmond County**

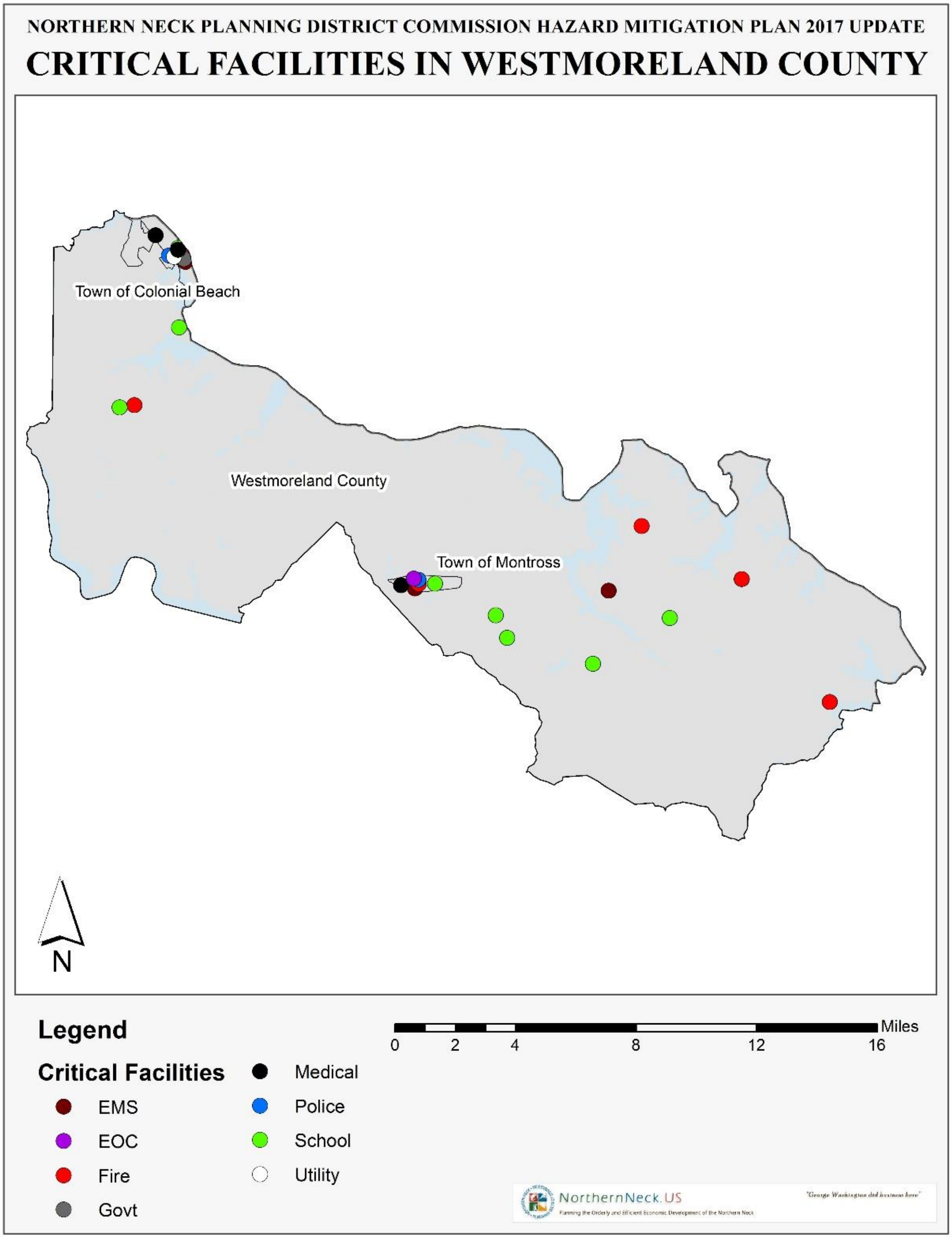


Figure Error! No text of specified style in document.**-13. Critical Facilities in Westmoreland County**

G.4 Critical Facilities Summary

Table 1. Critical Facilities Hazard Exposure Summary

Name	Address	Facility Type	FEMA Flood Zone	Wildland Urban Interface Zone
Callao Medical Arts	17452 Richmond Rd, Callao, VA 22435	Medical	X	Intermix
Callao Rescue Squad Inc	1348 Northumberland Hwy, Callao, VA 22435	EMS	X	Non-Vegetated
Callao Volunteer Fire Department	314 Northumberland Hwy, Callao, VA 22435	Fire	X	Intermix
Carousel Physical Therapy - Kilmarnock, VA	500 Irvington Rd, Kilmarnock, VA 22482	Medical	X	Intermix
Chesapeake Medical Group	95 Harris Rd, Kilmarnock, VA 22482	Medical	X	Intermix
Chesapeake Medical Group	95 Harris Rd, Kilmarnock, VA 22482	Medical	X	Intermix
Chesapeake Medical Group Kilmarnock Family Practice	86 Harris Rd, Kilmarnock, VA 22482	Medical	X	Interface
Chesapeake Medical Group: Daniel Bonnie E MD	8152 Northumberland Hwy, Heathsville, VA 22473	Medical	X	Intermix
Christine Collins, NP - Bon Secours Lively Medical Center	22507, 36 Lively Oaks Rd, Lively, VA 22507	Medical	X	Intermix
Colonial Beach Elementary School	102 First Street, Colonial Beach, VA 22443	School	X	Interface
Colonial Beach High School	100 First Street, Colonial Beach, VA 22443	School	X	Interface
Colonial Beach Medical Center: Dunn Richard MD	16 Delfae Dr, Warsaw, VA 22572	Medical	X	Interface
Colonial Beach Police Department	907 McKinney Blvd, Colonial Beach, VA 22443	Police	X	Interface
Colonial Beach Rescue Squad	225 Dennison St, Colonial Beach, VA 22443	EMS	AE	Interface
Colonial Beach Vol. Fire Department	312 Colonial Ave, Colonial Beach, VA 22443	Fire	X	Interface
Complete Care Medical Group	41, Peach Grove Ln, Montross, VA 22520	Medical	X	Intermix
Cople District Volunteer Fire Dept. Substation	5238 Tucker Hill Road, Hague, VA 22469	Fire	X	Non-Vegetated
Cople Elementary School	7114 Cople Highway, Hague, VA 22469	School	X	Intermix
Daymark Recovery Services	360917 VA-3, White Stone, VA 22578	Medical	X	Intermix
Gateway Private School	2054 Neenah Rd, Colonial Beach, VA 22443	School	X	Interface
Johnson High School	18849 Kings Hwy, Montross, VA 22520	School	X	Intermix
Kilmarnock Volunteer Fire Department	71 School St, Kilmarnock, VA 22482	Fire	X	Interface
Kilmarnock Volunteer Rescue Squad	Harris Rd, Kilmarnock, VA 22482	EMS	X	Interface
Kinsale Fire Department	123 Yeocomico Ln, Kinsale, VA 22488	Fire	X	Intermix

Name	Address	Facility Type	FEMA Flood Zone	Wildland Urban Interface Zone
Lancaster County Sheriff	8293 Mary Ball Rd, Lancaster, VA 22503	Police	X	Vegetated
Lancaster High School	8815 Mary Ball Rd, Lancaster, VA 22503	School	X	Vegetated
Lancaster Middle School	191 School St, Kilmarnock, VA 22482	School	X	Intermix
Lancaster Primary	36 Primary School Cir, Lancaster, VA 22503	School	X	Interface
Mary Washington Health Center	2400 McKinney Blvd., Colonial Beach, VA 22443	Medical	X	Interface
Mid-County Rescue Squad	7990 Northumberland Hwy, Heathsville, VA 22473	EMS	X	Intermix
Middle Peninsula Northern Neck	414 Main St, Warsaw, VA 22572	Medical	X	Interface
Middlesex County Volunteer Rescue Squad	17684 General Puller Hwy, Deltaville, VA 23043	EMS	NA	Intermix
Monroe Bay Christian Academy	903 Holly Vista, Colonial Beach, VA 22443	School	X	Interface
Montross Middle School	8884 Menokin Road, Montross, VA 22520	School	X	Intermix
Montross Volunteer Rescue Squad	72 Lyells St, Montross, VA 22520	EMS	X	Intermix
Northern Neck - Middlesex Free Health Clinic	51 William B Graham Ct, Kilmarnock, VA 22482	Medical	X	Intermix
Northumberland Elementary School	757 Academic Ln, Heathsville, VA 22473	School	X	Intermix
Northumberland High School	201 Academic Ln, Heathsville, VA 22473	School	X	Intermix
Northumberland Sheriff Office	76 Judicial Place, Heathsville, VA 22473	Police	X	Intermix
Oak Grove Volunteer Fire Department	121 James Monroe Hwy, Colonial Beach, VA 22443	Fire	X	Vegetated
Rappahannock General Hospital	101 Harris Rd, Kilmarnock, VA 22482	Medical	X	Intermix
Rappahannock High School	6914 Richmond Road, Warsaw, VA 22572	School	X	Interface
Richmond County Elementary/Middle School	361 Walnut Street, Warsaw, VA 22572	School	X	Interface
Richmond County Rescue Squad	Main Street, Warsaw, VA 22572	EMS	X	Interface
Richmond County Sheriff's Office/Animal Control	106 Wallace St, Warsaw, VA 22572	Police	X	Non-Vegetated
Richmond County Volunteer Fire	587 County Bridge Rd, Warsaw, VA 22572	Fire	X	Vegetated
Richmond County Volunteer Fire Department, Engine Company 1	123 Pine St, Warsaw, VA 22572	Fire	X	Interface
Riverside Bay Harbor Medical Center	Burgess, VA 22432	Medical	X	Vegetated
Riverside Warsaw Medical Arts	16 Delfae Dr, Warsaw, VA 22572	Medical	X	Interface
Tappahannock Police Department	315 Duke St, Tappahannock, VA 22560	Police	NA	Non-Vegetated

Name	Address	Facility Type	FEMA Flood Zone	Wildland Urban Interface Zone
Town of Colonial Beach Cell Tower	2301 McKinney Bldv., Colonial Beach, VA 22443	Utility	X	Interface
Town of Colonial Beach Fuel Tanks	700 Colonial Ave., Colonial Beach, VA 22443	Utility	X	Interface
Town of Colonial Beach Town Hall	315 Douglas Ave., Colonial Beach, VA 22443	Govt	X	Interface
Town of Colonial Beach Wastewater Treatment Plant	2301 McKinney Bldv., Colonial Beach, VA 22443	Utility	X	Interface
Town of Kilmarnock Police Department	1 N. Main ST, Kilmarnock, VA 22482	Police	X	Interface
Town of Kilmarnock Sewer Pump Station, Grace Hill	638 Pleasants Ln, Kilmarnock, VA 22482	Utility	X	Interface
Town of Kilmarnock Sewer Pump Station, Harvey	285 Fox Hill Dr, Kilmarnock, VA 22482	Utility	X	Intermix
Town of Kilmarnock Sewer Pump Station, Hills Qrtrs	552 Middle Gate, Irvington, VA 22480	Utility	X	Intermix
Town of Kilmarnock Sewer Pump Station, Norris pond	770 N. Main ST, Kilmarnock, VA 22482	Utility	X	Non-Vegetated
Town of Kilmarnock Sewer Pump Station, School ST	85 School ST, Kilmarnock, VA 22482	Utility	X	Intermix
Town of Kilmarnock Sewer Pump Station, Wiggins	186 Wiggins Ave, Kilmarnock, VA 22482	Utility	X	Intermix
Town of Kilmarnock Wastewater Treatment Plant	161 Mac's Pond Ln, Kilmarnock, VA 22482	Utility	X	Intermix
Town of Kilmarnock Water Tank and Well #2 Church ST	79 E. Church ST, Kilmarnock, VA 22482	Utility	X	Interface
Town of Kilmarnock Water Tank and Well #3 RGH	99 Harris RD, Kilmarnock, VA 22482	Utility	X	Intermix
Town of Kilmarnock Water Tank and Well #4 Radio	215 Hawthorne Ave, Kilmarnock, VA 22482	Utility	X	Non-Vegetated
U.S. Renal Care - Warsaw Dialysis & Home Dialysis	4709 Richmond Rd, Warsaw, VA 22572	Medical	X	Non-Vegetated
Upper lancaster vol fire dept	5123 Mary Ball Rd, Lancaster, VA 22503	Fire	X	Intermix
Virginia State Police	16835 History Land Hwy, Warsaw, VA 22572	Police	X	Non-Vegetated
Virginia Women's Center	102 DMV Dr, Kilmarnock, VA 22482	Medical	X	Intermix
Washington & Lee High School	16380 Kings Highway, Montross, VA 22520	School	X	Interface
Washington District Elementary School	454 Oak Grove Road, Colonial Beach, VA 22443	School	X	Intermix
Westmoreland County Administration/George D. English Building	111 Polk Street Montross, VA 22520	EOC	X	Interface
Westmoreland County Jail	105 Court Square, Montross, VA 22520	Police	X	Interface

Name	Address	Facility Type	FEMA Flood Zone	Wildland Urban Interface Zone
Westmoreland County Rescue	65 Mt Holly Rd, Mt Holly, VA 22524	EMS	X	Intermix
Westmoreland County Sheriff's Office	111 Polk St, Montross, VA 22520	Police	X	Interface
Westmoreland Fire Dept	52 Rectory Rd, Montross, VA 22520	Fire	X	Interface
Westmoreland Medical Center	18849 Kings Hwy, Montross, VA 22520	Medical	X	Intermix
Westmoreland Rehabilitation & Healthcare	2400 McKinney Blvd, Colonial Beach, VA 22520	Medical	X	Interface
Westmoreland Volunteer Fire Dept Substation	2429 Mt. Holly Road Montross, VA 22520	Fire	X	Intermix
Woodland Academy	2054 Neenah Rd, Montross, VA 22520	School	X	Interface

Appendix H: List of Abbreviated Terms

List of Abbreviations

BFE	Base Flood Elevation
CIP	Capital Improvement Program
COOP	Continuity of Operations
CRS	Community Rating System
DFIRM	Digital Flood Insurance Rate Map
DMA	Disaster Mitigation Act
EAS	Emergency Alert System
EF Scale	Enhanced Fujita Scale
EMS	Emergency Medical Services
EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Maps
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
HAZUS-MH	FEMA's loss estimating software for floods, earthquakes, and hurricane winds
HIRA	Hazard Identification and Risk Assessment
HMGP	Hazard Mitigation Grant Program
MAC	Mitigation Advisory Committee
NCDC	National Climatic Data Center
NFHL	National Flood Hazard Layer
NFIP	National Flood Insurance Program
NLCD	National Land Cover Data
NOAA	National Oceanic Atmospheric and Atmospheric Administration
NWS	National Weather Service
PDC	Planning District Commission
PRISM	Parameter-elevation Regressions on Independent Slopes Model
Risk MAP	Risk Mapping, Assessment, and Planning
RL	repetitive loss
SFHA	Special Flood Hazard Area
SRL	severe repetitive loss
STAPLE/E	Social, Technical, Administrative, Political, Legal, Economic, and Environmental
UASI	Urban Areas Security Initiative
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VA DCR	Virginia Department of Conservation and Recreation
VDEM	Virginia Department of Emergency Management
VDOF	Virginia Department of Forestry
VDOT	Virginia Department of Transportation

Appendix I: Capability Assessment Summary

Northern Neck Planning District Commission Mitigation Capability Matrix						
Programs and Capabilities	**NNPDC**	**Lancaster County**	**Northumberland County**	**Richmond County**	**Westmoreland County**	**Town of Colonial Beach**
Comprehensive Plan		Y	Y	Y	Y	Y
With Hazard Mitigation Element	Advisor	Y	Y	Y	Y	Y
Adoption		Oct. 2013	Nov.2016	Jul. 2013	Dec.2010	May 2017
With Coastal Protection Element		Y	Y	Y	Y	Y
Capital Improvement Plan	Advisor	Y	Y	Y	Y	Y
Economic Development Plan (2013 - 2018)	Y	N	Y	N	N	Y
Downtown Development/Re-Development Authority Plans	Advisor	Y		Y	Y	Y
Enterprise Zones	Advisor	Y		Y		
Transportation Planning	VDOT/PDC	N/A	N/A	N/A	N/A	N/A
Subdivision Regulations	N/A	Y	Y	Y	Y	Y
Zoning Ordinance	N/A	Y	Y	Y	Y	Y
Site Plan Review Procedures		Y	Y	Y	Y	Y
Building Code (or ordinance) addresses flood	N/A	Y	Y	Y	Y	Y
Designated Building Official		Y	Y	Y	Y	Y
Regular Inspection Protocols		Y	Y	Y	Y	Y
Mitigation Projects						
Private Residential Elevations (self-financed)	N/A	Y	Y	Y	Y	Y
Resident and Community Outreach Inc. Ready.gov	Y	Y	Y	Y	Y	Y
Exclude critical infrastructure from SFHA	N/A	Y	Y	Y	Y	Y
Elevate Residences or Property Protection through HMA grants	Y	Y	Y	Y[1]	N/A	N/A
Natural Systems Protection						
Natural or Cultural Resources Inventory		Y	Y	Y	Y	Y
Open Space	N/A	Y	Y		Y	Y
Parks and Recreation		Y	Y	Y	Y	Y
Living Shorelines Program	Y	Y	Y	Y	Y	Y
Stormwater Management and Water Quality Programs	N/A					Y
Total Daily Maximum Load (TMDL) Stream Segments**		Y[2]	Y[3]	Y	Y	Y[4]
Watershed Improvement Plans***	Y	Y	Y	Y	Y	Y
Erosion or Sediment Control Program	N/A	Y	Y	Y	Y	Y
Erosion and Sediment Control Ordinances		Y	Y	Y	Y	Y
Floodplain Management	N/A					
Floodplain Administrator		Y	Y	Y	Y	Y
Participates in NFIP		Y	Y	Y	Y	Y
Year Joined NFIP		3/4/1988	7/4/1989	3/16/1989	9/18/1987	9/18/1987
Effective FIRM Date		10/2/2014	2/18/2015	4/16/2015	4/16/2015	4/16/2015
Additional Freeboard Requirements (inches)		N/A	12" *	N/A	18"	12"
LiMWA standards in High Hazard Coastal Areas		Y	Y			
Participates in CRS		N	N	N	N	N
Emergency Operations Management	LEPC	Y	Y	Y	Y	Y
Emergency Operations Plan	2011	Y	Y	Y	Y	Y

Northern Neck Planning District Commission Mitigation Capability Matrix						
Programs and Capabilities	**NNPDC**	**Lancaster County**	**Northumberland County**	**Richmond County**	**Westmoreland County**	**Town of Colonial Beach**
Local Government EOPs	VDEM advisor	Y	Y	Y	Y	Y
Warning Sirens or warning alert systems		Y	Y	Y	Y	Y
Evacuation Plans		Y	Y	Y	Y	Y
Shelter and Family Re-Unification Plan		Y	Y	Y	Y	Y
Special Needs Population Emergency Planning		Y	Y	Y	Y	Y
Companion Animal Sheltering and Re-Unification Plan		Y	Y	Y	Y	Y
Dedicated Emergency Management Website	Y	Y	Y	Y	Y	Y
Education Programs	N/A	Y	Y	Y	Y	Y
School Facility Emergency Operations Plans		unknown	Y	Y	Y	unknown
School Emergency Notification, Evacuation and Emergency Planning		N	Y	unknown	Y	unknown
College Campus Plans		Y	N/A	Y	N/A	N/A
College/University Emergency Notification, Evacuation and Emergency Planning		Y	N/A	Y	N/A	N/A
Tourism	Y[5]	Y	Y	Y	Y	Y
Additional Capabilities			Debris Mgmt. Plan		Debris Mgmt. Plan	

Note: many functions for towns are performed by their County

N/A - not applicable.

1. Richmond County FY16 FMA application in progress.
2. Greenvale, Paynes, and Beach Creeks (Bacteria) TMDL study completed and implementation plan approved.
3. Coan Mill Stream (Dissolved Oxygen) listed as needing a TMDL study.
4. Monroe Creek identified as impaired stream segment as part of a baseline and TMDL PDB loads study.
5. Includes historic preservation protection; promotion of historic and natural site visitation.

* Northumberland County VE zone Freeboard is 24".

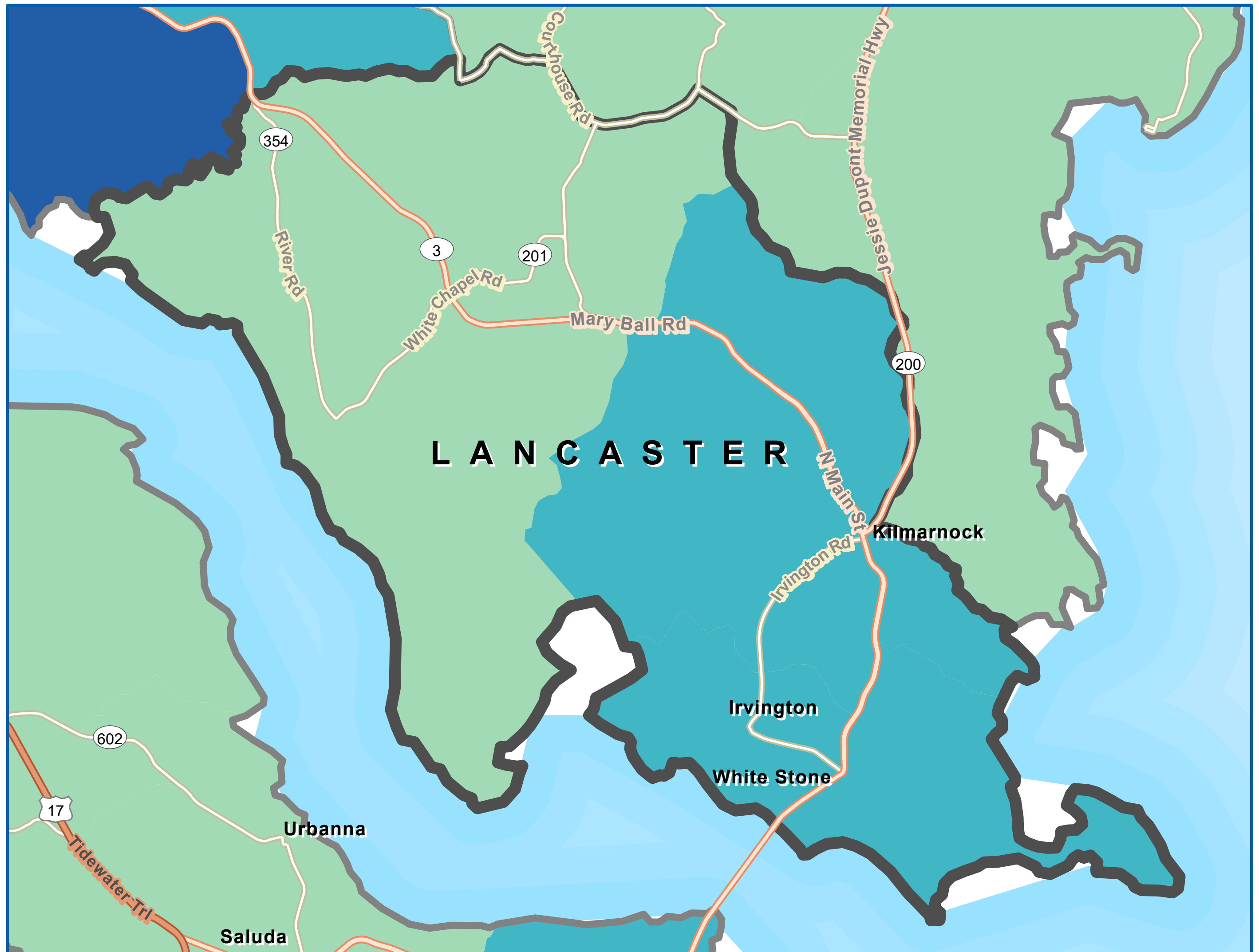
**All stream segments in each county are a part of the Chesapeake Bay Total Daily Maximum Load (TMDL) monitoring area.

***All stream segments part of the Chesapeake Bay WIP.

CDC Social Vulnerability Index 2018

Lancaster County, Virginia

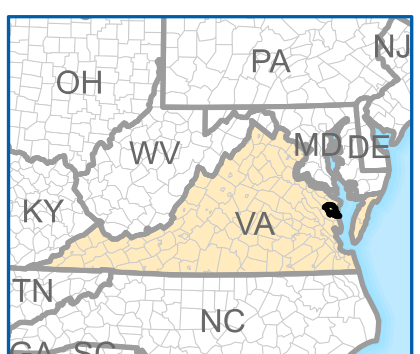
Overall Social Vulnerability[1]



Highest (Top 4th) — Vulnerability (SVI 2018)[2] — Lowest (Bottom 4th)

Data Unavailable[3]

0 0.75 1.5 3 4.5 Miles



Social vulnerability refers to a community's capacity to prepare for and respond to the stress of hazardous events ranging from natural disasters, such as tornadoes or disease outbreaks, to human-caused threats, such as toxic chemical spills. The **CDC Social Vulnerability Index (CDC SVI 2018)**[4] **County Map** depicts the social vulnerability of communities, at census tract level, within a specified county. CDC SVI 2018 groups **fifteen census-derived factors** into **four themes** that summarize the extent to which the area is socially vulnerable to disaster. The factors include economic data as well as data regarding education, family characteristics, housing, language ability, ethnicity, and vehicle access. Overall Social Vulnerability combines all the variables to provide a comprehensive assessment.

MAP PRODUCED 3/18/2020

Agency for Toxic Substances and Disease Registry

Division of Toxicology and Human Health Sciences

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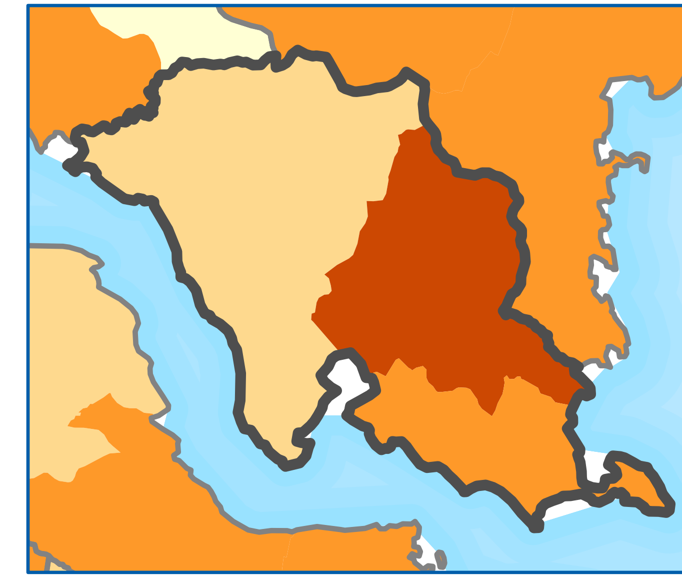
CDC SVI Themes

Socioeconomic Status[5]

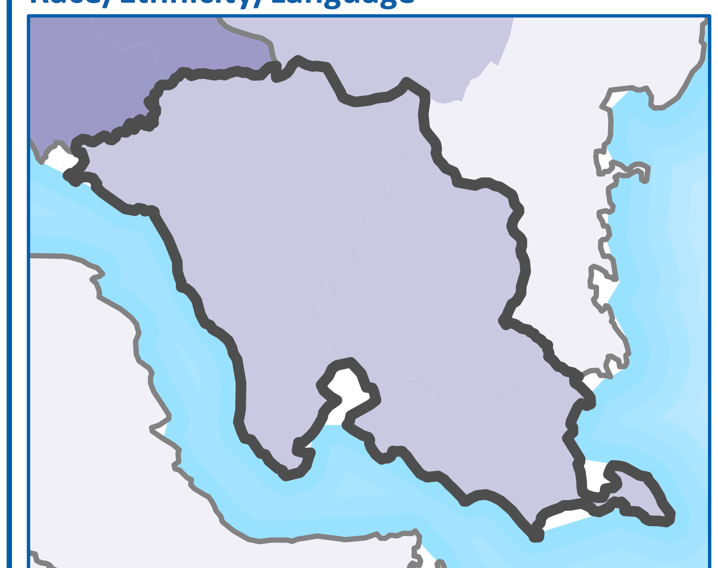
Highest (Top 4th) — Vulnerability (SVI 2018)[2] — Lowest (Bottom 4th)

Household Composition/Disability[6]



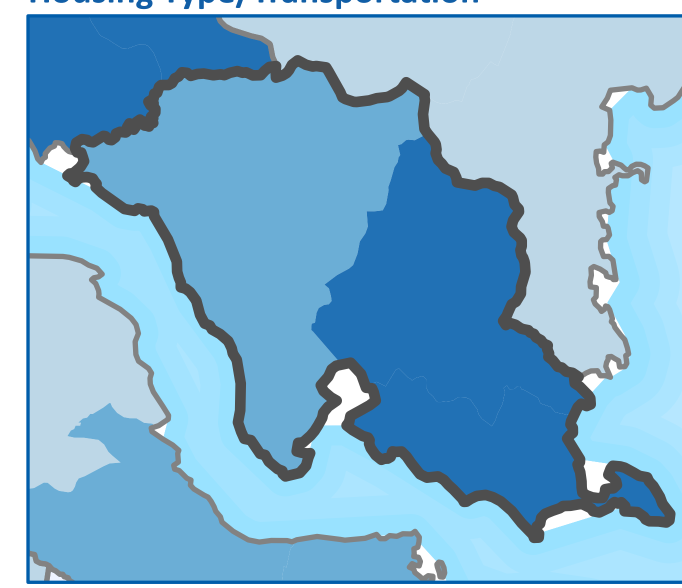
Highest (Top 4th) — Vulnerability (SVI 2018)[2] — Lowest (Bottom 4th)

Race/Ethnicity/Language[7]



Highest (Top 4th) — Vulnerability (SVI 2018)[2] — Lowest (Bottom 4th)

Housing Type/Transportation[8]



Highest (Top 4th) — Vulnerability (SVI 2018)[2] — Lowest (Bottom 4th)

Data Sources: [2]CDC/ATSDR/GRASP, U.S. Census Bureau, Esri® StreetMapTM Premium.

Notes: [1]Overall Social Vulnerability: All 15 variables. [3]Census tracts with 0 population. [4]The CDC SVI combines percentile rankings of US Census American Community Survey (ACS) 2014-2018 variables, for the state, at the census tract level. [5]Socioeconomic Status: Poverty, Unemployed, Per Capita Income, No High School Diploma. [6]Household Composition/ Disability: Aged 65 and Over, Aged 17 and Younger, Single-parent Household, Aged 5 and over with a Disability. [7]Race/Ethnicity/Language: Minority, English Language Ability. [8]Housing Type/Transportation: Multi-unit, Mobile Homes, Crowding, No Vehicle, Group Quarters.

Projection: NAD 1983 Virginia Lambert.

References: Flanagan, B.E., et al., A Social Vulnerability Index for Disaster Management. *Journal of Homeland Security and Emergency Management*, 2011. 8(1).

CDC SVI web page: http://svi.cdc.gov.

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Northern Neck Regional Hazard Mitigation Plan 2017 Update
January 2018

Lancaster County

Town of Irvington

Town of Kilmarnock

Town of White Stone

Northumberland County

Richmond County

Town of Warsaw

Westmoreland County

Town of Colonial Beach

Town of Montross

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Table of Contents

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1.0 Executive Summary

1.1 Hazard Mitigation

Hazard mitigation is commonly defined as sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects. A hazard mitigation plan states the aspirations and specific courses of action that a community intends to follow to reduce vulnerability and exposure to future hazard events. These plans are formulated through a systematic process centered on the participation of citizens, businesses, public officials, and other community stakeholders.

A multi-jurisdictional hazard mitigation plan is the physical representation of a group of local jurisdictions' commitment to reduce risks from natural hazards. Local officials can refer to the plan in their day-to-day activities and in decisions regarding land use and planning decisions, regulation and ordinance creation and enforcement, granting permits, capital improvement investments, and other community initiatives. Additionally, multi-jurisdictional hazard mitigation plans can serve as the basis for states to prioritize future grant funding as it becomes available.

The *Northern Neck Regional Hazard Mitigation Plan 2017 Update* will continue to be a useful tool for all community stakeholders by increasing public awareness about local hazards and risks, and providing information about options and resources available to reduce those risks. Educating the public about potential hazards will help each jurisdiction protect itself against the effects of future hazards, and will enable informed decision-making regarding where to live, purchase property, or locate business.

The 2011 plan was updated during 2017 by the Northern Neck Planning District Commission. The 2017 version of the plan includes the most recent population, demographics, a review of all mitigation strategies, goals, and objectives, and a review and update of most maps.

1.2 Authority

Beginning in 2003, the Commonwealth of Virginia encouraged the twenty-one planning districts in the Commonwealth to take the lead on development of local hazard mitigation plans. These plans, which are required by the Disaster Mitigation Act of 2000 (DMA 2000), help local governments determine risks and vulnerabilities and identify projects to reduce these risks. The Northern Neck Regional Hazard Mitigation Plan was developed through the coordination of the Northern Neck Planning District Commission (NNPDC). It should be noted that the area covered by this plan includes the unincorporated areas of Lancaster, Northumberland, Richmond, and Westmoreland Counties. Towns included in this plan are Colonial Beach, Irvington, Kilmarnock, Montross, Warsaw, and White Stone.

The communities of the Northern Neck have established a Local Emergency Planning Committee (LEPC) to address local emergency management issues. Members of the LEPC are appointed by resolution by the counties. The mission of this committee was closely aligned to the needs of a Mitigation Advisory Committee. The planning district commission, therefore, decided to utilize the existing LEPC as its Mitigation Advisory Committee. Representatives included county administrators, planning directors, emergency services staff, school board officials, local non-profits and state agencies such as the Virginia Department of Transportation.

1.3 Planning Area

The Northern Neck is a coastal region that is situated within easy driving distance of the major urban centers of Richmond, Norfolk, and Northern Virginia. The region is bordered to the east by the Chesapeake Bay, and situated between the Potomac River to the north and the Rappahannock River to the south.

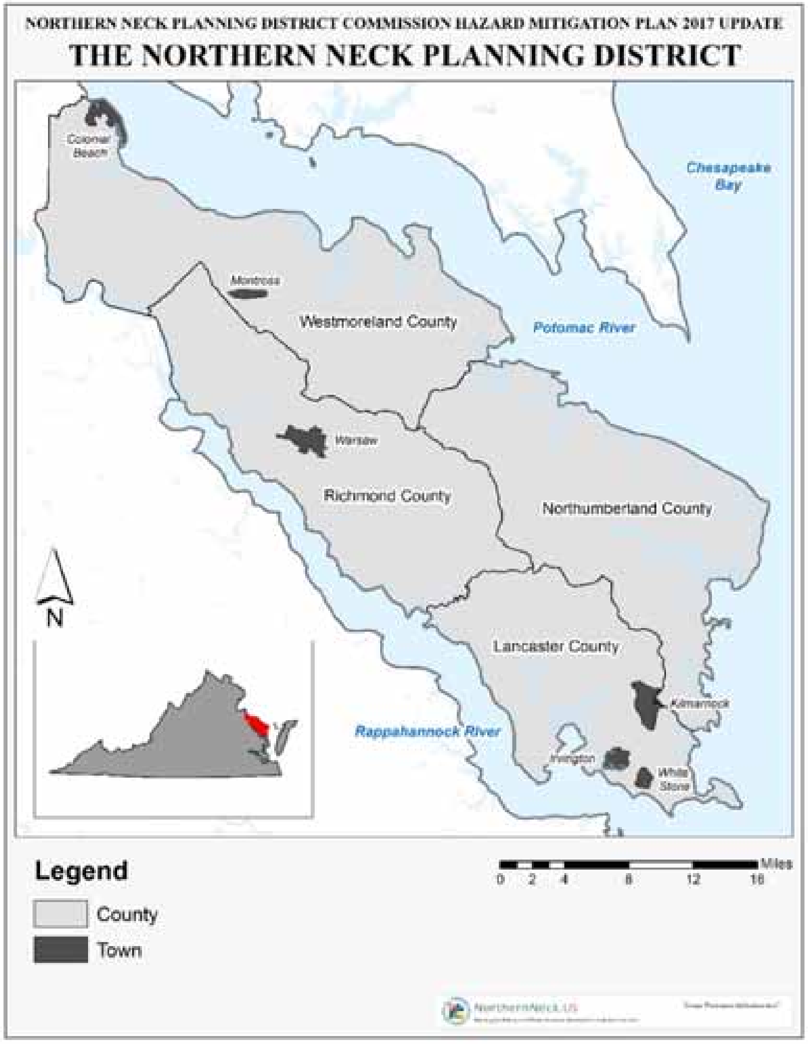

Figure 1-1. Northern Neck Planning District

1.4 Planning Committee Membership

The following agencies are designated members of the Mitigation Advisory Committee:

Table 1-1. Northern Neck Local Emergency Planning Committee 2017

Name	Title	Affiliation
Jerry W. Davis	Executive Director	NNPDC
John Bateman	Regional Planner	NNPDC

Table 1-1. Northern Neck Local Emergency Planning Committee 2017

Name	Title	Affiliation
Alex Eguiguren	Technical Assistant	NNPDC
Frank Pleva	County Administrator	Lancaster County
Wally Beauchamp	Board of Supervisors	Lancaster County
Terrence McGregor	Chief of Emergency Services	Lancaster County
Heather Brown	Department Coordinator	Lancaster County
Luttrell Tadlock	County Administrator	Northumberland County
Rick McClure	Emergency Services Chief	Northumberland County
Stuart McKenzie	County Planner	Northumberland County
Morgan Quicke	County Administrator	Richmond County
Greg Baker	Emergency Services Chief	Richmond County
Mitch Paulette	Captain	Richmond County
Jeff Beasley	Emergency Services Chief	Westmoreland County
David Farmer	Assistant Chief Emergency Services	Westmoreland County
Beth McDowell	Planner	Westmoreland County
Darrin Lee	Planner	Westmoreland County
Bill Cease	IT Director	Westmoreland County
Val Foulds	Town Manager	Town of Colonial Beach
Bob Hardesty	Town Administrator	Town of Irvington
Marshall Sebra	Planning/Zoning Administrator	Town of Kilmarnock
Patricia Lewis	Town Manager	Town on Montross
Patrick Frere	Town Manager	Town of White Stone
Tricia Chappell	VDEM Region V	VDEM
Andy John	Response & Recovery VDEM Region V	VDEM
Amy S. Howard	Grant Administrator	VDEM

1.5 Hazard Identification and Risk Assessment

The Hazard Identification and Risk Assessment (HIRA) is a key component of a hazard mitigation plan because it provides the solid fact base on which to base mitigation goals and strategies. The HIRA consists of three components:

1. Identification of hazards that could affect the Northern Neck
2. Profiling hazard events and determining what areas and community assets are the most vulnerable to damage from these hazards
3. Estimation of losses and prioritization of potential risks to the community

Hazards were ranked by the steering committee and reevaluated during the planning process to determine the hazards with the largest impact on the Northern Neck communities. Certain hazards such as tsunami were not addressed due to the infrequency of occurrence and/or limited impact. The “severe weather” hazard category includes thunderstorm, severe wind, lightning and hail. Table 1-2 summarizes the results of the hazard identification, which are explained fully in Section 4 of this plan.

Table 1-2. Northern Neck Hazard Planning Consideration Levels

Hazard	Planning Consideration
Coastal Flooding	Significant
Riverine Flooding	Significant
Hurricane	Significant
Tornado	Significant
Coastal Erosion	Medium
Severe Weather	Medium
Wildfire	Low
Winter Storm	Low
Drought	Low
Earthquake	Low

The HIRA describes each of these hazards in varying levels of detail consistent with the planning consideration level. In general, coastal flooding, riverine flooding, hurricanes, and tornados were found to be the most significant hazards in the Northern Neck.

1.6 Mitigation Goals and Strategies

The Northern Neck committee members used the results of the Hazard Identification and Risk Assessment (HIRA) as well as the Capability Assessment to develop goals and inform updated strategies, actions and projects for the region and their jurisdictions. The priorities differ somewhat from jurisdiction to jurisdiction. Each jurisdiction's priorities were developed based on historical damages, existing exposure to risk, community goals, and weaknesses identified in the Capability Assessment.

Mitigation strategy status on the 2011 Hazard Mitigation strategies, actions and projects may be found in Appendix C. Some strategies were completed and have outlived their relevancy while others are ongoing programmatic activities which are included in the new strategies outlined in Section 5.0 and listed in more detail in Appendix D.

The new 2017 to 2022 mitigation strategy, action and project types were re-organized into six categories shown in Table 1-3 that better correspond to County and Town government department organization, programs, and plans.

Table 1-3. Mitigation Categories and Project Types

Category	Project Type
Prevention	• Planning and zoning • Building codes • Open space preservation • Floodplain regulations • Stormwater management regulations • Drainage system maintenance • Capital improvements programming • Shoreline/riverine setbacks
Property Protection	• Acquisition/Demolition • Relocation • Building elevation • Critical facilities protection • Retrofitting (i.e., wind-proofing, floodproofing, seismic design) • Safe rooms, shutters, shatter-resistant glass • Insurance
Natural Resource Protection	• Land acquisition • Floodplain protection • Watershed management • Beach and dune preservation • Riparian buffers • Forest and vegetation management (i.e., fire resistant landscaping, fuel breaks) • Erosion and sediment control • Wetland preservation and restoration • Habitat preservation • Slope stabilization • Historic properties and archaeological site preservation
Structural Projects	• Reservoirs • Dams/levees/dikes/floodwalls/seawalls • Diversions/detention/retention • Channel modification • Beach nourishment • Storm sewers
Emergency Services	• Warning systems • Evacuation planning and management • Emergency response training and exercises • Sandbagging for flood protection • Installing temporary shutters for wind protection

Table 1-3. Mitigation Categories and Project Types

Category	Project Type
Education & Awareness	• Outreach projects • Speaker series/demonstration events • Hazard mapping • Real estate disclosure • Library materials • School children educational programs • Hazard expositions

In addition, MAC members and their staff identified and prioritized mitigation strategies for their organizations and programs who were engaged by email or phone conversations. Priorities were developed from data collected on past damages, existing exposure to risk, community goals, and needs based on local knowledge of County and Town needs.

The committee members reviewed the 2011 plan goals and revised them twice, at the April 5, 2017 HIRA and Mitigation Goals Meeting and at the final May 31, 2017 Goals, Actions and Plan Implementation Meeting. The 2017 – 2022 Updated plan goals are:

Goal 1: Promote new development that avoids undue risks posed by natural hazards and is resilient to natural disasters.

Goal 2: Address natural hazards and vulnerabilities that represent a threat to the community.

Goal 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents, property and critical infrastructure of the Northern Neck.

Goal 4: Enhance the capabilities of local government to address natural hazards to enhance the whole community for increased resilience.

Goal 5: Increase natural hazard awareness of our citizens. Educate Northern Neck citizens and part-time residents on citizen and community hazard resilience.

Goal 6: Participate and Comply with the National Flood Insurance Program (NFIP) through floodplain identification, mapping and floodplain management.

In addition, the committee reviewed the objectives and strategies from the previous plan update during a lengthy discussion at the May 31, 2017 committee meeting. At that time they discussed success stories and lessons learned along with actions worthy of continuing for the 2017 to 2022 planning cycle. Mitigation actions were organized into six strategy types further discussed in Section 5.0.

- Prevention
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Services
- Education and Outreach

Through discussions had by email, in person, and on the phone, 2011 actions to continue were supplemented with new 2017 to 2022 strategies, actions and projects. These were identified and prioritized for the planning district commission and each jurisdiction. Communities shared common strategies as well as developed community-specific actions that varied somewhat from jurisdiction to jurisdiction. Each jurisdiction's strategies were developed based on past damages, existing exposure to risk, community goals, and weaknesses identified in the Capability Assessment.

1.7 Capability Assessment, Implementation and Maintenance

The Capability Assessment evaluates the current capacity of the communities of the Northern Neck to mitigate the effects of the natural hazards identified in the Hazard Identification and Risk Assessment. By providing a summary of each jurisdiction's existing capabilities, the Capability Assessment serves as the foundation for designing an effective hazard mitigation strategy. Table 1-4 summarizes the results of the Capability Self-Assessment provided by participating jurisdictions.

Table 1-4. Community Capability Self-Assessment Results

Jurisdiction	Mitigation Assigned to Specific Department	GIS	Adequate Zoning Staff	Dedicated Floodplain Mgmt. Staff	Building Inspectors	Overall Technical Capabilities
Lancaster County	Yes	Yes (limited)	Yes	Yes	Yes (1)	Moderate
Northumberland County	Yes	Yes	Yes	Yes	Yes	Moderate
Richmond County	Yes	Yes	No	No	Yes	Moderate
Westmoreland County	Yes	Yes	Yes	Yes	Yes	Moderate
NNPDC	No	Yes	Local function	Yes	Local function	High
Town of Colonial Beach	No	Yes	No	No	Yes (1)	Moderate
Town of White Stone	Yes	No	Yes	Yes	No (county)	High
Town of Kilmarnock	Yes	Limited	Yes	Yes	No	Low
Town of Montross	Yes	No (1)	Yes	No (1)	No (1)	Low

High: No increase in capability needed.

Moderate: Increased capability desired but not needed.

Limited: Increased capability needed.

(1): County supports or provides service function

The towns of Irvington and Warsaw did not respond to the capability assessment survey.

The capability assessment evaluates the current capacity of the Northern Neck Planning District Commission and its member local governments to mitigate the effects of the natural hazards identified in the updated hazard identification, risk assessment and vulnerability analysis summarized in Section 4.0. By providing a summary of each jurisdiction’s existing programs and policies, the capability assessment serves as the foundation for designing an effective hazard mitigation strategy.

The plan outlines a procedure for implementation, maintenance, and plan updates. The Northern Neck Planning District Commission in partnership with the Local Emergency Planning Committee (LEPC) will be responsible for monitoring this plan. The Planning District Commission will request an annual progress update from the LEPC (Mitigation Advisory

Committee) participants and others designated as "Lead Agencies" for 2017 – 2022 Mitigation Strategies Alliance each January 31. Information will be consolidated and provided in a report to the Virginia Department of Emergency Management (VDEM) and the Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA) Region III. These annual progress reports will begin in 2018 and will include corrective action plans if needed, based on evaluation criteria set by the PDC, MAC or VDEM. In accordance with Federal Emergency Management Agency (FEMA) regulations, a written update will be submitted to the Virginia Department of Emergency Management and FEMA Region III every five years from the original date of the plan, unless circumstances (e.g., Presidential disaster declarations, changing regulations, etc.) require a formal update earlier. The public will be continually informed of changes to the plan as they occur.

1.8 Acknowledgements

The 2017 Plan update was supported by a Hazard Mitigation Assistance Pre-Disaster Mitigation grant program planning grant administered by VDEM with funding from the FEMA. The project was facilitated by Dewberry in Fairfax, Virginia.

1.9 Conclusion

The *Northern Neck Regional Hazard Mitigation Plan 2017 Update* embodies the continued commitment and dedication of the local governments and community members of the region to enhance the safety of residents and businesses by taking action before a disaster strikes. While nothing can be done to prevent natural hazard events from occurring, the region is poised to minimize the disruption and devastation that so often accompanies these disasters.

1.10 Plan Organization

The plan is organized as follows with detailed table and figure lists provided, by section, in the Table of Contents.

Section 1.0 – Executive Summary provides the plan update context of counties, towns, and the planning area which is the area that the Northern Neck Planning District encompasses. The Local Emergency Planning Committee (LEPC) that served as the update project's Mitigation Advisory Committee (MAC) is described, along with the planning process, Hazard Identification Risk Assessment outcome, refreshed mitigation plan goals and a brief summary of updated mitigation action organization and plan implementation.

Section 2.0 – Introduction and Planning Process summarizes the nearly two-decade planning history behind the Disaster Mitigation Act of 2000, its regulatory requirements and the planning process used by the Northern Neck MAC during the plan's update.

Section 3.0 –Community Profile defines the processes followed throughout the update of this plan including a description of stakeholder involvement and outreach. This section also provides a physical and demographic profile of the Northern Neck examining characteristics such as geography, hydrography, development, people, and land uses.

Section 4.0 – Hazard Identification and Risk Assessment evaluates the natural hazards likely to affect or impact the Northern Neck localities, quantifying whom, what, where, and how the area might be affected by natural hazards. Critical facility information has been redacted and is located in Appendix G, available upon request from the Northern Neck Planning District Commission in consultation with the LEPC.

Section 5.0 – Multiple Hazard Mitigation Strategy addresses local and regional hazard-related issues and concerns by establishing a revised framework for mitigation activities and policies. The strategy includes six revised goals and a range of updated mitigation strategies, actions and projects to support achievement of the goal to reduce hazard exposure to area citizens and to increase community resilience. Status on the 2010 mitigation strategies may be found in Appendix C and new 2017 – 2022 strategies, organized by six major mitigation project types, may be found in Appendix D.

Section 6.0 – Community Capability Assessment, Implementation and Plan Maintenance Procedures describes available programs and resources that can support plan implementation. This section describes how the plan will be monitored, evaluated, and updated, including a process for continuing stakeholder involvement after the plan is completed.

Section 7.0 – Plan Adoption described the local plan adoption process following FEMA Region III conditional approval of the plan update draft.

Section 8.0 – References includes a list of the reports and data used to develop this plan.

Section 9.0 –Appendices are included at the end of the plan, and contain supplemental reference materials and more detailed calculations and methodologies used in the planning process. The complete meeting and outreach support materials, history of federal disaster declarations in the region, additional HIRA data, and 2010 mitigation strategy status updates may all be found in the Appendices along with a detailed summary of updated information in the 2017 plan.

Appendix A – Meetings and Outreach

Appendix B – Additional Risk Assessment Information

Appendix C – 2011 Mitigation Actions Update

Appendix D – 2017 – 2022 Mitigation Actions

Appendix E – Record of Changes

Appendix F – Sample Adoption Resolutions

Appendix G – Redacted Materials

Appendix H – List of Abbreviated Terms

Appendix I – Capability Assessment Summary

2.0 Introduction and Planning Process

2.1 Introduction

Mitigation is commonly defined as the sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects. A mitigation plan states the aspirations and specific courses of action that a community intends to follow to reduce vulnerability and exposure to future hazard events. These plans are formulated through a systematic process centered on the participation of citizens, businesses, public officials, and other community stakeholders.

A local mitigation plan is the physical representation of a jurisdiction's commitment to reduce risks from natural hazards. Local officials can refer to the plan in their day-to-day activities and in decisions regarding regulations and ordinances, granting permits, and funding of capital improvements and other community initiatives. Additionally, these local plans will serve as the basis for states to prioritize future grant funding as it becomes available.

The Northern Neck Hazard Mitigation Plan will continue to be a useful tool for all community stakeholders by increasing public awareness about local hazards and risks, and providing information about options and resources available to reduce those risks. Educating the public about potential hazards will help each jurisdiction protect itself against the effects of future hazards, and will inform decision-making regarding where to live, purchase property, or locate business.

The areas covered by this plan includes:

Town of Colonial Beach
Town of Irvington
Town of Kilmarnock
Lancaster County
Town of Montross
Town of White Stone
Northumberland County
Richmond County
Town of Warsaw
Westmoreland County

2.1.1 The Local Mitigation Planning Impetus

On October 30, 2000, President Clinton signed into law the Disaster Mitigation Act of 2000 (DMA2K), which required state and local mitigation plans that would help to reduce loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters.

DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act and added a new section to the law, Section 322, Mitigation Planning. Section 322 requires local governments to prepare and adopt jurisdiction-wide hazard mitigation plans for disasters declared after November 1, 2004, as a condition of receiving Hazard Mitigation Grant Program (HMGP) project grants and other non-disaster related mitigation grant assistance programs. Local governments must review and, if necessary, update their mitigation plans every five years from the original date of the plans in order to continue Hazard Mitigation Assistance (HMA) program eligibility.

The requirements for local mitigation plans are found in Section 44 Code of Federal Regulations Part 201.6. FEMA's "*Local Multi-Hazard Mitigation* Planning Guidance" issued on October 1, 2011 provides updated FEMA interpretation and explanation of local plan mitigation regulations and FEMA's expectations for mitigation plan updates. In addition, VDEM and FEMA now use the 2013 *Local Mitigation Plan Review Tool* to ensure that a plan meets FEMA's regulatory requirements as well as additional requirements identified by the Commonwealth.

2.2 Planning Process

The Northern Neck Planning District Commission (PDC) is a voluntary organization of the region's four county governments, whose primary goal is to help find regional solutions to common problems. The Planning District Commission was formed by local governments in 1969 under the authority of the Regional Cooperation Act. The commission was established to plan for the orderly and efficient physical, social, and economic development of Virginia's Northern Neck region. Activities and policies of the Commission, which are set by sixteen Commissioners appointed by local governing bodies, include a wide range of comprehensive planning, technical assistance, grant seeking, and regional coordination activities.

The Northern Neck Regional Hazard Mitigation Plan incorporates a number of other plans, studies and reports that have been produced about the Northern Neck. These documents include county comprehensive plans, and shoreline erosion studies. Information about these plans and studies is included in Sections 3.0, 4.0, 5.0 and Section 6.0 of the plan and full reference information is provided in Section 8.0.

The following jurisdictions agreed to participate and collaborate to develop the 2017 regional hazard mitigation plan update:

- Lancaster County
  - Town of Kilmarnock
  - Town of Irvington
  - Town of White Stone
- Northumberland County
- Richmond County
  - Town of Warsaw
- Westmoreland County

- Town of Colonial Beach
- Town of Montross

2.2.1 The Hazard Mitigation Technical Advisory Committee

The communities of the Northern Neck established a Local Emergency Planning Committee (LEPC) to address local emergency management issues. Members of the LEPC are appointed by resolution by the counties. The membership of this committee is closely aligned to the needs of a Mitigation Advisory Committee so the Planning District Commission decided to use the existing LEPC as its Mitigation Advisory Committee. Additional members of the committee include county and town staff within the planning district commission. The Local Emergency Planning Committee is comprised of planning directors, emergency management personnel and staff.

The Mitigation Advisory Committee worked with the Northern Neck Planning District Commission to update the Northern Neck Regional Hazard Mitigation Plan starting in 2017. The Northern Neck Planning District Commission acknowledges the following persons and their representative departments and organizations who served as the Mitigation Advisory Committee to this project through their role as the Northern Neck Local Emergency Planning Committee.

Table 2-1. Northern Neck Mitigation Advisory Committee

Name	Jurisdiction/Organization	Title	Department
Jerry W. Davis	NNPDC	Executive Director	Administration
John Bateman	NNPDC	Regional Planner	Administration
Alex Eguiguren	NNPDC	Technical Assistant	Administration
Frank Pleva	Lancaster County	County Administrator	Administration
Wally Beauchamp	Lancaster County	Board of Supervisors	Administration
Terrence McGregor	Lancaster County	Chief of Emergency Services	Emergency Services
Heather Brown	Lancaster County	Department Coordinator	Emergency Services
Luttrell Tadlock	Northumberland County	County Administrator	Administration
Rick McClure	Northumberland County	Emergency Services Chief	Emergency Services
Stuart McKenzie	Northumberland County	County Planner	Planning Commission
Morgan Quicke	Richmond County	County Administrator	Administration
Greg Baker	Richmond County	Emergency Services Chief	Richmond County
Mitch Paulette	Richmond County	Captain	Richmond County
Jeff Beasley	Westmoreland County	Emergency Services Chief	Emergency Services

Table 2-1. Northern Neck Mitigation Advisory Committee

Name	Jurisdiction/Organization	Title	Department
David Farmer	Westmoreland County	Assistant Chief Emergency Services	Emergency Services
Beth McDowell	Westmoreland County	Planner	Planning
Darrin Lee	Westmoreland County	Planner	Planning
Bill Cease	Westmoreland County	IT Director	Information Technology
Val Foulds	Town of Colonial Beach	Town Manager	Administration
Bob Hardesty	Town of Irvington	Town Administrator	Administration
Marshall Sebra	Town of Kilmarnock	Planning/Zoning Administrator	Planning
Patricia Lewis	Town on Montross	Town Manager	Administration
Patrick Frere	Town of White Stone	Town Manager	Administration
Tricia Chappell	VDEM	VDEM Region V	Local Emergency Services Region V
Andy John	VDEM	Response & Recovery VDEM Region V	Local Emergency Services Region V
Amy S. Howard	VDEM	Grant Administrator	Finance

Between November 2004 and July 2005, the Mitigation Advisory Committee held four meetings and supervised work on the area's first hazard mitigation plan. The Mitigation Advisory Committee members coordinated and consulted with other entities and stakeholders to identify and delineate natural hazards within the ten local jurisdictions, and to assess the risks and vulnerability of public and private buildings, facilities, utilities, communications, transportation systems, and other vulnerable infrastructure. A consultant helped facilitate development of the first plan.

During late 2010, the Northern Neck Planning District Commission began working with local LEPC members and others to update the plan which was updated by PDC staff. In early 2011, the plan review process was formally kicked off and review of the plan began.

In 2016, the PDC requested funding to update the 2011 plan and subsequently received a FEMA Pre-Disaster Mitigation program grant to support the 2017 plan update. The PDC contracted with Dewberry, on behalf of all participating jurisdictions, to update the plan during 2017. The Planning District Commission staff and the Mitigation Advisory Committee members worked with the consultants throughout the planning process to ensure that potential stakeholders participated in the planning process including reviewing the draft and final versions of the plan.

2.2.2 Documentation of the Planning Process

The plan update followed a traditional mitigation plan update process initiated with a regional HMP update kick-off meeting, followed by draft updating of the capability analysis, community profile, and HIRA during March 2017. During April 2017, the draft HIRA was presented to the Mitigation Advisory Committee who then revised the 2011 plan goals.

Local and PDC 2011 strategies were updated through phone calls and electronic communication. Following the final Mitigation Advisory Committee meetings on May 31, 2017, where the new goals were slightly revised, 2017 to 2022 actions were developed by the PDC and the participating jurisdictions. The new mitigation actions were prioritized and categorized into six traditional types of mitigation actions. In addition, the local government department who would lead accomplishment of the action and the local resources necessary for action achievement were documented for each new action. The final plan was drafted, made available through a variety of media outlets, and submitted to VDEM for review. Stakeholder engagement was encouraged through invitations to meetings, newsletter updates, and the outreach process throughout the project. Localities also engaged stakeholders at the community level, inviting discussion whenever possible.

In the Commonwealth, the regional Planning District Commissions are composed of local jurisdictional elected officials such as members of county boards of supervisors, town council members, their appointees and chief administrative official such as the county/town administrator/manager. The majority of members are elected offices. For all land development activity, these are the officials who make final land development decisions, approve their comprehensive plans and ultimate adoption of the Northern Neck Hazard Mitigation Plan 2017 Update. Throughout the update process, beginning with application for financial support through a VDEM/FEMA Hazard Mitigation Assistance grant, each respective local jurisdiction has been updated on plan development progress in monthly PDC reports and at monthly PDC meetings. The approval responsibility of these elected officials connects the plan update, which they adopt upon FEMA conditional approval, to local comprehensive plan, zoning change and land use development decisions which they also approve.

Dewberry supported the update process of the Draft Northern Neck Planning District Commission Hazard Mitigation Plan 2017 Update. Since the Hazard Identification and Risk Assessment had only been minimally updated during the 2011 planning process, it was overhauled during the 2017 update to reflect priority hazards as advised by the Mitigation Advisory Committee. As part of the review and update process, the Northern Neck Planning District Commission conducted three Mitigation Advisory Committee meetings at the Northern Neck Planning District Commission office in Warsaw, Virginia. Follow-up meetings to work on 2011 mitigation action updates, 2017 to 2022 new mitigation actions and local government program capacity were conducted by telephone meetings and email correspondence.

The majority of necessary communication with local governments occurred through telephone calls and emails, as directed by the Mitigation Advisory Committee, to best accommodate budgets and schedules following numerous severe storm events that impacted the Northern Neck localities during the spring 2017. Table 2-2 documents formal meeting dates and their purposes.

Table 2-2. Mitigation Advisory Committee Meeting Dates

Meeting Date	Summary of Discussions
February 27, 2017	**Kick-off Meeting:** Introduced mitigation plan update process to the Mitigation Advisory Committee (Local Emergency Planning Committee), half of which had not participated in the 2011 update. Introductions were made, the schedule was presented and a visioning exercise was conducted to prioritize hazards for analysis.
April 5, 2017	**HIRA Presentation Meeting:** The Draft Hazard Identification and Risk Assessment which informed the Vulnerability Analysis for the Northern Neck region was presented to the Committee.
May 31, 2017	**Goals, Mitigation Actions & Implementation Meeting:** As only half of the committee was able to attend the April 5 meeting, the HIRA result highlights were reviewed. The plan goals, which had been revised during the April 5 meeting were also slightly revised. Each locality who had not responded to requests for 2011 mitigation action status as well as new 2017 mitigation actions was provided with printed copies of their localities actions to supplement a digital MS Excel jurisdiction action table which had been emailed to each committee member. Plan public participation, outreach and local adoption processes were also discussed.

Copies of the plan were made available to the Northern Neck's neighbors, the George Washington Regional Commission and the Middle Peninsula Planning District Commission for their review and input. Further copies of the plan were made available to the public at Rappahannock Community College and at the Northern Neck Planning District Commission. No comments were received from the public nor the George Washington Regional Commission and the Middle Peninsula Planning District Commission.

Table 2-3. Local Government Participation in Northern Neck Regional Plan 2017 Update

Jurisdiction/ Organization	Kick-off Meeting	Capability Survey/2011 Action Status	Data Provided	HIRA Meeting	2017 Mitigation Actions	Outreach Activities	Final Meeting
Town of Colonial Beach	X	X	X		X		X
Town of Irvington	X		X	X			X
Town of Kilmarnock	X	X	X				
Lancaster County	X	X	X	X	X		X
Town of Montross	X	X	X	X			
Town of White Stone	X	X	X				X
Northumberland County	X	X	X	X	X		X

Table 2-3. Local Government Participation in Northern Neck Regional Plan 2017 Update

Jurisdiction/ Organization	Kick-off Meeting	Capability Survey/2011 Action Status	Data Provided	HIRA Meeting	2017 Mitigation Actions	Outreach Activities	Final Meeting
Richmond County	X	X	X				X
Town of Warsaw			X		X		
Westmoreland County	X	X	X	X	X		X
Northern Neck PDC	X	X	X	X	X	X	X

When local jurisdictions reviewed their 2011 mitigation actions to report on status (Appendix C), they indicated whether to continue each action. Those to be continued were added to a slate of 2017 to 2022 planning update cycle mitigation strategies which are included in Appendix D. The Town of Warsaw had no 2011 mitigation actions to update. Documentation of the Mitigation Advisory Committee meetings, including the sign-in sheets and presentations, are included in Appendix A.

2.2.3 Public Participation and Stakeholder Input

From 2006 to present, the Northern Neck Local Emergency Planning Committee (LEPC) has represented the community and their local government through appointment by member jurisdictions. The LEPC monitors mitigation activities and reports back to government bodies, administrators, and the public on progress made in mitigation goals and strategies.

Given the rural nature of the Northern Neck communities, public officials and staff have a high degree of contact and interaction with the public and are fully informed of their concerns regarding hazards. The Planning Committee represented a comprehensive cross-section of constituents within the Northern Neck and was able to represent the spectrum of interests and concerns found there.

The Northern Neck PDC publicized the 2017 plan update progress on their website located at http://northernneck.us/hazard-mitigation-planning/. Dates of the various meetings and the presentations given were posted for public review. Further opportunities will be provided to comment on the plan during a public comment period initiated by the Northern Neck Planning District Commission as part of the 2017 regional adoption process.

No feedback from the public was received through these efforts.

2.2.4 Incorporation of Existing Plans and Studies

The Northern Neck Regional Hazard Mitigation Plan 2017 Update incorporates information from a number of other plans, studies, and reports. These documents include:

- College of William and Mary Virginia Institute of Marine Sciences Coastal Erosion Studies
- 2013 Virginia State Hazard Mitigation Plan, VDEM.
- 2012 Commonwealth of Virginia Emergency Operations Plan, VDEM
- Virginia Department of Conservation & Recreation (DCR) climate reports

- Virginia Employment Commission Economic Data
- Virginia Department of Forestry wildfire data and reports
- Landslide Incidence and Susceptibility in the Conterminous United States, U.S. Geological Survey (USGS).
- FEMA TEIF 2.0 Analysis 2014 and 2016
- Jurisdictional Comprehensive and Emergency Operations Plans
- USDA Census of Agriculture
- 2010 US Census Bureau and UVA Weldon Cooper Institute population data
- 2010 – 2016 American Community Survey population estimates

Information about how these plans and studies were incorporated into in Sections 3.0, 4.0, and 6.0 is in those sections where relevant and more specific data sources and information is cited. Full reference information is provided in Section 8.0, References. The progress of plan implementation, including the monitoring schedule, evaluating progress, success and lessons learned, and updates is included in Section 6.0 Capability, Maintenance and Monitoring.

3.0 Community Profile

The Northern Neck encompasses four counties and six towns in the eastern part of Virginia:

Counties:

- Lancaster
- Northumberland
- Richmond
- Westmoreland

Towns:

- Town of Colonial Beach
- Town of Irvington
- Town of Kilmarnock
- Town of Montross
- Town of Warsaw
- Town of White Stone

The Northern Neck is bound by the Potomac River on the north and east, the Chesapeake Bay on the east, the Rappahannock River to the south and west. In total, the planning area encompasses approximately 745 square miles. Based on total land mass, Lancaster County is the smallest county in the Northern Neck with 133 square miles. Westmoreland County is the largest at 229 square miles. Northumberland and Richmond Counties are comparable at 192 and 191 square miles, respectively. The four counties share more than 1,110 miles of shoreline. Figure 3-1 shows the Northern Neck Planning District with its associated towns and counties.

Nearby localities to the south include Caroline County, Essex County, and Middlesex County. The Northern Neck is approximately 65 miles northeast of the City of Richmond, the state capital, and 120 miles southeast of Washington, D.C. The region's northern border is the Potomac River and the State of Maryland.

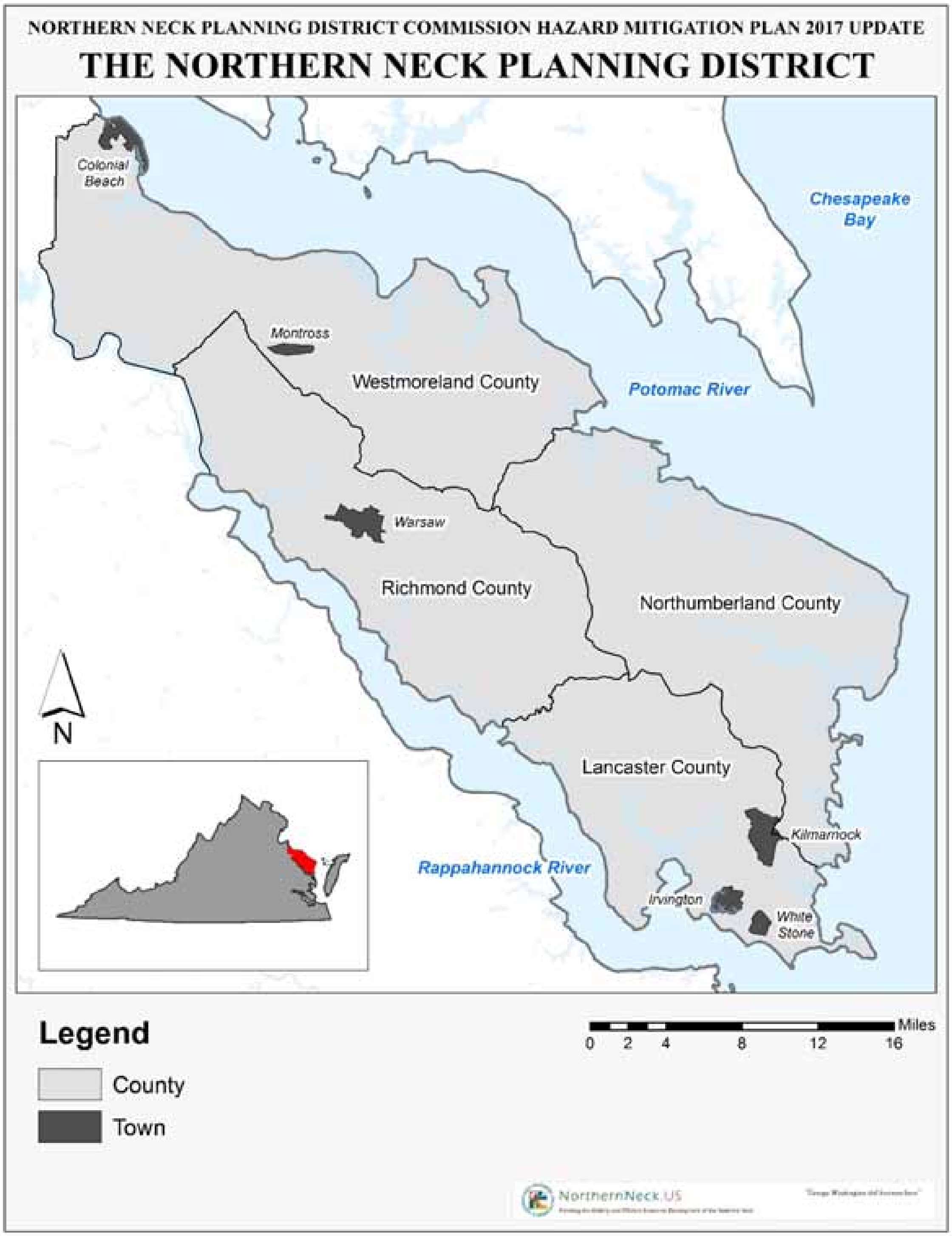

Figure 3-1. The Northern Neck Planning District

3.1 Physiography

The Planning District is part of the greater Atlantic Coastal Plain, a landscape that is characterized by gently rolling hills and valleys, but also can be locally quite rugged where short, high-gradient streams have incised steep ravine systems. The Planning District falls within two subprovinces of the Coastal Plain of Virginia. The Upland subprovince is characterized by low slopes and gentle drainage divides. Steep slopes develop in areas dissected by streams, and are also present where the upland meets the Potomac and Rappahannock Rivers. Elevations in the Upland subprovince range from 60 to 250 feet. The other subprovince is the Lowland subprovince, which is the flat, low-relief region along major rivers and near the Chesapeake Bay. Elevations in the Lowland subprovince range from 0 to 60 feet. The fall line, which delineates the division between Coastal Plain and Piedmont, lies to the west of the Northern Neck.

3.2 Hydrology

The Northern Neck lies within three major watersheds: the Potomac, the Rappahannock, and the Chesapeake Bay Coastal. Numerous creeks crisscross the Northern Neck, and the shoreline is marked by numerous inlets and coves. Figure 3-2 show the major watersheds of Virginia, emphasizing the Northern Neck in black bold outline.

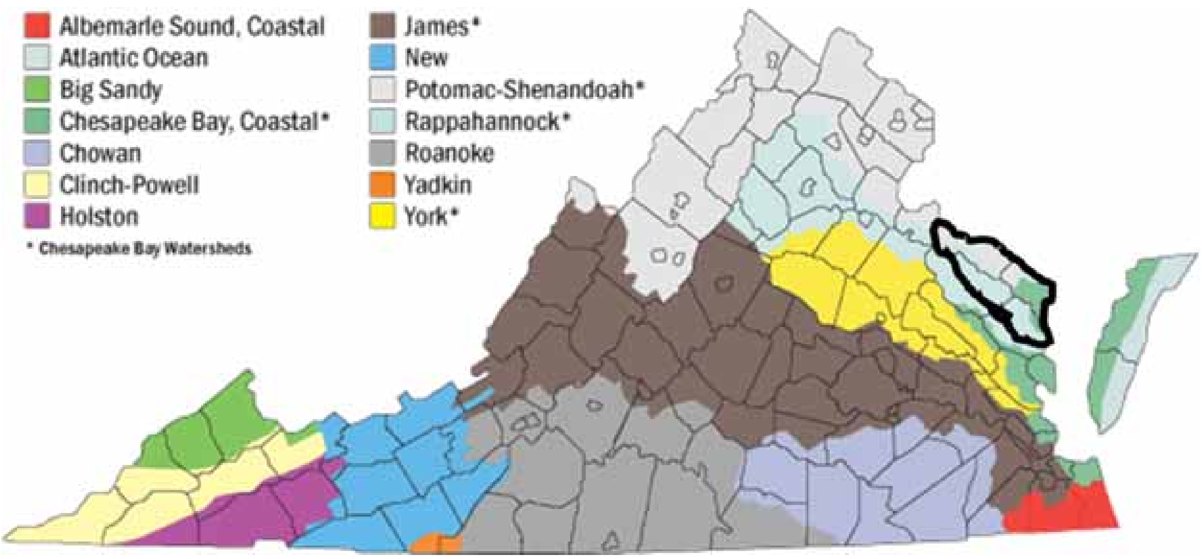

Figure 3-2. Virginia's Major Watersheds[1]

The Potomac Watershed comprises about 20% of the Chesapeake Bay watershed and is a major factor in the bay's restoration. The Potomac Watershed spans 5,702 square miles, is the third largest in Virginia, and is fed mainly by the Shenandoah, South Branch Potomac, Monocracy, and Anacostia Rivers and also by the Conocoheague Creek. Major uses of water in this area are for public and domestic water supply, power plant cooling, industrial use, and agriculture. About 600 million gallons per day (mgd) is used for the water supply, of which 500 mgd is used for the Washington area. About 1.6 billion gallons, most of which is returned to streams, is used daily for power plant cooling and industrial use. Population increases in the Washington area put major strain on the supply of drinking water, leading to issues related to water quality, legacy pollution, emerging contaminants, and reliability and safety of drinking water supplies.

The Rappahannock Watershed is fed primarily by the Rappahannock River, Rapidan River, and Hazel River to the west of the planning district commission. The majority of the Northern Neck

[1] Source: Virginia Department of Conservation and Recreation

falls within the bounds of this watershed. The Rappahannock Watershed covers about 2,715 square miles and supports a variety of land uses: largely fishing with manufacturing, light industrial, and retail applications in the Northern Neck. According to U.S. Geological Survey data, the Rappahannock Watershed (above the fall line) has the highest yield (load/unit area) of total nitrogen, total phosphorous, and total suspended solids of all the Chesapeake Bay tributary basins in Virginia. This contributes to localized dead zones (little or no oxygen) closer the mouth of the Rappahannock each summer due to excess nutrient pollution. According to the Virginia Marine Resources Commission, commercial fish landings for shad and oyster in this area of the Rappahannock have declined precipitously since the early 1970s.

The Chesapeake Bay Coastal Watershed is comprised of the Chesapeake Bay and is 2,577 square miles, though only a small portion of the Northern Neck falls within it. The Great Wicomico and Corrotoman Rivers flow through it. The Chesapeake Bay Coastal, along with the Potomac and the Rappahannock watersheds, are part of the larger Chesapeake Bay Watershed. The Chesapeake Bay is the largest estuary in North America and the third largest in the world. More than 150 major rivers and streams flow into the bay's 64,299 square mile drainage basin, which covers parts of six states (New York, Pennsylvania, Delaware, Maryland, Virginia and West Virginia) and all of Washington, D.C. The bay is approximately 200 miles long from its northern headwaters in Havre de Grace, Maryland to its outlet in the Atlantic Ocean in Virginia Beach, Virginia. The bay and its tidal tributaries have 11,684 miles of shoreline—more than the entire U.S. west coast. Approximately eight million acres of land in the Bay watershed are permanently protected from development.

Since the early twentieth century, the Chesapeake Bay has experienced serious environmental degradation. Problems include large reductions in sea grass, reduced amounts of finfish and shellfish (especially oysters and crab), seasonal depletions in dissolved oxygen, and increases in sedimentation. Environmental concerns were voiced in the 1970s over the damage to key habitats and the decline in water quality. Species in bay waters were being negatively affected, resulting in threats to the commercial and recreational activities. Most marine scientists believe that these changes are related to ecological stress due to increased human activities. Causes include deforestation, agriculture (including fertilizers), urbanization, pollution, and sewage. Between 1990 and 2016, there was an observed 28% increase in the watershed's population. In 2016, the Chesapeake Bay Program estimated 18.1 million people lived in the Chesapeake Bay Watershed, a 0.4% increase from 2015. Experts predict the watershed's population will pass 20 Million by 2030 and reach 21.1 Million by 2040.

3.3 Climate

The Northern Neck lies within the Atlantic Coastal Plain, with flat topography and sandy or muddy soil. This region has a humid subtropical climate, with hot, humid summers and a short, mild to cool winter. This humid subtropical climate is strongly influenced by Chesapeake Bay and the Atlantic Ocean, both of which moderate the weather but do not prevent ice formation almost every winter on the bay's northern tributaries. Mountains to the west produce blocking and steering effects on storms and air masses from the Great Lakes. The open water bodies that border the Northern Neck provide a buffer to atmospheric changes and allow for breezes that offset humidity.

Average high temperatures in the Northern Neck are about 77°F in the summer and 38°F in the winter. Precipitation is high, particularly along the coast, and seasonal. Average annual rainfall is approximately 43 inches and average annual snowfall is 15 inches.

3.4 Land Use and Development Trends

The jurisdictions in the Northern Neck are primarily rural. There are six incorporated towns in the four counties. The towns typically have a more suburban development pattern with a central node around the intersection of two primary roads, or as a corridor along a primary road.

3.4.1 Lancaster County

Lancaster County covers approximately 135 square miles, or approximately 86,267 acres of land. The county is rural in nature with limited public infrastructure. Due to limited public water supply and wastewater treatment infrastructure, development in Lancaster County usually requires on-site sewage facilities for disposal of waste and individual or community wells for domestic water supplies. Therefore, development of land in Lancaster County is closely tied to the physical characteristics of the land. This close bond with the land is further magnified by the wide variety of environmentally sensitive areas found in the county including steep slopes, floodplains, prime agricultural lands, wetlands, and soils not suitable for septic systems.

Roughly 65% of Lancaster County land is limited in some form. Specific physical limitations to development that cause concern include the suitability of soils for septic systems, the loss of prime agricultural farmlands to development, and the presence and location of shrink-swell soils. The continuing loss of farmland to other uses is a trend that needs to be stopped and ideally reversed. Farmlands provide acres of pervious land surface that act as recharge areas for groundwater aquifers. As more land is developed, remaining recharge areas become increasingly important. This is of particular importance to Lancaster County, which is entirely dependent on groundwater aquifers for its drinking water supply. Loss of prime agricultural farmlands also strains local employment. According to the 2010 Census, employment related to farming, fishing and forestry declined over 72% between 1990 and 2010 (253 jobs to 69 jobs).

Fortunately, some of the recent development activity in Lancaster County has focused on areas near existing towns, leaving many farms intact. However, it is likely that development momentum could start impacting rural areas as farmers retire and capitalize on their equity in the land. Furthermore, from a development economics standpoint, the attractiveness of farmland due to the flat topography and lower site clearing and preparation costs will increase development pressure on these areas. There is still a large quantity of land without development limitations that is suitable for development. About one-third of the county land is without development constraints.

Lancaster County is known for its tourist and recreational attractions. Historic sites, buildings and marinas attract visitors throughout the year. The retiree population is increasing while younger generations are leaving the area. The county's comprehensive plan states the need to retain the rural character of the county while providing economic opportunity to encourage younger generations to stay.

3.4.2 Northumberland County

According to the draft *2016 Northumberland County Comprehensive Plan*, the most significant land uses in Northumberland County are agriculture and forestry. Farming and forest uses have remained fairly untouched by development, except for conversions of land to development along waterfronts. Residential development is concentrated along roads and the waterfront. Manufactured homes are scattered throughout the county, but like other types of residential development, are found primarily along roads. Commercial development tends to occur along highways and in villages such as Fairport and Reedville. Marinas and industrial sites are found along the waterfront.

New subdivisions can serve as an important indicator to evaluate development potential because once subdivision lots are recorded and streets developed to serve them, the landscape of that site is changed forever. This is why subdivision ordinances were one of the first planning tools mandated by Commonwealth of Virginia legislation. Subdivisions have played an important role in Northumberland County development during the last two decades, particularly along the waterfront.

Prime farmland is a component of a healthy economy in Northumberland County. The county has policies in place that can protect prime farmland to maintain agricultural production at a high levels which supports taxable income, and reduce pollution at the same time. Deferred land use value taxation allows landowners to maintain their land in agricultural and forest production to reduce property taxes. If a landowner develops property enrolled in the program, they must repay the balance between the deferred and full tax rate for the previous five tax years. This program has helped maintain farm production in the county and has slowed conversion to residential development.

3.4.3 Richmond County

Agricultural land use dominates the landscape of primarily rural Richmond County. Agricultural and forest land protection is a primary objective of the county's Comprehensive Plan which designates most of the county land area for agriculture or forestry use. While forests cover approximately 59% of the county, agriculture is visible because the transportation network is adjacent to these lands. Many of the original roads found in Richmond County were constructed to accommodate the movement of people, equipment, and crops associated with farming. During the second half of the twentieth century roads evolved for automobile and truck use. Development is managed by ensuring that the best and most productive cultivated and forested lands are not divided into lots or removed from production.

Early in the 20th century, agriculture, fishing and timber were the main industries in Richmond County, but they have since been replaced by the retail trade and service industries centered in the Town of Warsaw. The retail trade and service industries work to support agricultural and forestry operations. Commercial and industrial designations for growth are limited to the Town of Warsaw. Convenient shopping, job opportunities, and a viable tax base are the most important components of business development. The Richmond County Board of Supervisors purchased 57 acres of land within the Town of Warsaw for development into Commerce Park. The site has been zoned for industrial and manufacturing uses and is the primary business development site for Warsaw and Richmond County.

The county recognizes the need for additional public recreational facilities. The Richmond County Board of Supervisors also purchased 85 acres of land adjoining Commerce Park for the development of a multi-function community park that would support the county fair and new sports facilities. It is anticipated that the adjoining facilities will provide an excellent opportunity for job creation and enhancement of cultural and recreational resources.

Richmond County envisions limited residential development along existing roads, predominantly in the southeastern half of the county. Roads in higher elevations, where soils are better, are seen as the predominant area for low density residential, while additional residential development is envisioned along the shorelines of the Rappahannock and its navigable tributaries where environmental and soil conditions will permit. According to the 2013 Richmond County

Comprehensive Plan, rural villages are planned at six locations throughout the county. Intensive development is rare except within and adjacent to the Town of Warsaw where it is possible that urban development will spill over into the county.

3.4.4 Westmoreland County

Westmoreland County remains a rural locality featuring numerous waterfront communities. The majority of the land is currently used for forestry or agriculture. Forestland is the most common land use in the county. Today, there are very few mature, diverse hardwood forests remaining in Westmoreland County. Intensive harvesting is occurring across the region, with retention only required for buffering along streams and wetlands. The forest landscape is extremely important to the future of the community for numerous reasons, including: maintained air quality, wildlife habitat, recreational and spiritual uses, tourism, and minimized soil erosion.

Agricultural land use is the second most common land use. Rotational grain - corn, soybeans and wheat –account for an estimated two thirds of the county’s total annual agricultural income. While a downward trend is not clearly established, future development in the county will pose a threat to farming through displacement and conflicting land uses. Dust, smells, and nighttime operations are some of the complaints that nearby residents often make about farms that can discourage the farmer or cause a change in farm practices. A gradual decline in farming can also mean the loss of support services for the farms or distribution channels for farm products, making farming more difficult.

Residences and businesses are distributed throughout the county, but are often clustered near the Towns of Colonial Beach and Montross, or in one of the numerous small communities. Residential land use includes: multi-acre tracts, subdivisions, apartments, and townhouses. There is also an unusually high percentage of seasonal homes used recreationally. Recent construction of residential dwellings in the county has typically followed two paths: either isolated homes, usually on waterfront lots; or residential subdivisions and town neighborhoods. Residential subdivisions are mostly located along the county’s creeks, bays, or rivers. Predominant businesses include construction, retail trade, accommodations and food services, architecture and engineering, real estate, health care and social assistance, and art and entertainment.

Westmoreland County will have to manage future development to maintain its rural atmosphere while still providing opportunities for growth near its towns. One approach to maintaining the rural economy is to identify areas where additional growth would be appropriate in existing development, while maintaining the existing character of the area. Use of this approach with the relatively slow recent rate of growth in the county may enable a long transitional period continuing the zoning districts that shaped existing development.

3.5 Population

The total population for the Northern Neck was 49,560 in 2016 using the newest population estimates from the U.S. Census Bureau’s 2016 American Community Survey (Table 3-1). This is a 1.75% decrease in total population since 2010. Three of the four counties experienced negative growth rates, with Westmoreland experiencing the only positive growth rate of 0.8%. Population projections for the Northern Neck are somewhat consistent with the U.S. Census population percent change from 2010 to 2016. Lancaster and Northumberland counties are projected to experience population decreases through 2040, while Richmond and Westmoreland counties are projected to experience population growth (Table 3-2). Generally, population is projected to be relatively flat for the next two decades.

Table 3-1. Population Statistics for the Northern Neck

Jurisdiction	Estimated Population, 2016	Percent Change in Population, 2010 - 2016
Lancaster	10,972	-3.70%
Northumberland	12,222	-0.90%
Richmond	8,774	-5.20%
Westmoreland	17,592	0.80%
Northern Neck (total)	49,560	-1.75%

Source: 2016 American Community Survey (ACS), 2010 Decennial Census

Table 3-2. Population Projections for Northern Neck, 2020-2040

Jurisdiction	2020	2030	2040
Lancaster	11,192	10,935	10,533
Northumberland	12,099	11,989	11,716
Richmond	8,982	9,125	9,139
Westmoreland	17,941	18,482	18,758
Northern Neck (total)	50,214	50,531	50,146

Source: Demographics Research Group of the Weldon Cooper Center for Public Service, March 2017

3.6 Race and Gender

Nearly the entire population (98.3%) of the Northern Neck reports being a single race according to U.S. Census Bureau's 2015 Population Estimates Program. The region's average population by race is 69.6% White alone, 27.5% Black or African American alone, and 0.7% Asian alone (Table 3-3). An average of 0.5% of Northern Neck residents reported being other races alone, and 1.7% reported being two or more races.

Table 3-3. Racial Demographics of the Northern Neck

Jurisdiction	White Alone	African American Alone	Asian Alone	Other Races Alone	Two or More Races
Lancaster	69.9%	27.9%	0.8%	0.3%	1.1%
Northumberland	73.3%	24.7%	0.4%	0.3%	1.2%
Richmond	66.8%	30.2%	0.7%	0.5%	1.9%
Westmoreland	68.5%	27.3%	0.8%	0.8%	2.5%
Northern Neck (average)	69.6%	27.5%	0.7%	0.5%	1.7%

Jurisdiction	White Alone	African American Alone	Asian Alone	Other Races Alone	Two or More Races

Source: 2015 U.S. Census Bureau Population Estimates Program

In the Northern Neck, there are slightly more males than females, with male persons accounting for 50.1% of the population and female persons make up the remaining 49.9% of the population. Richmond County has the largest difference in percentage of population that are females versus males, likely do to the presence of a correctional center in Haynesville.

Table 3-4. Gender Statistics for the Northern Neck

Jurisdiction	Female	Male
Lancaster	53.10%	46.90%
Northumberland	50.90%	49.10%
Richmond	44.30%	55.70%
Westmoreland	51.40%	48.60%
Northern Neck (average)	49.90%	50.10%

Source: 2015 U.S. Census Bureau Population Estimates

3.7 Language

About 3.6% of residents in the Northern Neck were foreign-born and 4.5% of persons age five and older speak a language other than English at home. These statistics indicate there may be a portion of the Northern Neck that may require special consideration when developing hazard reduction and outreach strategies for the community.

Table 3-5. Language Statistics for the Northern Neck

Jurisdiction	Foreign born persons, percent, 2011-2015	Language other than English spoken at home, percent of persons age 5 years+, 2011-2015
Lancaster	1.90%	3.60%
Northumberland	2.50%	2.30%
Richmond	6.60%	8.50%
Westmoreland	3.20%	3.70%
Northern Neck (average)	3.60%	4.50%

Source: American Community Survey (ACS) 5-Year Estimates

3.8 Age

Age can be used to identify certain groups of the population that have heightened risk to certain hazards. The 2015 U.S. Census Bureau's Population Estimates Program data shows that about

4.2% of the population in the Northern Neck is under the age of five and approximately 16.5% is under the age of 18. The Northern Neck age distribution is less than the Virginia total of 6.1% under the age of five and 22.3% under the age of 18. Additionally, the population that is 65 and older (28.7%) is double that of the Commonwealth's (14.2%).

Table 3-6. Age Statistics for the Northern Neck

Jurisdiction	Persons under 5 years	Persons under 18 years	Persons between 18 and 65 years	Persons 65 years and over
Lancaster	3.60%	14.60%	45.80%	36.00%
Northumberland	3.80%	15.50%	45.80%	34.90%
Richmond	4.00%	17.00%	59.10%	19.90%
Westmoreland	5.50%	18.80%	51.70%	24.00%
Northern Neck (average)	4.20%	16.50%	50.60%	28.70%

Source: 2015 U.S. Census Bureau Population Estimates Program

The counties of the Northern Neck are recognized as popular retirement communities. Lancaster and Richmond Counties have seen a trend towards an aging population of both long-term residents and newly relocated retirees. New residents are attracted to the Northern Neck's proximity to water, reasonable land and housing prices, low taxes, and rural character. There has been an increase in demand for residential development, recreational opportunities, and medical services aimed at senior citizens. During the recent recession there was an abundance of listed residential property throughout the Northern Neck. Consideration for the needs of the younger and older generations should influence development of public awareness mitigation strategies.

3.9 Education

Data from the U.S. Census Bureau's 2015 Population Estimates Program approximates that about 84.6% of residents in the Northern Neck graduated from high school and 21.1% hold bachelor's degrees or higher. Education levels are lower than Virginia averages (88.3% graduated from high school and 36.3% with bachelor's degrees or higher). Lancaster County has a higher education rate that is closer to the state average (27.9%). Education levels, coupled with the population characteristics described in the previous paragraphs, should influence mitigation and emergency management public outreach program development. The content and delivery of public outreach programs should be consistent with the audiences' needs and ability to understand complex information.

Table 3-7. Education Statistics for the Northern Neck

Statistics	High school graduate or higher, percent of persons age 25 years+	Bachelor's degree or higher, percent of persons age 25 years+
Lancaster	90.00%	27.90%
Northumberland	88.10%	25.40%
Richmond	79.10%	12.70%
Westmoreland	81.10%	18.30%
Northern Neck (average)	84.60%	21.10%

Source: 2015 U.S. Census Bureau Population Estimates Program

3.10 Income

As of 2015, the average median household income in the Northern Neck was approximately $49,365, 24% lower than the state average of $65,015 according to the U.S. Census Bureau. About 14.65% of residents within the Northern Neck live below the poverty line. This rate is slightly lower than that of the national rate of 14.8% in 2015, but higher than the state rate of 11.2%. Northumberland County has a slightly higher median household income and per capita income than the other counties in the Northern Neck. Overall, the income statistics summarized in Table 3-8 indicate that a significant portion of the population in the Northern Neck may not have the resources available to them to undertake mitigation projects that require self-funding.

Table 3-8. Income Statistics for the Northern Neck

Jurisdiction	Median household income (in 2015 dollars), 2011-2015	Per capita income in past 12 months (in 2015 dollars), 2011-2015	Persons in poverty, percent
Lancaster	$50,374	$31,062	13.10%
Northumberland	$51,885	$31,280	13.70%
Richmond	$47,288	$19,407	17.70%
Westmoreland	$47,911	$25,992	14.10%
Northern Neck (average)	$49,365	$26,935	14.65%

Source: 2015 U.S. Census Bureau Population Estimates Program

3.11 Housing

As of 2015, there were an estimated 31,516 housing units in the Northern Neck according to the U.S. Census Bureau (Table 3-9). Westmoreland County has the most housing units and Richmond County has the least. Only 4.7% of the housing units in the Northern Neck are multi-unit structures. Lancaster County has the most multi-unit structures (560 units) while Richmond County has the highest percentage in the Northern Neck with 7.8% (308 units).

About 77% of residents own their homes in the Northern Neck. Northumberland County has the highest homeownership rate of 83.70% while Richmond County has the lowest at 74.40%. All of the homeownership rates are significantly higher than the national average of 63.90% or the state average of 66.20%. When considering mitigation options, special attention should be given to the difference in capabilities between owners and renters. As previously stated, it is a “buyer’s market” on the Northern Neck with more than 600 residential properties listed for sale currently. Many of these are “second” homes used as vacation or weekend homes by out-of-area owners from Northern Virginia or the Richmond Metropolitan area. A surge of homes was listed for sale during the recession during the past decade with many still remaining on the market.

Table 3-9. Housing Statistics for the Northern Neck

Jurisdiction	Housing units	Owner-occupied housing unit rate	Median value of owner-occupied housing units
Lancaster	7,607	75.00%	$229,100
Northumberland	9,156	83.70%	$242,000
Richmond	3,922	74.40%	$150,000
Westmoreland	10,831	74.60%	$191,600
Northern Neck	31,516	76.90%	$203,175

Source: 2015 U.S. Census Bureau Population Estimates

3.12 Business and Labor

Most Northern Neck counties face unemployment and underemployment challenges. The decline in traditional industries and the growth in retirement and second home development are changing employment landscape. The area’s unemployment rates are generally lower than the U.S. average but higher than Virginia’s average (Table 3-10). The Northern Neck region was impacted by the 2008 recession but is recovering at about the same rate as the U.S. average. The Virginia Employment Commission (VEC) projects that employment for the Northern Neck will increase by about 9.25% by 2024.

Table 3-10. Northern Neck Unemployment Rates

Year	Northern Neck	Virginia	United States
2006	4.30%	3.10%	4.60%
2007	4.30%	3.00%	4.60%
2008	5.30%	3.90%	5.80%
2009	8.30%	6.70%	9.30%
2010	8.40%	7.10%	9.60%
2011	8.10%	6.60%	8.90%
2012	7.50%	6.10%	8.10%
2013	7.00%	5.70%	7.40%
2014	6.70%	5.20%	6.20%
2015	5.70%	4.50%	5.30%
2016	4.90%	4.00%	4.90%

Source: Virginia Employment Commission, Economic Information & Analytics, Local Area Unemployment Statistics.

The rural nature of the communities in the Northern Neck is reflected in the top 10 employment sectors summarized in Table 3-11.

Table 3-11. Top Ten Employment Sectors in the Northern Neck

Industry	Employment
Local Government	2,127
Retail Trade	1,801
Health Care and Social Assistance	1,661
Manufacturing	1,416
Accommodation and Food Service	1,088
State Government	803
Construction	798
Other Services (except Public Administration)	572
Professional, Scientific, and Technical Services	455

Source: Virginia Employment Commission, Economic Information & Analytics, Quarterly Census of Employment and Wages (QCEW), 4th Quarter (October, November, December) 2016.

According to profiles developed by the Virginia Economic Development Partnership, major employers in the Northern Neck region are listed by county below.

Lancaster County:

- Rappahannock General Hospital
- Lancaster County School Board
- Rappahannock Westminster Canterbury
- Walmart
- Manufacturing Techniques, Inc.
- Tides Inn

Northumberland County:

- Northumberland County School Board
- Omega Protein
- County of Northumberland
- Carry On Trailer Corporation

Richmond County:

- Haynesville Correctional Center
- Richmond County School Board
- Rappahannock Community College
- County of Richmond

Westmoreland County:

- Westmoreland County School Board
- Carry On Trailer Corporation
- County of Westmoreland
- Bevans Oyster Company
- Town of Colonial Beach Schools

3.13 Agriculture

Agriculture is a major economic sector in the Northern Neck. Total agricultural sales exceed $77 million annually, with the vast majority of revenue from the sales of crops including those from nurseries, greenhouses and vineyards. Major crops in the Northern Neck include soybeans, corn, and wheat. According to the 2010 U.S. Census, employment in Lancaster County related to farming, fishing and forestry declined over 72% between 1990 and 2010 (253 jobs to 69 jobs).[2] Table 3-12 summarizes agriculture in the Northern Neck region based on 2012 Agricultural Census statistics.

[2]Cited in the 2013 Lancaster County Comprehensive Plan

Table 3-12. Northern Neck Agriculture

Jurisdiction	Land in Farms (acres)	Total Value of Agricultural Products Sold	Total Value of Crops, including nursery and greenhouse crops	Total Value of livestock, poultry, and their products
Lancaster	10,695	$4,864,000	$4,690,000	$174,000
Northumberland	43,270	$21,357,000	$20,999,000	$359,000
Richmond	32,373	$15,467,000	$14,648,000	$819,000
Westmoreland	59,378	$35,758,000	$30,725,000	$5,032,000
Total	145,716	$77,446,000	$71,062,000	$6,384,000

Source: 2012 U.S. Census of Agriculture

3.14 Transportation

The Northern Neck is a peninsula bound by two rivers and the Chesapeake Bay. Transportation options are somewhat more limited than in surrounding counties.

US-360 is the main east-west route, while State Route-3 (SR-3) is the major north-south route in the Northern Neck. No interstate serves the Northern Neck directly, though Interstate-95, the major north to south route on the East Coast, is easily accessible via SR-3 (about 30 miles from the northern most point in Westmoreland County). US-17 is accessible via US-360 (across the Rappahannock River over Downing Bridge).

The closest commercial airports are in Richmond and Newport News (both approximately 55 miles away from the Northern Neck). Two general aviation facilities, Tappahannock Municipal Airport and Hummel Field, also serve the Northern Neck. There is no rail service to the Northern Neck.

A number of rivers run through the Northern Neck. The Potomac and Rappahannock Rivers and the Chesapeake Bay are all navigable by medium to large ships. However, the nearest major commercial ports are in Richmond and Norfolk, Virginia. There are several grain barge facilities in the Northern Neck that are used to transport agricultural products. Many local marinas servings dockage for pleasure craft dot the shorelines of the Northern Neck.

A bridge on SR-3 crosses the Rappahannock River between White Stone in Lancaster County and Grey's Point in Middlesex County. An additional bridge on US-360 spans the Rappahannock River at Richmond County and Tappahannock in Essex County. Seasonal (summer) passenger ferries run to Tangier Island and Maryland's Smith Island. VDOT operates two ferries in the Northern Neck, one at Sunnybank in Northumberland County and the other at Merry Point in Lancaster County.

3.15 Infrastructure

3.15.1 Electricity

The Northern Neck is served by two electricity providers: Dominion Virginia Power and the Northern Neck Electric Cooperative (Touchstone Energy Cooperatives). The Virginia Electric & Power Company operates a Petroleum Power Plant in the Town of Warsaw, in Richmond County.

Northumberland County's Middle/High School was the first of its kind at the time to have a wind turbine installed on February 11, 2011. The turbine is primarily used as an educational tool, giving the students the opportunity to learn through hands-on and interactive curricula.

3.15.2 Heating and Gas

AmeriGas Propane and Revere Gas serve the Northern Neck area's heating and gas needs.

3.15.3 Telephone

Telephone service for the Northern Neck is primarily provided by Verizon.

3.15.4 Public Water and Wastewater

Public water systems serve residents and businesses within the towns of Colonial Beach, Kilmarnock, Montross and Warsaw. Wastewater treatment is available in the towns of Colonial Beach, Montross, Kilmarnock, and Warsaw. The Reedville Sanitary District and Montross-Westmoreland Sewer Authority provide wastewater services. Westmoreland County also serves the Coles Point and Washington District areas with public wastewater services.

Private well and onsite sewage systems serve the remainder of the Northern Neck. According to the *2016 Northumberland County Comprehensive Plan*, there is a high concentration of soils of poor quality for septic tanks located in the low-lying areas seaward of the Suffolk Scarp, in addition to other upland areas located along stream beds and banks. This poor soil quality challenges future development in this region.

3.15.5 Television

Cable television is available in this area through MetroCast, DirecTV, Dish TV, and Verizon Fios.

3.15.6 Internet

Internet access varies throughout the Northern Neck. The following is a list of internet providers available: MetroCast (cable internet), Verizon (DSL), Cox (cable), SignaWave (fixed wireless), Virginia Broadband (fixed wireless), and HughesNet (satellite internet).

4.0 Hazard Identification and Risk Assessment

4.1 Introduction

The purpose of the Hazard Vulnerability Analysis is to provide an overview of how various natural hazards impact Virginia's Northern Neck. The Hazard Identification and Risk Assessment (HIRA) assesses all natural hazards deemed a threat through previous plan Hazard Identification Risk Assessments and the qualitative priorities of the Local Emergency Management Committee (LEMC) which serves as the plan update's "Mitigation Advisory Committee" or MAC. The analysis presented in Section 4.0 uses an all-hazards identification, classification, and vulnerability indexing process to ensure hazard analysis is comprehensive and as qualitative as possible based on all available data sources. The HIRA provides information to allow the planning district commission and its communities to better understand local hazards and the risks they pose to people, property and infrastructure so that mitigation goals and strategies, actions and projects can be developed to reduce risk exposure to hazards. This will make the Northern Neck more resilient.

For the purposes of the HIRA, a natural hazard is defined as a physical event or condition that has the potential to cause fatalities, injuries, property and infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.

Identifying the risk and vulnerability for a community is critical when determining how to allocate finite resources to carry out feasible and appropriate mitigation actions. The hazard analysis involves identifying all of the hazards that potentially threaten the Northern Neck, and then analyzing them to determine the degree of threat posed by each hazard and hazard vulnerability. Addressing risk and vulnerability through hazard mitigation measures will reduce societal, economic, and environmental exposure to natural hazard impacts.

The Northern Neck Planning District Commission includes four counties and six incorporated towns. All jurisdictions located throughout these counties have been included the risk analysis, but in many instances data is not granular enough to allow full analysis for towns. The Record of Changes in Appendix E details changes and updates to Section 4.0 HIRA.

The 2017 Hazard Mitigation Plan Section 4.0 HIRA consolidates, updates, and streamlines content from the 2011 HIRA. As part of the update, the following changes were made to the hazard identification and risk assessment section:

- Watershed information was moved to Section 3.0 Community Profile;
- Critical Facilities information was moved to Redacted Appendix G
- Earthquake, removed from the 2011 HIRA, is now included;
- Repetitive Loss and Severe Repetitive Loss Structures were summarized and mapped for each participating county;
- Wildfire analysis and historic occurrence by wildfire size and location was added to wildfire analysis and mapping; and
- Total Exposure in the Floodplain (TEIF) analysis was performed in place of Hazus to analyze the exposure of property to total loss during a 100 year (1% annual chance) and 500 year (2% annual chance) flood event. Exposure was summarized at the 1,000 square foot Census block level.

In addition, each section of the HIRA was also reformatted to improve clarity, and new maps and imagery were included.

4.2 Hazard Identification

4.2.1 Types of Hazards

The Northern Neck is exposed to a wide array of natural hazards that can affect people and property. The following hazard categories were reviewed during the 2017 plan update Kickoff Meeting where the LEMC agreed that the 2011 plan hazards were still relevant with the addition of earthquake:

- Riverine Flooding
- Coastal Flooding
- Coastal Erosion
- Hurricanes
- Severe Weather
- Tornadoes
- Winter Storm
- Drought
- Wildfire
- Earthquake

The "Severe Weather" hazard category was added by the plan update contractor to capture hazard-related damages in available datasets which were not captured otherwise. Tsunamis were not addressed. The impact of each natural hazard is presented in each respective hazard section.

4.2.2 NCEI Storm Events Database

The National Centers for Environmental Information (NCEI) Storm Events Database is published by the National Oceanic and Atmospheric Administration (NOAA)'s National Weather Service (NWS). The storm events database contains information on storms and weather phenomena that have caused loss of life, injuries, significant property damage, and/or disruption to commerce. The NCEI data currently provides information about events from January 1950 to January 2017. Records for the majority of weather events (48 types) were reported starting in 1996, as defined in NWS Directive 10-1605. The exception is tornado events that were recorded from 1950 through 1954 and tornado, thunderstorm and hail events that were recorded starting in 1955.

The NCEI Storm Events Database publishes data by county, therefore the storm events have been extracted for the four counties in the Northern Neck: Lancaster, Richmond, Northumberland, and Westmoreland. This data is summarized in Table 4-1 by county and by hazard category. It is important to note that for example if a winter storm occurred on February 5th, 2010 and affected the entire Northern Neck, that event would be reported by each of the four counties individually. Therefore, even though it is one storm for the region, each county has reported the event in the table below. Damages are reported by each county, therefore the sum of damages across counties is not duplicative. Table 4-2 reports the unique events that have impacted the entire Northern Neck, therefore accounting for duplication of reporting the same event between counties. The Severe Weather category consists of several hazards: Heavy Rain, High Wind, Thunderstorm Wind, Lightning, Hail, and Strong Wind. All of these reported hazard events were counted as unique events in Table 4-2 except for Heavy Rain, in which duplication across counties was accounted for.

Table 4-1. Hazard Events for Northern Neck Counties (January 2017)

Hazards	Reported Events	Property Damage (2017$)	Crop Damage (2017$)	Deaths	Injuries
Lancaster	164	$12,751,880.34	$6,377,132.06	0	3
Coastal Storms	9	$2,009,266.35	$0.00	0	0
Drought	3	$0.00	$5,833,250.55	0	0
Hurricanes	5	$868,611.49	$543,881.51	0	0
Riverine Flooding	5	$0.00	$0.00	0	0
Severe Weather	75	$3,945,636.61	$0.00	0	3
Tornado	7	$5,928,365.89	$0.00	0	0
Winter Storms	60	$0.00	$0.00	0	0
Northumberland	165	$44,516,378.49	$5,772,342.26	0	9
Coastal Storms	10	$24,576,638.17	$0.00	0	0
Drought	2	$0.00	$4,476,460.12	0	0
Hurricanes	5	$1,041,572.21	$1,295,882.13	0	0
Riverine Flooding	5	$0.00	$0.00	0	0
Severe Weather	71	$18,262,979.95	$0.00	0	0
Tornado	6	$635,188.16	$0.00	0	9
Winter Storms	66	$0.00	$0.00	0	0
Richmond	211	$7,268,586.05	$4,160,893.61	0	2
Coastal Storms	3	$2,156,905.99	$0.00	0	0
Drought	2	$0.00	$2,984,306.75	0	0
Hurricanes	2	$139,484.52	$877,995.60	0	0
Riverine Flooding	6	$954,781.12	$291,981.99	0	0
Severe Weather	119	$210,968.24	$6,609.27	0	0
Tornado	11	$3,785,259.67	$0.00	0	2
Winter Storms	68	$21,186.50	$0.00	0	0
Westmoreland	211	$2,729,405.29	$8,755,578.09	0	0
Coastal Storms	5	$250,709.66	$0.00	0	0
Drought	2	$0.00	$7,460,766.87	0	0
Hurricanes	3	$540,637.68	$1,135,471.65	0	0
Riverine Flooding	8	$284,682.44	$80,295.05	0	0
Severe Weather	115	$271,110.51	$0.00	0	0
Tornado	7	$1,361,078.49	$79,044.52	0	0
Winter Storms	71	$21,186.50	$0.00	0	0

Source: NOAA NCEI Storm Events Database

Table 4-2. Total Unique Hazard Events in the Northern Neck (January 2017)

Hazard	Total Unique Events
Coastal Storms	11
Drought	3
Hurricanes	7
Riverine Flooding	12
Severe Weather	345
Tornado	26
Winter Storms	93
Total:	**497**

Source: NOAA NCEI Storm Events Database

Table 4-1 only summarizes the NCEI database hazards and does not include other hazards that will be discussed in the analysis, such as earthquakes, wildfire and coastal erosion. These estimates are also believed to be an underrepresentation of the actual damages since some hazard losses go unreported or are difficult to accurately quantify; this is especially true with crop damage. Other best available national and local datasets were used in some hazard sections to quantify losses.

4.2.3 Presidential Disaster Declarations

The Federal Emergency Management Agency (FEMA) maintains the National Disaster Declarations Summary dataset. The first disaster declared in the national dataset was in 1953, and was supplemented with fire management assistance wildfire declarations per the Robert T. Stafford Disaster Recovery Act and related Department of Homeland Security regulations. For an event to be declared a disaster by FEMA, the Governor of Virginia must first declare a state of emergency and then formally demonstrate to the President that Commonwealth and local government resources to support disaster recovery are exhausted necessitating Federal assistance. Table 4-3 shows the FEMA Disaster Declarations Summary for events declared within the Northern Neck from 1953 to January, 2017. There were 14 major disasters declarations issued since 1969 and six emergency declarations issued since 1993, totaling 20 declarations.

Table 4-3. FEMA Declared Disasters for Northern Neck (1953-2017)

Disaster Number	Disaster Type	Incident Type	Incident Begin Date	Programs Declared			
				IH	IA	PA	HM
274	Major Disaster	Hurricane	8/23/1969	No	Yes	Yes	Yes
339	Major Disaster	Flood	6/23/1972	No	Yes	Yes	Yes
525	Major Disaster	Freezing	1/26/1977	No	Yes	No	No
3046	Emergency	Drought	7/23/1977	No	No	Yes	Yes
755	Major Disaster	Flood	11/9/1985	No	Yes	Yes	Yes
3112	Emergency	Snow	3/13/1993	No	No	Yes	Yes
1014	Major Disaster	Snow	2/8/1994	No	No	Yes	Yes
1086	Major Disaster	Snow	1/6/1996	No	No	Yes	Yes

Table 4-3. FEMA Declared Disasters for Northern Neck (1953-2017)

Disaster Number	Disaster Type	Incident Type	Incident Begin Date	Programs Declared			
				IH	IA	PA	HM
1135	Major Disaster	Hurricane	9/5/1996	No	Yes	Yes	Yes
1293	Major Disaster	Hurricane	9/13/1999	No	Yes	Yes	Yes
3147	Emergency	Hurricane	9/13/1999	No	No	Yes	No
1318	Major Disaster	Severe Storm(s)	1/25/2000	No	No	Yes	Yes
1491	Major Disaster	Hurricane	9/18/2003	Yes	Yes	Yes	Yes
3240	Emergency	Hurricane	8/29/2005	No	No	Yes	No
1661	Major Disaster	Severe Storm(s)	8/29/2006	No	No	Yes	Yes
4024	Major Disaster	Hurricane	8/26/2011	No	No	Yes	Yes
3329	Emergency	Hurricane	8/26/2011	No	No	Yes	No
4045	Major Disaster	Severe Storm(s)	9/8/2011	No	No	Yes	Yes
4092	Major Disaster	Hurricane	10/26/2012	Yes	No	Yes	Yes
3359	Emergency	Hurricane	10/26/2012	No	No	Yes	No

FEMA Disaster Declarations Summary – Open Government Dataset. https://www.fema.gov/media-library/assets/documents/28318

4.2.4 Hazard-Specific Datasets

The level and type of analysis that can be completed in the vulnerability assessment is dependent on the type and quality of data available. Table 4-4 provides a breakdown, by hazard, of the datasets used for this analysis and mapping in the hazard-specific sections that follow.

Best Available Data:

a. The recent NOAA national shoreline erosion evaluation was not granular enough to be relevant for planning district commission level or county planning so the College of William and Mary Virginia Institute of Marine Science county coastal erosion studies were used for each county as these represented the best available data. As coastal erosion rates are accelerating due to sea level rise and climate change it is anticipated that updated data will be available when the plan is updated during 2021 to 2022.
b. Building footprint data was available for Richmond and Westmoreland Counties, allowing a more precise flood hazard vulnerability analysis.
c. Preliminary 2020 Census information was used to assist with vulnerability analysis using updated population and property demographics.
d. Department of Forestry county wildfire occurrence information has not been available for several years so more detailed analysis of wildfire risk and vulnerability was limited.
e. Coastal hazards can be characterized in several ways. Damage information datasets often overlap or there are gaps among damages characterized by NOAA or FEMA as “coastal storm,” “hurricane,” “tropical depression,” etc. Coastal erosion damages are not specified but the risk exposure to structures proximate to the region’s shorelines is significant and coastal erosion resulting from these storm events does cause significant property damage.

Table 4-4. Hazard Specific Data Used for Analysis and Mapping

Hazard	Dataset	Source
Riverine and Coastal Flooding	Digital Flood Insurance Rate Maps (DFIRMs)	Federal Emergency Management Agency (FEMA)
	NFIP Policy & Claims	FEMA
	Repetitive & Severe Repetitive Loss Properties	FEMA
	NCEI Storm Events Database	NOAA NCEI
	FEMA HAZUS-MH	FEMA
	2012 U.S. Census Block Property Value	U.S. Census Bureau
Coastal Erosion	Shoreline Evolution Studies for Lancaster (2006), Northumberland (2006), Richmond (2011), and Westmoreland (2012) Counties	Virginia Institute of Marine Science
	2012 U.S. Census Block Property Value	U.S. Census Bureau
Hurricanes/Tropical Storms	NCEI Storm Events Database	NOAA NCEI
Severe Weather (thunderstorms, high wind, hail, and lightning)	NCEI Storm Events Database	NOAA NCEI
Tornadoes	NCEI Storm Events Database	NOAA NCEI
Winter Storms	NCEI Storm Events Database	NOAA NCEI
Drought	Agriculture General Information by County	2012 U.S. Census of Agriculture
	NCEI Storm Events Database	NOAA NCEI
Wildfires	Wildland Urban Interface (WUI) geospatial dataset	SILVIS Lab, University of Wisconsin - Madison
	Wildfire Risk Assessment model	2003 Virginia Department of Forestry (VDOF)

Table 4-4. Hazard Specific Data Used for Analysis and Mapping

Hazard	Dataset	Source
	Historical Wildfires in Virginia	VDOF
Earthquake	Latest Earthquakes	US Geologic Survey (USGS)

4.3 Risk Assessment

The purpose of the hazard identification and risk assessment is to provide a factual basis for developing mitigation strategies by prioritizing areas most threatened and vulnerable to natural hazards. During the Kickoff meeting for the plan held on February 27, 2017, the natural hazards applicable to the Northern Neck were discussed in terms of frequency and historic damages.

A standardized methodology, which allows for greater flexibility and room for subject matter expertise, was developed to compare different hazards' risk for the 2017 update. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCEI database and other available data sources. Some of the hazards assessed in the HIRA analysis did not have quantifiable probability or impact data, thus a semi-quantitative ranking system was used to compare all of the hazards of interest instead. The factors assessed include:

- ***Frequency of Events:*** Primarily based on the NCEI data for a specific hazard, a score from significant to low was given based on the annualized number of events for a given hazard. Significant was four or more times in a year, medium was between one and four times in a year, and low was less than one time annually. Not Applicable (N/A) is used when no events were recorded.
- ***Hazard Impact (Property Damages):*** Primarily based on the NCEI damages, scores from significant to low were given based on annual property damages provided and possible future damages.
- ***Northern Neck Ranking:*** A score was given from significant to low based on the feedback from local officials during the Kick-Off Meeting. Local officials are respected sources of information, and not all events are recorded in national, or state-wide databases.
- ***Warning Time:*** Based on how much perceived warning time would be given for a particular event. A hazard was ranked low for warning times of three or more days before an event. If an event can happen with less than 24 hours of warning time, it is ranked significant.
- ***Potential Exposure:*** Primarily based on the NCEI damages, scores from significant to low were assigned based on annual total damages provided and possible future damages. Unlike the Hazard Impact, potential crop damage was considered in addition to property damage.

A score of 0 to 3 was assigned to the ranking for each factor. A composite score for each hazard was computed by multiplying each factor's ranking score by the importance factor. Based on this total score, the hazards are separated into three categories based on the hazard level they pose to the communities: Significant, Moderate, and Limited. Table 4-5 summarizes the categories used to rank the hazards and their weighted values for the Composite Hazard Index. The overall hazard rankings are provided at the end of this section in Table 4-49. Hazard Rankings and Risk Assessment.

Table 4-5. Hazard Ranking Parameters

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure
1.5	1	2	0.5	1
Significant Events Recorded more than 4 times annually	**Significant** Annual Damages Exceeded $100,000 annually (adjusted for inflation)	**Significant** Ranked Hazard as Significant	**Significant** Less than 24 hours	**Significant** Vulnerability Analysis showed that Exposure Exceeded $1.0 Million
Medium Event Recorded between 1 to 3.9 times annually	**Medium** Annual Damages between $10,000 and $100,000 annually (adjusted for inflation)	**Medium** Voted Hazard as Moderate	**Medium** At least 1 Day	**Medium** Vulnerability Analysis showed Exposures between $100,000 and $1.0 Million
Low Events Recorded less than 1 time annually	**Low** Annual Damages less than $10,000 annually (adjusted for inflation)	**Low** Voted Hazard as Limited	**Low** At least 2 Days	**Low** Vulnerability Analysis showed Exposures less than $100,000
N/A Events not recorded	**N/A** No damages of any type were recorded	**N/A** Did not vote on Hazard	**N/A** 3 or more Days	**N/A** No potential exposure was analyzed or calculated

4.4 Vulnerability Assessment Overview

4.4.1 Critical Facilities

A critical facility is defined as a facility in the public or private sector that provides essential products and services to the general public; is necessary to preserve the welfare and quality of life in the community; or fulfills important public safety, emergency response, and/or disaster recovery functions. Examples include public safety facilities (police, fire, and emergency medical services), cell towers, courthouses, medical facilities, utilities, transportation networks and schools. Table 4-6 summarizes the number of critical facilities by type in the Northern Neck and Figure 4-1 maps their relative location. It is difficult to discern the exact location of the critical facilities on this map due to map scale and the co-location of many of these facilities.

More localized maps and additional critical facilities data and analysis can be found in the redacted Appendix G due to the sensitive nature of secure data within Northern Neck.

Table 4-6. Critical Facilities in Northern Neck

Facility Type	Number of Facilities
Emergency Medical Services (EMS)	8
Emergency Operations Centers (EOC)	5
Fire	11
Government	1
Medical	20
Police	9
School	17
Utility	13
Total	**80**

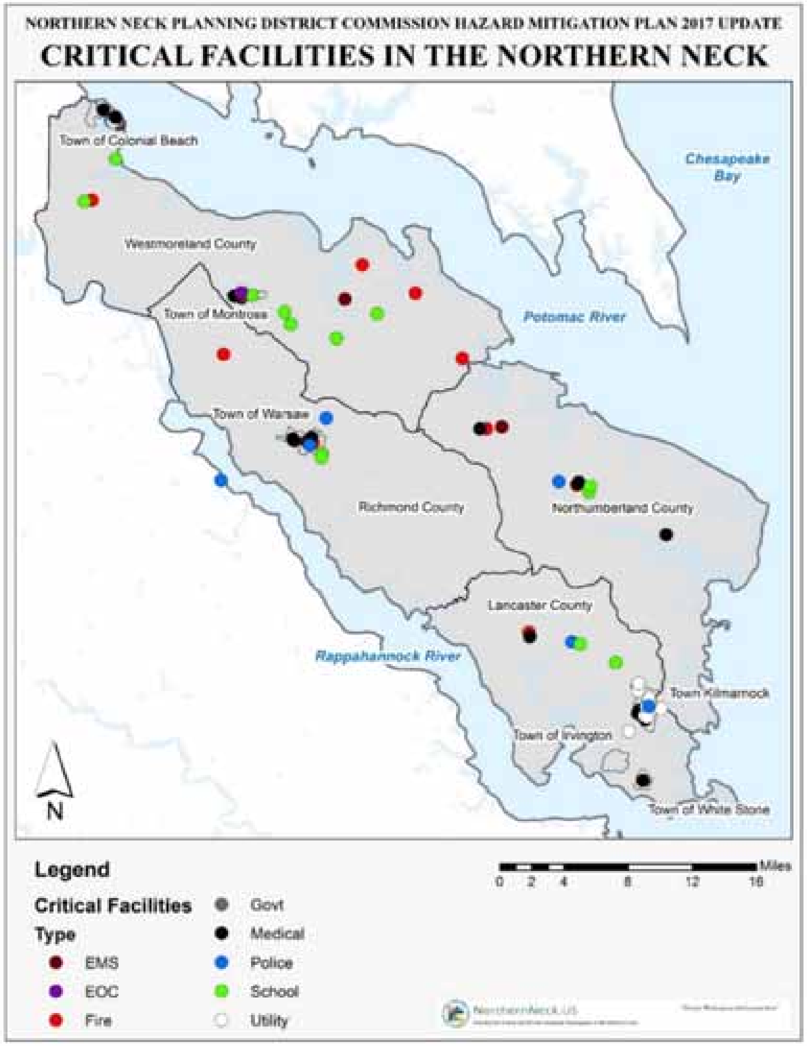

Figure 4-1. Critical Facilities in the Northern Neck

4.4.2 Building data

Building footprint data for Westmoreland and Richmond Counties was provided through the Virginia Geographic Information System Clearing House. The Virginia Geographic Information Network (VGIN), a part of the Clearinghouse, coordinates the development and maintenance of a statewide building footprint data layer in conjunction with local governments to create a seamless feature class with building footprints to complement the Virginia Base Mapping Program (VBMP). Building footprint data for Lancaster County or Northumberland County was not available so Census block information was used.

4.5 Riverine Flooding

4.5.1 Description

Flooding is the most frequent and costly natural hazard in the United States. A majority of presidential disaster declarations result from weather events where flooding was a major component. Flooding, as defined by the National Flood Insurance Program for insurance purposes is: "a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of inland or tidal waters, unusual and rapid accumulation or runoff of surface waters from any source, or a mudflow."

Floods generally result from excessive precipitation, and can be classified under two categories: general floods, precipitation within a watershed for an extended period of time that may include storm-induced wave or tidal action; and flash floods, the product of heavy localized precipitation in a short time period over a more localized location. The severity of a flood event is typically determined by a combination of several factors, including: stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing and impervious surface. This section will focus on riverine flooding, however there is also urban draining flooding and coastal flooding. Coastal flooding will be addressed in more detail in Section 4.6.

Riverine flooding occurs when a channel, such as a stream or river, receives more water than it can hold and the excess water overflows the channel banks flooding the surrounding area. Heavy rain and large amounts of snow melt can cause riverine flooding. In the Northern Neck, nor'easters, tropical storms, and hurricanes have been known to cause severe riverine flooding due to high rainfall rates. Nor'easters are very slow moving storms that rotate in a counter-clockwise direction that can also generate flooding and runoff when soil infiltration rates are exceeded.

4.5.2 Location and Extent

The Northern Neck is boarded by the Potomac River, Rappahannock River, and the Chesapeake Bay. The close proximity of multiple large rivers to this region puts it at high risk of experiencing riverine flooding. Areas of risk are delineated by the floodplain, an area typically adjacent to rivers, streams and shorelines that experiences periodic flooding that is expected to occur based upon established recurrence intervals. The recurrence interval of a flood is defined as the average time interval, in years, expected between a flood event of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

Floodplains are designated by the frequency of the flood that is large enough to inundate the area. Flood frequencies such as the 100-year flood are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. Another way of expressing the flood frequency is the chance of occurrence at any time, which is expressed as a percentage of the probability of flooding each year. For example, the 100-year flood has a one percent chance of occurring at any time. The 500-year flood zone has a 0.2 percent chance of occurrence in any given year. Flood Insurance Rate Maps (FIRMs) are developed as part of a FEMA Flood Insurance Study (FIS) to delineate the areas that are at risk of being flooded during a one percent chance or 100-year flood event. The one percent chance floodplains are also referred to as the Special Flood Hazard Area (SFHA).

The SFHA shown on a FIRM is typically labeled as Zones A/AE/AO/AH (areas subject to inundation by the one-percent-annual-chance, or 100 year flood event) and Zone VE (areas subject to inundation by the one-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action). FIRMs also delineate the 500-year flood event (0.2 percent annual chance of being equaled or exceeded). The 500-year flood event is labeled as a shaded X Zone. Areas of minimal flood hazard, outside the SFHA and higher in elevation than the 500-year flood zone, are labeled as unshaded X Zones.[3] It is important to note that while FEMA digital flood data is recognized as best available data for planning purposes, it does not always reflect the most accurate and up-to-date flood risk. Flooding and flood-related losses often do occur outside of delineated special flood hazard areas.

Figure 4-2 illustrates the location and extent of the higher risk flood zones (SFHA) in the Northern Neck based on the effective FEMA FIRMs for Lancaster, Northumberland, Richmond, and Westmoreland counties.

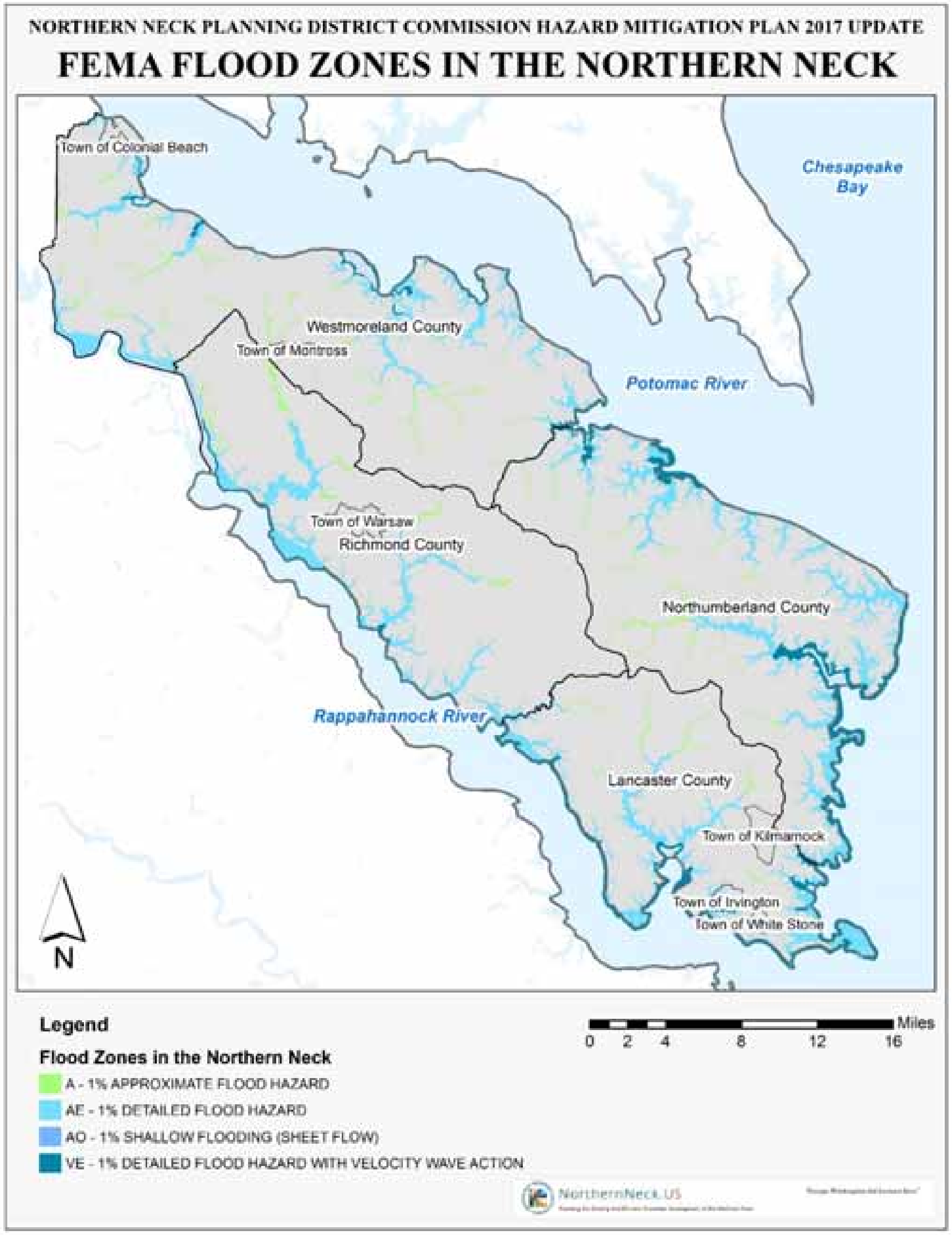

Figure 4-2. FEMA Flood Zones in the Northern Neck

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[3] https://www.fema.gov/flood-zones

4.5.3 Previous Occurrences

According to the NCEI database, there have been 12 riverine flood events recorded in the Northern Neck since 1996. These events, in particular flash floods, have caused more than $1.2 million in property damage (in 2017 dollars) and $370,000 in crop damage (Table 4-1). Table 4-7 lists the most significant of these events. While these events were caused by tropical storms or hurricanes, the specific events reported are the result of heavy rainfall associated with the storm, not flooding caused by storm surge which will be addressed in subsequent sections.

Table 4-7. Previous Occurrences of Flooding Events

Event Date	Hazard History
9/16/1999	Very heavy rain from Hurricane Floyd produced widespread flooding and flash flooding across much of central and eastern Virginia. The flooding was considered to be a 500-year flood of record. Richmond and Westmoreland counties reported property damages totaling $850,000 and crop damages of about $255,000.
8/27/2011	Heavy rains associated with Hurricane Irene produced widespread low-land flooding across much of the Northern Neck, including roadways which were washed out or closed. Storm total rainfall generally ranged from six to eleven inches. Lottsburg reported 8.67 inches of rain. Newland reported 10.50 inches of rain. Montross reported 7.20 inches of rain.
9/8/2011	The combination of the remnants from Tropical Storm Lee and a frontal boundary draped over the region caused heavy rain which produced flash flooding across portions of central and eastern Virginia. In Westmoreland, many streets were closed by VDOT and the Fire Department. Many homes were flooded on Washington and Irving Streets. Flooding was also reported on Monticello Road.
10/29/2012	Superstorm Sandy which moved northward well off the Mid-Atlantic coast produced heavy rain which caused flooding across much of eastern and southeast Virginia. Numerous roads were closed due to flooding. Total rainfall ranged from three to ten inches across the Northern Neck. Total rainfall of 9.90 inches was reported at Reedville. Total rainfall of 6.77 inches was reported at Lottsburg.

4.5.4 Probability of Future Events

Riverine flood events will continue to occur frequently in the Northern Neck due to the location of the area between two major rivers and the Chesapeake Bay. The probability of future flood events is based on historic storm magnitude and best available data. Further, it is highly likely that the Northern Neck will continue to experience inland flooding as a result of tropical storms, hurricanes, and Nor'easters. Based on the annualized events from the NCEI database (Table 4-51) the Northern Neck can expect at least one riverine flooding event every two years and an average of $73,000 in property and crop damages.

It should also be noted that short duration high intensity rainfall events are increasing in the United States.[4] While annual rainfall has not increased dramatically during the last decade, the intensity and magnitude of storms has. As a result, a flood event that is currently a two percent annual probability (50-year) flood may become a 10 percent annual probability (10-year) flood.

4.5.5 FEMA National Flood Insurance Program Participation

The National Flood Insurance Program (NFIP) is a federal program that enables property owners in participating communities to purchase insurance for flood losses. For a community to participate in the NFIP they must adopt FEMA's flood risk maps and the Flood Insurance Study as well as floodplain management regulations that reduce future flood damages.

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. Nationally, flood damage is reduced by nearly $1 billion annually through community implementation of sound floodplain management requirements, and property owner purchase of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80% less damage annually than those which predate floodplain management regulations or are not built in compliance.

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the nation's floodplains. Mapping of flood hazards creates broad-based awareness of these hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance.

Floodplain management regulations are the cornerstone of NFIP participation. Communities that participate in the NFIP are expected to adopt and enforce floodplain management regulations. These regulations apply to all types of floodplain development and ensure that development activities will not cause an increase in future flood damages. Buildings are required to be elevated at or above the Base Flood Elevation which is the predicted level of the one-percent flood.

Communities that participate in the NFIP are required to adopt and enforce the minimum federal NFIP floodplain management regulations. These regulations apply to all types of floodplain development and ensure that development activities will not cause an increase in future flood damages. Buildings are required to be reasonably safe from flooding which usually requires the finished floor elevation at or above the site's Base Flood Elevation (BFE). The BFE is determined based on modeling and mapping detailed in the community's Flood Insurance Study (FIS). The FIS and its corresponding Flood Insurance Rate Maps (FIRMs) provide information on areas of flood risk per NFIP standards. FIRMs identify areas that have a one-percent annual chance of flooding as well as those areas with a 0.2%-annual chance of flooding. When new structures are built, or existing structures are improved at more than 50 percent of their market value, they are required to adhere to floodplain management regulations. If the structure is financed through a federally insured loan, there is a mandatory flood insurance purchase requirement. Many mortgage lenders in high hazard areas are now requiring flood insurance even for structures outside of the regulated floodplain. Insuring high risk structures is one method used by the NFIP to offset the escalating costs of flood disasters.

[4] Westra, S., H. J. Fowler, J. P. Evans, L. V. Alexander, P. Berg, F. Johnson, E. J. Kendon, G. Lenderink, and N. M. Roberts (2014), Future changes to the intensity and frequency of short-duration extreme rainfall, Rev. Geophys., 52, 522–555, doi:10.1002/2014RG000464.

The Towns of Irvington, Kilmarnock, White Stone, and Colonial Beach as well as the unincorporated parts of Lancaster, Northumberland, Richmond, and Westmoreland Counties participate in the NFIP but do not participate in the Community Rating System. The Town of Montross in Westmoreland County and the Town of Warsaw in Richmond County do not participate in the NFIP. NFIP participation and the current effective map dates of each county and town are listed in Table 4-8. The Reg-Emer Date is the date the community first joined the NFIP. All jurisdictions listed below participate in the "Regular" Program. The Town of Warsaw does not participate in the NFIP.

Table 4-8. FEMA NFIP Participation Dates[5]

County	Jurisdiction	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Reg-Emer Date
Lancaster	Irvington, Town of	10/18/74	8/4/87	10/2/14	08/04/87
	Kilmarnock, Town of	N/A	9/17/10	10/2/14	09/17/10
	Unincorporated County	1/24/75	3/4/88	10/2/14	03/04/88
	White Stone, Town of	8/30/74	9/24/84	10/02/14	09/24/84
Northumberland	Unincorporated County	12/13/74	7/4/89	2/18/15	07/04/89
Richmond	Unincorporated County	4/11/75	3/16/89	4/16/15	03/16/89
Westmoreland	Colonial Beach, Town of	8/9/74	9/18/87	4/16/15	09/18/87
	Unincorporated County	7/18/75	9/18/87	4/16/15	09/18/87

Table 4-9 shows the total policies in force in the Northern Neck, 1,942 policies, and their associated insurance value and premiums. Table 4-10 summarizes the NFIP policy and claim statistics for the counties and towns within the Northern Neck Planning District Commission. Reported losses include all flooding events. It should be emphasized that these numbers include only those losses to structures that were insured through the NFIP, and losses in which claims were sought and received except for those labeled as Closed Without Payment (CWOP). It is likely that there are additional instances of flood losses in the counties and towns that were uninsured, denied claims payment, or not reported.

Table 4-9. NFIP Policies in Force[6]

County	Jurisdiction	Policies In-Force	Insurance In-Force Whole $	Written Premium In-Force
Lancaster	Irvington, Town of	13	$3,585,900	$27,876

[5] FEMA. Community Status Book Report. Virginia. https://www.fema.gov/cis/VA.html

[6] FEMA. Policy Statistics as of 12/31/2016.

Table 4-9. NFIP Policies in Force[6]

County	Jurisdiction	Policies In-Force	Insurance In-Force Whole $	Written Premium In-Force
	Kilmarnock, Town of	2	$700,000	$830
	Unincorporated County	589	$164,332,200	$582,511
	White Stone, Town of	3	$721,200	$4,279
Northumberland	Unincorporated County	735	$220,102,400	$536,772
Richmond	Unincorporated County	84	$22,489,400	$82,130
Westmoreland	Colonial Beach, Town of	206	$53,226,100	$141,451
	Unincorporated County	310	$93,020,500	$224,566
Total	**Northern Neck**	**1942**	**$558,177,700**	**$1,600,415**

Table 4-10. NFIP Claims as of 31 January 2017[7]

County	Jurisdiction	Total Losses	Closed Losses	Open Losses	CWOP Losses	Total Payments
Lancaster	Irvington, Town of	15	12	0	3	$268,192.03
	Kilmarnock, Town of	N/A	N/A	N/A	N/A	N/A
	Unincorporated County	365	294	0	71	$5,656,672.35
	White Stone, Town of	11	5	0	6	$63,849.49
Northumberland	Unincorporated County	391	290	0	101	$6,934,255.31
Richmond	Unincorporated County	84	78	0	6	$1,764,532.32
Westmoreland	Colonial Beach, Town of	81	71	0	10	$3,585,030.95
	Unincorporated County	131	95	0	36	$2,738,975.05
Total	**Northern Neck**	**1,078**	**845**	**0**	**233**	**$21,011,508**

An NFIP survey was sent to the four Northern Neck Counties to document how each actively participates in the NFIP. These questions ask about floodplain identification and mapping, floodplain management, and flood insurance. The survey and answers for each County can be found in Appendix J.

4.5.6 FEMA Repetitive Loss and Severe Repetitive Loss Properties

FEMA defines a Repetitive Loss (RL) property as: "any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP"[8]. A Severe Repetitive Loss (SRL) property is any property that: "has four or more separate claim payments of more than $5,000 each; or has two or more separate claim

[7] FEMA. Loss Statistics Country Wide as of 01/31/2017.

[8] FEMA. National Flood Insurance Program: Frequently Asked Questions. https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt

payments where the total payments exceeds the current building value of the property"[9]. Nationwide, RL properties constitute two percent of all NFIP insured properties, but are responsible for 40% of all NFIP claims. Mitigation for RL and SRL properties is a high priority for FEMA.

The identification of RL and SRL properties is an important element to conducting a local flood risk assessment, as the inherent characteristics of properties with multiple flood losses strongly suggest that they are at a high risk of future flood losses. RL and SRL properties are also important to the NFIP, since structures that flood frequently put a strain on NFIP funds. A primary goal of FEMA is to reduce the numbers of structures that meet these criteria, whether through elevation, acquisition, relocation, or a flood control project that lessens the potential for future losses. Since FEMA's database tracks RL and SRL properties on a rolling ten-year basis, the number of properties fluctuates based on flooding events.

Using the redacted data provided by the Virginia Department of Conservation and Recreation State NFIP Coordinator, the Northern Neck has 189 RL properties and five SRL properties. The current RL and SRL list may not represent all properties that have been previously affected or could be affected by future flooding. Table 4-11 and Table 4-12 shows severe repetitive losses per each Northern Neck community. All of the severe repetitive loss properties in the Northern Neck are residential. There are no repetitive loss properties in Kilmarnock and White Stone when this plan was submitted for FEMA review in September 2017.

Figure 4-3 shows the general location of RL and SRL properties within the Northern Neck.[10]

Table 4-11. Repetitive Loss Structures in the Northern Neck

County	Jurisdiction Name	RL Buildings	RL Losses	Residences	Non-Residential	Condominiums	2 – 4 Family	Total Payments	Property value
Lancaster County	Unincorporated Areas, Lancaster County	67	152	64		2	1	$3,726,597	$30,012,6465B
Lancaster County	Town of Irvington	1	2		1			$75,789	$451,039
Northumberland County	Unincorporated Areas, Northumberland County	72	173	66	1	4		$4,495,717	$40,014,093B

[9] FEMA. Guidance for Severe Repetitive Loss Properties. https://www.fema.gov/pdf/nfip/manual201205/content/20_srl.pdf

[10] NFIP repetitive loss data is protected under the federal Privacy Act of 1974 (5 U.S.C. 552a) which prohibits personal identifiers (i.e., owner names, addresses, etc.) from being published in local mitigation plans.

Table 4-11. Repetitive Loss Structures in the Northern Neck

County	Jurisdiction Name	RL Buildings	RL Losses	Residences	Non-Residential	Condominiums	2 – 4 Family	Total Payments	Property value
Richmond County	Unincorporated Areas, Richmond County	16	51	8	8			$1,265,458	$3,784,628
Westmoreland County	Unincorporated Areas, Westmoreland County	20	43	18	2			$2,063,133	$3,563,409
Westmoreland County	Town of Colonial Beach	13	30	10	3			$1,452,579	$5,371,179
Total	**Northern Neck**	**189**	**451**	**173**	**11**	**6**	**1**	**$13,079,273**	**$70,039,909 B**

Table 4-12 shows severe repetitive losses per each Northern Neck community. All of the severe repetitive loss properties in the Northern Neck are residential.

Table 4-12. Severe Repetitive Loss Structures in the Northern Neck

County	Jurisdiction Name	SRL Buildings	Number of Claims	Building Payments	Average Claim	Property Value
Northumberland County	Unincorporated Areas, Northumberland County	4	18	$362,730	$22,144	$1,067,177
Richmond County	Unincorporated Areas, Richmond County	1	5	$97,464	$24,036	$89,604
Total	**Northern Neck**	**4**	**23**	**$460,194**	**$23,090**	**$1,156,781**

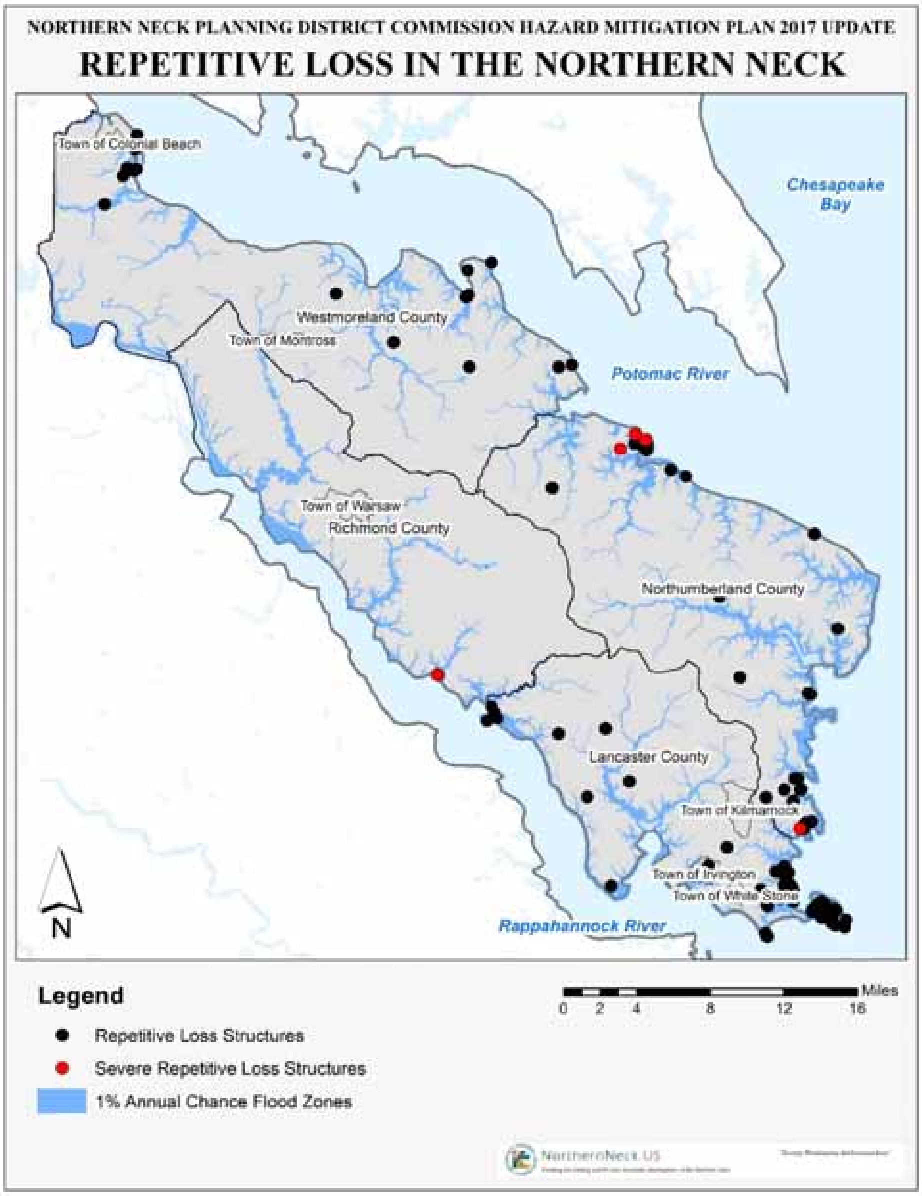

Figure 4-3. Repetitive Loss and Severe Repetitive Loss Properties

4.5.7 Vulnerability and Risk Assessment

Table 4-13 shows the annualized damages for riverine flooding in the Northern Neck. The NCEI Storm Events data was annualized by taking the total number of riverine flooding events and dividing by the length of record. Annualized values should only be used as an estimate of what can be expected during any year. Using historical records, individual counties can expect to experience one event every three to five years. The Northern Neck can expect to experience a riverine flooding event once every two years. Annual total damages (adjusted for inflation) from these events for each county was found to be between $0 and $56,671, though it is possible that actual annual damages in some counties could be higher due to unreported damages. There are no expected deaths or injuries from these events but nationally deaths due to vehicular accidents during floods is increasing.

Table 4-13. Annualized Damages from Riverine Flooding Events

Riverine Flooding	Annualized Events	Annualized Property Damages	Annualized Crop Damage	Annualized Total Damage	Annualized Deaths	Annualized Injuries
Lancaster	0.2	$0	$0	$0	0	0
Northumberland	0.2	$0	$0	$0	0	0
Richmond	0.3	$43,399	$13,272	$56,671	0	0
Westmoreland	0.4	$12,940	$3,650	$16,590	0	0

4.5.7.1 Vulnerability and Impact to People and Property

Flooding has the greatest effect on the people living in the area impacted. Flooding directly impacts a community's ability to function by damaging homes and businesses, disrupting community services, and interrupting utility service. Flooded roadways can increase congestion on alternative routes and lengthen travel times for emergency vehicles and school buses. Businesses that are flooded may sustain damage to the structure and its contents, resulting in economic losses to the business.

Riverine and flash floods have the potential to pick up chemicals, sewage, and toxins from roads, factories, and farms; therefore, any property affected by a flood may be contaminated with hazardous materials and present a health and safety risk to residents. Debris from vegetation and structures may also become hazardous following the occurrence of a flood. In addition, floods may threaten water supplies and water quality, and create health issues such as mold. Damages from storm water runoff events also includes wall damage due to "wicking", mildew damage, damages to building contents, minor foundation damage, damage to water distribution systems, and potable water contamination. Public related costs include debris clearance; equipment, material and labor expenses related to emergency response; and building or facility repair or replacement (county parks, utilities, communications, buildings, vehicles, etc.).

A number of factors contribute to the relative vulnerabilities of certain areas in the floodplain. Development, or the presence of people and property in the hazardous areas, is a critical factor in determining vulnerability to flooding. Additional factors that contribute to flood vulnerability range from specific characteristics of the floodplain to characteristics of the structures located within the floodplain. The following is a brief discussion of some of these factors and how they may relate to the area.

- *Flood depth*: The greater the depth of flooding, the higher the potential for significant damages.
- *Flood duration*: The longer duration of time that floodwaters are in contact with building components, such as structural members, interior finishes, and mechanical equipment, the greater the potential for damage. Floodwaters may linger because of the low relief of the area, but the degree varies.
- *Velocity*: Flowing water exerts force on the structural members of a building, increasing the likelihood of significant damage. A one-foot depth of water, flowing at a velocity of five feet per second or greater, can knock an adult over and cause significant scour around structures and roadways.

- *Elevation*: The lowest possible point where floodwaters may enter a structure is the most significant factor contributing to its vulnerability to damage due to flooding. Data on the specific elevations of structures in the Northern Neck has not been compiled for use in this analysis.
- *Construction type*: Certain types of construction are more resistant to the effects of floodwaters than others. Masonry buildings, constructed of brick or concrete blocks, are typically the most resistant to flood damages simply because masonry materials can be in contact with limited depths of water without sustaining significant damage. Wood frame structures are more susceptible to flood damage because the construction materials used are easily damaged when inundated with water. The type of construction throughout the Planning District varies.

4.5.7.2 Total Exposure in Floodplain (TEIF) Analysis

In support of FEMA's RiskMAP Program, FEMA endeavored to produce national-level flood risk analyses to estimate the potential losses from flooding across the nation. This effort occurred during 2009 and 2010 and produced a product known as the 2010 Hazus Average Annualized Loss (AAL) Study Results. The 2010 AAL Study and its associated results were intended to be a mechanism for FEMA - as well as local stakeholders - to assist in the prioritization of flood mitigation activities across the lower 48 states. Further information on the 2010 AAL Results and its use in RiskMAP Risk Assessments can be viewed in Guidance for Flood Risk Analysis and Mapping (May 2014). Notably, there were some areas in which the Hazus software was unable to produce valid results for the 2010 AAL Study in certain coastal areas. A lack of estimated flood damages limited the ability to assess potential damage across the entirety of the regional geography.

An analysis was performed in order to estimate the Total Exposure in the Floodplain (TEIF) of the building stock in the Virginia Northern Neck region. Building footprint polygons were available for Richmond and Westmoreland counties through the Virginia Geographic Information Network (VGIN) and were used for the TEIF analysis. For Lancaster and Northumberland Counties, the TEIF method was applied at the 1,000 square foot Census Block level. The subsequent section describes the methodology and vulnerability assessment as part of this analysis.

TEIF Methodology for Building Footprints: TEIF uses the 2010 Topologically Integrated Geographic Encoding and Referencing (TIGER) Census block level data to assume the total property value for each census block within the county. The analysis divides that total census tract property value by the number of buildings in the tract, proportional to the area of each of the building footprints[11]. For example, if the total value of one census block is $1,000,000 and there are 10 equally sized 1,000 square foot buildings within the block, each building would be assigned a value of $100,000. If the buildings were not equal in size, they would receive more or less value proportional to the size of the other buildings within that block.

The building footprints are then intersected with the FEMA effective 100-year and 500-year floodplain data. The proportion of how much of each building lies within each floodplain is then used to calculate the value of the building's exposure to the floodplain. Due to a combination of the low resolution of the property values from the Census block data, the high resolution of the

[11] Building footprints shape file provided by VGIN.

buildings, and the assumption of total exposure within the floodplain, the exposed property values are extrapolated to 1000 square foot grids. This resolution best summarizes the results of the TEIF analysis at a countywide scale, identifies areas that may be more affected by a flood, and represents the uncertainty within this method of extrapolating building values from Census block property values.

TEIF Methodology for Census Blocks: When building footprints are not available, the 2010 Census TIGER block data is intersected with the effective 100-year and 500-year floodplain data directly. This method is also extrapolated to 1000 square foot grids because of some uncertainty in this approach. On a countywide scale, this method helps summarize areas with high valued property at risk of flooding.

TEIF Vulnerability Analysis and Assessment: The results of the analysis identified areas within each of the four counties that have high levels of flood exposure. The Unincorporated Areas of Lancaster County, Northumberland County, Westmoreland County, and the Town of Colonial Beach account for the most property value exposed to the floodplain accounting for 39%, 27%, 16%, and 12%, respectively, of the total damage within the Northern Neck.

For the Northern Neck Planning District Commission, the TEIF analysis showed that there is an estimated $346.8 million worth of property exposed to losses in the 100 year floodplain, and $425 million exposed to losses in the 500 year floodplain. A summary of the flood exposure for the Planning District Commission can be found in Table 4-14. All values are rounded to three significant figures.

Figure 4-4 and

Figure 4-5 map the results of the TEIF analysis for the 100 and 500 year floodplains for the entire Northern Neck area. TEIF analysis maps for each county can be found in Appendix B.

Table 4-14. TEIF Summary for Northern Neck

County	Jurisdictions	100 Year Exposure	500 Year Exposure
Lancaster	County Total	$131,000,000	$176,000,000
	Town of Irvington	$3,610,000	$3,720,000
	Town of Kilmarnock	$531,000	$531,000
	Town of White Stone	$0	$0
	Unincorporated Areas	$127,000,000	$172,000,000
Northumberland	County Total	$98,800,000	$113,000,000
Richmond	County Total	$16,000,000	$21,000,000
	Town of Warsaw	$0	$0
	Unincorporated Areas	$16,000,000	$21,000,000
Westmoreland	County Total	$101,000,000	$115,000,000
	Town of Colonial Beach	$42,100,000	$50,400,000
	Town of Montross	$155,000	$155,000
	Unincorporated Areas	$59,000,000	$64,600,000
Total	**Northern Neck**	**$346,800,000**	**$425,000,000**

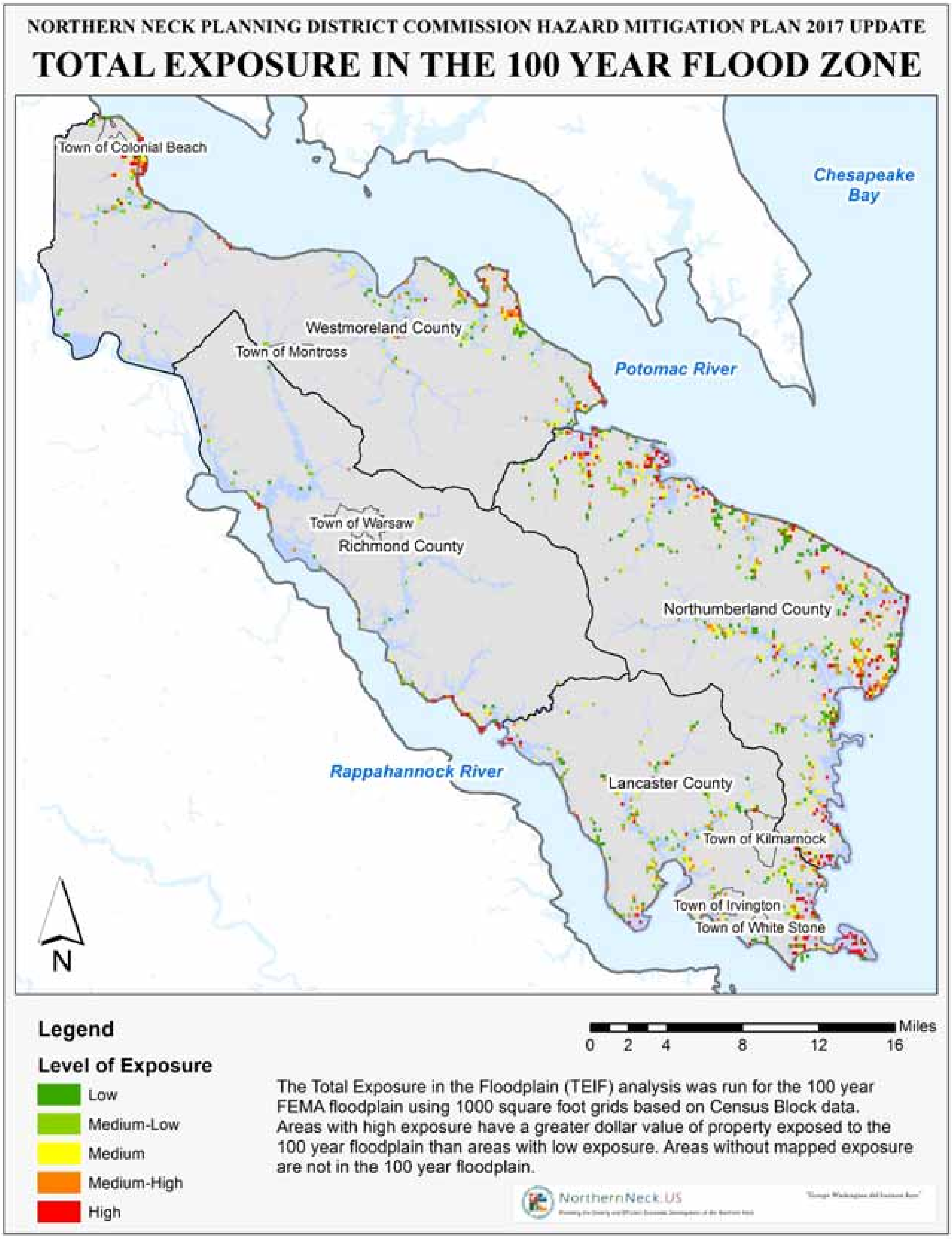

Figure 4-4. Total Exposure in the 100 Year Floodplain

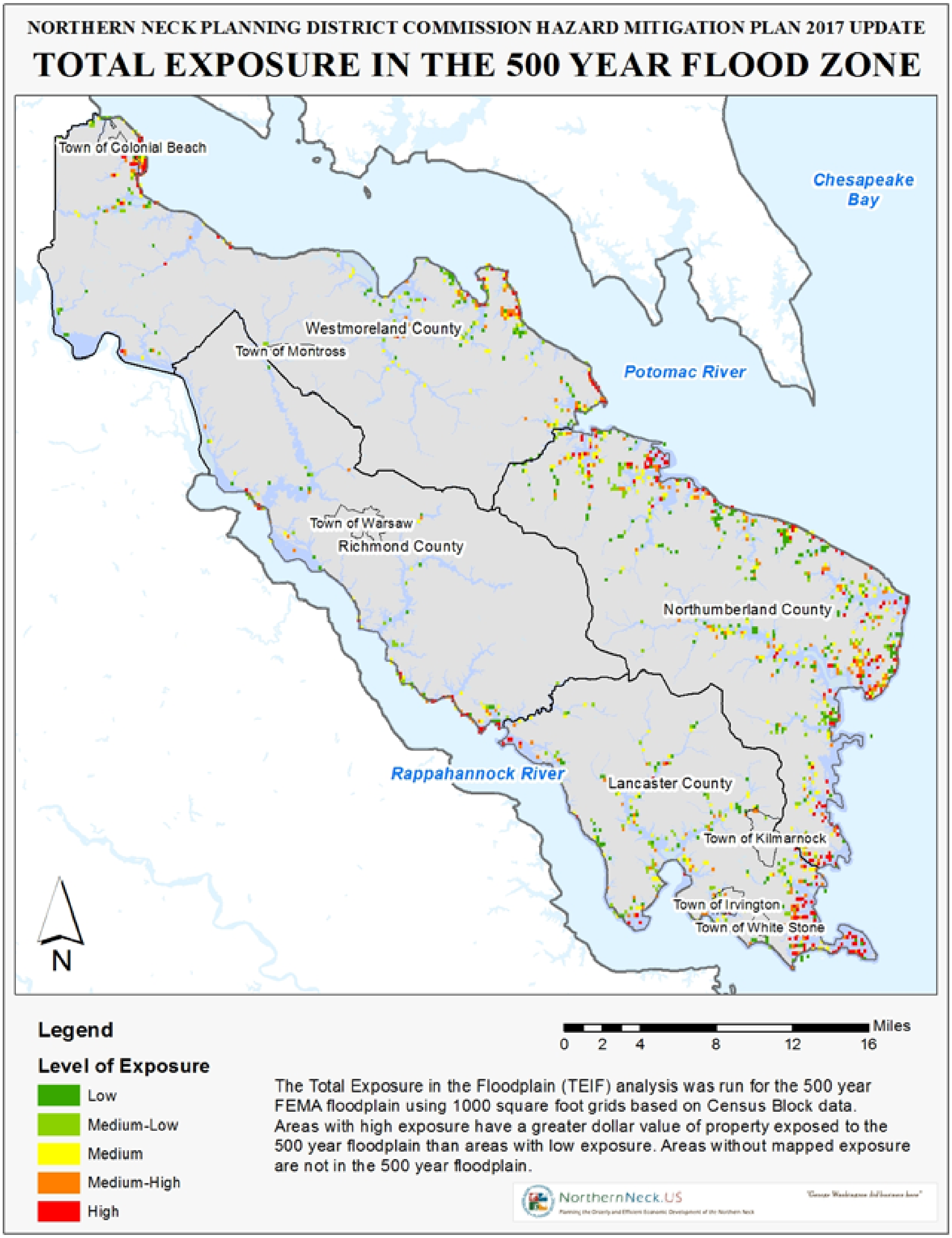

Figure 4-5. Total Exposure in the 500 Year Floodplain

4.5.7.3 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined riverine flooding to be a "significant" hazard in the Northern Neck. As described in the profile above, flood events within the region are likely events with between 1 and 3.9 events annually. Flood events have a "medium" range of impacts, accounting for annual property damages between $10,000 and $100,000 (adjusted for inflation). The potential exposure for flooding is "high" with $1 million or greater in potential damages. Warning time of at least one day is expected before an event. Table 4-15 outlines the hazard ranking for each of the hazard priority criteria related to riverine flooding.

Table 4-15. Riverine Flooding Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	Medium	Significant	Medium	Significant	Significant

4.6 Coastal Flooding

4.6.1 Description

Coastal flooding is the inundation of land areas along the coasts of oceans, bays, estuaries, coastal rivers by seawater that is greater than normal tide action. Coastal flooding is the result of storm surge caused by winds and forward motion associated with a storm that piles water up in front of it as it moves toward shore. This advancing surge combines with normal tides to create a storm tide that can increase the mean water level 15 feet or more. Severe storm surge is also frequently associated with nor'easters and hurricanes that impact the Northern Neck.

A nor'easter is a macro-scale cyclone that can form during the fall, winter, or early spring and produces heavy snow, high wind, and rain. The term "nor'easter" refers to the direction of the system's counter clockwise winds which usually manifests as an offshore air mass rotating counterclockwise northeast-to-southwest over the northwest quadrant of the cyclone or storm system. According to the National Weather Service, the U.S. East Coast provides an ideal breeding ground for nor'easters. During winter, the polar jet stream transports cold Arctic air southward across the plains of Canada and the United States, then eastward toward the Atlantic Ocean where warm air from the Gulf of Mexico and the Atlantic tries to move northward. The warm waters of the Gulf Stream help keep the coastal waters relatively mild during the winter, which in turn helps warm the cold winter air over the water. This difference in temperature between the warm air over the water and cold Arctic air over the land is the fuel that feeds nor'easters. High wind gusts, which can reach hurricane strength, are also associated with a nor'easter. The combination of high wind with heavy snow fall can result in blizzard conditions and can cause widespread power outages.

4.6.2 Location and Extent

The entirety of the Northern Neck is susceptible to the damaging effects of nor'easters due to its location adjacent to the Chesapeake Bay and near the Atlantic Ocean. Its low-lying coastal areas that are in close proximity to the shore, sounds, and estuaries are particularly exposed to the threat of flooding from storm surge and wind-drive waves that are associated with nor'easters.

Unlike a hurricane, a nor'easter can linger through several tides and cause more severe coastal flooding since each tide piles more water along shorelines and bays, becoming stationary or slow moving, continuing to spin and drench the impacted area. Nor'easters can also cause significant beach erosion that damages property and habitats.

Storm surge heights, wind speed, fetch length, pressure and associated waves are dependent upon the configuration of the continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). These as well as other factors can impact storm surge height and wave height. A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water in close proximity to the shoreline, tends to produce a lower surge but higher and more powerful storm waves. Table 4-16 highlights the general impacts of storm surge hazards.

Table 4-16. Storm Surge Impacts

Extent of Hazard (Storm Surge)	Impacts
High: 4-10 feet	Major structural flooding, loss of life, and major beach erosion
Medium: 3-4 feet	Flood damage to homes
Low: 0-3 feet	Damage to sea turtle nests, minor beach erosion

4.6.3 Previous Occurrences

The NCEI storm events database contains reports of 11 coastal flood events in the Northern Neck area totaling nearly $29 million in property damage. These events are primarily the result of storm surge associated with nor'easters and higher than average tidal flooding. Table 4-17 lists the notable coastal flood events that have affected the Northern Neck. When no community-specific description is given, the general description applies to the entire region.

Table 4-17. Notable Coastal Flooding Events

Event Date	Hazard History
January 27 – 28, 1998	A nor'easter battered eastern Virginia on Tuesday, January 27 and Wednesday, January 28. The slow movement of the storm combined with the highest astronomical tides of the month resulted in an extended period of gale to storm force onshore winds which drove tides to 6.44 feet above Mean Lower Low Water (MLLW) at Sewells Point in Norfolk. Locally moderate coastal flooding was reported across the Middle Peninsula and Northern Neck areas.
February 4 – 6, 1998	A nor'easter battered eastern Virginia from Tuesday, February 3rd through Thursday, February 5th. The slow movement of the storm resulted in an extended period of gale to storm force onshore winds which drove tides to 7.0 feet above Mean Lower Low Water (MLLW) at Sewells Point in Norfolk.
September 1, 2006	Tides of 4 to 5 feet above normal, combined with 6 to 8 foot waves caused significant damage to homes, piers, bulkheads, boats, and marinas across portions of the Virginia's Northern Neck and Eastern Shore. Some of the most significant damage occurred in the Lewisetta area of Northumberland County. More

Table 4-17. Notable Coastal Flooding Events

Event Date	Hazard History
	than $21 million in damage was reported in the Northern Neck from this event.
November 12 – 14, 2009	An intense Nor'easter produced moderate to severe coastal flooding across much of eastern and southeast Virginia and the Virginia Eastern Shore. Several streets, homes and businesses were flooded in low lying areas that are close to or directly exposed to the Chesapeake Bay. There were also damaged piers, bulkheads, and groins.
October 28 – 29, 2012	Superstorm Sandy moved northward well off the Mid-Atlantic Coast then northwest into extreme southern New Jersey produced very strong northeast winds followed by very strong west or northwest winds. Very strong winds caused moderate to severe coastal flooding across portions of eastern and southeast Virginia. Water levels reached 2.0 feet to 3.5 feet above normal adjacent to the Chesapeake Bay and Rappahannock River resulting in moderate to severe coastal flooding. Reported property damages totaled more than $600,000 in the Northern Neck.
October 2– 5, 2015	A combination of Hurricane Joaquin near the Bahamas and strong high pressure over New England produced strong onshore winds over the Mid-Atlantic. The strength and duration of the onshore winds produced moderate coastal flooding along the Atlantic Coast and Chesapeake Bay. A tidal departure of 2 to 3 feet resulted in moderate flooding along the Rappahannock River, Potomac River, and Chesapeake Bay. Several roads were closed, and a number of homes and other buildings sustained flood related damage. Hundreds of residents were evacuated from low-lying areas in Lancaster County on Virginia's Northern Neck. Reported property damages exceeded $1 million.
September 30, 2016	Prolonged east to northeast winds produced minor to moderate coastal flooding in parts of the Chesapeake Bay region. Water levels reached moderate flood levels on the Northern Neck. Tides of 2 feet above normal caused moderate flooding near the Potomac River and areas adjacent to the Chesapeake Bay. Water levels reached nearly 3.7 feet MLLW at Lewisetta VA. No damage was reported in the Northern Neck.

4.6.4 Probability of Future Events

The extensive coastal areas of the Northern Neck are considered equally at risk of experiencing the damaging effects of future Nor’easters. Coastal flooding is expected to occur in the Northern Neck once every two years and cause an average of $1.3 million in property and crop damages, based on past occurrences reported in the NCEI Storm Events Database. Nor'easters are expected to continue developing between the months of September and April, with the most powerful storms affecting the area in January, February, and March but they can occur at any time. It should also be noted that anticipated sea level rise will increase the probability and intensity of future tidal flooding events in years to come.

4.6.5 Vulnerability and Risk Assessment

Table 4-18 shows the annualized damages for coastal flooding in the Northern Neck. The NCEI Storm Events data was annualized by dividing the total number of coastal flooding events by the length of record. The annualized values should only be utilized as an estimate of what can be expected in a given year. Using historical records, individual counties can expect to experience one event every two to five years. The Northern Neck can expect to see one coastal flooding event every two years. Annual total damages (adjusted for inflation) from these events for each county was found to be between $11,396 and $1,117,120, though it is possible that actual annual damages in some counties could be higher due to unreported damages. There are no expected deaths or injuries from these events.

Table 4-18. Annualized Damages from Coastal Flooding

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	0.4	$91,330	$0	$91,330	0	0
Northumberland	0.5	$1,117,120	$0	$1,117,120	0	0
Richmond	0.1	$98,041	$0	$98,041	0	0
Westmoreland	0.2	$11,396	$0	$11,396	0	0

4.6.5.1 Vulnerability and Impact to People and Property

The low-lying coastal areas of the Northern Neck are most vulnerable to the damaging effects of storm surge due to nor'easters and Hurricanes as well as above average tidal flooding. Non-elevated structures built prior to the 1980s when National Flood Insurance Program (NFIP) building standards were adopted are especially vulnerable to damage. Storm surge has the potential to cause damage to foundations of structures, damage contents, cut off utilities such as power, damage infrastructure such as bridges and roads, and cause extensive beach erosion. Coastal erosion will be addressed as a separate hazard in Section 4.7. Many of the same vulnerabilities and impacts to people and property as described in the riverine flooding section apply also to coastal flooding.

4.6.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined coastal flooding to be a significant hazard. Coastal flood events within the Northern Neck are a likely event with between 1 and 3.9 events annually. Coastal storm events have a high range of impacts, accounting for more than $100,000 (adjusted for inflation) in annual property damages. The potential exposure for coastal storms is high with more than $1 million in potential damages. Coastal flooding is ranked medium for having a warning time of at least one day before an event. Table 4-19 outlines the hazard ranking for each of the hazard priority criteria related to coastal flooding.

Table 4-19. Coastal Flooding Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	High	High	Medium	Significant	Significant

4.7 Coastal Erosion

4.7.1 Description

Coastal erosion is the landward displacement of the shoreline caused by the forces of waves and currents. Sea level rise, land subsidence and increasing rates of shoreline development intensify tidal erosion, causing property loss and water quality degradation. Coastal erosion has a significant impact on water quality and natural resources. About 4.7 million cubic yards of Chesapeake Bay shoreline erode each year, adding sediments, toxins, and nutrients to the water[12].

Coastal erosion poses an increasingly serious threat to the region's local governments since each county features significant shoreline areas encompassing a large percentage of each communities' higher value residential building stock. Coastal erosion is wearing away the land exacerbating the removal of beach or dune sediments. Wind and fast moving motor craft can also cause coastal erosion, initiating temporary or long term loss of sediment, rocks and redistribution of coastal sediments. These processes often result in shoreline loss due to erosion in one location balanced by nearby accretion.

4.7.2 Location and Extent

Coastal erosion impacts the four counties in the Northern Neck in varying degrees. The two driving forces of coastal erosion in the Northern Neck are the slow rise in sea level that started about 15,000 years ago that has flooded the coastal plain watersheds, and wave action from hurricanes and nor'easters.[13] As the shorelines recede and erode, the bank material creates sandy beaches and is carried offshore to create sand bars.

Erosion rates and potential impacts are highly localized. Coastal erosion rates are determined by four principle factors: storm frequency; storm type and direction; resulting wind, tides, current, and waves; and storm intensity and duration. Other forces which cause increased levels of storm water runoff and coastal erosion are:

- human activity
- grading
- upland runoff
- vegetation removal

The beaches and dune system along the Chesapeake Bay are protected by the Coastal Primary Sand Dune Protection Act of 1980[14]. Research by Hardaway *et al.* (2001) located, classified, and

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[12] "Eroding shores reshape the Chesapeake", Blankenship, Karl, June 01, 1991, http://www.bayjournal.com/article/eroding_shores_reshape_the_chesapeake

[13] Shoreline Evolution Chesapeake Bay and Potomac River Shorelines Northumberland County, Virginia (2006), Hardaway et al.

[14] The General Assembly of Virginia enacted the Coastal Primary Sand Dune Protection Act (the Dune Act) in

counted the dune systems within the eight localities listed in the Act, including Northumberland and Lancaster Counties. Subsequently, the Northumberland County Dune Inventory was created by Hardaway *et al.* in 2003 to detail the location and nature of the jurisdictional primary dunes along the Northumberland County Chesapeake Bay shoreline. Figure 4-6 outlines an example of a typical Chesapeake Bay dune profile.[15]

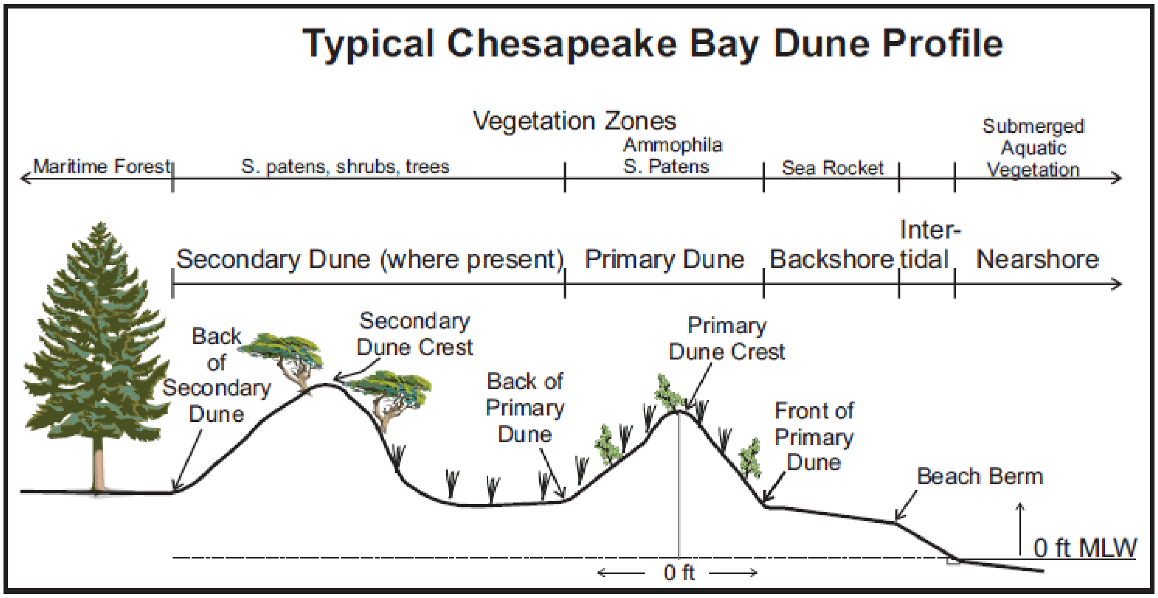

Figure 4-6. Typical Profile of a Chesapeake Bay Dune System

Shoreline evolution studies have been completed for Northumberland (2006), Lancaster (2006), Richmond (2011), and Westmoreland (2012) Counties by the Virginia Institute of Marine Science (VIMS) to document how these dune profiles have evolved since 1937 using aerial imagery. The results of these analyses can be found in Appendix B. Erosion extent is related to the following factors defined by the Virginia Department of Mines, Minerals and Energy (DMME):

- composition of the shoreline (rock, sand, clay, marsh, or man-made structures)
- fetch
- orientation to prevailing wind direction
- relative sea-level rise

Additionally, there is the localized effect of land subsidence, and flood heights that can vary by several feet over the tidal areas given basin shape, wind direction, and state of the tide. The effects of coastal erosion can be seen in

1980. The Dune Act was originally codified in § 62.1-13.21 to -13.28. The Dune Act is now recodified as Coastal Primary Sand Dunes and Beaches in § 28.2-1400 to -1420.

[15] Hardaway, C.S., Jr., L.M. Varnell, D.A. Milligan, G.R. Thomas, and C.H. Hobbs, III, 2001. Chesapeake Bay Dune Systems: Evolution and Status. Technical Report. Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, Virginia.

Figure 4-7, an example of a major slump feature found at the Nomini Cliffs in Westmoreland County along a scarp.[16] A scarp is a steep slope along the coastline, often as part of a series of beach ridges that are produced by higher stands of sea level, or a low, steep beach slope caused by wave erosion. A slump is caused by the erosion of fine-grained silt and clay (basal clay layers) at the base of a scarp, giving way to the upper layer of sand.[17]

Figure 4-7. Major Slump Feature Along Nomini Cliffs in Westmoreland County

4.7.3 Previous Occurrences

The College of William and Mary's Virginia Institute of Marine Science published a series of Shoreline Evolution studies for Lancaster (2006), Northumberland (2006), Richmond (2011), and Westmoreland (2012) counties. Recent and historical aerial imagery was obtained to analyze the past shoreline positions and understand trends in shoreline evolution. The rate of change for each plate, which is a mosaic of aerial images, is an average across large sections of shoreline between 1937 and 2002 (Lancaster and Northumberland) and 1937 and 2009 (Richmond and Westmoreland).

For each county in the Northern Neck, the three plates with the highest rate of change were summarized in Table 4-20. The highest rate of change, -11.1 feet per year, was observed in Lancaster County along the shoreline between Mosquito Point and Windmill Point. The entire Windmill Point area experienced high rates of change. Northumberland County also experienced comparably high rates of change, especially at Jarvis and Bluff Points along the Chesapeake Bay.

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[16] Shoreline Management in Chesapeake Bay, Hardaway, C.S., and Byrne, R.J. October 1999, Virginia Sea Grant Publication

[17] Ibid.

Table 4-20. Northern Neck Top Areas of Coastal Erosion by County

County	Location	Rate of Change (ft/year)	Description
Lancaster	Plate 16A	-11.1	Shoreline between Mosquito Point and Windmill Point
Lancaster	Plate 17	-6.7	Windmill Point
Lancaster	Plate 18	-4.6	Shoreline outside of Little Bay
Northumberland	Plate 21	-8.8	Jarvis Point
Northumberland	Plate 5	-7.4	Great Point and Walnut Point
Northumberland	Plate 22	-6.9	Bluff Point and area fed by Henrys Creek
Richmond	~Plate 14	-3.1	L Rappahannock River - Richardson Creek
Richmond	~Plate 9	-2.1	G Rappahannock River - Shoreline just north of Totuskey Creek
Richmond	~Plate 10	-1.5	H Rappahannock River Shoreline just north of Totuskey Creek
Westmoreland	~Plate 12	-4	I Nomini Bay, Hollis Marsh
Westmoreland	~Plate 31	-2.2	P Potomac River, Jackson Creek to Sandy Point
Westmoreland	~Plate 36	-1.4	Q Potomac River, Sandy Point to Lynch Point

Source: Data obtained from the Virginia Institute of Marine Science's Shoreline Evolution studies for Lancaster, Northumberland, Richmond, and Westmoreland counties.

Note: For the Richmond and Westmoreland studies, the shoreline segments analyzed for the rate of change analysis were lettered. The lettered segments do no line up one-to-one with the numbered plates therefore the lettering was maintained in the Description column and a plate number was estimated for the Location column.

4.7.4 Probability of Future Events

The Northern Neck will continue to be impacted by hurricanes and nor'easters in the future. These severe storms will cause shoreline erosion from increased wave action that will exacerbate the rate of erosion that already occurs on the Northern Neck during normal tidal conditions. While there is no single continuous record of coastal erosion events for the Northern Neck, coastal erosion is a constant and pervasive issue that could cost the Northern Neck billions in future property damages. The Northern Neck includes more than 1,000 miles of shoreline that includes beaches, marinas, and historic towns that contain valuable waterfront property. With the increase in storm events and sea level rise in the future, coastal erosion will be an increasing threat to the region.

4.7.5 Vulnerability and Risk Assessment

4.7.5.1 Vulnerability and Impact to People and Property

Some of the assets most vulnerable to coastal erosion in the Northern Neck are infrastructure such as bridges and roads, personal property, public and private beaches, and the natural habitats of shorebirds and other wildlife. Severe storms such as hurricanes and nor'easters that impact the Northern Neck have the potential to exacerbate the coastal erosion due to the higher wave action and storm surge. Severe storms can remove wider beaches, along with substantial dunes, in a single event. In undeveloped areas, these recession rates are not likely to cause significant concern, but in more heavily populated locations, one or two feet of erosion may be considered catastrophic to beach and shore-front property.

Shoreline protection installations, such as bulkheads and seawalls, can have positive and negative effects on the surrounding area. Eroding sediment banks that once provided sands for beaches, spits and offshore bars no longer has a supply of natural sand input. In addition, these now-protected segments of shoreline will remain as hard points or headland features while adjacent unprotected properties will continue to erode, sometimes at an accelerated rate[18].

To understand the quantity of assets in the Northern Neck at risk of coastal erosion, an exposure analysis was performed using data from each county. For Richmond and Westmoreland counties, actual building footprints and tax assessment values were used to determine the value of coastal property exposed to the hazard. For Lancaster and Northumberland Counties, the FEMA 2010 TIGER Census block data was used to estimate property value exposed. Since rising sea level is a driving factor of coastal erosion, the USGS Climate Resilience Toolkit dataset that assesses the coastal vulnerability to sea level rise was used to estimate areas at high risk of erosion. This dataset includes a Coastal Vulnerability Index (CVI) that provided a subjective assessment of local risk along with sea level rise.[19] The dataset includes ranking values from very low, low, moderate, high, and very high. The entire Northern Neck's coastal areas were assessed at a "high" risk for coastal erosion compared to other national coastal areas.

To quantify the potential exposure and risk of the Northern Neck, a 500 foot buffer was created around the CVI shoreline and intersected with the building footprints or Census blocks of each county. The total risk exposure in Lancaster and Northumberland Counties was much higher because the Census blocks include a much larger area than individual buildings and therefore have a higher total value that could potentially be exposed. Since a national data set was used, shoreline resolution is also poor at the county level. With advances in climate change and sea level rise research, it is anticipated that some of these data gaps will be filled as more information becomes available to future hazard mitigation plan updates. However, at this time this analysis provides a reasonable estimate of the property, most of it residential, at risk to coastal erosion. A summary of the exposure within 500 feet of the CVI shoreline is shown in Table 4-21.

Table 4-21. Building Exposure to Coastal Erosion in Northern Neck

County	Number Affected	Exposure within 500 ft.	Percent Affected	Total Count	Total Value
Richmond	222 Buildings	$16,600,000	1.83%	9749	$906,014,000
Westmoreland	1550 Buildings	$209,000,000	8.04%	20963	$2,598,329,000
Lancaster	324 Census Blocks	$792,000,000	41.1%	1071	$1,928,632,000

[18] Shoreline Management in Chesapeake Bay, Hardaway, C.S., and Byrne, R.J. October 1999, Virginia Sea Grant Publication

[19] USGS. Coastal Vulnerability to Sea-Level Rise. https://pubs.usgs.gov/dds/dds68/htmldocs/data.htm

Table 4-21. Building Exposure to Coastal Erosion in Northern Neck

County	Number Affected	Exposure within 500 ft.	Percent Affected	Total Count	Total Value
Northumberland	651 Census Blocks	$1,130,000,000	51.7%	1603	$2,187,319,000
Northern Neck	**N/A**	**$2,147,600,000**	**25.67%**	**33386**	**$7,620,294,000**

4.7.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined coastal erosion to be a moderate hazard in the Northern Neck. Coastal erosion within the Northern Neck is a highly likely event with more than four predicted events annually. Coastal erosion events can have a wide range of impacts, however no recorded property damages were available to quantify that prior impact. Damages have been ranked "significant" because damages are reported as caused by hurricanes, tropical depressions, nor'easters, etc. However, the potential exposure for coastal erosion is "significant" based on a vulnerability analysis that estimated exposure exceeding $1.0 million. Coastal erosion is ranked very low for having a warning time of more than three days before an event. Table 4-22 outlines the hazard rankings for each of the hazard priority criteria related to coastal erosion. With ongoing climate change, sea level rise and coastal erosion research, it is highly likely that the coastal erosion ranking will grow to 'significant' in the next plan update HIRA.

Table 4-22. Coastal Erosion Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Significant	**Damages not reported as erosion**	**Medium**	**Low**	**Significant**	**Medium**

4.8 Hurricanes

4.8.1 Description

A tropical cyclone is defined by the NOAA's National Hurricane Center as a warm-core non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation about a well-defined center. Tropical cyclones are defined by atmospheric and hydrologic characteristics such as severe winds, storm surge flooding, high waves, coastal erosion, extreme rainfall, thunderstorms, lightning, and, in some cases, tornadoes. Tropical cyclones that impact the east coast of the United States originate in the Atlantic basin, which includes the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico.

Depending on strength, tropical cyclones are classified as hurricanes or tropical storms. The Saffir-Simpson Hurricane Wind Scale (Table 4-23) uses wind speed, central pressure, and damage potential to create storm classifications. This scale is the standard describing an event's disaster potential. The Scale uses a 1 to 5 categorization based on the hurricane's intensity at the indicated time. 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.

Table 4-23. Saffir-Simpson Hurricane Wind Scale and Typical Damages

Category	Sustained Wind Speeds (mph)	Surge (ft.)	Pressure (mb)	Typical Damage
Tropical Depression	<39	--	--	
Tropical Storm	39-73	--	--	
Hurricane 1	74-95	4-5	> 980	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
Hurricane 2	96-110	6-8	965-980	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. 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.
Hurricane 3	111-129	9-12	945-965	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
Hurricane 4	130-156	13-18	920-945	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Table 4-23. Saffir-Simpson Hurricane Wind Scale and Typical Damages

Category	Sustained Wind Speeds (mph)	Surge (ft.)	Pressure (mb)	Typical Damage
Hurricane 5	> 157	> 18	< 920	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: NOAA National Hurricane Center: http://www.nhc.noaa.gov/aboutsshws.php?

4.8.2 Location and Extent

All areas within the Northern Neck are equally at risk of being affected by a hurricane, but storm damage is dependent on the specific storm track, whether the storm hits the area at high tide, and many other localized factors. The hurricanes that affect Virginia typically form in the Atlantic or Gulf of Mexico during the months of June through November. These storms form from strong low-pressure systems originating in the tropics, which cause the updraft of warm ocean water. Typically, these systems result in strong damaging winds and high seas that can cause flooding and shoreline erosion. A storm originating in the Atlantic is defined as a hurricane when the maximum sustained winds reach 74 miles per hour. Below this level, it is defined as either a tropical storm or tropical depression.

A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. The average diameter of hurricane force winds is 100 miles, with tropical storm force winds extending out 300 – 400 miles. Figure 4-8 shows the distribution of the four wind zones in the United States that reflect the number and strength of extreme windstorms. The Northern Neck is located in a “Hurricane-Susceptible Region” of Zone II where damaging wind speeds of up to 160 mph can be experienced. Buildings should be built to withstand this “design” wind event.

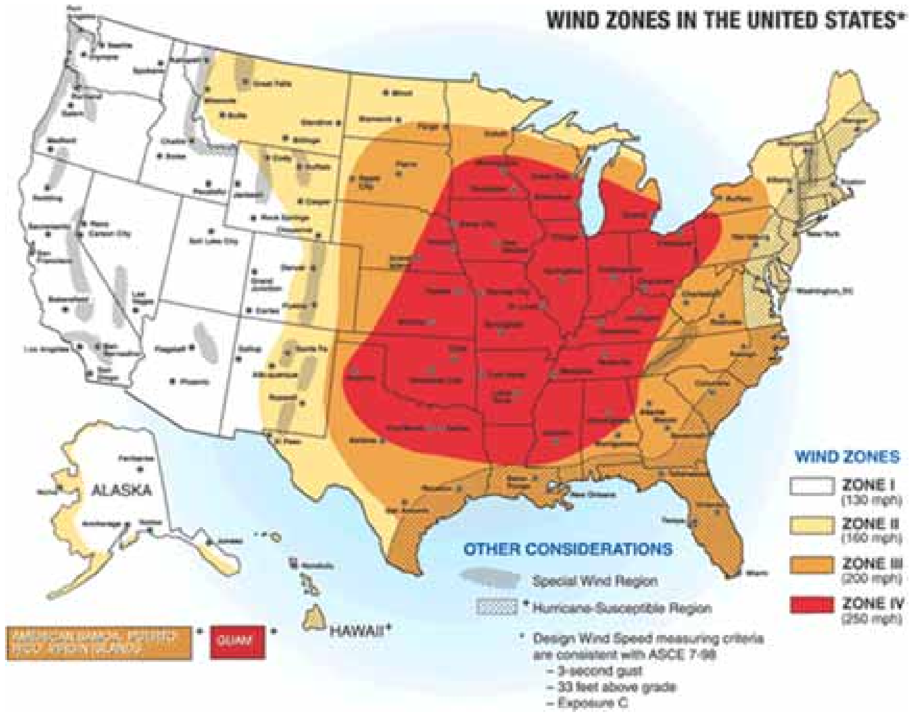

Figure 4-8. Wind Zones in the United States

Storm surge flooding can push inland, and riverine flooding associated with heavy inland rains can be extensive. High winds are associated with hurricanes, with two significant effects: widespread debris due to downed and damaged trees and building debris; and power outages. The Northern Neck is especially vulnerable to hurricanes and their impacts. A tropical cyclone or hurricane has the potential to affect the entire region demonstrated by many past topical depressions, tropical storms and hurricanes. As a storm moves into more shallow waters, wave heights may lessen, but water levels rise, bulging up on the storm's front right quadrant in what is called the "storm surge." This is the deadliest part of a hurricane. Storm surge and wind driven waves can devastate a coastline

4.8.3 Previous Occurrences

According to the NCEI database, three reported hurricanes have impacted the Northern Neck: Hurricanes Fran, Floyd and Isabel. While these storms did not directly track over the Northern Neck, damages were reported in the area due to coastal flooding and high wind associated with the storms because of their relative high strength in the storms' northeastern quadrant. There have also been four tropical storms that have impacted the Northern Neck. Table 4-24 summarizes the most significant hurricanes and tropical storm to impact the Northern Neck.

Table 4-24. Previous Occurrences of Hurricane

Event Date	Hazard History
September, 5, 1996	Hurricane Fran was a Category 3 hurricane that struck Virginia and North Carolina in September, 1996. In Virginia, winds between 39 and 73 mph lashed Chesapeake Bay and increased water levels in the

Table 4-24. Previous Occurrences of Hurricane

Event Date	Hazard History
	Potomac River around the nation's capital. There was severe damage to power lines that left 415,000 households in Virginia without electricity, making it the largest storm related power outage in history until Hurricane Isabel in 2003. Along the Rappahannock River, a storm surge of 5 foot damaged or sank several small boats and damaged wharfs and bulkheads. An F1 tornado touched down in Lancaster County on the Northern Neck, producing winds up to 90 mph that caused $2.5 million in residential damage to 45 structures and $200,000 in commercial damage.
September 15, 1999	Hurricane Floyd was a Category 1 hurricane as it entered Virginia on September 15, 1999. For the Northern Neck area, Hurricane Floyd brought very heavy rainfall due to the presence of a stalled frontal boundary. The rainfall led to overflowing rivers in the Chowan River Basin, some of which exceeded 500-year flood levels. Northumberland and Lancaster counties reported a total of $1.1 million in property damage and $147,000 in crop damage as result of this storm.
September 18, 2003	Hurricane Isabel was a Category 1 hurricane as it crossed the Virginia Beach area. Sustained tropical storm force winds with frequent gusts to hurricane force occurred over Eastern Virginia, along and near the Chesapeake Bay and Atlantic coastal waters. While Hurricane Isabel ultimately made landfall in Ocracoke Island, NC and tracked inland west of Richmond, Virginia, the high winds and storm surge greatly affected the Northern Neck region. The storm surge at Colonial Beach in Westmoreland County reached 6.5 feet. The storm caused widespread power outages, downed numerous trees and eroded beaches throughout the Northern Neck. Westmoreland County reported about $450,000 in crop damage as a result of the storm.
September 1, 2006	The remnants of Tropical Storm Ernesto interacted with an unusually strong high pressure over New England to generate strong winds, heavy rainfall, and storm surge-related tidal flooding and damage. Five to 8 inches of rainfall amounts were common across central and eastern Virginia. This rainfall caused flooding in many areas, although no substantial river flooding resulted from the heavy rain. Wind gusts of 60 to 70 mph occurred on the Eastern Shore of Virginia, as well as areas adjacent to the Chesapeake Bay from Yorktown northward. Tides were particularly high from communities adjacent to the York River, northward through the Rappahannock River to tidal portions of the Potomac River. Tides of 4 to 5 feet above normal, combined with 6 to 8 foot waves, caused significant damage to homes, piers, bulkheads, boats, and marinas across portions of the Peninsula and Middle Peninsula near the Chesapeake

Table 4-24. Previous Occurrences of Hurricane

Event Date	Hazard History
	Bay and adjacent tributaries. At some locations on the Middle Peninsula, Northern Neck and Eastern Shore, the tidal flooding and damage rivaled that from Hurricane Isabel in 2003. Power outages were widespread across the Virginia's Northern Neck and Middle Peninsula. Reported property damages in Northumberland county were over $23 million (2017$).
August 27, 2011	Hurricane Irene affected the Mid-Atlantic Region by bringing strong winds, storm surge flooding, and up to 12 inches of rain across eastern North Carolina, central and eastern Virginia, and the DELMARVA peninsula. Although Irene passed east of the Mid-Atlantic coast, the most substantial wind damage occurred in a swath from Caroline and Westmoreland counties (Northern Neck) southward into the Richmond metropolitan area, then southeastward into Surry, Sussex, James City, and Southampton counties. Winds estimated between 70 and 80 mph downed many trees, blocked roads and caused widespread power outages. The Richmond Times-Dispatch reported widespread downed trees, standing water, and minor damage to homes.
October 28, 2012	Hurricane Sandy was the deadliest and most destructive hurricane of the 2012 Atlantic hurricane season, and the second-costliest hurricane in United States history. On October 26, Governor of Virginia Bob McDonnell declared a state of emergency.
October 8, 2016	Hurricane Matthew was a powerful and devastating tropical cyclone which became the first Category 5 Atlantic hurricane since Hurricane Felix in 2007. While damage was primarily confined to the coast in Florida and Georgia, torrential rains spread inland in the Carolinas and Virginia, causing widespread flooding. Impacts to the Northern Neck were localized.

4.8.4 Probability of Future Events

Hurricanes are a low probability event that can greatly impact large areas. Based on the NCEI historic records of hurricane activity to the Northern Neck, it is estimated that the area will experience one hurricane or tropical storm every three to four years and an average of $292,000 in property and crop damages. Virginia's hurricane season is June 1 through November 30 but usually the most intensive hurricanes occur during August and September.

4.8.5 Vulnerability and Risk Assessment

Table 4-25 shows the annualized damages for hurricanes in the Northern Neck. The NCEI Storm Events data was annualized by dividing the total number of hurricane events by the length of record. The annualized values should only be utilized as an estimate of what can be expected annually. Using historical records, individual counties can expect to experience one hurricane or tropical storm every five to 10 years. The Northern Neck can expect to experience hurricanes and tropical storms in a similar frequency. Annual total damages (adjusted for inflation) from these events for each county was found to be between $46,249 and $106,248, though it is possible that actual annual damages in some counties could be higher due to unreported damages. There are no expected deaths or injuries from these events.

Table 4-25. Annualized Damages from Hurricanes

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	0.2	$39,482	$24,722	$64,204	0	0
Northumberland	0.2	$47,344	$58,904	$106,248	0	0
Richmond	0.1	$6,340	$39,909	$46,249	0	0
Westmoreland	0.1	$24,574	$51,612	$76,187	0	0

4.8.5.1 Vulnerability and Impact to People and Property

Secondary hazards from a hurricane often include high winds, flooding, heavy waves, and tornadoes. Hurricane force winds can easily destroy poorly constructed buildings and mobile homes. Once inland, the hurricane's band of thunderstorms produces torrential rains and, sometimes, tornadoes. A foot or more of rain may fall in less than a day causing flash floods and localized shoreline landslides. The rain eventually drains into the Potomac and Rappahannock Rivers and their tributaries which can exacerbate coastal flooding. Hurricane or tropical depression force winds damage and topple trees, impact utilities, and damage buildings. Utilities, including power, water and waste water treatment and communications can be impaired for days, or in the case of 2003's Hurricane Isabel, for weeks. Transportation networks can be impassable due to high standing water, debris on roadways, and damaged roads and bridges.

4.8.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined hurricane to be a "significant" hazard in Northern Neck. Hurricane events within the Northern Neck are somewhat likely events with less than one event annually. Hurricane events have a "high" range of impacts, accounting for over $100,000 (adjusted for inflation) in annualized property damages. The potential exposure for hurricane events is "high" with more than $1 million in potential damages. Hurricane is ranked low for having a warning time of at least two days before an event. Table 4-26 outlines the hazard ranking for each of the hazard priority criteria related to hurricane events.

Table 4-26. Hurricane Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	**Significant**	**Significant**	**Low**	**Significant**	**Significant**

4.9 Severe Weather (Thunderstorms, Severe Wind, Lightning, and Hail)

4.9.1 Description

For the purposes of the hazard mitigation plan update, severe weather includes thunderstorms, severe wind, lightning, and hail events. The National Weather Service (NWS) defines a thunderstorm as a localized storm produced by a cumulonimbus cloud and accompanied by lightning and thunder. Thunderstorms are typically the result of warm, moist air that is pushed upwards into the atmosphere where it cools and forms into cumulonimbus clouds. As the air continues to cool, it starts to form water droplets or ice. As these droplets or ice start to fall, they may collide and combine many times into larger forms before reaching the Earth's surface. These severe storms are associated with the presence of strong winds, thunder, and lightning. It is also possible to experience a thunderstorm with no precipitation which can cause wildfires to occur. Thunderstorms can form in any geographic region, and are sometimes the cause of other natural phenomena such as downburst winds, heavy rain, flash floods, large hailstones, tornadoes, and waterspouts.

A severe thunderstorm includes damaging winds greater than 58 mph (50 knots) or greater and hail one inch or larger in diameter. Severe winds have been further broken down into three categories by the NWS Storm Events database:

- *High Wind*: Sustained non-convective winds of 35 knots (40 mph) or greater lasting for one hour or longer or winds (sustained or gusts) of 50 knots (58 mph) for any duration (or otherwise locally/regionally defined), on a widespread or localized basis. In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.
- *Strong Wind*: Non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph) resulting in a fatality, injury, or damage.
- *Thunderstorm Wind*: Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage. Events with maximum sustained winds or wind gusts less than 50 knots (58 mph) should be entered as a Storm Data event only if they result in fatalities, injuries, or serious property damage.

Hail is precipitation in the form of ice pellets larger than five mm that forms in thunderstorms between currents of rising air (updrafts) and currents of descending air (downdrafts) as shown in Figure 4-9. These events typically occur in late spring and early summer. One criteria for severe thunderstorms, as defined by the NWS, is hail that is one inch in diameter (quarter-size) or larger.

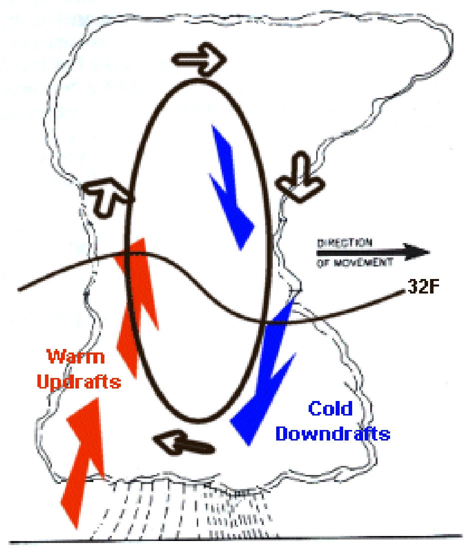

Figure 4-9. Formation of Hail (Source: NOAA)

Lightning is defined by the NWS as a visible electrical discharge (i.e. lightning bolt) produced by a thunderstorm. The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground or between the ground and a cloud. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes, but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes thunder.

4.9.2 Location and Extent

Since it is difficult to determine the probability of future occurrences in a specific area with any degree of accuracy, all areas within the Northern Neck are assumed to be equally at risk to the damaging effects of a thunderstorm that causes high wind, lightning, or hail. Therefore, all assets across the region should be considered vulnerable to these hazards and precautions should be taken to protect them.

Using the NWS definition for a severe thunderstorm, dime-sized hail is considered a minimum hazard and quarter-sized hail is considered a major hazard. Quarter-sized hail can cause significant damage to agricultural crops and livestock, as well as property such as automobiles, aircraft, and roofs. Although rare, large hailstones may even cause injury or death. The amount of cover obtained during a hail storm can greatly reduce the risk to human health during these events.

While there is no established index for lightning, a lightning strike is considered to be of minimum severity when it has limited impacts on infrastructure (ex. tree limbs) and major severity when it causes extensive damage (ex. loss of life, fire, structural damage). The potential damages resulting from lightning strikes are primarily injury, loss of life, power outages, business interruption, fire and minor structural damage. A false sense of security often leads people to believe that they are safe from a lightning strike because it may not appear to be near their location. However, lightning can strike 10 miles away from a rain column, which puts people that are still in clear weather at risk.

High wind events can occur for a variety of reasons: low and high pressure systems, isolated thunderstorms, tropical cyclones, and Nor'easters. Using the NWS severe wind categories listed above, sustained non-convective winds of 40 mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration, on a widespread or localized basis are considered a minimum severity event. A major severe event would be wind events of greater than 58 mph or a wind event resulting in death, injury or significant damage.

4.9.3 Previous Occurrences

There have been 254 severe wind events (including high wind, strong wind, and thunderstorm wind), four lightning strikes and 74 hail events recorded in the Northern Neck according to the NCEI Storm Events Database. Based on the NCEI Storm Events Database, the most significant severe weather events in the Northern Neck are extracted and summarized in Table 4-27. Significant events include any event that caused a death or injury (direct or indirect), as well as the top seven most costly events in terms of property damage. No direct deaths or indirect injuries were reported.

Table 4-27. Significant Severe Weather Events

Location	Event Date	Event Type	Wind Speed/Magnitude	Direct Injuries	Indirect Deaths	Property Damage ($2017)
Northumberland	9/1/2006	High Wind	37	0	0	$15,000,000
Lancaster	7/12/2009	Thunderstorm Wind	52	0	0	$1,000,000
Lancaster	7/12/2009	Thunderstorm Wind	52	0	0	$1,000,000
Lancaster	7/12/2009	Thunderstorm Wind	50	0	0	$1,000,000
Lancaster	9/1/2006	High Wind	35	0	0	$200,000
Lancaster	7/16/2000	Lightning		0	0	$50,000
Lancaster	8/6/2000	Lightning		0	0	$50,000
Lancaster	5/2/1989	Thunderstorm Wind	100	3	0	$0
Richmond	6/13/2013	Thunderstorm Wind	52	0	1	$5,000
Westmoreland	4/21/2017	High Wind, Hail	125	0	0	Reported damage to 170 residences; $8M in damages in Colonial Beach.

The likelihood and potential severity of thunderstorm wind/lightning/hail events can be assessed by reviewing the number and severity of thunderstorm events that have occurred in the period of history available for the Northern Neck. Of the 254 severe wind events, 76 did not have a recorded magnitude or had a magnitude of 0 within the NCEI database. Of the remaining 178 recorded events, the recorded wind speeds varied from 28 to 100 miles per hour (mph). There are a significant number of severe wind events reported because during the same incident, such as an isolated thunderstorm, it can result in multiple reports of thunderstorm wind (of various speeds) from different towns in the same county. Table 4-28 shows the distribution of events by recorded wind speed, where the maximum wind speeds for an average thunderstorm range from 50 to 55 mph. Similarly, Table 4-29 shows the distribution of hail events by recorded hail size, where a majority of reported hail events in the Northern Neck are one inch or less in size.

Table 4-28. Frequency of Severe Wind Events

Wind Speed (mph)	Number of Events
Not Recorded	43
0-30	33
31-35	1
36-40	3
41-45	0
46-50	150
51-55	10
56-60	7
61-65	3
66-70	2
71-75	0
76-80	1
81-85	0
86-90	0
91-95	0
96-100	1
Total	**254**

Table 4-29. Frequency of Hail Events

Hail Size (in.)	Object Analog Reported	Number of Events
0.5	Marble, moth ball	0
0.75	Penny	25
0.88	Nickel	11
1	Quarter	19
1.25	Half dollar	1
1.5	Walnut, ping pong	5
1.75	Golf ball	11
2	Hen egg	2
2.5	Tennis ball	0
2.75	Baseball	0
3	Tea cup	0
4	Softball	0
4.5	Grapefruit	0
	Total	**74**

4.9.4 Probability of Future Events

The chance of future occurrences of high wind, hail and lightning in the Northern Neck is high: between five and six events each year after annualizing reported events by the length of record from the NCEI database. Based on the frequency tables above, the average hail event is expected to produce hail sizes ranging from 0.75" and 1." Future severe wind events will likely cause 46 to 55 mph gusts and sustained winds.

4.9.5 Vulnerability and Risk Assessment

Table 4-30 shows the annualized damages for severe weather events in the Northern Neck. The NCEI Storm Events data was annualized by dividing the number of severe weather events by the length of record. The annualized values should only be used as an estimate of what can be expected each year. Using historical records, an individual county can expect to experience between one to two severe weather events annually. The Northern Neck can expect to see between five and six events annually. Annual total damages (adjusted for inflation) from these events for each county was found to be between $3,454 and $289,889, though it is possible that actual annual damages in some counties could be higher due to unreported damages. There was a reported injury in Lancaster County due to severe weather, however overall for the Northern Neck there are no expected deaths or injuries from these events.

Table 4-30. Annualized Damages from Severe Weather

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	1.2	$62,629	$0	$62,629	0	0.048
Northumberland	1.1	$289,889	$0	$289,889	0	0
Richmond	1.9	$3,349	$105	$3,454	0	0
Westmoreland	1.8	$4,303	$0	$4,303	0	0

4.9.5.1 Vulnerability and Impact to People and Property

High wind events pose a danger because they can result in localized or widespread power outages, property damage, and falling trees. Mobile homes are particularly vulnerable to high winds, especially if improperly anchored. Injury or death can result from falling objects, vehicle accidents, and flying debris. Most deaths associated with extreme wind events occur in cars, especially lightweight vehicles and high-profile tractor trailers.

Older critical facilities are vulnerable to wind damage due to the age of construction and possible poor condition. It is important to identify specific critical facilities and assets that are most vulnerable to the hazard. Evaluation criteria include the age of the building (and what building codes may have been in effect at the time of construction), type of construction, and condition of the structure (i.e., how well the structure has been maintained).

4.9.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined severe weather events to be a “moderate” hazard in Northern Neck. Severe weather events within the Northern Neck are highly likely events with more than four events annually. Severe weather events have a “high” range of impact, accounting for more than $100,000 (adjusted for inflation) in annual property damages. The potential exposure for severe weather events is “medium” with between $100,000 and $1.0 million in potential damages. Severe weather is ranked medium for having a warning time of at least one day before an event. Table 4-31 outlines the hazard rankings for each of the hazard priority criteria related to severe weather events.

Table 4-31. Severe Weather Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Significant	Significant	N/A – Did not rank	Medium	Medium	Medium

4.10 Tornado

4.10.1 Description

A tornado is described as a violently rotating column of air extending from a thunderstorm to the ground. The rotating column of air often resembles a funnel-shaped cloud. Winds are typically less than 100 mph, with the most violent tornado wind speeds exceeding 250 mph. The widths of most Virginia tornados are generally several yards across, but the path length can vary from a few hundred yards to dozens of miles long. A tornado moves at speeds between 30 and 125 miles per hour (mph), and can generate winds that reach 300 mph.

4.10.2 Location and Extent

In the United States, tornadoes have been classified on the Fujita Scale, assigning numeric scores from zero to five (or higher) based on the severity of observed damages. The traditional Fujita scale, introduced in 1971, was used to rate the intensity of tornadoes thereafter, and was also applied to previously documented tornadoes. The scale assigns numerical values for wind speeds inside the tornado according to the type of damage and degree of the tornado. Most tornadoes are F0 and F1, resulting in little widespread damage. Low-intensity tornadoes can also cause localized transportation route disruption due to debris from trees and impacted buildings, signs, etc. Utilities can also be out of service for several days due to downed power and phone lines. A tornado's intense power can destroy buildings, especially manufactured homes, downed power lines and can cause significant tree and crop damage.

In February, 2007, an "enhanced" Fujita scale was implemented with somewhat lower wind speeds at the higher F-numbers, and more thoroughly-refined structural damage indicator definitions. It was developed to better align tornado wind speeds with associated damages. Table 4-32 shows the differences between the old and new tornado intensity scales, wind speeds, typical damages, and frequency.

Table 4-32. Tornado Damage Scale

Derived EF Scale		Fujita Scale		Damage	Frequency
EF Number	3 Second Gust (mph)	F Number	3 Second Gust (mph)		
EF0	65 to 85	F0	40 to 72	Light Damage. Some damage to chimneys, TV antennas, roof shingles, trees, and windows	29%
EF1	86 to 110	F1	73 to 112	Moderate Damage. Automobiles overturned, carports destroyed, trees uprooted	40%
EF2	111 to 135	F2	113 to 157	Considerable Damage. Roofs blown off homes, sheds and outbuildings demolished, mobile homes overturned	24%
EF3	136 to 165	F3	158 to 206	Severe Damage. Exterior walls and roofs blown off homes. Metal buildings collapsed or severely damaged. Forests and farmland flattened.	6%

Table 4-32. Tornado Damage Scale

Derived EF Scale		Fujita Scale		Damage	Frequency
EF Number	3 Second Gust (mph)	F Number	3 Second Gust (mph)		
EF4	166 to 200	F4	207 to 260	Devastating Damage. Few walls, if any, standing in well-built homes. Large steel and concrete missiles thrown far distances.	2%
EF5	Over 200	F5	261 to 318	Incredible Damage. Homes leveled with all debris removed. Schools, motels, and other larger structures have considerable damage with exterior walls and roofs gone. Top stories demolished.	Less than 1%

Source: NOAA Storm Prediction Center http://www.spc.noaa.gov/efscale/ef-scale.html

Tornado season typically is March through August; however, tornados can occur in any month. In Virginia, peak tornado activity is in July since hot, humid conditions stimulate tornado growth. Strong tornadoes may be produced by thunderstorms and are often associated with the passage of hurricanes. The total number may be higher as incidents may occur over areas with sparse populations, or may not cause any property damage.

4.10.3 Previous Occurrences

According to the NCEI storm events database, there have been 26 recorded tornado events since 1950, which includes two funnel clouds and two water spouts. These tornado events have resulted in a total of $11.7 million in property damage. Figure 4-10 shows the location of historic tornado tracks and touch downs in the Northern Neck. Table 4-33 lists the most significant of these events along with recent events not recorded by the NCEI database.

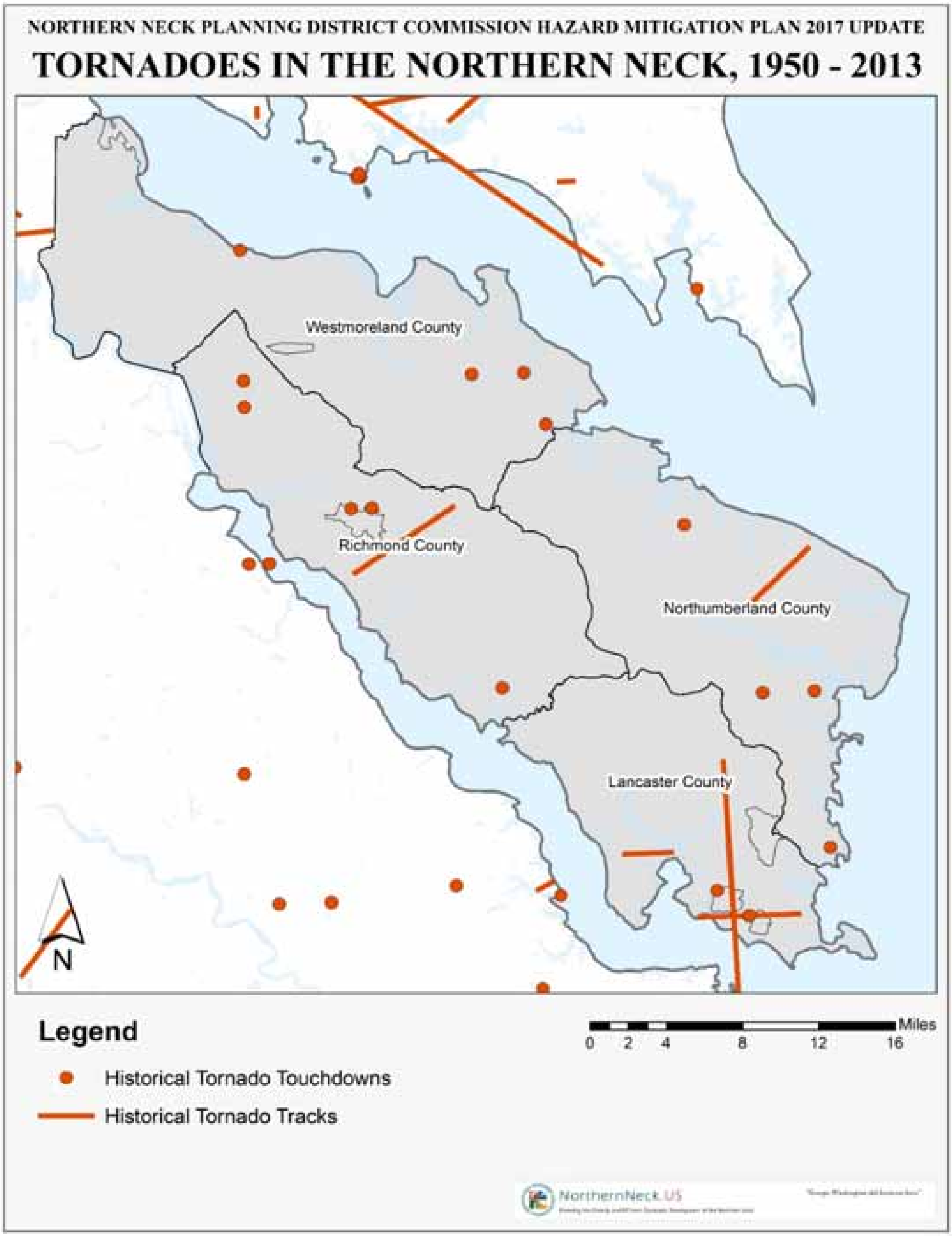

Figure 4-10. Historic Tornado Tracks and Touchdowns in the Northern Neck

Table 4-33. Previous Occurrences of Tornado Events

Event Date	Hazard History
5/10/1990	Lancaster County. This tornado traveled in an east-northeast direction from two miles southwest of White Stone, and ending about two miles east-northeast of White Stone. The path was just over four miles long and it was intermittent. The greatest damage occurred in the center of White Stone. In addition to considerable tree damage, three buildings were heavily damaged, five stores lost plate-glass windows, and a mobile home was destroyed by trees.
8/6/1993	White Stone. At 1515 EDT, a tornado moved northeast through White Stone. Tree were broken and knocked down damaging hones.
6/24/1996	Westmoreland County. Brief tornado touched down at Westmoreland State Park. Numerous trees and power lines were downed throughout the park. Roofs of three cabins were damaged by downed trees. One cabin suffered the most damage as a large tree trunk crashed through the roof, damaging the rafters and inside walls of the kitchen and a bedroom.
7/12/1996	Northumberland County. Tornado damage occurred from Burgess to Oyster Cove. The most significant damage was found in the Edwardsville area, where nearly 20 mobile homes were severely damaged or destroyed. Numerous trees were downed or suffered damage. Nine, mostly minor, injuries were reported.
	Westmoreland County. The same storm which produced the Edwardsville storm produced a second weaker tornado in Hague. One house sustained minor damage, and numerous trees were sheared off or uprooted.
9/10/1997	Northumberland County. A tornado damaged 5 homes, with a large porch on one home and a garage/breezeway on another home completely destroyed. Damage to 2 other homes was primarily incidental, and caused by flying debris. The fifth home sustained siding and substantial roof damage. Several boats were damaged/overturned at local marina. One row boat near the initial damage area was lifted up and tossed 300-400 yards from its tied-down position. Several other items were thrown distances of several hundred yards. Two cars were damaged, one severely. Several trees were severely damaged, one tree was uprooted by an airborne

Table 4-33. Previous Occurrences of Tornado Events

Event Date	Hazard History
	boat. There were no injuries or fatalities. Property damage totaled about $150,000.
5/25/2004	Lancaster County. A waterspout formed over Carters Creek and came ashore at Irvington Marina as a tornado. A boat house was blown over and numerous boats damaged. Several cars were also damaged.
6/18/2015	Scattered severe thunderstorms associated with a trough of low pressure produced damaging winds and three weak tornadoes across portions of central and eastern Virginia. Richmond County. The tornado began 2 miles west of German's Corner in Richmond County, tracking southeast for about 6 miles passing near Naylors Beach and crossing Highway 360. Peak winds were between 70 and 80 mph. Hardwood trees were uprooted and snapped off. Power lines were downed. Lancaster County. The tornado touched down in Lancaster County near Mollusk and tracked southeast to Ottoman. The tornado remained mostly in the tree tops and bounced as it tracked southeast for about 4 miles. The tornado paralleled River Road eventually crossing River Road near Ottoman. Peak. Winds were between 60 to 70 mph. Hardwood trees were uprooted and snapped off. Power lines were downed.
2/24/2016	Lancaster County. The tornado that began as an EF0 in Middlesex County, intensified briefly to an EF1 in the Norwood Church Road area near Flagstaff Road in Lancaster County. In this area, a brick wall on a garage was flattened, the roof was ripped off a house, and an outbuilding was destroyed. Numerous large trees were snapped including two foot diameter pine trees. The tornado continued north and northeast for a short distance before lifting.
	Richmond County. Tornado crossed the Rappahannock River from Essex County into Richmond county. The tornado struck Naylors Beach as an EF2 tornado removing significant portions of the upper floor of one two story home and destroying several other smaller homes. At this point, the tornado was 300 yards wide with winds around 120 mph. The tornado then crossed Newland Road, weakening slightly too low end EF1 with winds around 90 mph and continuing to Tallent Town Road and Piney Grove Road. The tornado then

Table 4-33. Previous Occurrences of Tornado Events

Event Date	Hazard History
	tracked into Westmoreland County. The tornado caused over $3.3 million in property damage.
2/24/2016 (continued)	Westmoreland County. The tornado re-intensified as it moved from Richmond County into Westmoreland county, crossing Kings Highway (Route 3) west of Naomi Grove as a high EF1 tornado. Tornadic winds increased to 100 mph, severely damaging two homes and destroying a mobile home along Kings Highway. It continued to Cople Highway near Mount Holly, severely damaging numerous homes. After crossing Nomini Creek, the tornado crossed Bushfield Road damaging several homes. The tornado then continued northeast along Mount Holly Road, uprooting and snapping trees before moving into the Potomac River toward Maryland. Reported property damages totaled over $900,000 in Westmoreland County, in addition to over $78,000 in crop damage.
4/6/2017	Town of Irvington. On April 6, an enhanced risk for severe weather was issued for parts of the Mid-Atlantic region. An EF1 touched down in the Town of Irvington in Lancaster County. Some windows were blown out at the local hospital, forcing the hospital to operate on emergency power for a couple hours. Homes in the town had their roofing material, gutters or awnings, and siding material damaged. Numerous trees were snapped or uprooted. According to VDEM records, one home was destroyed, seven suffered major damage, 22 experienced minor damage and an additional 19 were affected for a total loss of $2,707,180. Additionally, there was $10,000 in damage to parks and recreation facilities. Local governments were reimbursed $35,000 for debris removal and emergency protective measures.

4.10.4 Probability of Future Events

Tornadoes are considered to be low-frequency, high-impact events. The NWS advises that tornadoes strike randomly, so all areas within Northern Neck are equally at risk. Tornado and high-wind events can occur at any time of the year, but are more frequent in this area in the spring and summer. Based on the NCEI historic records of tornado activity in the Northern Neck, it is estimated that the region will experience about one tornado every three years. Due to the proximity of this area to open water, proper precautions should be taken to protect infrastructure from damaging wind events.

4.10.5 Vulnerability and Risk Assessment

Table 4-34 shows the annualized damages for tornado events in the Northern Neck. The NCEI Storm Events data was annualized by dividing the tornado events and by the length of record. The annualized values should only be utilized as an estimate of what can be expected each year. Using historical records, an individual county can expect to see one tornado every five to 10 years. The Northern Neck can expect to see one tornado every three to four years. It should be noted that tornado and high wind event frequencies have increased dramatically since the 2011 mitigation plan update. Annual total damages (adjusted for inflation) from these events for each county was found to be between $9,341 and $87,182, though it is possible that actual annual damages in some counties could be higher due to unreported damages. Overall, the region can expect to see at least one injury due to tornados every five years.

Table 4-34. Annualized Damages from Tornados

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	0.1	$87,182	$0	$87,182	0.0	0.0
Northumberland	0.1	$9,341	$0	$9,341	0.0	0.1
Richmond	0.2	$55,666	$0	$55,666	0.0	0.0
Westmoreland	0.1	$20,016	$1,162	$21,178	0.0	0.0

4.10.5.1 Vulnerability and Impact to People and Property

A structure's tornado vulnerability is the same as that for other types of extreme wind events and is based in large part on building construction and standards. Other factors such as location, condition, and maintenance of trees also play a significant role in determining vulnerability. A tornado will cause severe damage or destruction to any structure in its path. Clusters of mobile homes are more vulnerable to tornadoes. Proper anchoring can reduce damage exposure, but not entirely as these structures are extremely vulnerable to damage from downed trees and a tornado's effect on the structure of the manufactured home itself.

Human vulnerability is based on the availability, reception, and understanding of early warnings of tornadoes (e.g., tornado warnings issued by the NWS) and access to safe, substantial indoor shelter. Once warned of an impending tornado hazard, to seek shelter indoors on the lowest floor of a substantial building away from windows is recommended as the best protection.

Electrical utilities and communications infrastructure are also vulnerable to tornadoes. Damage to power lines or communication towers has the potential to cause power and communication outages for residents, businesses, and critical facilities. In addition to lost revenues, downed power lines present a threat to personal safety. Further, downed wires and lightning strikes have been known to spark fires.

4.10.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined tornado events to be a "significant" hazard in Northern Neck. Tornado events within the Northern Neck are somewhat likely events with less than one event annually. Tornado events have a "high" range of impacts, accounting for annual property damages exceeding $100,000 (adjusted for inflation). The potential exposure for tornado events is "medium" with between $100,000 and $1.0 million in potential damages. Tornado is ranked high for having a warning time of less than 24 hours before an event. Table 4-35 outlines the hazard rankings for each of the hazard priority criteria related to tornado events.

Table 4-35. Tornado Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	Significant	Significant	Significant	Medium	Significant

4.11 Winter Storm

4.11.1 Description

Winter storms are events in which varieties of precipitation are formed that only occur at low temperatures, such as snow or sleet, or a rainstorm where ground temperatures are low enough to form ice (i.e. freezing rain). The following are the National Weather Service's descriptions of various components of a winter storm:

- **Heavy snowfall** - the accumulation of six or more inches of snow in a 12 hour period or eight or more inches in a 24 hour period.
- **Blizzard** - the occurrence of sustained wind speeds over 35 mph accompanied by heavy snowfall or large amounts of blowing or drifting snow for more than three hours.
- **Freezing drizzle/freezing rain** - precipitation that falls as liquid, but freezes on contact with roads, trees, power lines and other surface structures that are below 32 degrees F, forming a dangerous glaze of ice.
- **Ice storm** - a type of winter storm characterized by freezing rain which results in a dangerous coating of ice on trees, power lines, and road surfaces.
- **Sleet** - solid grains or pellets of ice formed by the freezing of raindrops or the refreezing of largely melted snowflakes. Sleet does not cling to surfaces.
- **Wind chill** – a calculated temperature index that describes the combined effect of wind and low air temperatures on exposed skin.

Winter storms usually form along a stationary front. An area of lower pressure develops along the front as the atmosphere tries to even out the pressure difference. This pressure difference creates wind that blows from high pressure towards low pressure, in an attempt to move enough air to even out the pressure difference. As the air moves toward the low-pressure area, it has nowhere to go but up into the colder regions of the atmosphere. This causes water vapor in the air to condense. To the north of the storm, where temperatures are colder, this condensed water falls as snow. To the south, if the temperatures are warm enough, it can fall as heavy rain in within thunderstorms.

4.11.2 Location and Extent

Winter storms derive their energy when two air masses of substantially different temperatures and moisture levels meet. In Northeastern Virginia, winter storms usually form when an air mass of cold, dry, Canadian air moves south and interacts with a warm, moist air mass moving north from the Gulf of Mexico. The point where these two air masses meet is called a front. If cold air advances and pushes away the warm air, it forms a cold front. When warm air advances, it rides up over the denser, cold air mass to form a warm front. If neither air mass advances, it forms a stationary front.

In the temperate eastern Virginia climate, winter storms infrequently occur during late fall or spring but are largely contained to the winder season, particularly between January and early March. Winter storms can include heavy snow, freezing rain, and high winds that completely disrupt communities’ transportation networks, cause power outages, close schools, and hamper communication.

4.11.3 Previous Occurrences

According to the NCEI storm events database, there have been 93 recorded winter storm events across the Northern Neck counties since 1996, including the following types of event: Winter Weather, Winter Storms, Ice Storms, Heavy Snow, and Frost/Freeze.

These severe winter weather events have resulted in a total of $42,373 in property damage. It should be noted that these numbers reflect only the reported damages. In addition, the Northern Neck has had four major disaster declarations and two emergency declarations related to winter storm weather. Table 4-36 lists some of the most significant of these events.

Table 4-36. Previous Occurrences of Winter Storm Events

Event Date	Hazard History
January 26, 1987	A record 17.0 inches of snow fell during a 24-hour period on January 26, 1987 in Richmond County.
March 13, 1993	The "Blizzard of '93", also known as the "Superstorm '93" and the first coined "Storm of the Century" during the 1990's, was an extremely intense nor'easter which impacted the entire East Coast of the U.S. An emergency declaration was made in the Northern Neck area.
January 6, 1996	The blizzard of 1996 was a strong winter storm that impacted the eastern United States, especially the metropolitan areas of Washington, DC, Philadelphia, New York City, and Boston. Three day snowfall totals ranged from 10-20 inches in the Northern Neck area. A presidential disaster was declared that included Northern Neck Counties.
December 23, 1998	A major ice storm affected central and eastern Virginia from Wednesday, December 23rd into Friday, December 25th, including all four counties on the Northern Neck. A prolonged period of freezing rain and some sleet resulted in ice accumulations of one half inch /0.50/ to one inch /1.00/ in many locations. The heavy ice accumulations on trees and power lines caused widespread power outages across the region. Approximately 400,000 customers were without power during the maximum outage period, Christmas Eve day. Some customers were without power for about ten days. Many accidents occurred due to slippery road conditions, especially bridges and overpasses. Secondary roads were impassable due to fallen tree limbs and in a few cases, whole trees.

Table 4-36. Previous Occurrences of Winter Storm Events

Event Date	Hazard History
January 25, 2000	A significant winter storm dumped more than one foot of snow across much of central and eastern Virginia, with isolated amounts of up to 19 inches reported. There was also significant blowing and drifting of snow as winds gusted over 30 mph during the storm. The Richmond International Airport was closed during this storm. A very cold air mass built into the region after the storm, preserving the snowpack for over a week in many areas. Snow totals on the Northern Neck included: Richmond county 11 to 12 inches, Westmoreland county 12 to 13 inches, and Northumberland county 12 inches.
January 30,2000	An ice storm affected a large portion of central and eastern Virginia with ice accumulations of up to one-half inch. Freezing rain mixed with sleet and snow spread over the area during the morning hours. Freezing rain then mixed with rain during the afternoon and evening along the eastern counties of Richmond, and Westmoreland Counties. More than $30,000 in property damage was reported.
April 7, 2007	Low pressure developed over southern Virginia and deepened as it moved offshore. A band of moderate to heavy snow fell over portions of eastern Virginia as the storm strengthened off the Atlantic seaboard. Heavy snow was reported in Richmond, Northumberland, and Lancaster Counties.
January 30, 2010	Low pressure moving off the coastal Carolinas produced between five and fifteen inches of snow across central and eastern Virginia from Friday night, January 29th, into Saturday night January 30th. Snowfall amounts reported in the Northern Neck counties ranged from as low as seven inches to thirteen inches of snow reported in Richmond County.
February 5, 2010	Low pressure moving off the coastal Carolinas produced between four and twelve inches of snow across central and eastern Virginia from Friday afternoon, February 5th, through Saturday afternoon February 6th. In the Northern Neck, some of the heaviest snow fell in Newland, Richmond County, where 11 inches was reported.
January 22,2016	Strong low pressure moving from the Southeast United States northeast and off the Mid-Atlantic Coast produced between five and thirteen inches of snow and strong winds across the Virginia Northern Neck and south central Virginia. Heathsville reported 11 inches of snow.
January 7, 2017	Low pressure tracking northeast just off the Southeast and Mid-Atlantic Coasts produced heavy snow and strong winds across eastern Virginia. In Northumberland and Lancaster Counties, snowfall totals were generally between 8 inches and 12 inches. Strong north winds affected the area, producing some blowing snow and reduced visibilities. Heathsville and Brook Vale reported 12 inches of snow.

4.11.4 Probability of Future Events

Based on the NCEI historic records of winter storm activity in the Northern Neck, it is estimated that the region will experience about between four and five reports of winter weather per year. This includes reports of freezing rain, ice, and small accumulations of snow typically found in the region. While this data includes weaknesses discussed previously, it is reasonable to conclude that severe winter weather events will likely continue to occur on at least an annual basis in the Northern Neck.

4.11.5 Vulnerability and Risk Assessment

Table 4-37 shows the annualized damages for winter storm events in the Northern Neck. The NCEI Storm Events data was annualized by taking the total number of winter storm events and dividing by the length of record. The annualized values should only be used to estimate what can be expected annually. Using historical records, the individual counties can expect to experience on average between two and four winter storm related events every year. The region can expect to see between 4 and 5 winter storm related events annually. The annual average for the region is higher than each individual county since it encompasses a larger area overall and some events were only reported in single counties whereas the annual average for the region accounts for storm events in all four counties. Total damages from winter storm events is expected to be very low on an annual basis for the region. There are no expected deaths or injuries from these events.

Table 4-37. Annualized Damages from Winter Storm Events

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	2.7	$0	$0	$0	0	0
Northumberland	3.0	$0	$0	$0	0	0
Richmond	3.1	$963	$0	$963	0	0
Westmoreland	3.2	$963	$0	$963	0	0

4.11.5.1 Vulnerability and Impact to People and Property

All critical facilities in the Northern Neck are considered vulnerable to the effects of severe winter storms due to the potential disruption of services and transportation systems as well as possible structure failure due to heavy snow loads. The level of vulnerability of a building depends on the age of the building (and the building codes in effect at the time of construction), type of construction, and condition of the structure (i.e., how well it has been maintained, materials used, etc.). FEMA Risk Management has published a Snow Load Safety Guide[20]. The guide states:

> *Most buildings are not at risk of snow induced failure More often than not, attempting to remove snow from a roof is more hazardous than beneficial, posing a risk to both personnel and the roofing structure. However, snow accumulation in excess of building design conditions can result in more than a temporary loss of electrical power and inaccessible roads. Buildings may be vulnerable to structural failure and possible*

[20] FEMA Risk Management Series: Snow Load Safety Guide. FEMA P-957 January 2013. https://www.fema.gov/media-library-data/7d8c55d1c4f815edf3d7e7d1c120383f/FEMA957_Snowload_508.pdf

> *collapse if basic preventative steps are not taken in advance of a snow event. Knowledge of the building roof framing system and proper preparation in advance of a snow event is instrumental in reducing risk to the structure.*

Using the FEMA Snow Load Safety Guide, it can be assumed that certain roof types and materials are more susceptible to snow-induced collapse. Buildings vulnerable to increased snow accumulation and unbalanced loads include:

- Gable/multi-span gable roof
- Mono-slope roof
- Flat or low-slope roof with or without roof drains
- Stepped roof
- Saw-tooth roof

Even small accumulations of ice can cause a significant hazard, especially on power lines and trees. An ice storm occurs when freezing rain falls and freezes immediately upon impact. Communications and power can be disrupted for days, and even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Extended power outages from ice storms would require residents to look for supplemental heat sources; improper use of these sources could result in house fires. Injuries could result from slipping on ice if residents, especially elderly, were to leave their home.

4.11.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined winter storms to be a "limited" hazard in Northern Neck. Winter storm related events within the Northern Neck are likely events with between 4 and 5 events reported annually. Winter storm events have a "low" range of impacts, accounting for less than $10,000 (adjusted for inflation) in annual property damages. The potential exposure for winter storms is "low" with less than $100,000 in potential damages. Winter storms in the Northern Neck cause more problems with impacts to transportation networks and power outages. This leads to school, government and business closings. For these reasons, while annualized property losses are low and the hazard ranking is low, winter storms have serious impacts to the region. Winter storms are ranked low for having a warning time of at least two days before an event. Table 4-38 outlines the hazard rankings for each of the hazard priority criteria related to winter storms.

Table 4-38. Winter Storm Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	Low	Medium	Low	Low	Low

4.12 Drought

4.12.1 Description

A ***drought*** is a period in which an unusual scarcity of rain causes a serious hydrological imbalance in which water supply reservoirs empty, water wells dry up, and crop damage ensues. A prolonged period of drought may or may not accompany the periods of extreme heat. Drought is a complex physical and social process that can vary on a regional basis. Unlike floods, droughts are not a distinct event and typically do not have a well-defined start or end date.

A drought can last for months or years, or may be declared after as few as 15 days. Droughts are classified based on meteorological, agricultural, hydrological, and socioeconomic effects:

- Meteorological drought is an extended period of time (six or more months) with precipitation of less than 75% of normal. Meteorological drought usually precedes the other types of drought.
- Agricultural droughts are characterized by unusually dry conditions during the growing season. A traditional agricultural drought is caused by an extended period of below average precipitation.
- Hydrological drought occurs when water reserves available in aquifers, lakes and reservoirs fall below the statistical average. Hydrological drought tends to emerge more slowly because it involves stored water that is used but not replenished.
- Socio-economic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace.

4.12.2 Location and Extent

Agricultural droughts are the most common form of drought in the Northern Neck and pose the greatest threat to region's agricultural operations. High summer temperatures can exacerbate the severity of a drought. When soils are wet, a significant portion of the sun's energy goes toward evaporation of the ground moisture. However, when drought conditions eliminate soil moisture, the sun's energy heats the ground surface and temperatures can soar, further drying the soil. Table 4-39 summarizes the levels of drought severity and their possible impacts on a community or region[21].

Table 4-39. Drought Severity Classification and Possible Impacts

Category	Description	Possible Impacts
D0	Abnormally dry	Going into a drought: short-term dryness slows planting, growth of crops or pastures; fire risk above average. Coming out of a drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low; some water shortages develop or are imminent; voluntary water use restrictions requested.
D2	Severe drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.

[21] U.S. Drought Monitor.

Category	Description	Possible Impacts
D3	Extreme drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.

The Drought Monitoring Task Force (DMTF) is a Commonwealth of Virginia interagency group of technical representatives from state and federal agencies responsible for monitoring natural resource conditions and the effects of drought on people, business and natural resources. When activated, the Drought Task Force meets to assess conditions and make recommendations regarding drought status. The Task Force periodically releases Drought Status Reports summarizing drought conditions in the Commonwealth. Through the DMTF, the group can make recommendations for declaring four Drought Stages based on how the measured groundwater levels compare to historic levels: Normal, Watch, Warning, and Emergency. Each Drought Stage involves a list of response activities that are generally initiated when a specific Drought Stage declaration is made[22].

Table 4-40 summarizes the 2012 US Census of Agriculture information by county in the Northern Neck. As of 2012, there are a total of 401 farms that produce more than $77 million in regional agricultural production annually. The 2017 US Census of Agriculture is ongoing during the time of the 2017 plan update, therefore 2012 data was used (the most current information available).

Table 4-40. 2012 US Census of Agriculture General Information by County

Jurisdiction	Number of Farms	Land in Farms (Acres)	Average Size of Farm (Acres)	Market Value of Products	Average Value Per Farm
Lancaster	61	10,695	175	$4,864,000	$79,741
Northumberland	98	43,270	442	$21,357,000	$217,932
Richmond	90	32,373	360	$15,467,000	$171,858
Westmoreland	152	59,378	391	$35,758,000	$235,248
Northern Neck	**401**	**145,716**	**363**	**$77,446,000**	**$193,132**

Source: 2012 U.S. Census of Agriculture

4.12.3 Previous Occurrences

Historically, Virginia droughts have tracked somewhat consistently with precipitation levels, whether a limited drought or a longer term agricultural drought such as those during the 1930's, 1963 and during the late 1980's through early 1990's. During the past five years, drought on the Northern Neck has been localized and usually a result of low precipitation during July through September impacting crop revenue but not significantly harming aquifers or drinking water wells.

[22] National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center, Climate at a Glance

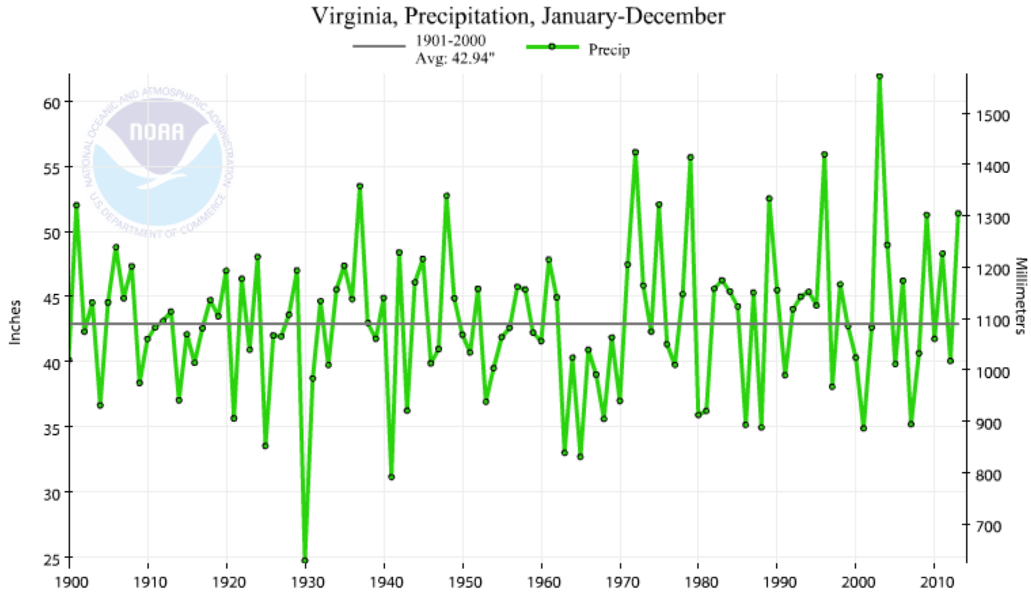

Figure 4-11. Virginia Precipitation since 1900

According to the NCEI database, there have been three recorded droughts since 1996 that have affected all of the Northern Neck counties. Table 4-41 lists the most significant droughts which impacted the Northern Neck, both of which occurred several decades ago. Drought is cyclical, severe droughts were experienced in the 1960's, 1970's and during 1988. In recent years, short-term droughts of several months impacted horticulture, lawns, and even crops but not aquifers. Severity was not extensive enough to activate the Commonwealth of Virginia Drought Monitoring Task Force.

Table 4-41. Previous Occurrences of Drought Events

Event Date	Hazard History
September 1, 1997	A very dry period from May through September resulted in drought-like conditions across much of central and eastern Virginia. Of the four Northern Neck counties, Lancaster reported $1,880,000 in crop damages as a result of this drought.
October 1, 1998	A very dry period from July through October resulted in drought-like conditions across much of the eastern piedmont and northern neck of Virginia. The four Northern Neck counties reported a total of $8 million in crop damage as a result of this drought.

Table 4-41. Previous Occurrences of Drought Events

Event Date	Hazard History
November 1, 1998	Drought-like conditions continued to affect much of the eastern Piedmont and Northern Neck through November. This was the fifth month in a row that drought conditions were seen across Northern Virginia. Persistent high pressure over the Southeast U.S. forced rain producing low pressure systems to steer north of the region. There was an additional $4 million in reported crop damage in the Northern Neck. This was the first year the USDA Farm Service Agency had to make direct payments for grazing losses. The extended drought damaged root systems of grass and was expected to have an effect on the 1999 hay crop. The drought also contributed to a high frequency of forest and brush fires.

Source: NCEI Storm Events Database

4.12.4 Probability of Future Events

Droughts are often unpredictable and may be localized, which makes it difficult to assess the probability. Historical records of drought shows that when droughts occur, they have a costly impact on agricultural production of the Northern Neck. According to the USGS analysis of droughts since 1930, on average they occur once every ten years with variation in duration and severity[23]. Most droughts in this area are shorter, multi-month droughts, while widespread multiyear droughts are much less common.

4.12.5 Vulnerability and Risk Assessment

Table 4-42 shows the annualized damages for drought events in the Northern Neck. The NCEI Storm Events data was annualized by dividing total drought events by the length of record. The annualized values should only be used to estimate what can be expected annually. Using historical records, individual counties can expect to experience a drought once every ten years and the region can expect to see a drought every five to ten years. However, lengthy, agricultural droughts have not been experienced in more than two decades. Annual total damages (adjusted for inflation) from these events for each county was found to be between $135,650 and $339,126, though it is possible that actual annual damages in some counties could be higher due to unreported damages. There are no expected deaths or injuries from these events.

[23] Virginia Floods and Droughts. https://md.water.usgs.gov/publications/wsp-2375/va/

Table 4-42. Annualized Damages from Drought

Jurisdiction	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Lancaster	0.1	$0	$265,148	$265,148	0	0
Northumberland	0.1	$0	$203,475	$203,475	0	0
Richmond	0.1	$0	$135,650	$135,650	0	0
Westmoreland	0.1	$0	$339,126	$339,126	0	0

4.12.5.1 Vulnerability and Impact to People and Property

If a significant drought event were to occur, it could bring economic, social, and environmental impacts to the region. One of the most significant economic effects of a drought to a community is the agricultural impact that includes the undernourishment of livestock and crop damage. Droughts severely impact farm income and can increase the cost of potable water if water supplies have to be augmented.

High summer temperatures can exacerbate the severity of a drought. When soils are wet, a significant portion of the sun's energy goes toward evaporation of the ground moisture. However, when drought conditions eliminate soil moisture, the sun's energy heats the ground surface and temperatures can soar, further drying the soil. The impact of excessive heat is most prevalent in urban areas, where urban heat-island effects prevent inner-city buildings from releasing heat built up during the daylight hours. Secondary impacts of excessive heat are severe strain on the electrical power system and potential brownouts or blackouts.

Droughts can also create conditions that enable the occurrence of other natural hazard events such as wildfires or wind erosion. The likelihood of flash flooding is increased if a period of severe drought is followed by a period of extreme precipitation. Low-flow conditions also decrease the quantity and pressure of water available to fight fires, while the dry conditions increase the likelihood that fires will occur.

4.12.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined drought to be a moderate hazard in Northern Neck. Drought events within the region are a somewhat likely event with less than one event recorded annually. Drought events have a very low range of impacts with no reported annual property damages. The potential exposure for drought is "high" with over $1 million in reported crop damages. Drought is ranked low for having a warning time of more than three days. Table 4-43 outlines the hazard ranking for each of the hazard priority criteria related to drought.

Table 4-43. Drought Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Medium	N/A No property damages were recorded	Medium	Medium	Significant	Low

4.13 Wildfire

4.13.1 Description

A wildfire is an undesirable fire occurring in a forest, brush land, or wooded development that is a serious and growing hazard over much of the United States. Fires within forested areas that are ignited by natural causes such as lightning or as part of a controlled burn process are part of the natural fire cycle and an important contributor to forest health.

Wildfires are classified as uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures for areas greater than one acre. Wildfires may create additional environmental concerns well after they are extinguished such as increased erosion and water quality concerns in storm water runoff. Three main factors influence wildfire behavior – topography, fuel, and weather. Other hazards can contribute to the potential for wildfires or can influence wildfire behavior. High winds can down power lines and lightning can spark fires. Lightning is a major cause of structural fires and wildfires.

Drought conditions also increase wildfire potential by decreasing fuel moisture. Warm winters, hot, dry summers, severe drought, insect and disease infestations, years of fire suppression, and growth in the wildland-urban interface (WUI) continue to increase wildfire risk and the potential for catastrophic wildland fires. Forest insect epidemics and forest parasites contribute to wildfire potential by increasing fuel loading.

4.13.2 Location and Extent

The Wildland Urban Interface (WUI) is the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuel. [24] The three types of communities that occur in or around the WUI are:

- **Interface Community** - The Interface Community exists where structures directly about wildland fuels. There is a clear line of demarcation between residential, business, and public structures and wildland fuels. The development density for an interface community is usually 3 or more structures per acre or a population density of 250 or more people per square mile, with shared municipal services.
- **Intermix Community** - The Intermix Community exists where structures are scattered throughout a wildland area. There is no clear line of demarcation; wildland fuels are continuous outside of and within the developed area. The development density in the

[24] Radeloff, V. C., R. B. Hammer, S. I Stewart, J. S. Fried, S. S. Holcomb, and J. F. McKeefry. 2005. The Wildland Urban Interface in the United States. Ecological Applications 15:799-805.

intermix ranges from structures very close together to one structure per 40 acres or a population density in between 28-250 people per square mile.

- **Occluded Community** - The Occluded Community generally exists in a situation, often within a city, where structures abut an island of wildland fuels (e.g., park or open space). There is a clear line of demarcation between structures and wildland fuels. The development density for an occluded community is usually similar to those found in the interface community, but the occluded area is usually less than 1,000 acres in size.

The areas where forested lands meet with urban areas (WUI) are considered most at risk to sustaining damages to property and structures as well as injuries and loss of life. Drought or near-drought conditions can significantly increase the potential for wildfires to spread. Figure 4-12 shows the location of the wildland-urban interface and intermix zones as well as other types of development zones. Because most densely settled areas are in towns or along the coast, the WUI risk is much lower than in more suburban areas of the Commonwealth but should be monitored in future plans if significant development occurs near or within forested areas.

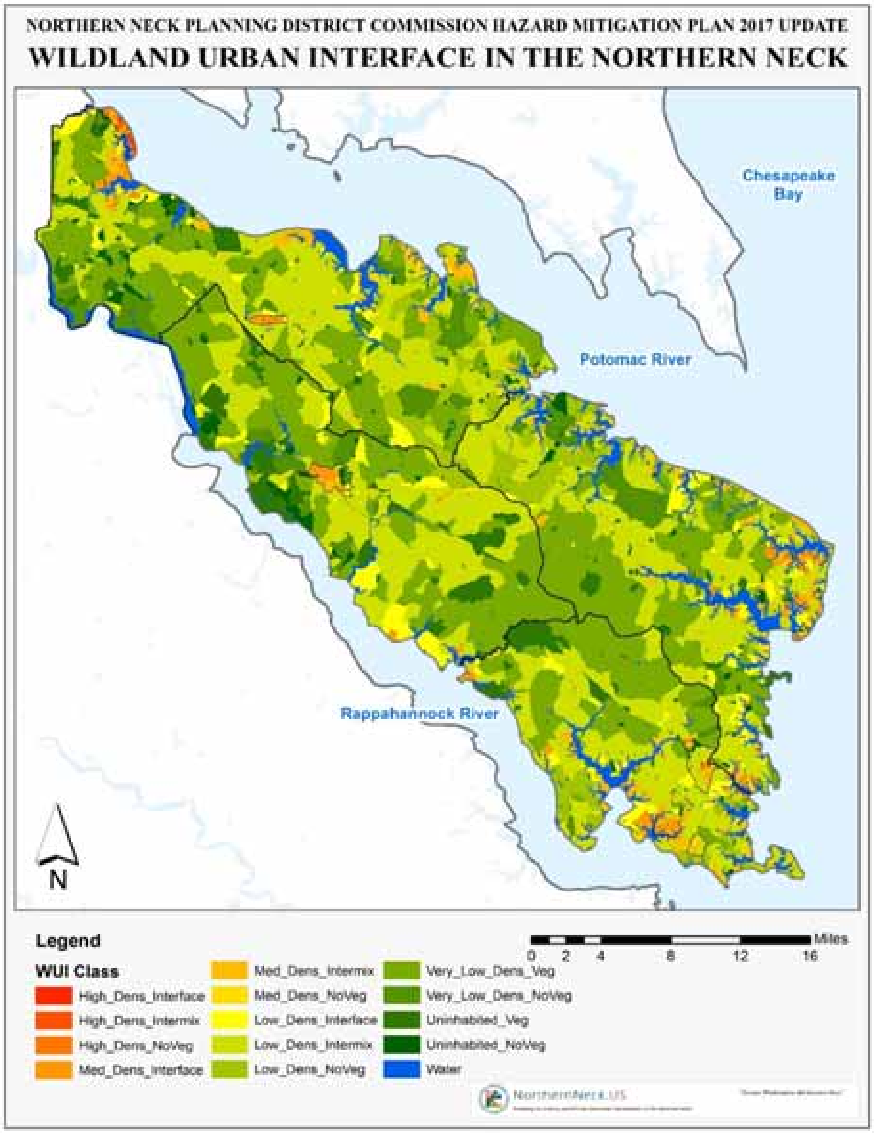

Figure 4-12. Wildland Urban Interface Areas in Northern Neck

4.13.3 Previous Occurrences

According to the Virginia Department of Forestry, formerly the Virginia Division of Forestry established in 1914, 1,460 wildfires have been reported since 1917[25]. Since 2000, there have been 279 recorded wildfires in the Northern Neck documented in a database obtained from Virginia Department of Forestry's GIS Data Portal. This geospatial database does not include earlier recorded wildfires due to data limitations, nor does it include wildfires reported during the spring 2017 season, where occurrence was rare due to sufficient rainfall. This database is updated on an annual basis in the fall for federal reporting purposes. Wildfire sizes range from less than a quarter of an acre (Class A) to larger than 5000 acres (Class G). Of the 279 wildfires in Northern Neck, 157 were one-fourth acre or less, 108 were more than one-fourth acre but less

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[25] "Virginia's Fire History" http://www.dof.virginia.gov/fire/va-fire-history.htm

than 10 acres, and 14 were between 10 acres and 100 acres. Upon reviewing the data, no fire exceeded 31 acres in extent. Table 4-44 lists the fires specific to the counties in Northern Neck. Figure 4-13 shows the locations of historic wildfires in the Northern Neck.

Table 4-44. Fires in the Northern Neck (2000-2016)

Jurisdiction	One-fourth acre or less	More than one-fourth acre, but less than 10 acres	10 acres or more, but less than 100 acres	Total
Lancaster	79	33	3	115
Northumberland	8	11	1	20
Richmond	34	34	5	73
Westmoreland	36	30	5	71
Northern Neck	**157**	**108**	**14**	**279**

Source: Virginia Department of Forestry https://vdof.maps.arcgis.com/home/index.html

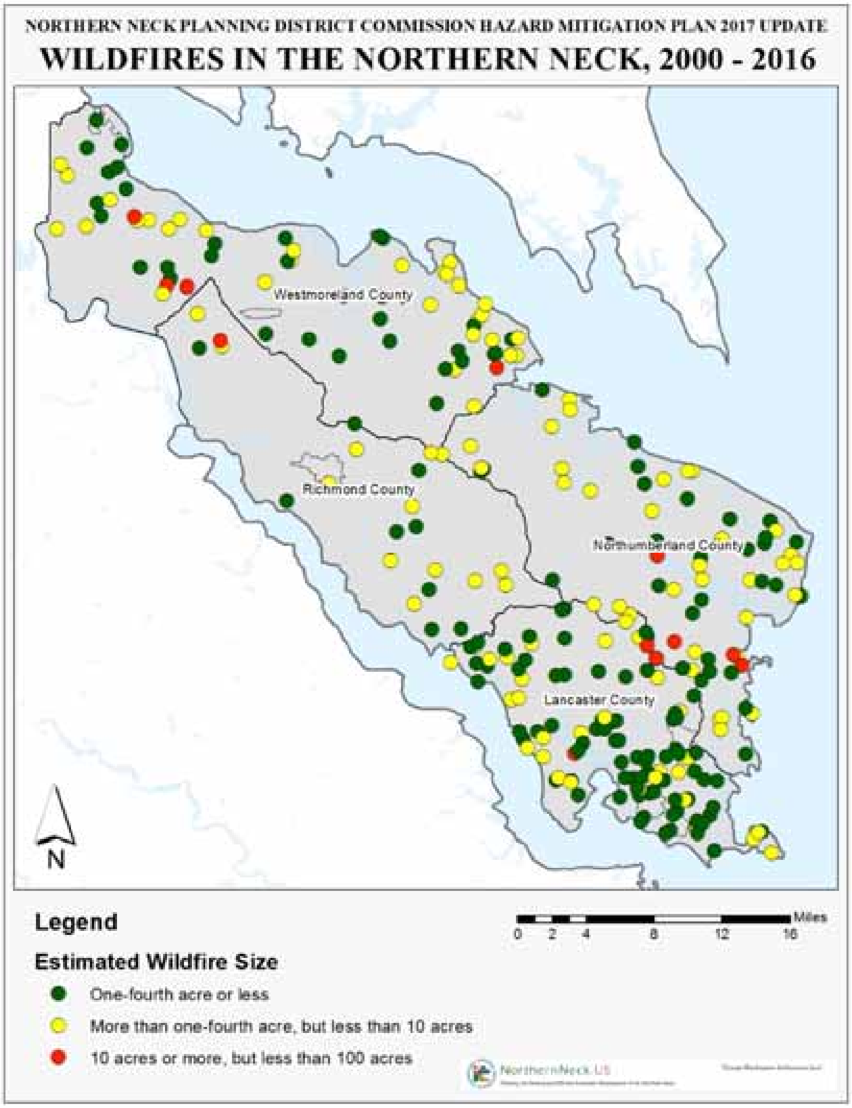

Figure 4-13. Historic Wildfires in the Northern Neck

4.13.4 Probability of Future Events

The probability of wildfires is difficult to predict and is dependent on many factors, including the type of vegetative cover in a particular area, and weather conditions, including humidity, wind, and temperature. There have been an average of 15 wildfires annually in the Northern Neck based on the VDOF historical wildfire data recorded since 2000. A similar number of fires would be expected to occur in the future, contingent on rainfall amount/drought levels, quantity of new development, and accuracy of reporting. A Wildfire Risk Assessment model was done by VDOF in 2003 that shows the potential for an area to burn during a wildfire. As seen in Figure 4-14, most of Lancaster County and the eastern part of Northumberland County have a high burn potential that is closely correlated with historical reported fires.

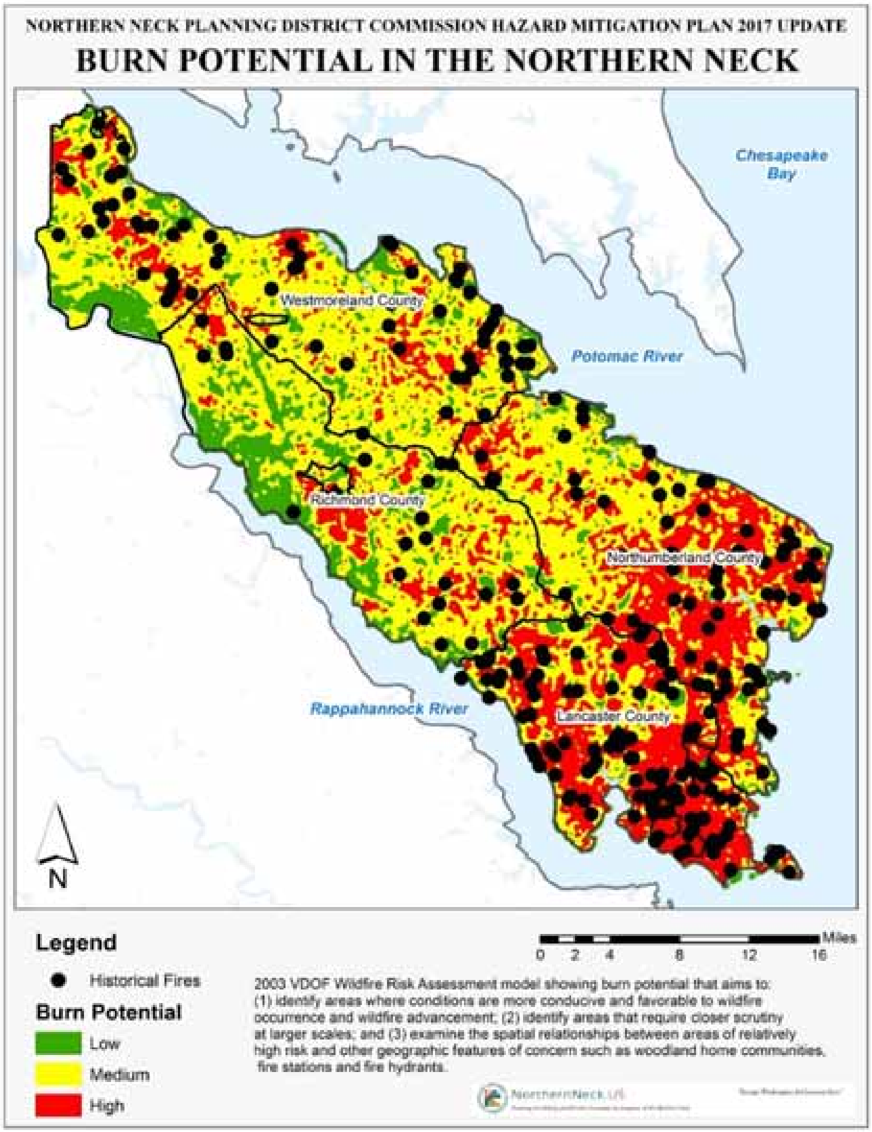

Figure 4-14. Wildfire Burn Potential in the Northern Neck

4.13.5 Vulnerability and Risk Assessment

4.13.5.1 Vulnerability and Impact to People and Property

Wildfires can have disastrous consequences causing damage to residences, commercial buildings, and to timber, grasslands and natural resources. Economic consequences include the cost of suppression, reduced property values, lost sales and business revenues, reduced tourism, and increased water treatment costs. Resources threatened include communities, homes, gas transmission lines, electrical facilities and lines, timber, watershed and recreation areas, and wildlife. Wildfires may create additional environmental concerns well after they are extinguished such as increased erosion and water quality concerns in storm water runoff.

Timber loss and environmental damage frequently result from wildfires. Wildfire poses a significant threat to nearby buildings and populations. Forest damage from thunderstorms may block interior access roads and fire breaks, pull down overhead power lines, or damage pavement and underground utilities, thereby creating heavy fire load and making suppression and response more difficult. While the risk is apparent with many Northern Neck second homes located in wooded areas, even with limited volunteer fire departments, wildfire size remains small. The lack of drought during the past two decades has greatly helped reduce wildfire occurrence and limit size.

4.13.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined wildfires to be a "limited" hazard in Northern Neck. Wildfire events within the region are highly likely with more than four events reported annually. Wildfire events have a "low" range of impacts, accounting for less than $10,000 (adjusted for inflation) in annual reported property damages. The potential exposure for wildfires is "low" with less than $100,000 in potential damages. Wildfire ranks high for having a warning time of less than 24 hours before an event. Table 4-45 outlines the hazard rankings for each of the hazard priority criteria related to wildfires.

Table 4-45. Wildfire Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Significant	**Low**	**Low**	**Significant**	**Low**	**Low**

4.14 Earthquakes

4.14.1 Description

The earth's surface is covered by solid rock approximately 50 miles thick, referred to as the lithosphere. The lithosphere is made up of the Earth's crust, which ranges in size from about 22 miles thick for continents to about five miles thick for the oceans, and the upper mantle which is composed of solidified magma. This lithosphere "floats" above a thick layer of molten rock known as the lower mantle. The lithosphere is divided into large and small sections that geologists call plates. Earthquakes occur when those geologic plates slide against each other, resulting from the sudden release of energy that creates seismic waves. Most movements between plates are extremely small, generating tiny earthquakes that cannot be sensed by people. Other less frequent movements between plates can be quite large, generating powerful earthquakes that can shake the ground surface and cause widespread damage. Earthquakes can be violent enough to destroy whole cities.

The term "earthquake" is used to describe any seismic event — whether natural or caused by humans — that generates seismic waves. Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An earthquake's point of initial rupture is called its focus or hypocenter. The epicenter is the point at ground level directly above the hypocenter.

Most earthquakes occur at weak points in the earth's crust along surfaces where two or more geologic plates meet, called faults. Large faults within the Earth's crust result from the action of plate tectonic forces, with the largest forming the boundaries between the plates. The location of faults can provide an indication of where future earthquakes are likely to occur. Some of the more active earthquake faults in the United States include the San Andreas Fault in California and the New Madrid Fault in the Midwest.

4.14.2 Location and Extent

Earthquakes in the United States occur most frequently along the West Coast, where both convergent and transform plate boundaries are present. Earthquakes also occur along the East Coast of the United States, but the mechanisms causing these earthquakes are not well understood, as these earthquakes occur within the plate rather than at plate boundaries (USGS, 2003).

The potential effects of an earthquake are dependent on the magnitude of the event, the intensity (distance from the epicenter), and the type of geologic material in the area:

- Magnitude is a measure of the strength of an earthquake or energy released by it. Magnitude is measured by a device known as a seismograph. The scale used to measure earthquake magnitude was originally defined by Charles Richter in the 1930s, and is commonly referred to as the Richter scale, which assigns a magnitude number to quantify the strength of an earthquake. Since January 2002, the Moment Magnitude Scale (MMS) has been used by seismologists in the USGS to calculate and report magnitudes for all modern large earthquakes. The MMS was developed in the 1970s and measures the size of earthquakes in terms of its energy released.
- Intensity is a measure of the effects of an earthquake at a particular place on people, structures, or the land itself. Earthquake intensity is most commonly measured in the United States using the Modified Mercalli (MMI) scale. The intensity at a point depends not only upon the strength of the earthquake, but also upon the distance from the earthquake to the point and the local geology at that point.
- Peak Ground Acceleration (PGA) is another common measure of earthquake shaking along the earth's surface. PGA expresses acceleration along the earth's surface as a percentage of g, the acceleration due to gravity (32.2 ft. /s^2). PGA varies significantly depending on the ground type and the geology of an area.

Table 4-46 summarizes the intensities typically observed at locations near the epicenter of earthquakes of different magnitudes and defines the intensity scale based on the effects on people, human structures, and the natural environment. Table 4-47 compares the PGA with earthquake intensities and the perceived damage and shaking expected.

Table 4-46. Modified Mercalli Intensity Scale for Earthquakes

Scale	Intensity	Effects	Richter Magnitude Scale
I	Instrumental	Detected only on seismographs	1.0 to 3.0
II	Feeble	Some people feel it	3.0 to 3.9
III	Slight	Felt by people resting; like a truck rumbling by	
IV	Moderate	Felt by people walking	4.0 to 4.9
V	Slightly Strong	Sleepers awake; church bells ring	

Table 4-46. Modified Mercalli Intensity Scale for Earthquakes

Scale	Intensity	Effects	Richter Magnitude Scale
VI	Strong	Trees sway; suspended objects swing; objects fall off shelves	5.0 to 5.9
VII	Very Strong	Mild alarm; walls crack; plaster falls	
VIII	Destructive	Moving cars uncontrollable; masonry fractures; poorly constructed buildings damaged	6.0 to 6.9
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	7.0 and Higher
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards	
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	

Table 4-47. Modified Mercalli Intensity (MMI) and PGA Equivalents

MMI	Acceleration (%g) (PGA)	Perceived Shaking	Potential Damage
I	<0.17	Not Felt	None
II	0.17 - 1.4	Weak	None
III	0.17 - 1.4	Weak	None
IV	1.4 - 3.9	Light	None
V	3.9 - 9.2	Moderate	Very Light
VI	9.2 - 18	Strong	Light
VII	18 - 34	Very Strong	Moderate
VIII	34 - 65	Severe	Moderate to Heavy
IX	65 - 124	Violent	Heavy
X	> 124	Extreme	Very Heavy
XI	> 124	Extreme	Very Heavy
XII	> 124	Extreme	Very Heavy

Source: Virginia State Hazard Mitigation Plan

4.14.3 Previous Occurrences

Since 1900, there is no record of an earthquake having its epicenter within the boundaries of the Northern Neck. The earthquake that occurred on August 23, 2011, with an epicenter in Louisa County, Virginia resulted in a Federal Disaster Declaration in nine jurisdictions, and was felt as far north as Vermont. Due to the orientation of the fault, this earthquake was felt in the Northern Neck, though not as strongly as in those nine jurisdictions. Figure 4-15 shows the location of past earthquakes in the Commonwealth relative to the Northern Neck Region.

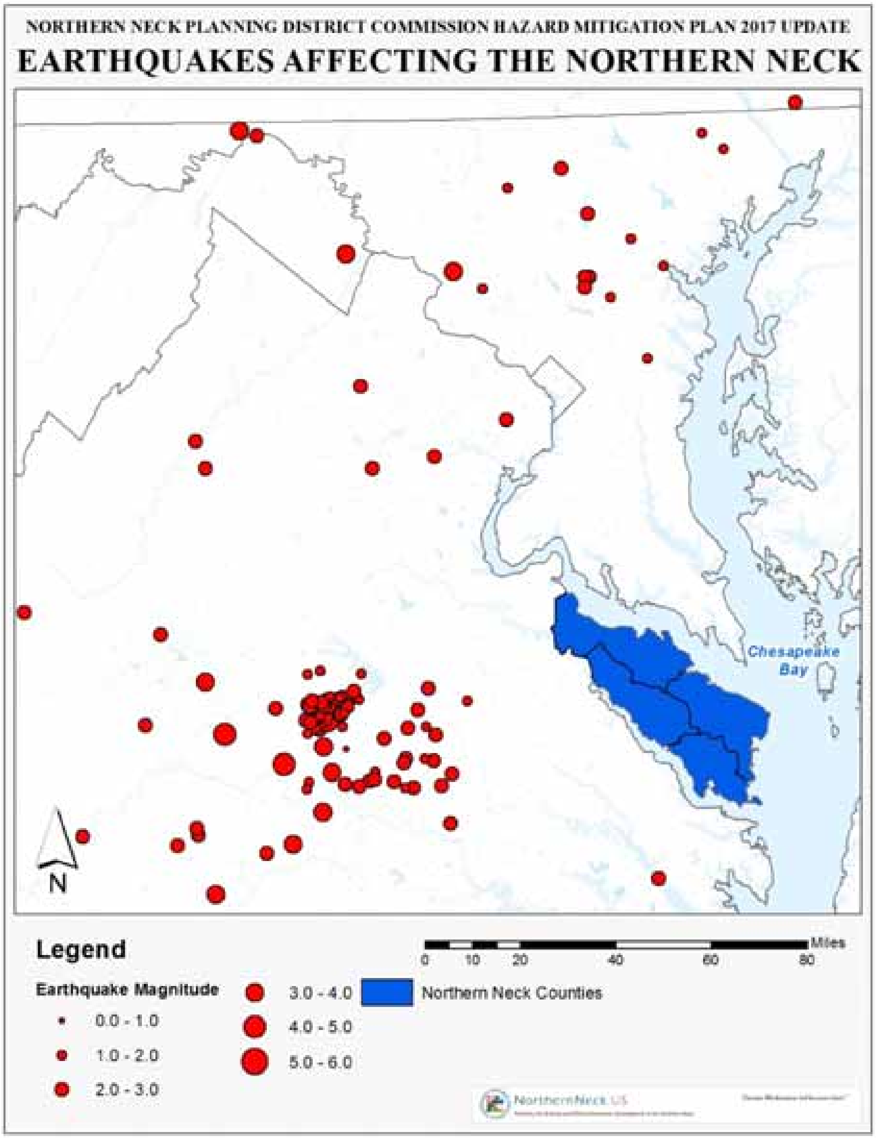

Figure 4-15 Historical Earthquakes in the Commonwealth of Virginia

4.14.4 Probability of Future Events

Earthquakes are low probability, high-consequence events. Earthquakes and tsunamis are not considered significant hazards in the Northern Neck, and the probability of these events occurring within the region is unlikely. The closest offshore fault lies east of Charleston, South

Carolina, and has the potential to impact the Northern Neck in the event of a moderate to severe earthquake event.

4.14.5 Vulnerability and Risk Assessment

4.14.5.1 Vulnerability and Impact to People and Property

Although earthquakes may occur infrequently they can have devastating impacts that affect entire communities and regions. The destructiveness of an earthquake depends on a number of factors, including the magnitude of the tremor, direction of the fault, distance from the epicenter, regional geology, and the design characteristics of buildings and infrastructure. Buildings in the Northern Neck are seldom designed to deal with an earthquake threat because of the very low likelihood of occurrence; therefore, they are extremely vulnerable to the impacts of moderate and large earthquakes.

Earthquake intensity is generally greater on soft soils than solid rock. Liquefaction can occur when loose sand and silt that is saturated with water behaves like a liquid when shaken by an earthquake[26] to the point where it can no longer support the weight of any object that is located on it. Areas in the Northern Neck that contain alluvial soils are more at risk of liquefaction occurring in the event of an earthquake. Other effects of a strong earthquake include landslides, fissuring and slumping at the ground surface, and even tsunamis. When the epicenter of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Tsunami waves can travel across the ocean at very high speeds, depending on the location and source of the seismic event.

4.14.5.2 Hazard Ranking

The priority hazard ranking process for the 2017 HIRA determined earthquakes to be a limited hazard in the Northern Neck. As described in the profile above, earthquakes are unlikely events with no epicenters recorded in the Northern Neck. There are no recorded property damages as a result of earthquakes. The potential exposure for an earthquake event is “medium” with between $100,000 and $1 million in potential damages. Due to the infrequency of events in this area, infrastructure could sustain considerable damage in a medium strength earthquake. Earthquake is ranked high for having a warning time of less than 24 hours before the event. Table 4-48 outlines the hazard rankings for each of the hazard priority criteria related to earthquakes.

Table 4-48. Earthquake Hazard Priority

Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
N/A	N/A	Low	Significant	Medium	Low

4.15 Summary/Conclusions on Vulnerability Assessment

A variety of natural hazards have the potential to impact the Northern Neck. In addition to the potential for injury or loss of life and damage to property and crops, a hazard event can disrupt utilities, communication and transportation impacting the well-being of people and communities.

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26 “About Liquifaction” https://geomaps.wr.usgs.gov/sfgeo/liquefaction/aboutliq.html

Since so many residents are second-home owners along the Northern Neck's shores, full understanding of hazard potential and severity, along with recovery after an event, are a unique challenge to the area.

It is important to point out that data limitations for some hazards prevented a complete analysis of past occurrence and or potential future losses. The availability of more precise building footprint data for Lancaster and Northumberland County, more complete damage information on April and May, 2017, wind events, and expanded Department of Forestry wildfire occurrence data will improve future plan updates, reflecting a broader data set than just the NCEI and localized media reports. Increased research on sea-level rise and climate change will also be presented in future hazard vulnerability analysis. Also, the NOAA NCEI database recognizes that it may not contain every hazard event and complete damage statistics since a lot of storm damage is never reported. Additionally, new 2017 U.S. Agricultural Census data will help better characterize hazard risk to agricultural commodities. Thus, the information presented herein should be considered an "informed estimate."

4.15.1 Hazard Rankings

The purpose of the hazard ranking is to categorize and prioritize all potential hazards for the Northern Neck based on risk. Combined with the asset inventory and quantitative vulnerability assessment, the summary hazard classifications allow for the prioritization of those high hazard risks for mitigation planning purposes, and more specifically, the identification of hazard mitigation opportunities for the Northern Neck to consider as part of their proposed mitigation strategy. Each hazard was ranked by 0 (no data), 1 (low), 2 (medium), and 3 (high) in five categories, which were then weighted and averaged together to develop a Composite Hazard Index. This index was then used to rank the hazards to give the community some sense of how the hazards ranked in comparison to the others. Table 4-5 provides a summary of the categories used to rank the hazards and their weighted values for the Composite Hazard Index.

Table 4-49 contains a detailed accounting of the ranking for each of the ten hazards discussed in this section. The highest priority hazards were coastal flooding, riverine flooding, hurricanes, and tornados. Coastal erosion and severe weather were ranked as moderate hazards. The rest, ranked as Limited, were Wildfire, Winter Storm, Drought, and Earthquakes.

Table 4-49. Hazard Rankings and Risk Assessment

Hazard	Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Coastal Flooding	Medium	Significant	Significant	Medium	Significant	Significant
Riverine Flooding	Medium	Medium	Significant	Medium	Significant	Significant
Hurricane	Medium	Significant	Significant	Low	Significant	Significant
Tornado	Medium	Significant	Significant	Significant	Medium	Significant

Table 4-49. Hazard Rankings and Risk Assessment

Hazard	Frequency	Hazard Impact (Property Damages)	Northern Neck Ranking	Warning Time	Potential Exposure	Composite Rank
Coastal Erosion	Significant	Damages not reported as erosion	Medium	Low	Significant	Medium
Severe Weather	Significant	Significant	N/A Did not rank	Medium	Medium	Medium
Wildfire	Significant	Low	Low	Significant	Low	Low
Winter Storm	Medium	Low	Medium	Low	Low	Low
Drought	Medium	N/A - No property damages reported	Medium	Medium	Significant	Low
Earthquake	N/A	N/A	Low	Significant	Medium	Low

4.15.2 Summary of Loss Estimates

As described in the hazard-specific estimated loss sections, there have been a total of 352 storm events since 1950 reported across the Northern Neck, as recorded in the NOAA NCEI Storm Events database. This total accounts for any duplication in instances where the same storm event was reported in multiple counties of the Northern Neck. Total damages, which are also reported at a county level, are not duplicative since each county only reports their local damages. Similarly, deaths and injuries are not duplicative. The NOAA NCEI Storm Events Database data was annualized using the total years of record for each hazard category. Table 4-50 summarizes the estimated annualized events and damages for the Northern Neck. This information is additionally presented by county in Table 4-51 and Table 4-52. Reported damages for coastal erosion, wildfire, and earthquake hazards were not available NCEI Storm Events Database and are therefore not included in the table below. Historical wildfire data that was available from 2000 to 2016 averages out to about 15 wildfires annually. No property damage, deaths, or injuries were included in this dataset.

Table 4-50. Northern Neck Annualized Hazard Events, Damages, Deaths, and Injuries

Hazard	Events	Property Damages	Crop Damage	Total Damage	Deaths	Injuries
Coastal Flooding	0.5	$1,317,887	$0	$1,317,887	0	0
Drought	0.1	$0	$943,399	$943,399	0	0
Hurricane	0.3	$117,741	$175,147	$292,888	0	0
Riverine Flooding	0.5	$56,339	$16,922	$73,261	0	0
Severe Weather	3.2	$360,170	$105	$360,275	0	0.0
Tornado	0.4	$172,204	$1,162	$173,367	0	0.2
Winter Storm	4.2	$1,926	$0	$1,926	0	0

Table 4-51. Annualized Hazard Events by County and the Northern Neck Region

Hazard	Lancaster	Northumberland	Richmond	Westmoreland	Region
Coastal Flooding	0.4	0.5	0.1	0.2	0.50
Drought	0.1	0.1	0.1	0.1	0.14
Hurricane	0.2	0.2	0.1	0.1	0.32
Riverine Flooding	0.2	0.2	0.3	0.4	0.55
Severe Weather	1.2	1.1	1.9	1.8	3.17
Tornado	0.1	0.1	0.2	0.1	0.38
Winter Storm	2.7	3.0	3.1	3.2	4.23

Table 4-52. Annualized Hazard Damages by Type and County

Hazard	Lancaster		Northumberland		Richmond		Westmoreland		REGION
	Property	Crop	Property	Crop	Property	Crop	Property	Crop	TOTAL
Coastal Flooding	$91,330.29	$0.00	$1,117,119.92	$0.00	$98,041.18	$0.00	$11,395.89	$0.00	$1,317,887.28
Drought	$0.00	$265,147.75	$0.00	$203,475.46	$0.00	$135,650.31	$0.00	$339,125.77	$943,399.29
Hurricane	$39,482.34	$24,721.89	$47,344.19	$58,903.73	$6,340.21	$39,908.89	$24,574.44	$51,612.35	$292,888.04
Riverine Flooding	$0.00	$0.00	$0.00	$0.00	$43,399.14	$13,271.91	$12,940.11	$3,649.77	$73,260.93
Severe Weather	$62,629.15	$0.00	$289,888.57	$0.00	$3,348.70	$104.91	$4,303.34	$0.00	$360,274.67
Tornado	$87,181.85	$0.00	$9,341.00	$0.00	$55,665.58	$0.00	$20,015.86	$1,162.42	$173,366.71
Winter Storm	$0.00	$0.00	$0.00	$0.00	$963.02	$0.00	$963.02	$0.00	$1926.04
Total	**$280,623.63**	**$289,869.64**	**$1,463,693.68**	**$262,379.19**	**$207,757.84**	**$188,936.02**	**$74,192.67**	**$395,550.31**	**$3,163,002.96**

5.0 Mitigation Strategy

5.1 Introduction

The hazard mitigation planning process conducted by the Northern Neck Planning District Commission used a typical problem-solving methodology:

- Describe the problem (Hazard Identification).
- Estimate the impacts the problem could cause (Risk Assessment).
- Assess what local programs, staff, and technical abilities are in place (or potentially could be in place) to lessen those impacts. Using this information, determine what, if anything, can be done to reduce hazard impacts and promote community resilience, and select those actions that are appropriate for the Northern Neck region (Mitigation Strategy).

The Mitigation Strategy section of the hazard mitigation plan update describes the development of the mitigation strategy. Through the process of reviewing and updating the 2011 plan update goals and debriefing the 2011 plan update objectives and mitigation strategies during the May 31, 2017, Mitigation Action Committee meeting, the updated 2017 mitigation plan goals were set. During this process Planning District Commission and local government 2017 to 2022 mitigation actions were developed (including re-prioritization of 2011 actions that were continued).

5.2 Existing Authorities, Policies, Programs, and Resources for Mitigation

Relevant authorities, policies, programs, and resources available to support the Northern Neck's hazard mitigation activities are outlined in Section 6.0 Capabilities, Plan Implementation and Maintenance. Northern Neck jurisdictions have long-established, experienced program administrators and staff who can work with the Local Emergency Planning Committee and Mitigation Advisory Committee to advance not only the 2017 to 2022 mitigation strategies herein but can also further facilitate a holistic, integrated mitigation program to reduce risk exposure and increase resilience of the region's population (described in Section 3.0 Community Profile).

5.3 Setting Mitigation Goals

When a community decides that certain risks are unacceptable and that certain mitigation actions may be achievable, the development of *goals* and *actions* takes place. *Goals* are long-term and general statements. *Actions* are detailed and specific strategies, actions, or projects that support accomplishment of the 2017 mitigation plan update goals as well as holistic hazard mitigation programs.

The Mitigation Advisory Committee (MAC) reviewed the goals from the 2011 Northern Neck Regional Hazard Mitigation Plan at the April 5, 2017, HIRA and Mitigation Goals review meeting conducted at the Northern Neck PDC office in Warsaw, Virginia. The goals were reviewed, discussed, and edited to better address hazards as profiled in Section 4.0 Hazard Identification and Risk Assessment, and to inject resilience concepts into the hazard mitigation plan update. The goals are broad and applicable to the jurisdictions served by the NNPDC. The goals were addressed a second time during the final MAC meeting conducted May 31, 2017, where they were slightly modified. A column on the 2017 to 2022 Mitigation Actions table (Appendix D) aligns each action to the revised mitigation goals.

2017 – 2022 Mitigation Goals

Goal 1: Promote new development that avoids undue risks posed by natural hazards and is resilient to natural disasters.

Goal 2: Address natural hazards and vulnerabilities that represent a threat to the community.

Goal 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents, property and critical infrastructure of the Northern Neck.

Goal 4: Enhance the capabilities of local government to address natural hazards to enhance the whole community for increased resilience.

Goal 5: Increase natural hazard awareness of our citizens. Educate Northern Neck citizens and part-time residents on citizen and community hazard resilience.

Goal 6: Participate and Comply with the National Flood Insurance Program (NFIP) through floodplain identification, mapping, and floodplain management.

5.4 Selecting Mitigation Actions

Actions are detailed and specific strategies, actions, and projects that help support regional natural hazard resilience and mitigation goal achievement. The actions from the 2011 plan formed a platform for discussion about mitigation actions for the 2017 plan. During the April 5, 2017, MAC Meeting, the group decided that it did not want objectives but wanted to go with a goal-action mitigation strategy structure. A lengthy discussion was held at that meeting on the 2011 plan mitigation actions and strategies to help frame which 2011 actions should be continued and what organizational form the 2017 – 2022 mitigation actions should take.

5.4.1 2011 Plan Mitigation Goals, Objectives, and Strategies Discussion Points

2011 GOAL 1: Promote new development that acknowledges the risks posed by natural hazards and is resilient to natural disasters.

2017 Comments

- Within the Chesapeake Bay coastal high hazard area are no build zones for Northumberland.
- The region has done a good job of not locating critical facilities in the floodplain?
- Westmoreland has a steep slope ordinance to address issues on high hazard Potomac River shorelines.
- Every jurisdiction adopted updated Flood Insurance Studies (FIS) and Flood Insurance Rate Maps (FIRMs) during the planning period along with updated floodplain management ordinances.
- PDC is working on shoreline management mechanisms through the "Living Shores" Program to promote better practices to manage coastal shoreline erosion. Specific county strategies will be included.

2011 GOAL 2: Address risks that threaten existing development.

2017 Comments

- Manufactured housing (trailers) and fuel tanks continue to be a danger. We can address them with new siting and VDEM elevation projects, but there are a lot of existing, non-compliant structures throughout the region.
- Some residents have self-financed building elevation in Northumberland County.

2011 GOAL 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents of the Northern Neck.

2017 Comments

- When asked about infrastructure performance during spring 2017 wind events, the MAC felt that response operations and critical infrastructure performed as designed.
- York county drone team came and flew over to do initial damage assessment. This is an emerging technology with great future potential.
- Town of Irvington – response time was incredible for the tornado. No injuries, no deaths. Trees fell on houses. One house shifted on the foundation. Windows were blown out in a hospital. Didn't stop servicing patients, but one person did get transferred to Walter Reed.
- Stormwater management systems are not common on the Northern Neck so heavy rainfall was either absorbed in the watershed or drained quickly. Standing floodwaters are generally not an issue but coastal surge and erosion are.
- Make sure your critical facilities can handle exposure to water.

2011 GOAL 4: Enhance the capabilities of local government to address natural hazards and potentially limit their impacts.

- No comments

2011 GOAL 5: Increase the awareness of our citizens regarding the natural hazards present in the Northern Neck. Educate them about how to prepare for and mitigate against these hazards.

2017 Comments

- Website information has increased and social media use will continue to grow during the next plan cycle.
- Counties have implemented Code Red which features notification messaging that raises an awareness among citizens.
- Use volunteers with drones for damage assessment if carefully trained.

2011 GOAL 6: Participate and Comply with the National Flood Insurance Program (NFIP) through Floodplain Identification and Mapping, Floodplain Management, and Flood Insurance.

- No comments.

The status of the 2011 plan update strategies and actions were discussed at the April 5 and May 31, 2017, MAC meetings. Status was obtained through return of MS Excel hard copy and digital worksheets developed for each county and town and the NNPDC. The summary workbook sheets for each community may be found in Appendix C.

In addition, a range of new action alternatives were identified by each jurisdiction in individual local government meetings. These alternatives are presented in Appendix D. Generally, the jurisdiction representatives evaluated the actions for inclusion in the plan with the following criteria:

- Time – Can the strategy be implemented quickly?
- Ease of implementation – How easy is the strategy to implement? Will it require many financial or staff resources?
- Effectiveness – Will the strategy be highly effective in reducing risk?
- Lifespan – How long will the effects of the strategy be in place?
- Hazards – Does the strategy address a high-priority hazard or does it address multiple hazards?

After the 2017 actions were selected, the STAPLEE (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) criteria (Table 5-1) were used to inform prioritization the most appropriate actions for the Northern Neck. This methodology requires that social, technical, administrative, political, legal, economic, and environmental considerations be taken into account when reviewing potential actions for the area's jurisdictions to undertake. This process was used to help ensure that the most equitable and feasible actions would be undertaken based on each County's capabilities.

Table 5-1. STAPLEE Project Evaluation Criteria

Social	• Is the proposed action socially acceptable to the community? • Are there equity issues involved that would mean that one segment of a community is treated unfairly? • Will the action cause social disruption?
Technical	• Will the proposed action work? • Will it create more problems than it solves? • Does it solve a problem or only a symptom? • Is it the most useful action in light of other community goals?
Administrative	• Can the community implement the action? • Is there someone to coordinate and lead the effort? • Is there sufficient funding, staff, and technical support available? • Are there ongoing administrative requirements that need to be met?
Political	• Is the action politically acceptable? • Is there public support both to implement and to maintain the project?

Table 5-1. STAPLEE Project Evaluation Criteria

Legal	• Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity? • Are there legal side effects? Could the activity be construed as a taking? • Is the proposed action allowed by a comprehensive plan, or must a comprehensive plan be amended to allow the proposed action? • Will the community be liable for action or lack of action? • Will the activity be challenged?
Economic	• What are the costs and benefits of this action? • Do the benefits exceed the costs? • Are initial, maintenance, and administrative costs taken into account? • Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)? • How will this action affect the fiscal capability of the community? • What burden will this action place on the tax base or local economy? • What are the budget and revenue effects of this activity? • Does the action contribute to other community goals, such as capital improvements or economic development? • What benefits will the action provide?
Environmental	• How will the action affect the environment? • Will the action need environmental regulatory approvals? • Will it meet local and state regulatory requirements? • Are endangered or threatened species likely to be affected

Each STAPLEE factor was of primary concern when selecting measures. For those measures, such as education and outreach, that do not result in a quantifiable reduction of damages, the relationship of the probable future benefits and the cost of each measure was considered when developing the mitigation actions. Action ideas were evaluated based on technical feasibility (i.e., whether they could be done and would solve the problem); cost-effectiveness (i.e., the benefits outweighed the costs); environmental and historic/cultural resource impacts; and political and social acceptance. A priority level was assigned to each project based on the potential for the projects to be completed given the existing and potential funding; this prioritization method was selected because the MAC believed it would foster a realistic expectation of what could be accomplished in the next five years. A priority level of High indicates that these projects are currently in progress and have designated funds for completion or require minimal funds to complete (resulting in a high return on investment or measure of cost-effectiveness). A priority level of Medium indicates that the community is likely to receive funding for these particular projects, and if funding is received, the projects will be completed. Lastly, a priority level of Low indicates that these actions will be complete only if outside funding becomes available.

Actions were developed for each community by creating a spreadsheet that carried forward each 2011 action that the community indicated it wished to "continue." Then through hard copy and electronic correspondence and interviews, each community updated their 2017 to 2022 mitigation actions, as did the Northern Neck Planning District Commission.

The new 2017 to 2022 mitigation actions have been organized into six major categories of mitigation, as shown in Table 5-2.

Table 5-2. Hazard Mitigation Categories and Associated Projects

Mitigation Category	Project Type
Prevention	• Planning and zoning • Building codes • Open space preservation • Floodplain regulations • Stormwater management regulations • Drainage system maintenance • Capital improvements programming • Shoreline/riverine setbacks
Property Protection	• Acquisition/Demolition • Relocation • Building elevation • Critical facilities protection • Retrofitting (i.e., wind-proofing, floodproofing, seismic design) • Safe rooms, shutters, shatter-resistant glass • Insurance
Natural Resource Protection	• Land acquisition • Floodplain protection • Watershed management • Beach and dune preservation • Riparian buffers • Forest and vegetation management (i.e., fire resistant landscaping, fuel breaks)

Table 5-2. Hazard Mitigation Categories and Associated Projects

Mitigation Category	Project Type
	• Erosion and sediment control • Wetland preservation and restoration • Habitat preservation • Slope stabilization • Historic properties and archaeological site preservation
Structural Projects	• Reservoirs • Dams/levees/dikes/floodwalls/seawalls • Diversions/detention/retention • Channel modification • Beach nourishment • Storm sewers
Emergency Services	• Warning systems • Evacuation planning and management • Emergency response training and exercises • Sandbagging for flood protection • Installing temporary shutters for wind protection
Education & Awareness	• Outreach projects • Speaker series/demonstration events • Hazard mapping • Real estate disclosure • Library materials • School children educational programs • Hazard expositions

NOTES:

- Many 2011 floodplain management and NFIP-related actions were carried forward for each community but are listed independently for each community as priorities, staff responsibility and local implementation resources vary.
- A holistic mitigation project action was added for each community to fully insure project type for HMA grant eligibility. Again, these are listed on each community worksheet to allow community-specific prioritization, etc.
- A holistic plan integration action is also included for each community to better ensure plan coordination during the next hazard mitigation planning period. It should be noted that the current local comprehensive plans do a good job of hazard mitigation integration.

5.5 Developing a Mitigation Action Plan

Mitigation action plans were developed for all of the identified actions. Each mitigation action plan includes:

- the goal(s) it is intended to help achieve,
- the hazard(s) it is designed to mitigate,
- the agency assigned responsibility for carrying out the strategy,
- general resources needed,
- a timeframe for completion, and
- Priority level for its implementation (high, medium, or low).

The 2017 to 2022 Mitigation Action tables do include notation where the community did not provide all requested information. The following timeframes are defined in Table 5-3 for the completion of the identified mitigation actions.

Table 5-3. Timeframes Defined

Timeframe	Definition
Short-term	Less than three years
Long-term	More than three years
As funding becomes available	Project timeline is dependent on funding
Ongoing	Project is continuous with no designated end date

The mitigation action plans for each jurisdiction within the Northern Neck are listed in alphabetical order in Appendix D.

6.0 Capabilities, Plan Implementation, and Maintenance

6.1 Capability Assessment

This portion of the Plan assesses the current capacity of the communities of the Northern Neck Planning District to mitigate the effects of the natural hazards identified in Section 4 of the plan. This assessment includes a comprehensive examination of the following local government capabilities:

- *Administrative Capability* – describes the forms of government in the region, including the departments that may be involved in hazard mitigation.
- *Technical Capability* – addresses the technical expertise of local government staff.
- *Fiscal Capability* – examines budgets and currently used funding mechanisms.
- *Policy and Program Capability* – describes past, present, and future mitigation projects in the region and examines existing plans (e.g., emergency operations plan, comprehensive plan).
- *Legal Authority* – describes how jurisdictions in the region use the four broad government powers (i.e., regulation, acquisition, taxation, and spending) to influence hazard mitigation activities.

The purpose of conducting the capability assessment is to assess methods that the Northern Neck Regional Planning District's local governments, specifically Lancaster, Northumberland, Richmond, and Westmoreland Counties, have available to implement successful mitigation programs. Through careful analysis, any existing gaps, shortfalls, or weaknesses within existing governmental activities that could exacerbate a community's vulnerability were identified. The assessment also highlights the positive measures underway at the local level that will continue to be supported and enhanced through future mitigation efforts.

The capability assessment serves as the foundation for designing an effective hazard mitigation strategy. It not only helps inform plan goals to be both achievable but aspirational to reduce planning district regional exposure to natural hazards. A master capability assessment matrix table which summarizes each jurisdiction's programs is located in Appendix I. Elements of the master table and a capability assessment survey completed by most of the participating local governments was used to inform this analysis.

6.1.1 Administrative Capability

As described previously, the planning area is comprised of four counties. The counties operate under a Board of Supervisors - County Administrator/Manager system. In this form of government, the elected Board of Supervisors hires a County Administrator who oversees daily operations of the County. In the Northern Neck, each of Board of Supervisors has five members.

The Northern Neck Emergency Operations Plan designates seven departments with specific responsibilities for hazard mitigation:

- Board of Supervisors, Town Councils and Local Government Administrators
- Emergency Management
- Department of Health
- Building/Planning/Zoning
- Law Enforcement

- Public Safety (including fire department and rescue squads)
- School systems

These major functions exist in each of the Northern Neck counties and to some extent the towns with similar responsibilities but sometimes varying local government organization to meet local needs. Additionally, Lancaster County and Northumberland County have identified responsibilities for the General Services Department (Public Works) and the Reedville Sanitary District. Implementation of Hazard Mitigation Assistance (HMA) grants to elevate residential buildings most recently segued to grant administration by the Northern Neck Planning District Commission with on-site supervision and code enforcement through the local building official. Most aspects of the floodplain management program lie within the planning or zoning office with final field enforcement through submission of completed Elevation or Floodproofing Certificates through the local building official. Outreach aspects of hazard mitigation are more holistically driven by local public information officers, emergency managers, planners and non-profit organizations.

Representatives of local governments supported the hazard mitigation plan update and, as part of the process, completed a capability assessment that helped identify local program strengths, gaps, and opportunities for existing or future emergency management, hazard mitigation, or resilience programs. This is especially timely as the region recovers from a sustained recession, has experienced increased severe weather events, and faces sea level rise and continued, accelerating coastal erosion. While exact responsibilities differ from jurisdiction to jurisdiction, general functions and responsibilities of Northern Neck local government departments are described in the sections which follow.

The responsibility to the public for effective hazard mitigation rests with the elected officials, which in the Northern Neck are the County Boards of Supervisors and the Town Councils. They enact the codes, regulations, and ordinances through the authorities granted them by the Commonwealth of Virginia under the Dillon Rule. Emergency management is directed through local emergency management or emergency services offices. County and Town leaders direct local hazard mitigation efforts and work cooperatively as appropriate on regional initiatives through the Northern Neck Local Emergency Planning Committee or with specific counties to provide FEMA-VDEM Hazard Mitigation Assistance (HMA) grant project administration and management. Many related regional plans and programs are administered by the Northern Neck PDC that directly inform and benefit its local governments related to natural resources, economic development, climate change and sea-level rise.

County and Town emergency management operations are focused in two areas. First responders, primarily volunteers (except for 911 dispatchers), sheriffs, and state police support immediate response to incidents such as building, brush and woodland fires, medical emergencies, accidents and hazardous materials spills. Virginia Department of Forestry staff aide response to brush and woodland fires. Several Counties are beginning to add professional emergency medical technicians to provide full-time emergency-medical-services-response capability for medical emergencies.

Additionally, emergency managers are responsible for the mitigation, preparedness, response, and recovery operations relative to natural and man-made disaster events. Specifically, County Administrators and Town Managers, in their roles as Coordinators of Emergency Services, have designated management responsibility for the floodplain management and emergency management programs, often including hazard mitigation program, and assigns program operations to appropriate departments or staff.

The Virginia Department of Health enforces ordinances related to the safe handling and the emergency distribution of water and food. In addition, the Department of Health is responsible for the prevention or spread of disease. The Northern Neck is served by the Three Rivers Health District. Ninety-six employees support the ten-county region of the Northern Neck and Middle Peninsula. An emergency planner and epidemiologist are on District staff.

Planning, zoning and site inspections are conducted by staff or departments that have responsibility for administering and enforcing existing building codes and zoning ordinances. Planning and code compliance staff also ensure that all new construction, repair and building additions or improvements comply with State and County building codes, zoning, and land-use regulations. While the Town of Colonial Beach also has its own building inspector, other small Northern Neck towns use County building officials to support building-code compliance and construction monitoring. Local compliance with the Chesapeake Bay Preservation Act, erosion and sediment control regulations, and stormwater management start with proposed development plan review by local planners, with additional technical and field inspection support provided by the Northern Neck Soil and Water Conservation District. In addition, these departments support project review and code enforcement for hazard mitigation such as elevation of flood-prone residential buildings, and ensure that FEMA Elevation Certificates and Floodproofing Certificates are properly completed for applicable projects.

The County Building Official is licensed by the Commonwealth of Virginia and locally enforces the Virginia Uniform Statewide Building Code (VUSBC). This code includes implications for floodplain management. Local Planning or Community Development departments address land-use planning and, in most cases, house the local floodplain management program enforcing local floodplain management regulations. Public Works departments have a role in hazard resilience through oversight and maintenance of local infrastructure, some critical, which varies amongst Northern Neck jurisdictions. While the responsibilities and infrastructure are varied, critical infrastructure includes wastewater treatment facilities, a few local water treatment systems, and several new local drainage systems. Primary and secondary road maintenance is largely the responsibility of the Virginia Department of Transportation, which coordinates closely with local emergency managers during and immediately after disaster events and storms to address road closures and detours, debris management, and messaging.

Other departments may have responsibilities for programs that could complement hazard mitigation activities. For instance, parks and recreation departments may be responsible for open space programs. If demolition/acquisition projects are undertaken, coordination to manage created open space may include the parks and recreation staff.

Table 6-1 summarizes the number of staff who perform key functions in Northern Neck County governments. For the most part, County self-evaluations determined that programs are adequately funded and staffed (with the exception of emergency medical and fire response), and staff are adequately trained to support government program mission functions.

Table 6-1. Staffing Levels

County	Emergency Services	Building/ Planning/ Zoning	Law Enforcement (local)	Fire Department	Public Works
Lancaster	2	4	24	125	12
Northumberland	1	6	28	60 Active 90 Total	2
Richmond	2	4	15	55	N/A
Westmoreland	2	7	41	96 Active 102 Total	N/A

6.1.2 Technical Capability

Mitigation is multi-disciplinary. For a successful mitigation program, it is necessary to have a broad range of people involved who can inform and contribute to holistic mitigation programs through diverse backgrounds and experience. Mitigation process participant diversity is reflected on the MAC but can further include additional local planners, engineers, building inspectors, emergency managers, floodplain managers, Geographic Information Systems (GIS) analysts, and grant writers.

GIS systems include the hardware, software, and technicians that collect, manage, analyze and display spatially-referenced data. Many local governments are now incorporating GIS systems into their existing planning and management operations. GIS is invaluable in identifying areas vulnerable to hazards. Improved online-archived technical information has greatly improved update processes and quality of emergency operations plans, continuity of operations plans, hazard mitigation plans and emergency management, resilience and mitigation messaging. This increases community resilience, especially outreach efforts using social media.

Table 6-2 summarizes the technical capabilities of the jurisdictions per their self-rated assessment. A summary capability assessment matrix table can be found in Appendix I. As demonstrated in the table, Northern Neck local governments do not have dedicated mitigation funding project sources to manage and administer HMP grant-funded projects so the Northern Neck PDC supports the administrative aspects of those projects. The Northern Neck PDC's website offers a central location to publicize information about a variety of different hazard mitigation and planning efforts throughout the region. Emergency managers devote staff time and use existing web sites, social media and events like tornado awareness month and hurricane preparedness month as a platform for mitigation messaging. Strong preparedness and mitigation messages, techniques, and program links are provided on local websites to enable residents and businesses to create disaster preparedness plans and carry adequate flood insurance on at-risk properties and property contents.

Northern Neck jurisdictions have dedicated emergency managers and floodplain managers with the exception of the Town of Colonial Beach where town managers often perform emergency management and floodplain management functions. The final mitigation measure for new or substantially improved building construction or critical facility installation is the final inspection performed by the local building official. Northern Neck counties and the Town of Colonial

Beach staff feature dedicated building inspectors while this function is performed for smaller towns by the county building official.

Table 6-2. Technical Capability Matrix by Jurisdiction

Jurisdiction	Mitigation Assigned to Specific Dept.	GIS	Adequate Zoning Staff	Dedicated Floodplain Mgmt. Staff	Building Inspectors	Overall Technical Capabilities
Lancaster	Yes	Yes (limited)	Yes	Yes	Yes (2)	Moderate
Northumberland	Yes	Yes	Yes	Yes	Yes	Moderate
Richmond	Yes	Yes	No	No	Yes	Moderate
Westmoreland	Yes	Yes	Yes	Yes	Yes	Moderate
NNPDC		Yes	N/A – localities staff	Yes	N/A – localities staff	High
Town of Colonial Beach	No	Yes	No	No	Yes (1)	Moderate
Town of White Stone	Yes	No	Yes	Yes	No (county)	High
Town of Kilmarnock	Yes	Yes (limited)	Yes	Yes	No	Low
Town of Montross	Yes	No (county)	Yes	No (county)	No (county)	Low

High: Higher standards, high program management.

Moderate: Adequate program management.

Limited: Increased capability desired.

Note: Towns of Warsaw and Irvington did not respond to 2017 capability assessment survey

6.1.3 Fiscal Capability

For Fiscal Year 2017, the budgets of the participating jurisdictions range from about $22 million (Richmond County) to $30 million (Westmoreland County) and smaller budgets for towns. Revenues which support local budgets come from property taxes, State and local sales taxes, local service fees, and through restricted intergovernmental contributions (federal and state pass through dollars). Mitigation projects have been funded through FEMA’s post-disaster Hazard Mitigation Grant Program (HMGP). The Commonwealth of Virginia historically and presently provides 20 percent of the required non-federal project match, leaving only a required 5 percent local match, usually using property-owner resources. Considering current budget challenges combined with trends in reduced federal support to state and local governments, funding for future mitigation work could be a challenge.

FY 2017 budgets provided by local LEPC representatives (and internet search for some towns) are shown in Table 6-3. Northumberland County has created a development impact fee structure to supplement county income. Capital Improvement Plans (CIPs) and intergovernmental agreements are used by three of the four Northern Neck counties.

Table 6-3. Fiscal Capability Matrix by Jurisdiction

Jurisdiction	Total FY17 Budget	Public Safety FY17 Budget
Lancaster	$29 million	$5.5 million
Northumberland	$36.7 million	$4.3 million
Richmond	$21-22 million	$1 million
Westmoreland	$29.7 million	$5.9 million
NNPDC	$790,000	N/A
Town of Colonial Beach	$26 million	$1.3 million
Town of Irvington	$142,705	$2,100
Town of Kilmarnock		
Town of Montross	$388,225	$17,650
Town of Warsaw	$1.4 million	$332,510
Town of White Stone	$181,730	$46,614

N/A – not applicable

6.1.4 Policy and Program Capability

Local officials generally felt that their government capacity, through staffing, technical expertise and regulatory programs was at least moderate in most areas. Stormwater management is regulated by the Department of Environmental Quality's Chesapeake Bay Preservation Program but most Northern Neck communities are not experiencing the type and volume of development covered by these regulations, so a rating of "low" is not reflective of a program deficiency, but a reflection of low need.

Table 6-4. Local Planning Mechanisms and Their Relationship to Hazard Mitigation

Locality	Comp. Plan Adoption Date & Horizon	Floodplain Mgmt. Ordinance	Storm Water Mgmt. Plan	Emergency Operations Plan	Erosion and Sediment Control Ordinance
Lancaster	High Adopted: 10/31/13	Moderate	Low Need	Moderate/High	High

Table 6-4. Local Planning Mechanisms and Their Relationship to Hazard Mitigation

Locality	Comp. Plan Adoption Date & Horizon	Floodplain Mgmt. Ordinance	Storm Water Mgmt. Plan	Emergency Operations Plan	Erosion and Sediment Control Ordinance
Northumberland	High Adopted: 11/10/16	Moderate	Moderate	Moderate/High	High
Richmond	High Adopted: 7/11/2013	Moderate	Moderate	Moderate/High	High
Westmoreland	High Adopted: 12/13/2010	Moderate	Low Need	Moderate/High	High

6.1.4.1 Past Mitigation Efforts

A Community Development Block Grant (CDBG) was used in the past in Westmoreland County to make storm water improvements. Homeowners self-financed home elevations after Hurricane Floyd, but the region became more active in use of the HMGP program following 2003's Hurricane Isabel for residential elevation projects in Northumberland and Lancaster County. HMGP has supported further residential elevation projects. Grant management for these projects has shifted to the PDC, which is more experienced in grant management because of the variety of grants it supports throughout the region that benefit local governments.

One local frustration has been the eligibility challenge due to the required FEMA positive benefit-cost ratio for each project. Following severe impacts, several projects in the past seemed necessary and viable but did not achieve the required positive benefit-cost ratio (greater than 1.0) despite significant storm damage. This was a challenge after Tropical Depression Ernesto and continues to be an issue.

Elevation projects have moved forward to address properties listed on FEMA's Repetitive and Severe Repetitive Loss list. Due to continued flood damages and increased flood insurance claims, grant requirements for these properties are more relaxed so the Northern Neck has had some success in more recent residential elevation grant applications. Award for several projects are currently pending.

The Tidewater Resource Conservation and Development District, in coordination with the US Department of Agriculture and the Virginia Department of Forestry, implemented a FIREWISE program in the Northern Neck and Middle Peninsula regions. The project began in 2001 with a data collection and awareness phase. Areas of apparent risk were identified using GIS, followed by completion of field verification. A workshop for local planners was conducted introducing them to wildfire mitigation principles and ways to incorporate them into the local planning process. Demonstration projects have been conducted in several small communities to illustrate and promote mitigation practices. While wildfire occurrence in the Northern Neck is low, the risk is great due to numerous loblolly pine plantations interspersed with rural residences. This forest plantation type can be highly flammable in dry conditions.

6.1.4.2 Emergency Operations Plan

The Northern Neck Planning District Commission worked with Northern Neck communities to develop the 2011 Regional Emergency Operations Plan Update. The plan was originally developed in 2004. It consisted of a basic concept of operations, seven hazard-specific annexes, ten region-wide functional annexes, and community-specific functional annexes. This plan represented a full adoption of the operational Incident Command System during emergency events.

The 2011 regional plan update serves as a foundational plan for independent County Emergency Operations Plans (EOPs) which have been drafted and adopted by County Boards of Supervisors during the past several years. These plans, while not publically available for security reasons, generally provide the legal and organizational basis for operations in each specific county or community in response to any type of disaster or large-scale emergency situation. Local Northern Neck Emergency Operations Plans (EOPs) outline a set of assumptions, which include a statement that primary hazards in the Northern Neck are severe weather events and numerous man made hazards (e.g., hazardous material incidents). The hazard statement may be modified as informed by the 2017 hazard mitigation plan update, as local emergency operations plans are updated.

Each plan outlines roles and responsibilities for the various county departments and agencies, ranging from the County Administrator, Emergency Manager, public safety officials and other government functions ranging from planning to public works and the Virginia Department of Health. While EOPs focus on emergency response, most include the emergency functional annex that addresses disaster recovery and mitigation. They usually do not describe mitigation needs or planned actions but rather outlines responsibilities for various organizations including the County Administrator, Emergency Manager, county staff and volunteer organizations.

The 2010 regional EOP stated that mitigation measures should "include, but are not limited to, the development of zoning laws and land use ordinances, building codes, regulations, and licensing for handling and storage of hazardous materials, and the inspection and enforcement of such ordinances, codes, and regulations." This language should be maintained. Additionally, following a state or federal emergency and disaster declaration, VDEM coordinates recovery efforts with local governments through the LEPC, local emergency managers, and VDEM Regional Support teams.

The information that follows for each Northern Neck County is paraphrased from local emergency management websites.

Lancaster County Office of Emergency Services

The Lancaster County Office of Emergency Services maintains a separate web site. Please refer to www.ReadyLancaster.org for more comprehensive information on Emergency Services information and programs. The www.ReadyLancaster.org website is deep and provides diverse information directed at local citizens, businesses, and organizations providing advice on emergency and disaster preparedness planning, instructions for sheltering and other emergency and disaster needs, and post-event instructions. In accordance with state law, the Lancaster

County Board of Supervisors has adopted an Emergency Operations Plan which establishes the legal and organizational basis for operations in response to any type of disaster or large scale emergency situation. The Plan assigns broad responsibilities to local government agencies and support organizations for disaster mitigation, preparedness, response and recovery. These responsibilities are generally extensions of normal day-to-day functions involving the same personnel and material resources.

The types of disasters most likely to affect Lancaster County are weather-related occurrences such as hurricanes, coastal flooding, tornadoes, and severe thunderstorms that produce high winds and significant rainfall.

Northumberland County

Northumberland County is one of the few counties left in Virginia that has all-volunteer emergency services. The county is served by two fire departments, Callao Volunteer Fire Department, in Callao, and Fairfield Volunteer Fire Department, with buildings in Reedville and Burgess. There are three rescue squads that serve the county: Callao Volunteer Rescue Squad, in Callao; Mid-County Volunteer Rescue Squad, in Heathsville; and Northumberland County Rescue Squad, in Reedville and Burgess. The county also has a water rescue service, Smith Point Sea Rescue.

Richmond County Department of Emergency Services

The Richmond County Department of Emergency Services is organized into two functional areas: the Division of Emergency Medical Services and the Office of Emergency Management. The Division of Emergency Medical Services provides 24 hour-a-day, state of the art basic and advanced life support emergency medical services to Richmond County residents and visitors.

The Office of Emergency Management writes and maintains the Richmond County Emergency Operations Plan, manages the County's Emergency Operations Center, and coordinates post-disaster recovery activities. OEM also provides emergency planning in such areas as special needs, continuity of operations, and emergency operations. OEM staff members are available to give presentations on emergency preparedness to homeowners' associations, civic groups, businesses, or faith community members.

Westmoreland Public Safety

Westmoreland County's public safety personnel are trained and ready to prevent harm to citizens and property and to respond effectively to routine matters, emergencies and disasters when they occur. Instructions on dialing 911 to report fires, crime, life-threatening situations or other emergencies is given along with detailed instructions on how to communicate the situation with the 911 dispatcher.

The Westmoreland County All Hazards Preparedness Brochure and the Ready Virginia Emergency Brochure are linked to the website. Highlights of information available to residents from Ready Virginia, VDEM, and FEMA are highlighted. Evacuation and sheltering information is also highlighted on the website with instructions to contact the Sheriff's Office or County Administrator's Office for assistance when evacuation transportation is needed.

6.1.4.3 Floodplain Management

Communities that regulate development in floodplains participate in the National Flood Insurance Program (NFIP). In return, the NFIP makes federally-backed flood insurance policies available for properties in the community. Table 6-5 shows the effective Flood Insurance Rate

Map (FIRM) dates for each NFIP participating Northern Neck community as well as other applicable historic information about the community's participation. FIRMs and Flood Insurance Studies (FIS) were developed by FEMA to show the boundaries of the one-percent and 0.2 percent annual chance floodplain. As the table shows, FEMA's recent investment in updating flood risk hazard maps, especially in high risk coastal areas, has resulted in revision of the Northern Neck community flood hazard risk maps. Following lengthy local and public citizen review of draft FIRMs and FIS reports, each jurisdiction's elected officials adopted the FIRMs, FIS, and an updated floodplain management ordinance or zoning ordinance section with an embedded floodplain management ordinance.

Despite new flood risk mapping, local landscape features such as increased frequency of coastal storms, sea-level rise, and coastal erosion rates are taken into consideration by local governments reviewing requests for development or construction within the regulated floodplain called the Special Flood Hazard Area (SFHA).

Statutes of the Commonwealth of Virginia provide cities and counties land use authority. Floodwater control is empowered through §15.2-2223 and §15.2-2280 of the Code of the Commonwealth of Virginia. Each Northern Neck jurisdiction with land use authority has adopted a local floodplain ordinance as a requirement of participation in the NFIP.

Table 6-5. NFIP Entry and FIRM Date

County	Jurisdiction	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Reg-Emer Date
Lancaster	Irvington, Town of	10/18/74	8/4/87	10/2/14	08/04/87
	Kilmarnock, Town of	N/A	9/17/10	10/2/14	09/17/10
	Unincorporated County	1/24/75	3/4/88	10/2/14	03/04/88
	White Stone, Town of	8/30/74	9/24/84	10/02/14	09/24/84
Northumberland	Unincorporated County	12/13/74	7/4/89	2/18/15	07/04/89
Richmond	Unincorporated County	4/11/75	3/16/89	4/16/15	03/16/89
Westmoreland	Colonial Beach, Town of	8/9/74	9/18/87	4/16/15	09/18/87
	Unincorporated County	7/18/75	9/18/87	4/16/15	09/18/87

Source: FEMA. Community Status Book Report. Virginia. https://www.fema.gov/cis/VA.html

Each community has designated staff who enforce their floodplain management ordinance, which is included, in some cases, in the zoning ordinance. The Department of Conservation and Recreation's Floodplain Management Program, including their NFIP Coordinator and his staff, conduct Community Assistance Visits or Community Assistance Calls (CACs) to review program administration locally, on about a two-year rotation

Local floodplain management ordinances often feature more restrictive measures than the required FEMA model ordinance. “Higher Standards” such as “freeboard” require a higher first-floor elevation than that depicted on the FIRMs and FIS report’s data tables. For example, Northumberland County requires 12” of additional freeboard above Base Flood Elevation (BFE) for substantial improvements in an AE Zones and 24” of freeboard in VE Zones. Westmoreland County requires 18” of additional freeboard above the Base Flood Elevation.

The Community Rating System (CRS) was created by FEMA during 1990 as an incentive program to recognize and encourage community floodplain management activities that exceed the minimum NFIP standards. Residents of CRS participating communities receive a reduction in their flood insurance annual premiums. These are awarded in five percent increments following a rigorous community floodplain management program review. There are ten CRS classes: Class 1 requires the most credit points and gives a 50-percent premium reduction; Class 10 communities’ NFIP policy holders do not receive a premium reduction. None of the communities in the Northern Neck currently participate in the CRS.

One of the CRS requirements is a community floodplain management plan. The Northern Neck hazard mitigation plan update is intended to fulfill the CRS planning requirement should any NFIP participating communities wish to pursue CRS program participation.

Local emergency managers who responded to the capability assessment were not well-versed on how the NFIP is administered locally. In the next plan update, the plan should include more in-depth information on how the NFIP is managed in each of the jurisdictions. Examples could include: process to ensure new construction is compliant with the local floodplain ordinances; how residents are assisted in mapping issues and how substantially damaged structures are managed to ensure compliance with the latest floodplain ordinance.

6.1.4.4 Comprehensive Plans

A community’s comprehensive plan provides the future vision for the community regarding growth and development. However, many of the plans include land use or environmental protection goals that could support future mitigation efforts. For example, limiting development in the floodplain (which is considered mitigation) may also help meet open-space goals laid out in a comprehensive plan. Several comprehensive plans address mitigation, resilience and long-term community sustainability. These are new inclusions, and, as communities continue to update their comprehensive plans, it is anticipated that mitigation and resiliency issues will be more comprehensively addressed. Virginia comprehensive plans are usually updated on a five-year cycle.

For the most part, the region’s comprehensive plans includes strategies that address development in the floodplain or otherwise flood-prone areas. In addition, the comprehensive plans indicate that communities in the Northern Neck use zoning and subdivision regulations to retain the rural character of their areas while they preserve traditional livelihoods like agriculture, forestry, fishing and aquaculture. A significant focus is recession recovery and protection of coastal resources.

Table 6-4 shows the comprehensive plan adoption status for each comprehensive plan. Demographic information is from the U.S. Census. Some plans use growth projections from either the Virginia Employment Commission or the University of Virginia’s Weldon Cooper Center. The Weldon Cooper Center’s population projection data was also used to inform Section 3.0 Community Profile in the 2017 hazard mitigation plan update. Population projects in the

Northern Neck are generally flat for the next two decades due to an aging population, limited new development and an overabundance of housing stock due to the lingering effects of the recession.

Lancaster County

Hazard mitigation concepts are found throughout the Lancaster County Comprehensive Plan, adopted October 31, 2013. The first goal derived from the land suitability study is "to encourage new and orderly development in areas of the County most suitable for growth." One of the means that the plan recommends to achieve this goal is to develop amendments to the zoning ordinance that help protect property owners from potential hazards of shrink-swell soil and high water tables. The second goal is to “ensure that new development is designed in a manner that provides for continued protection of the surface and groundwater resources in Lancaster County and the State of Virginia.” Furthermore, Chapter 3 is dedicated to discussing the protection of the Lancaster County potable water supply. Chapter 4 of the comprehensive plan is devoted to shoreline protection and includes a shoreline protection study and plan to address shoreline erosion. The plan advocates for the use of vegetative methods as opposed to structural solutions such as rip rap and groins on individual parcels. The plan also encourages a coordinated approach to shoreline protection suggesting that density credits and other innovative techniques could be used to encourage such actions.

The plan notes that a variety of growth tools may be appropriate for Lancaster County, including performance standards, conservation easements, use valuation taxation, overlay zones, and open space provisions that prioritize flood control.

Northumberland County

The opening goal for the 2016 Northumberland County Comprehensive Plan is similar to Lancaster County: "To provide a framework for managing future development of the County in a way that promotes opportunity for its citizens while directing growth to areas best able to accommodate growth."

Another plan goal is to “reduce soil erosion on steep slopes particularly along creek and stream banks.” The steep slopes and unstable soils impact development in the area by increasing project costs. These conditions cause serious soil erosion and can increase sediment and other pollutants entering local streams, estuaries, rivers, and bays.

The plan includes a section on flood-prone areas and delineates numerous goals and strategies directed toward protection of life and property from floods. These strategies include public education, performance standards, enforcement of existing ordinances, and utility-siting criteria. The plan also highlights that the current County regulations require that any building constructed within the floodplain have a finished floor elevation two feet above the base flood elevation.

As with Lancaster County, shoreline erosion is of concern for Northumberland. The plan includes numerous strategies designed to protect shorelines. These include use of vegetation for shoreline protection and performance standards for structures that modify the shoreline. The plan also recognizes the need for coordinated or subdivision-wide actions.

Richmond County

Like its neighboring counties, Richmond County's Comprehensive Plan (adopted July 11, 2013) calls for accommodating future growth while maintaining the rural character of the County. The recommendations in the plan also recognize that growth cannot occur unchecked but should be guided away from environmentally-sensitive areas such as floodplains. For instance, the plan calls for the use of cluster design techniques to allow for environmentally-sensitive areas to remain undeveloped.

Shoreline erosion is featured in the Richmond County Comprehensive Plan. One recommendation calls for promoting the use of natural shoreline protection strategies.

Recommendations include establishing setbacks in known erosion areas, the use of vegetation and other natural features to protect the shoreline, enforcement of existing ordinances and facility sitting requirements.

The plan also recommends that the County develop programs to encourage maintenance of existing properties. Hazard mitigation principles could be incorporated into such a program.

Westmoreland County

Flood is a primary concern in the Westmoreland County 2010 Comprehensive Plan as well as the draft 2016 plan. Both plans suggest that appropriate development practices, land use controls and protection of vulnerable shoreline and drainage should be improved to minimize the effects of flooding. One of the goals to address flooding is to follow proper design practices including community retention ponds and other measures to improve flood-insurance ratings for the county. These recommendations were informed by the *Westmoreland County Shoreline Management Plan, 2013,* which was prepared for the county and the Virginia Coastal Zone Management Program by the Virginia Marine Institute of Marine Science, College of William and Mary.

The comprehensive plan recommends a variety of studies to address shoreline erosion and storm water drainage. The future land use plan also includes a conservation designation that incorporates areas of the floodplain and calls for limited to no future development. The plan recommends that Westmoreland County pursue measures to reduce facilitate entry into the Community Rating System.

It is clear from the plan that the County is willing to use easements to protect land. While floodplains and other high risk areas are not specifically mentioned, the use of easements and coordination with the Virginia Department of Conservation and Recreation, the Northern Neck Chesapeake Bay Public Access Authority, and other public agencies may provide an opportunity to protect property and achieve open space goals. The plan also recommends the underground placement of utilities in new development.

6.1.5 Legal Authority

Local governments in Virginia, including those in the Northern Neck region, have a wide range of tools available to them for implementing mitigation programs, policies, and actions. A hazard mitigation program can use any or all of the four broad types of government powers granted by the State of Virginia, which are (a) regulation, (b) acquisition, (c) taxation, and (d) spending. The scope of this local authority is subject to constraints; however, as all of Virginia's political subdivisions must not act without proper delegation from the state. All power is vested in the state and can only be exercised by local governments to the extent it is delegated (in accordance with Dillon's Rule). Thus, this portion of the capabilities assessment will summarize Virginia's enabling legislation that grants the four types of government powers within the context of available hazard mitigation tools and techniques.

6.1.5.1 Regulation

General Police Power

Virginia's local governments have been granted broad regulatory powers in their jurisdictions. The statutes of the Commonwealth of Virginia bestow the general police power on local governments, allowing them to enact and enforce ordinances which define, prohibit, regulate or abate acts, omissions, or conditions detrimental to the health, safety, and welfare of the people, and to define and abate nuisances (including public health nuisances). Since hazard mitigation can be included under the police power (as protection of public health, safety and welfare), towns, cities, and counties may include requirements for hazard mitigation in local ordinances. Local governments also may use their ordinance-making power to abate "nuisances," which could include, by local definition, any activity or condition making people or property more vulnerable to any hazard.

All of the jurisdictions in the Northern Neck planning area have enacted and enforce regulatory ordinances designed to promote the public health, safety, and general welfare of its citizenry.

6.1.5.2 Land Use

Regulatory powers granted by the state to local governments are the most basic manner in which a local government can control the use of land within its jurisdiction. Through various land use regulatory powers, a local government can control the amount, timing, density, quality, and location of new development. All these characteristics of growth can determine the level of vulnerability of the community in the event of a natural hazard. Land use regulatory powers include the power to engage in planning, and to enact and enforce zoning ordinances, floodplain ordinances, and subdivision controls. Each local community possesses great power to prevent unsuitable development in hazard-prone areas.

6.1.5.3 Planning

According to State Statutes, local governments in Virginia may create or designate a planning agency. The planning agency may perform a number of duties, including:

- Make studies of the area;
- Determine objectives;
- Prepare and adopt plans for achieving those objectives;
- Develop and recommend policies, ordinances, and administrative means to implement plans;
- Perform other related duties.

The importance of the planning powers of local governments is illustrated by the requirement that zoning regulations be made in accordance with a comprehensive plan. While the ordinance itself may provide evidence that zoning is being conducted "in accordance with a plan," the existence of a separate planning document ensures that the government is developing regulations and ordinances that are consistent with the overall goals of the community.

Each Northern Neck county and the Town of Colonial Beach have dedicated planning staff, zoning regulations and comprehensive plans. Town managers with assistance from counties perform planning and floodplain management functions. The towns in the study area all have planning commissions that meet regularly, receiving support as necessary from county planning departments.

6.1.5.4 Zoning

Zoning is the traditional and most common tool available to local governments to control the use of land. Broad enabling authority is granted for municipalities and counties in Virginia to engage in zoning. Land "uses" controlled by zoning include the type of use (e.g., residential, commercial, and industrial) as well as minimum specifications that control height and bulk such as lot size, building height and setbacks, and density of population. Local governments are authorized to divide their territorial jurisdiction into districts, and to regulate and restrict the erection, construction, reconstruction, alteration, repair or use of buildings, structures, or land within those districts. Districts may include general use districts, overlay districts, and special use or conditional use districts. Zoning ordinances consist of maps and written text.

Only Lancaster County implements floodplain regulations via the zoning ordinance. An overlay district is used to impose additional requirements on properties within the designated floodplain area.

6.1.5.5 Subdivision Regulations

Subdivision regulations control the division of land into parcels for the purpose of building development or sale. Flood-related subdivision regulations are included in the floodplain management ordinance, requiring developers to install adequate drainage facilities and design water and sewer systems to minimize flood damage and contamination. They also may prohibit the subdivision of land subject to flooding unless flood hazards are mitigated through filling or other measures, and they prohibit filling of floodway areas.

All of the jurisdictions in Northern Neck have adopted a subdivision ordinance. Some of the ordinances contain floodplain-specific provisions. For instance, Lancaster, Richmond, and Westmoreland Counties require that sufficient buildable land exist for each lot to ensure that the site is free of flood danger.

6.1.5.6 Floodplain Management Regulations

Each Northern Neck community with land use authority has adopted floodplain management regulations. As noted previously, only Lancaster County has done so specifically through the zoning ordinance. Northumberland, Richmond, and Westmoreland counties have adopted floodplain management ordinances into various locations in their municipal code.

Generally, the regulations adopted by the study communities do not go beyond the minimum standards of the NFIP. Several Northern Neck localities have adopted “freeboard” requirements, which require that first floors of new or substantially improved buildings exceed the base flood elevation (BFE) to provide extra flood risk exposure mitigation. Buildings built to this higher standard usually are eligible for a “preferred risk” flood insurance policy with lower annual premiums. Each NFIP participating local government that allows development in the regulated floodplain require at least 1-foot of freeboard, with Northumberland and Westmoreland counties requiring greater flood protection levels. Each county floodplain management ordinance establishes design criteria requiring elevation and flood resistant construction of utility equipment. Three of the four Northern Neck counties also have higher standard design criteria for coastal high-hazard buildings. None of the communities prohibit manufactured homes in the floodplain, however all ordinances require proper elevation and foundation anchoring.

Local floodplain management programs are supported by the Virginia Department of Conservation and Recreation's National Floodplain Management Program Coordinator and his staff. Technical assistance is provided by in-person Community Assistance Visits (CAVs), check in phone interviews called Community Assistance Contacts (CACs) which consists of a program "check-in" or address specific technical issues or situations. CAVs are performed on a two to three year rotation. All Northern Neck communities are in good standing with the NFIP and the state NFIP Coordinator's office, continuing property owner and renter eligibility for flood insurance purchase and FEMA HMA grant program participation.

6.1.5.7 Chesapeake Bay Protection Regulations

The Chesapeake Bay Preservation Act (Bay Act) was enacted by the Virginia General Assembly in 1988 as a critical element of Virginia's non-point source management program. The Bay Act program is designed to improve water quality in the Chesapeake Bay and other waters of the State by requiring the use of effective land management and land use planning.

Virginia designed the Bay Act to enhance water quality with continued reasonable development. The Bay Act balances state and local economic interests and water quality improvement by creating a unique cooperative partnership between state and Tidewater local governments to reduce and prevent nonpoint source pollution. Local governments retain the primary responsibility for land use decisions, expanding local government authority to manage water quality, and establishing a more specific relationship between water quality protection and local land use decision-making.

The Bay Act Program is the only program in Virginia state government that deals comprehensively with the relationships between water quality, and land use planning and development. It is also the only program that assists local governments with land use planning needs to meet water quality goals: the development of land use regulations, ordinances and comprehensive plans.

Virginia is a signatory to the Chesapeake Bay Agreement, a unique regional partnership aimed at restoration of the Chesapeake Bay. Communities in certain parts of the state are required to implement local land use controls to minimize runoff and other adverse impacts to the water quality of the Bay. Each PDC jurisdiction is part of the Tidewater area and therefore required to enforce Bay Act provisions locally. The program's agricultural non-point source pollution reduction efforts have been led by the Northern Neck Soil and Water Conservation District. Prevention of sediment, nutrient and other pollution from land development is directed through erosion and sediment control and stormwater management ordinances. The local Bay Act program has three phases: Phase I program elements include the designation of local Chesapeake Bay Preservation Areas (including Resource Protection Areas and Resource Management Areas that often include floodplains) and adoption of local ordinances that include the required performance criteria. Phase II required local governments to adopt a comprehensive plan or plan element that addresses the protection of water quality through the discussion of a number of policy areas. Phase III requires an assessment during 2017 to review progress toward meeting the nutrient and sediment pollutant load reductions necessary for Bay restoration.

6.1.5.8 Other Ordinances

Northern Neck communities have adopted Erosion and Sediment Control ordinances compliant with Chesapeake Preservation Area Program regulations as well as those of the Department of Environmental Quality. Stormwater management is also managed through the Chesapeake Bay

Preservation Area Program for projects meeting specific criteria. Lancaster County has enacted a dune protection ordinance that authorizes specific uses and requires use and alteration permits.

6.1.5.9 Building Codes and Building Inspection

Mitigation measures which involve elevation or building and infrastructure retrofit are required to be compliant with not only local floodplain management standards but flood risk reduction design standards outlined in building codes.

Northern Neck jurisdictions have adopted the Uniform Virginia Building Code. While municipalities and counties may adopt codes for their respective areas if approved by the state as providing "adequate minimum standards," none of the participating jurisdictions have chosen to do so.

Local governments in the Commonwealth perform building inspections. The state empowers cities and counties to create an inspection department, and enumerates their duties and responsibilities, which include enforcing state and local laws relating to the construction of buildings; installation of plumbing, electrical, and heating systems; building maintenance; and other matters. Northern Neck counties and the Town of Colonial Beach have appointed a specific individual or established an office to carry out building inspections. Westmoreland County has adopted a minimal building maintenance ordinance. Enforcement is focused on vacant unoccupied buildings. Table 6-6 summarizes the various ordinances that are in effect in the jurisdictions in the study area.

Table 6-6. Availability of Ordinances and their Support for Hazard Mitigation

Ordinance Type	Lancaster	Northumberland	Richmond	Westmoreland
Building Code	Yes	Yes	Yes	Yes
Floodplain Management	Yes	Yes	Yes	Yes
Historic Preservation	Yes	Yes	Yes	No*
Subdivision	Yes	Yes	Yes	Yes
Unified Development	Yes	No	No	No
Zoning	Yes	Yes	Yes	Yes

*Consideration to historic properties is integrated through Westmoreland’s zoning ordinance.

6.1.5.10 Fire Codes

Virginia has a statewide fire code. The code establishes statewide standards to safeguard life and property from the hazards of fire or explosion arising from the improper maintenance of life safety, and fire prevention and protection of materials, devices, systems, and structures. The Virginia State Fire Marshal’s Office is charged with enforcement of the code statewide except in those localities that choose to enforce the code locally. Localities that choose to enforce the code locally must employ their own certified fire official.

6.1.5.11 Taxation

The power to levy taxes and special assessments is an important tool delegated to local governments by Virginia's law. The power of taxation extends beyond merely the collection of revenue, and can have a profound impact on the pattern of development in the community. Communities have the power to set preferential tax rates for areas which are more suitable for development in order to discourage development in otherwise hazardous areas. Local units of government also have the authority to levy special assessments on property owners for all or part of the costs of acquiring, constructing, reconstructing, extending or otherwise building or improving flood protection works within a designated area. This can serve to increase the cost of building in such areas, thereby discouraging development.

Because the usual methods of apportionment seem mechanical and arbitrary, and because the tax burden on a particular piece of property is often quite large, the major constraint in using special assessments is political. Special assessments seem to offer little in terms of control over land use in developing areas. They can, however, be used to finance the provision of necessary services within municipal or county boundaries. In addition, they are useful in distributing the costs of the infrastructure required by new development to the new property owners.

Localities in Virginia collect a one-percent sales tax. In addition, all of the counties in the Northern Neck levy property taxes.

6.1.5.12 Spending

The fourth major power that has been delegated from the Virginia General Assembly to local governments is the power to make expenditures in the public interest. Hazard mitigation principles can be made a routine element of all spending decisions made by local governments, including during adoption of annual budgets and the Capital Improvement Plan (CIP) for protection of critical facilities.

A CIP is a schedule for provision of town or county services over a specified period of time. By tentatively committing itself to a timetable for the provision of capital to extend services, a community can control growth in areas where the provision of on-site sewage disposal and water supply are unusually expensive.

In addition to forming a timetable for provision of services, a local community can regulate the extension of and access to services. A CIP that is coordinated with extension and access policies can provide a significant degree of control over the location and timing of growth. These tools also can influence the cost of growth. If the CIP is effective in directing growth away from environmentally sensitive or high hazard areas, for example, it can reduce environmental costs.

The majority of counties in the Northern Neck have a capital improvements program. The construction or renovation of capital facilities, such as schools, municipal offices, and police/fire stations are often highlighted in capital improvements programs. Investments in water treatment, wastewater treatment, drainage improvements and critical facility hardening are priority mitigation improvements which can be included in a capital improvements program.

6.1.6 Other Relevant Plans and Studies

Northern Neck citizens, local and regional government officials, elected officials and non-governmental organizations have seen increased vulnerability along the region's coasts. Several relevant studies have supported an evolving understanding of coastal shoreline processes.

A series of county coastal erosion evaluations was performed by the Virginia Institute of Marine Sciences at the College of William and Mary. These were used to inform the Section 4.0 Hazard Identification and Risk Assessment coastal hazard analysis and are referenced in Appendix B.

6.1.6.1 Changing Flood Risk

The *North Atlantic Coast Comprehensive Study* was conducted by the U.S. Army Corps of Engineers. The results of the study were published in a report detailing the two year study to address coastal storm and flood risk to vulnerable populations, property, ecosystems, and infrastructure affected by Hurricane Sandy in the United States' North Atlantic region. This study is designed to help communities better understand how flood risk is changing as a result of climate change and to provide tools to help communities better prepare for future flood risk. The study builds on lessons learned from Hurricane Sandy and attempts to bring to bear the latest scientific information available for state, local, and tribal planners. The Northern Neck communities are a part of the study area and the results of the study should be consulted when developing climate change adaptation measures based on future flood risk.

The *Costs of Doing Nothing: A Sea Level Rise Synopsis for the Hampton Roads Region* study (November 2016) was conducted by the Research Triangle Institute and estimated the annualized economic impacts of future sea level rise for the Hampton Roads region. The results show a negative impact on local economies that will increase as sea levels rise. While the study only extended to the south shore of the Rappahannock River, information and holistic messaging can be interpreted even conservatively to a conclusion that sea level rise will significantly impact the Northern Neck, especially eastern areas of the region, within the next 25 years.

6.1.6.2 Economic and Business Development

The Stronger Economics Together: Strategies for Building New Economic Development Northern Neck Economic Development Plan 2013 – 2018 (SET) was collaboratively prepared with the USDA Regional Rural Development Center and local governments to strengthen local community capacity to work together to create a blueprint to capture clusters of emerging economic advantages. The effort served as a catalyst for regional thinking and included SET training for participating communities. Hazard mitigation principles can be interwoven into the SET plan's four goal and opportunity centers, especially as the SET plan enters its fifth year with the availability of the updated hazard mitigation plan:

1) Infrastructure to facilitate expansion of existing businesses and attraction of new, higher wage jobs;
2) Workforce preparedness to succeed in a technology-based economy;
3) Creation of a business-friendly atmosphere for the region; and
4) Effective and sustainable use of the regional's natural beauty.

Several towns have developed business revitalization plans during 2017, in addition to a plan developed by the Town of Colonial Beach in 2012. While these plans do not directly address hazard mitigation, the Northern Neck has suffered continued, localized flood and wind events during 2017, providing an opportunity to work with small business to promote emergency and storm preparedness and resilience to reduce losses. The following plans were developed:

- Callao Business District Revitalization Plan
- Warsaw Business District Revitalization Plan
- White Stone Business District Revitalization Plan

- Town of Colonial Beach Business District Revitalization Plan (2012)

6.1.6.3 Coastline Protection

Since throughout the Northern Neck and coastal plain, homes and businesses are experiencing increased erosion from winds, waves, currents, tides and recreational activities making homes and businesses more vulnerable, the region has embarked on a “living shorelines” initiative. This is informed, in part, due to continued research that has demonstrated the harm to the immediate shoreline and bathymetric processes which occur from of lot-specific shoreline hardening like riprap, sea walls and groins. *Living Shorelines* is a shoreline management system designed to protect or restore the natural shoreline ecosystem from powerful storms, accelerated sea level rise, and landward erosion through the use of natural elements, sometimes combining them with structural components if necessary.

There are two categories for living shorelines: Nonstructural and Combined structural/non-structural. Each uses vegetation to protect the shoreline from erosion, flooding, and storm surges. The type of living shoreline application depends on the amount of erosion, wave energy, and size. Depending on the scope of the living shoreline, landowners can apply for a free *Living Shoreline Group 1 General Permit* through the Virginia Marine Resources Commission and local Wetlands Board. Program partners include:

- Friends of the Rappahannock
- Science Education at Sea (SEAS) Program
- Virginia Marine Resources Commission
- Local Wetlands Boards
- Northern Neck Master Gardeners
- NNKgreen
- The Wetlands Project
- Virginia Institute of Marine Science

6.2 Implementation

Upon adoption, the plan faces the biggest test: implementation. While the 2017 plan update outlines many aspirational "High" priority recommendations, the decision of which actions to address first will be a continued implementation challenge.

Each participating jurisdiction is responsible for integrating its mitigation actions into various planning documents, processes and budgets pursuant to locally-administered governing policies and procedures. Each action is assigned a responsible department or departments that will work together to implement designated actions.

Funding is always an important and critical issue when it comes to implementing mitigation actions. While several Northern Neck counties have been active in pursuing and implementing mitigation projects funded by FEMA/VDEM Hazard Mitigation Assistance programs, low or no-cost high-priority strategies broaden the region's approach to mitigation and long-term resilience. The Planning District Commission and its local governments will still pursue grant funding to implement more challenging actions. While resources remain limited, some counties in the Northern Neck have received funding to elevate homes. An example of a low-cost, high-priority recommendation would be to install flood level markers on bridges to warn motorists, pedestrians and cyclists of high water levels or to expand green shores programs to stabilize eroding shorelines.

In the past five years, four mitigation projects within the Northern Neck have been funded through FEMA hazard mitigation grants:

- DR-1905 in Northumberland County to raise the elevation of one of their residential properties;
- DR-4042 in Lancaster County to raise the elevation of five of their residential properties;
- FMA-2014 in Northumberland County to raise the elevation of one of their severe repetitive loss properties; and
- FMA-2016 in Richmond and Northumberland to raise the elevation of one repetitive loss property and one severe repetitive loss property, a project that was just approved in early September 2017.

Another implementation approach is to prioritize actions that can be completed in a short amount of time. Being able to publicize a successful project can build momentum to implement other mitigation actions.

It is important to long-term implementation of the plan update that the underlying principles of the hazard mitigation plan update are incorporated into other community plans and mechanisms, such as:

- comprehensive plans
- development ordinances (Zoning Ordinance, Subdivision Ordinance, or Building Code)
- resilience planning
- disaster recovery planning
- economic development plans
- natural resource protection and shoreline protection plans, and
- Capital Improvement Program (CIP) budgeting

Section 3.0 Community Profile provides insight into the current comprehensive plans for each community. Communities should work to ensure that the appropriate information from this plan is incorporated into the next update of their comprehensive plan. Information from the hazard identification and risk assessment as well as mitigation goals and strategies can be directly included as a comprehensive plan element. Projects that require large investments, such as at-risk property acquisition or infrastructure hardening are candidates for inclusion in capital improvement plans. Hazard vulnerability analysis can be incorporated into local emergency operations plans, debris management, coastal protection and disaster recovery plans. Floodplain management data and mitigation actions can be used to leverage Community Rating System (CRS) program participation. Mitigation is most successful when it is included within day-to-day functions and priorities of government. Integration is accomplished by a constant effort to network and to identify and highlight multi-objective, benefits to each program, the communities and their constituents. This effort is achieved through constant communication, messaging, monitoring agendas, attending meetings, and sending memos.

Simultaneous to these efforts, it will be important to constantly monitor funding opportunities that can be used to implement high priority, high cost mitigation actions. Funding opportunities that can be monitored include special pre- and post-disaster funds, special district budgeted funds, state or federal ear-marked funds, and grant programs, including those that can serve or support multi-objective applications.

With adoption of the 2017 plan update, the Northern Neck communities commit to:

- Pursuing the implementation of the high-priority, low/no-cost recommended actions.
- Keeping the concept of mitigation in the forefront of community decision-making by identifying and stressing the recommendations of the Hazard Mitigation Plan when other community goals, plans and activities are discussed and decided upon.
- Maintaining a constant monitoring of multi-objective, cost-share opportunities to assist the participating communities in implementing the recommended actions of this plan for which no current regular funding or support exists.
- Incorporate hazard risk information, and priority mitigation actions into appropriate local initiatives and programs through collaborative interaction between all related community departments and staff; and
- Evaluating and assessing regional mitigation plan goal and local jurisdiction action effectiveness to reduce hazard risk exposure.

In addition, the communities of the Northern Neck region remain committed to the NFIP. They will continue to enforce floodplain regulations and undertake other actions to remain in compliance with the program such as continued flood hazard risk evaluation, participation in Community Assistance Visits (CAV's) with the Commonwealth of Virginia NFIP staff, and education and outreach activities directed at flood-prone residents and businesses.

6.3 Maintenance

Plan maintenance requires an ongoing effort to monitor and evaluate the implementation of the plan, and to update the plan as progress, roadblocks, or changing circumstances are recognized. The Executive Director and Northern Neck PDC staff will be responsible for monitoring the plan. The Mitigation Advisory Committee representative from each jurisdiction will make annual updates to the Northern Neck Planning District on progress of their Mitigation Actions. Timing of annual reports can coincide with either the anniversary of the approval date of this plan or another date chosen by the committee in consultation with VDEM, such as the anniversary of a significant event (e.g., Tropical Depression Ernesto). The annual progress reports will be evaluated by the Mitigation Advisory Committee who will determine if corrective actions are needed. Figure 6-1 shows a sample update form.

This monitoring and updating will take place through:

- Annual progress reports from each jurisdiction on Mitigation Action Plan,
- An annual review by the Mitigation Advisory Committee, and
- Annual updates submitted to VDEM and FEMA Region III, unless a disaster or other circumstances (e.g., changing regulations) lead to a revised time frame.

Jurisdiction:		
Updated through:		
Action number:	Status: Not started In progress (percent complete___) Completed for purposes of this plan Ongoing Activities Successes Effectiveness	Notes (e.g., changes in action/funding/responsible department/timeframe):
Action number:	Status: Not started In progress (percent complete___) Completed for purposes of this plan Ongoing Activities Successes Effectiveness	Notes (e.g., changes in action/funding/responsible department/timeframe):

Figure 6-1. Sample Update Form

The Mitigation Advisory Committee will be responsible for setting annual measures of success and a five-year measure of success for each strategy. These indicators can be used to measure the progress and success of implementation of the mitigation plan during the 2021 update process. The Mitigation Advisory Committee can use this information to determine if corrective action needed or if the action should be continued or discontinued. In addition, the Mitigation Advisory Committee should review the composition of the committee annually and add members if needed.

In evaluating the plan, the Mitigation Advisory Committee should assess:

- The goals and objectives addressed in the current plan and any expected conditions
- The nature, magnitude, and/or types of risk present in the region and assess if
- those risks have changed
- The current resources that are required and appropriate for implementing the plan
- Issues with implementation, (ex. technical, political, legal, or coordinating with state and federal agencies)
- The outcome of mitigation strategies, and evaluate their success
- The agencies and partners and their level of participation as originally proposed
- The Mitigation Advisory Committee will determine at the annual meeting, if an update of the plan is needed. At a minimum, the plan will be updated every five years. Factors to consider when determining if an update is necessary include:
- Lessened vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions, and/or,
- Increased vulnerability as a result of new development (and/or annexation).
- New state/federal laws, policies, or programs
- Changes in resource availability

Ongoing public outreach will continue and public participation will be encouraged through available web postings, social media and press releases to local media outlets, primarily weekly community newspapers and radio stations. As with the previous plan, the Local Emergency Planning Committee (serving as the MAC) shall be charged with maintaining public outreach through reporting back to government officials.

Table 6-7. Northern Neck Hazard Mitigation Plan Update Maintenance Schedule

Timeframe	Activity	Leadership
2017	Jurisdictions Adoption	Local jurisdictions; Northern Neck PDC submittal to FEMA
2018	Annual implementation review	MAC/LEPC
2019	Annual implementation review	MAC/LEPC
2020	Annual implementation review; seek FEMA HMA funding for 2022 plan update	MAC/LEPC
2021	Annual implementation review initiate 2022 Plan update process;	MAC/LEPC

Table 6-7. Northern Neck Hazard Mitigation Plan Update Maintenance Schedule

Timeframe	Activity	Leadership
2022	Continue 2022 Plan update process	MAC/LEPC

A major event, such as a Presidentially-declared disaster, may trigger a need to review the plan. If such an event occurs in the Northern Neck, the Mitigation Advisory Committee will coordinate to determine how best to review and update the plan. The updating of the plan will be through written changes and submissions, as the Northern Neck communities and Mitigation Advisory Committee deem appropriate and necessary. Major changes to the plan will be submitted to the state and to FEMA Region III.

Public notice will be given and public participation will be invited, at a minimum, through available web postings and press releases to the local media outlets, primarily newspapers and radio stations. In addition, an annual event will be held to publicize progress on implementing the mitigation plan. This event could be timed to coincide with the anniversary of a significant event or annual awareness event (i.e., Hurricane Preparedness Week). Jurisdictions also should provide annual updates to the governing body to keep them informed about plan implementation.

7.0 Plan Adoption

Four counties and their incorporated towns in eastern Virginia participated in the planning process and will formally adopt this plan by resolution of their governing board. These local governments are the counties of Lancaster, Northumberland, Richmond, and Westmoreland Counties and the Towns of Colonial Beach, Irvington, Kilmarnock, Montross, Warsaw, and White Stone. The plan was completed through leadership of the Mitigation Advisory Committee that was led by the Northern Neck Planning District Commission and the Local Emergency Planning Committee (LEPC). Sample adoption language will be provided to the participating jurisdictions to facilitate the adoption process after FEMA conditionally approved the plan Draft (Appendix F).

The adoption process will take several months, as significant coordination by the Mitigation Advisory Committee with their governing bodies is required to:

1) Place the plan review and adoption on the appropriate meeting agendas in each jurisdiction;
2) Advertise the review process and provide copies in the County Board of Supervisors and Town County members' adoption meeting packets;
3) Facilitate the actual adoption;
4) Collect the adoption resolutions; and
5) Incorporate the adopted resolutions into the final hazard mitigation plan.

The Northern Neck Planning District appreciates the willingness that both Virginia Department of Emergency Management and FEMA Region III demonstrated by reviewing this plan concurrently and providing comments for revision prior to the adoption process. Not having done so would clearly have added more months to the adoption process.

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2013 Richmond County Comprehensive Plan

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9.0 Appendices

Appendix A – Meetings and Outreach
Appendix B – Additional Risk Assessment Information
Appendix C – 2011 Mitigation Actions Update
Appendix D – 2017 – 2022 Mitigation Actions
Appendix E – Record of Changes
Appendix F – Sample Adoption Resolutions
Appendix G – Redacted Materials
Appendix H – List of Abbreviated Terms
Appendix I – Capability Assessment Summary

Appendix A - Meetings and Outreach

Meetings Contents:

The Northern Neck, VA Multi-Jurisdictional HMP Update Kick-off Meeting February 27, 2017 – Presentation

The Northern Neck, VA Multi-Jurisdictional HMP Update Kick-off Meeting February 27, 2017 – Sign-in Sheet

The Northern Neck, VA Multi-Jurisdictional HMP Update HIRA Results Meeting April 5, 2017 – Presentation

The Northern Neck, VA Multi-Jurisdictional HMP Update HIRA Results Meeting April 5, 2017 – Sign-in Sheet

The Northern Neck, VA Multi-Jurisdictional HMP Update Final Meeting May 31, 2017 – Presentation

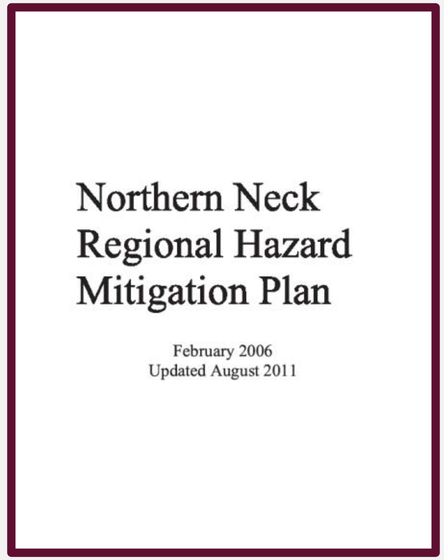
The Northern Neck, VA Multi-Jurisdictional HMP Update Final Meeting May 31, 2017 – Sign-in Sheet

The Northern Neck, VA Multi-Jurisdictional HMP Update Final Meeting May 31, 2017 – Mitigation Strategy, Action & Project Types, and Regional Goals Handout

Outreach Contents:

The Northern Neck Planning District Commission – Hazard Mitigation Planning Update Web-Announcement

Dewberry



Northern Neck
Regional Hazard
Mitigation Plan

February 2006
Updated August 2011

Northern Neck Multi-Jurisdictional Hazard Mitigation Plan Update

Kick-off Meeting

February 27, 2017

Agenda

1. Welcome & Introductions
2. Schedule and Plan Update Process
3. Hazard Prioritization
4. Data Needs
5. Committee Member Responsibilities
6. HMP Update Aspirations
7. Next Steps
8. Wrap Up & Future Meetings

Introductions

- **Name**
- **Jurisdiction/Department/Role**

Hazard Mitigation Plan Update

Project Scope:

Update the *Northern Neck Regional Hazard Mitigation Plan 2011 Update* to remain compliant with Virginia Department of Emergency Management and FEMA requirements

LEPC, Northern Neck PDC, VDEM and Dewberry roles

Committee members need to: ensure that this is your plan through Local Emergency Planning Committee (LEPC) which serves as this project's "Mitigation Advisory Committee (MAC) through your engagement with the Northern Neck PDC, VDEM and Dewberry

- Critical facilities update to Dewberry
- Capacity assessment survey and 2011 mitigation actions update to Dewberry
- 2017 new mitigation actions (in-person meetings/calls)
- Support draft review and outreach
- **Participate & make the final decisions**

Northern Neck PDC Project Role:

- Organize dates and host LEPC meetings
- Coordinate Public Outreach and participation (social media emphasis)
- Facilitate communication and project scheduling/reporting with Virginia Department of Emergency Management and Dewberry

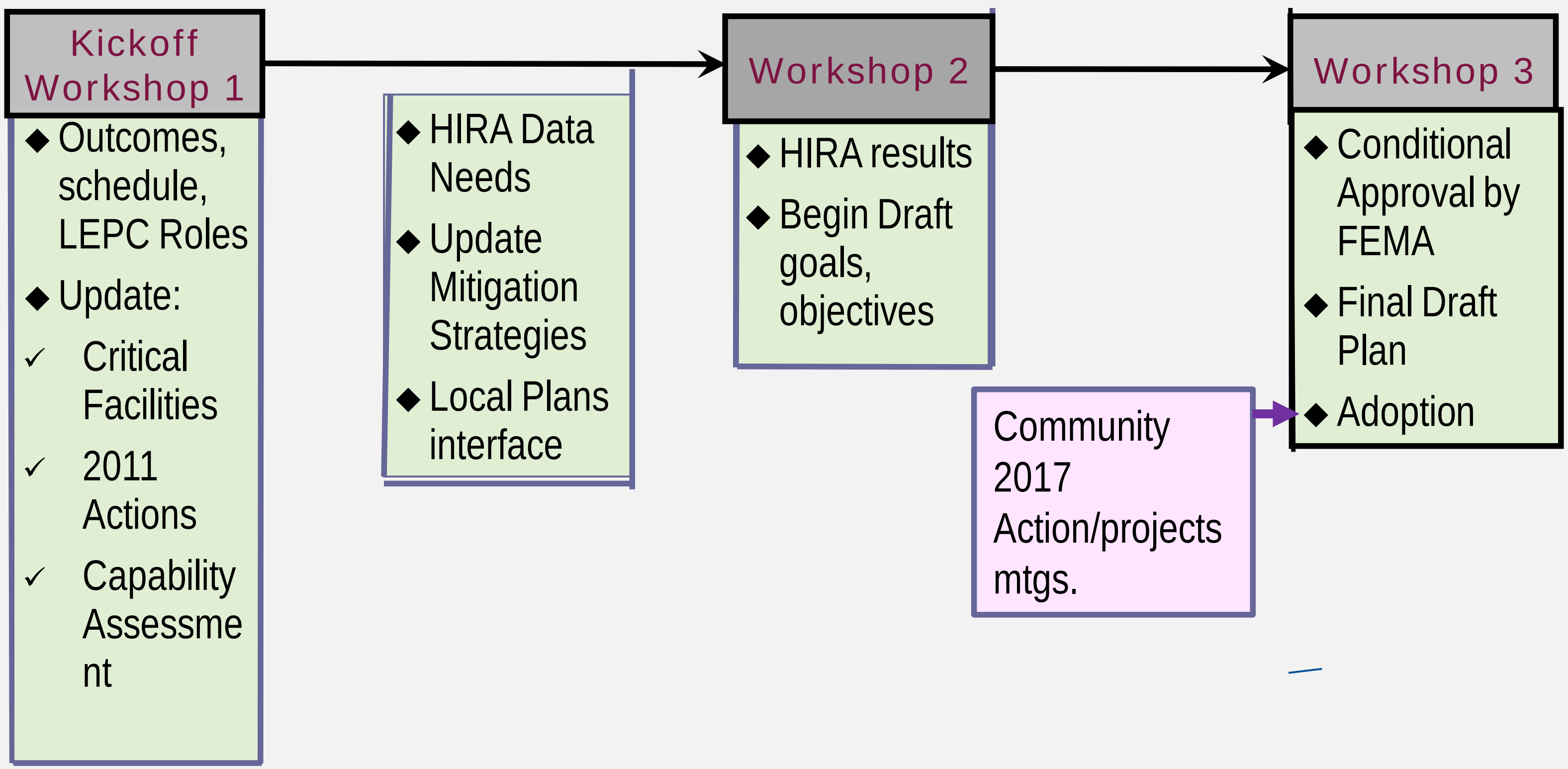
LEPC and Dewberry

Dewberry is here to:

- Lend technical expertise and consultation
- Partner with NNPDC and local government staff to update all required sections of the plan
- Prepare and check the plan against FEMA mitigation plan update requirements.
- Draft and final plan sections

We will do the heavy lifting to assure you receive a compliant, relatable plan that positions your region to become more resilient.

Project Approach: Planning Process



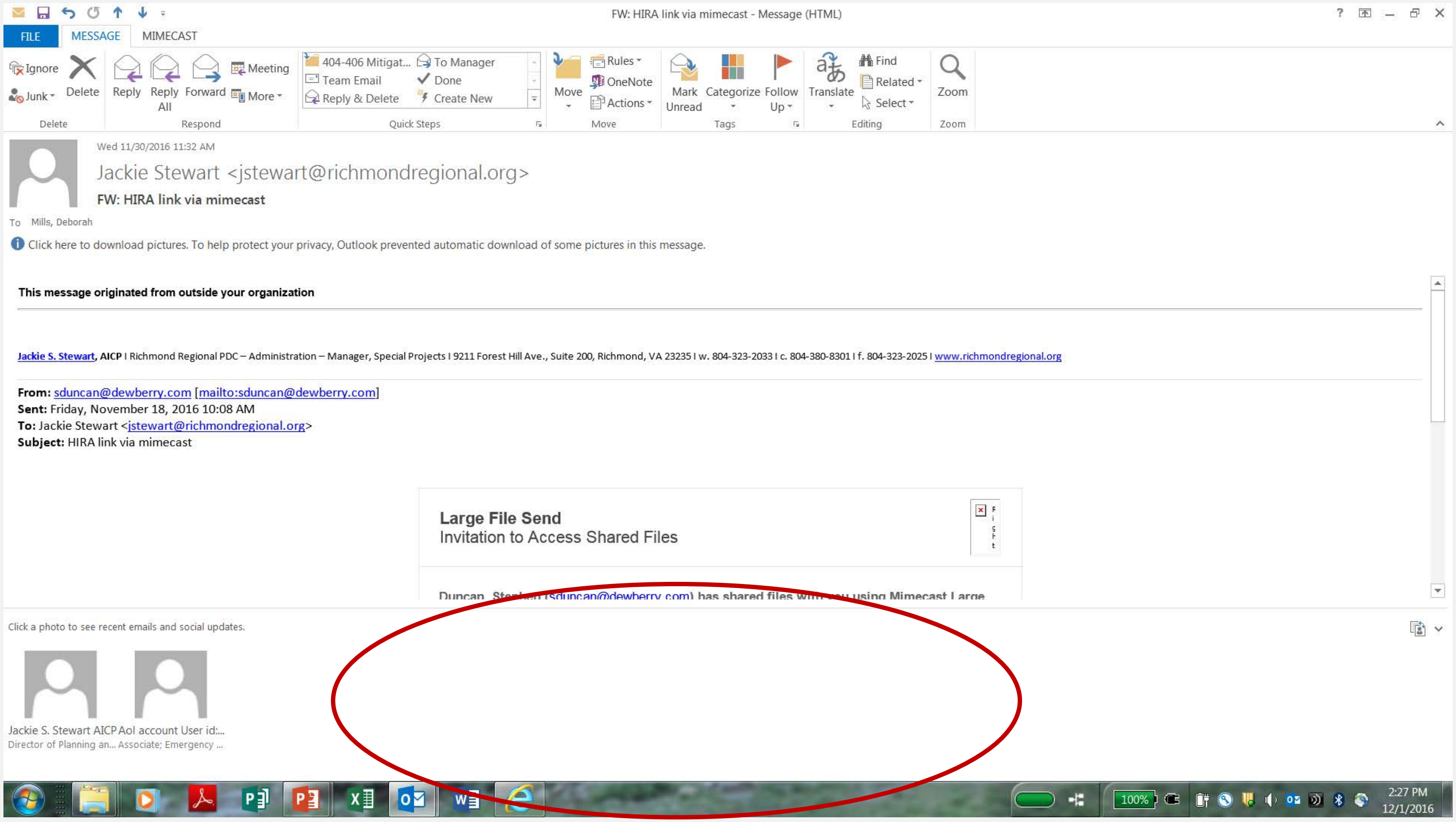
Schedule

Task	Feb	Mar	April	May	June	Jul
Kick-off Meeting	1					
HIRA Update/Development						
Capability Assessment			2			
Draft Plan/ Mitigation Strategies						
Final Meeting & Implementation Kick-off				3		
VDEM/FEMA Review			✪	✪		
Plan Submittal/Adoption Support/Close Out						

1 – 3 **LEPC** Workshops – HIRA Results/Mitigation workshop

✪ Draft Plan review submittal and meeting with VDEM if needed

Mime Cast Large File Submittal



Why does hazard mitigation matter?

Hazard Mitigation

…is a sustainable action that will reduce or eliminate injury to citizens, damages to structures and allow continuity of critical society functions…

Resiliency Definition

…capacity to maintain/regain functionality &vitality from natural, climate-induced, or man-made stressors and disturbances. Resiliency strategies can provide communities with tools for bouncing back more quickly from extreme weather or other high-impact events.

Resiliency planning provides communities with the ability to adapt and thrive despite changing environmental, social, and economic conditions.

BREAK - Hazard Rankings

Hazard Type	**2011 HMP Planning Consideration Level**		2017 Northern Neck Regional Hazard Mitigation Plan Update LEPC Kick-off Meeting
Natural			
Hurricane	**Significant**		
Flooding (river, stream, coast)	**Moderate**		
Winter Storm	**Moderate**		
Coastal Erosion	**Moderate**		
Drought	**Limited**		
Coastal Storm (Nor'easter)	**Limited**		
Tornado	**Limited**		
Wildfire	**Limited**		
Earthquake	**None**		

Hazard Identification, Risk Assessement and Vulnerabilty Analysis Update

- **What natural hazard events have occurred since 2010?**
- **What specific vulnerabilities exist in the Counties and Towns which may not have been captured in the previous plan?**
- **Please provide any updates to areas of concern noted in HIRA narrative.**

Critical Facilities

- Critical facilities include public safety, buildings used for sheltering, schools, health care (hospitals and long-term care), correctional facilities, utilities and other vital to community continuity of services after a disaster.
- Other “critical facilities” of concern can be added to this list – transportation, drainage, shelters, etc.
- Existing list will be emailed next week. Please review and provide deletions/modifications/additions by March 14, 2017.

Capability Assessment

- Increased emphasis on melding the mitigation plan with other local and regional planning and program initiatives
- Update information provided in tables and text in Hazard Identification, Risk Assessment and Vulnerability (HIRA) Chapter
- Develop a master table for summary program/plan initiative data customized to 2010 HMP actions included in the Appendix.
- We will reach out to you with specifics for your locality and departments in early March.
- Target completion late-March.
- Many programs or functions are performed for towns by counties – example: building inspections.

Mitigation Actions Status

- **ID completed, deleted, or deferred actions or activities from the 2010 plan as a benchmark for progress.**
- **Existing list will be distributed by early March.**
- **Please review and provide deletions/modifications/additions by March 24, 2017 to Jillian Browning jbrowning@dewberry.com copied to Deborah Mills at dmills@dewberry.com.**
- **We will call you to follow-up over the phone.**

Public Involvement in Plan Update

- **Document how the community was kept involved during the plan maintenance process over the previous five years.**
  - **What has been done since 2011?**

LEPC Hazard Mitigation Plan Update Aspirations

- **What keeps you up at night?**
- **What do you like about current plan?**
- **To enable cross-cutting mitigation themes and actions/projects are the necessary people/departments ready to participate?**
- **Are there other efforts currently going on in your community that we should be aware of?**
- **What would some positive outcomes be?**
- **What information/expertise can you contribute?**

What's Next?

- Data gathering for HIRA (VDEM, NNPDC, open data sources)
- Data gathering for Capability Assessment
- Initiation of Public Outreach
- Reporting and updates to 2011 Plan Strategy/Action Accomplishments
- Vulnerability analysis Update and Kick-off for Goals, Objectives and Mitigation actions Workshop (early April)

Questions, Comments, Discussion

Deborah G. Mills, C.F.M.

Associate

Dewberry

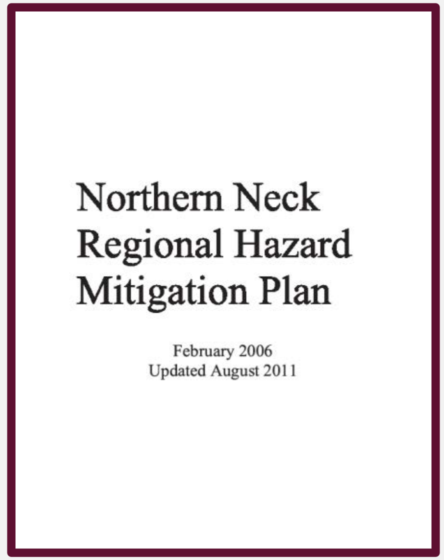
804.823.6971 Desk

804.335.9946 Mobile

dmills@dewberry.com

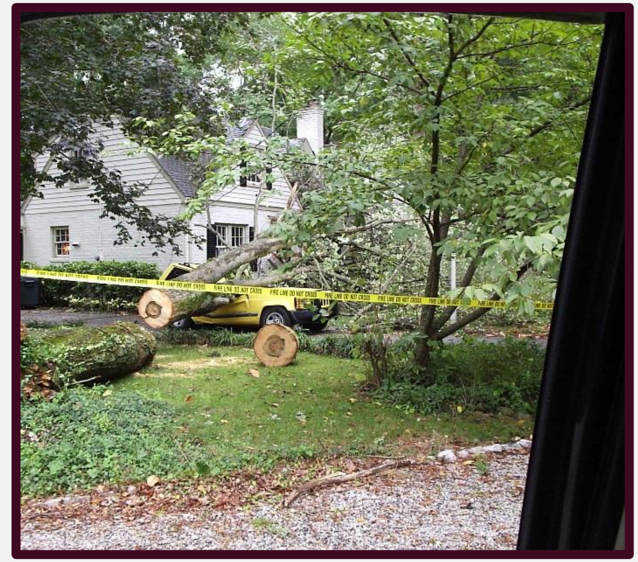
Northen Neck PDC Hazard Mitigation Plan Update Kick Off Meeting February 27, 2017 Sign-In Sheet

Jurisdiction	Name	Position	Email	Phone
Colonial Beach, Town	Val Foulds	Town Manager	vfoulds@colonialbeachva.net	804-224-7181/540-848-4517
Town of White Stone	Patrick Frere	Town Manager	frere37@yahoo.com	804-436-4935
TOWN OF IRVINGTON	BOB HARDESTY	TOWN ADMINISTRATOR	INFO@IRVINGTONVA.ORG	804-438-6230
County of Lancaster	Terrence McGregor	Chief of Emergency Services	tmcgregor@lancova.com	804-436-3553
County of Lancaster	Frank Pleva	County Administrator	fpleva@lancova.com	804-462-5129
County of Northumberland	Luttrell Tadlock	County Administrator	ltadlock@co.northumberland.va.us	804-580-7666
LANCASTER CO.	Wally Beauchamp	Bd. of Supervisors	wbeauchamp@lancova.com	804-436-3605
Northumberland County	Rick McClure	Emergency Services Chief	rmcclure@co.northumberland.va.us	804-580-5221
~~Greg~~ Richmond Co	Greg Baker	Chief	gbaker@co.richmond.va.us	804-761-8485
Richmond Co.	Mitch Paulette	Captain	mpaulette@co.richmond.va.us	804-313-1332
Richmond Co.	Morgan Quicke	County Administrator	rmquicke@co.richmond.va.us	804-333-3415
Westmoreland Co.	Beth McDowell	planner	bmcdowell@westmoreland-county.org	804-493-0120
Westmoreland Co.	Darrin Lee	planner	dlee@westmoreland-county.org	804-493-0120
Westmoreland Co	Jeff Beasley	Emergency Services	jbeasley@westmoreland-county.org	804 456 1777
Westmoreland Co.	David Farmer	Asst chief Emergency Services	dfarmer@westmoreland-county.org	804-456-7925
WESTMORELAND CNTY	BILL CEASE	IT DIRECTOR	bcease@westmoreland-county.org	804-456-6268
Town of Montross	Patricia Lewis	Town Manager	townofMontross@verizon.net	804-493-9623
Northumberland County	Stuart McKenzie	County Planner	smckenzie@co.northumberland.va.us	804 580-8910
NNPDC	Alex Eguiguren	Technical Assistant	aeguiguren@nnpdc17.state.va.us	804-333-1900
Town of Kilmarnock	Marshall Sebra	Planning/Zoning Administrator	msebra@kilmarnockva.com	804-435-1552 x 32
VDEM	Amy S. Howard	Grant Administrator	amy.howard@vdem.virginia.gov	804-897-9974
VDEM	Tricia Chappell	VDEM Region V	patricia.chappell@vdem.virginia.gov	(804)516-5983
County of Lancaster	Heather Brown	Dep. Coordinator	hbrown@lancova.com	(804) 238-8302



Northern Neck
Regional Hazard
Mitigation Plan

February 2006
Updated August 2011



Northern Neck Multi-Jurisdictional Hazard Mitigation Plan Update

HIRA, Goals and Mitigation Actions Meeting

April 5, 2017 – as modified during

Agenda

1. Welcome
2. Project Schedule
3. Risk Assessment
4. Mitigation Goal Refresh and Strategies
5. PDC, County & Town Mitigation Action Update
6. Outreach Brainstorming
7. Next Steps

Major HIRA Components

Identify and profile hazards affecting the region:

Vulnerability to critical facilities and estimate losses

Vulnerability for current and future land use and development

Plan Update Requirements

- **Hazard Identification and Risk Assessment**
  - Describe all hazards that affect the region; rationale for omitting recognized hazards from analysis
    - Hazard Profiles
    - Location
    - Extent
    - Previous occurrences
    - Probability of future events
  - Vulnerability Assessment
    - Summary of the Counties and Towns vulnerability to each hazard
    - Summary of potential hazard impacts

Schedule

Task	Feb	Mar	April	May	June	Jul
Kick-off Meeting	1					
HIRA Update/Development						
Capability Assessment			2			
Draft Plan/ Mitigation Strategies						
Final Meeting & Implementation Kick-off				3		
VDEM/FEMA Review			✪	✪		
Plan Submittal/Adoption Support/Close Out						

1 – 3 **LEPC** Workshops – HIRA Results/Mitigation workshop

✪ Draft Plan review submittal and meeting with VDEM if needed

2017 Plan Update Changes

New analyses and updates: Updated each hazard profile

- Hazard profile
- NCEI storm events data
- 2010 – present storm/disaster occurrences
- Summary risk by jurisdiction using new data

New maps based on updated data

- HIRA summary that includes overall relative risk comparison by hazard.

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Flood Risk

FEMA NFIP Participation Dates

County	Jurisdiction	Init FHBM Identified	Init FIRM Identified	Curr Eff Map Date
Lancaster	Irvington, Town of	10/18/74	8/4/87	10/2/14
	Kilmarnock, Town of	N/A	9/17/10	10/02/14(M)
	Unincorporated County	1/24/75	3/4/88	10/2/14
	White Stone, Town of	8/30/74	9/24/84	10/02/14(M)
Northumberland	Unincorporated County	12/13/74	7/4/89	2/18/15
Richmond	Unincorporated County	4/11/75	3/16/89	4/16/15
Westmoreland	Colonial Beach, Town of	8/9/74	9/18/87	4/16/15
	Unincorporated County	7/18/75	9/18/87	4/16/15

NFIP Policies in Force

County	Jurisdiction	Policies In-Force	Insurance In-Force Whole $	Written Premium In-Force
Lancaster	Irvington, Town of	13	$3,585,900	$27,876
	Kilmarnock, Town of	2	$700,000	$830
	Unincorporated County	589	$164,332,200	$582,511
	White Stone, Town of	3	$721,200	$4,279
Northumberland	Unincorporated County	735	$220,102,400	$536,772
Richmond	Unincorporated County	84	$22,489,400	$82,130
Westmoreland	Colonial Beach, Town of	206	$53,226,100	$141,451
	Unincorporated County	310	$93,020,500	$224,566

NFIP Claims as of 31 Jan 2017

County name	Jurisdiction	Total Losses	Closed Losses	Open Losses	CWOP Losses	Total Payments
Lancaster	Irvington	15	12	0	3	$268,000
	Kilmarnock	N/A	N/A	N/A	N/A	N/A
	Unincorporated	365	294	0	71	$5,660,000
	White Stone	11	5	0	6	$63,800
Northumberland	Unincorporated	391	290	0	101	$6,930,000
Richmond	Unincorporated	84	78	0	6	$1,760,000
Westmoreland	Colonial Beach	81	71	0	10	$3,590,000
	Unincorporated	131	95	0	36	$2,740,000

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

FLOOD HAZARD AREAS IN NORTHERN NECK, VIRGINIA

Flood Zones in Northern Neck

- A - 1% APPROXIMATE FLOOD HAZARD
- AE - 1% DETAILED FLOOD HAZARD
- AO - 1% SHALLOW DETAILED (SLOPING TERRAIN)
- VE - 1% COASTAL DETAILED

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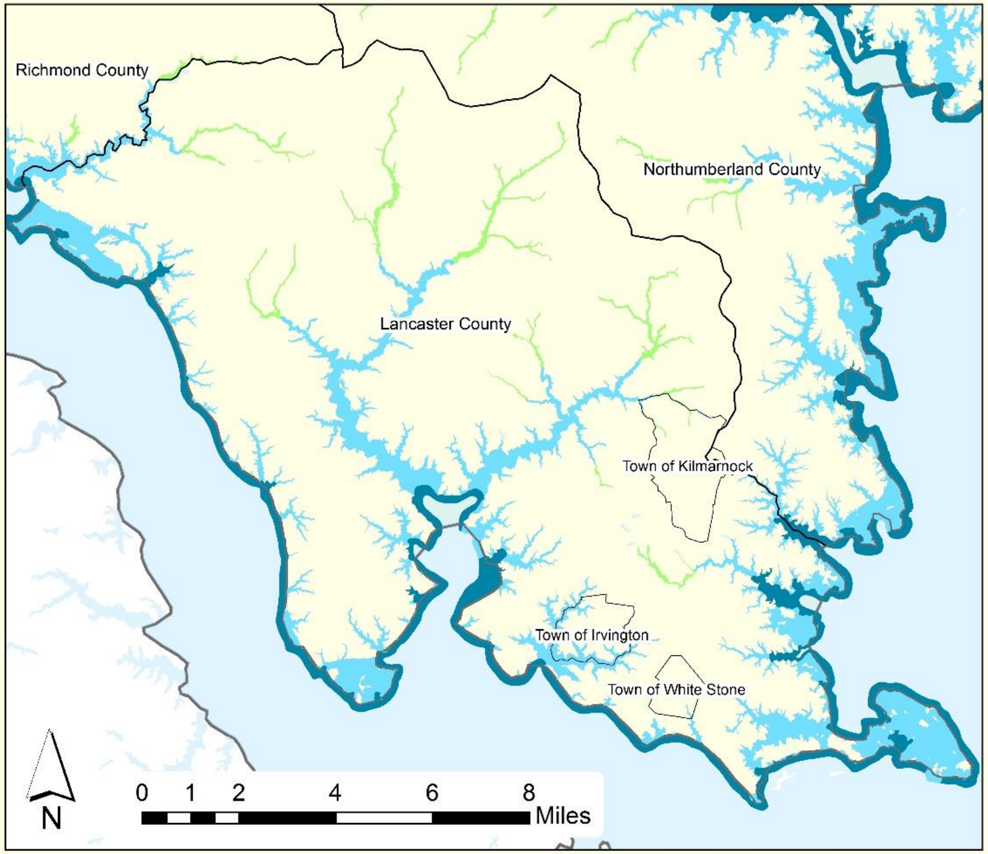
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

FLOOD HAZARD AREAS IN LANCASTER COUNTY



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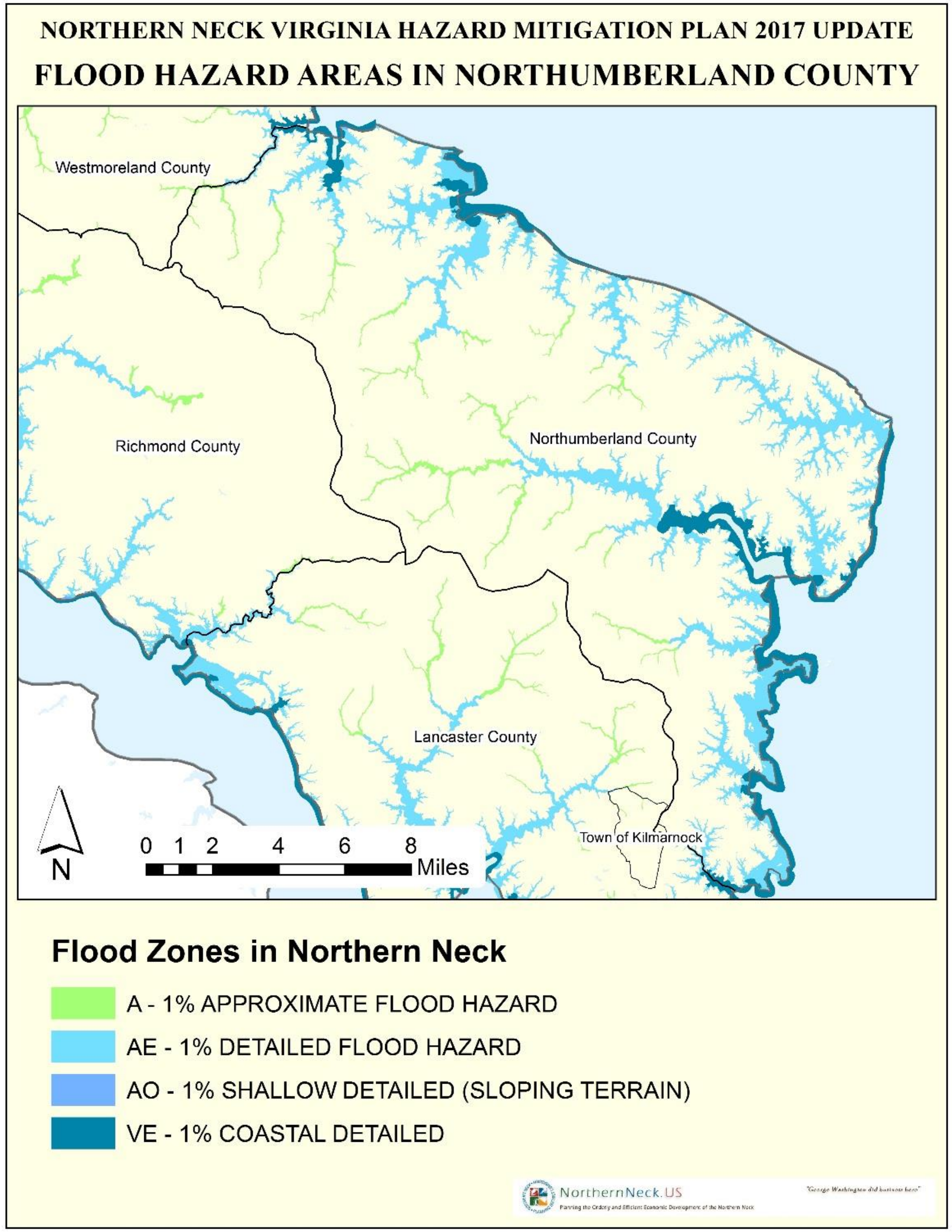
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
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Richmond County
Northumberland County
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N
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Miles
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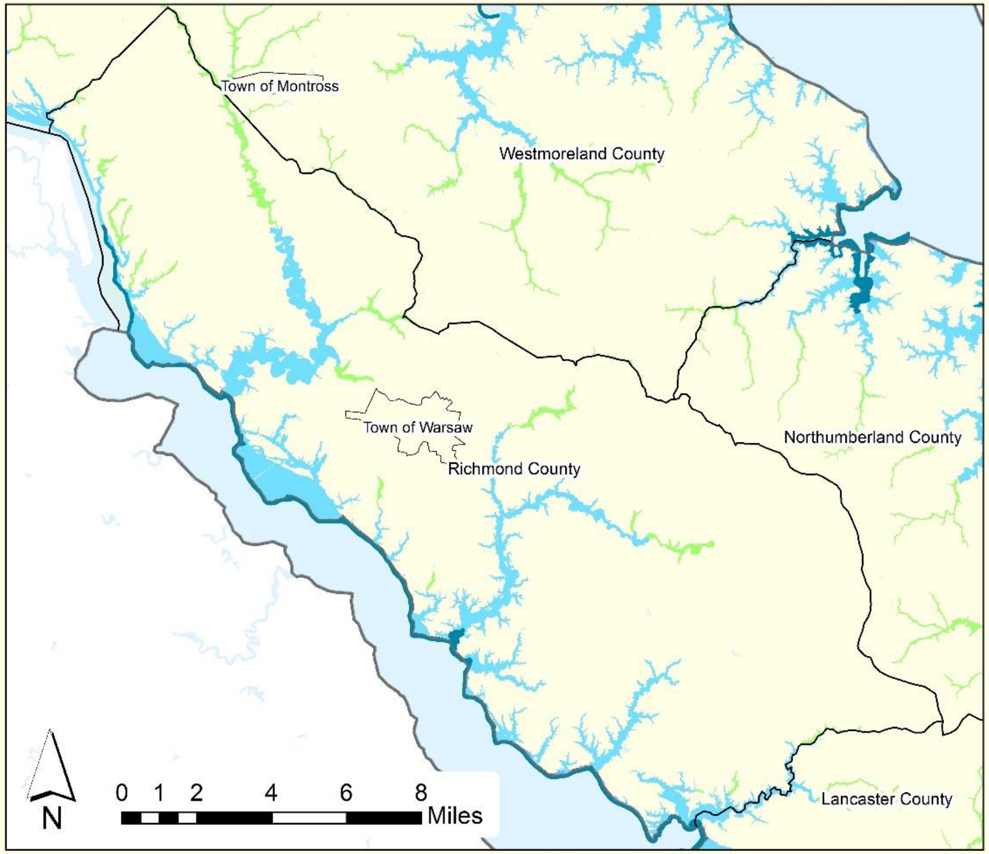
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

FLOOD HAZARD AREAS IN RICHMOND COUNTY



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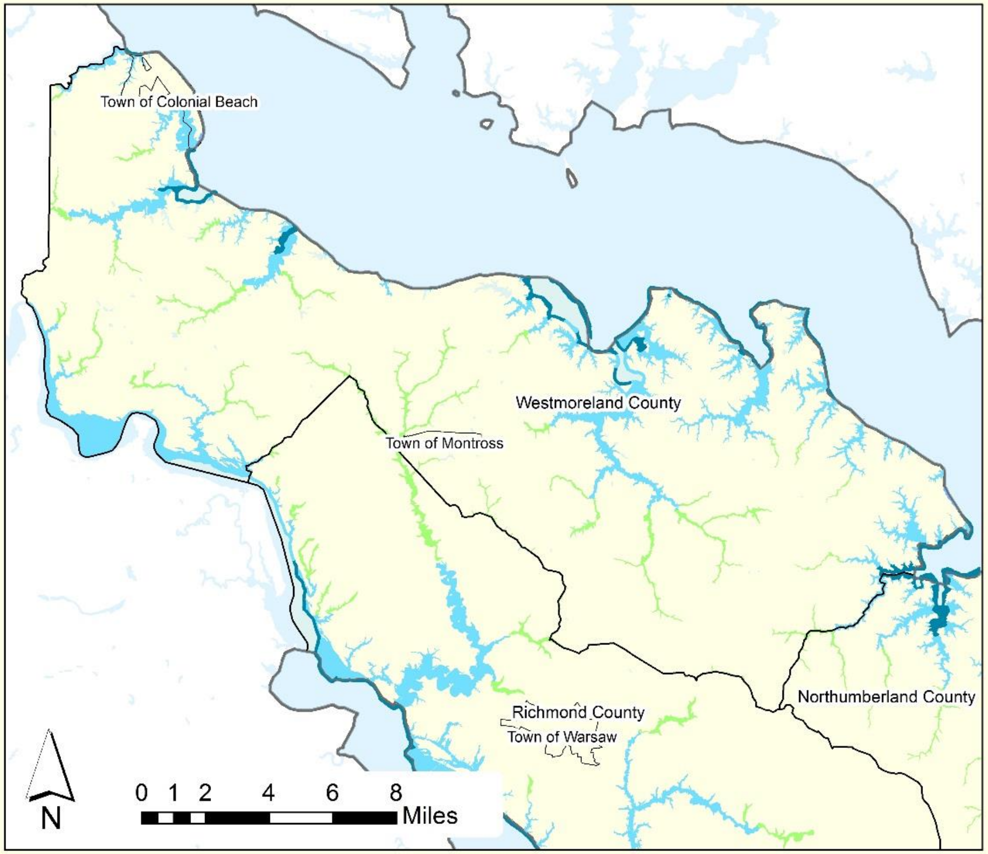
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

FLOOD HAZARD AREAS IN WESTMORELAND COUNTY



Flood Zones in Northern Neck

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- AO - 1% SHALLOW DETAILED (SLOPING TERRAIN)
- VE - 1% COASTAL DETAILED

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NCEI Flooding Damages

County	Events	Number of Events	Original Paid Damage	Adjusted 2017 Property Damage	Adjusted 2017 Crop Damage	Adjusted 2017 Total Damage
Lancaster	Coastal Flood	9	$1,870,000	$2,010,000	$0	$2,010,000
	Flash Flood	2	$0	$0	$0	$0
	Riverine Flood	3	$0	$0	$0	$0
Northumberland	Coastal Flood	10	$20,400,000	$24,600,000	$0	$24,600,000
	Flash Flood	3	$0	$0	$0	$0
	Riverine Flood	2	$0	$0	$0	$0
Richmond	Coastal Flood	3	$1,800,000	$2,160,000	$0	$2,160,000
	Flash Flood	2	$854,000	$955,000	$292,000	$1,250,000
	Riverine Flood	4	$0	$0	$0	$0
Westmoreland	Coastal Flood	5	$220,000	$251,000	$0	$251,000
	Flash Flood	6	$250,000	$285,000	$80,300	$365,000
	Riverine Flood	2	$0	$0	$0	$0

Total Exposure In Floodplain (TEIF)

- Analysis to estimate the Total Exposure in the Floodplain of the building stock in the NNPDC.
- TEIF performed for Richmond and Westmoreland Counties and Towns using building footprint polygons from the Virginia Geographic Information Network (VGIN).
- Lancaster and Northumberland Counties and Towns analysis used the TEIF method applied at a census block level.

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TEIF Exposure by Political Area

County	Jurisdictions	100 Year Exposure	500 Year Exposure
Lancaster	Town of Irvington	$3,610,000	$3,720,000
	Town of Kilmarnock	$531,000	$531,000
	Town of White Stone	$0	$0
	Unincorporated Areas	$127,000,000	$172,000,000
	Total Lancaster County	**$131,000,000**	**$176,000,000**
Northumberland	**Northumberland County**	**$98,800,000**	**$113,000,000**
Richmond	Town of Warsaw	$0	$0
	Unincorporated Areas	$16,000,000	$21,000,000
	Total Richmond County	**$16,000,000**	**$21,000,000**
Westmoreland	Town of Colonial Beach	$42,100,000	$50,400,000
	Town of Montross	$155,000	$155,000
	Unincorporated Areas	$59,000,000	$64,600,000
	Total Westmoreland County	**$101,000,000**	**$115,000,000**
Total	**Northern Neck PDC**	**$348,000,000**	**$425,000,000**

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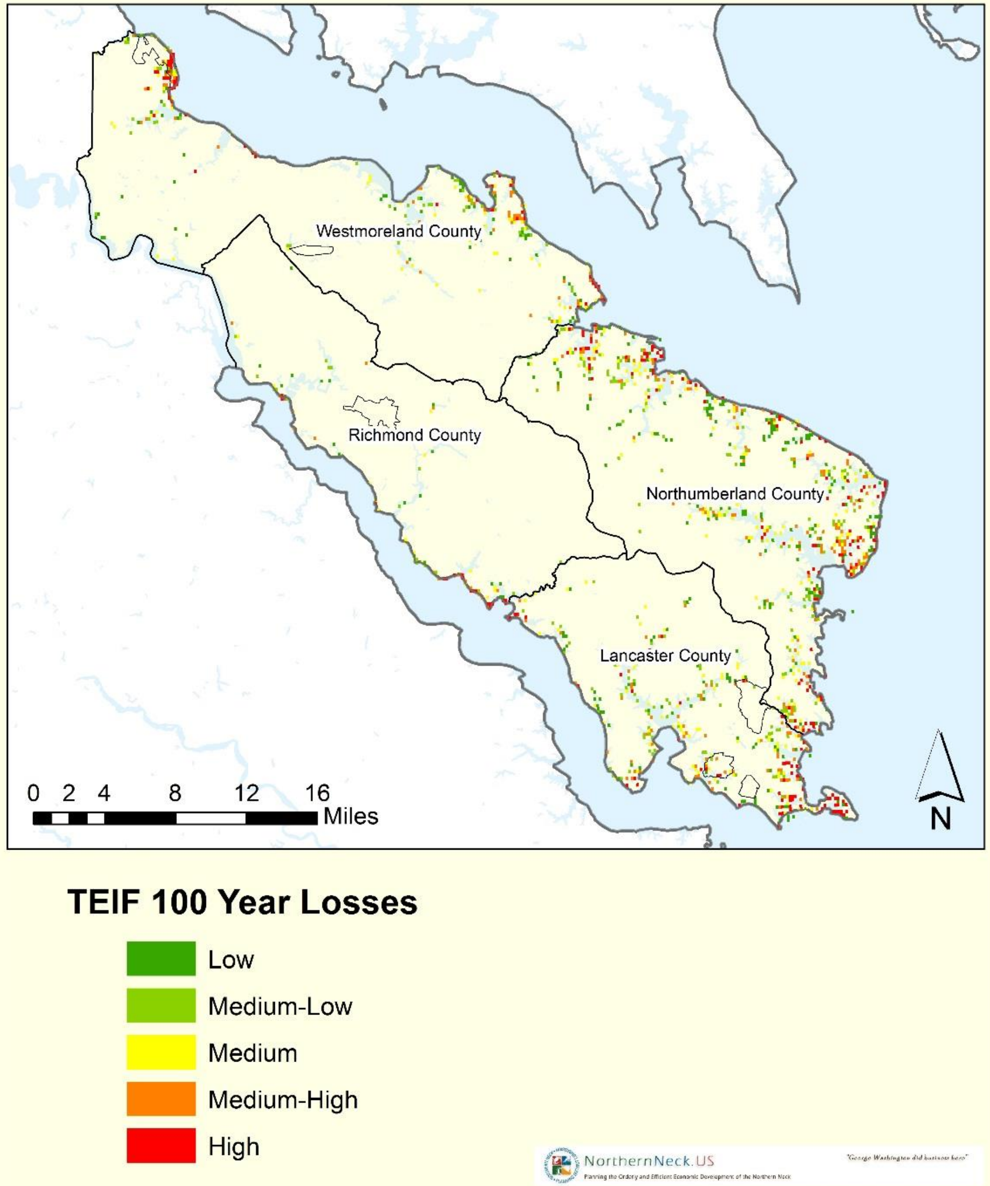
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 100 YR WITH 1000 FT GRIDS



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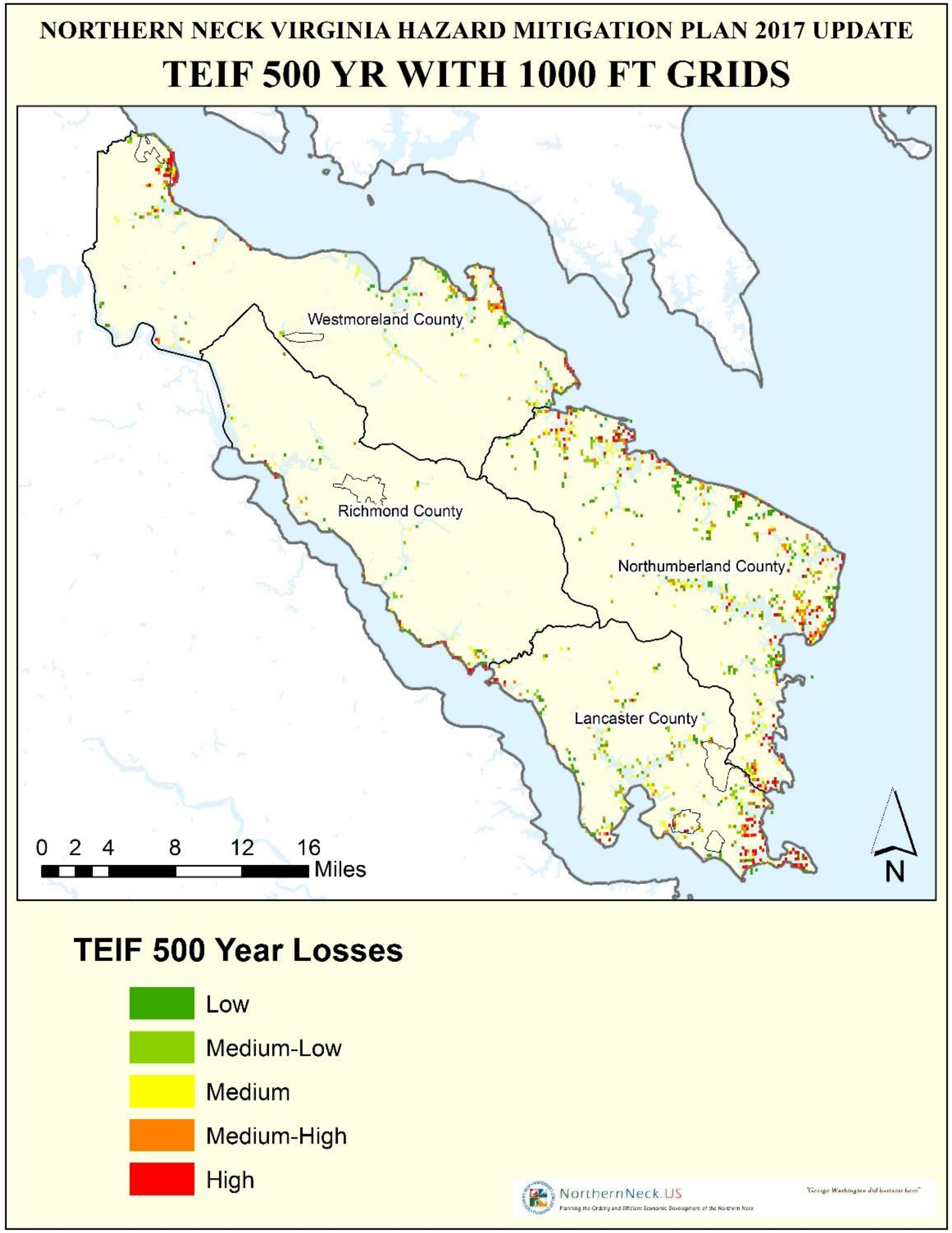
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
TEIF 500 YR WITH 1000 FT GRIDS
Westmoreland County
Richmond County
Northumberland County
Lancaster County
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Miles
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TEIF 500 Year Losses
Low
Medium-Low
Medium
Medium-High
High
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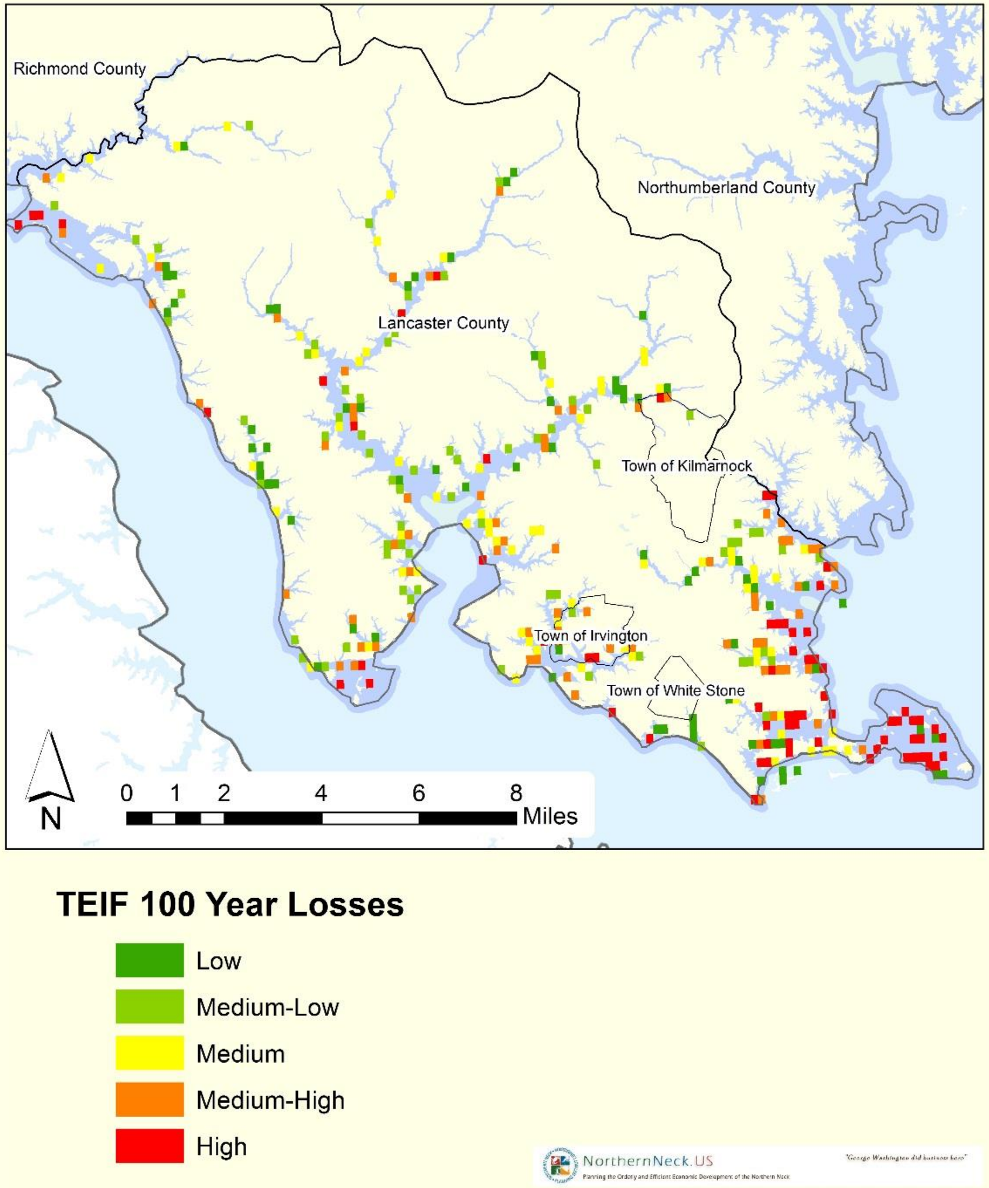
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 100 YR WITH 1000 FT GRIDS, LANCASTER COUNTY



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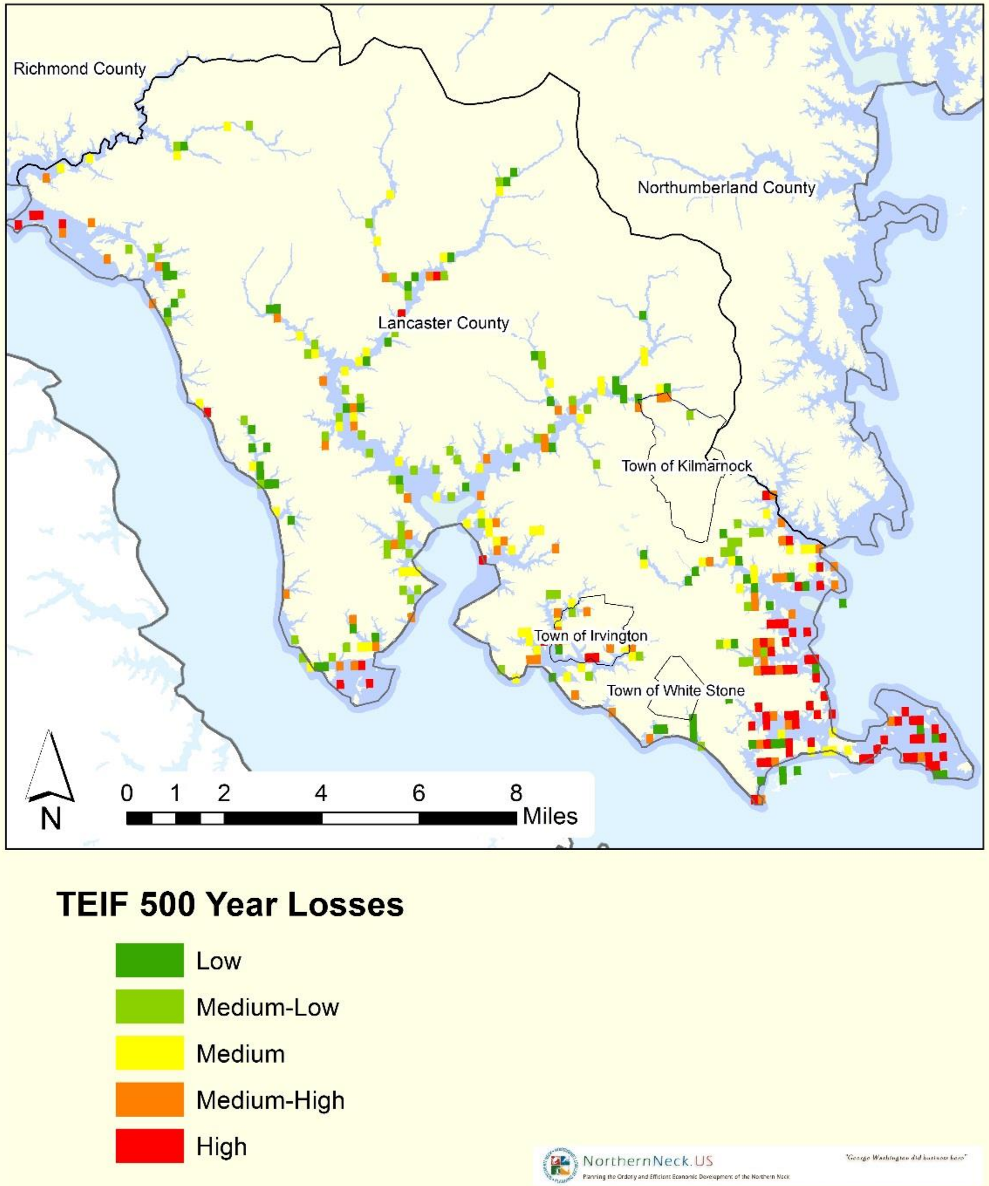

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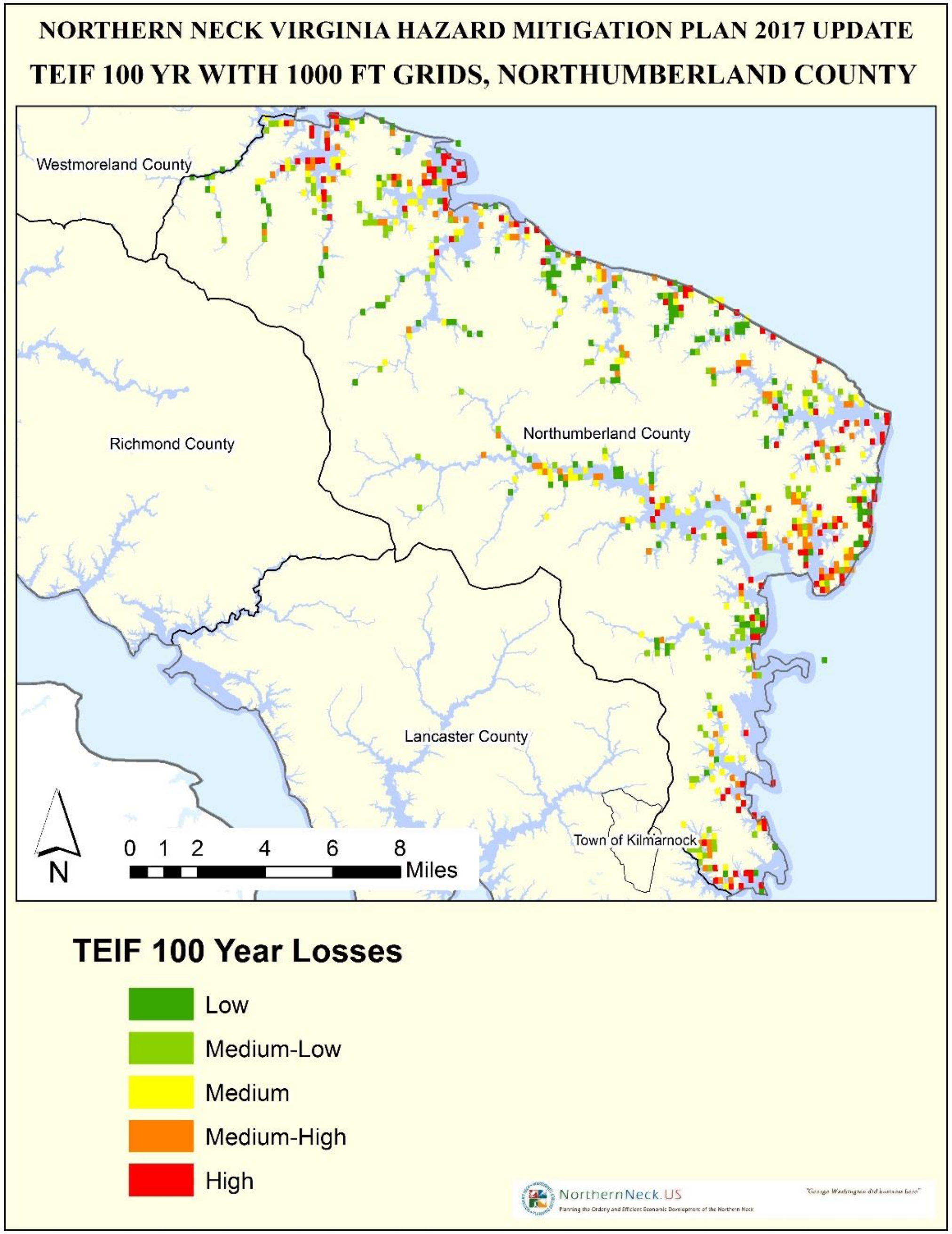

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TEIF 100 YR WITH 1000 FT GRIDS, NORTHUMBERLAND COUNTY
Westmoreland County
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Northumberland County
Lancaster County
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TEIF 100 Year Losses
Low
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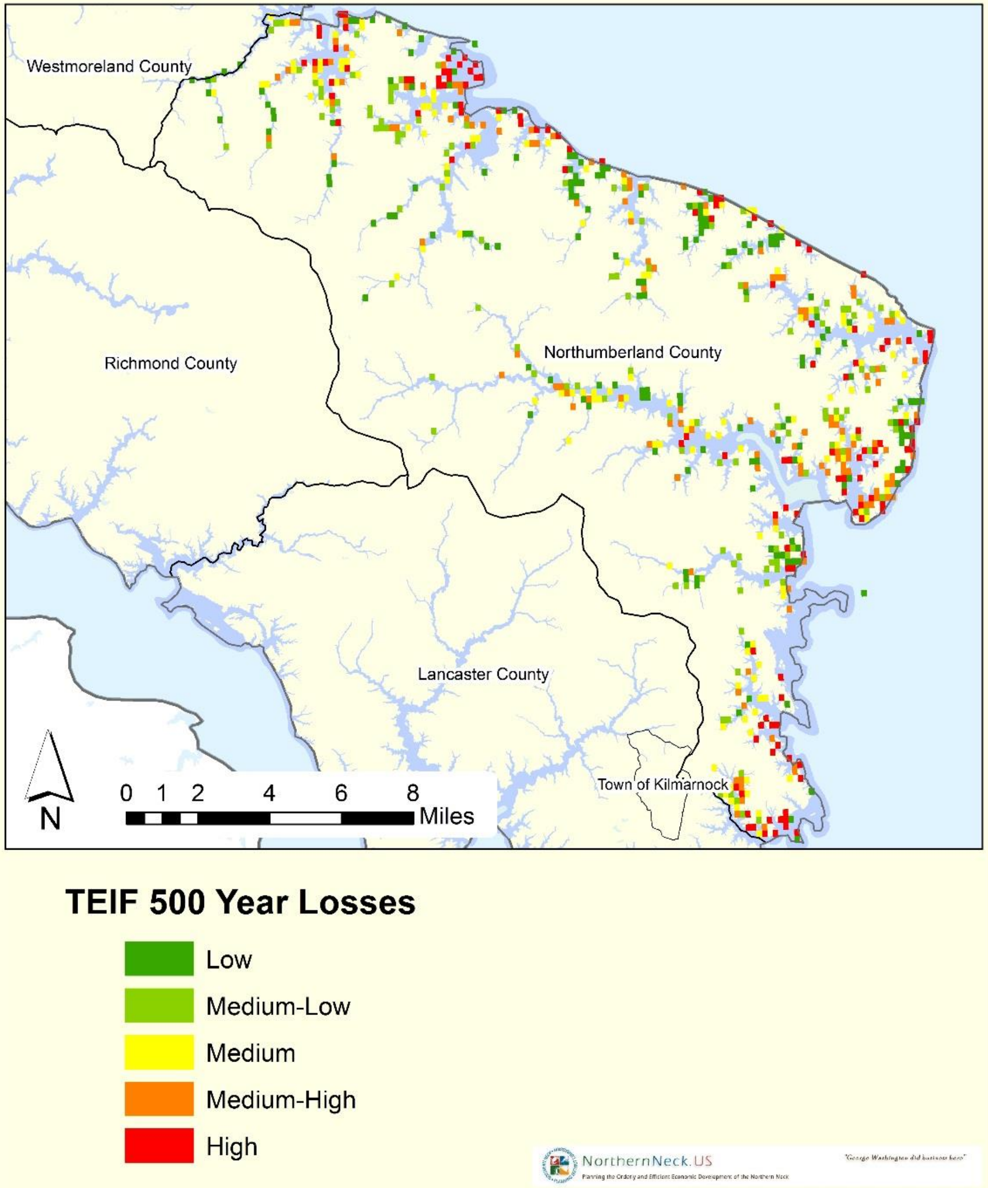
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 500 YR WITH 1000 FT GRIDS, NORTHUMBERLAND COUNTY



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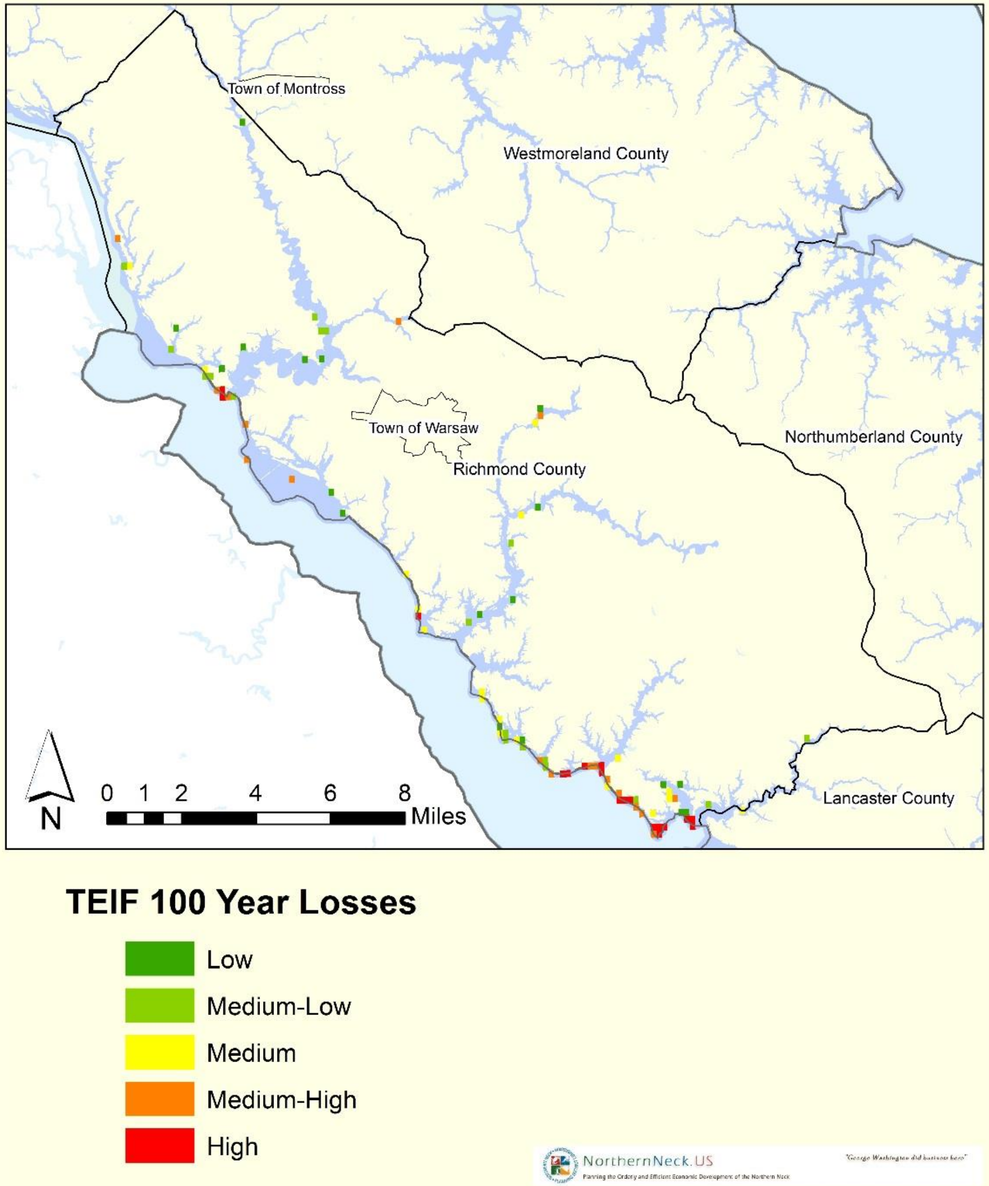
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 100 YR WITH 1000 FT GRIDS, RICHMOND COUNTY



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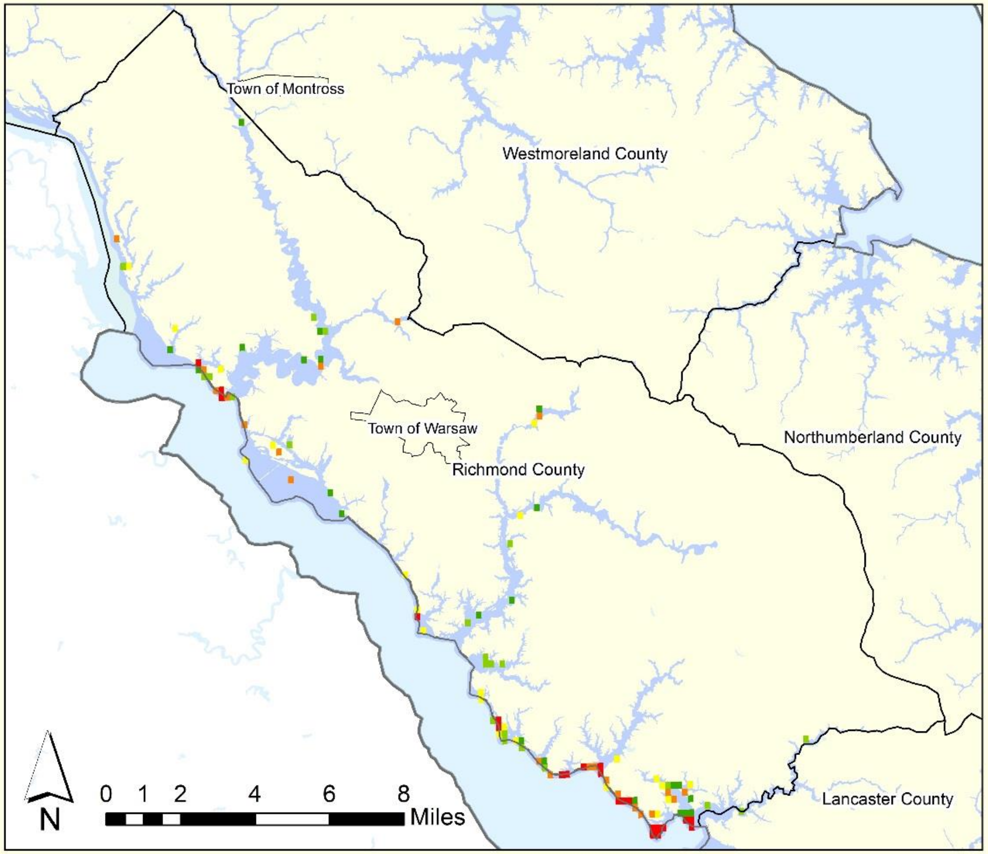
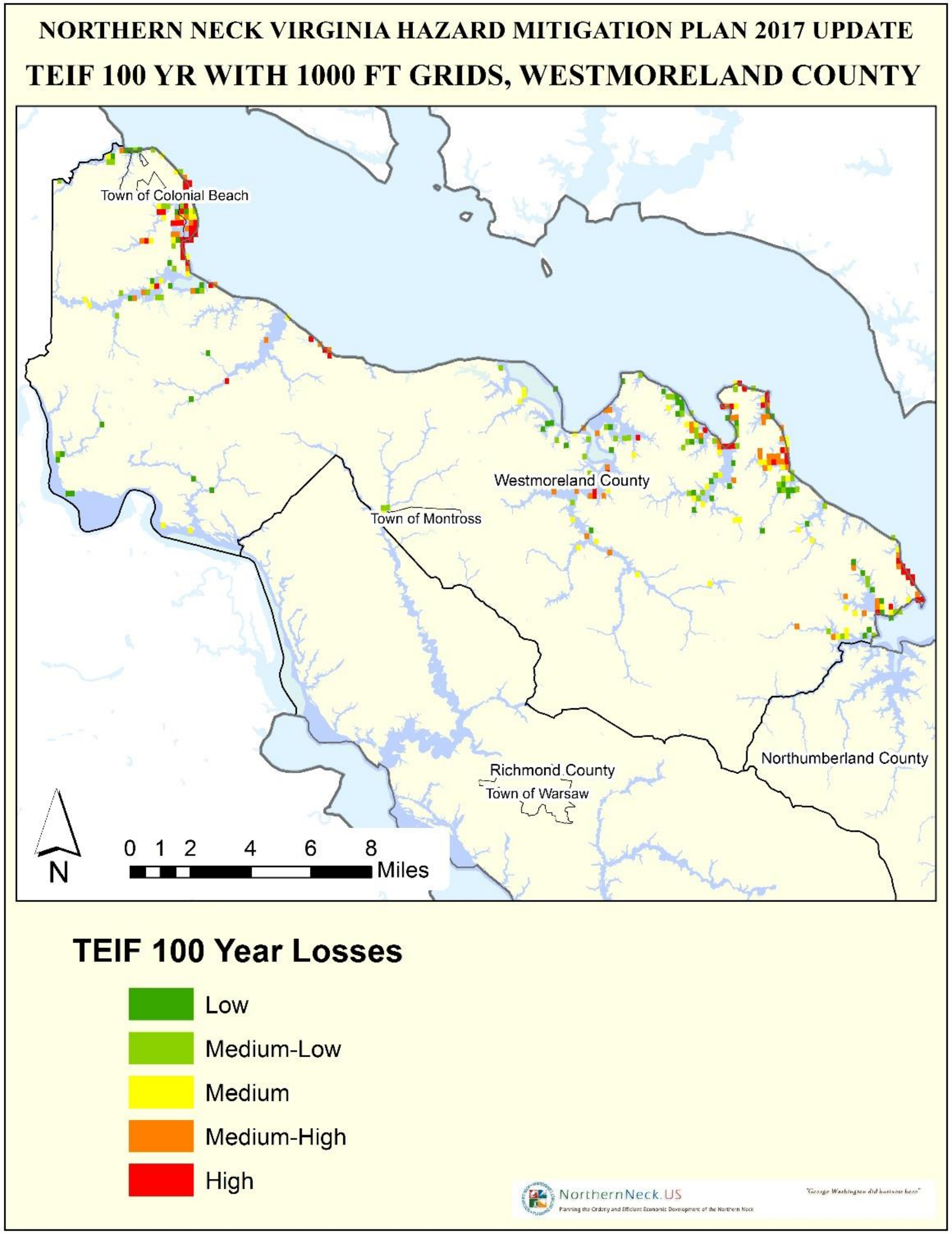
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

TEIF 500 YR WITH 1000 FT GRIDS, RICHMOND COUNTY



TEIF 500 Year Losses

- Low
- Medium-Low
- Medium
- Medium-High
- High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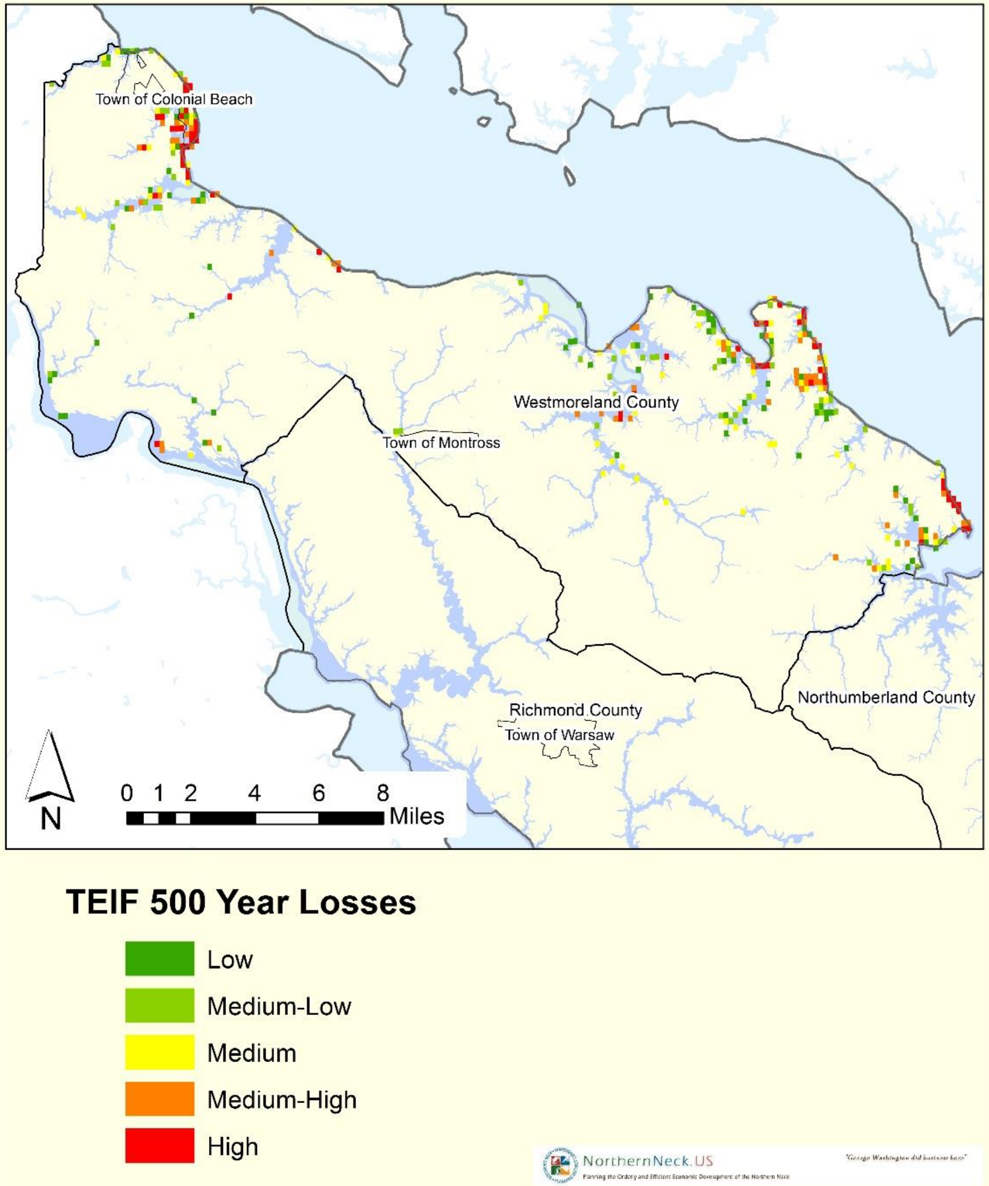

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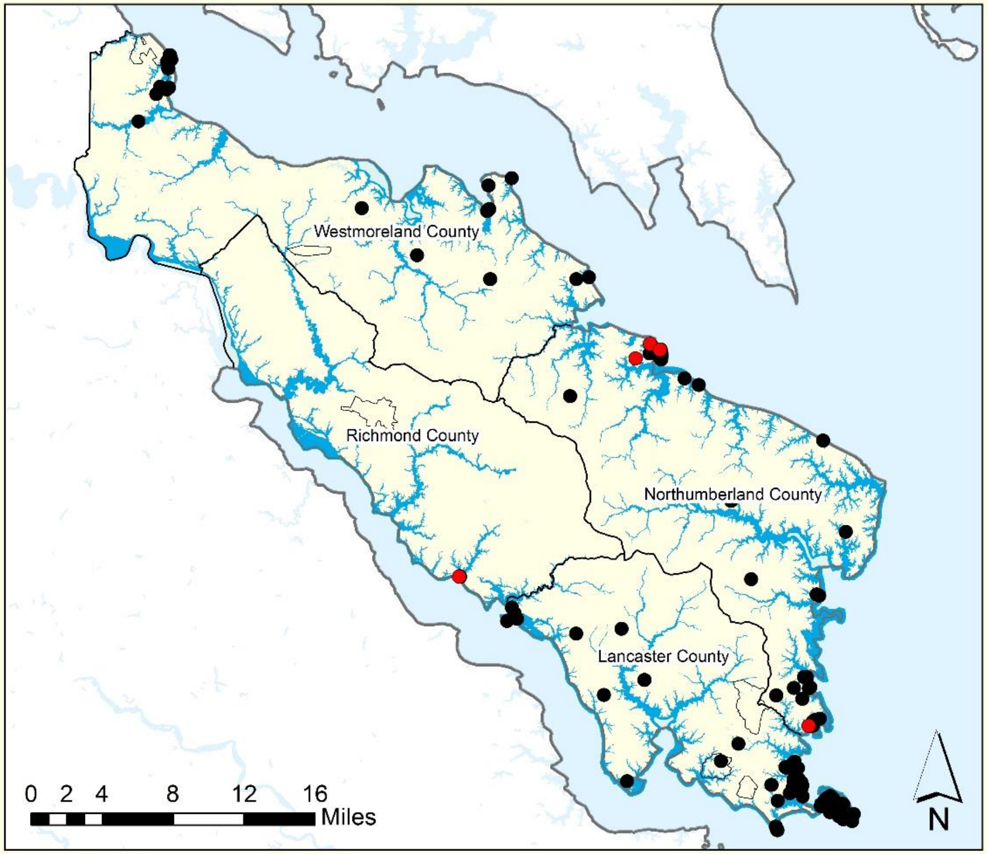
Repetitive Loss

- Repetitive Loss (RL) property: any insurable building w/ 2 or more claims >/= $1,000 paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.
- A Severe Repetitive Loss (SRL) property: any property with 4 or more separate claim payments >$5,000 each; or 2 or more separate claim payments where the total payments > the current building value of the property.
- Nationwide, RL properties constitute 2% of all NFIP insured properties, but are responsible for 40% of all NFIP claims

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS STRUCTURES IN NORTHERN NECK



Repetitive Loss

- Repetitive Loss Structures
- Severe Repetitive Loss Structures
- Flood Hazard Area

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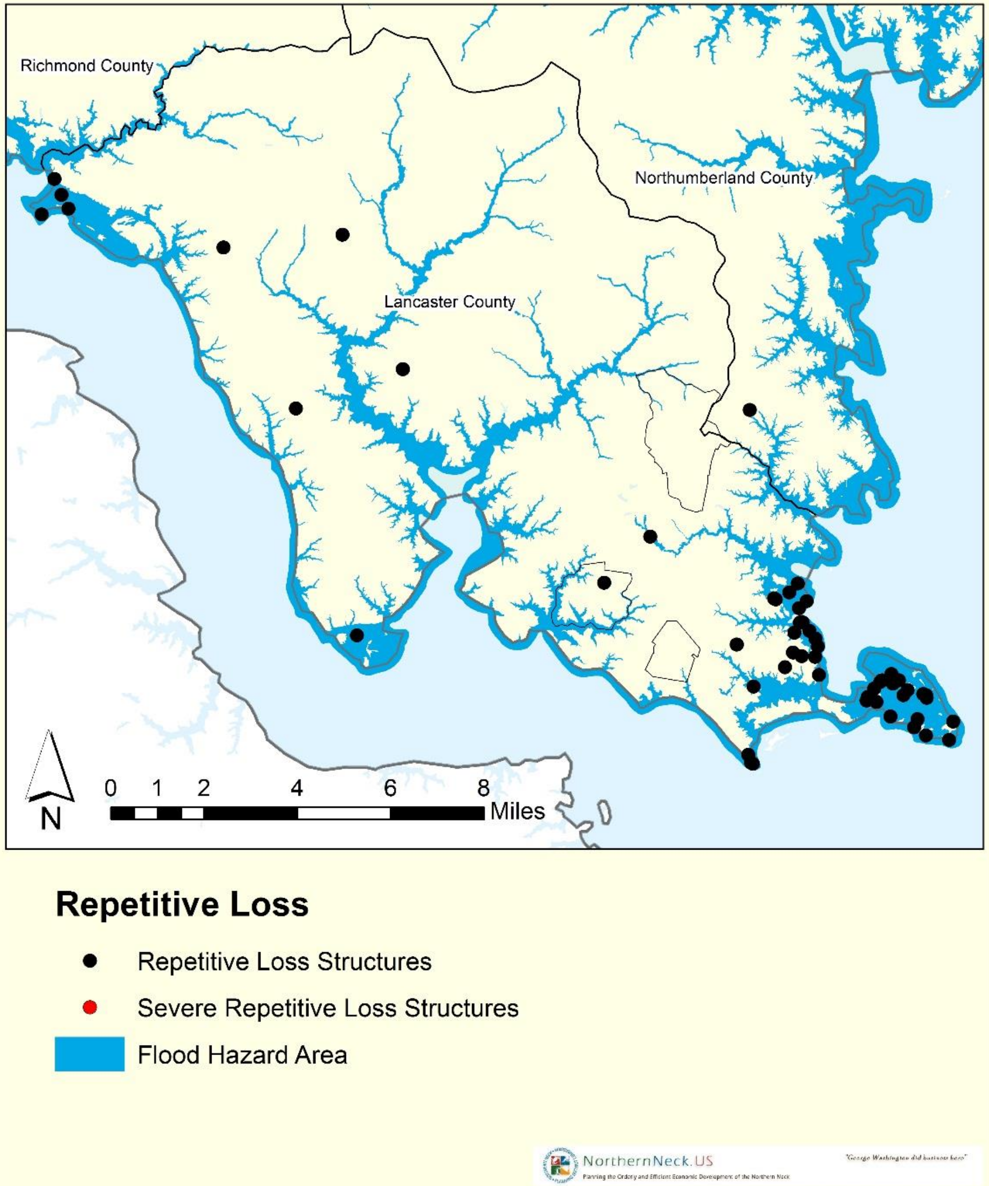
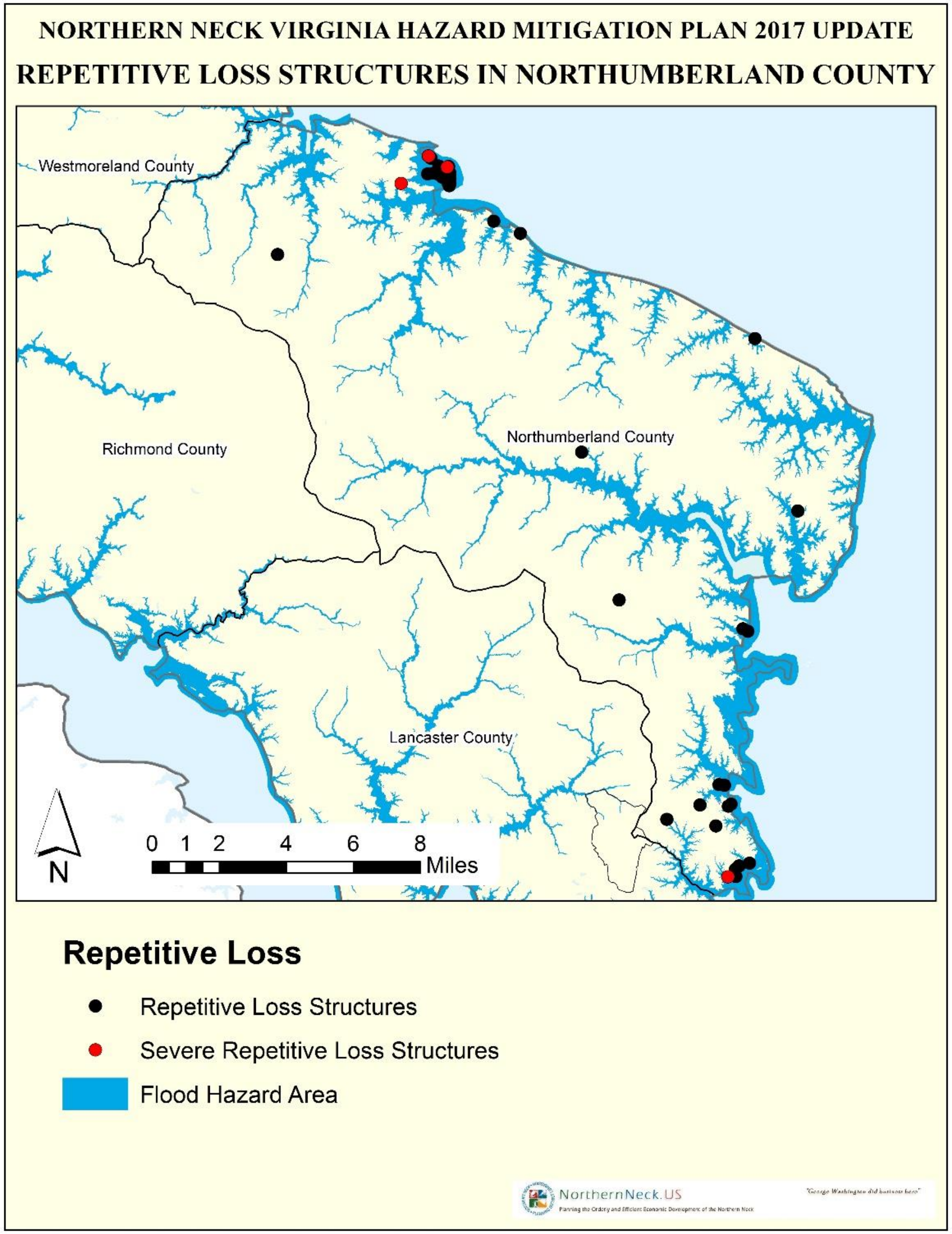
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS STRUCTURES IN LANCASTER COUNTY





NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
REPETITIVE LOSS STRUCTURES IN NORTHUMBERLAND COUNTY
Westmoreland County
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0 1 2 4 6 8
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Repetitive Loss
Repetitive Loss Structures
Severe Repetitive Loss Structures
Flood Hazard Area
NorthernNeck.US

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS STRUCTURES IN RICHMOND COUNTY

Repetitive Loss

- Repetitive Loss Structures
- Severe Repetitive Loss Structures
- Flood Hazard Area

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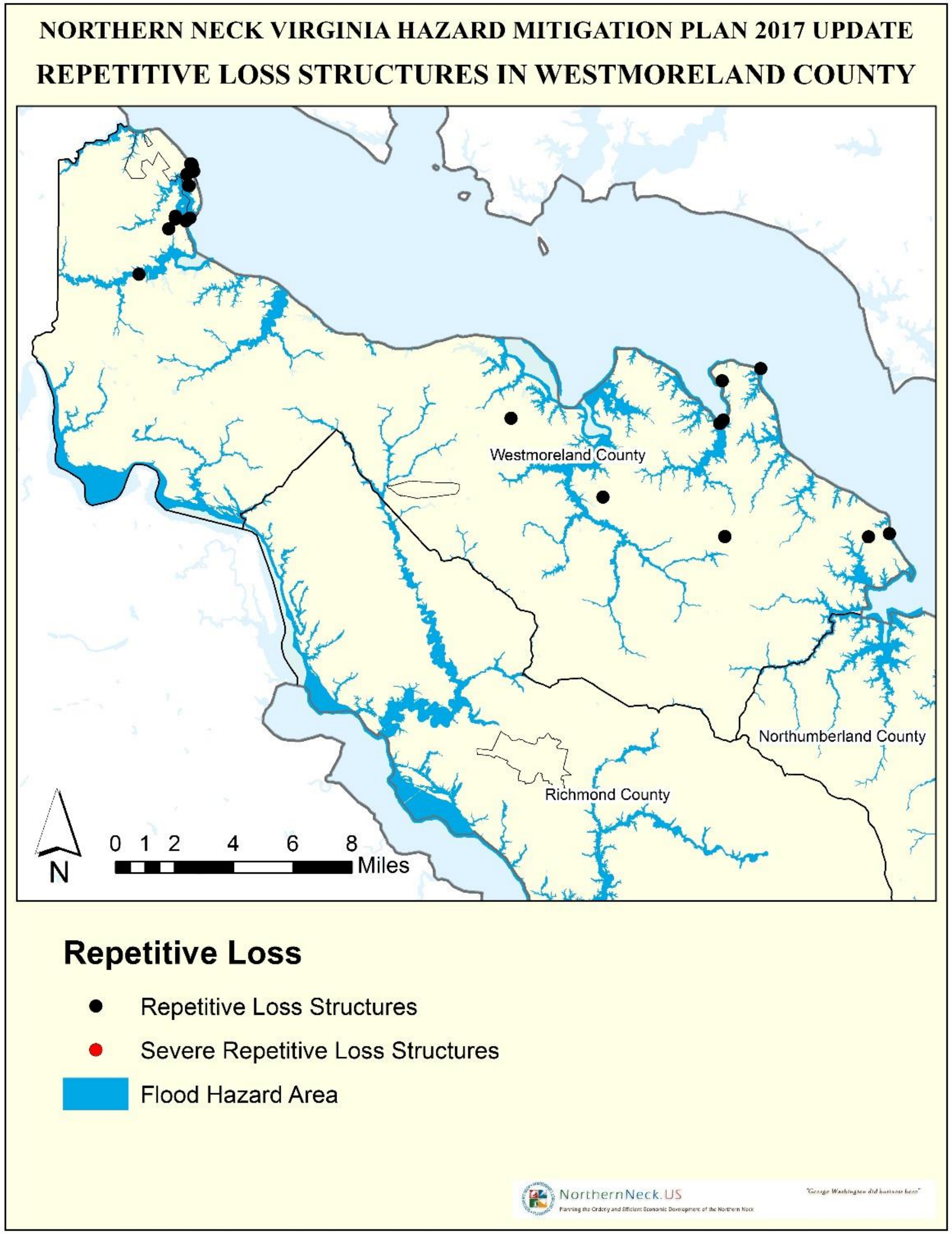
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Flood Hazard Area
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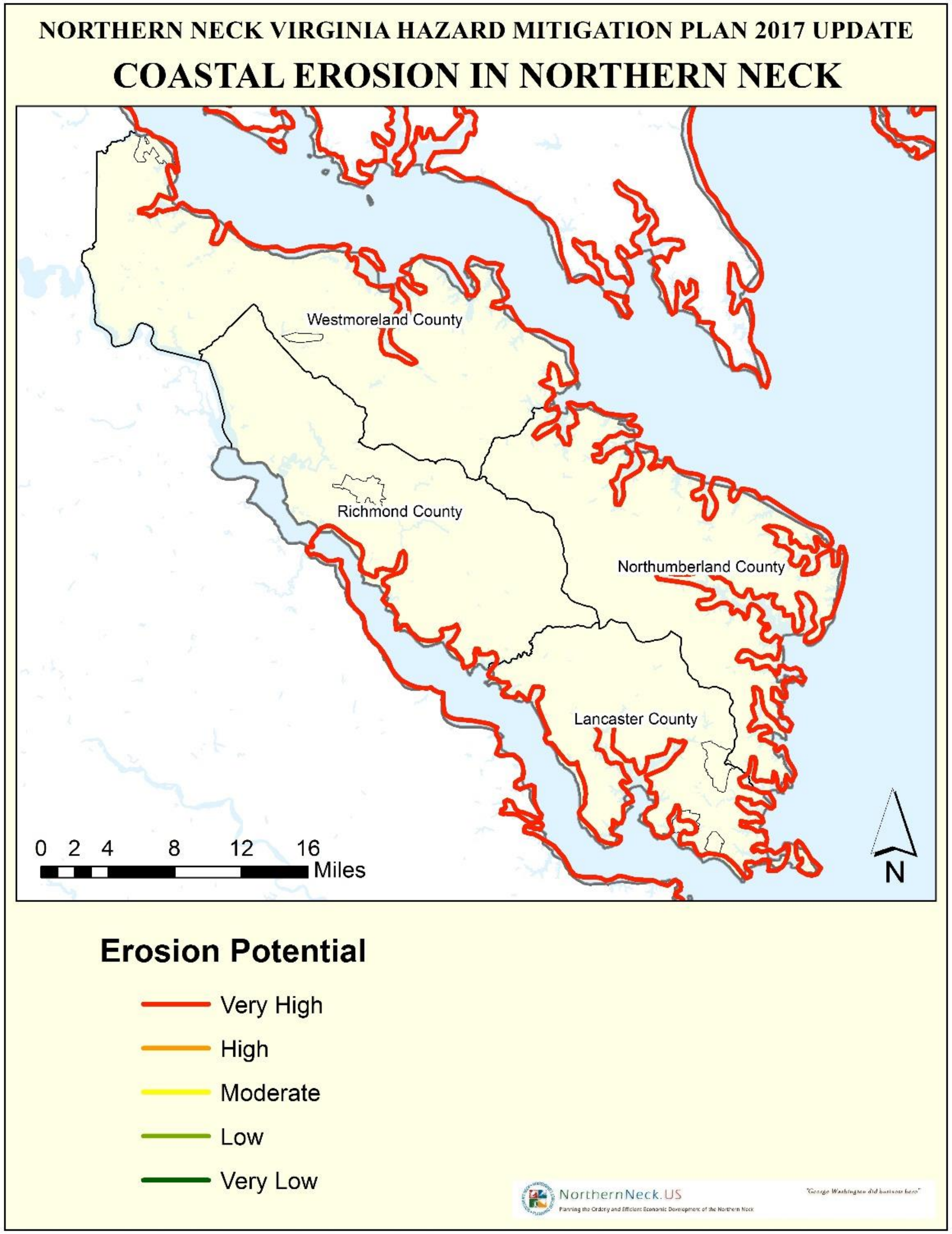
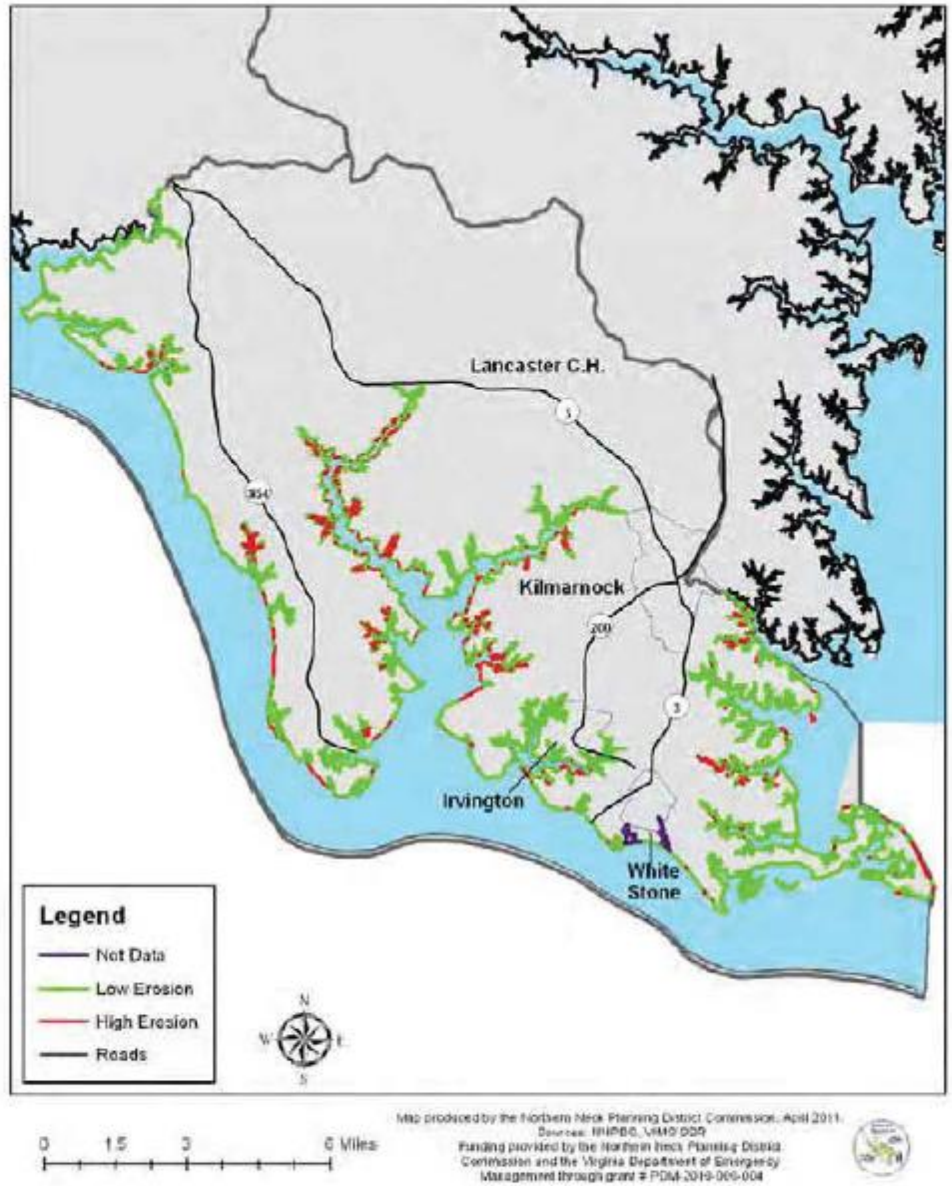
Coastal Erosion Risk

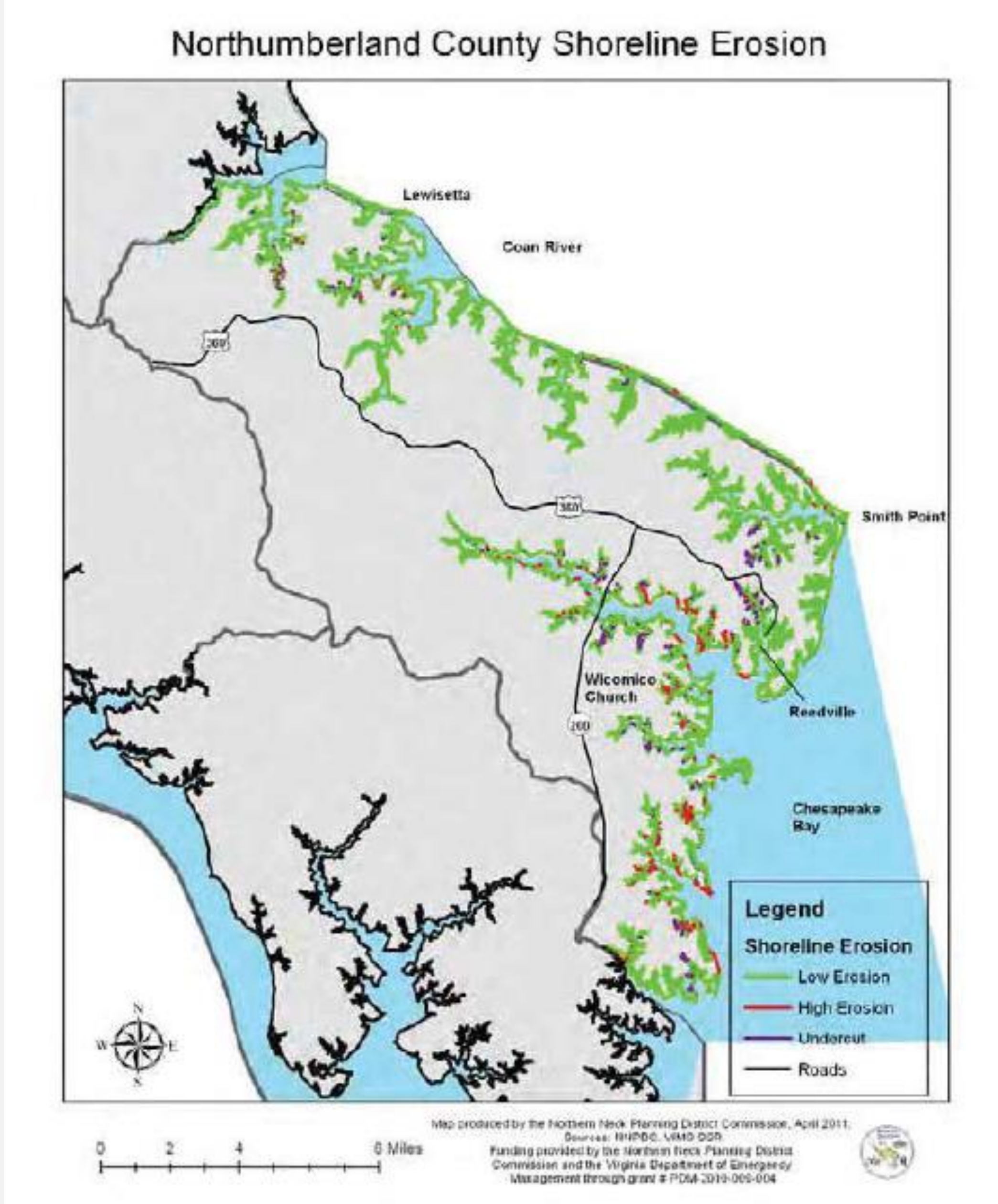


- USGS Climate Resilience Toolkit provides a coastal dataset showing vulnerability to sea level rise and erosion.
- Includes the Coastal Vulnerability Index (CVI) to give subjective assessment of risk to sea level rise and erosion.
- Ranking values range from very low, low, moderate, high, to very high.
- **NNPDC ranked mostly very high.**

Lancaster County Shoreline Erosion



* From 2011 Plan



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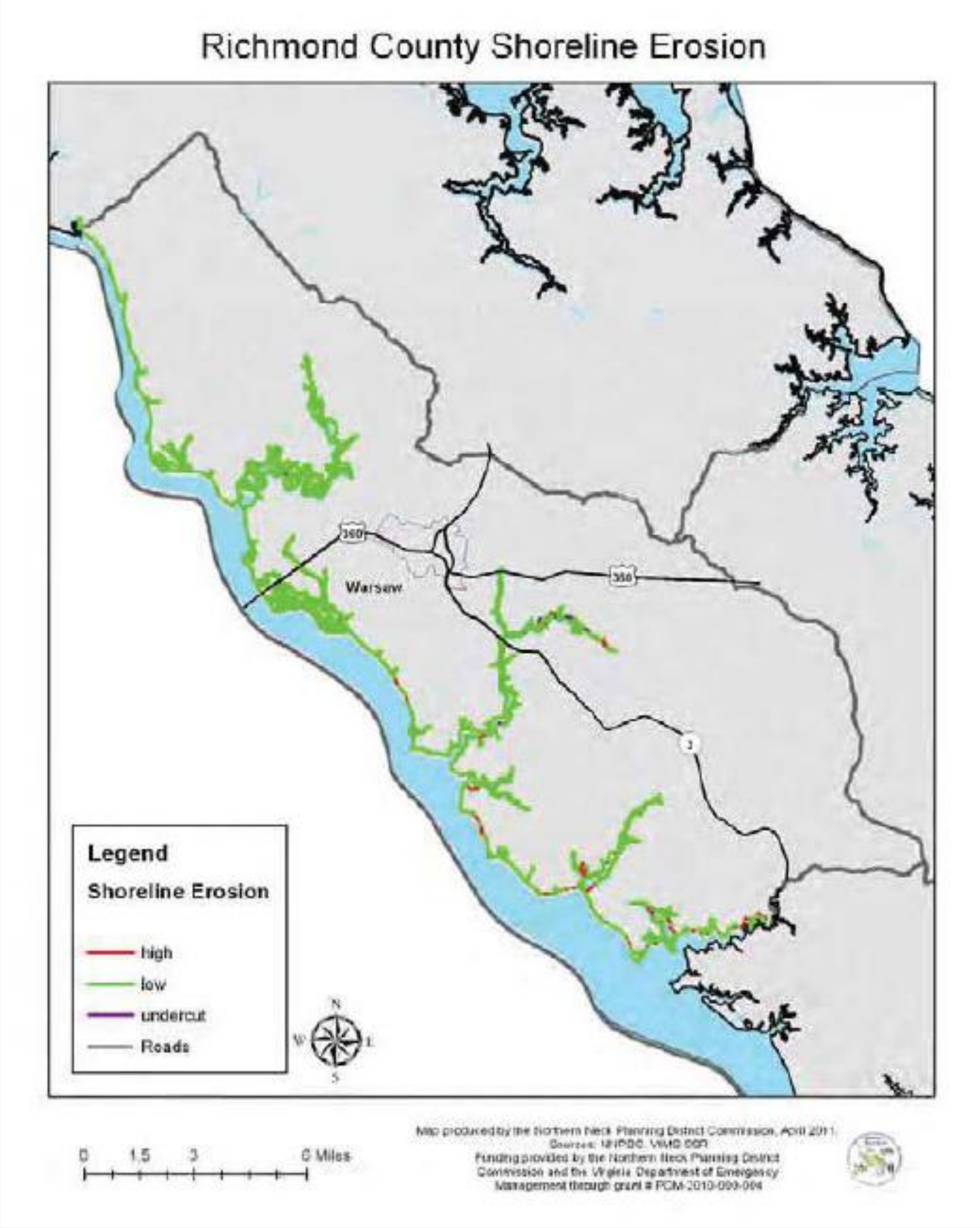

* From 2011 Plan

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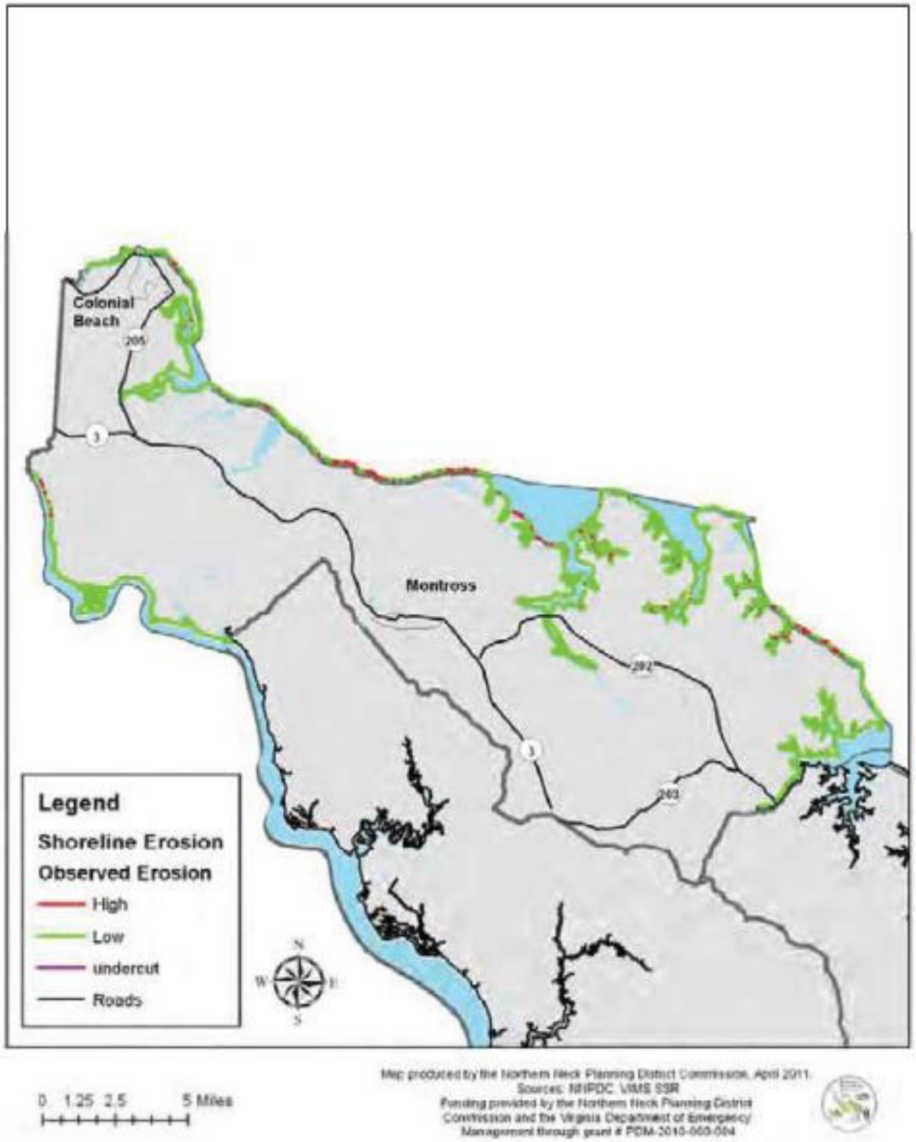
Westmoreland County Shoreline Erosion



* From 2011 Plan

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Shoreline Studies Program, Virginia Institute of Marine Science, September 2012

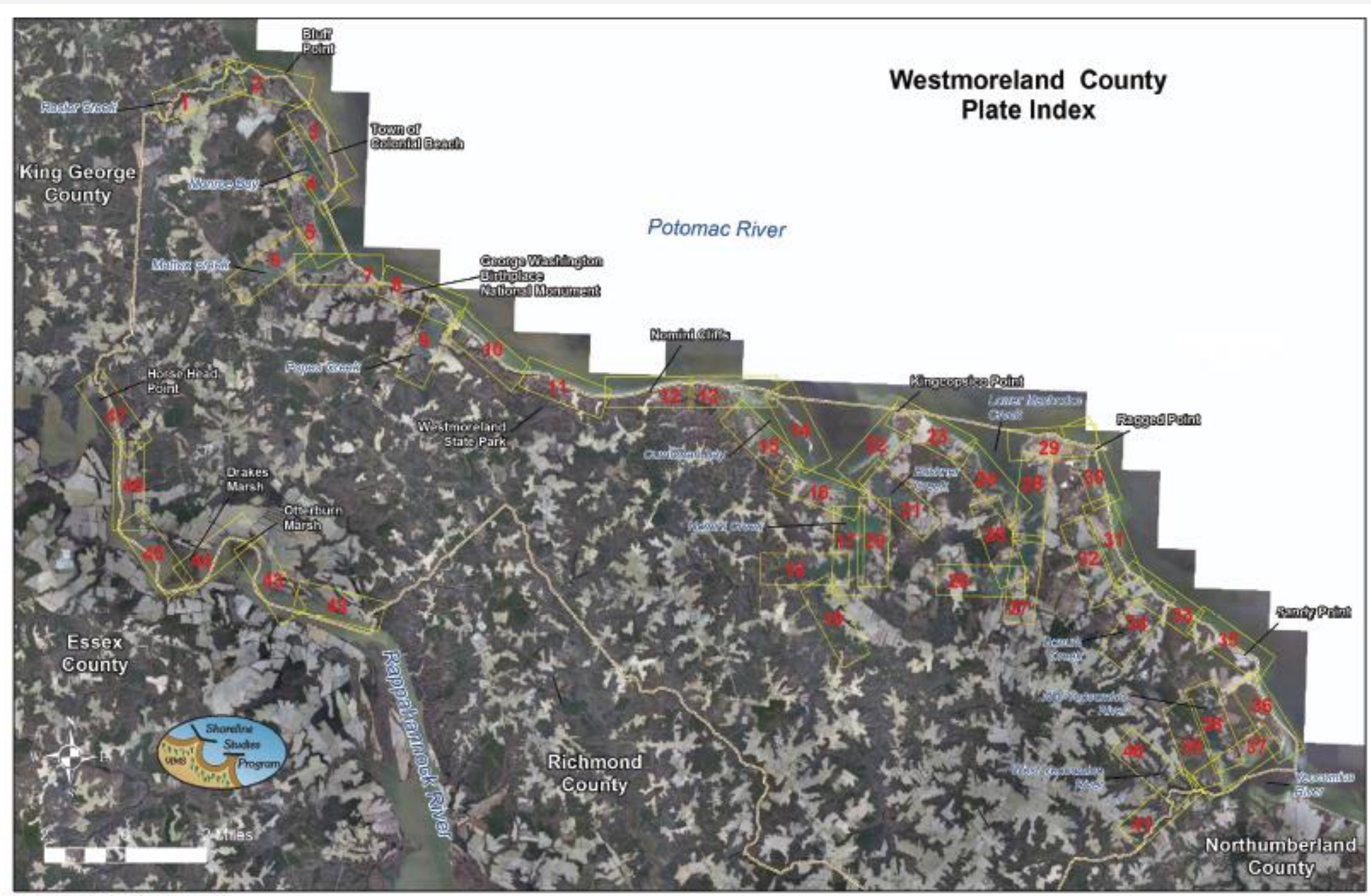

Figure 2. Index of shoreline plates.

Segments of the shoreline where shoreline erosion was calculated

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Shoreline Studies Program, Virginia Institute of Marine Science, September 2012

Table 1. Average end point rate of change (ft/yr) between 1937 an d2009 for segments along Westmoreland County's shoreline. Segment locations are show on maps in Appendix A.

Segment Name	Location	Average Rate of Change (ft/yr)
A	Rosier Creek	-0.7
B	Potomac River, Mouth of Rosier Creek to Bluff Point	-0.1
C	Potomac River, Town of Colonial Beach	0.1
D	Monroe Bay	-0.2
E	Potomac River, Sebastian Point to Paynes Point	-0.7
F	Mouth of Mattox Creek, Wirt Wharf	-0.1
G	Potomac River, Church Point to Westmoreland State Park	-1.1
H	Potomac River, Westmoreland State Park to Haulover Inlet	-0.8
I	Nomini Bay, Hollis Marsh	-4.0
J	Currioman Bay, Haulover Inlet to Nomini Creek	-0.6
K	Nomini Creek including Buckner Creek	-0.3
L	Nomini Bay, White Point to Kingcopsico Point	-0.3
M	Lower Machodoc Creek	-0.8
N	Potomac River, Grapevine Point to Ragged Point	-1.1
O	Potomac River, Ragged Point to Jackson Creek	-0.9
P	Potomac River, Jackson Creek to Sandy Point	-2.2
Q	Potomac River, Sandy Point to Lynch Point	-1.4
R	Yeocomico River	-0.5
S	Rappahannock River, Richmond County Line to Layton Landing Rd.	-0.4
T	Rappahannock River, Layton Landing Rd. to Blind Point	-1.2
U	Rappahannock River, Blind Point to King George County Line	-0.4

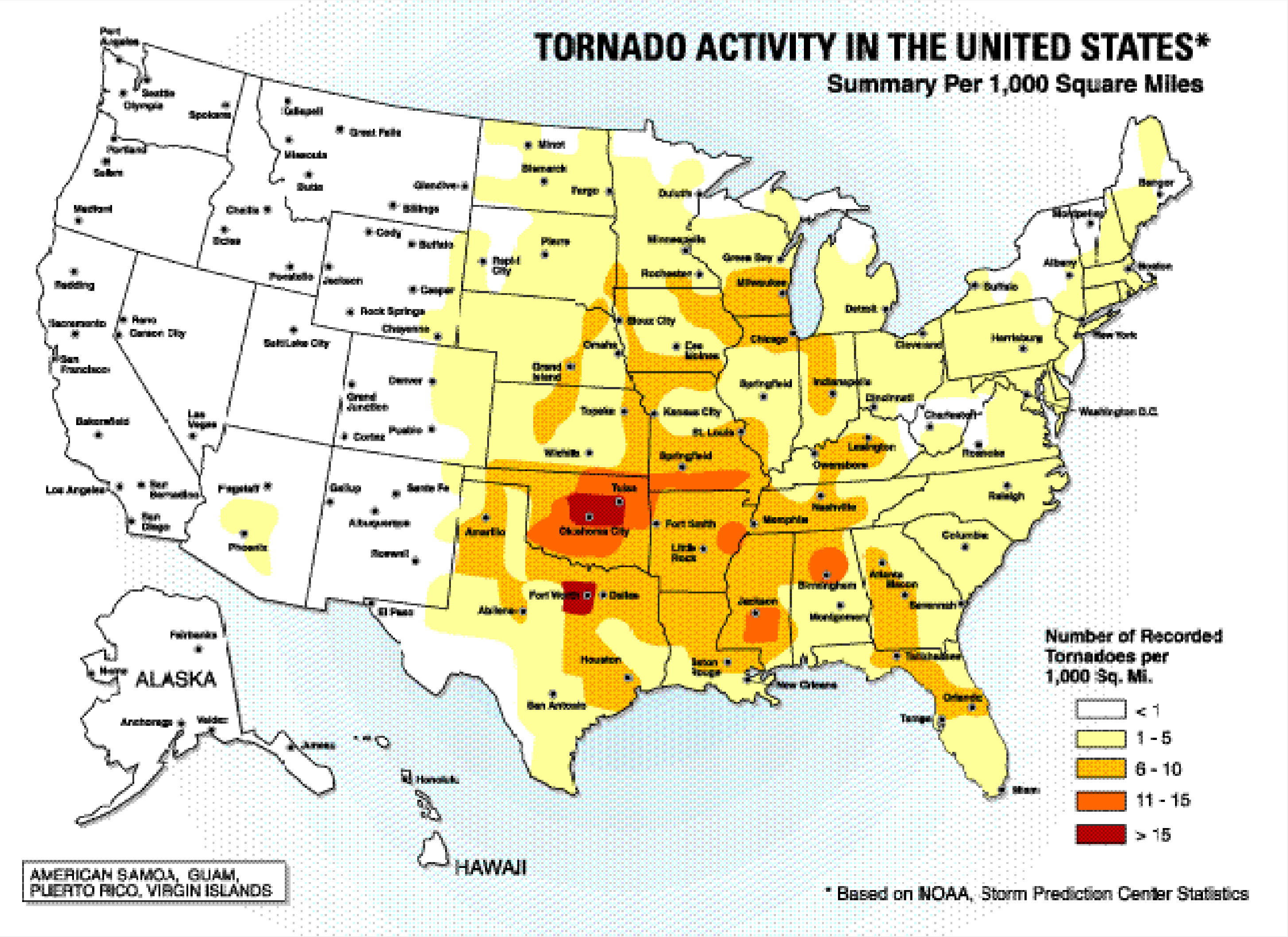
- Segments of the shoreline and their calculated shoreline erosion rate of change
- Annual losses predicted losses from -0.1 to -4.0 ft./yr.

Tornado Hazard Risk

Tornado Damage Scale

Enhanced Fujita Scale	Wind Speeds (mph)	F-Scale	Wind Speeds (mph)	Damage	Frequency
EF0	65 to 85	F0	40 to 72	Light Damage. Some damage to chimneys, TV antennas, roof shingles, trees, and windows	29%
EF1	86 to 110	F1	73 to 112	Moderate Damage. Automobiles overturned, carports destroyed, trees uprooted	40%
EF2	111 to 135	F2	113 to 157	Considerable Damage. Roofs blown off homes, sheds and outbuildings demolished, mobile homes overturned	24%
EF3	136 to 165	F3	158 to 206	Severe Damage. Exterior walls and roofs blown off homes. Metal buildings collapsed or severely damaged. Forests and farmland flattened.	6%
EF4	166 to 200	F4	207 to 260	Devastating Damage. Few walls, if any, standing in well-built homes. Large steel and concrete missiles thrown far distances.	2%
EF5	Over 200	F5	261 to 318	Incredible Damage. Homes leveled with all debris removed. Schools, motels, and other larger structures have considerable damage with exterior walls and roofs gone. Top stories demolished.	Less than 1%

National Tornado Risk



Tornado History 1965-2016

Fujita Scale	Date	Counties Affected	Deaths	Injuries	2017 Property Damages	2017 Crop Damages	2017 Total Damages
EF1	**2/24/2016**	**Lancaster, Westmoreland**	**0**	**0**	**$1,299,168**	**$79,045**	**$1,378,212**
EF2	**2/24/2016**	**Richmond**	**0**	**0**	**$3,344,191**	**$0**	**$3,344,191**
EF0	6/18/2015	Lancaster, Richmond	0	0	$46,178	$0	$46,178
EF0	2/21/2014	Westmoreland	0	0	$15,411	$0	$15,411
F1	1/14/2005	Northumberland, Richmond	0	0	$37,361	$0	$37,361
F1	5/25/2004	Lancaster	0	0	$25,751	$0	$25,751
F0	8/26/2003	Richmond	0	0	$6,609	$0	$6,609
F0	4/4/1999	Westmoreland	0	0	$36,498	$0	$36,498
F1	9/10/1997	Northumberland	0	0	$227,309	$0	$227,309
F0	7/13/1996	Westmoreland	0	0	$15,502	$0	$15,502
F1	7/12/1996	Northumberland	0	0	$387,541	$0	$387,541
F0	6/24/1996	Westmoreland	0	0	$263,528	$0	$263,528
F0	1/19/1996	Richmond	0	0	$23,252	$0	$23,252
F0	8/6/1993	Lancaster	0	0	$841,595	$0	$841,595
F1	**5/10/1990**	**Lancaster**	**0**	**0**	**$4,652,276**	**$0**	**$4,652,276**
F1	5/2/1989	Northumberland	0	0	$0	$0	$0
F2	5/2/1989	Northumberland	0	0	$0	$0	$0
F2	8/31/1983	Richmond	0	0	$61,049	$0	$61,049
F1	9/6/1975	Lancaster	0	0	$11,302	$0	$11,302
F2	4/25/1975	Richmond	0	0	$113,021	$0	$113,021
F0	8/10/1969	Northumberland	0	0	$1,657	$0	$1,657
F3	11/2/1966	Richmond	0	0	$187,671	$0	$187,671

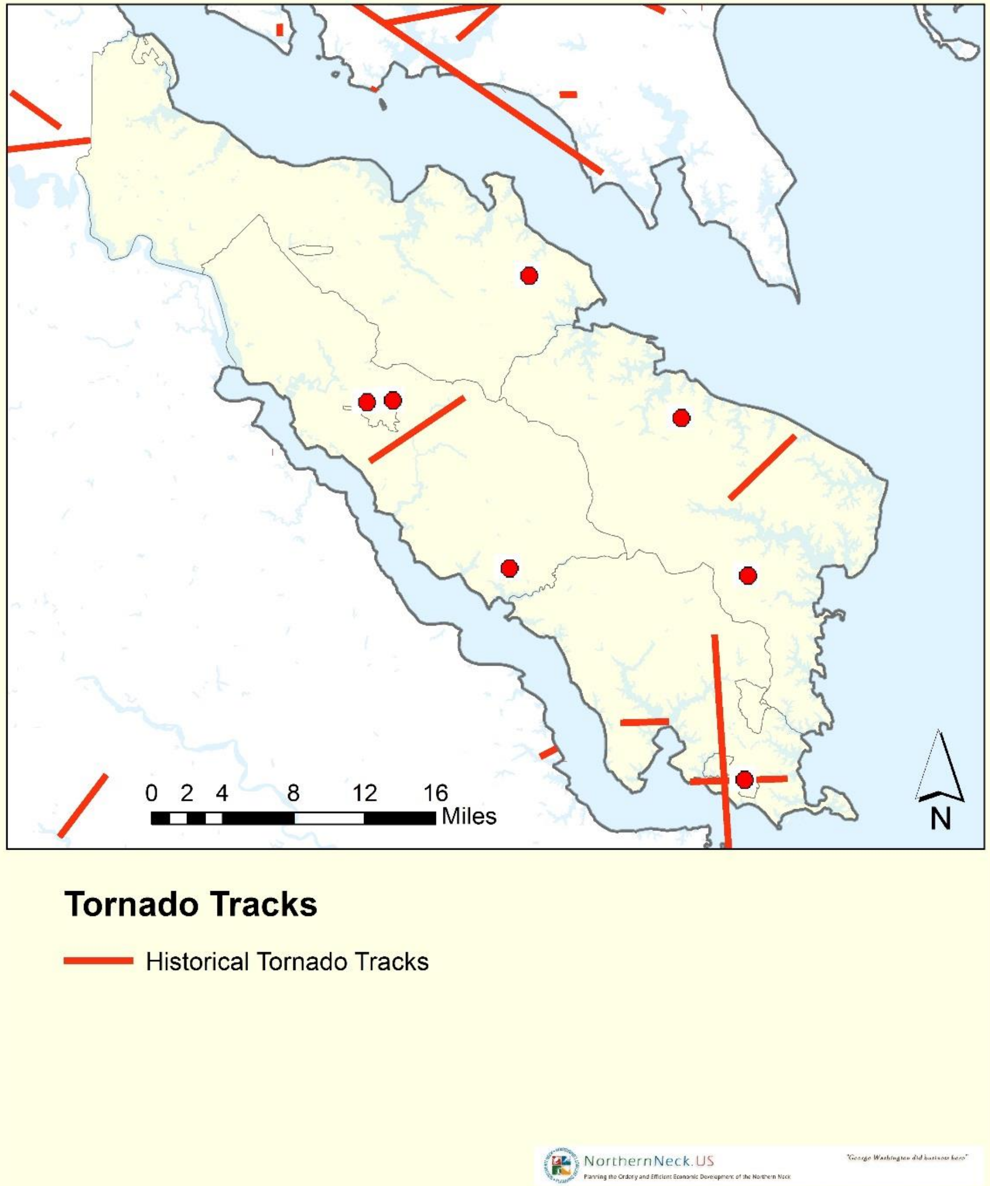
Local Tornado Risk

EF Scale Rating	Estimated Tornado Counts Northern Neck (1965-2016)
EF0	4
EF1	2
EF2	1
F0	7
F1	8
F2	2
F3	1

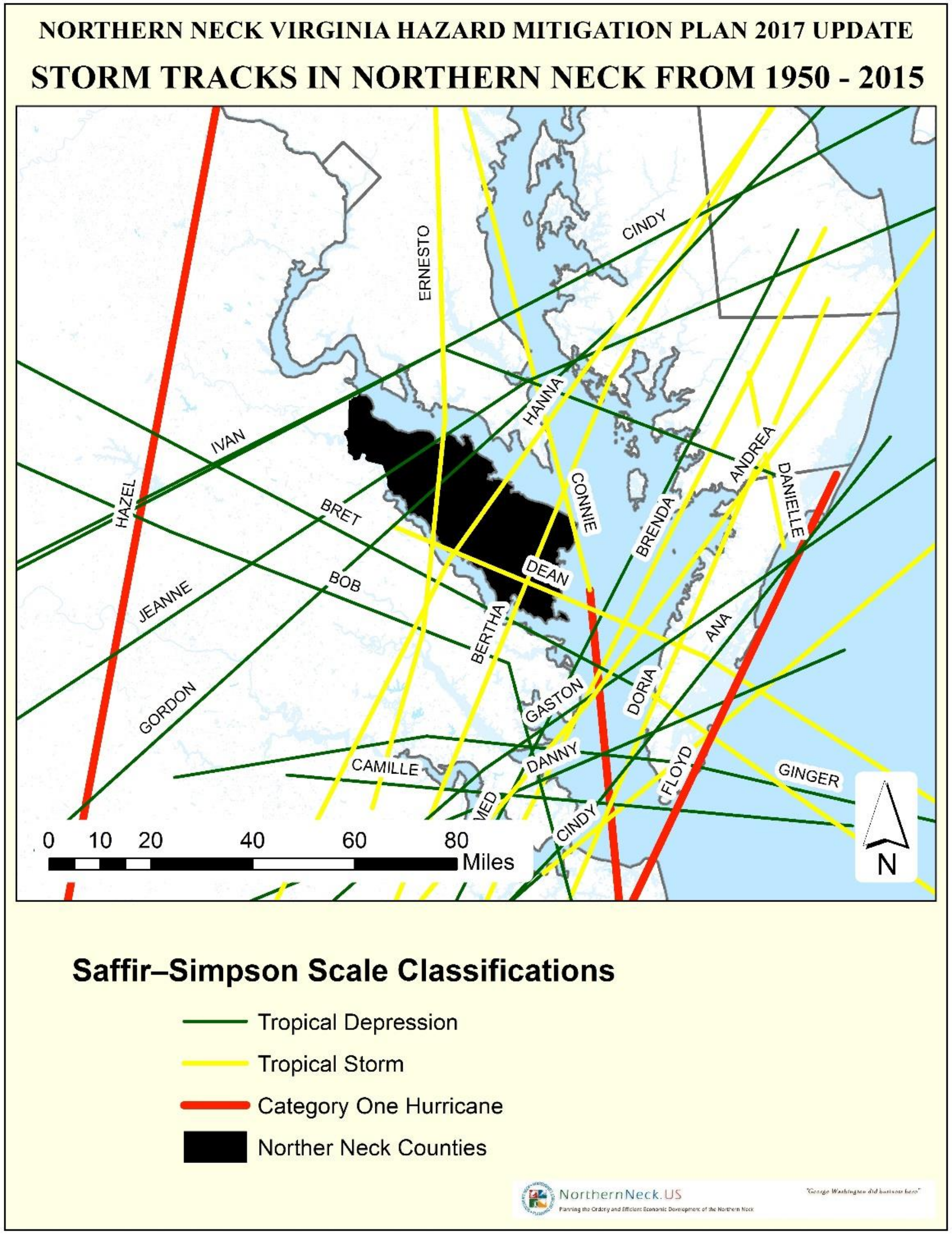
Source: NCEI Database for 2016.

NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

NCEI TORNADO EVENTS FROM 1950 - 2013



Hurricanes and Tropical Storm Risk



NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE
STORM TRACKS IN NORTHERN NECK FROM 1950 - 2015
ERNESTO
CINDY
HANNA
IVAN
HAZEL
BRET
CONNIE
ANDREA
DANIELLE
BRENDA
DEAN
BOB
JEANNE
BERTHA
ANA
GORDON
GASTON
DORIA
CAMILLE
DANNY
FLOYD
GINGER
CINDY
0 10 20 40 60 80
Miles
N
Saffir–Simpson Scale Classifications
Tropical Depression
Tropical Storm
Category One Hurricane
Norther Neck Counties
NorthernNeck.US

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Coastal Storm (Nor'easter) Risk

Coastal Storm Hazard Risk

Coastal storms (Nor'easters) are a persistent problem for Northern Neck. Recent notable storms include:

- February 2017 – On February 9 the system reached the East Coast and rapidly grew into a powerful nor'easter. Blizzard from Philadelphia north; precipitation on the Northern Neck was fortunately rainfall accompanied with high winds. Prior to the storm, unprecedented and record-breaking warmth had enveloped the region, with record highs of above 60 °F.
- January 2016 - Winter Storm Jonas. Between January 23 and 24, a very severe Nor'easter dumped 2 to 3 feet of snow in the East Coast of the United States. Sustained damaging winds over 50 mph were recorded in many coastal communities, with a maximum gust to 85 mph on Assateague Island, Virginia. Snow and high wind on the Northern Neck.
- October 2015 - Early October Atlantic low pressure system tapped into moisture from Hurricane Joaquin; the storm resulted in heavy rains and flooding in the mid-Atlantic.

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Winter Storm Risk

Winter Storm Hazard Risk

Winter storms are a persistent problem for Northern Neck.

Recent notable storms (excluding Nor'easters) include:

- January 2017 – Southern system resulted in snow from central to northern and northeastern VA – school closings, limited power outages.
- January 2016 – Low pressure from the south resulted in snow throughout central and northern Virginia and the Northern Neck resulting in limited power outages, school closings.
- March 2015 - Low pressure moving northeast produced freezing rain and freezing drizzle across portions of the Virginia Northern Neck. Ice accumulations ranged from a trace to 0.12 inch.
- Winter 2010 – Three significant winter storms severely affected northern Virginia and the Northern Neck resulting in road closures, extened power outages and periods of schools closings.
- December 2009 – A blizzard originating in the mid-west left the Northern Neck with 18-24 inches of snow, causing road closures, school closings and power outages.

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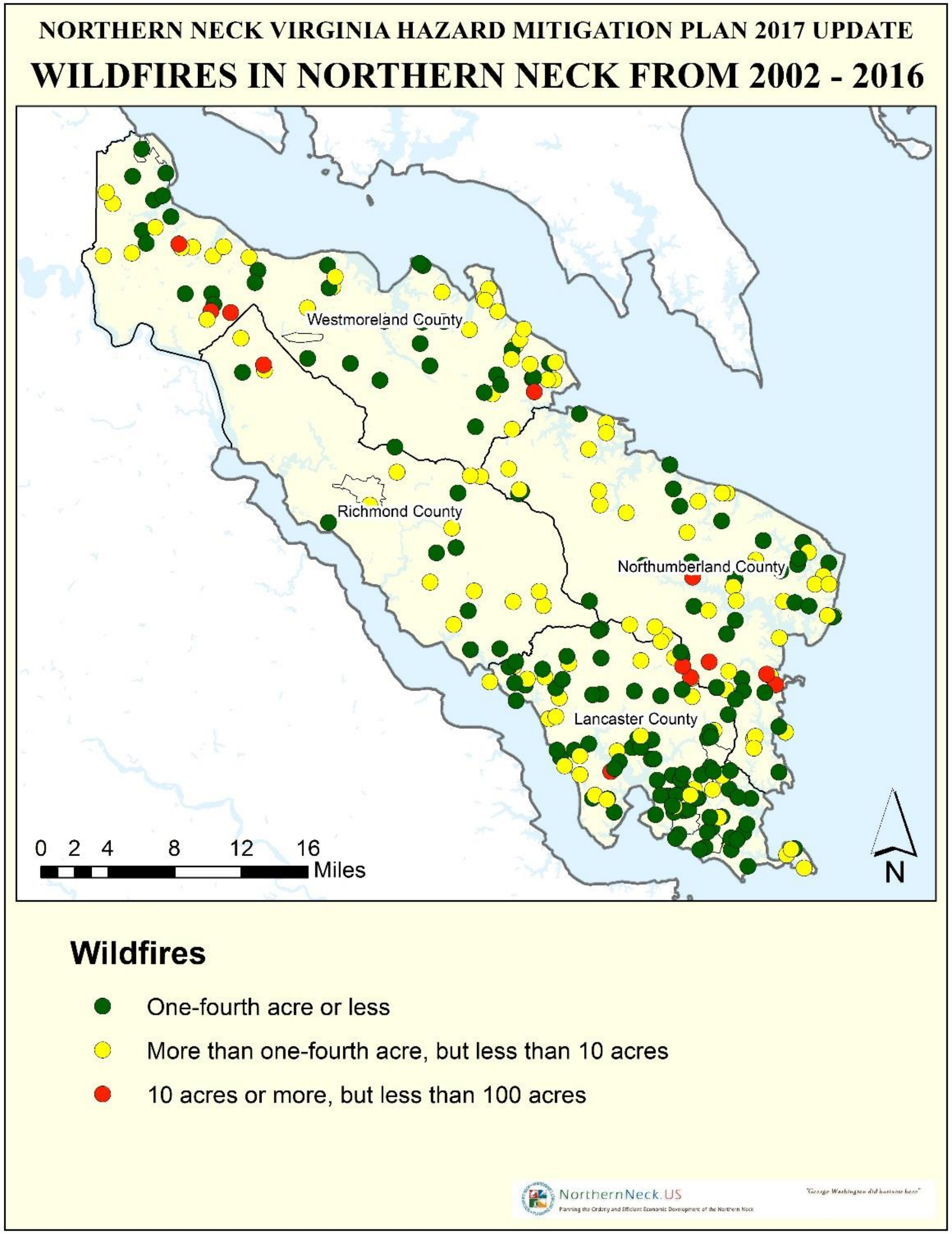
Wildfire Risk

Wildfires 2002-2016

County	Size Class	Fire Description	Numbers of Fires
Lancaster	**A**	**One-fourth acre or less**	**79**
	B	**More than one-fourth acre, but less than 10 acres**	**33**
	C	10 acres or more, but less than 100 acres	3
Richmond	A	**One-fourth acre or less**	**34**
	B	**More than one-fourth acre, but less than 10 acres**	**34**
	C	10 acres or more, but less than 100 acres	5
Northumberland	A	One-fourth acre or less	8
	B	**More than one-fourth acre, but less than 10 acres**	**11**
	C	10 acres or more, but less than 100 acres	1
Westmoreland	A	**One-fourth acre or less**	**36**
	B	**More than one-fourth acre, but less than 10 acres**	**30**
	C	10 acres or more, but less than 100 acres	5

Wildfire Risk

- Northern Neck has on average 19 wildfire events per year
- However, as shown in the map on the right, most wildfires are small and are quickly extinguished



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Drought Risk

Drought Categories

Category	Description	Possible Impacts
D0	Abnormally dry	Going into a drought: short-term dryness slows planting, growth of crops or pastures; fire risk above average. Coming out of a drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low; some water shortages develop or are imminent; voluntary water use restrictions requested.
D2	Severe drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.
D3	Extreme drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.

US Census of Agriculture General Information by County

(areas at risk of Drought Impacts)

County	Farms	Total Acres	Average Acres/Farm	Market Value of Products	Average Farm Value
Lancaster County	61	10,695	175	$4,864,000	$79,741
Northumberland County	566	79,107	140	$16,485,000	$29,125
Richmond County	90	32,373	360	$15,467,000	$171,858
Westmoreland County	152	59,378	391	$35,758,000	$235,248

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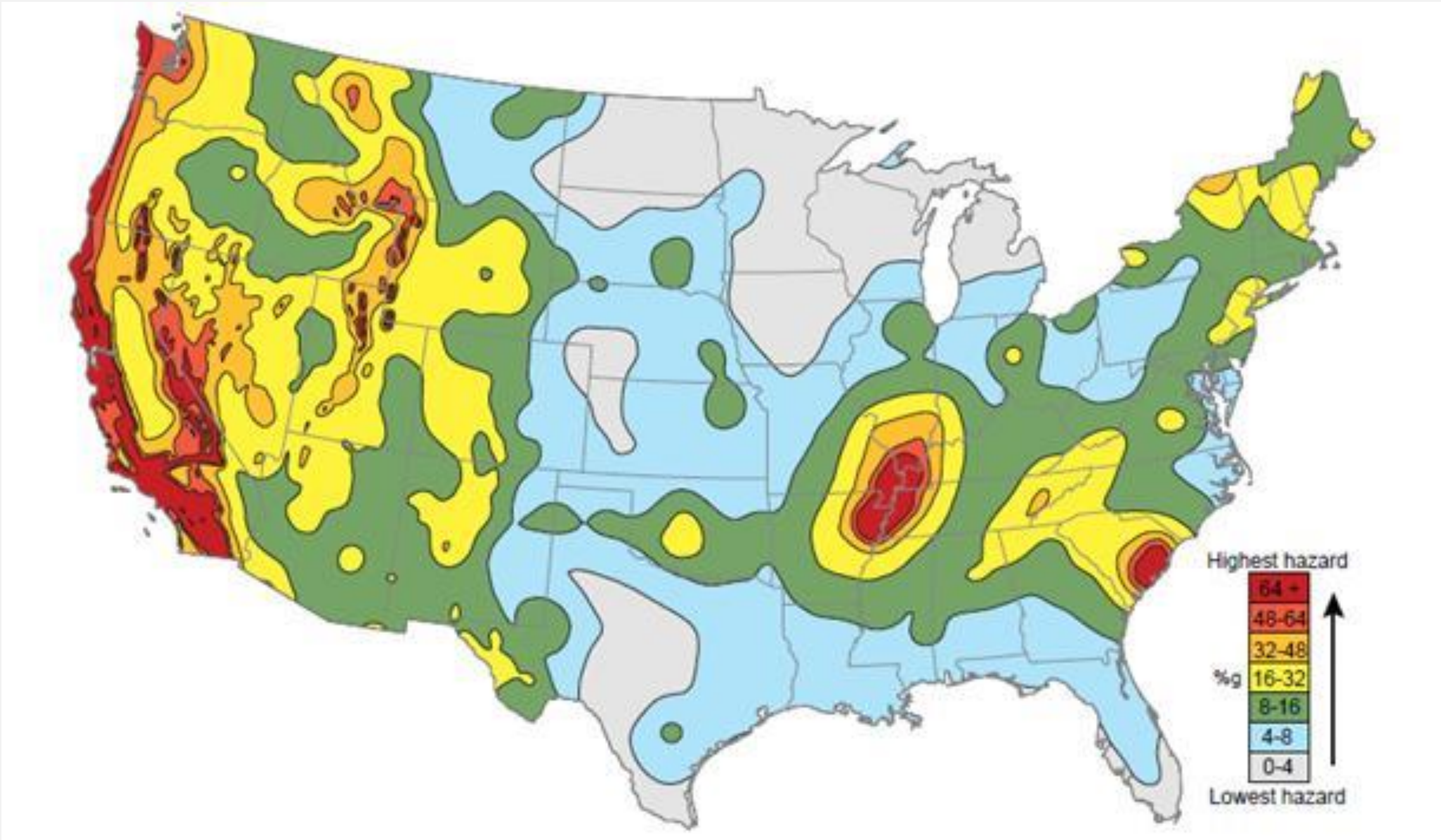
Earthquake Hazard Risk

National Earthquake Risk



Source: United States Geological Survey (USGS) Earthquake Map (based on peak ground accelerations for a 2% probability event in the next 50 years), with earthquake ground accelerations expressed as a percentage of gravity, g (32.2 ft/s^2)

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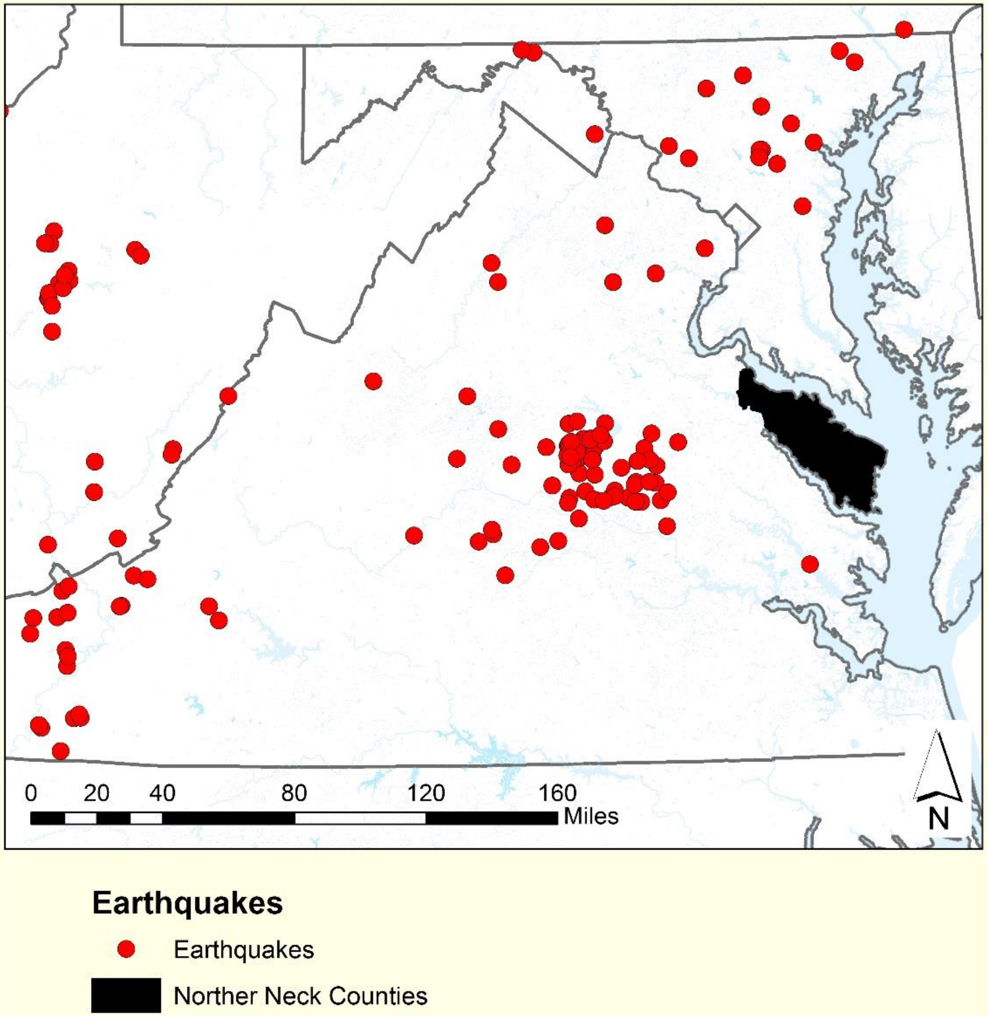
NORTHERN NECK VIRGINIA HAZARD MITIGATION PLAN 2017 UPDATE

EARTHQUAKES AFFECTING NORTHERN NECK



Northern Neck Hazard Rankings

Hazard Rankings

Hazard Type	2011 HMP Planning Consideration Level	2017 LEPC Kick-Off Meeting	2017 Draft HIRA Update
Hurricane	Significant	Significant	Significant
Flooding (river, stream, inc. coastal flooding)	Moderate	Moderate	Significant
Winter Storm	Moderate	Moderate	Moderate
Coastal Erosion	Moderate	Moderate	Moderate
Drought	Limited	Moderate	Moderate
Coastal Storm (Nor'easter)	Limited	Significant	Significant
Tornado	Limited	Significant	Significant
Wildfire	Limited	Limited	Limited
Earthquake	None	Limited	Limited

Mitigation Actions and Goals

- Committee chose to eliminate objectives underneath 2011 plan goals.
- 2011 plan goals were modified to reflect resiliency and "whole community" concepts.
- The goals which follow reflect edited, new 2017 hazard mitigation plan goals.

2011 Northern Neck PDC 2011 HMP Goals

- Goal 1: Promote new development by avoiding undue risks posed by natural hazards and is resilient to natural disasters.

- Goal 2: Address natural hazards and vulnerability that represent a threat to the community.

2011 Northern Neck PDC Revised HMP Goals

- Goal 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents, property and critical infrastructure of the Northern Neck.

- Goal 4: Enhance the capabilities of local government to address natural hazards to enhance the whole community for increased resilience.

2011 Northern Neck PDC Revised HMP Goals

- Goal 5: Increase natural hazard awareness of our citizens. Educate Northern Neck citizens and part-time residents on citizen and community hazard resiliency.

- Goal 6: Participate and Comply with the National Flood Insurance Program (NFIP) through Floodplain Identification, Mapping and Floodplain Management.

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LEPC Hazard Mitigation Plan Update Actions

- Do you want to retain Objectives?
- What keeps you up at night?
- To enable cross-cutting mitigation themes and actions/projects are the necessary people/departments ready to participate?
- Must address as many hazards through actions as possible.
- Are there other efforts currently going on in your community that we should be aware of?
- What would some positive outcomes be?

2011 Mitigation Actions Status Review

Number in 2011 Plan	Strategy	Responsible Department	Priority	2016 Update	Notes - If cancelled, discontinued or no action, please state why?
Regional-1 (Richmond Regional PDC)	Leverage regional partnerships (e.g., law enforcement) to better use their data to inform mitigation planning and project development.	Local Emergency Managers	High	Continue	This strategy is an ongoing practice that PDCs continue to perform. Most PDC work involves relationships and partnerships with varied entities.

- Any strategy revisions
- Responsible party department
- Priority
- Complete, Continue, Delete, Other
- Notes

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Mitigation Actions

- Preventative Measures
- Property Protection
- Emergency Services
- Structural Projects
- Natural Resources Protection
- Public Information Programs

2017 – 2022 Actions

- Include 2011 “Carry-forward” actions
- Actions must include:
  - Strategy/action statement
  - Responsible Department
  - Priority
  - Goals supported
  - Hazard Addressed
  - Timeframe
  - Resources – funding source, staff, etc.

2017 – 2022 Mitigation Actions

2017 - 2022 Mitigation Actions							
Number	**Strategy**	**Responsible Department**	**Priority**	**Goals**	**Hazards**	**Time**	**Resources**
Regional - 1 (RR PDC)	Leverage regional partnerships (e.g., law enforcement) to better use their data to inform mitigation planning and project development.	Local Emergency Managers	High	1, 2, 3,	All	ongoing	staff
Regional - 2 (RR PDC)	Work with state partners and neighboring regions to expand planning efforts regarding regional strategy for incoming evacuees (topics to include traffic management, shelters, information sharing, etc.).	Local Emergency Managers	Low	1, 2, 3, 4, 5	All	ongoing	staff, CVEMA
Regional - 3 (RRI PDC)	Continue to refine improve the quality and detail of data to prepare usable and effective hazard assessments and vulnerability analysis	PDC, Local GIS Managers		1, 2, 3	All	ongoing	staff, grants

Outreach Brainstorming

Next Steps

- Draft HIRA chapter comments to Deborah Mills (dmills@dewberry.com) or Jillian by April 21, 2017
- 2011 Mitigation Action Status to Jillian Browning (jbrowning@dewberry.com) by April 28, 2017
- 2017 – 2022 Mitigation Actions to Jillian Browning by May 5, 2017
- Draft Plan to Northern Neck PDC and LEP/MAC by mid-May.

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LEPC Hazard Mitigation Plan Update Aspirations

- **What keeps you up at night?**
- **What do you like about current plan?**
- **To enable cross-cutting mitigation themes and actions/projects are the necessary people/departments ready to participate?**
- **Are there other efforts currently going on in your community that we should be aware of?**
- **What would some positive outcomes be?**
- **What information/expertise can you contribute?**

Questions, Comments, Discussion

Deborah G. Mills, C.F.M.

Associate

Dewberry

804.823.6971 Desk

804.335.9946 Mobile

dmills@dewberry.com

Northen Neck PDC Hazard Mitigation Plan Update HIRA, Goals and Objectives Meeting April 5, 2017 Sign-In Sheet

Jurisdiction	Name	Position	Email	Phone
Westmoreland Co.	Beth McDowell	planner	BMcdowell@westmoreland-county.org	804-493-~~8~~0120
Westmoreland CO.	Darrin Lee	planner	dlee@westmoreland-county.org	(804)493-0120
Virginia Dept. of EM	Andy John	Response + Recovery	Andy.John@vdem.virginia.gov	804-624-8327
VA Dept. of Emerg. Mgt.	Tricia Chappell	Response Recovery - East	patricia.Chappell@vdem.virginia.gov	(804) 516-5783
Lancaster County	Terrence McGregor	Emergency Coordinator	tmcgregor@lancova.com	(804) 436-3553
LANCASTER Co.	Wally Beauchamp	SUPERVISOR	wbeauchamp@LANCOVA.COM	804-436-3605
TOWN OF IRVINGTON	[illegible]A. HARDESTY	TOWN ADMINISTRATOR	INFO@IRVINGTONVA.ORG	804-438-6230
Northumberland County	Rick McClure	Emergency Services Chief	rmcclure@co.northumberland.va.us	804-761-3250
Westmoreland County	Jeff Beasley	Emergency Services	jbeasley@westmoreland-county.org	804 456 1777
Town of Montross	Patricia Lewis	Town Manager	townofmontross@verizon.net	804-493-9623
NNPDC	JERRY W DAVIS	EXECUTIVE DIRECTOR	jDAVIS@NNPDC17.STATE.VA.US	804 333 1900 ex22
NNPDC	John Bateman	Regional Planner	jbateman@nnpdc17.state.va.us	804-313-8478
NNPDC	Alex Eguiguren	Technical Assistant	aeguiguren@nnpdc17.state.va.us	804-333-1900

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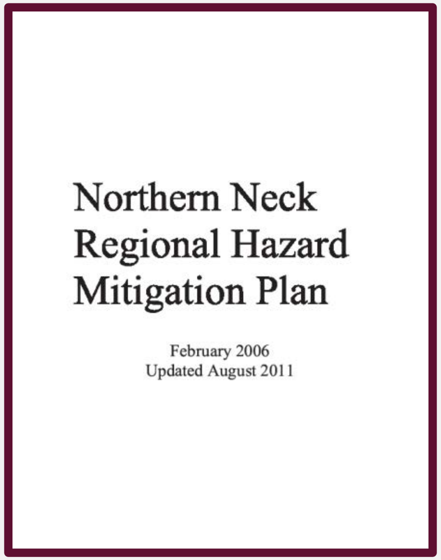
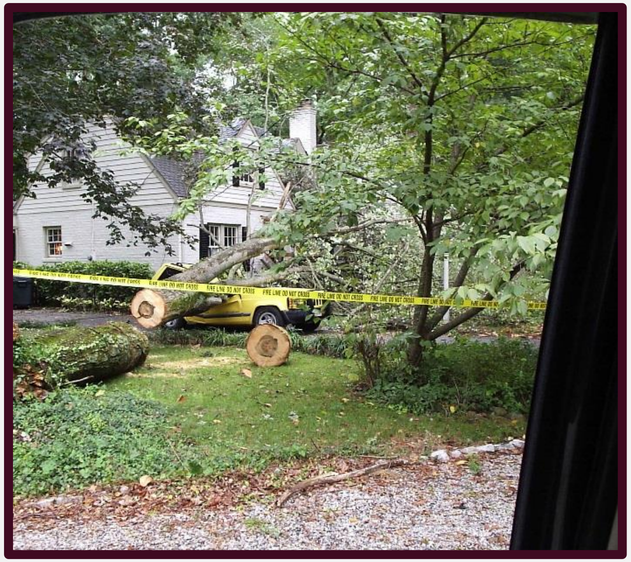

Northern Neck
Regional Hazard
Mitigation Plan

February 2006
Updated August 2011



Northern Neck Multi-Jurisdictional Hazard Mitigation Plan Update

Hazard Vulnerability Review, Mitigation Actions & Next Steps Meeting

May 30, 2017 – as modified during meeting

NORTHERN NECK PLANNING DISTRICT COMMISSION

Agenda

1. Welcome
2. Hazard Vulnerability Review
3. 2011 Mitigation Strategies Update
4. Mitigation Goal Refresh
5. Develop 2017 – 2022 Mitigation Strategies, actions and projects
6. Outreach Brainstorming
7. Next Steps

2017 Plan Update Changes

New analyses and updates: Updated each hazard profile

- Hazard profile
- NCEI storm events data
- 2010 – present storm/disaster occurrences
- Summary risk by jurisdiction using new data

New maps based on updated data

- HIRA summary that includes overall relative risk comparison by hazard.

Flood Risk

NFIP Claims as of 31 Jan 2017

County name	Jurisdiction	Total Losses	Closed Losses	Open Losses	CWOP Losses	Total Payments
Lancaster	Irvington	15	12	0	3	$268,000
	Kilmarnock	N/A	N/A	N/A	N/A	N/A
	Unincorporated	365	294	0	71	$5,660,000
	White Stone	11	5	0	6	$63,800
Northumberland	Unincorporated	391	290	0	101	$6,930,000
Richmond	Unincorporated	84	78	0	6	$1,760,000
Westmoreland	Colonial Beach	81	71	0	10	$3,590,000
	Unincorporated	131	95	0	36	$2,740,000

National Flood Insurance Policies-in-Force cover about $400 M in structure and contents value on the Northern Neck

Total Exposure In Floodplain (TEIF)

- Analysis to estimate the Total Exposure in the Floodplain of the building stock in the NNPDC.
- TEIF performed for Richmond and Westmoreland Counties and Towns using building footprint polygons from the Virginia Geographic Information Network (VGIN).
- Lancaster and Northumberland Counties and Towns analysis used the TEIF method applied at a census block level.

TEIF Exposure by Community

County	Jurisdictions	100 Year Exposure	500 Year Exposure
Lancaster	Town of Irvington	$3,610,000	$3,720,000
	Town of Kilmarnock	$531,000	$531,000
	Town of White Stone	$0	$0
	Unincorporated Areas	$127,000,000	$172,000,000
	Total Lancaster County	**$131,000,000**	**$176,000,000**
Northumberland	**Northumberland County**	**$98,800,000**	**$113,000,000**
Richmond	Town of Warsaw	$0	$0
	Unincorporated Areas	$16,000,000	$21,000,000
	Total Richmond County	**$16,000,000**	**$21,000,000**
Westmoreland	Town of Colonial Beach	$42,100,000	$50,400,000
	Town of Montross	$155,000	$155,000
	Unincorporated Areas	$59,000,000	$64,600,000
	Total Westmoreland County	**$101,000,000**	**$115,000,000**
Total	**Northern Neck PDC**	**$348,000,000**	**$425,000,000**

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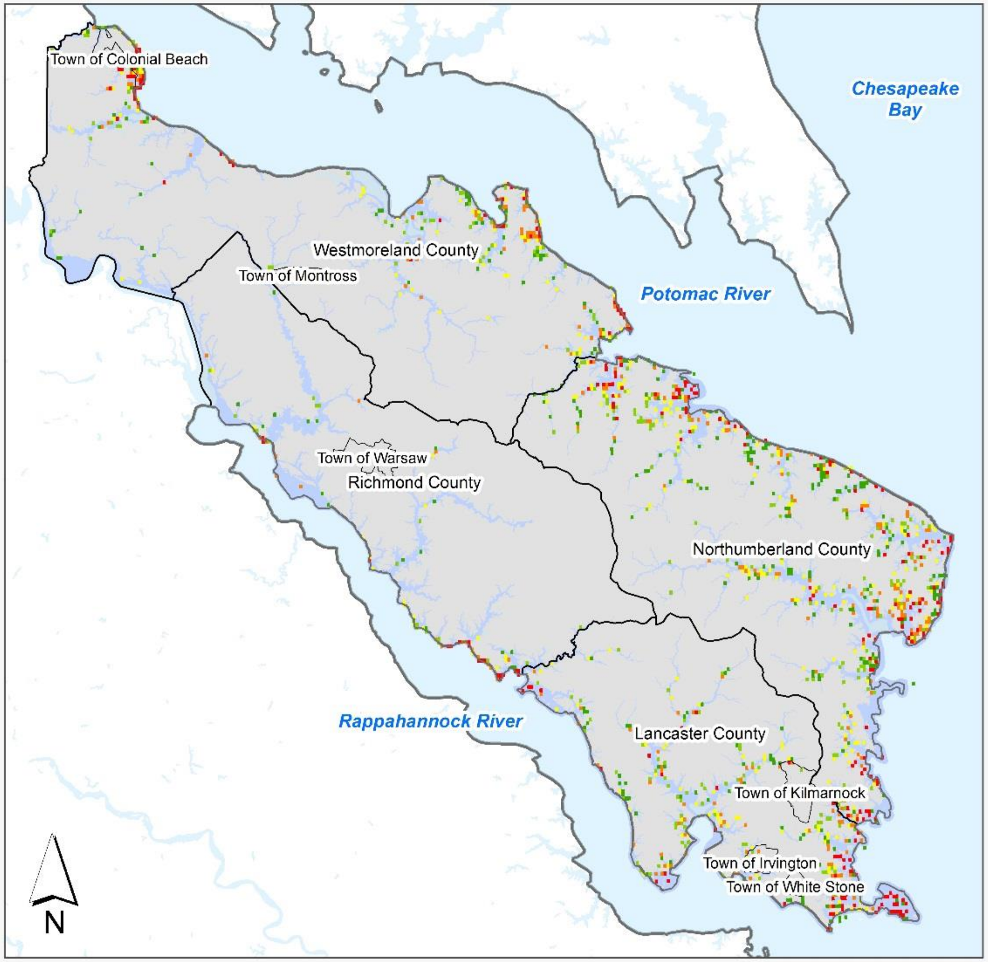
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

TOTAL EXPOSURE IN THE 100 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles: 0 2 4 8 12 16

The Total Exposure in the Floodplain (TEIF) analysis was run for the 100 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 100 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 100 year floodplain.

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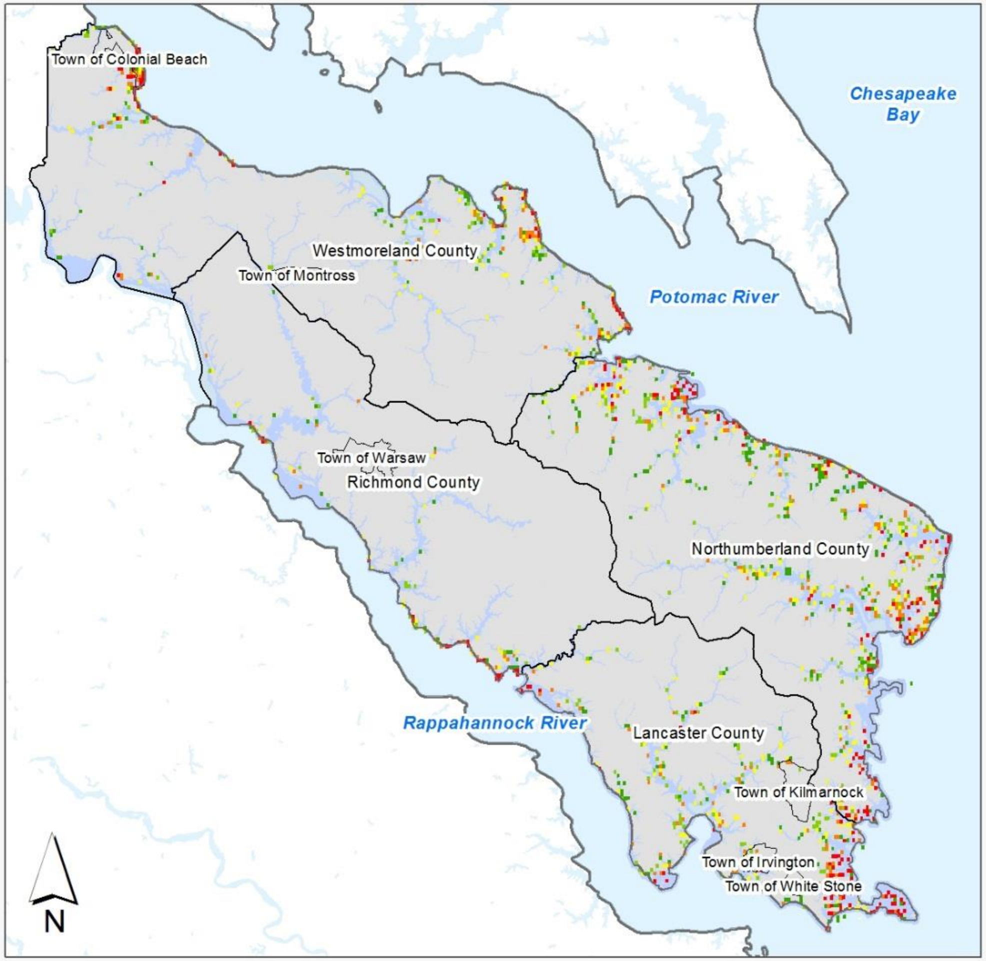
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

TOTAL EXPOSURE IN THE 500 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

The Total Exposure in the Floodplain (TEIF) analysis was run for the 500 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 500 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 500 year floodplain.

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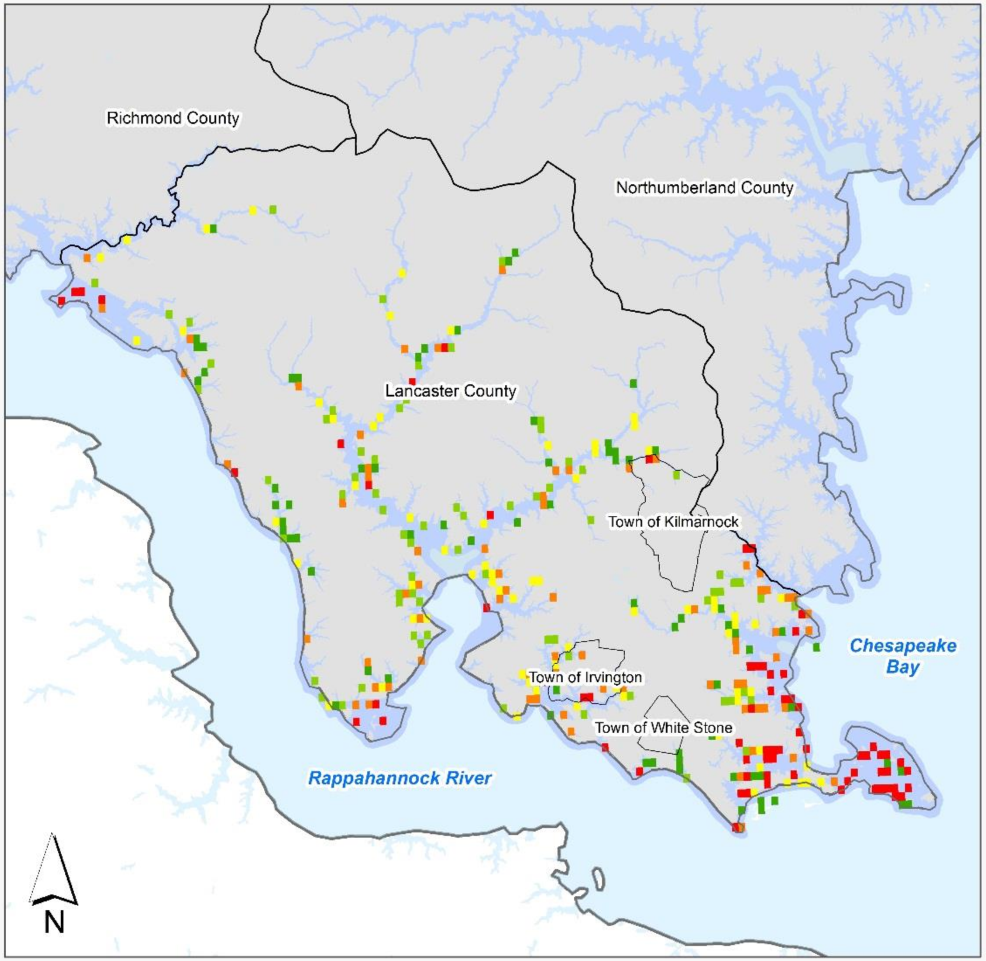
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

LANCASTER TOTAL EXPOSURE IN THE 100 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

The Total Exposure in the Floodplain (TEIF) analysis was run for the 100 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 100 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 100 year floodplain.

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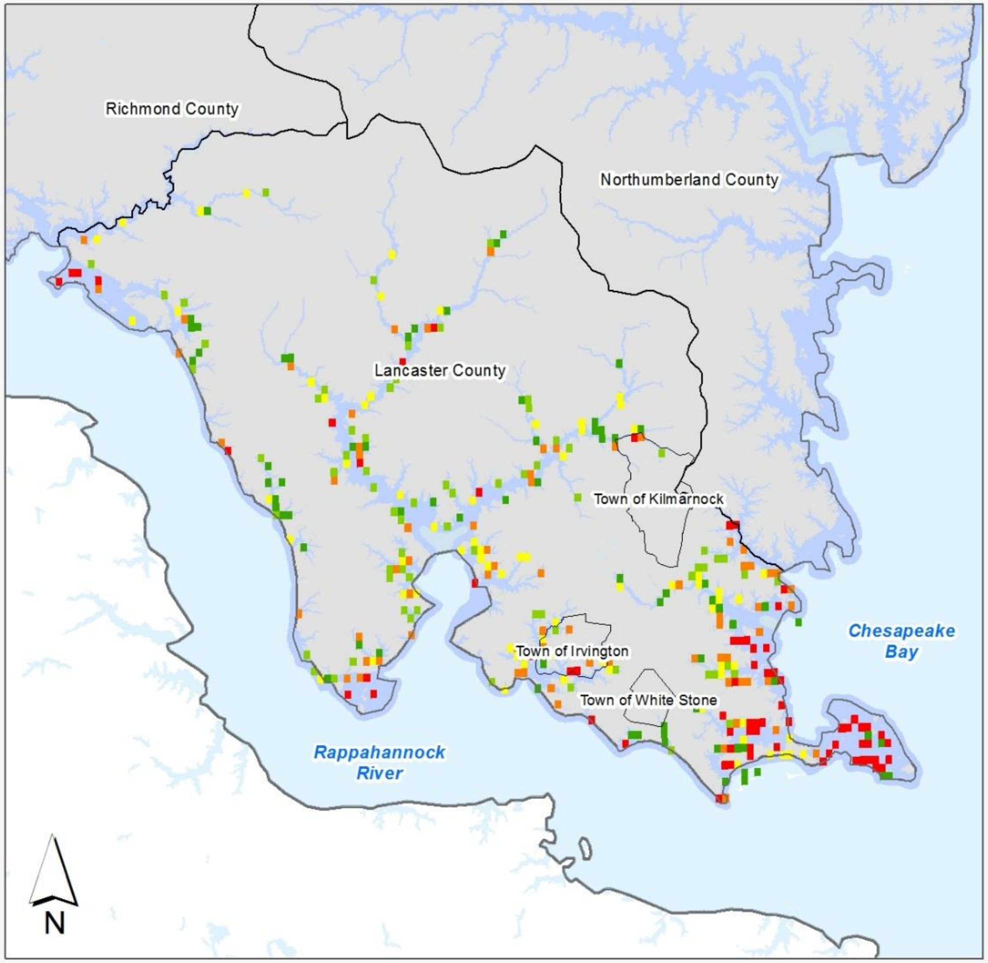
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

LANCASTER TOTAL EXPOSURE IN THE 500 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles: 0, 1.25, 2.5, 5, 7.5, 10

The Total Exposure in the Floodplain (TEIF) analysis was run for the 500 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 500 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 500 year floodplain.

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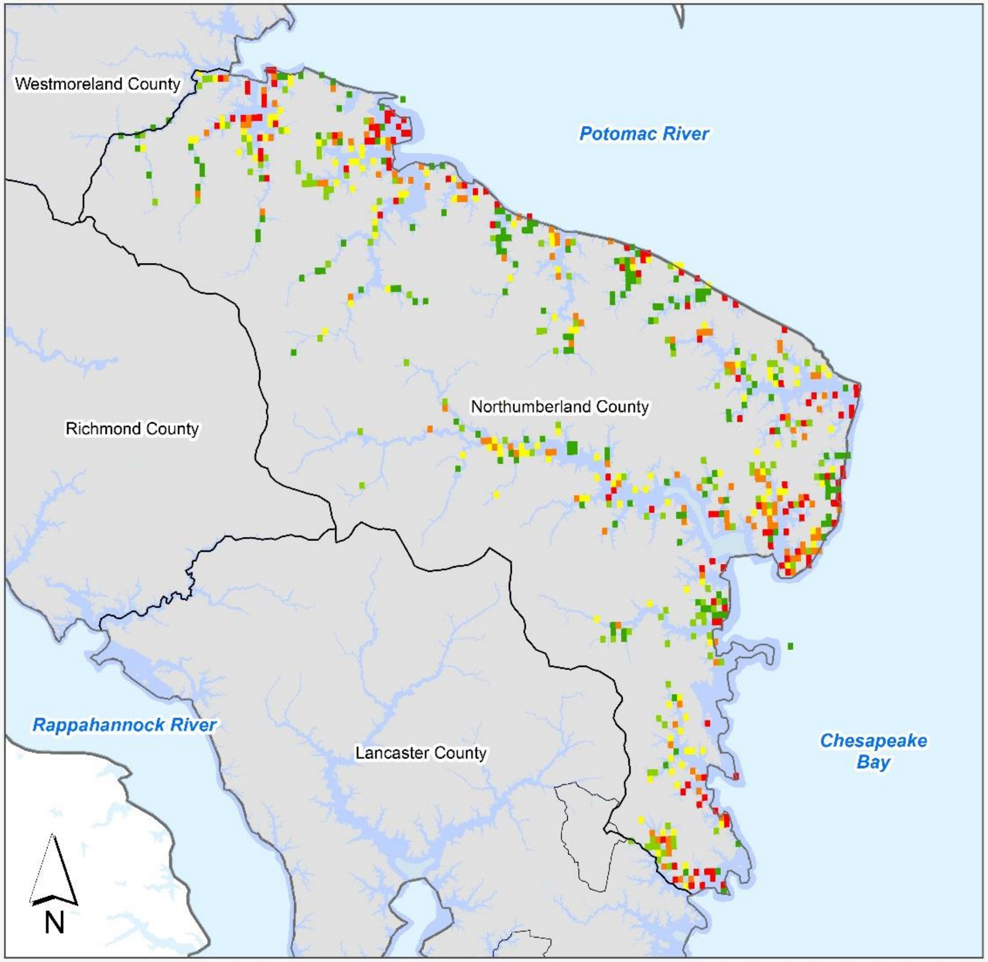
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

NORTHUMBERLAND TOTAL EXPOSURE IN THE 100 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles 0 1 2 4 6 8

The Total Exposure in the Floodplain (TEIF) analysis was run for the 100 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 100 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 100 year floodplain.

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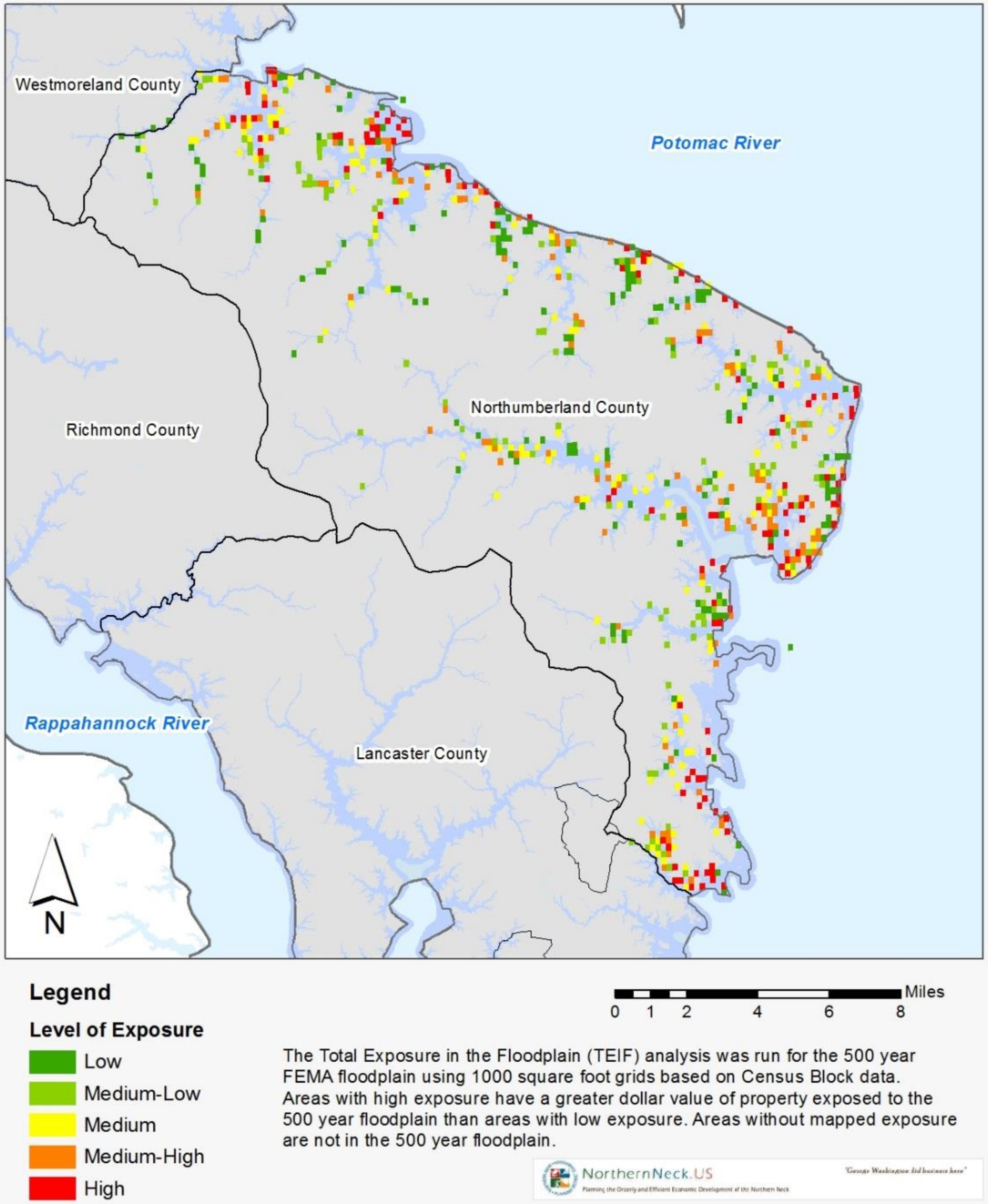
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

NORTHUMBERLAND TOTAL EXPOSURE IN THE 500 YEAR FLOOD ZONE



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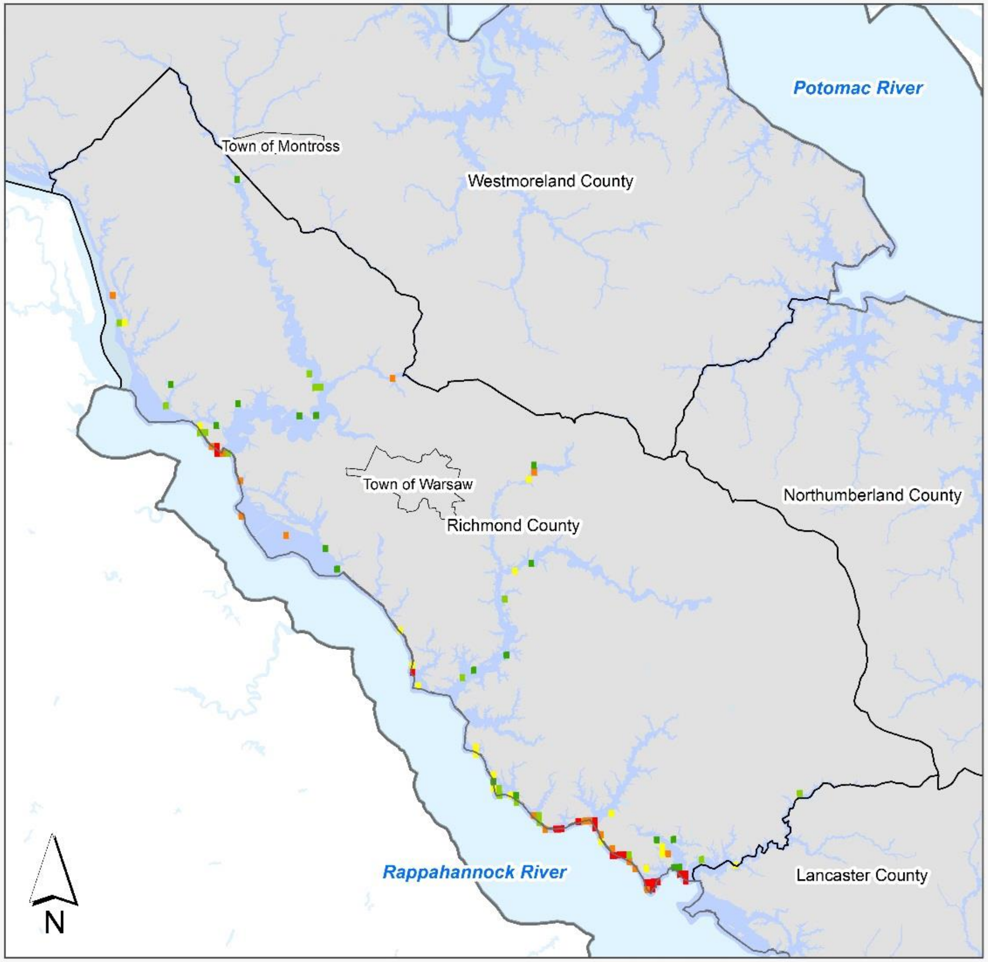
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

RICHMOND TOTAL EXPOSURE IN THE 100 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

The Total Exposure in the Floodplain (TEIF) analysis was run for the 100 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 100 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 100 year floodplain.

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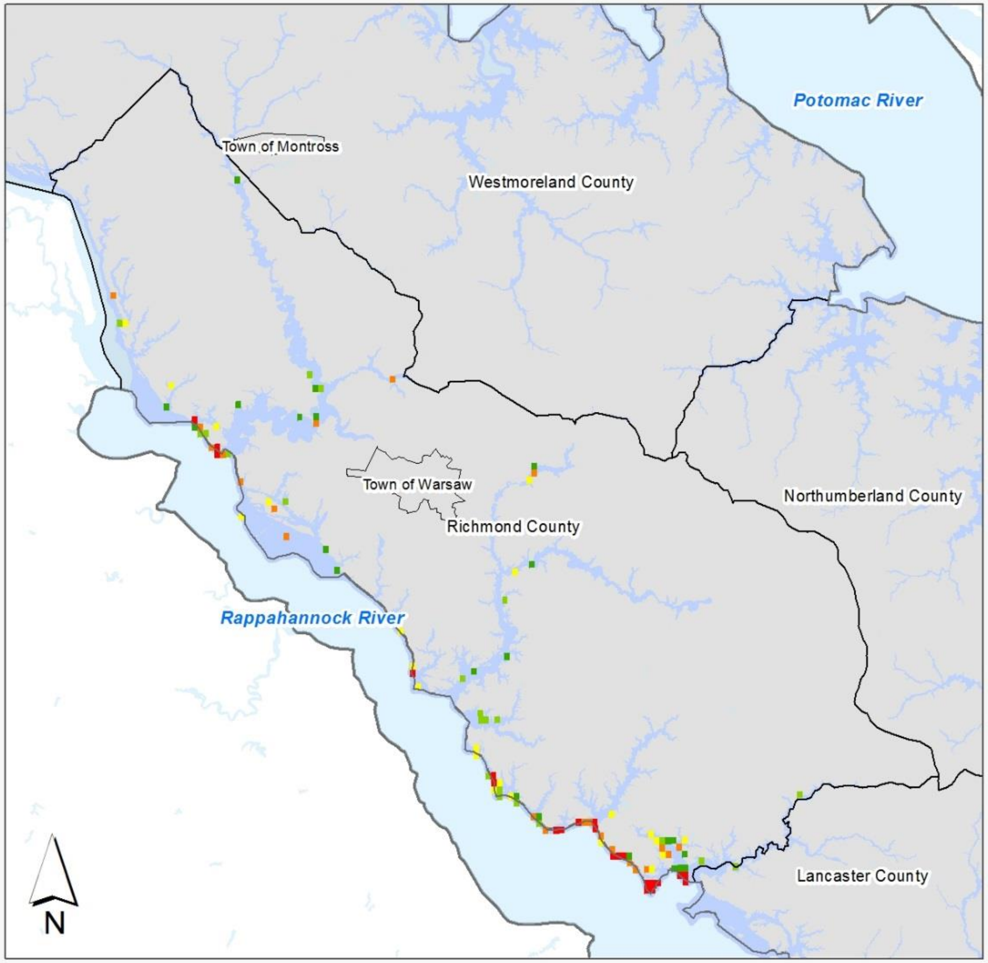
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

RICHMOND TOTAL EXPOSURE IN THE 500 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles 0 1 2 4 6 8

The Total Exposure in the Floodplain (TEIF) analysis was run for the 500 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 500 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 500 year floodplain.

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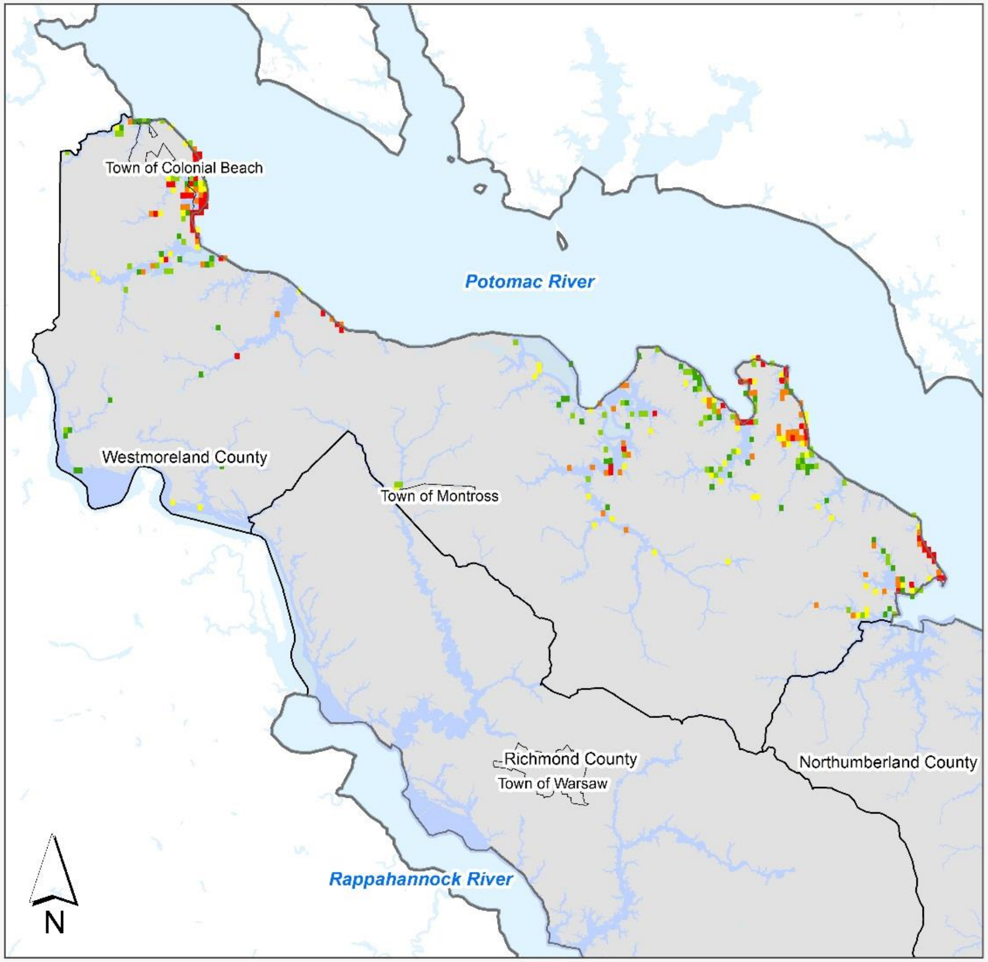
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

WESTMORELAND TOTAL EXPOSURE IN THE 100 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

Miles: 0 2 4 8 12 16

The Total Exposure in the Floodplain (TEIF) analysis was run for the 100 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 100 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 100 year floodplain.

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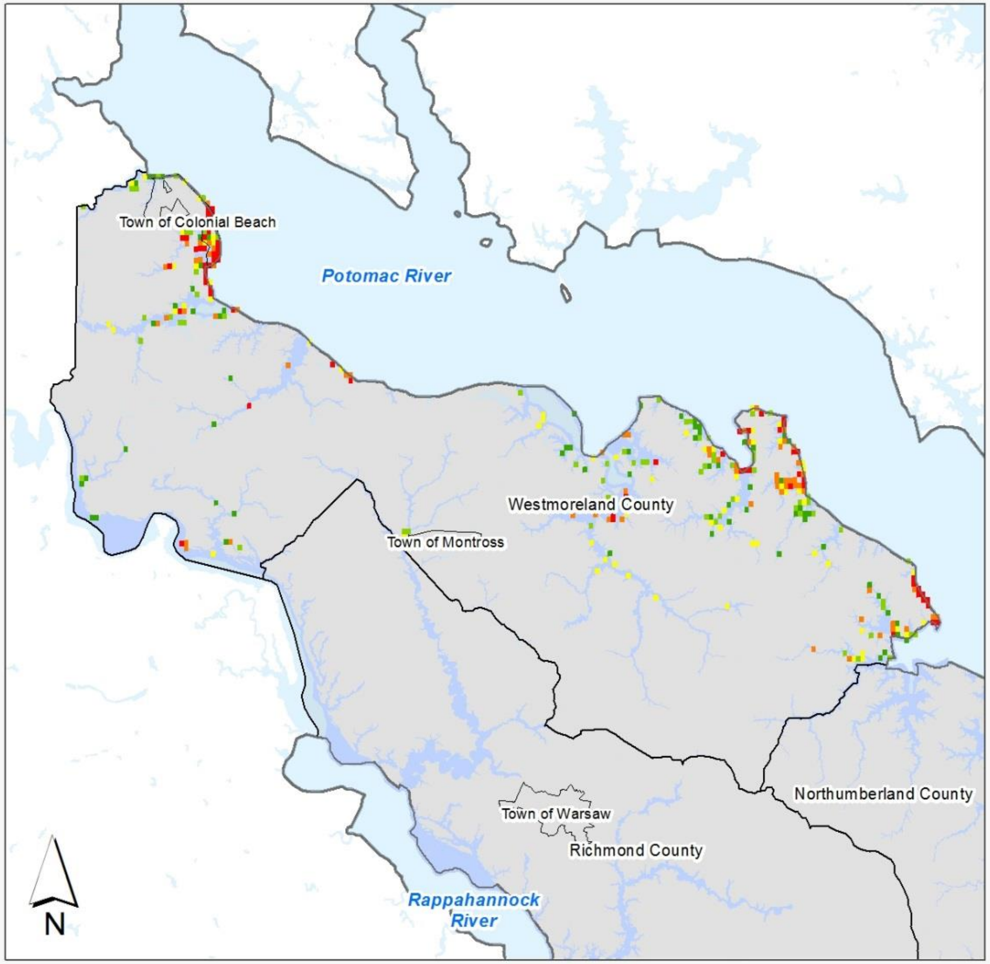
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

WESTMORELAND TOTAL EXPOSURE IN THE 500 YEAR FLOOD ZONE



Legend

Level of Exposure

- Low
- Medium-Low
- Medium
- Medium-High
- High

The Total Exposure in the Floodplain (TEIF) analysis was run for the 500 year FEMA floodplain using 1000 square foot grids based on Census Block data. Areas with high exposure have a greater dollar value of property exposed to the 500 year floodplain than areas with low exposure. Areas without mapped exposure are not in the 500 year floodplain.

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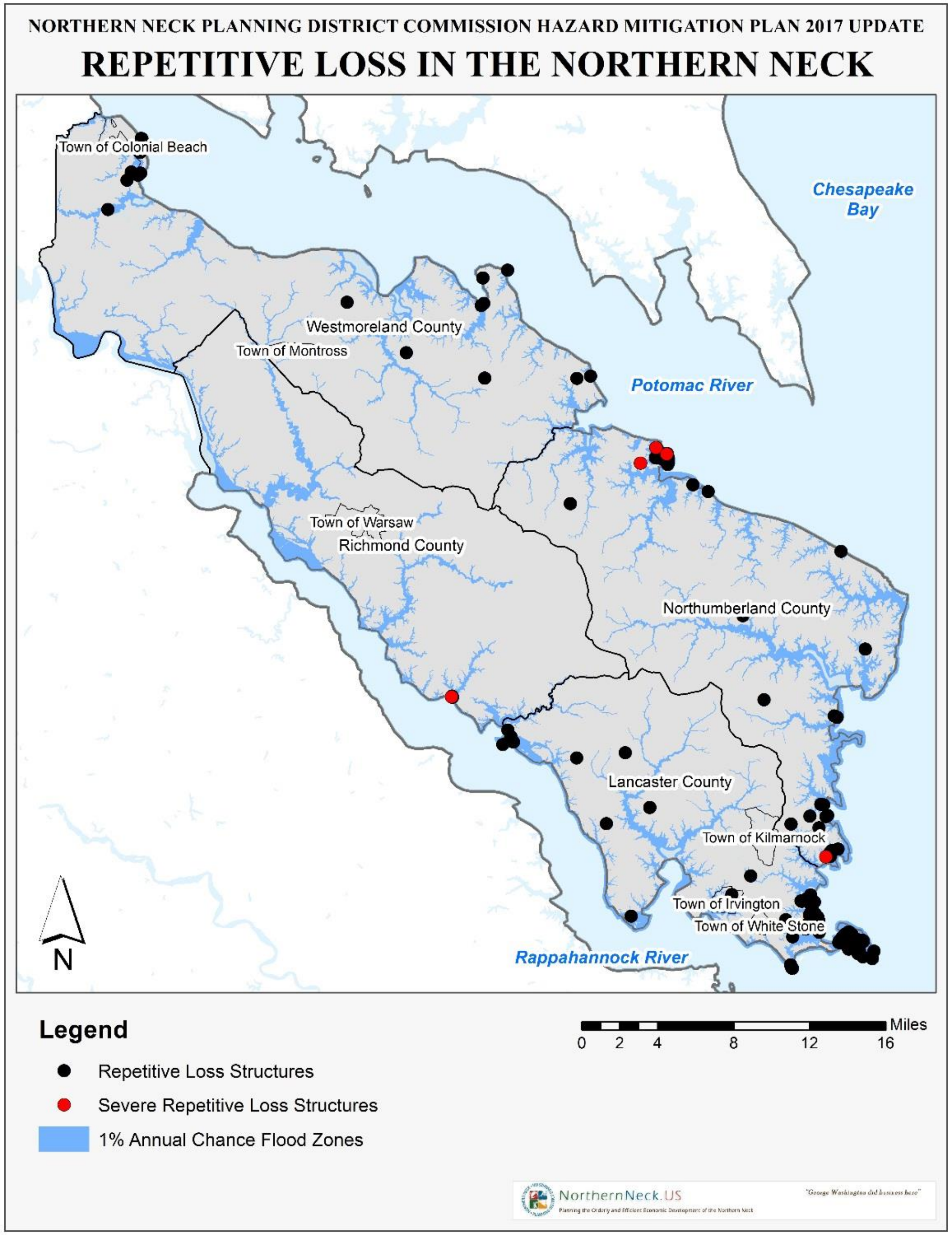
Repetitive Loss

- Repetitive Loss (RL) property: any insurable building w/ 2 or more claims >/= $1,000 paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. May or may not be currently insured by the NFIP.
- A Severe Repetitive Loss (SRL) property: any property with 4 or more separate claim payments >$5,000 each; or 2 or more separate claim payments where the total payments > the current building value of the property.
- Nationwide, RL properties constitute 2% of all NFIP insured properties, but are responsible for 40% of all NFIP claims



NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE
REPETITIVE LOSS IN THE NORTHERN NECK
Town of Colonial Beach
Chesapeake Bay
Westmoreland County
Town of Montross
Potomac River
Town of Warsaw
Richmond County
Northumberland County
Lancaster County
Town of Kilmarnock
Town of Irvington
Town of White Stone
Rappahannock River
N
Legend
Repetitive Loss Structures
Severe Repetitive Loss Structures
1% Annual Chance Flood Zones
Miles
0 2 4 8 12 16
NorthernNeck.US

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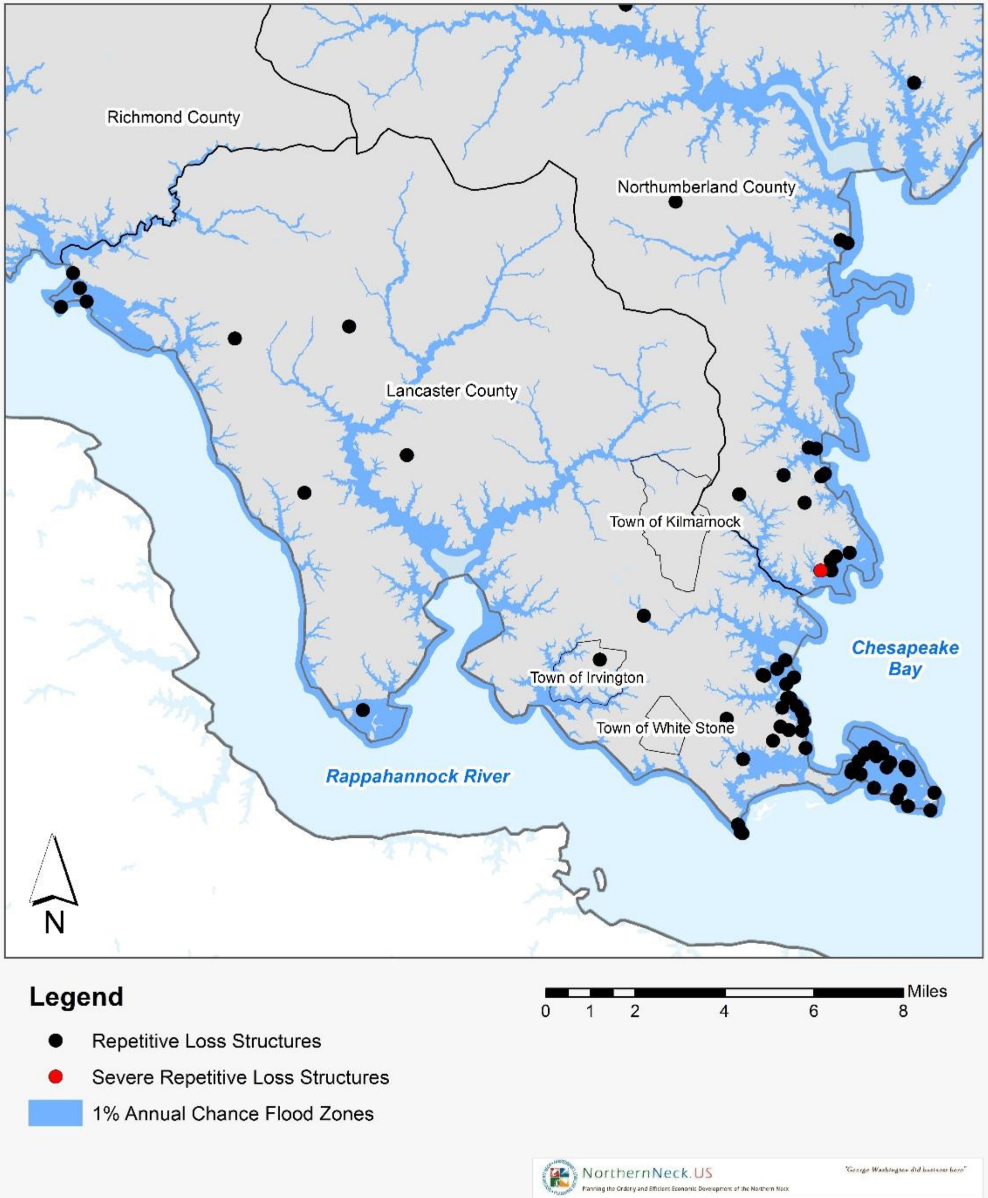
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

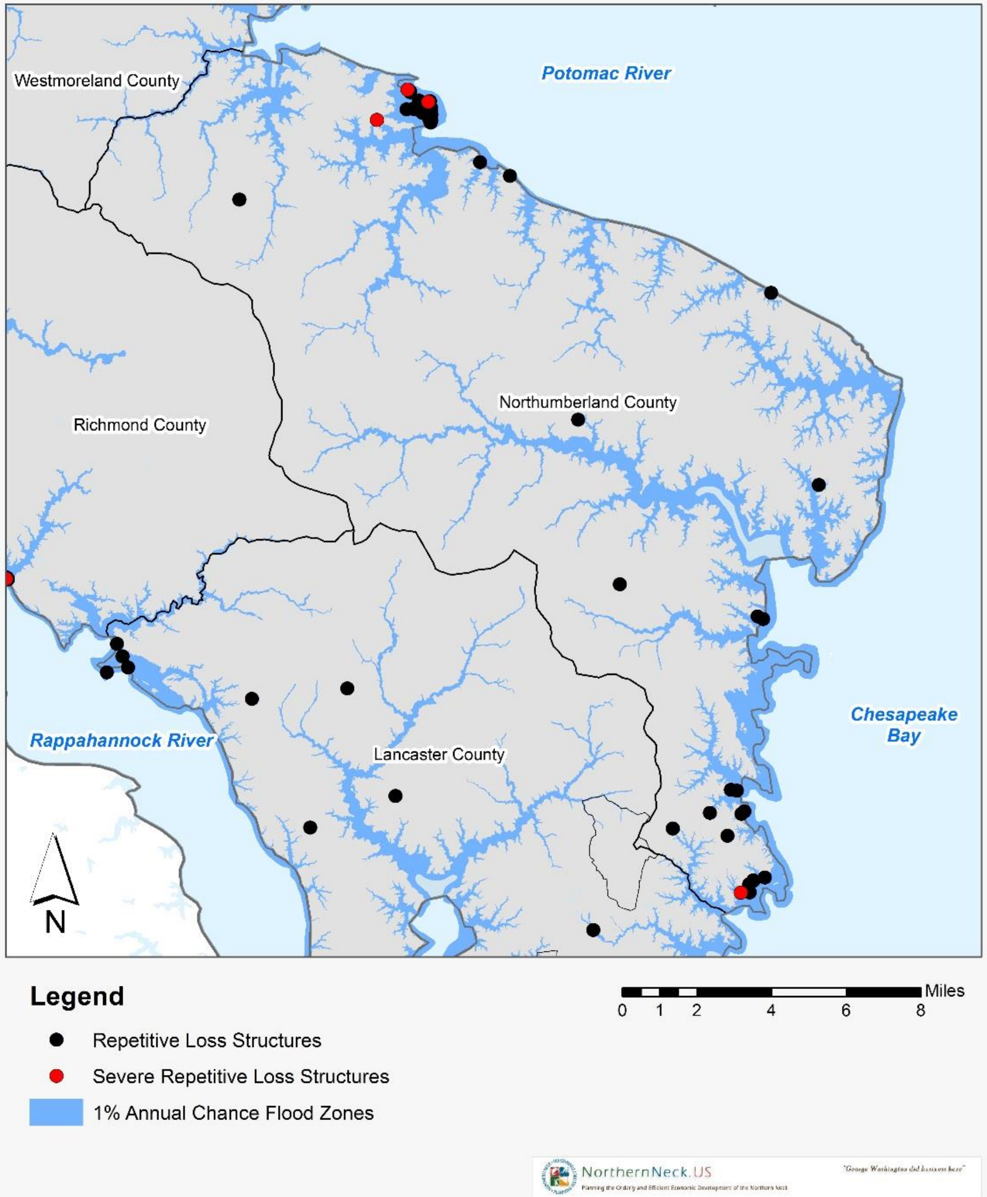
REPETITIVE LOSS IN LANCASTER COUNTY



Dewberry

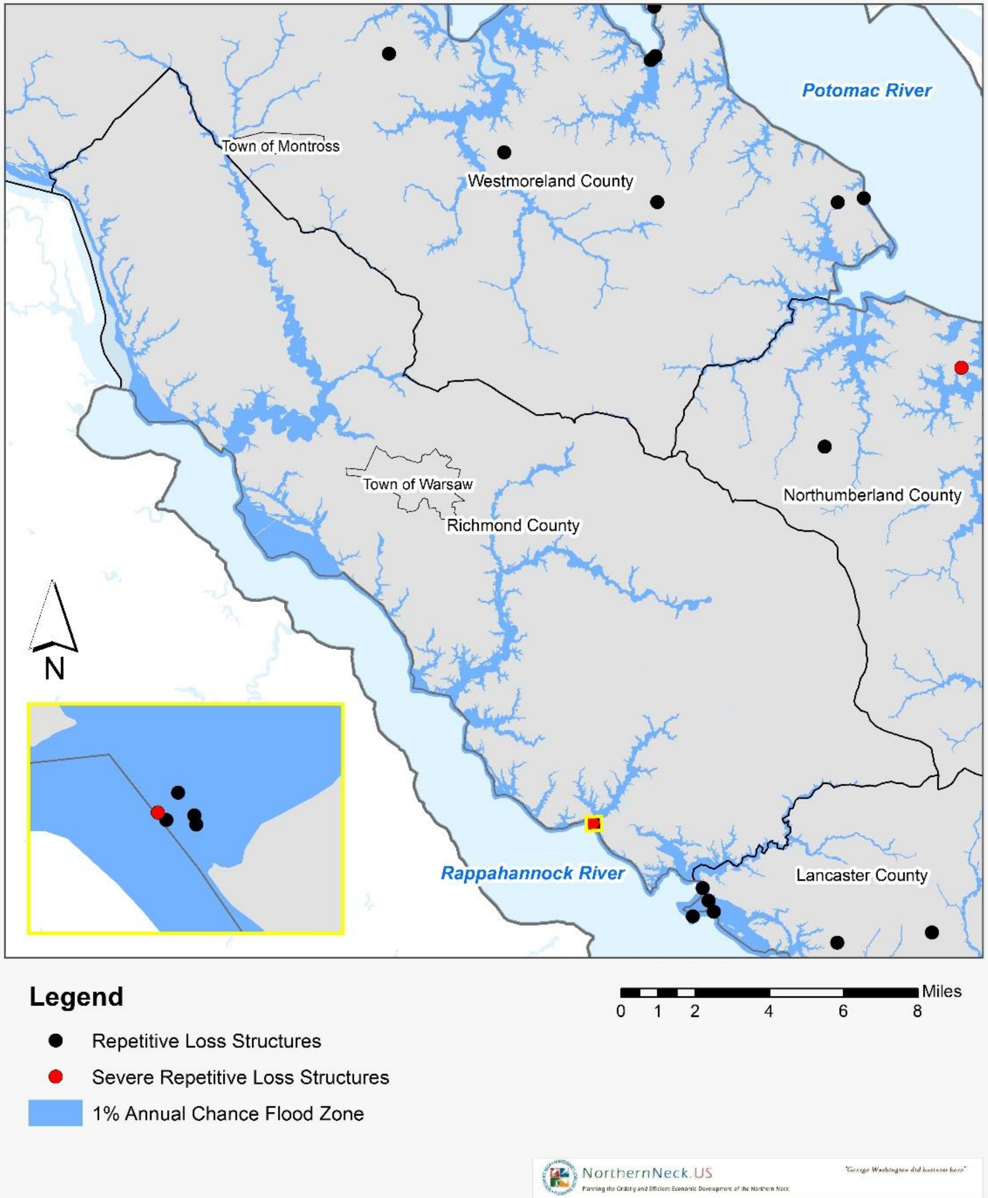
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS IN NORTHUMBERLAND COUNTY



NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

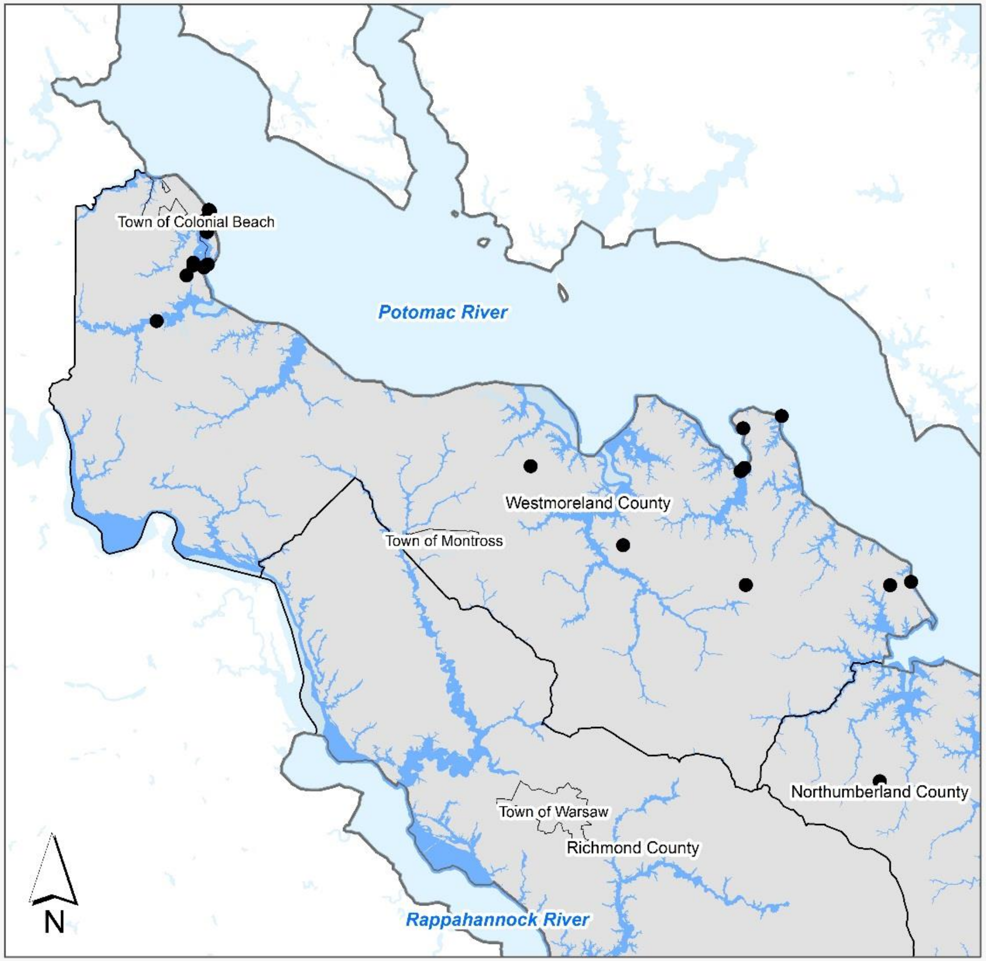
REPETITIVE LOSS IN RICHMOND COUNTY



Dewberry

NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

REPETITIVE LOSS IN WESTMORELAND COUNTY



Legend

- Repetitive Loss Structures
- Severe Repetitive Loss Structures
- 1% Annual Chance Flood Zones

Miles: 0 1 2 4 6 8

NorthernNeck.US

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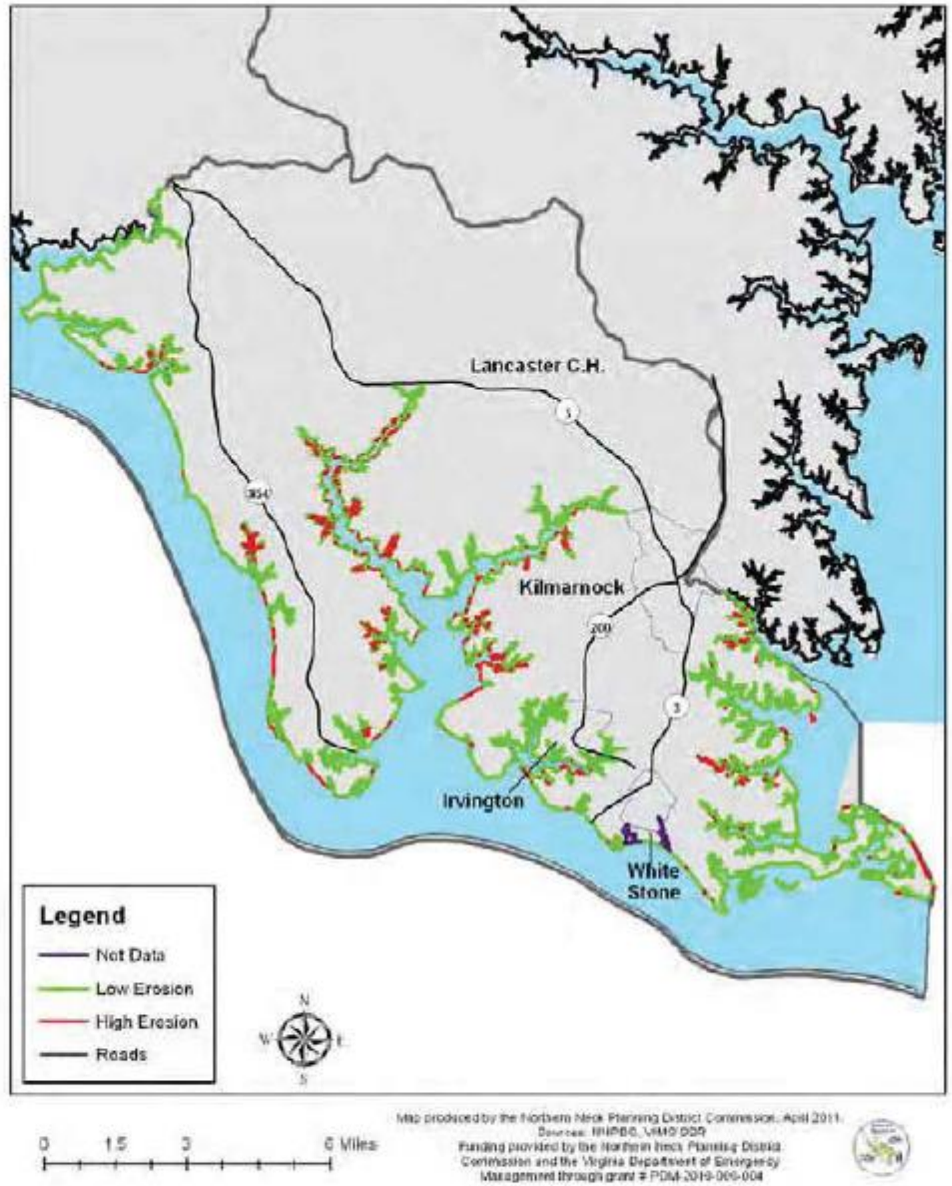
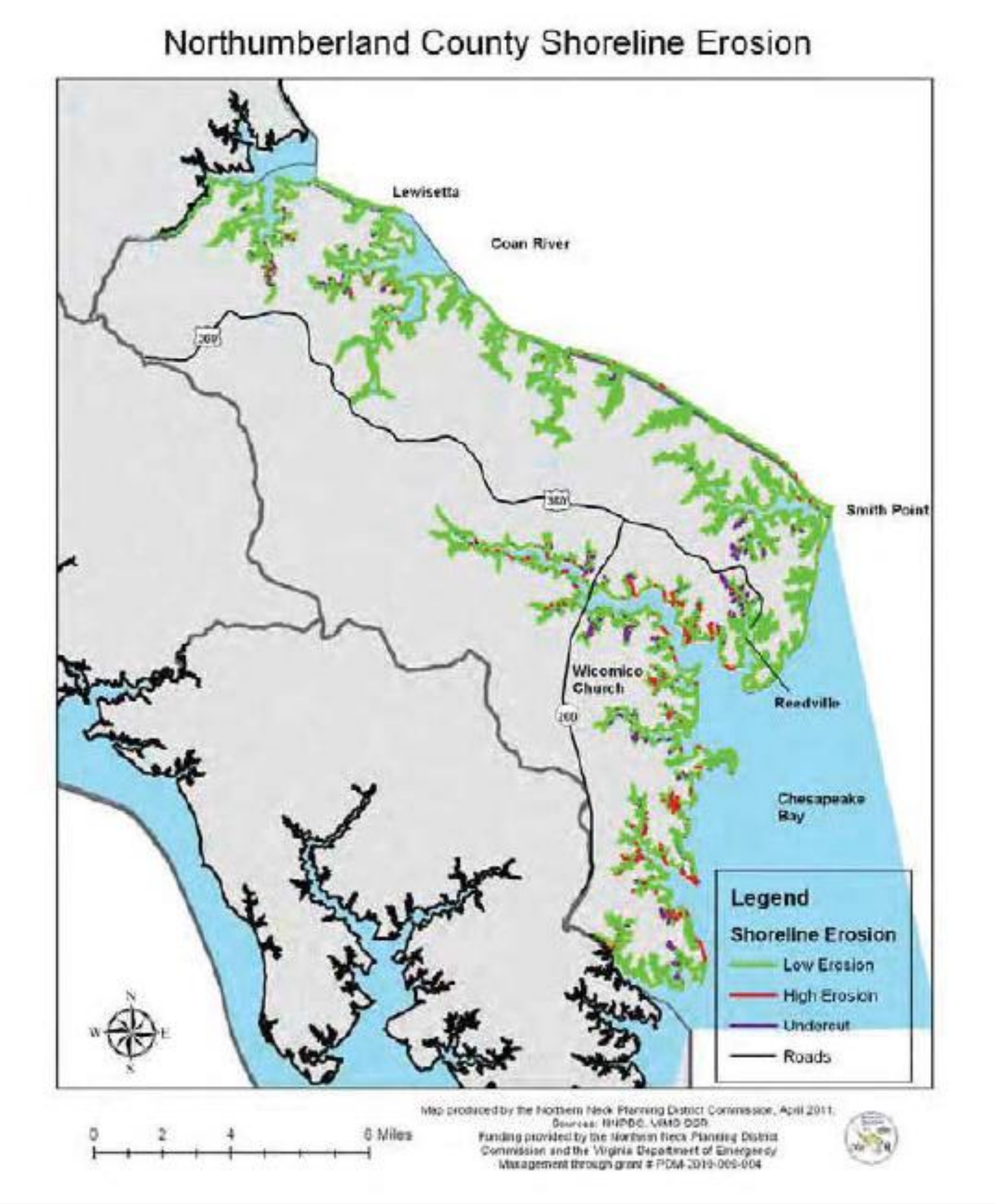
Coastal Erosion Risk

Lancaster County Shoreline Erosion



* From 2011 Plan



* From 2011 Plan

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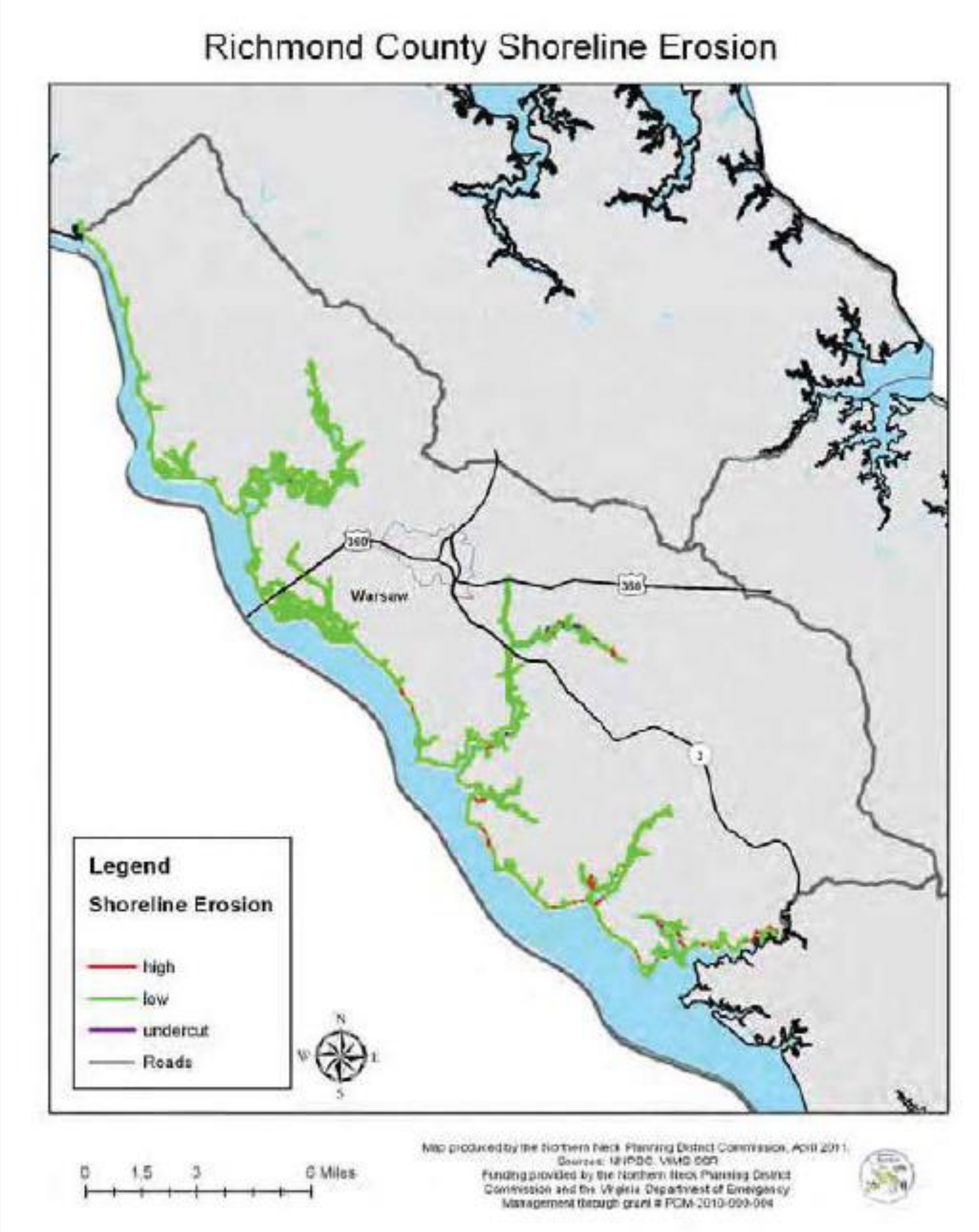

* From 2011 Plan

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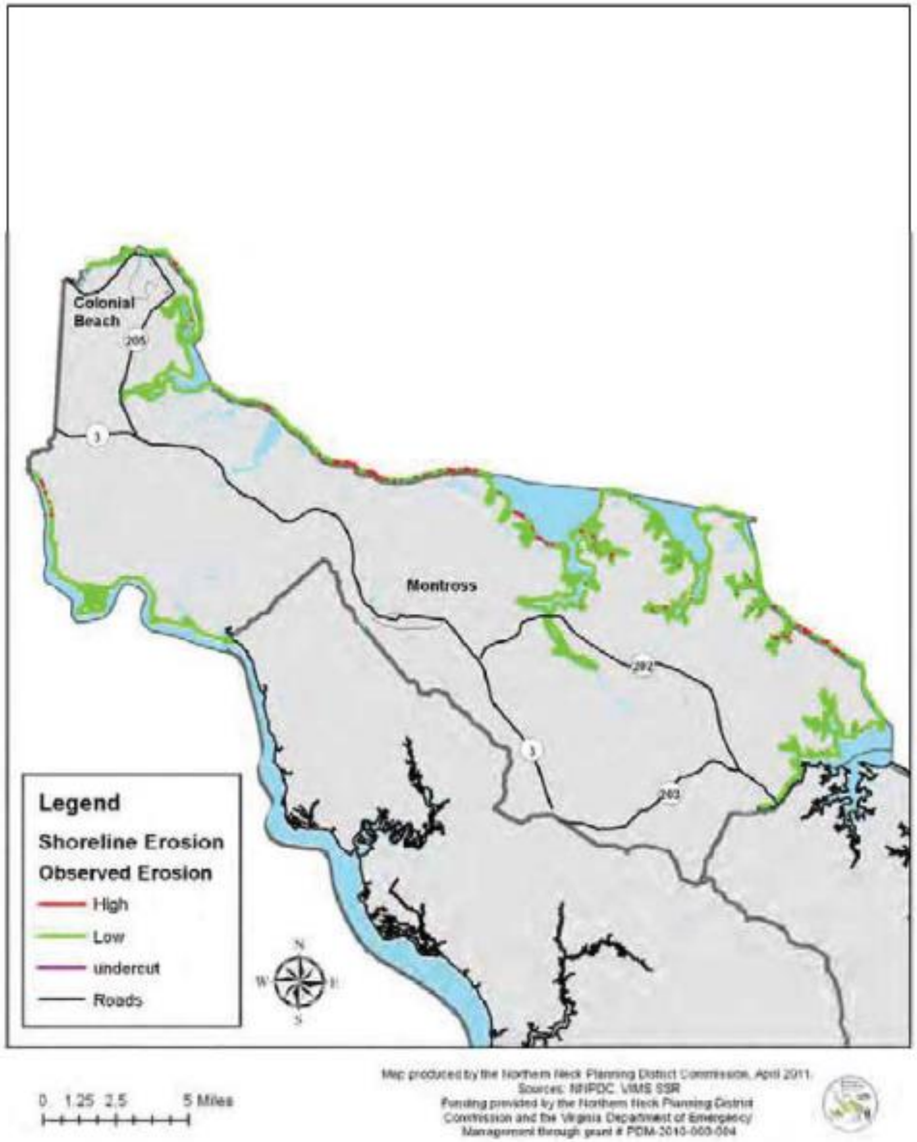
Westmoreland County Shoreline Erosion



* From 2011 Plan

Shoreline Studies Program, Virginia Institute of Marine Science, September 2012

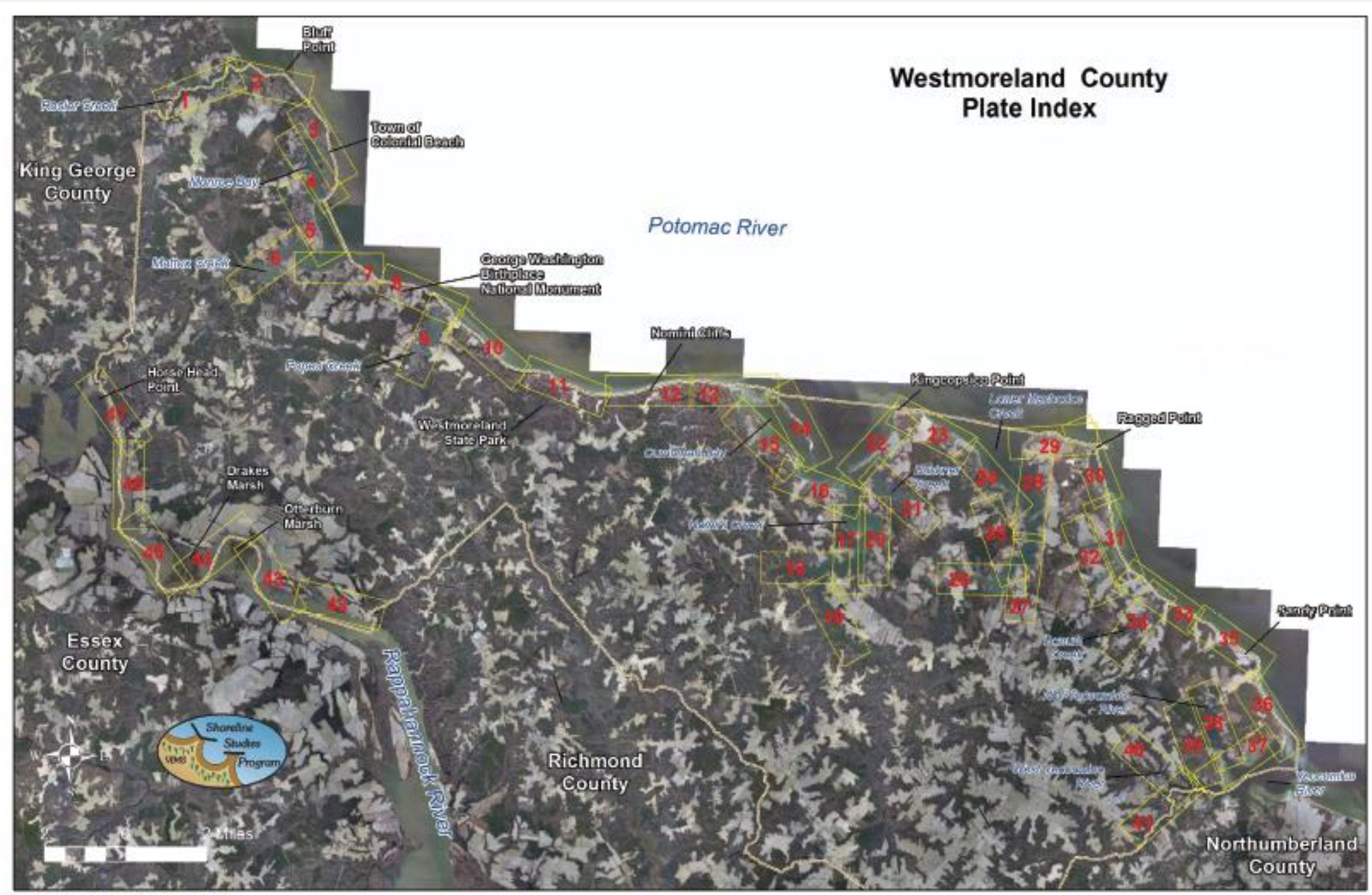


Figure 2. Index of shoreline plates.

Segments of the shoreline where shoreline erosion was calculated

Dewberry®

Shoreline Studies Program, Virginia Institute of Marine Science, September 2012

Table 1. Average end point rate of change (ft/yr) between 1937 an d2009 for segments along Westmoreland County's shoreline. Segment locations are show on maps in Appendix A.

Segment Name	Location	Average Rate of Change (ft/yr)
A	Rosier Creek	-0.7
B	Potomac River, Mouth of Rosier Creek to Bluff Point	-0.1
C	Potomac River, Town of Colonial Beach	0.1
D	Monroe Bay	-0.2
E	Potomac River, Sebastian Point to Paynes Point	-0.7
F	Mouth of Mattox Creek, Wirt Wharf	-0.1
G	Potomac River, Church Point to Westmoreland State Park	-1.1
H	Potomac River, Westmoreland State Park to Haulover Inlet	-0.8
I	Nomini Bay, Hollis Marsh	-4.0
J	Currioman Bay, Haulover Inlet to Nomini Creek	-0.6
K	Nomini Creek including Buckner Creek	-0.3
L	Nomini Bay, White Point to Kingcopsico Point	-0.3
M	Lower Machodoc Creek	-0.8
N	Potomac River, Grapevine Point to Ragged Point	-1.1
O	Potomac River, Ragged Point to Jackson Creek	-0.9
P	Potomac River, Jackson Creek to Sandy Point	-2.2
Q	Potomac River, Sandy Point to Lynch Point	-1.4
R	Yeocomico River	-0.5
S	Rappahannock River, Richmond County Line to Layton Landing Rd.	-0.4
T	Rappahannock River, Layton Landing Rd. to Blind Point	-1.2
U	Rappahannock River, Blind Point to King George County Line	-0.4

- Segments of the shoreline and their calculated shoreline erosion rate of change
- Annual losses predicted losses from -0.1 to -4.0 ft./yr.

Tornado Hazard Risk

Tornado History 1965-2016

Fujita Scale	Date	Counties Affected	Deaths	Injuries	2017 Property Damages	2017 Crop Damages	2017 Total Damages
EF1	**2/24/2016**	**Lancaster, Westmoreland**	**0**	**0**	**$1,299,168**	**$79,045**	**$1,378,212**
EF2	**2/24/2016**	**Richmond**	**0**	**0**	**$3,344,191**	**$0**	**$3,344,191**
EF0	6/18/2015	Lancaster, Richmond	0	0	$46,178	$0	$46,178
EF0	2/21/2014	Westmoreland	0	0	$15,411	$0	$15,411
F1	1/14/2005	Northumberland, Richmond	0	0	$37,361	$0	$37,361
F1	5/25/2004	Lancaster	0	0	$25,751	$0	$25,751
F0	8/26/2003	Richmond	0	0	$6,609	$0	$6,609
F0	4/4/1999	Westmoreland	0	0	$36,498	$0	$36,498
F1	9/10/1997	Northumberland	0	0	$227,309	$0	$227,309
F0	7/13/1996	Westmoreland	0	0	$15,502	$0	$15,502
F1	7/12/1996	Northumberland	0	0	$387,541	$0	$387,541
F0	6/24/1996	Westmoreland	0	0	$263,528	$0	$263,528
F0	1/19/1996	Richmond	0	0	$23,252	$0	$23,252
F0	8/6/1993	Lancaster	0	0	$841,595	$0	$841,595
F1	**5/10/1990**	**Lancaster**	**0**	**0**	**$4,652,276**	**$0**	**$4,652,276**
F1	5/2/1989	Northumberland	0	0	$0	$0	$0
F2	5/2/1989	Northumberland	0	0	$0	$0	$0
F2	8/31/1983	Richmond	0	0	$61,049	$0	$61,049
F1	9/6/1975	Lancaster	0	0	$11,302	$0	$11,302
F2	4/25/1975	Richmond	0	0	$113,021	$0	$113,021
F0	8/10/1969	Northumberland	0	0	$1,657	$0	$1,657
F3	11/2/1966	Richmond	0	0	$187,671	$0	$187,671

Local Tornado Risk

EF Scale Rating	Estimated Tornado Counts Northern Neck (1965-2016)
EF0	4
EF1	2
EF2	1
F0	7
F1	8
F2	2
F3	1

Source: NCEI Database for 2016.

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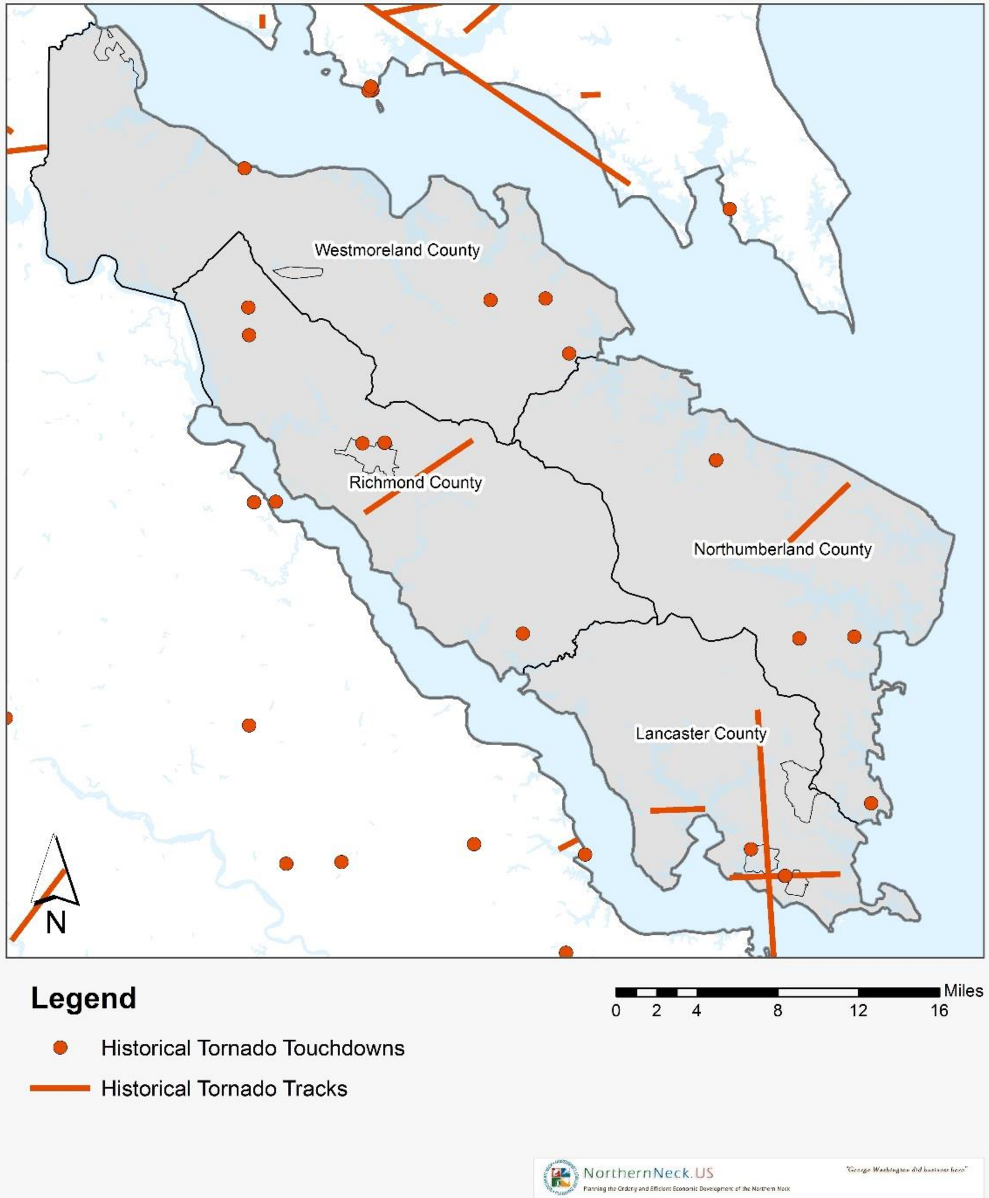
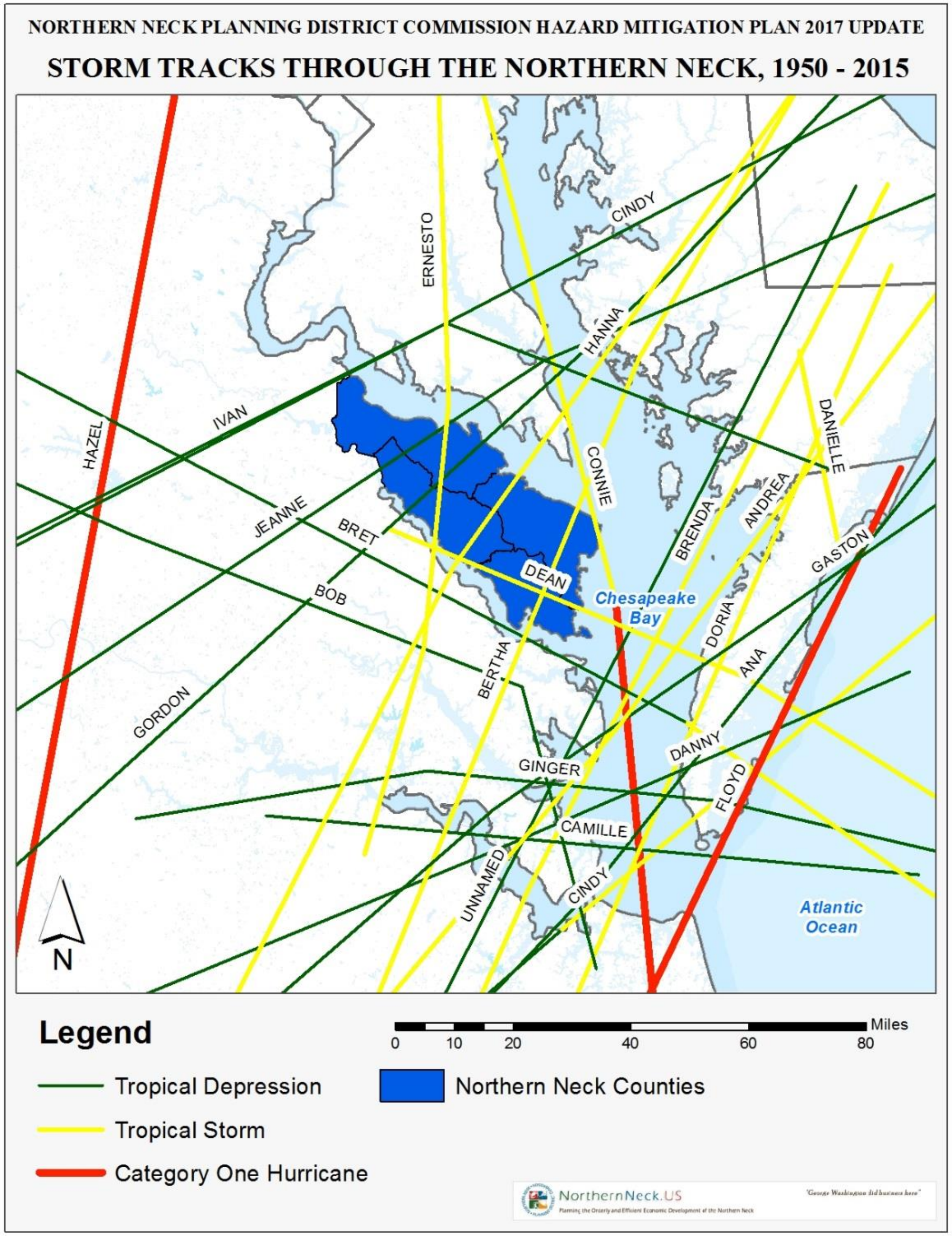
NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE

TORNADOES IN THE NORTHERN NECK, 1950 - 2013



Hurricanes and Tropical Storm Risk

Note: While the PDC experienced significant damage from Fran and Isabel, the tracts were west of the PDC.



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Winter Storm Risk

Winter Storm Hazard Risk

Winter storms are a persistent problem for Northern Neck.

Recent notable storms (excluding Nor'easters) include:

- January 2017 – Southern system resulted in snow from central to northern and northeastern VA – school closings, limited power outages.
- January 2016 – Low pressure from the south resulted in snow throughout central and northern Virginia and the Northern Neck resulting in limited power outages, school closings.
- March 2015 - Low pressure moving northeast produced freezing rain and freezing drizzle across portions of the Virginia Northern Neck. Ice accumulations ranged from a trace to 0.12 inch.
- Winter 2010 – Three significant winter storms severely affected northern Virginia and the Northern Neck resulting in road closures, extended power outages and periods of schools closings.
- December 2009 – A blizzard originating in the mid-west left the Northern Neck with 18-24 inches of snow, causing road closures, school closings and power outages.

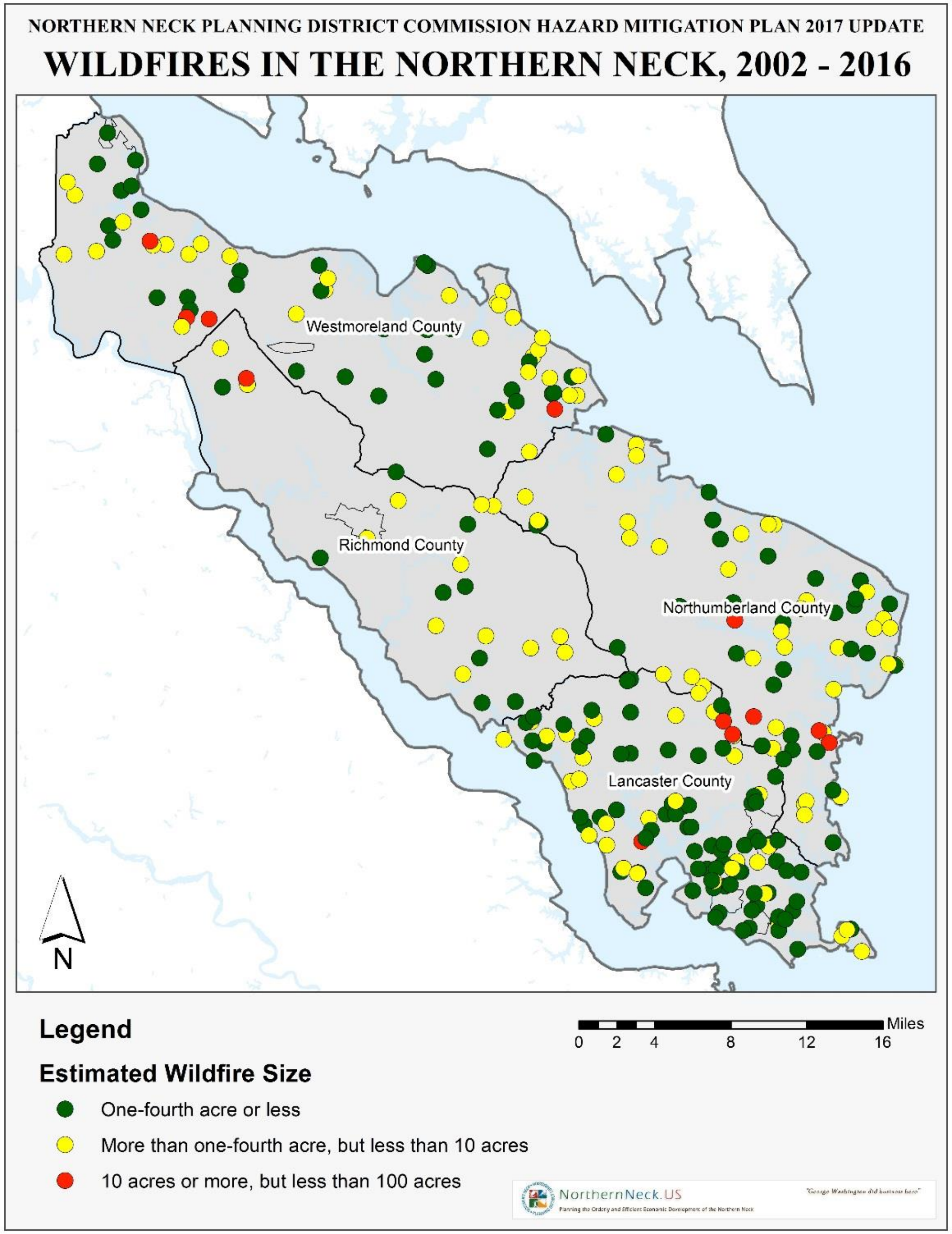
Wildfire Risk

Wildfires 2002-2016

County	Size Class	Fire Description	Numbers of Fires
Lancaster	**A**	**One-fourth acre or less**	**79**
	B	**More than one-fourth acre, but less than 10 acres**	**33**
	C	**10 acres or more, but less than 100 acres**	**3**
Richmond	A	**One-fourth acre or less**	**34**
	B	**More than one-fourth acre, but less than 10 acres**	**34**
	C	**10 acres or more, but less than 100 acres**	**5**
Northumberland	A	**One-fourth acre or less**	8
	B	**More than one-fourth acre, but less than 10 acres**	**11**
	C	**10 acres or more, but less than 100 acres**	1
Westmoreland	A	**One-fourth acre or less**	**36**
	B	**More than one-fourth acre, but less than 10 acres**	**30**
	C	**10 acres or more, but less than 100 acres**	**5**

Wildfire Risk

- Northern Neck has on average 19 wildfire events per year
- However, as shown in the map on the right, most wildfires are small and are quickly extinguished



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Drought Risk

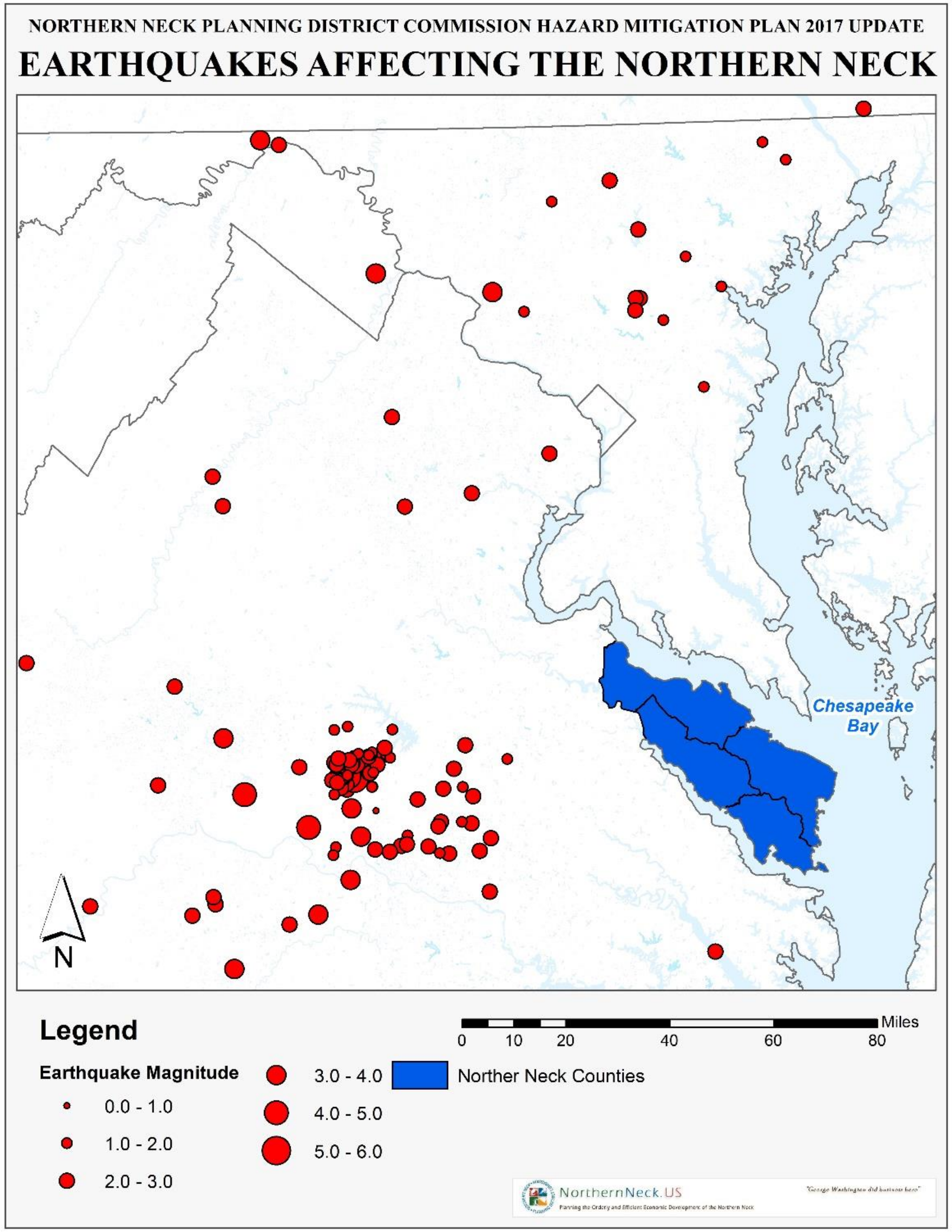
Drought Categories

Category	Description	Possible Impacts
D0	Abnormally dry	Going into a drought: short-term dryness slows planting, growth of crops or pastures; fire risk above average. Coming out of a drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low; some water shortages develop or are imminent; voluntary water use restrictions requested.
D2	Severe drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.
D3	Extreme drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.

US Census of Agriculture General Information by County

(areas at risk of Drought Impacts)

County	Farms	Total Acres	Average Acres/Farm	Market Value of Products	Average Farm Value
Lancaster County	61	10,695	175	$4,864,000	$79,741
Northumberland County	566	79,107	140	$16,485,000	$29,125
Richmond County	90	32,373	360	$15,467,000	$171,858
Westmoreland County	152	59,378	391	$35,758,000	$235,248


NORTHERN NECK PLANNING DISTRICT COMMISSION HAZARD MITIGATION PLAN 2017 UPDATE
EARTHQUAKES AFFECTING THE NORTHERN NECK
Chesapeake Bay
N
Legend
Earthquake Magnitude
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
Norther Neck Counties
0 10 20 40 60 80
Miles
NorthernNeck.US

Northern Neck Hazard Rankings

Hazard Rankings

Hazard Type	2011 HMP Planning Consideration Level		2017 LEPC Kick-Off Meeting	2017 Draft HIRA Update
Hurricane	Significant		Significant	Significant
Flooding (river, stream, inc. coastal flooding)	Moderate		Moderate	Significant
Winter Storm	Moderate		Moderate	Limited
Coastal Erosion	Moderate		Moderate	Moderate
Drought	Limited		Moderate	Limited
Coastal Storm (Nor'easter)	Limited		Significant	Significant
Tornado	Limited		Significant	Significant
Wildfire	Limited		Limited	Limited
Earthquake	None		Limited	Limited
Severe Weather (Lightening, Wind, Hail)	None		None	Moderate

Mitigation Actions and Goals

- Committee chose to eliminate objectives underneath 2011 plan goals.
- 2011 plan goals were modified to reflect resiliency and “whole community” concepts.
- The goals which follow reflect edited, new 2017 hazard mitigation plan goals.
- Let’s talk through each goal’s actions and how mitigation success stories, gaps, new approaches.

2011 Northern Neck PDC 2011 HMP Goals

- Goal 1: Promote new development that avoids undue risks posed by natural hazards and is resilient to natural disasters.

- Goal 2: Address natural hazards and vulnerabilities that represent a threat to the community.

2011 Northern Neck PDC Revised HMP Goals

- Goal 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents, property and critical infrastructure of the Northern Neck.

- Goal 4: Enhance the capabilities of local government to address natural hazards to enhance the whole community for increased resilience.

2011 Northern Neck PDC Revised HMP Goals

- Goal 5: Increase natural hazard awareness of our citizens. Educate Northern Neck citizens and part-time residents on citizen and community hazard resiliency.

- Goal 6: Participate and Comply with the National Flood Insurance Program (NFIP) through Floodplain Identification, Mapping and Floodplain Management.

2011 Mitigation Actions Status Review

Number in 2011 Plan	Strategy	Responsible Department	Priority	2016 Update	Notes - If cancelled, discontinued or no action, please state why?
Regional-1 (Richmond Regional PDC)	Leverage regional partnerships (e.g., law enforcement) to better use their data to inform mitigation planning and project development.	Local Emergency Managers	High	Continue	This strategy is an ongoing practice that PDCs continue to perform. Most PDC work involves relationships and partnerships with varied entities.

- Assignment: Look these over; amend, correct and complete.
- Add an explanation in the Notes column of why any “high” priority strategy was not completed or was “discontinued.”

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Mitigation Actions

- Preventative Measures
- Property Protection
- Emergency Services
- Structural Projects
- Natural Resources Protection
- Public Information Programs

2017 – 2022 Actions

- 2011 “Carry-forward” actions pre-populated
- Two actions pre-populated to cover HMA grant eligibility and plan integration
- Actions must include:
  - **Strategy/action statement**
  - **Responsible Department**
  - **Priority**
  - **Goals supported (Dewberry will align to Goals)**
  - **Hazard Addressed**
  - **Timeframe**
  - **Resources – funding source, staff, etc.**
  - **Check the project category box (or Dewberry will complete)**

2017 – 2022 Mitigation Actions

2017 - 2022 Mitigation Actions							
Number	**Strategy**	**Responsible Department**	**Priority**	**Goals**	**Hazards**	**Time**	**Resources**
Regional - 1 (RR PDC)	Leverage regional partnerships (e.g., law enforcement) to better use their data to inform mitigation planning and project development.	Local Emergency Managers	High	1, 2, 3,	All	ongoing	staff
Regional - 2 (RR PDC)	Work with state partners and neighboring regions to expand planning efforts regarding regional strategy for incoming evacuees (topics to include traffic management, shelters, information sharing, etc.).	Local Emergency Managers	Low	1, 2, 3, 4, 5	All	ongoing	staff, CVEMA
Regional - 3 (RR PDC)	Continue to refine improve the quality and detail of data to prepare usable and effective hazard assessments and vulnerability analysis	PDC, Local GIS Managers		1, 2, 3	All	ongoing	staff, grants

Outreach

- PDC and local government initiated
- Send copies/scans/web postings, tweets and Facebook screen captures to: jbrowning@dewberry.com


Northern Neck News

Groundwater withdrawal requirements

Tree climbing as an international sport

Town Hall meeting sponsored by Indivisible Essex chapter

Prescription drug take-back

Severe storm crushes Colonial Beach

Fed up with big banks that don't follow through?

Next Steps

- Draft HIRA chapter comments to Deborah Mills (dmills@dewberry.com) or Jillian by June 23, 2017
- 2011 Mitigation Action Status to Jillian Browning (jbrowning@dewberry.com) NLT June 2, 2017
- 2017 – 2022 Mitigation Actions to Jillian Browning by June 9, 2017
- Draft Plan to Northern Neck PDC and LEP/MAC by July 1, 2017

Questions, Comments, Discussion

Deborah G. Mills, C.F.M.

Associate

Dewberry

804.823.6971 Desk

804.335.9946 Mobile

dmills@dewberry.com

Northern Neck PDC Hazard Mitigation Plan Update FINAL Meeting May 31, 2017 Sign-In Sheet				
Jurisdiction	**Name**	**Position**	**Email**	**Phone**
NNPDC	Alex Eguiguren	Technical Assisstant	aeguiguren@nnpdc17.state.va.us	804.333.1900
NNPDC	Jerry Davis	Executive Director	jdavis@nnpdc17.state.va.us	804.516.5783
NNPDC	John Bateman	Regional Planner	jbateman@nnpdc17.state.va.us	804.313.8478
Westmoreland	Jeff Beasley	Emergency Services Chief	jbeasley@westmoreland-county.org	804.456.1777
Westmoreland	Bill Cease	IT Director	bcease@westmoreland-county.org	804.456.6268
Colonial Beach	Val Foulds	Town Manager	vfoulds@colonialbeachva.net	804.224.7181/590.848.4577
Westmoreland	Beth McDowell	Planner	bmcdowell@westmoreland-county.org	804.493.0120
"	"	"	bamst41@msn.com	"
Westmoreland	Darrin Lee	Planner	dlee@westmoreland-county.org	804.493.0120
Irvington	Bob Harresty	Town Administrator	info@irvingtonva.org	804.438.6230
Whitestone	Patrick Freve	Patrick Freve	frere37@yahoo.com	804.436.4935
Lancaster	Heather Brown	Dept. Coordinator	hbrown@lancova.com	804.238.8302
Richmond	Mitch Paulette	Captain	mpaulette@co.richmond.va.us	804.313.1332
Northumberland	Stuart McKenzie	County Planner	smckenzie@co.northumberland.va.us	804.580.8910
Northumberland	Rick McClure	Emergency Services Chief	rmcclure@co.northumberland.va.us	804.580.5221
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Mitigation Strategy, Action & Project Types

Northern Neck PDC 2017 Regional Goals

Mitigation Project Type and Project Types	
Prevention	• Planning and zoning • Building codes • Open space preservation • Floodplain regulations • Stormwater management regulations • Drainage system maintenance • Capital improvements programming • Shoreline/riverine setbacks
Property Protection	• Acquisition/Demolition • Relocation • Building elevation • Critical facilities protection • Retrofitting (i.e., wind-proofing, floodproofing, seismic design) • Safe rooms, shutters, shatter-resistant glass • Insurance
Natural Resource Protection	• Land acquisition • Floodplain protection • Watershed management • Beach and dune preservation • Riparian buffers • Forest and vegetation management (i.e., fire resistant landscaping, fuel breaks) • Erosion and sediment control • Wetland preservation and restoration • Habitat preservation • Slope stabilization • Historic properties and archaeological site preservation
Structural Projects	• Reservoirs • Dams/levees/dikes/floodwalls/seawalls • Diversions/detention/retention • Channel modification • Beach nourishment • Storm sewers
Emergency Services	• Warning systems • Evacuation planning and management • Emergency response training and exercises • Sandbagging for flood protection • Installing temporary shutters for wind protection
Education & Awareness	• Outreach projects • Speaker series/demonstration events • Hazard mapping • Real estate disclosure • Library materials • School children educational programs • Hazard expositions

2017 – 2022 Mitigation Goals:

Goal 1: Promote new development by avoiding undue risks posed by natural hazards and is resilient to natural disasters.

Goal 2: Address natural hazards and vulnerability that represent a threat to the community.

Goal 3: Ensure that the appropriate infrastructure is in place and maintained to ensure continued functionality of all critical services necessary to protect the residents, property and critical infrastructure of the Northern Neck.

Goal 4: Enhance the capabilities of local government to address natural hazards to enhance the whole community for increased resilience.

Goal 5: Increase natural hazard awareness of our citizens. Educate Northern Neck citizens and part-time residents on citizen and community hazard resiliency.

Goal 6: Participate and Comply with the National Flood Insurance Program (NFIP) through Floodplain Identification, Mapping and Floodplain Management.

Contact

NorthernNeck.US

Planning the Orderly and Efficient Economic Development of the Northern Neck

"George Washington did business here"

HOME PROJECTS PROGRAMS PROPERTIES RESOURCES PDC ARCHIVE TITLE VI

Hazard Mitigation Planning

The Hazard Mitigation Plan for the Northern Neck was last updated in 2011. FEMA and the Virginia Department of Emergency Management have provided funding to hire a consultant to update the plan and thus remain compliant with VDEM and FEMA requirements. The update process consists of a series of meetings with the region's stakeholders and the consultants:

02/27/17 – Kick-off Meeting – Presentation

04/05/17 – HIRA, Goals, and Mitigation Actions Meeting – Presentation

Appendix B: Additional Risk Assessment Information

B.1 Flood Zones

B.2 TEIF Analysis Results

B.3 Virginia Institute of Marine Science (VIMS) Shoreline Erosion Reports

B.1 Flood Zones

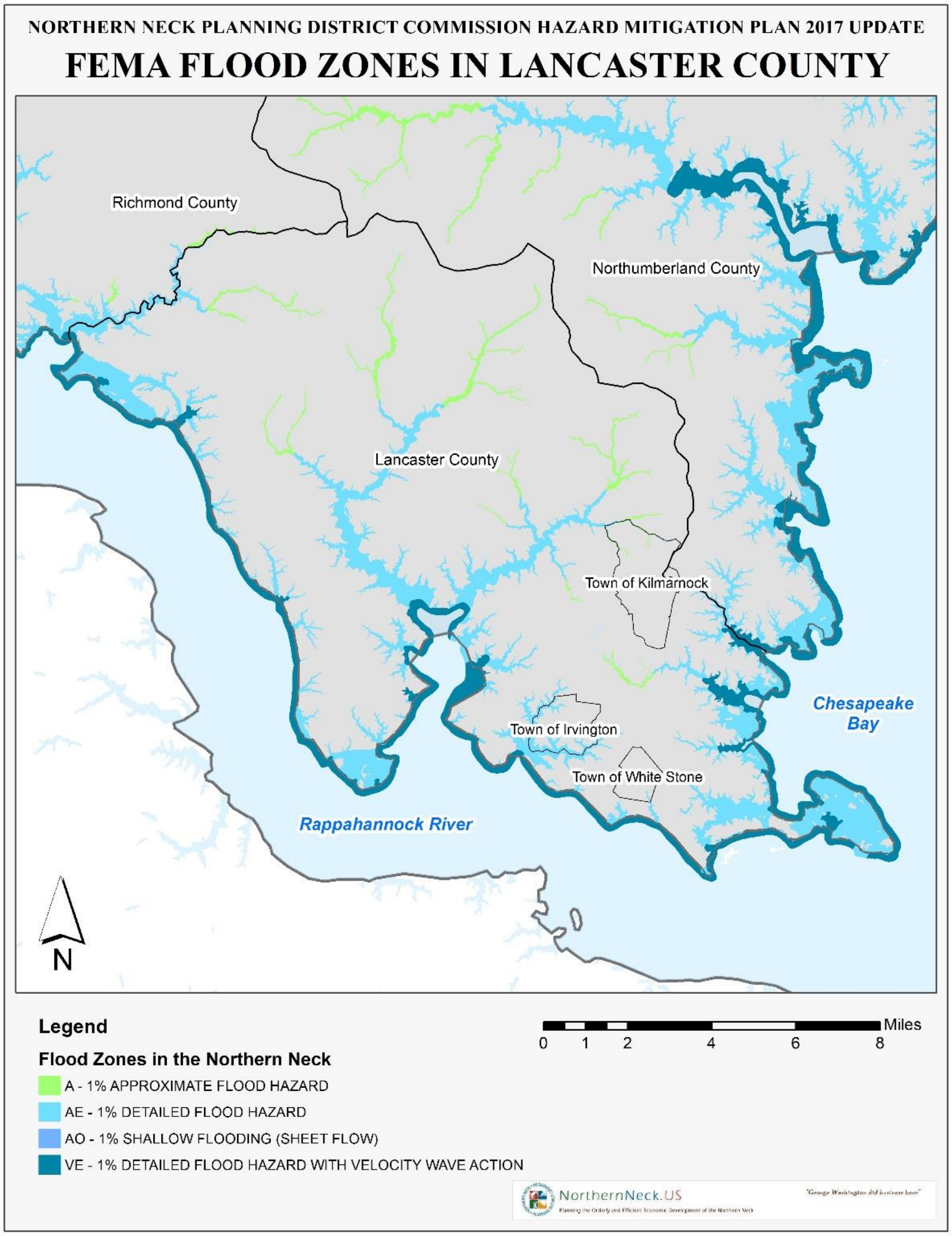

Figure 1. FEMA Flood Zones in Lancaster County

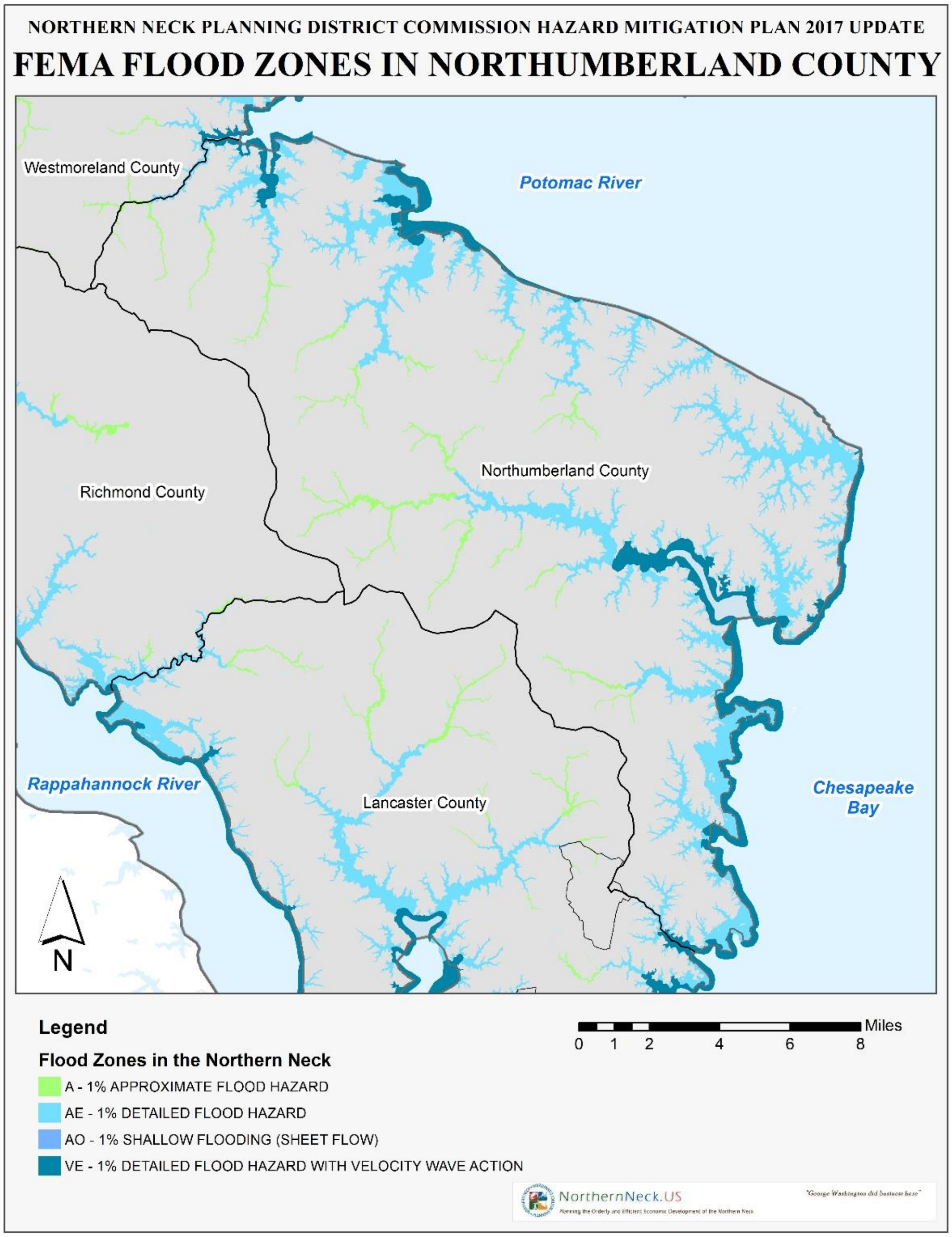

Figure 2. FEMA Flood Zones in Northumberland County

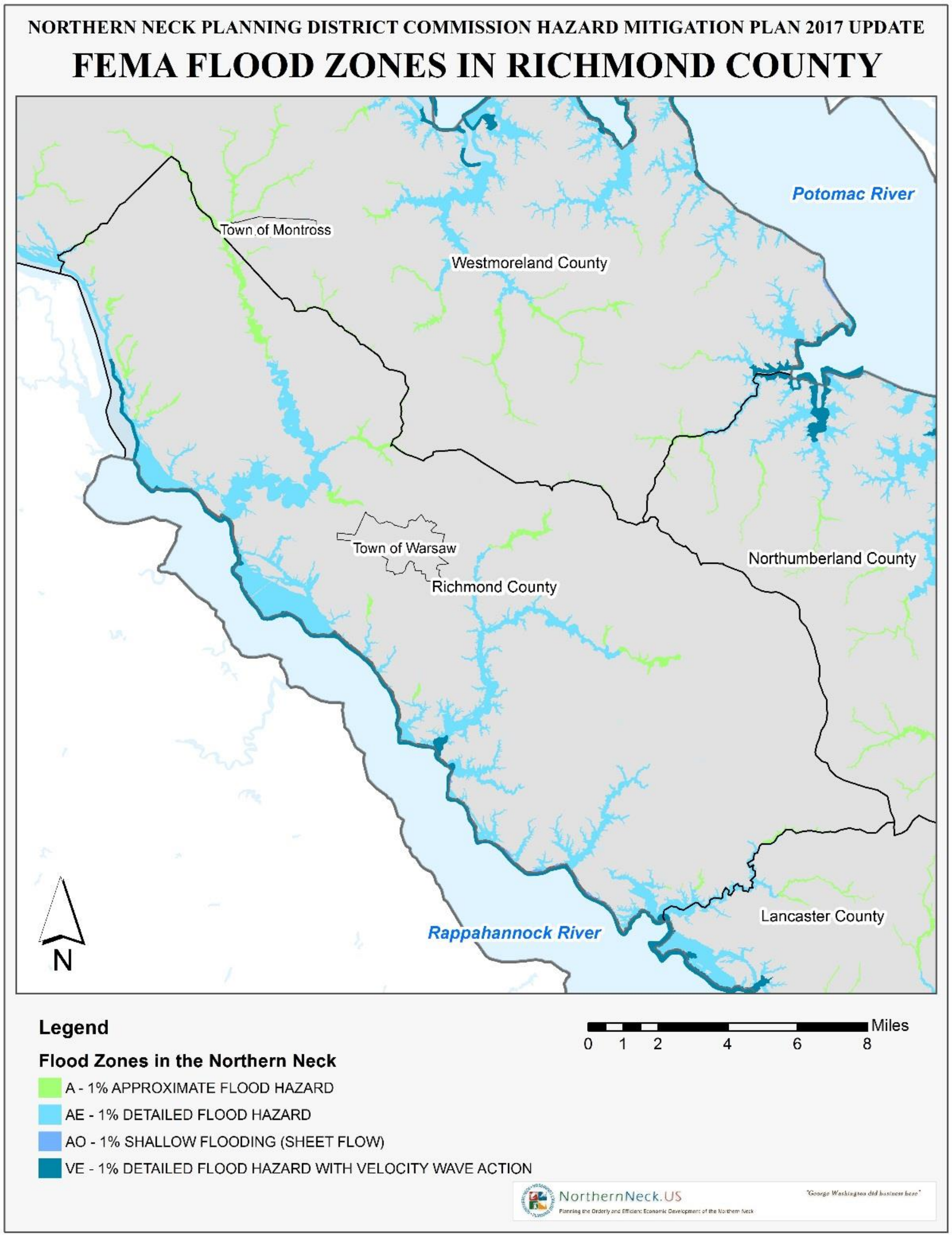

Figure 3. FEMA Flood Zones in Richmond County

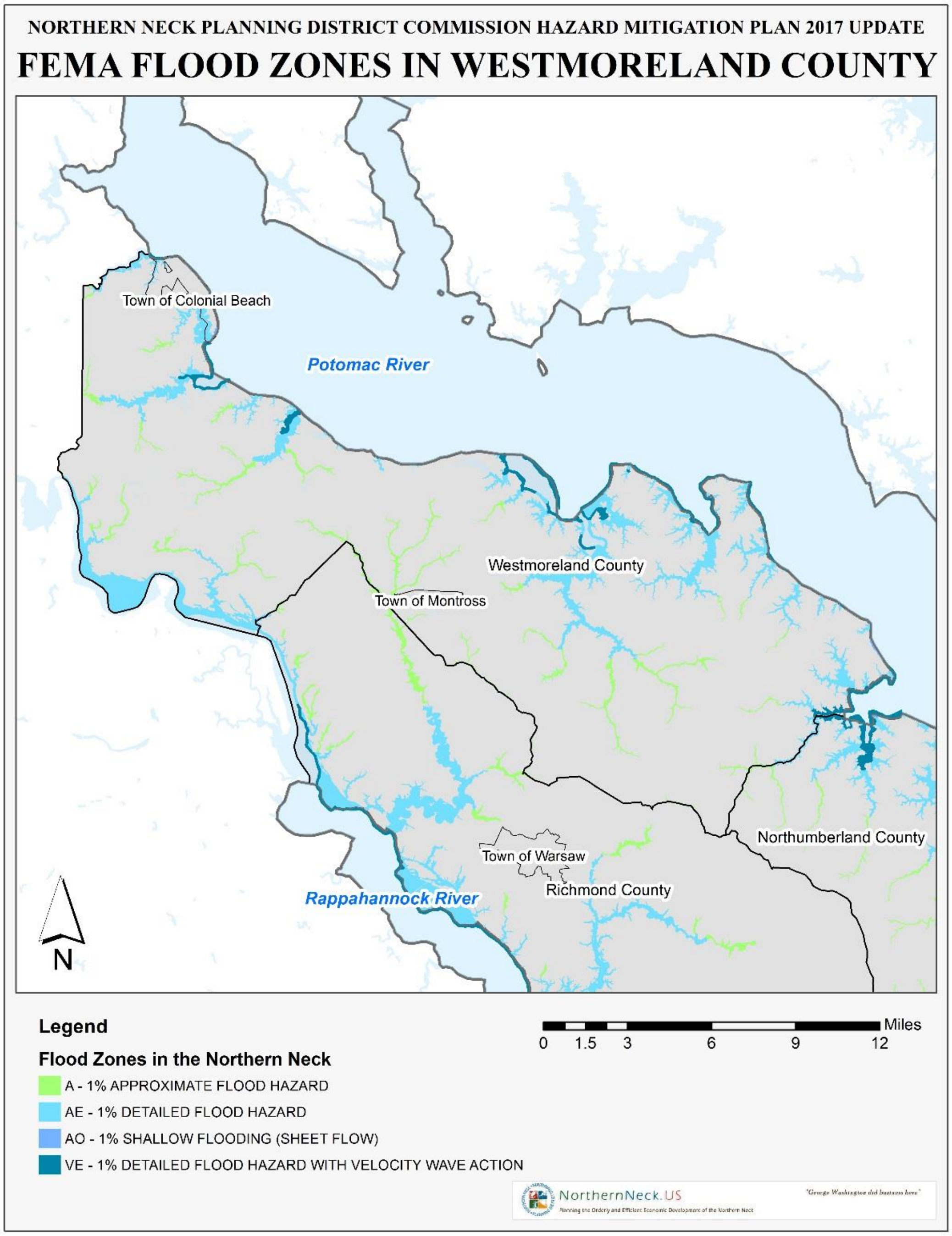

Figure 4. FEMA Flood Zones in Westmoreland County

B.2 TEIF Analysis Results

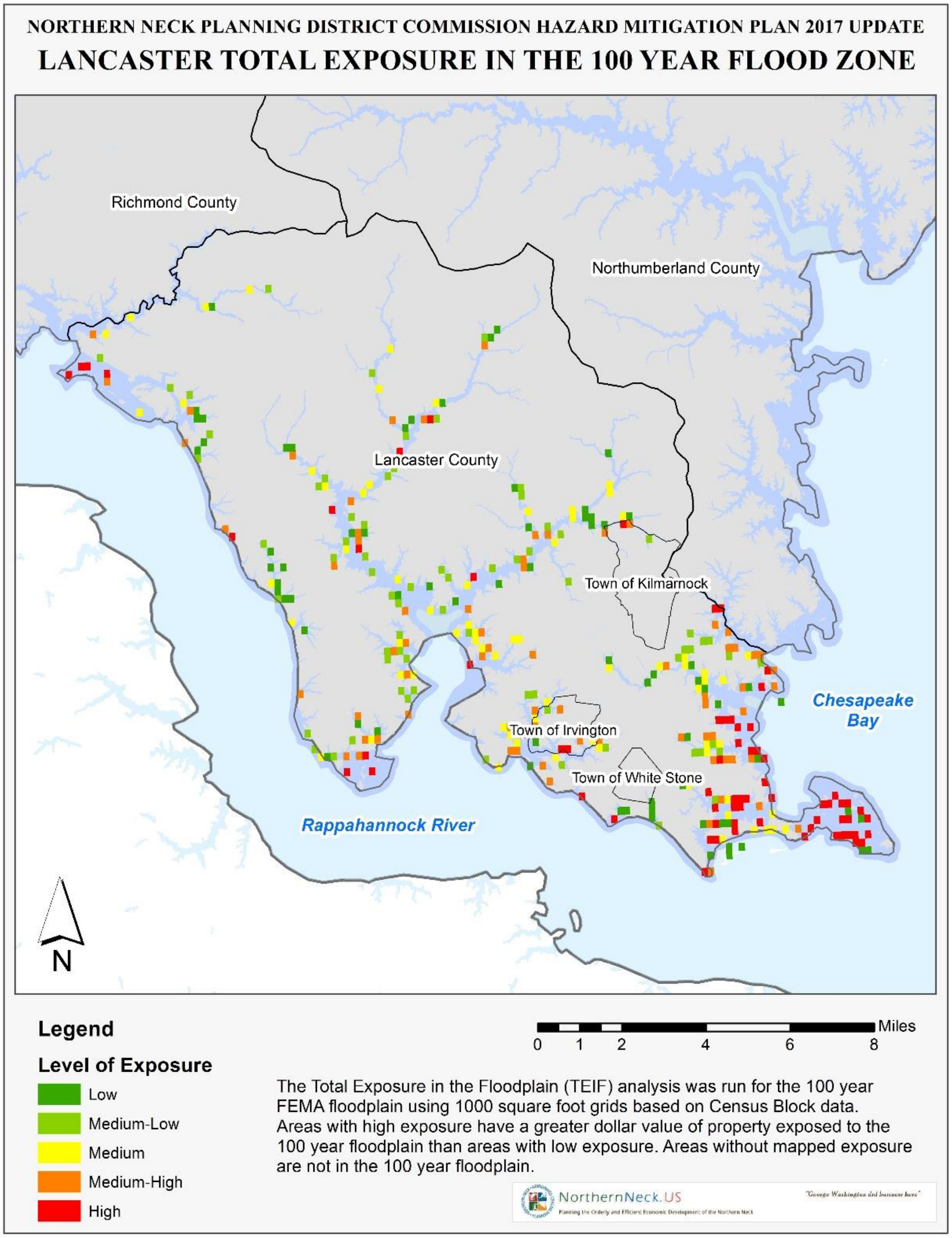

Figure 5. Lancaster Total Exposure in the 100 Year Flood Zone

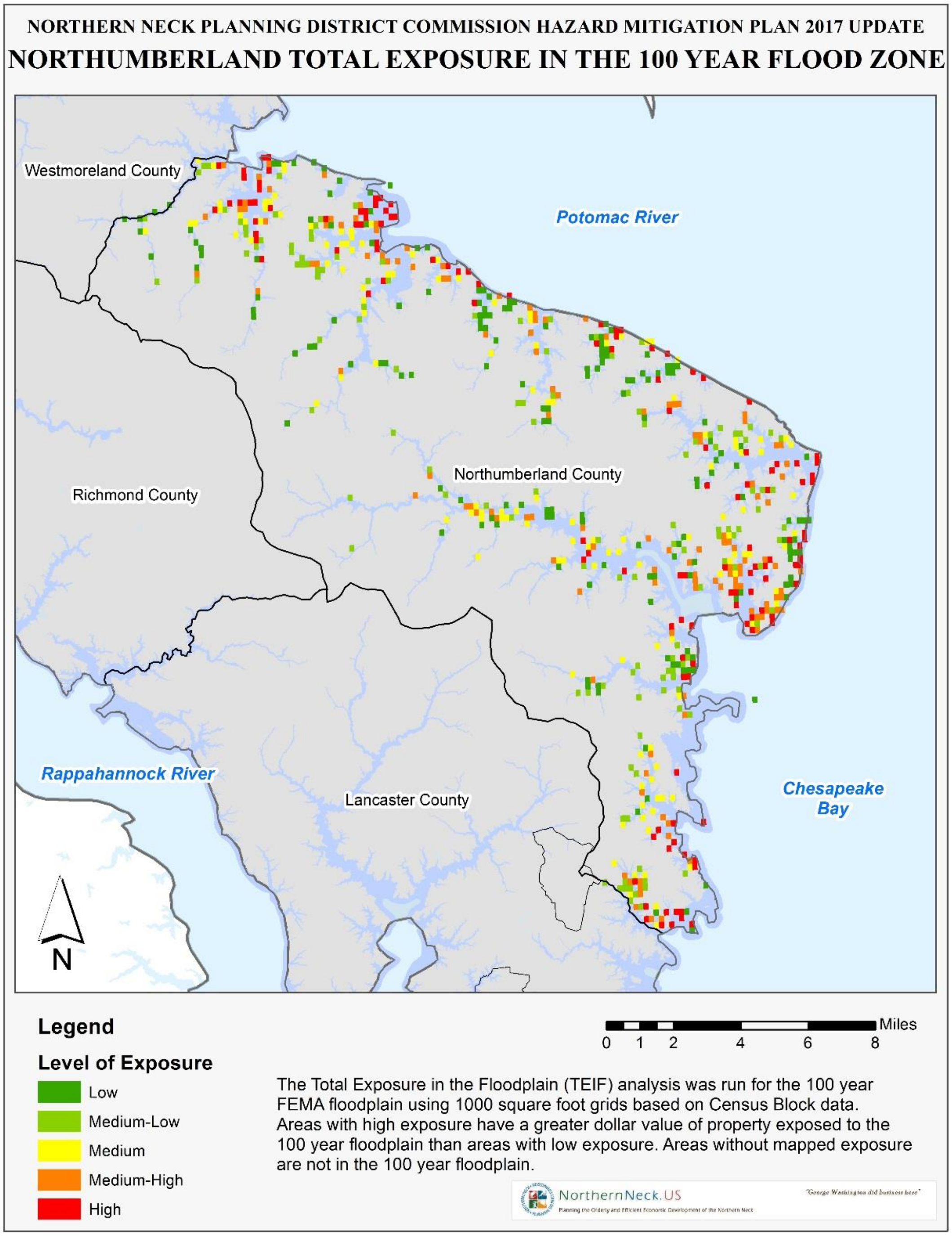

Figure 6. Northumberland Total Exposure in the 100 Year Flood Zone

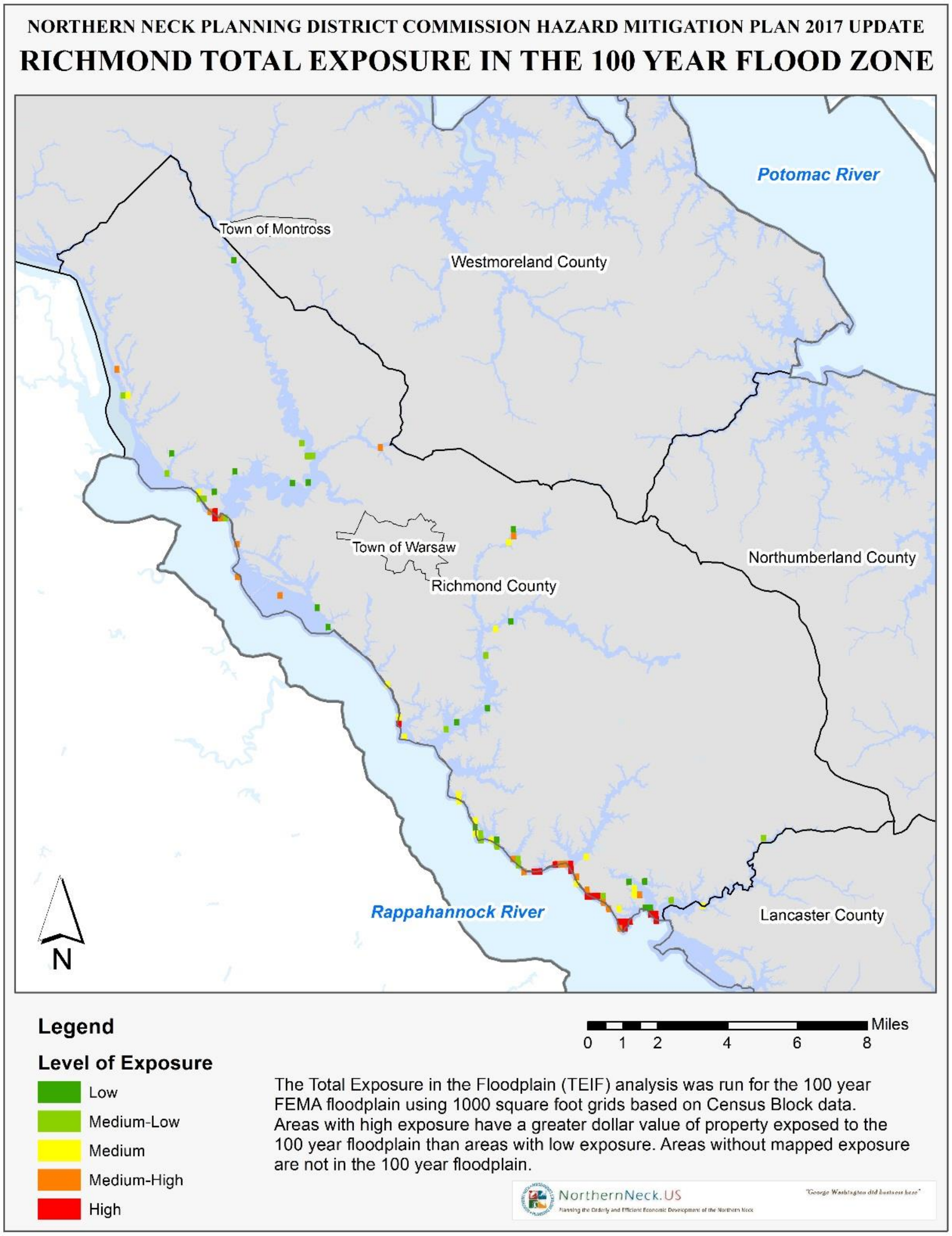

Figure 7. Richmond Total Exposure in the 100 Year Flood Zone

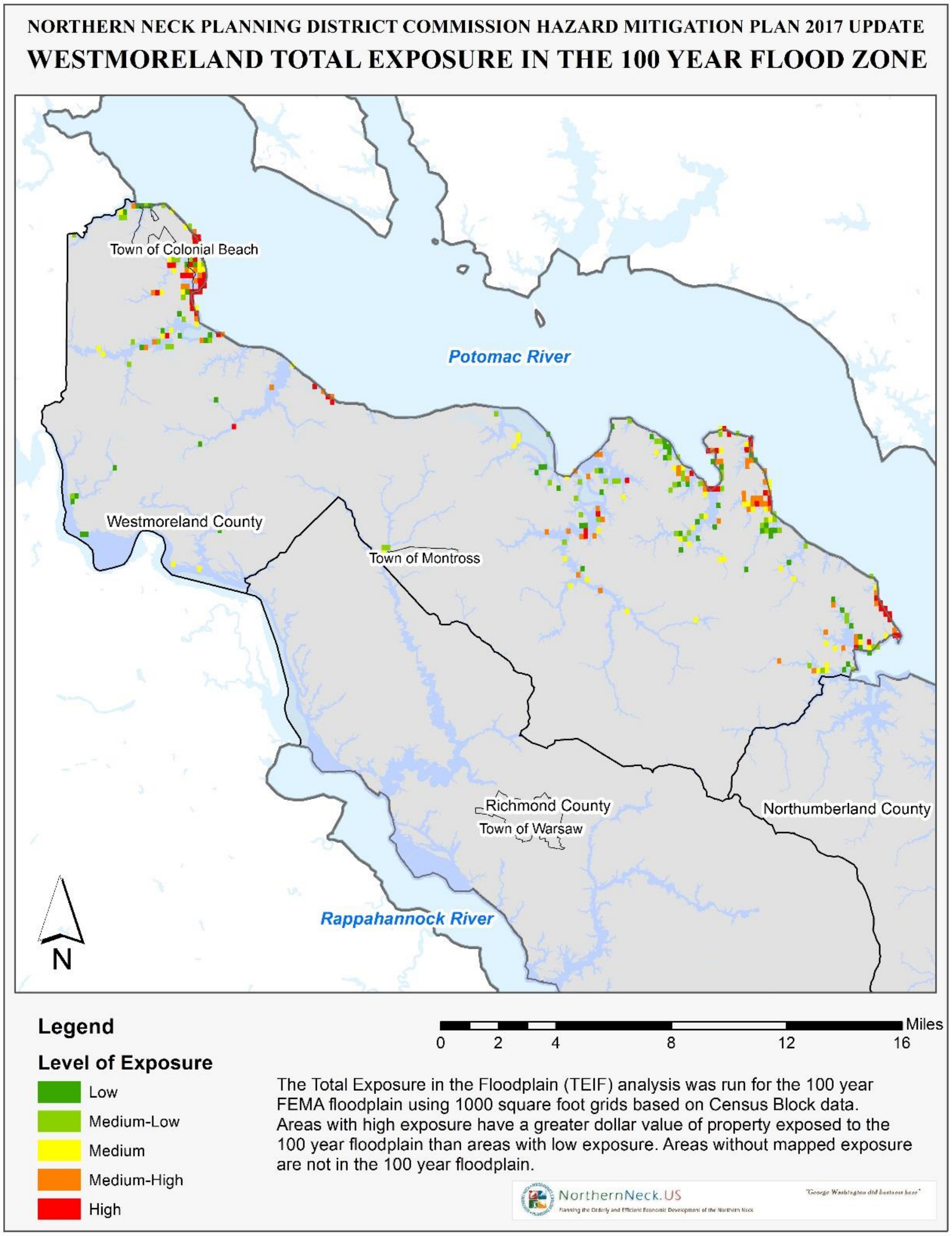

Figure 8. Westmoreland Total Exposure in the 100 Year Flood Zone

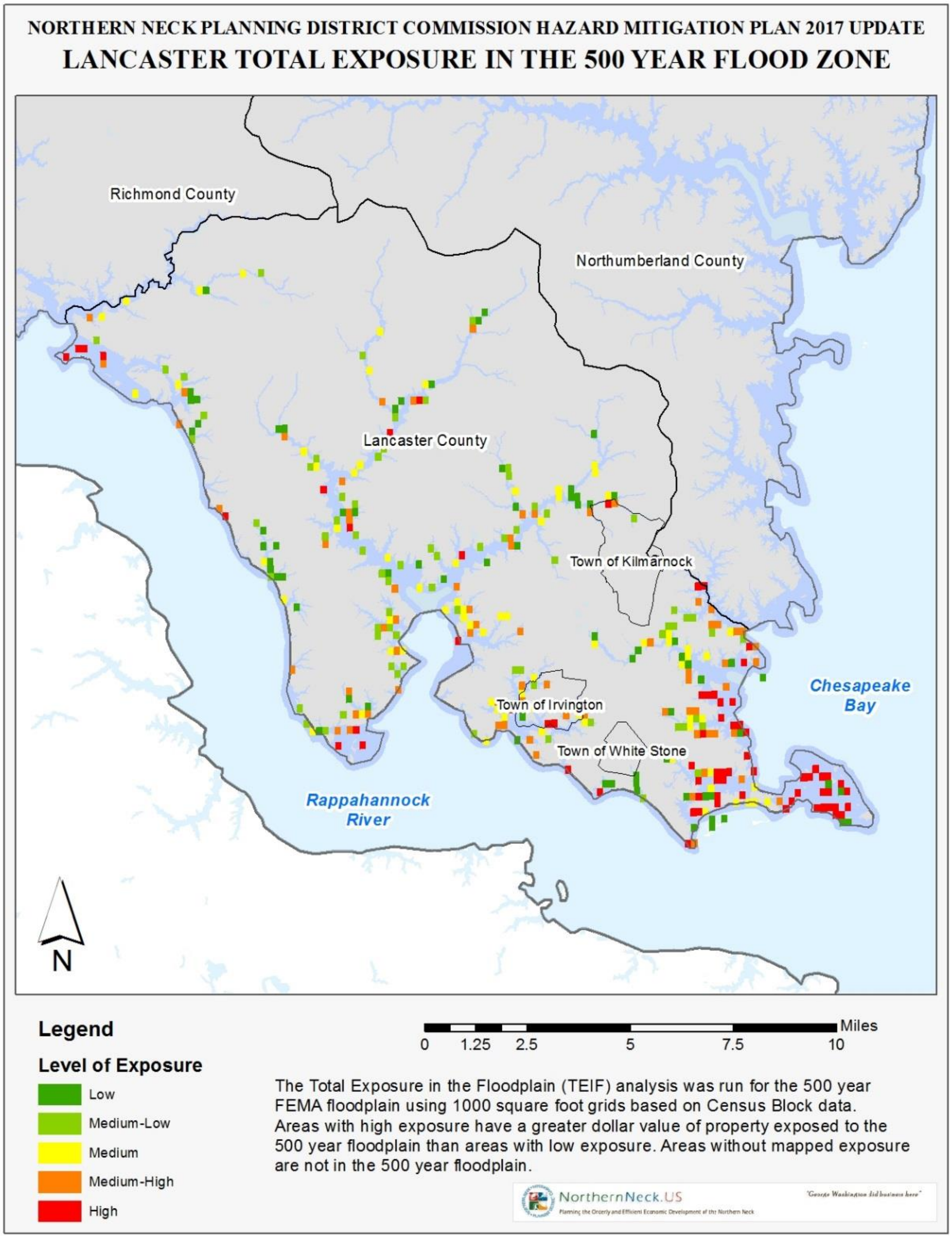

Figure 9. Lancaster Total Exposure in the 500 Year Flood Zone

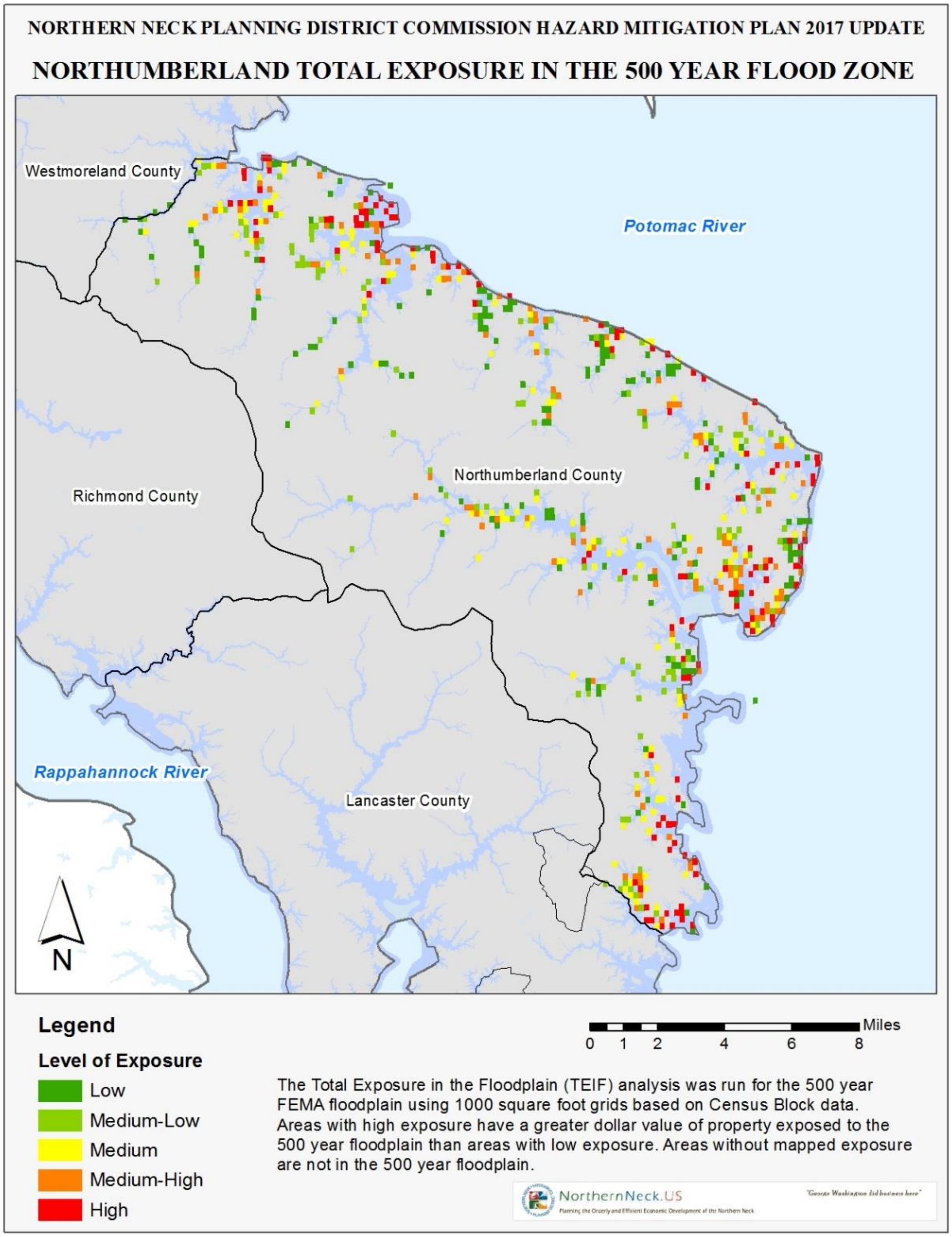

Figure 10. Northumberland Total Exposure in the 500 Year Flood Zone

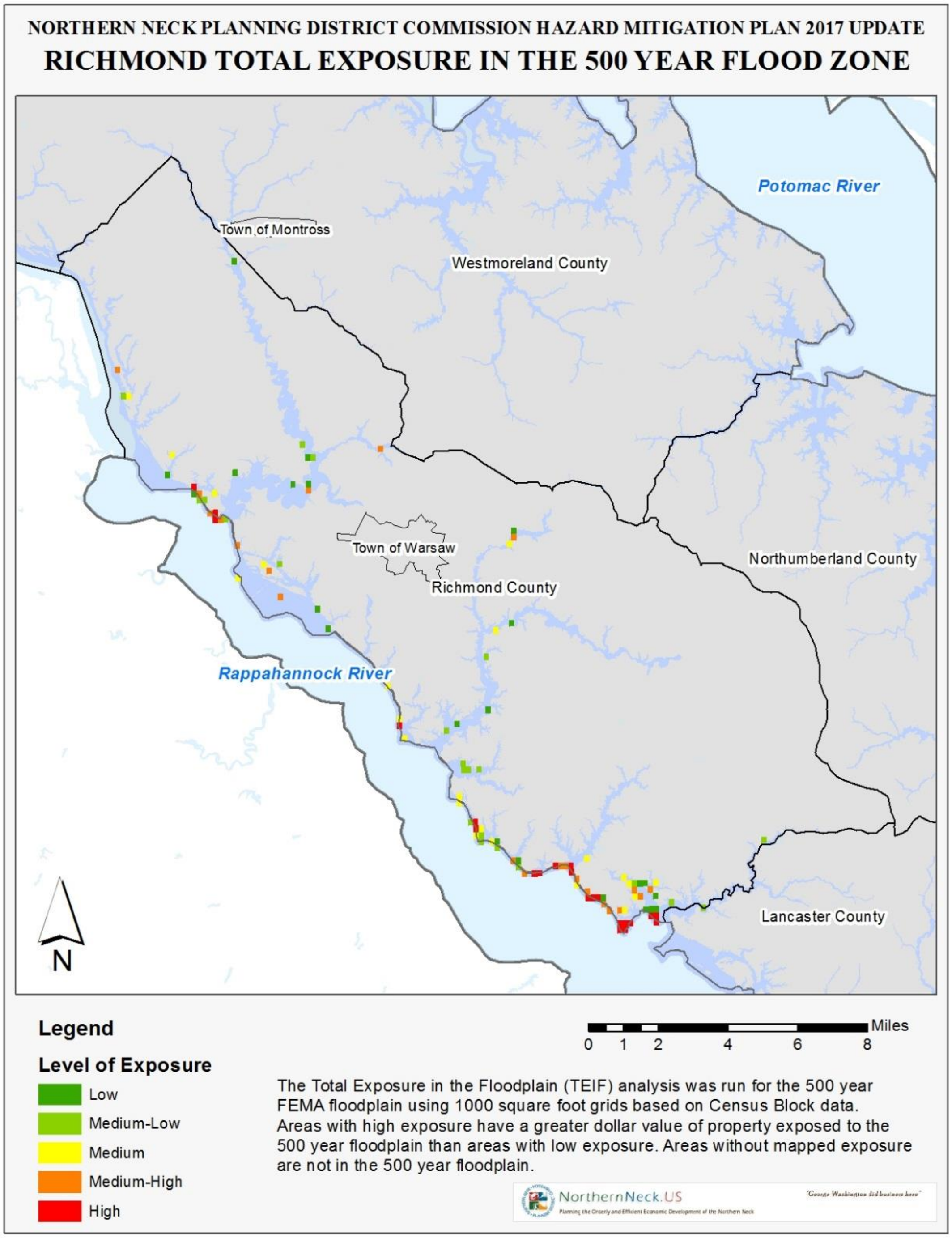

Figure 11. Richmond Total Exposure in the 500 Year Flood Zone

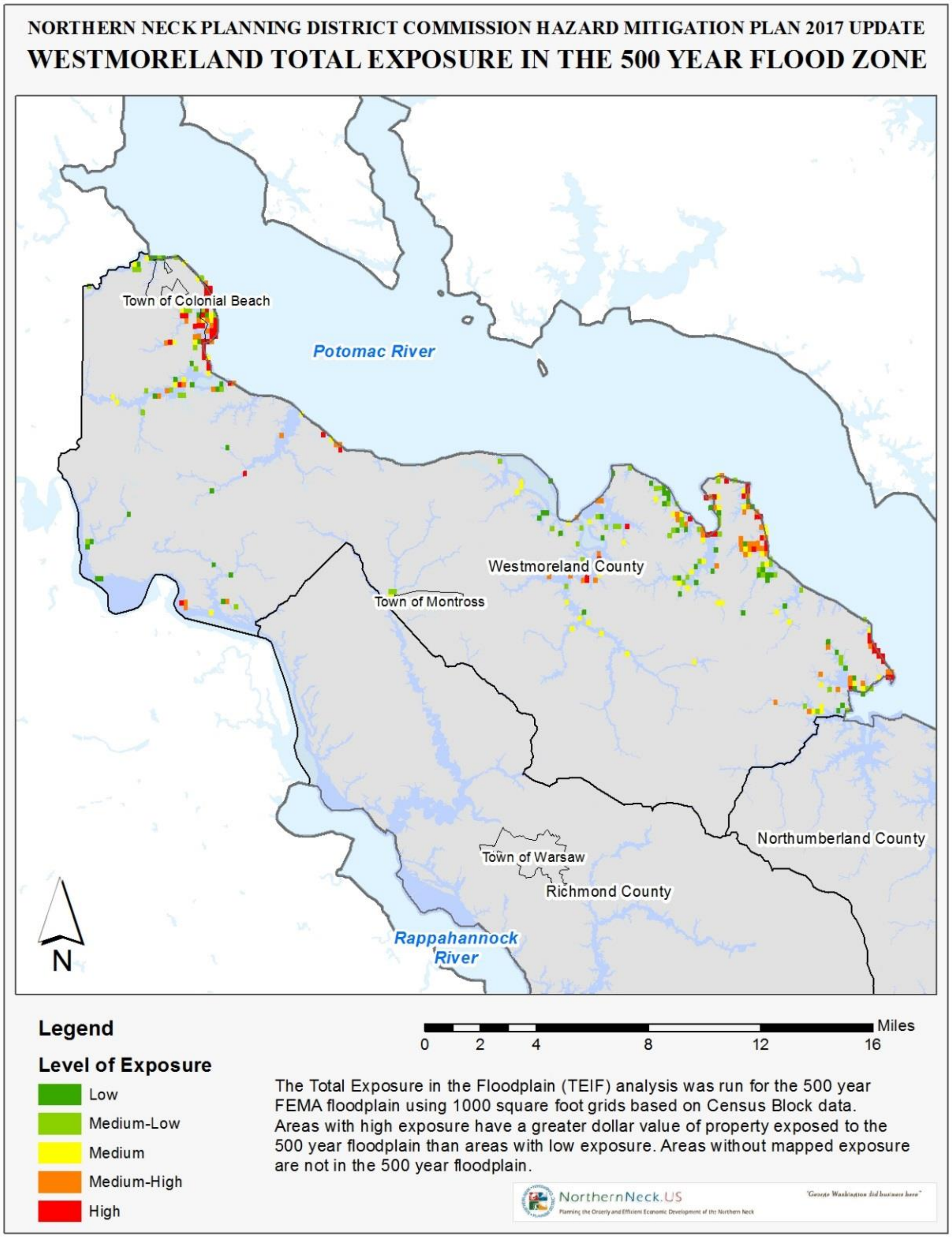

Figure 12. Westmoreland Total Exposure in the 500 Year Flood Zone

B.3 Virginia Institute of Marine Science (VIMS) Shoreline Erosion Reports

The Virginia Institute of Marine Science published Shoreline Evolution reports for Lancaster, Northumberland, Richmond, and Westmoreland Counties. These reports were referenced for the Coastal Erosion section of the HIRA chapter in this hazard mitigation plan update. Copies of these reports are attached for reference.

Shoreline Evolution
Lancaster County, Virginia
Chesapeake Bay and Rappahannock River Shorelines

2006

Shoreline Evolution
Lancaster County, Virginia
Chesapeake Bay and Rappahannock River Shorelines

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Virginia Institute of Marine Science
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Gloucester Point, Virginia

2006

This project was funded by the Virginia Department of Environmental Quality's Coastal Resources Management Program through Grants NA17OZ2355, NA17OZ1142,and NA04NOS4190060 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended.

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Cover Photo: Photograph of Mosquito Point in Lancaster County. Photo taken by Shoreline Studies Program on 15 August 2003.

I. INTRODUCTION

A. General Information

Shoreline evolution is the change in shore position through time. In fact, it is the material resistance of the coastal geologic underpinnings against the impinging hydrodynamic (and aerodynamic) forces. Along the shores of Chesapeake Bay and Rappahannock River, it is a process-response system. The processes at work include winds, waves, tides and currents, which shape and modify coastlines by eroding, transporting and depositing sediments. The shore line is commonly plotted and measured to provide a rate of change but it is as important to understand the geomorphic patterns of change. Shore analysis provides the basis to know how a particular coast has changed through time and how it might proceed in the future.

The purpose of this report is to document how the dunes along the Bay and river shores of Lancaster (Figure 1) have evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year, and it is this imagery that allows one to assess the geomorphic nature of shore change. Aerial imagery shows how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man through shore hardening or inlet stabilization come to dominate a given shore reach. Most of the change in shore positions will be quantified in this report. Others, particularly very irregular coasts, around inlets, and other complicated areas will be subject to interpretation.

B. Chesapeake Bay Dunes

The primary reason for developing this Shoreline Evolution report is to be able to determine how dunes and beaches along the Bay and river coast of Lancaster have and will evolve through time. The premise is that, in order to determine future trends of these important shore features, one must understand how they got to their present state. Beaches and dunes are protected by the Coastal Primary Sand Dune Protection Act of 1980 (Act)[1]. Research by Hardaway *et al.* (2001) located, classified and enumerated jurisdictional dunes and dune fields within the eight localities listed in the Act. These include the counties of Accomack, Lancaster, Mathews, Northampton and Northumberland and the cities of Hampton, Norfolk and Virginia Beach (Figure 2). Only Chesapeake Bay and river sites were considered in that study.

In 2004, Hardaway *et al*. created the Lancaster County Dune Inventory. That report detailed the location and nature of the jurisdictional primary dunes along the Bay shore of Lancaster County and those results appear in Appendix B. For this study, the positions of the dune sites are presented using the latest imagery in order to see how the sites sit in the context of past shoreline positions. The dune location information has not been field verified since the original visits in 2000. This information is not intended to be used for jurisdictional determinations regarding dunes.

[1]The General Assembly of Virginia enacted the Coastal Primary Sand Dune Protection Act (the Dune Act) in 1980. The Dune Act was originally codified in § 62.1-13.21 to -13.28. The Dune Act is now recodified as Coastal Primary Sand Dunes and Beaches in § 28.2-1400 to -1420.

II. SHORE SETTING

A. Physical Setting

The Bay shoreline of the Lancaster includes about 12 miles of shoreline from Windmill Point to Indian Creek which is the border with Northumberland County. The Rappahannock River shoreline extends from Windmill Point to Morattico Creek which is the border with Richmond County. This includes about 40 miles of tidal shoreline on the Rappahannock River and Corrotoman River. The shorelines along Chesapeake Bay are mostly low sandy banks and marsh. Historic shore change rates vary from 0 ft/yr (inside Little Bay) to -8 ft/yr (Windmill Point) for shore recession along the Bay coast (Byrne and Anderson, 1978). The open Bay coasts have the highest erosion rates. Up the Rappahannock River, shore erosion and accretion rates are highly variable. The point at Morrattico Creek had an erosion rate of -3.1 ft/yr. The shore along the Corrotoman River has erosion and accretion rates between -5 ft/yr and +2 ft/yr. Between the Corrotoman River and Mosquito Point, erosion and accretion occurred between +2.4 ft/yr (Mosquito Point) and -1.6 ft/yr (farther upriver). Some areas showed no change (Byrne and Anderson, 1978). The shore along the Rappahannock River includes high and low sandy banks and occasional marshes.

The coastal geomorphology of the County is a function of the underlying geology and the hydrodynamic forces operating across the land/water interface, the shoreline. The Chesapeake Bay coast of Lancaster County varies between Holocene marsh and Holocene beach sands (Figure 3). Both sediment types overlie the Lynnhaven Member of the Tabb Formation (Late Pleistocene). Along the Rappahannock River, the Sedgefield Member, Shirley Formation and Lynnhaven Member outcrop along the shoreline. In addition, Quaternary alluvium was deposited at Towles Point. The Atlantic Ocean has come and gone numerous times over the Virginia coastal plain over the past million years or so. The effect has been to rework older deposits into beach and lagoonal deposits at the time of the transgressions. The last low stand found the ocean coast about 60 miles to the east when sea level about 300 feet lower than today and the coastal plain was broad and low. The current estuarine system was a meandering series of rivers working their way to the coast. About 15,000 years ago, sea level began to rise and the coastal plain watersheds began to flood. Shorelines began to recede. The slow rise in sea level is one of two primary long-term processes which cause the shoreline to recede; the other is wave action, particularly during storms. As shorelines recede or erode the bank material provides the sands for the offshore bars, beaches and dunes.

Sea level is continuing to rise in the Chesapeake Bay Region. Tide data collected at Gloucester Point on the York River showed that sea level has risen 3.95 mm/yr or 1.3 ft/century (http://www.co-ops.nos.noaa.gov/). Lewisetta on the Potomac River rose 4.85 mm/yr or 1.59 ft/century. Windmill Point and the Rappahannock River are between these two guages. The amount of sea level rise directly effects the reach of storms and their impact on shorelines. Anecdotal evidence of storm surge during Hurricane Isabel, which impacted North Carolina and Virginia on September 18, 2003, put it on par with the storm surge from the "storm of the century" which impacted the lower Chesapeake Bay in August 1933. Boon (2003) showed that even though the tides during the storms were very similar, the difference being only 4 cm or about an inch and a half, the amount of surge was different. The 1933 storm produced a storm surge that was greater than Isabel's by slightly more than a foot. However, analysis of the mean water levels for the months of both August 1933 and September 2003 showed that sea level has risen by 41 cm (1.35 ft) at Hampton Roads in the seventy years between these two storms (Boon, 2003). This is the approximate time span between our earliest aerial imagery (1937) and our most recent (2002), which means the impact of sea level rise to shore change is significant. The beaches, dunes, and nearshore sand bars try to keep pace with the rising sea levels. Five shore reaches are described along the coast of Lancaster County (Figure 4). Reaches I, III, and IV are on the north shore of the Rappahannock River. Reach II is on the Corrotoman River, and Reach V is on the open Chesapeake Bay.

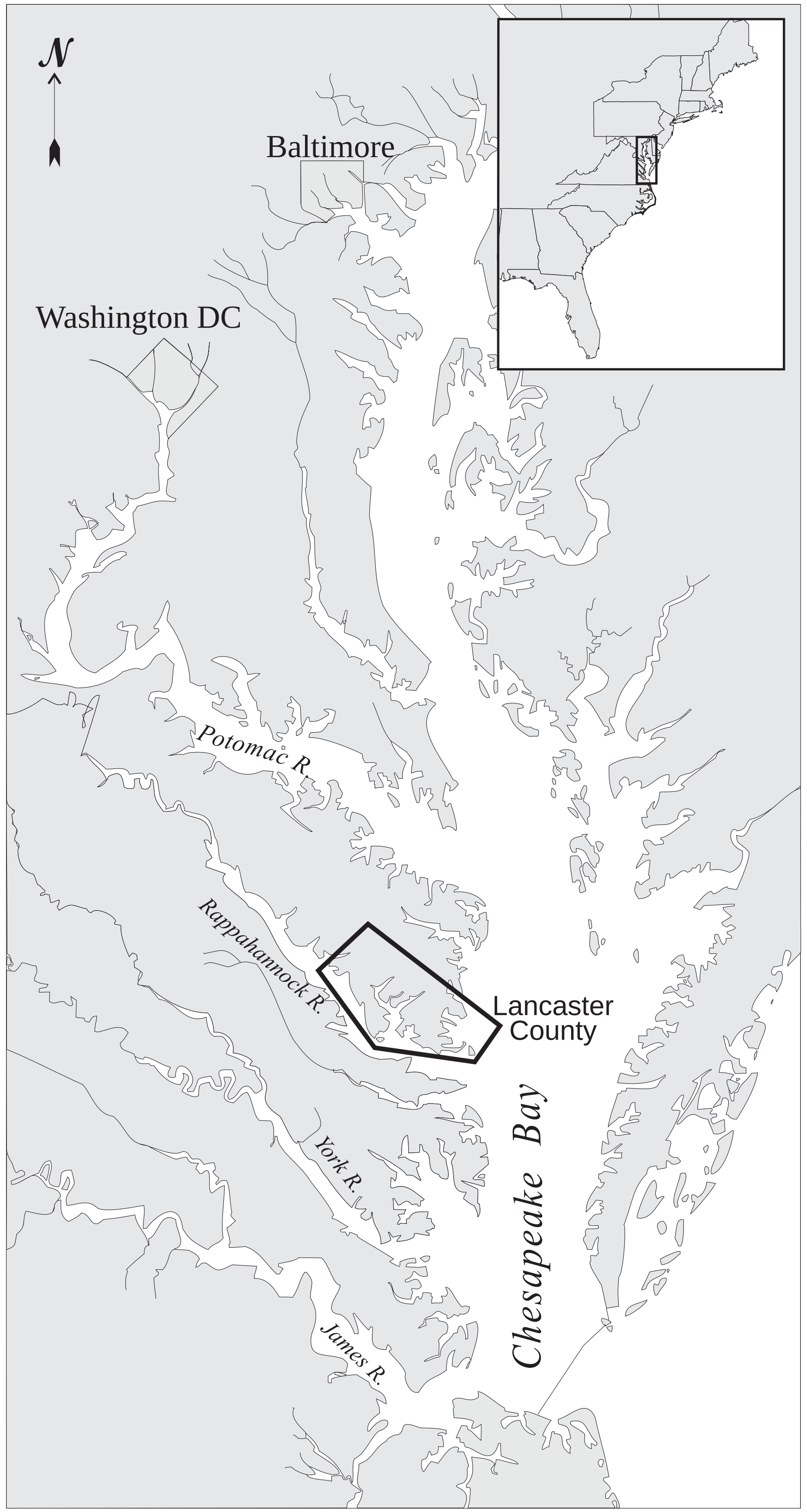


Figure 1. Location of Lancester County within the Chesapeake Bay estuarine system.

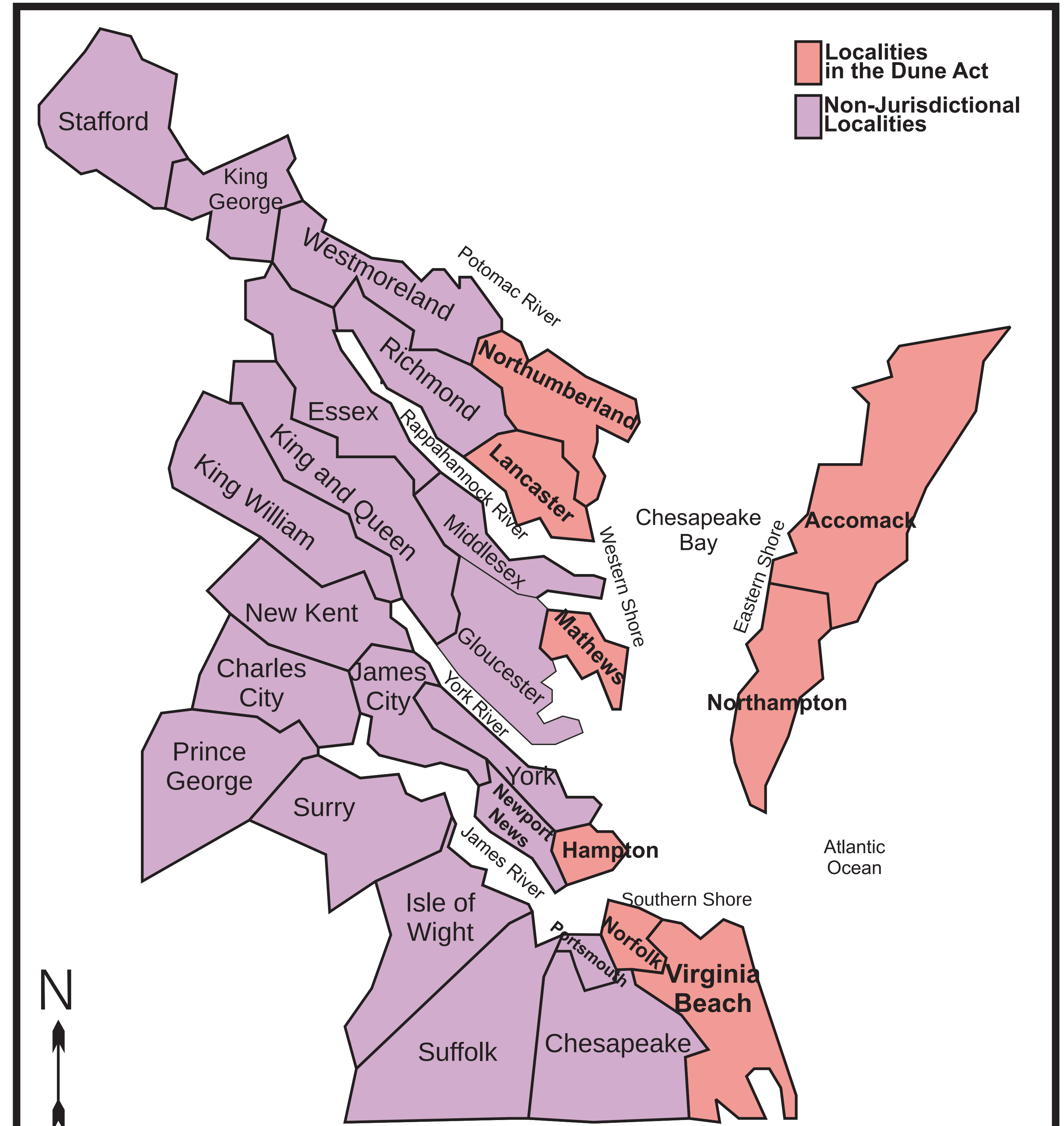
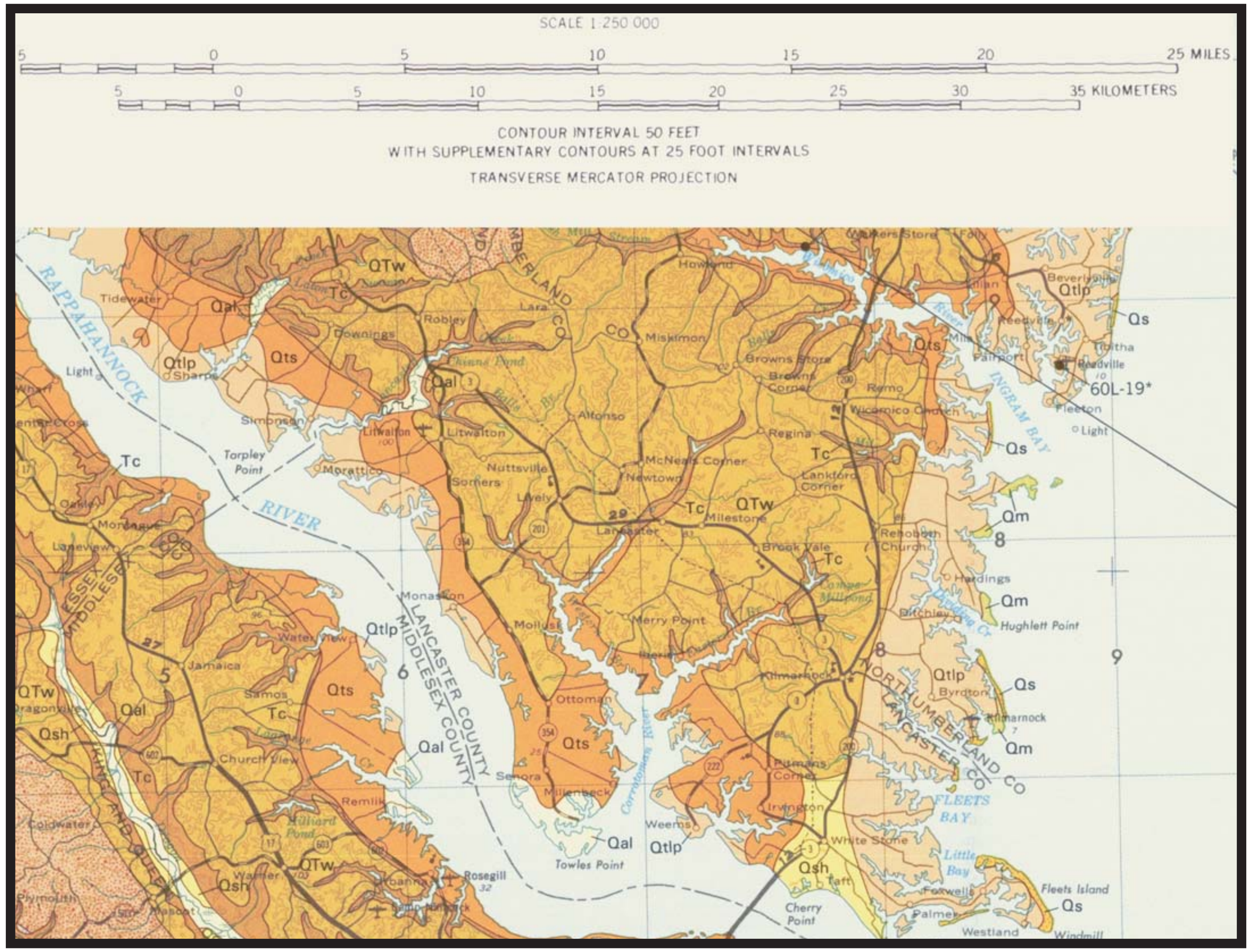


Figure 2. Location of localities in the Dune Act with jurisdictional and non-jurisdictional localities noted.



Qm — **Holocene Soft Mud** - Medium to dark-gray, and peat, grayish brown. Comprises sediment of marshes in coastal areas and Chesapeake Bay. Thickness is 0-10 ft.

Qs — **Holocene Sand** - Pale gray to light-yellowish gray, fine to coarse, poorly sorted to well sorted, shelly in part; contains angular to rounded fragments and whole valves of mollusks. Comprises deposits of coastal barrier islands and narrow beach-dune ridges bordering brackish-water marshes of Chesapeake Bay. As much as 40 ft in thickness.

Qtlp — **Lynnhaven and Poquoson Members, undifferentiated**.

Qts — **Sedgefield Member** - Pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt; locally, channel fill at base of unit includes as much as 50 ft of fine to coarse, crossbedded sand and clayey silt and peat containing in situ tree stumps. Sandy bay facies commonly contains Crassostrea biostromes, Mercenaria, Anadara, Polynices, Ensis, and other mollusks. Specimes of the coral Astrangia have yielded estimated uranium-series ages averaging 71,000 +/- 7,000 yrs B.P. (Mixon and others, 1982). Unit constitutes surficial deposit of river- and coast-parallel plains (alt. 20-30 ft) bounded on landward side by Suffolk and Harpersville scarps. Thickness is 0-50 ft.

Qal — **Alluvium -** Fine to coarse gravelly sand and sandy gravel, silt, and clay, light- to medium- gray and yellowish-gray. Deposited mainly in channel, point-bar, and flood-plain environments; includes sandy deposits of narrow estuarine beaches, and mud, muddy sand, and peat in swamps and in fresh- and brackish-water marshes bordering tide-water rivers. Grades into colluvium along steeper valley walls at margins of unit. Mostly Holocene but, locally, includes low-lying Pleistocene(?) Terrace deposits. As much as 80 ft thick along major streams.

QTw — **Windsor Formation (lower Pleistocene or upper Pliocene) -** Gray and yellow to reddish-brown sand, gravel, silt, and clay. Constitutes surficial deposits if extensive plain (alt. 85-95 ft) seaward of Surry scarp and coeval, fluvial-estuarine terrace west of scarp. Fining-upward sequence beneath plain consists of basal pebbly sand grading upward into crossbedded, quartzose Sand and massive, clayey silt and silty clay; lower and upper parts of sequence were deposited, repectively, in shallow-marine or open-bay and restricted-bay or lagoonal environments. In terraces west of Surry scarp, fluvial-estuarine deposit comprise muddy, coarse, trough-crossbedded sand and gravel grading upward to sandy silt and clay. Unit is 0-40 ft thick.

Qsh — **Shirley Formation (middle Pleistocene)** - Light-to dark-gray and brown sand, gravel, silt, clay, and peat. Constitutes surficial deposits of riverine terraces and relict baymouth barriers and bay-floor plains (alt. 35-45 ft) inset below depositional surfaces of the Chuckatuck Formation (Johnson and Peebles, 1984). Upper part of unit is truncated on the east by the Suffolk and Harpersville scarps; locally, lower part extends east of scarps. Fluvial-estuarine facies comprises (1) a lower pebble to boulder sand overlain by (2) fine to coarse sand interbedded with peat and clayey silt rich in organic material, including in situ tree stumps and leaves and seeds of cypress, oak, and hickory, which grades upward to (3) medium- to thick-bedded, clayey and sandy silt and silty clay. Marginal-marine facies in lower James River and lowermost Rappahannock River areas is silty fine sand and sandy silt containing *Crassostrea virginica*, *Mulinia*, *Noetia*, *Mercenaria*, and other mollusks. *Astrangia* from lower Rappahannock River area has yielded a uranium-series age of 184,000 +/- 20,000 years B.P. (Mixon and other, 1982). Thickness is 0-80 ft.

Tc — **Chesapeake Group (upper Pliocene to lower Miocene) -** Fine to coarse, quartzose sand, silt, and clay; variably shelly and diatomaceous, deposited mainly in shallow, inner- and middle-shelf waters. Ages of units based in studies of foraminiferal, nannofossil, diatom, and molluscan assemblages in Virginia and adjacent states (Andrews, 1988; Gibson, 1983; Gibson and others, 1980; Poag, 1989; Ward and Blackwelder, 1980; Ward and Krafft, 1984), Includes the following formations (see also sheet 2, figure 1), from youngest to oldest; Chowan River Formation (upper Pliocene), Yorktown Formation (lower upper and lower Pliocene), Eastover Formation (upper Miocene), St. Mary's Formation (upper and middle Miocene), Choptank Formation (middle Miocene), and Calvert Formation (middle and lower Miocene).

Figure 3. Geologic map of Lancaster County (from Mixon *et al*., 1989).

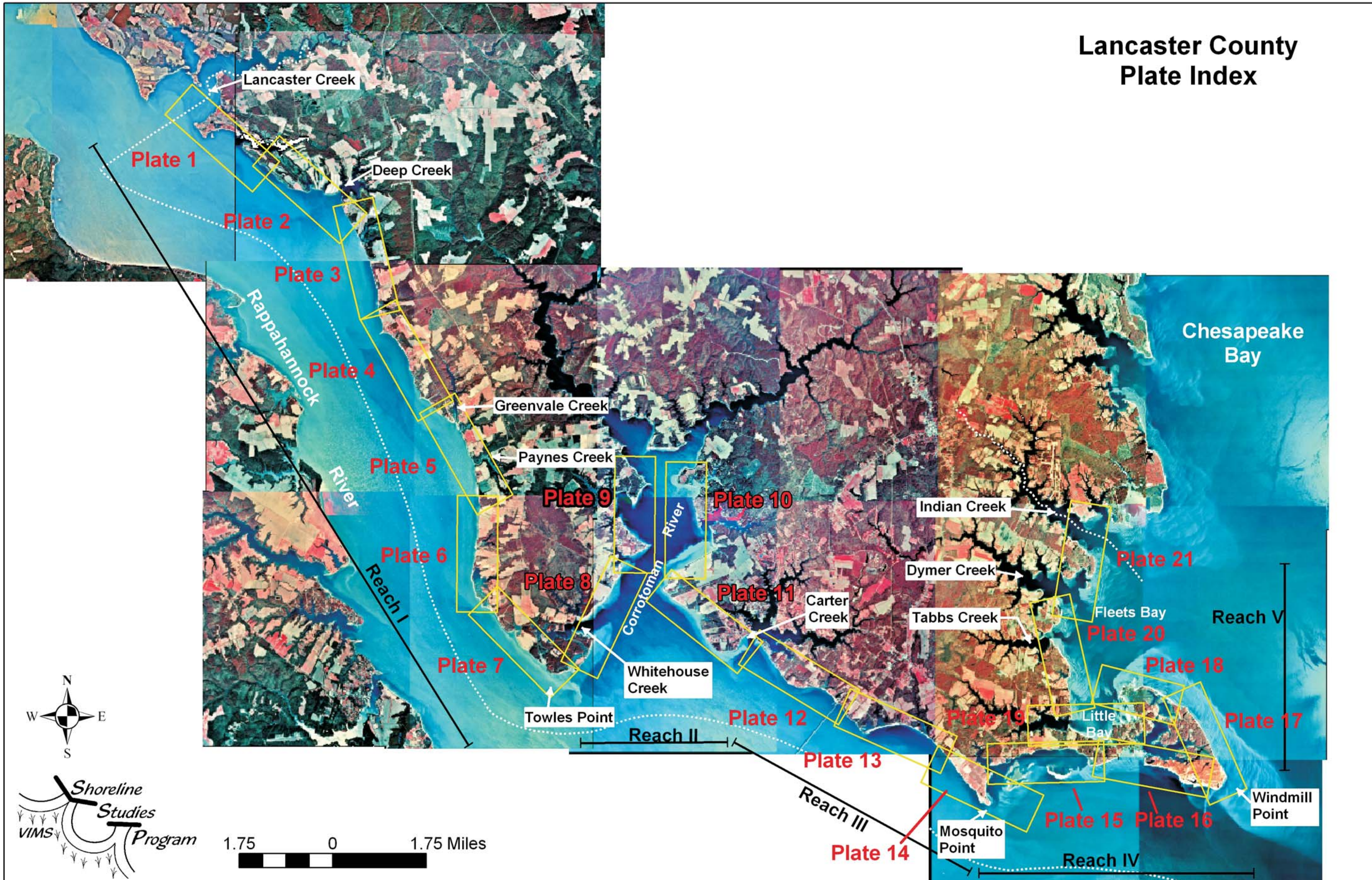


Figure 4. Index of shoreline plates.

B. Hydrodynamic Setting

Mean tide range at Windmill Point in Lancaster County is 1.2 ft (1983-2001). Up the Rappahannock River, mean tide range is 1.3 ft on the Corrotoman River, and 1.6 ft at Bayport which is across the river from Morattico Creek. The wind/wave climate impacting the Bay coast is defined by large fetch exposures to the northeast, east and southeast across Chesapeake Bay. Wind data from Norfolk International Airport reflect the frequency and speeds of wind occurrences from 1960 to 1990 (Table 1). Northeasters can be particularly significant in terms of the impacts of storm surge and waves on beach and dune erosion. The Rappahannock River is more fetch-limited. With the exception of the shore between Mosquito Point and Windmill Point, the coast is impacted by waves from the southwest, south, and southeast across limited open water.

Hurricanes, depending on their proximity and path can also have an impact to the Lancaster County Bay coast. On September 18, 2003, Hurricane Isabel passed through the Virginia coastal plain. The main damaging winds began from the north and shifted to the east then south. Beach and dune erosion were significant. Storm surge and wave action combined to create wrack lines measuring up to 8 ft above MLW around much of the Bay and up the rivers.

Table 1. Summary wind conditions at Norfolk International Airport from 1960-1990.

		WIND DIRECTION								
Wind Speed (mph)	**Mid Range (mph)**	**South**	**South west**	**West**	**North west**	**North**	**North east**	**East**	**South east**	**Total**
< 5	3	5497* 2.12$^+$	3316 1.28	2156 0.83	1221 0.47	35748 13.78	2050 0.79	3611 1.39	2995 1.15	56594 21.81
5-11	8	21083 8.13	15229 5.87	9260 3.57	6432 2.48	11019 4.25	13139 5.06	9957 3.84	9195 3.54	95314 36.74
11-21	16	14790 5.70	17834 6.87	10966 4.23	8404 3.24	21816 8.41	16736 6.45	5720 2.20	4306 1.66	100572 38.77
21-31	26	594 0.23	994 0.38	896 0.35	751 0.29	1941 0.75	1103 0.43	148 0.06	60 0.02	6487 2.5
31-41	36	25 0.01	73 0.03	46 0.02	25 0.01	162 0.06	101 0.04	10 0.00	8 0.00	450 0.17
41-51	46	0 0.00	0 0.00	0 0.00	1 0.00	4 0.00	4 0.00	1 0.00	0 0.00	10 0.00
Total		41989 16.19	37446 14.43	23324 8.99	16834 6.49	70690 27.25	33133 12.77	19447 7.50	16564 6.38	259427 100.00

*Number of occurrences $^+$Percent

III. METHODS

A. Photo Rectification and Shoreline Digitizing

Recent and historic aerial photography was used to estimate, observe, and analyze past shoreline positions and trends involving shore evolution for Lancaster County. Some of the photographs were available in fully geographically referenced (georeferenced) digital form, but most were scanned and orthorectified for this project.

Aerial photos from VIMS Shoreline Studies and Submerged Aquatic Vegetation (SAV) Programs, as well as from United States Geological Survey (USGS) archives were acquired. The years used for the shoreline change analysis included 1937, 1959, 1982, 1994, and 2002. Color aerials were obtained for 1982 and 1994. The 1994 imagery was processed and mosaicked by USGS, while the imagery from 2002 was mosaicked by the Submerged Aquatic Vegetation Program. The aerial photography for the remaining years were mosaicked by the VIMS Shoreline Study Program.

The images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. They were orthorectified to a reference mosaic, the 1994 Digital Orthophoto Quarterquadrangles (DOQQ) from USGS. The original DOQQs were in MrSid format but were converted into .img format as well. ERDAS Orthobase image processing software was used to orthographically correct the individual flightlines using a bundle block solution. Camera lens calibration data was matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. A minimum of four ground control points were used per image, allowing two points per overlap area. The exterior and interior models were combined with a 30-meter resolution digital elevation model (DEM) from the USGS National Elevation Dataset (NED) to produce an orthophoto for each aerial photograph. The orthophotographs that cover each USGS 7.5 minute quadrangle area were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic also in an .img format.

To maintain an accurate match with the reference images, it was necessary to distribute the control points evenly. This can be challenging in areas with little development. Good examples of control points are permanent features such as manmade features and stable natural landmarks. The maximum root mean square (RMS) error allowed is 3 for each block.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background to help delineate and locate the shoreline. For Lancaster' coast, an approximation to mean low water (MLW) was digitized. This often was defined as the "wetted perimeter" on the beach sand as the last high water location. In areas where the shoreline was not clearly delineated on the aerial photography, the location was estimated based on the experience of the digitizer. Digitizing the shoreline brings in, perhaps, the greatest amount of potential error because of the problems of image clarity and definition of shore features. A series of Lancaster dune site profiles are displayed in Figure 5 which shows beach/dune variability. Figure 6 shows the relationship of MHW, MLW and beach/dune system components.

B. Rate of Change Analysis

A custom Arcview extension called "shoreline" was used to analyze shoreline rate of change. A straight, approximately shore parallel baseline is drawn landward of the shoreline. The extension creates equally-spaced transects along the baseline and calculates distance from the baseline at that location to each year's shoreline. The output from the extension are perpendicular transects of a length and interval specified by the user. The extension provides the transect number, the distance from beginning baseline to each transect, and the distance from the baseline to each digitized shoreline in an attribute table. The attribute table is exported to a spreadsheet, and the distances of the digitized shoreline from the baseline are used to determine the rates of change. The rates of change are summarized as mean or average rates and standard deviations for each Plate.

It is very important to note that this extension is only useful on relatively straight shorelines. In areas that have unique shoreline morphology, such as creek mouths and spits, the data collected by this extension may not provide an accurate representation of true shoreline change. The shore change data was manually checked for accuracy. However, where the shoreline and baseline are not parallel, the rates may not give a true indication of the rate of shoreline change.

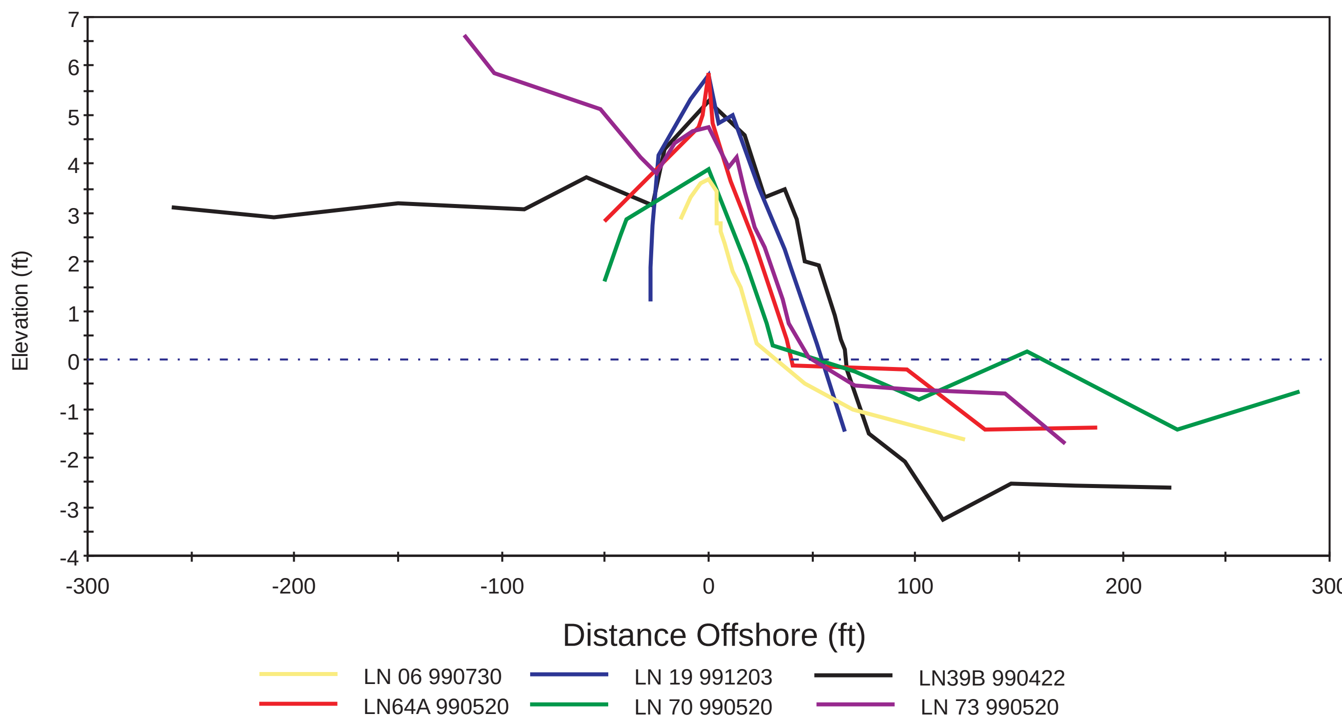


Figure 5. Variability of dune and beach profiles in Lancaster County.

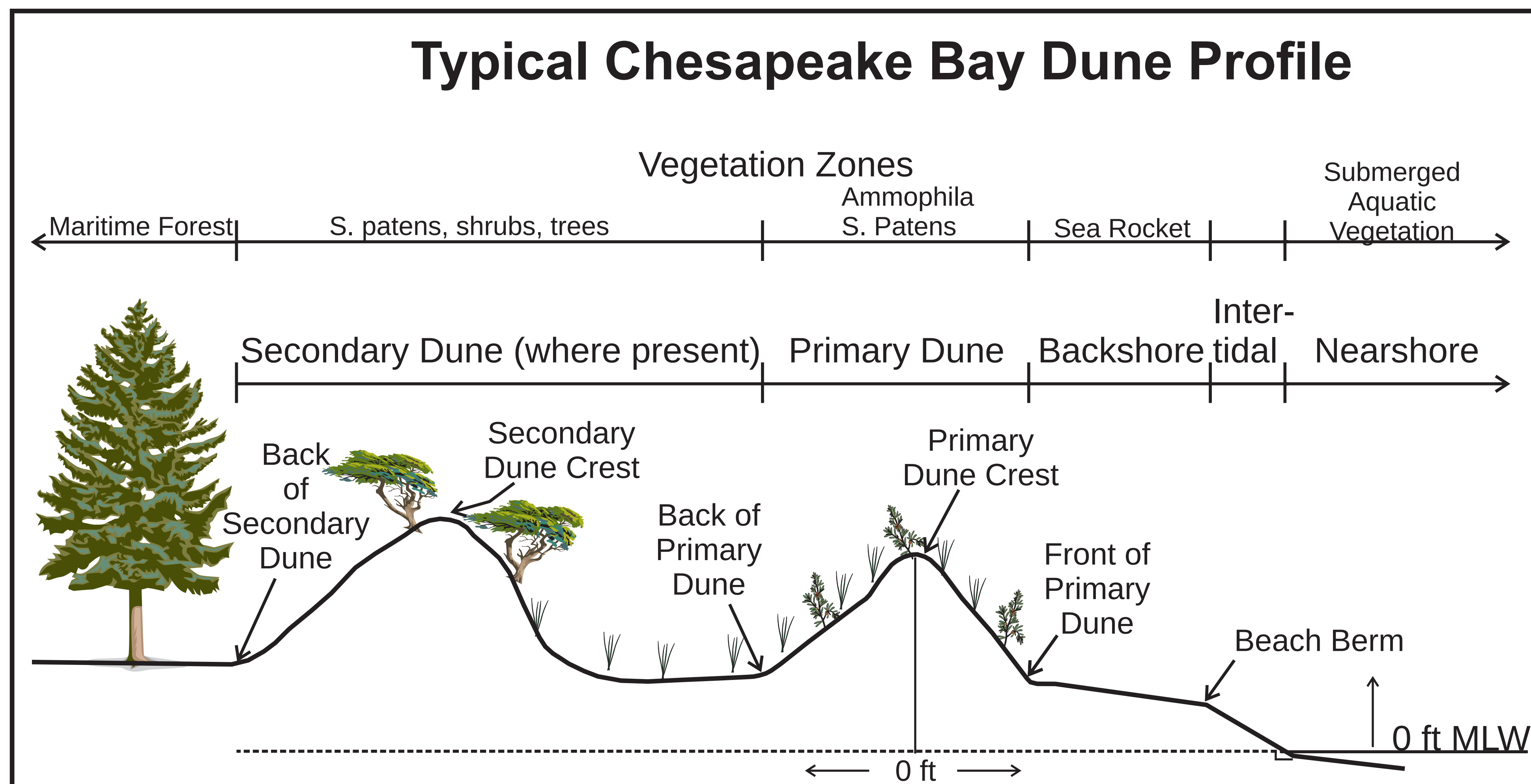


Figure 6. Typical profile of a Chesapeake Bay dune system (from Hardaway *et al.*, 2001).

IV. RESULTS

The Plates referenced in the following sections are in Appendix A. Dune locations are shown on all photo dates for reference only. Dune sites and lengths are positioned accurately on the 2002 photo. Because of changes in coastal morphology, the actual dune site might not have existed earlier. Site information tables are in Appendix B. More detailed information about Chesapeake Bay dunes and individual dune sites in Lancaster County can be found in Hardaway *et al.* (2001) and Hardaway *et al.* (2004). Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits. Some Plates did not have dunes identified on them, but the shore change information can still be valuable from a shoreline management perspective.

A. Reach I

Reach I occurs along the Rappahanock River and extends from the upriver county line at Lancaster Creek down to Towles Point and includes Plates 1 thru 7. The dune sites along Reach I are riverine dunes and generally face southwest. Plates 1 and 2 have no identified dune sites. The long-term trend for shore change (1937-2002) is negative on all three baselines on Plate 1. Baseline 1C has the highest due to its open exposure along the Rappahannock River. Shore trend is erosional along the single baseline on Plate 2.

Plate 3 contains dune sites LN3, LN4 and LN5. Site LN3 came into its present day form by 1994 and is maintained by a series of low groins. Sites LN4 and LN5 have evolved around respective small creek inlets since 1937 and are likely to continue change as the inlet spits and shoals do but stay in the same geomorphic setting. The overall shore change for Plate 3 is slightly erosional.

Plate 4 contains dune sites LN6, LN7, LN8, LN10 and LN11. Sites LN6, LN7 and LN8 reside along a relatively stable curvilinear coast protected on the upriver end by an unnamed point at Monaskon where the remains of an old pier help hold the headland. The sites are separated by breaks in the semi-continuos beach/dune system. Site LN10 and LN11 sit on either side of a man-made point (fill) that has eroded back over the years. Site LN11 has a secondary dune. The advance of these points can be seen in the shore change rates from 1937 to 1959. The long-term shore change trend along Plate 4 is slightly erosional.

Dune sites LN12, LN13, LN15 and LN16 are shown on Plate 5. Site LN12 is very small and developed as an overwash into a small tidal pond. Site LN 13 has been some type of beach feature since 1937 as it resides just upriver of Greenvale Creek. Dredging of Greenvale Creek was first performed in 1965 and sporadically since. Much of the material was placed just downstream of the entrance where it formed a large sandy headland. This headland has eroded away, but it has provided material for a small spit dune site, LN15, at its distal end. Dune site LN16 is a small dune on a spit across the mouth of Payne's Creek. The shoreline along Plate 5 has been relatively stable over time except for an advance and subsequent recession spike at the mouth of Greenvale Creek associated with dredge material disposal.

Plate 6 is the home of nine isolated dune sites labeled LN17 thru LN25. Sites LN17 and LN18 sit on either side of Bulls Creek as creek mouth dunes. Dune sites LN19 to LN24 are erosional remnants of a once more continuous beach/dune shoreline that fronts a marsh spit separating Beach Creek from the Rappahannock River. Most likely this is why this creek got its name. Dune site LN25 was formed as the distal end of the spit as it continued to lengthen. Channel dredging can be seen at the distal end of the spit since 1937 just downriver of LN24. The material was placed downriver which sealed up the natural channel. Site LN25 is attached to land on its downriver end. Grass became established, and a riverine dune developed. The shoreline rates of change are quite variable but show a long-term erosional trend for the baseline shown. The high variability of shore change along the Beach Creek spit is not quantified but can be seen pictorially.

Dune sites LN24 and LN25 also are shown on Plate 7, but no other sites occur. Shoreline change is minimal but slightly erosional. The shore attachment of the Beach Creek spit and its subsequent accretion is reflected between stations 0 and 1000.

B. Reach II

Reach II includes Plates 8, 9 and 10; no identified dune sites exist along this reach. These plates cover the main trunk of the Corrotoman River. Plate 8 has two baselines both showing erosional trends. Baseline 9A on Plate 9 shows a stable coast while baseline 9B is slightly erosional. The short single baseline on Plate 10 is also erosional.

C. Reach III

Reach III extends from the downstream side of the entrance to the Corrotoman River to Mosquito Point. This coast is a series of headland and embayments where the subreaches alternate riverine fetch exposures from the southwest then south. Reach III includes Plates 11 thru 14.

Plate 11 had dune site LN28 and LN29 (discussed in next plate). Site LN28 is a small isolated dune that resides in a small coastal embayment. This embayment can be seen in the imagery as early as 1937. The overall long-term shore trend from Corrotoman Point to Orchard Point has been stable.

Plate 12 has dune sites LN29 and LN32. Site LN29 has resided against the jetty at Crab Point since at least 1959. Site LN32 has developed on the upstream side of the Norris Bridge approach abutment since it was installed in the 1950s. It has developed a series of secondary dune ridges. Long-term shoreline trends along the Plate 12 coast are erosional becoming stable to accretional toward the Norris Bridge, then erosional on the downriver side.

Two dune sites occur along the Plate 13 shoreline, LN34 and LN36. They are the dune segments of a long curvilinear sandy embayment on the downstream side of Cherry Point. Portions of the beach are known locally as White Stone Beach. This is a relatively stable coast as reflected in the near zero net shore change rate for that shore segment. The Plate 13 shoreline is the upsteam, spiral bay section of a larger embayment that extends from Cherry Point downriver to Mosquito Point. Site LN34 is the longer site on Plate 13 and has had a tidal creek near its center breach intermittently over the years. This would cause an ebb shoal to form at its exit. The inlet's position can be seen in 1937 and 1959 imagery, but then the shoal moves downriver forcing the channel alongshore where it exits again and shoals as seen in 1982, 1994 and 2002.

The Plate 14 shoreline is the dowriver extension of the Plate 13 shoreline; it is the tangential section of the embayed shoreline from Cherry Point to Mosquito Point. It has one continuous dune site but with two wind/wave fetch exposures. Site LN39A faces west-southwest up the Rappahannock River while LN39B faces the open Bay. The dune crests vary accordingly with the higher one on LN39B (Bay Influenced) and the lower

one along LN39A (Riverine). Mosquito Point dunes are also a VIMS monitoring site (http://www.vims.edu/physical/research/shoreline). They have evolved over time as Mosquito Point has moved upriver. Most of the Plate 14 shoreline on the Rappahannock River has been slightly erosional over time.

D. Reach IV

Reach IV includes Plate 15 and 16 and extends from Mosquito Point to Windmill Point. The coast includes several island complexes and faces generally southerly. Plate 15 includes the small isolated dune site LN40A along the sheltered mainland coast. LN40A resides against a protruding bulkhead and has been there since 1937. A long spit ending at Deep Hole Point with dune signature existed until 1982. This spit was actually an island in 1937 which became shore connected in 1959 and 1982. The spit was significantly breached by 1994 leaving the distal end an island that has advanced upriver into Deep Hole. Shoreline change rates are for the sheltered embayed coast showing it to be very stable.

The Deep Hole Island spit extended to Windmill Point Creek in 1937 and was an island (Plate 16). The island attached by 1959 creating two spits with one going to Deep Hole Point and the other ending at Windmill Point Creek. This spit receded landward and connected to the mainland by 1982 creating the foundation for site LN43 and has persisted since. Other dune sites along the Plate 16 coast include LN47, LN50, LN51 and LN52. These are all isolated erosional remnants that were once part of a continuous beach/dune system along the south side of Fleet's Island from Windmill Point Creek to Windmill Point (Plate 17). Numerous groins, large and small have been installed over the years, and each of the dune sites resides within a groin field.

E. Reach V

From Windmill Point north to the county line is designated Reach V and includes Plates 17, 18, 19, 20 and 21. This is mostly open bay shoreline that is broken by four smaller tidal creeks including Little Bay, Tabbs Creek, Dymer Creek and Indian Creek. Plate 17 includes Fleets Island with no identified dune sites. Historical erosion is significant at an average of 7 ft/yr. In order to abate erosion, a series of breakwaters were placed along the shoreline between 1994 and 2002. Plate 18 has no dune sites identified either and is also very erosive at about 5 ft/yr. The erosion of Fleets Island has provided sediments to upriver shorelines, particularly the Rappahannock River coast, where spits, islands, beach and dune have evolved and decayed over time. Plate 19 has no dune sites identified and was too irregular to apply the straight line shore change model.

Plate 20 contains dune sites LN64A, LN65, LN66 LN67 and LN68 which all occur along the distal end of Poplar Neck between Dymer Creek and Poplar Creek. These sites evolved and were created as the Bay-exposed end of Poplar Neck eroded. Dune sites LN64A and LN65 were not in existence in 1937. Site LN64 evolved by 1982 between two groins. A pond existed in 1937 and 1959, but it had completely breached by 1982. By 1959, LN65 had found a niche at a small washover into the pond and stabilized. Dune sites LN66 and LN67 evolved as isolated dunes on the mainland side of the old pond shoreline after the pond was breached as seen in 1982 imagery. Site LN68 resides as a small pocket beach bounded by a marsh headland and stone revetment.

Plate 21 shows the end of Fleets Neck which lies between Rones Bay and Indian Creek. Five dune sites occur on Fleets Neck including LN69, LN70, LN71, LN72 and LN73. They were all part of more extensive dune/beach coast in 1937. Over time, shore recession and development fragmented the coast. Each site settled into its own isolated geomorphic setting. Erosion has been most severe on the distal end on the Neck, and Grogg Island has been reduced to almost non-existence.

V. DISCUSSION: NEAR FUTURE TRENDS OF DUNE SITES

The following discussion is a delineation of shoreline trends based on past performance. Ongoing shore development, shore stabilization and/or beach fill, and storms will have local impacts on the near term. "Near Future" is quite subjective and only implies a reasonable expectation for a given shore reach to continue on its historic course for the next 10 to 20 years. In addition, the basis for the predictions are the shorelines digitized on geo-rectified aerial photography which have an error associated with them (see Methods, Section III). Each site's long-term and recent stability as well as a near future prediction are shown in a table in Appendix B. **This data is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.**

A. Reach I

Dune site LN3 has been stable for the last 30 years or so and should remain so for the near term (Figure 7). Site LN4 that occurs across a creek mouth has advanced and receded over time and will most likely continue that trend so it might be deemed erosional in that regard. Site LN5 appears stable as long as the bounding marsh headlands remain intact.

Site LN6 has lost much of its beach and the *Spartina patens* is eroding. The upriver headland also is eroding so this site will continue to recede. Site LN7 resides in a relatively stable coastal setting (Figure 7), and LN8 is reasonably secure within its groinfield. Site LN10 is in an erosional trend, and LN11 appears stable as it resides on the "sheltered" side of the adjacent upriver headland.

Dune site LN12 appears to be in a stable setting with the potential to advance and recede as the creek mouth opens and closes (Figure 7). Site LN13 is fairly stable within the existing groinfield. Although relatively stable now, LN15 may face potential long-term impacts as the bounding marsh headland recede. Site LN16 will most likely continue to recede.

Dune sites LN17 and LN18 are generally receding while LN19 resides in a relatively stable groinfield. Dune sites LN20, LN21, LN22 and LN23 are isolated dune features along a decaying shoreline while LN24 might be stable against the old jetty for the near term. Dune site LN25 will probably maintain its existence as the spit recedes to the mainland.

B. Reach II

No dune sites exist along this reach.

C. Reach III

Site LN28 and LN29 appear stable for the near term in their isolated geomorphic settings. The Norris bridge has provided a stable coastal setting for LN32 (Figure 8). Dune sites LN34 and LN36 also occur along a stable beach planform though their vegetative extent may transition alongshore (Figure 8). The Mosquito Point dunes, LN39A and LN39B will continue to exist as mobile features an the point migrates upriver (Figure 8).

D. Reach IV

Site LN40A is in a stable setting. Dune site LN43 is transgressing landward while LN47 is stable within its groinfield (Figure 9). Site LN50 is stable to accretionary, and LN51 and LN52 appear stable on either side of the old wharf/groin (Figure 9).

E. Reach V

Along the end of Poplar Neck, LN64A and LN65 appear to be in an erosional/transgressive state while LN66 is stable if not advancing. Site LN67 is presently in a stable configuration but will recede as the adjacent headland erodes, and LN68 appears stable to accretionary for the near term (Figure 9).

Site LN69 is stable between groins, and LN70 is still mobile between a revetment and breakwater but might become stable over time as it evolves between these man-made headlands. A groinfield helps maintain the stability of LN71 and LN72 in a stable embayment. Site LN73 also appears stable between a jetty and groin (Figure 9).

Figure 7. Selected dune site ground photos in Reach I.

Figure 8. Selected dune site ground photos in Reach III.

Figure 9. Selected dune site ground photos in Reach IV and V.

VI. SUMMARY

Shoreline change rates are based on aerial imagery taken at a particular point in time. We have attempted to portray the same shoreline feature for each date along the coast of Lancaster County. Every 500 feet along each baseline on each plate, the rate of change was calculated. The mean or average rate for each plate is shown in Table 2 for five time periods with the long-term rate determined between 1937 and 2002. The total average and standard deviation (Std Dev) for the entire data set of individual rates is also given. The standard deviation shows the relative spread of values about the mean or average. Larger standard deviation values relative to the mean indicates a wider scatter of erosion rates about the mean while lower standard deviation values indicates erosion rates are concentrated near the mean (*i.e.* all the rates calculated for the entire plate were similar).

The largest variability in mean shore change rates and standard deviations were recorded for the shoreline described by baseline 16A. For instance, between 1982 and 1994, the standard deviation was larger than the average rate of change indicating that the overall rate is probably not indicative of the change which occurred on this section of shore. However, not all of the dates for this section of shore had mean shore change rates with large standard deviations. In fact, many standard deviations were equal to or significantly less than the average rate of change, indicating that the shore change rates were relatively consistent for those time periods. In general, the plates influenced by the Chesapeake Bay wave climate (Plates 16-21) had the largest rates of change.

When short time frames are used to determine rates of shoreline change, shore alterations may seem amplified. The rates based on short-time frames can modify the overall net rates of change. Hopefully, the shore change patterns shown in this report along with the aerial imagery will indicate how the coast will evolve based on past trends and can be used to provide the basis for appropriate shoreline management plans and strategies. Dunes and beaches are a valuable resource that should be either maintained, enhanced or created in order to abate shoreline erosion and provide sandy habitat.

Table 2. Summary average shoreline rates of change and their standard deviation for Lancaster County.

	Plate 1A		Plate 1B		Plate 1C		Plate 2		Plate 3		Plate 4		Plate 5		Plate 6	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	-0.3	0.7	0.3	0.7	-0.5	1.4	-0.4	0.9	-0.2	2.8	0.2	4.4	-0.8	1.9	-0.5	1.6
1959-1982	-1.0	0.7	-0.4	0.6	-2.6	1.3	-2.3	1.3	-1.0	1.4	0.1	2.3	1.2	5.9	0.0	1.4
1982-1994	-0.1	0.7	-0.6	0.8	-5.0	3.7	-2.8	1.2	-1.5	2.6	-0.7	2.7	-1.6	2.1	-0.4	2.2
1994-2002	-3.8	1.3	-0.4	0.8	-4.3	4.8	-3.3	2.8	-0.6	3.7	-1.9	4.8	-1.8	4.9	-3.3	1.9
1937-2002	**-0.9**	**0.4**	**-0.2**	**0.3**	**-2.6**	**0.8**	**-1.9**	**0.8**	**-0.8**	**1.0**	**-0.7**	**2.0**	**-0.3**	**1.3**	**-0.9**	**1.4**
	Plate 7		**Plate 8A**		**Plate 8B**		**Plate 9A**		**Plate 9B**		**Plate 10**		**Plate 11**		**Plate 12**	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	0.3	1.7	-3.4	3.4	-3.0	2.2	0.9	0.6	4.5	1.1	-0.7	1.5	-1.2	1.7	0.0	2.4
1959-1982	-1.8	1.6	-0.7	0.9	-0.7	1.1	-1.9	0.7	-5.9	2.3	-1.3	0.4	-0.4	0.9	-1.2	2.1
1982-1994	1.2	9.7	-1.3	1.5	0.0	1.6	0.1	0.3	3.3	2.6	-0.4	0.7	-0.8	1.4	-0.6	3.5
1994-2002	-3.7	5.6	-1.7	0.9	-1.6	1.7	-0.5	0.6	-4.8	3.1	-1.6	2.6	-0.6	2.4	0.1	1.7
1937-2002	**-0.7**	**1.7**	**-1.9**	**1.3**	**-1.4**	**1.0**	**-0.4**	**0.3**	**-0.6**	**0.5**	**-1.0**	**0.5**	**-0.8**	**0.6**	**-0.5**	**1.0**
	Plate 13		**Plate 14**		**Plate 15**		**Plate 16A**		**Plate 16B**		**Plate 17**		**Plate 18**		**Plate 20**	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	-0.7	1.0	-0.2	5.5	0.5	0.9	-5.7	8.6	-2.1	5.0	-9.6	1.3	-3.3	4.3	-2.9	2.8
1959-1982	-1.2	1.6	-0.4	3.5	-0.6	0.9	-14.4	7.4	-0.7	3.4	-6.8	3.6	-4.3	3.6	-3.0	2.4
1982-1994	-1.8	2.4	-2.0	4.8	-0.9	1.7	-20.1	27.7	-1.0	2.1	-4.3	7.1	-9.3	11.7	-1.4	3.9
1994-2002	0.9	2.6	2.7	4.1	1.1	3.4	-3.0	1.8	-0.4	2.3	-1.8	5.2	-1.6	9.9	-1.8	2.5
1937-2002	**-0.9**	**1.0**	**-0.3**	**1.7**	**-0.1**	**0.6**	**-11.1**	**4.5**	**-1.2**	**1.5**	**-6.7**	**2.0**	**-4.6**	**2.4**	**-2.5**	**1.8**

VII. REFERENCES

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APPENDIX A

For each Plate shown on Figure 4 (Page 4), Appendix A contains orthorectified aerial photography flown in 1937, 1959, 1982, 1994, and 2002. Also shown are the digitized shorelines, identified dune sites, and an arbitrarily created baseline. A plot shows only the relative locations of the shorelines while another one depicts the rate of shore change between dates. A summary of the average Plate rate of change in ft/yr as well as the standard deviation for each rate is also shown.

This data is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

APPENDIX B

The data shown in the following tables were primarily collected as part of the Chesapeake Bay Dune: Evolution and Status report and presented in Hardaway *et al.* (2001) and Hardaway *et al.* (2004). Individual site characteristics may now be different due to natural or man-induced shoreline change.

An additional table presents the results of this analysis and describes each dune site's relative long-term, recent, and near-future predicted stability. This data results from the position of the digitized shorelines which have an error associated with them (see Methods, Section III).

Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al.*, 2001).
Site characteristics may now be different due to natural or man-influenced shoreline change.

Identified dune sites in Lancaster County as of 2000.

Dune Site No.	Location^ Easting (Feet)	Northing (Feet)	Date Visited	Dune Shore Length (feet)	Primary Dune Site?	Secondary Dune Site?	*Public Ownership?
3	2,555,400	525,350	30-Jul-1999	250	Yes	No	No
4	2,555,750	524,600	30-Jul-1999	210	Yes	No	No
5	2,557,700	518,400	30-Jul-1999	130	Yes	No	No
6	2,558,750	515,750	30-Jul-1999	670	Yes	No	No
7	2,559,900	514,900	30-Jul-1999	1,025	Yes	No	No
8	2,560,450	514,150	30-Jul-1999	580	Yes	No	No
10	2,562,200	509,650	30-Jul-1999	110	Yes	No	No
11	2,562,800	509,450	30-Jul-1999	990	Yes	Yes	No
12	2,564,500	507,800	30-Jul-1999	190	Yes	No	No
13	2,565,400	507,250	30-Jul-1999	300	Yes	No	No
15	2,566,000	507,200	30-Jul-1999	150	Yes	No	No
16	2,567,750	503,350	30-Jul-1999	125	Yes	No	No
17'	2,568,300	495,050	30-Jul-1999	120	Yes	No	No
18	2,568,350	494,750	30-Jul-1999	310	Yes	No	No
19	2,568,050	492,350	30-Jul-1999	200	Yes	No	No
20'	2,568,150	491,450	03-Dec-1999	140	Yes	No	No
21'	2,568,200	491,200	03-Dec-1999	160	Yes	No	No
22'	2,568,550	490,250	03-Dec-1999	100	Yes	No	No
23'	2,568,950	489,800	03-Dec-1999	170	Yes	No	No
24'	2,569,200	489,150	03-Dec-1999	240	Yes	No	No
25	2,570,000	488,750	03-Dec-1999	420	Yes	No	No
28'	2,593,600	485,650	03-Dec-1999	120	Yes	No	No
29'	2,596,400	486,600	03-Dec-1999	150	Yes	No	No
32	2,604,050	481,450	22-Apr-1999	900	Yes	Yes	No
34	2,608,900	478,650	22-Apr-1999	1,200	Yes	No	No
36	2,610,700	479,100	22-Apr-1999	140	Yes	No	No
39A	2,619,050	471,800	22-Apr-1999	850	Yes	Yes	No
39B	2,619,050	471,800	22-Apr-1999	600	Yes	No	No
40A	2,623,930	476,750	22-Apr-1999	320	Yes	No	No
43	2,631,650	476,200	22-Apr-1999	820	Yes	No	No
47	2,636,250	475,750	22-Apr-1999	360	Yes	No	No
50	2,638,500	474,850	22-Apr-1999	580	Yes	No	No
51	2,638,750	747,350	22-Apr-1999	250	Yes	No	No
52	2,639,000	474,150	22-Apr-1999	100	Yes	No	No
64A	2,626,220	489,950	20-May-1999	200	Yes	No	No
65	2,626,300	490,350	20-May-1999	150	Yes	No	No
66	2,626,100	490,600	20-May-1999	170	Yes	No	No
67	2,625,750	491,250	20-May-1999	140	Yes	No	No
68	2,625,350	491,900	20-May-1999	250	Yes	Yes	No
69	2,628,800	494,300	20-May-1999	100	Yes	No	No
70	2,628,550	496,450	20-May-1999	100	Yes	No	No
71	2,628,250	496,850	20-May-1999	300	Yes	No	No
72	2,627,400	497,650	20-May-1999	570	Yes	Yes	No
73	2,626,700	498,050	20-May-1999	300	Yes	Yes	No

*Public ownership includes governmental entities including local, state, and federal; otherwise ownership is by the private individual.
^Location is in Virginia State Plane South, NAD 1927
'Sites were noted as dunes but were not photographed or surveyed

Dune site measurements in Lancaster County as of 2000.

Dune Site Measurements							
Primary Dune			Secondary Dunes				
Crest Elev	Distance from Crest landward to back base	To MLW	2nd Dune Site	Crest Elev	Distance From Primary Crest to 2nd Crest	2ndCrest landward	2nd Crest seaward to 1st back base
(ftMLW)	(feet)	(feet)		(ftMLW)	(feet)	(feet)	(feet)
5	18	35					
3.94	21	44					
3.44	32	45					
3.67	14	33					
5	6	53					
4.81	39	40					
4.06	12	32					
3.53	3	28	Yes	3.27	29	3	26
3.87	9	47					
4.58	23	28					
3.75	19	35					
2.77	13	23					
5.09	18	27					
5.83	24	54					
4.59	15	50					
4.52	18	45	Yes	4.41	61	29	43
5.54	28	60					
3.7	32	61	Yes	3.44	143	86	25
5.28	27	65					
5.5	20	45					
5	20	30					
5	50	41					
4.34	15	60					
5	40	28					
7.15	32	63					
5.84	50	40					
4.86	44	48					
3.74	7	42					
5.13	63	50					
3.63	18	79	Yes	3.42	60	13	42
5.41	25	65					
3.91	50	52					
5.25	4	44					
3.39	18	29	Yes	3.03	40	18	4
4.74	25	50	Yes	5.11	104	52	27

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

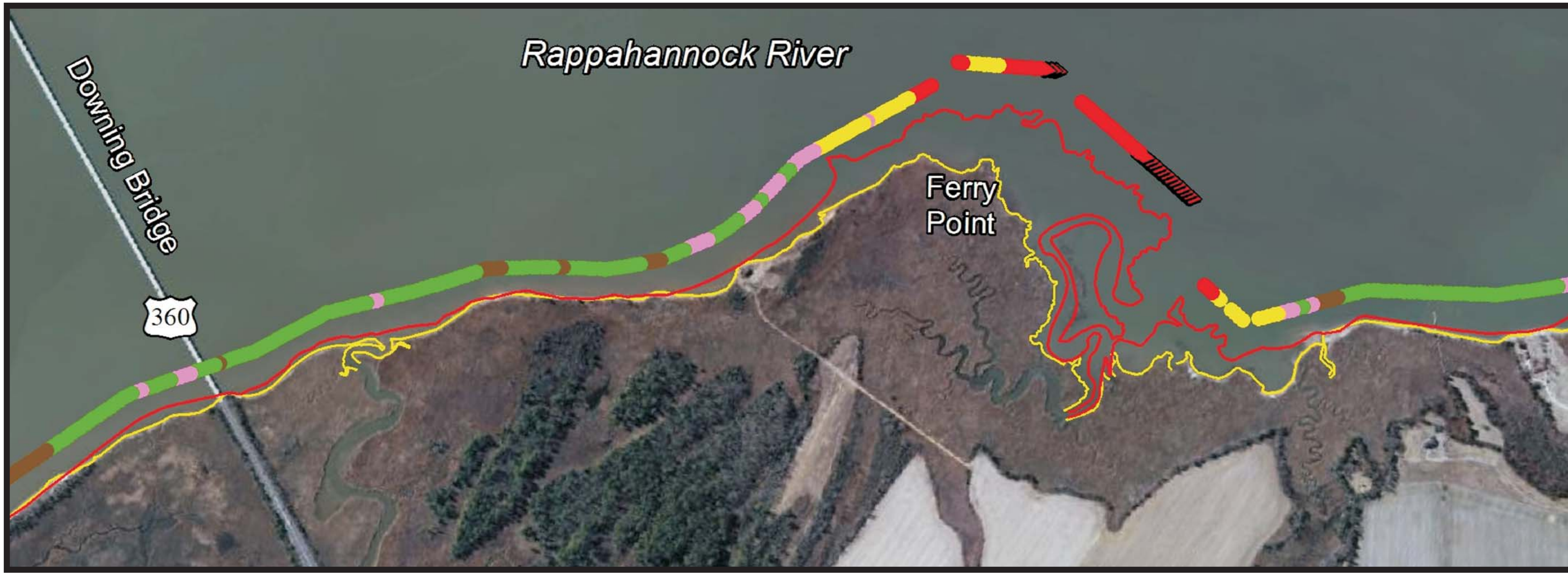
Dune site parameters in Lancaster County as of 2000.

Site No.	Type	Dune Site Parameters Fetch Exposure A	Shoreline Direction of Face B	Nearshore Gradient C		Morphologic Setting D	Relative Stability E	Underlying Substrate F	Structure or Fill G
3	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Pocket	Stable	Upland	Groin
4	Natural	Riverine	Southwest	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	
5	Natural	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	
6	Natural	Riverine	South	Steep	No Bars	Isolated, Shallow Bay	Erosional	Upland	
7	Natural	Riverine	Southwest	Steep	No Bars	Dune Field, Linear	Stable	Upland	
8	Man Inf	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
10	Natural	Riverine	West	Steep	No Bars	Isolated, Linear	Erosional	Upland	
11	Natural	Riverine	Southwest	Medium	No Bars	Dune Field, Shallow Bay	Stable	Upland	
12	Man Inf	Riverine	Southwest	Medium	No Bars	Ck Mouth Barrier/Spit	Accretionary	Marsh	Revet/Bulkhead
13	Man Inf	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
15	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Linear	Erosional	Marsh	Beach Fill
16	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
17	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
18	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
19	Man Inf	Riverine	West	Medium	No Bars	Isolated, Linear	Stable	Upland	Groin
20	Man Inf	Riverine	West	Medium	No Bars	Isolated, Linear	Erosional	Marsh	Groin
21	Natural	Riverine	West	Medium	No Bars	Isolated, Linear	Erosional	Marsh	
22	Natural	Riverine	Southwest	Steep	No Bars	Isolated, Pocket	Erosional	Marsh	
23	Natural	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Erosional	Marsh	
24	Man Inf	Riverine	West	Steep	No Bars	Ck Mouth Barrier/Spit	Accretionary	Marsh	Jetty
25	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Linear	Stable	Marsh	Beach Fill
26	Natural	Riverine	Southwest	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	
27	Man Inf	Riverine	Southeast	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
28	Natural	Riverine	South	Steep	No Bars	Isolated, Pocket	Stable	Marsh	
29	Man Inf	Riverine	Southwest	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Upland	Jetty
32	Man Inf	Riverine	Southwest	Steep	No Bars	Dune Field, Linear	Stable	Upland	Jetty
34	Man Inf	Riverine	South	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	Groin
36	Man Inf	Riverine	South	Steep	No Bars	Isolated, Shallow Bay	Stable	Upland	Groin
39A	Natural	Riverine	West	Steep	No Bars	Dune Field, Salient	Accretionary	Upland	
39B	Natural	River, Bay Inf	South	Steep	No Bars	Dune Field, Salient	Erosional	Upland	
40A	Man Inf	River, Bay Inf	Southeast	Shallow	No Bars	Isolated, Shallow Bay	Stable	Upland	Revet/Bulkhead
43	Natural	River, Bay Inf	Southeast	Medium	Bars	Dune Field, Linear	Erosional	Upland	
47	Man Inf	River, Bay Inf	South	Medium	Bars	Isolated, Linear	Stable	Upland	Groin
50	Man Inf	River, Bay Inf	Southwest	Medium	No Bars	Dune Field, Shallow Bay	Stable	Upland	Groin
51	Man Inf	River, Bay Inf	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
52	Man Inf	River, Bay Inf	South	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
64A	Man Inf	Open Bay	East	Medium	Bars	Isolated, Linear	Erosional	Upland	Beach Fill
65	Man Inf	Open Bay	East	Medium	Bars	Isolated, Pocket	Erosional	Upland	Revet/Bulkhead
66	Natural	Riverine	Northeast	Shallow	No Bars	Isolated, Salient	Accretionary	Upland	
67	Natural	River, Bay Inf	East	Medium	Bars	Isolated, Pocket	Erosional	Marsh	
68	Natural	River, Bay Inf	North	Steep	No Bars	Isolated, Salient	Accretionary	Upland	
69	Man Inf	River, Bay Inf	South	Steep	Bars	Isolated, Pocket	Erosional	Upland	Groin
70	Man Inf	River, Bay Inf	Northeast	Steep	Bars	Isolated, Linear	Erosional	Marsh	Breakwaters
71	Man Inf	River, Bay Inf	Northeast	Steep	Bars	Isolated, Linear	Stable	Upland	Groin
72	Natural	River, Bay Inf	North	Steep	No Bars	Dune Field, Shallow Bay	Stable	Upland	
73	Man Inf	River, Bay Inf	Northeast	Steep	No Bars	Isolated, Salient	Stable	Upland	Jetty

Long-term, recent stability and future predictions of shore erosion and accretion rates for dune sites in Lancaster County.

	Site No.	Long-Term Stability 1937-2002	Recent Stability 1994-2002	Near Future Prediction
LN	3	Erosional	Stable	Stable
LN	4	Stable	Erosional	Erosional
LN	5	Erosional	Erosional	Stable
LN	6	Erosional	Erosional	Erosional
LN	7	Accretionary	Erosional	Stable
LN	8	Accretionary	Stable	Stable
LN	10	Accretionary	Erosional	Erosional
LN	11	Accretionary	Stable	Stable
LN	12	Erosional	Accretionary	Stable
LN	13	Stable	Stable	Stable
LN	15	Erosional	Stable	Erosional
LN	16	Erosional	Erosional	Erosional
LN	17	Erosional	Erosional	Erosional
LN	18	Accretionary	Erosional	Erosional
LN	19	Accretionary	Stable	Stable
LN	20	Erosional	Erosional	Erosional
LN	21	Erosional	Erosional	Erosional
LN	22	Erosional	Erosional	Erosional
LN	23	Erosional	Erosional	Erosional
LN	24	Accretionary	Erosional	Stable
LN	25	Accretionary	Erosional	Erosional
LN	28	Erosional	Stable	Stable
LN	29	Stable	Stable	Stable
LN	32	Accretionary	Stable	Stable
LN	34	Erosional	Stable	Stable
LN	36	Erosional	stable	Stable
LN	39A	Accretionary	Accretionary	Accretionary
LN	39B	Accretionary	Erosional	Erosional
LN	40A	Accretionary	Accretionary	Stable
LN	43	Accretionary	Erosional	Erosional
LN	47	Erosional	Stable	Stable
LN	50	stable	Stable	Stable
LN	51	Erosional	stable	Stable
LN	52	Erosional	Stable	Stable
LN	64A	Erosional	Erosional	Erosional
LN	65	Erosional	Erosional	Erosional
LN	66	Erosional	stable	Accretionary
LN	67	Erosional	Accretionary	Stable
LN	68	Accretionary	Stable	Stable
LN	69	Stable	Stable	Stable
LN	70	Erosional	Erosional	Erosional
LN	71	Erosional	Stable	Stable
LN	72	Accretionary	Stable	Stable
LN	73	Accretionary	Stable	Stable

Shoreline Evolution: Richmond County, Virginia Rappahannock River Shorelines



Virginia Institute of Marine Science
College of William & Mary
Gloucester Point, Virginia

September 2011

Shoreline Evolution:
Richmond County, Virginia
Rappahannock River Shorelines

Data Summary Report

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C. Scott Hardaway, Jr.

Shoreline Studies
Department of Physical Sciences
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Gloucester Point, Virginia

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September 2011

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1 Introduction

Richmond County is situated on the Northern Neck Peninsula in the eastern portion of Virginia (Figure 1). The Rappahannock River forms the southern boundary of this 192 square mile community. The County has 149 miles of shoreline on the Rappahannock River and Cat Point and Totuskey Creeks. Through time, the County's shoreline has evolved, and determining the rates and patterns of shore change provides the basis to know how a particular coast has changed through time and how it might proceed in the future. Along Chesapeake Bay's estuarine shores, winds, waves, tides and currents shape and modify coastlines by eroding, transporting and depositing sediments.

The purpose of this report is to document how the shore zone of Richmond County has evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year and can be used to assess the geomorphic nature of shore change. Aerial photos show how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man, through shore hardening or inlet stabilization, come to dominate a given shore reach. In addition to documenting historical shorelines, the change in shore positions along the rivers and larger creeks in Richmond County will be quantified in this report. The shorelines of very irregular coasts, small creeks around inlets, and other complicated areas, will be shown but not quantified.

2 Methods

2.1 Photo Rectification and Shoreline Digitizing

An analysis of aerial photographs provides the historical data necessary to understand the suite of processes that work to alter a shoreline. Images of the Richmond County Shoreline from 1937, 1953, 1969, 1994, 2002, 2007 and 2009 were used in the analysis. The 1994, 2002, 2007 and 2009 images were available from other sources. The 1994 imagery was orthorectified by the U.S. Geological Survey (USGS) and the 2002, 2007 and 2009 imagery was orthorectified by the Virginia Base Mapping Program (VBMP). The 1937, 1953, and 1969 photos were a part of the VIMS Shoreline Studies Program archives. The historical aerial images acquired to cover the entire shoreline were not always flown on the same day. The dates for each year are: *1937* - April 1, 6,7 and 17; *1953* - October 2, 3, and November 27; *1969* - December 5 and 11. The exact dates the 1994 images were flown could not be determined, and the 2002, 2007, and 2009 were all flown in February and March of their respective years.

The 1937, 1953, and 1969 images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. These aerial photographs were orthographically corrected to produce a seamless series of aerial mosaics following a set of standard operating procedures. The 1994 Digital Orthophoto Quarter Quadrangles (DOQQ) from USGS were used as the reference images. The 1994 photos are used rather than higher quality, more recent aerials because of the difficulty in finding control points that match the earliest 1937 and 1953 images.

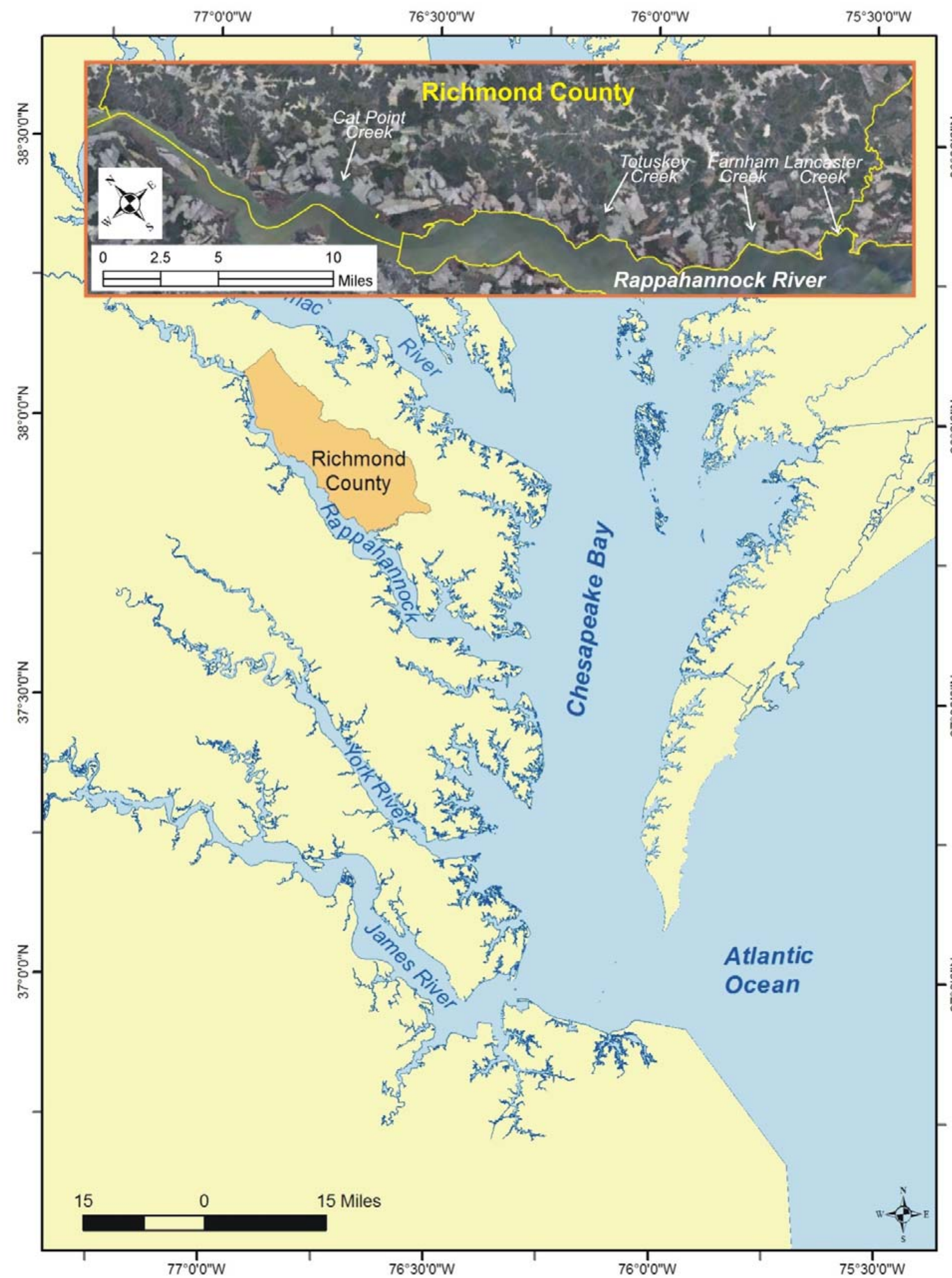

Figure 1. Location of Richmond County within the Chesapeake Bay estuarine system.

ERDAS Orthobase image processing software was used to orthographically correct the individual flight lines using a bundle block solution. Camera lens calibration data were matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. The exterior and interior models were combined with a digital elevation model (DEM) from the USGS National Elevation Dataset to produce an orthophoto for each aerial photograph. The orthophotographs were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic .img format. To maintain an accurate match with the reference images, it is necessary to distribute the control points evenly, when possible. This can be challenging in areas with lack of ground features, poor photo quality and lack of control points. Good examples of control points were manmade features such as road intersections and stable natural landmarks such as ponds and creeks that have not changed much over time. The base of tall features such as buildings, poles. or trees can be used, but the base can be obscured by other features or shadows making these locations difficult to use accurately. Most areas of the county were particularly difficult to rectify, either due to the lack of development when compared to the reference images or due to no development in the historical and the reference images.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background. The morphologic toe of the beach or edge of marsh was used to approximate low water. High water limit of runup can be difficult to determine on the shoreline due to narrow or non-existent beaches against upland banks or vegetated cover. In areas where the shoreline was not clearly identifiable on the aerial photography, the location was estimated based on the experience of the digitizer. The displayed shorelines are in shapefile format. One shapefile was produced for each year that was mosaicked.

Horizontal positional accuracy is based upon orthorectification of scanned aerial photography against the USGS digital orthophoto quadrangles. To get vertical control, the USGS 30m DEM data was used. The 1994 USGS reference images were developed in accordance with National Map Accuracy Standards (NMAS) for Spatial Data Accuracy at the 1:12,000 scale. The 2002, 2007, and 2009 Virginia Base Mapping Program's orthophotography were developed in accordance with the National Standard for Spatial Data Accuracy (NSSDA). Horizontal root mean square error (RMSE) for historical mosaics was held to less than 20 ft.

Using methodology reported in Morton *et al.* (2004) and National Spatial Data Infrastructure (1998), estimates of error in orthorectification, control source, DEM and digitizing were combined to provide an estimate of total maximum shoreline position error. The data sets that were orthorectified (1937, 1953, and 1969) have an estimated total maximum shoreline position error of $\pm$20.0 ft, while the total maximum shoreline error for the four existing datasets are estimated at 18.3 ft for USGS and 10.2 ft for VBMP. The maximum annualized error for the shoreline data is $\pm$0.7 ft/yr. The smaller rivers and creeks are more prone to error due to their lack of good control points for photo rectification, narrower shore features, tree and ground cover and overall smaller rates of change. These areas are digitized but due to the higher potential for error, rates of change analyses are not calculated.

The Richmond County shoreline was divided into 21 plates (Figure 2) in order to display that data in Appendices A and B. In Appendix A, all of the digtized shorelines are shown, and the 2009 image is shown with only the 1937 and 2009 shorelines to show the long-term trends. In Appendix B, two photo dates and their associated shoreline are shown on each plate.

2.2 Rate of Change Analysis

The Digital Shoreline Analysis System (DSAS) was used to determine the rate of change for the County's shoreline (Himmelstoss, 2009). All DSAS input data must be managed within a personal geodatabase, which includes all the baselines created for Richmond County and the digitized shorelines for 1937, 1953, 1969, 1994, 2002, 2007, and 2009. Baselines were created about 200 feet seaward of the 1937 shoreline and encompassed most of the County's main shorelines but generally did not include the smaller creeks. It also did not include areas that have unique shoreline morphology such as creek mouths and spits. DSAS generated transects perpendicular to the baseline about 33 ft apart , which were manually checked and cleaned up. For Richmond County, this method represented about 43 miles of shoreline along 6937 transects. The End Point Rate (EPR) is calculated by determining the distance between the oldest and most recent shoreline in the data and dividing it by the number of years between them. This method provides an accurate net rate of change over the long term and is relatively easy to apply to most shorelines since it only requires two dates. This method does not use the intervening shorelines so it may not account for changes in accretion or erosion rates that may occur through time. However, Milligan *et al.* (2010a, 2010b, 2010c, 2010d) found that in several localities within the bay, EPR is a reliable indicator of shore change even when intermediate dates exist. Average rates were calculated along selected areas of the shore; segments are labeled in Appendix A and shown in Table 1.

3 Summary

The rates of change shown in Table 1 are averaged across large sections of shoreline and may not be indicative of rates at specific sites within the reach. Along many segments, rate of change is very low. Most change occurs at headlands, marshes or southwest or southeast-facing shorelines. The largest average rates occur on the Rappahannock River while the more fetch limited creeks have smaller average erosion rates. Segment L has the highest rate of change due to the loss of land at Waverly Point at the mouthof Totusky Creek and the barrier across Richardson Creek.

Table 1. Average end point rate of change (ft/yr) between 1937 and 2009 for segments along Richmond's shoreline. Segment locations are shown on maps in Appendix A.

Segment Name	Location	Average Rate of Change (ft/yr)
A	Rappahannock River	-0.4
B	Rappahannock River	-0.7
C	Rappahannock River - Mulberry Island	-0.6
D	Rappahannock River	-0.5
E	Cat Point Creek	-0.6
F	Rappahannock River	-0.5
G	Rappahannock River	-2.1
H	Rappahannock River	-1.5
I	Rappahannock River	-0.7
J	Rappahannock River	-0.8
K	Totuskey Creek	-0.5
L	Rappahannock River - Richardson Creek	-3.1
M	Rappahannock River	-0.4
N	Rappahannock River	-0.4
O	Farnham Creek	-0.4
P	Rappahannock River	-1.0
Q	Lancaster Creek	-0.8
R	Morattico Creek	-0.4

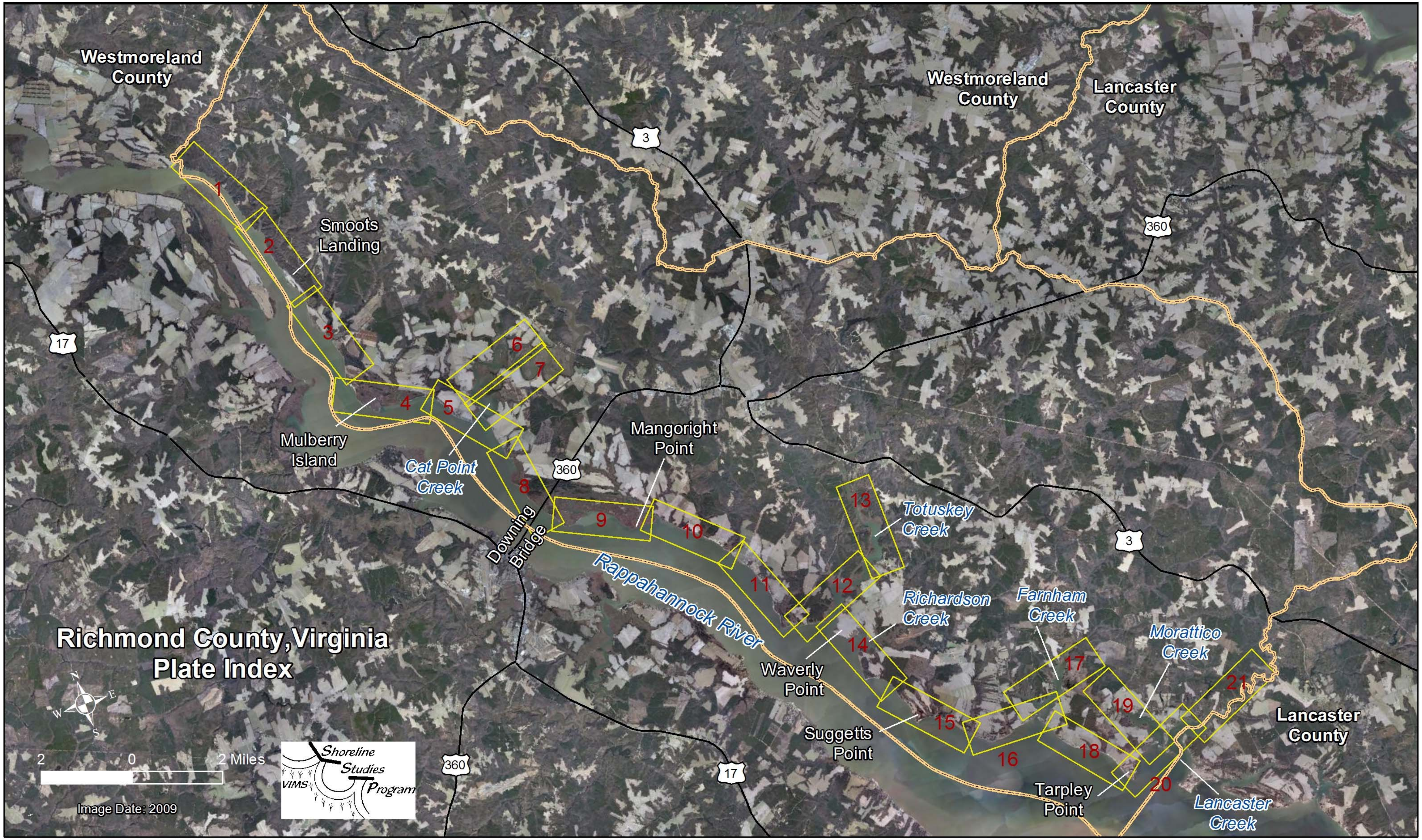

Figure 2. Index of shoreline plates.

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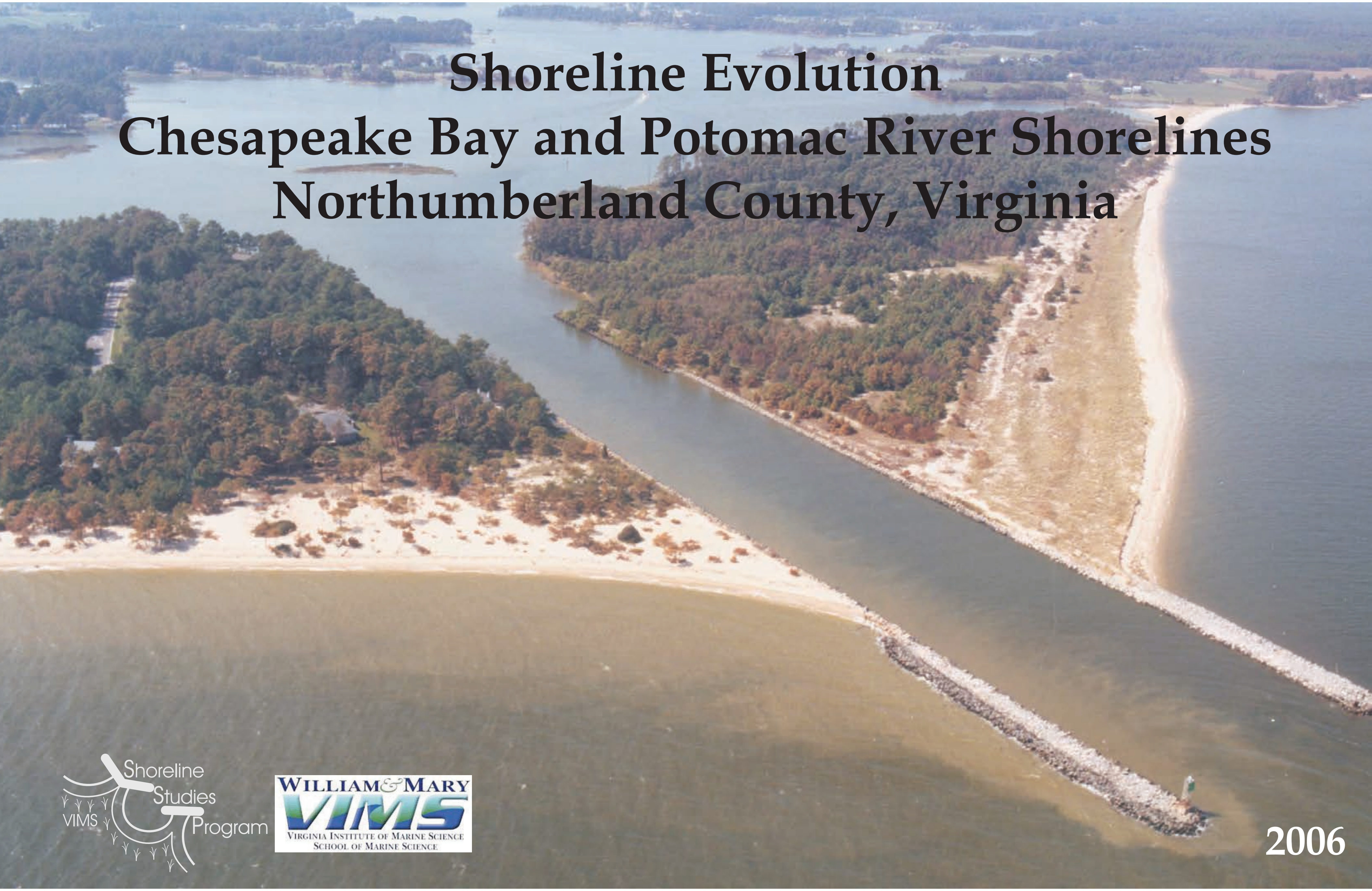
Shoreline Evolution
Chesapeake Bay and Potomac River Shorelines
Northumberland County, Virginia



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2006

Shoreline Evolution
Chesapeake Bay and Potomac River Shorelines
Northumberland County, Virginia

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Cover Photo: Photograph of Smith Point jetties and the Little Wicomico River. Photo taken by Shoreline Studies Program on 25 September 2003 .

I. INTRODUCTION

A. General Information

Shoreline evolution is the change in shore position through time. In fact, it is the material resistance of the coastal geologic underpinnings against the impinging hydrodynamic (and aerodynamic) forces. Along the shores of Chesapeake Bay, it is a process-response system. The processes at work include winds, waves, tides and currents, which shape and modify coastlines by eroding, transporting and depositing sediments. The shore line is commonly plotted and measured to provide a rate of change but it is as important to understand the geomorphic patterns of change. Shore analysis provides the basis to know how a particular coast has changed through time and how it might proceed in the future.

The purpose of this report is to document how dunes on the Potomac River and Chesapeake Bay shores of Northumberland (Figure 1) has evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year, and it is this imagery that allows one to assess the geomorphic nature of shore change. Aerial imagery shows how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man through shore hardening or inlet stabilization come to dominate a given shore reach. Most of the change in shore positions will be quantified in this report. Others, particularly very irregular coasts, around inlets, and other complicated areas will be subject to interpretation.

B. Chesapeake Bay Dunes

The primary reason for developing this Shoreline Evolution report is to be able to determine how dunes and beaches along the River and Bay coasts of Northumberland have and will evolve through time. The premise is that, in order to determine future trends of these important shore features, one must understand how they got to their present state. Beaches and dunes are protected by the Coastal Primary Sand Dune Protection Act of 1980 (Act)[1]. Research by Hardaway *et al.* (2001) located, classified and enumerated jurisdictional dunes and dune fields within the eight localities listed in the Act. These include the counties of Accomack, Lancaster, Mathews, Northampton and Northumberland and the cities of Hampton, Norfolk and Virginia Beach (Figure 2). Only Chesapeake Bay and river sites were considered in that study.

In 2003, Hardaway *et al*. created the Northumberland County Dune Inventory. That report detailed the location and nature of the jurisdictional primary dunes along the Bay shore of Northumberland and those results appear in Appendix B. For this study, the positions of the dune sites are presented using the latest imagery in order to see how the sites sit in the context of past shoreline positions. The dune location information has not been field verified since the original visits in 1999. This information is not intended to be used for jurisdictional determinations regarding dunes.

[1]The General Assembly of Virginia enacted the Coastal Primary Sand Dune Protection Act (the Dune Act) in 1980. The Dune Act was originally codified in § 62.1-13.21 to -13.28. The Dune Act is now recodified as Coastal Primary Sand Dunes and Beaches in § 28.2-1400 to -1420.

II. SHORE SETTING

A. Physical Setting

The Potomac River and Chesapeake Bay shoreline of Northumberland County extends from the county line with Westmoreland at the Yeocomico River down river to Smith Point and southward to the Lancaster County line at Indian Creek. This includes about 17 miles of tidal shoreline along the Potomac River and 18 miles along Chesapeake Bay. Additional shoreline is included in the tributaries. Historic shore erosion rates vary from 0 ft/yr to over 7 ft/yr along the Bay coast with several areas of localized accretion. The Potomac River shoreline change rates varied between +1 ft/yr to -10 ft/yr (Byrne and Anderson, 1978).

The coastal geomorphology of the County is a function of the underlying geology and the hydrodynamic forces operating across the land/water interface, the shoreline. The Chesapeake Bay and Potomac River coasts of Northumberland are almost exclusively Upper Pliestocene undifferentiated members of the Tabb Formation. Several areas of Holocene beach sands and muds occur along the Chesapeake Bay shore (Figure 3). The Atlantic Ocean has come and gone numerous times over the Virginia coastal plain over the past million years or so. The effect has been to rework older deposits into beach and lagoonal deposits at time of the transgressions. The last low stand found the ocean coast about 60 miles to the east when sea level about 300 feet lower than today and the coastal plain was broad and low. The current estuarine system was a meandering series of rivers working their way to the coast. About 15,000 years ago, sea level began to rise and the coastal plain watersheds began to flood. Shorelines began to recede. The slow rise in sea level is one of two primary long-term processes which cause the shoreline to recede; the other is wave action, particularly during storms. As shorelines recede or erode, the bank material provides the sands for the offshore bars, beaches and dunes. Parts of Northumberland's littoral system is sand rich from erosion over time of the sandy, sometimes high, upland banks and the nearshore substrate. Many sand beaches occur along the coast and an extensive system of offshore sand bars exist along both the Potomac and Chesapeake shores. These sand bars greatly influenced and are themselves influenced by the impinging wave climate.

Sea level is continuing to rise in Chesapeake Bay. Tide data collected at Sewells Point in Norfolk show that sea level has risen 4.42 mm/yr (0.17 inches/yr) or 1.45 ft/century (http://www.co-ops.nos.noaa.gov/). Lewisetta on the Potomac River in Northumberland County rose 4.85 mm/yr or 1.59 ft/century. Increased water levels directly effect the reach of storms and their impact on shorelines. Anecdotal evidence of storm surge during Hurricane Isabel, which impacted North Carolina and Virginia on September 18, 2003, put it on par with the storm surge from the "storm of the century" which impacted the lower Chesapeake Bay in August 1933. Boon (2003) showed that even though the tides during the storms were very similar, the difference being only 4 cm (~0.5 in), the amount of surge was different. The 1933 storm produced a storm surge that was greater than Isabel's by slightly more than a foot. However, analysis of the mean water levels for the months of both August 1933 and September 2003 showed that sea level has risen by 41 cm (1.35 ft) at Hampton Roads in the seventy years between these two storms (Boon, 2003). This is the approximate time span between our earliest aerial imagery (1937) and our most recent (2002), which means the impact of sea level rise to shore change is significant. The beaches, dunes, and nearshore sand bars try to keep pace with the rising sea levels.

Four shore reaches are considered in this report along the shoreline of Northumberland (Figure 4). Reach I extends along the Yeocomico River and Potomac River from the boundary with Westmoreland County to Lewisetta. Reach II goes from the Coan River to the jetties at Smith Point. Reach III picks up at the jetties and heads south to the Wicomico River. Reach IV occurs on Chesapeake Bay from the Wicomico River to the boundary with Lancaster County at Indian Creek.

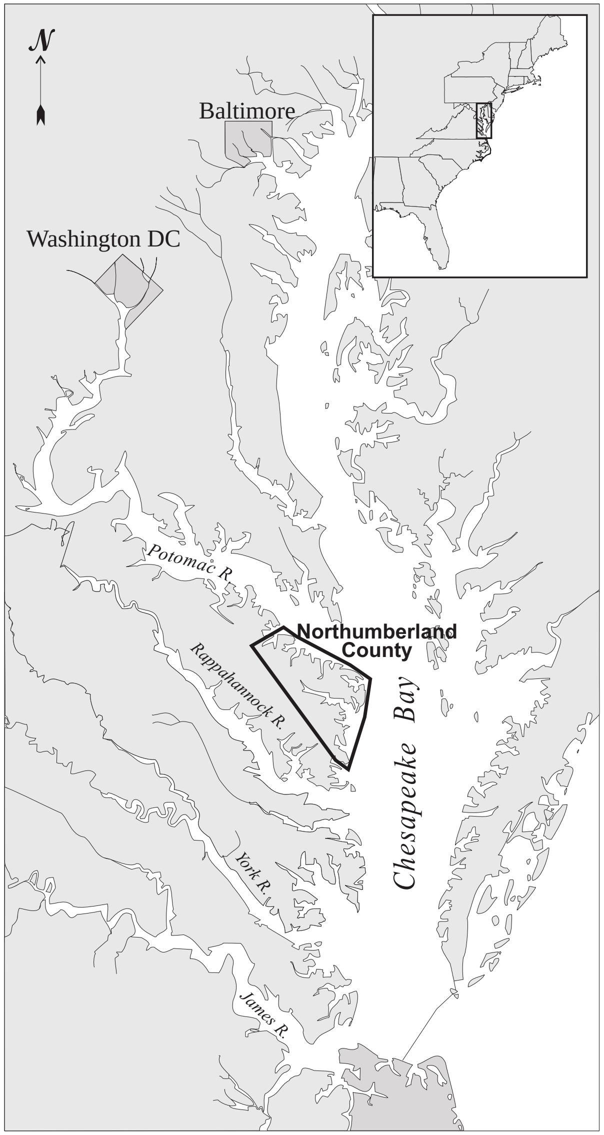

Figure 1. Location of Northumberland County within the Chesapeake Bay estuarine system.

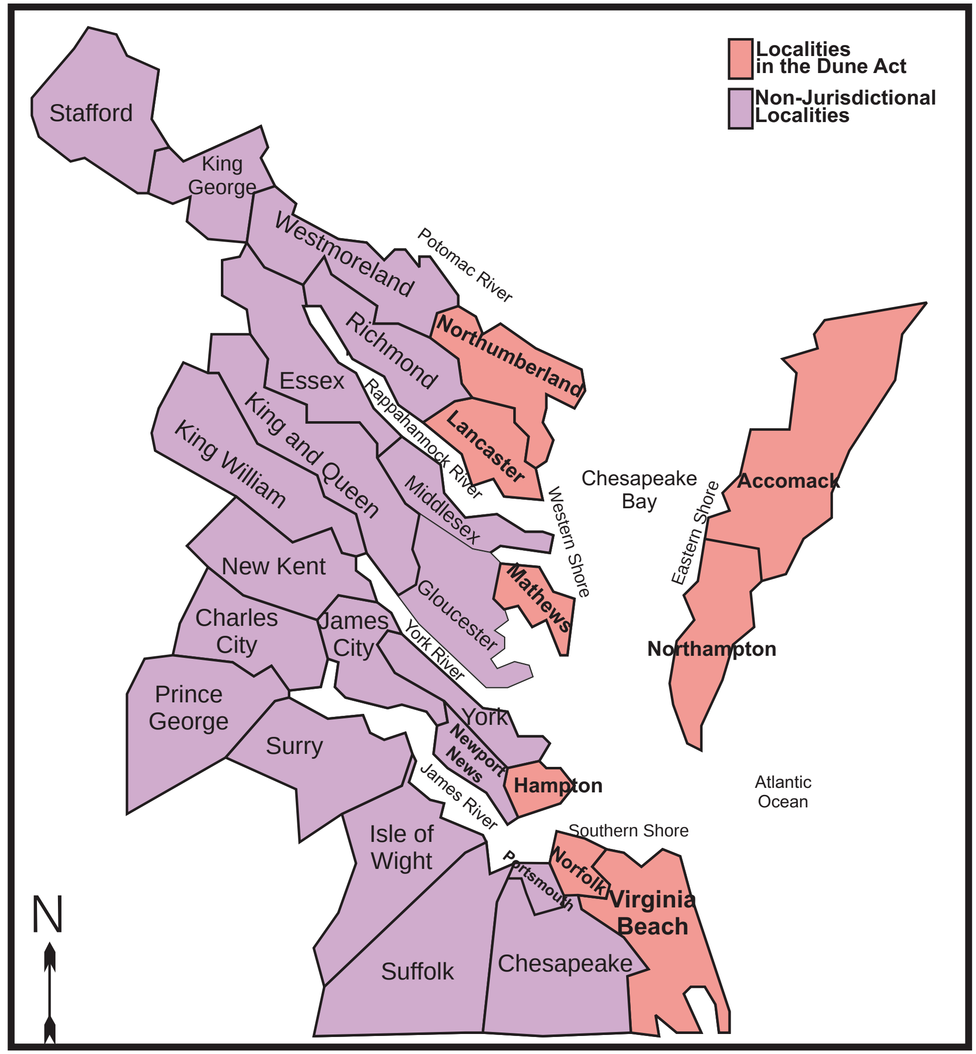

Figure 2. Location of localities in the Dune Act with jurisdictional and non-jurisdictional localities noted.

Qm **Holocene Soft Mud** - Medium to dark-gray, and peat, grayish brown. Comprises sediment of marshes in coastal areas and Chesapeake Bay. Thickness is 0-10 ft.

Qs **Holocene Sand** - Pale gray to light-yellowish gray, fine to coarse, poorly sorted to well sorted, shelly in part; contains angular to rounded fragments and whole valves of mollusks. Comprises deposits of coastal barrier islands and narrow beach-dune ridges bordering brackish-water marshes of Chesapeake Bay. As much as 40 ft in thickness.

Qtlp **Lynnhaven and Poquoson Members, undifferentiated (Upper Pleistocene)**.

Qts **Sedgefield Member (Upper Pleistocene)** - Pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt; locally, channel fill at base of unit includes as much as 50 ft of fine to coarse, crossbedded sand and clayey silt and peat containing in situ tree stumps. Sandy bay facies commonly contains Crassostrea biostromes, Mercenaria, Anadara, Polynices, Ensis, and other mollusks. Specimes of the coral Astrangia have yielded estimated uranium-series ages averaging 71,000 +/- 7,000 yrs B.P. (Mixon and others, 1982). Unit constitutes surficial deposit of river- and coast-parallel plains (alt. 20-30 ft) bounded on landward side by Suffolk and Harpersville scarps. Thickness is 0-50 ft.

Qsh **Shirley Formation (middle Pleistocene)** - Light-to dark-gray and brown sand, gravel, silt, clay, and peat. Constitutes surficial deposits of riverine terraces and relict baymouth barriers and bay-floor plains (alt. 35-45 ft) inset below depositional surfaces of the Chuckatuck Formation (Johnson and Peebles, 1984). Upper part of unit is truncated on the east by the Suffolk and Harpersville scarps; locally, lower part extends east of scarps. Fluvial-estuarine facies comprises (1) a lower pebble to boulder sand overlain by (2) fine to coarse sand interbedded with peat and clayey silt rich in organic material, including in situ tree stumps and leaves and seeds of cypress, oak, and hickory, which grades upward to (3) medium- to thick-bedded, clayey and sandy silt and silty clay. Marginal-marine facies in lower James River and lowermost Rappahannock River areas is silty fine sand and sandy silt containing *Crassostrea virginica*, *Mulinia*, *Noetia*, *Mercenaria*, and other mollusks. *Astrangia* from lower Rappahannock River area has yielded a uranium-series age of 184,000 +/- 20,000 years B.P. (Mixon and other, 1982). Thickness is 0-80 ft.

QTw **Windsor Formation (lower Pleistocene or upper Pliocene) -** Gray and yellow to reddish-brown sand, gravel, silt, and clay. Constitutes surficial deposits if extensive plain (alt. 85-95 ft) seaward of Surry scarp and coeval, fluvial-estuarine terrace west of scarp. Fining-upward sequence beneath plain consists of basal pebbly sand grading upward into crossbedded, quartzose Sand and massive, clayey silt and silty clay; lower and upper parts of sequence were deposited, repectively, in shallow-marine or open-bay and restricted-bay or lagoonal environments. In terraces west of Surry scarp, fluvial-estuarine deposit comprise muddy, coarse, trough-crossbedded sand and gravel grading upward to sandy silt and clay. Unit is 0-40 ft thick.

Tc **Chesapeake Group (upper Pliocene to lower Miocene) -** Fine to coarse, quartzose sand, silt, and clay; variably shelly and diatomaceous, deposited mainly in shallow, inner- and middle-shelf waters. Ages of units based in studies of foraminiferal, nannofossil, diatom, and molluscan assemblages in Virginia and adjacent states (Andrews, 1988; Gibson, 1983; Gibson and others, 1980; Poag, 1989; Ward and Blackwelder, 1980; Ward and Krafft, 1984), Includes the following formations (see also sheet 2, figure 1), from youngest to oldest; Chowan River Formation (upper Pliocene), Yorktown Formation (lower upper and lower Pliocene), Eastover Formation (upper Miocene), St. Mary's Formation (upper and middle Miocene), Choptank Formation (middle Miocene), and Calvert Formation (middle and lower Miocene).

Tm **Moorings unit of Oaks and Coch (1973) (upper Pliocene) -** White, light-gray, and grayish-yellow quartzose sand and gray to grayish-brown clayed silt and silty clay. Constitutes discontinuous linear body along and just west of Surry scrap; depositional surfaces range in altitude from 130 ft along slightly higher, ridge-like topography at scarp to about 110 ft west of scarp. Eastern facies of unit is unfossiliferous, massive to cross-laminated, moderately well-sorted, fine sand believed to have been deposited in beach and near shore environments. Upper part of fine sand facies interfingers westward with massive, bioturbated clay and slit deposited in a lagoon or shallow bay. Unit is as much as 30 ft thick.

Tb1 **Tb2** **Bacons Castle Formation (upper Pliocene) -** Gray, yellowish-orange, and reddish-brown sand, gravel, silt, and clay; Constitutes surficial deposits of high plain extending from Richmond, VA., Eastward to Surry Scrap. Unit is subdivided into two members: Tb^1 and Tb^2. Tb^2 predominantly thin-bedded and laminated clayey silt and silty fine sand. TB^2 is characterized by flaser, wayy, and lenticular bedding and rare to common clay-lined burrows including *Ophiomorpha nodosa.* Unit is 0-70 ft thick.

Figure 3. Geologic map of Northumberland County (from Mixon *et al*., 1989).

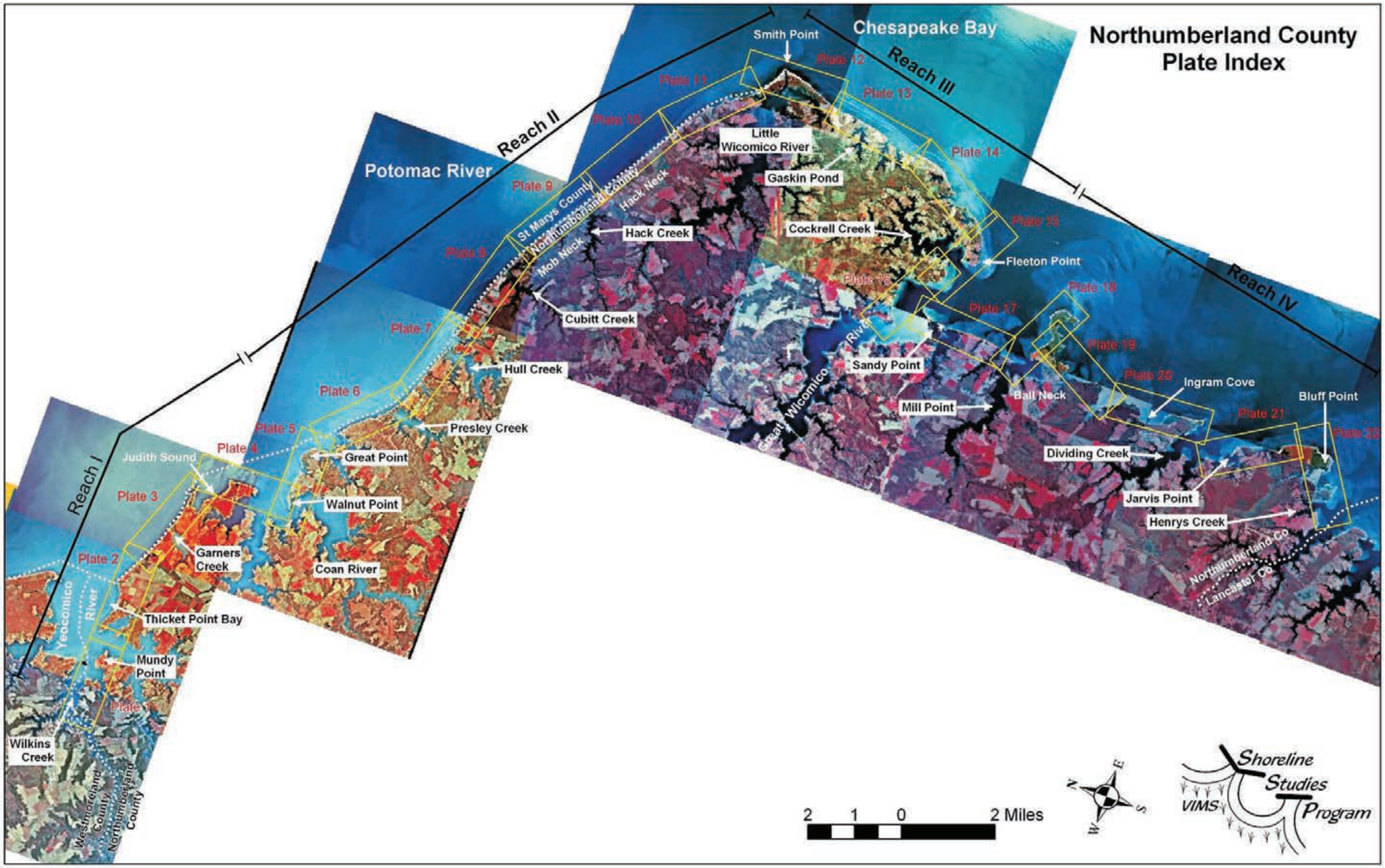

Figure 4. Index of shoreline plates.

B. Hydrodynamic Setting

Mean tide range along the upper Potomac River coast of Northumberland is about 1.2 ft (1983-2001 Tidal Epoch at Lewisetta). Spring tide range is 1.5 ft. The Chesapeake Bay shoreline in Northumberland has similar tide ranges. The wind/wave climate impacting the Northumberland Bay coast is defined by large fetch exposures to the northeast, east, and spoutheast across Chesapeake Bay and fetch exposures to the northwest, north, and northeast along Potomac River. Wind data from Quantico Marine Corps Base upriver reflect the frequency and speeds of wind occurrences from 1973 to 2001 (Table 1) which characterize the locally-generated Bay waves.

Northeasters are particularly significant in terms of the impacts of storm surge and waves on beach and dune erosion. Hurricanes, depending on their proximity and path can also have an impact to the Virginia Beach coast. On September 18, 2003, Hurricane Isabel passed through the Virginia coastal plain. The main damaging winds began from the north and shifted to the east then south. Beach erosion and dune scarping were significant but areas with wide beaches offered more protection to the adjacent dunes.

Table 1. Summary wind conditions at Quantico Marine Corps Base from 1973-2001.

		WIND DIRECTION								
Wind Speed (mph)	**Mid Range (mph)**	**North**	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**	**Total**
< 5	3	5703* 3.21+	3330 1.87	3868 2.18	4792 2.70	12257 6.90	4291 2.42	7070 3.98	15437 8.69	56748 31.95
5-11	8	17454 9.82	10087 5.68	6504 3.66	8117 4.57	22593 12.72	8515 4.79	13391 7.54	18453 10.39	105114 59.17
11-21	16	3698 2.08	1460 0.82	386 0.22	517 0.29	2030 1.14	1156 0.65	1129 0.64	4601 2.59	14977 8.43
21-31	26	165 0.09	64 0.04	34 0.02	21 0.01	60 0.03	64 0.04	102 0.06	274 0.15	784 0.44
31-41	36	7 0	1 0	2 0	0 0	1 0	1 0	7 0	7 0	26 0.01
41-50	46	0 0	0 0	0 0	0 0	1 0	0 0	0 0	0 0	1 0
>50		1 0	3 0	3 0	3 0	4 0	0 0	7 0	5 0	26 0.01
Total		27028 15.20	14945 8.41	10797 6.08	13450 7.57	36946 20.79	14027 7.9	21706 12.22	38777 21.82	177676 100.00

*Number of occurrences +Percent

III. METHODS

A. Photo Rectification and Shoreline Digitizing

Recent and historic aerial photography was used to estimate, observe, and analyze past shoreline positions and trends involving shore evolution for Northumberland. Some of the photographs were available in fully geographically referenced (georeferenced) digital form, but most were scanned and orthorectified for this project.

Aerial photos from VIMS Shoreline Studies and Submerged Aquatic Vegetation (SAV) Programs, as well as from United States Geological Survey (USGS) archives were acquired. The years used for the shoreline change analysis included 1937, 1953, 1969, 1994, and 2002. Color aerials were obtained for 1994 and 2002. The 1994 imagery was processed and mosaicked by USGS, while the imagery from 2002 was mosaicked by the Virginia Base Mapping Program (VBMP). The aerial photography for the remaining years were mosaicked by the VIMS Shoreline Study Program.

The images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. They were orthorectified to a reference mosaic, the 1994 Digital Orthophoto Quarterquadrangles (DOQQ) from USGS. The original DOQQs were in MrSid format but were converted into .img format as well. ERDAS Orthobase image processing software was used to orthographically correct the individual flightlines using a bundle block solution. Camera lens calibration data was matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. A minimum of four ground control points were used per image, allowing two points per overlap area. The exterior and interior models were combined with a 30-meter resolution digital elevation model (DEM) from the USGS National Elevation Dataset (NED) to produce an orthophoto for each aerial photograph. The orthophotographs that cover each USGS 7.5 minute quadrangle area were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic also in an .img format.

To maintain an accurate match with the reference images, it was necessary to distribute the control points evenly. This can be challenging in areas with little development. Good examples of control points are permanent features such as manmade features and stable natural landmarks. The maximum root mean square (RMS) error allowed is 3 for each block.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background to help delineate and locate the shoreline. For Northumberland's coast, an approximation to mean low water (MLW) was digitized. This often was defined as the "wetted perimeter" on the beach sand as the last high water location. In areas where the shoreline was not clearly delineated on the aerial photography, the location was estimated based on the experience of the digitizer. Digitizing the shoreline brings in, perhaps, the greatest amount of potential error because of the problems of image clarity and definition of shore features. A series of Northumberland dune site profiles are displayed in Figure 5 which shows beach/dune variability. Figure 6 shows the relationship of MHW, MLW and beach/dune system components.

B. Rate of Change Analysis

A custom Arcview extension called "shoreline" was used to analyze shoreline rate of change. A straight, approximately shore parallel baseline is drawn landward of the shoreline. The extension creates equally-spaced transects along the baseline and calculates distance from the baseline at that location to each year's shoreline. The output from the extension are perpendicular transects of a length and interval specified by the user. The extension provides the transect number, the distance from beginning baseline to each transect, and the distance from the baseline to each digitized shoreline in an attribute table. The attribute table is exported to a spreadsheet, and the distances of the digitized shoreline from the baseline are used to determine the rates of change. The rates of change are summarized as mean or average rates and standard deviations for each Plate.

It is very important to note that this extension is only useful on relatively straight shorelines. In areas that have unique shoreline morphology, such as creek mouths and spits, the data collected by this extension may not provide an accurate representation of true shoreline change. The shore change data was manually checked for accuracy. However, where the shoreline and baseline are not parallel, the rates may not give a true indication of the rate of shoreline change.

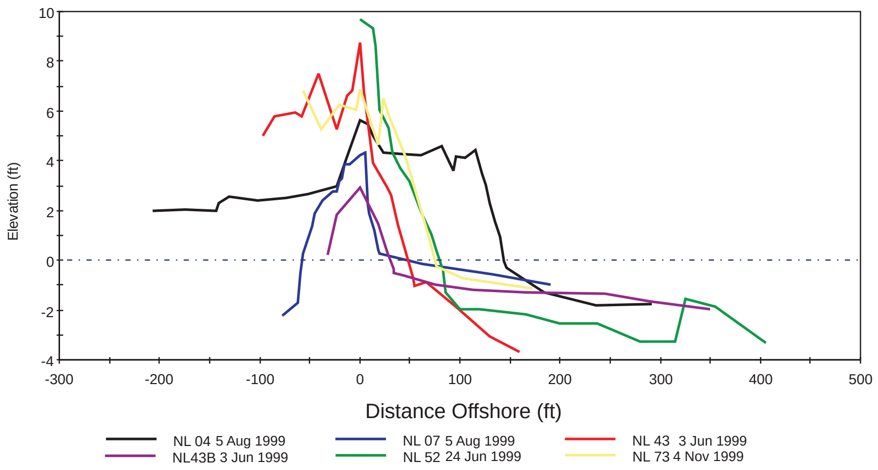

Figure 5. Variability of dune and beach profiles in Northumberland County.

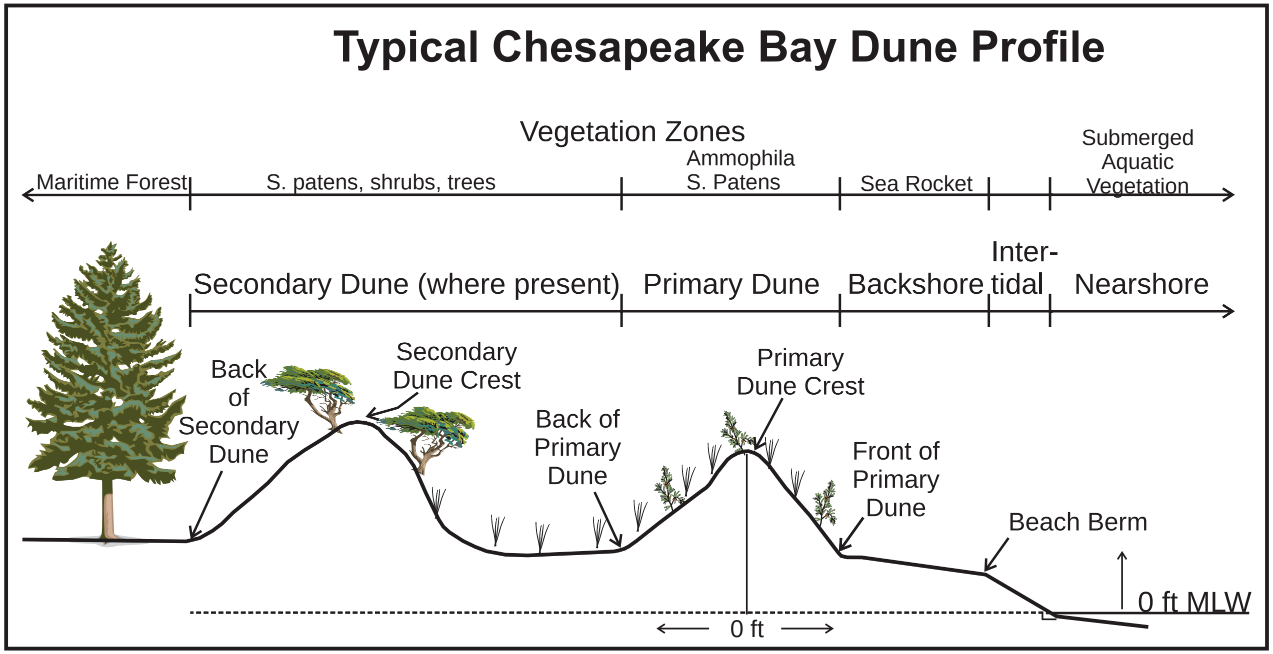

Figure 6. Typical profile of a Chesapeake Bay dune system (from Hardaway *et al.*, 2001).

IV. RESULTS

The Plates referenced in the following sections are in Appendix A. Dune locations are shown on all photo dates for reference only. Dune sites and lengths are positioned accurately on the 2002 photo. Because of changes in coastal morphology, the actual dune site might not have existed earlier. Site information tables are in Appendix B. More detailed information about Chesapeake Bay dunes and individual dune sites in Northumberland can be found in Hardaway *et al.* (2001) and Hardaway *et al.* (2003). Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

A. Reach I

Reach I begins on the upriver side of the Potomac River coast at the Yeocomico River and extends downriver to Lewisetta. It includes Plates 1 through 5. Only Plate 4 has a dune site, NL78. Plate 1 shows the convoluted coast of Yeocomico River where shore change is minimal, and no erosion rate baselines were created. Plate 2 has two baselines, 2A and 2B which indicate a net long term (1937-2002) shore change rate of -1.3 and -1.1 ft/yr respectively. Long-term erosion rates of over -8 ft/yr occur at and adjacent to Thicket Point. Plate 3 has a long-term erosional trend of -2.6 ft/yr with significant recession of -5 ft/yr along the Potomac River side of the peninsula to Judith Sound.

Plate 4 highlights the Travis Point/Lewisetta Neck and dune site NL78 which can be seen evolving between two groins in the 1969 imagery. The embayment has become relatively stable. This evolution is reflected in shore change at station 500. The long-term trend for the subreach is -0.5 ft/yr. Plate 5 has no dune sites and has a significant long-term erosional trend of -7.3 ft/yr. Great Point has had some of the severest erosion along the Potomac River due to its low bank with rates greater than -25 ft/yr for the time period 1953-1969.

B. Reach II

Reach II is extends from the Coan River to Smith Point, approximately 14 miles. Most of the coast is relatively straight and is included in Plates 6 through 12. Plate 6 has dune site NL73 which can be seen forming at the mouth of Presley Creek in 1969 and has remained in place even though the inlet channel has moved upriver over the years. The overall long-term erosion rate along the Plate 6 shorelines is -2.6 ft/yr. Plate 7 also has one dune site, NL70, that has evolved over time as an erosional remnant of a once more extensive dunal spit across the mouth of Hull Creek. Average long-term erosion rates along the Plate 7 coast is -3.5 ft/yr.

Plate 8 has three dune sites, NL62, NL63, and NL67. All three sites are isolated erosional remnants of a once more extensive dune fields. Dune site NL67 resides in front of a pond that was once an intermittent drainage and is controlled by a groin field. Dune sites NL63 and NL62 are creek mouth dunes lying on either side of Cubitt Creek. The average long-term erosion rate along the Plate 8 coast is -1.4 ft/yr.

Plate 9 includes dune sites NL61, NL59, and NL58. All sites are remnants of a more extensive beach/dune system which existed in 1937. Site NL61 resides in front of Condit Pond while NL59 is controlled by a groin field that was installed in the 1970s. Site NL58 lies on a broad spit feature that crosses the mouth of Hack Creek and has a secondary dune. A few groins and a wood jetty help stabilize this site. The Plate 9 coast has a long-term erosion rate of only -0.3 ft/yr due, in part, to shore stabilization efforts.

Five dune sites exist along Plate 10 including NL55, NL54, NL52, NL51, and NL50. They are all isolated remnants of a once continuous beach/dune system. Site NL55 developed on the old (1937) flood shoal of Flag Pond. The other four have been maintained and controlled by a long groin field. Long-term average erosion rate for Plate 10 is 0.9 ft/yr, but with a high degree of variability between interim years.

Plate 11 has eight dune sites, all are located well landward from the 1937 shoreline. Shoreline evolution and intermittent shoreline hardening by bulkheads and groins created an irregular set of headlands and embayments where sand accumulated, and beaches and dunes developed. Isolated dune sites NL50, NL49, and NL48 developed within an extensive groin field that created enough backshore to allow dunes to grow. Site NL47 developed in a large shoreline offset and embayment between adjacent man-made headlands (groins) by 1969. Sites NL46 and NL45 came into being as the uplands evolved between headlands. By 1994, enough backshore had accumulated to allow dune development. Dune sites 43B and 43A developed on beach fill placed there over the years from maintenance dredging of the Little Wicomico River. Constant erosion and deposition keeps these sites very mobile. Long-term shore change is erosional at -4.1 ft/yr. Shorelines on both sides of Smith Point have been influenced by the channel jetties at the mouth of the Little Wicomico River. The dunes sites on the Potomac River shore of Plate 12, NL43A and NL43 are segments of a semi-continuos beach/dune system separated by a short wooded area. Over time, major accretion against the northwest jetty has allow these systems to evolve and are maintained, in part, by the jetty and ongoing dredging and subsequent fill at dune site NL43B (Plate 11). Net shore change has been positive along this subreach.

C. Reach III

Reach III extends from Smith Point to the Great Wicomico River and includes Plates 12, 13, 14, 15, and 16. This is a fairly continuous coast interrupted by a several small tidal creeks. It has long fetch exposures up, across, and down Chesapeake Bay to the north, east and southeast.

Reach III on Plate 12 encompasses the shoreline on the Chesapeake Bay side of Smith Point and includes dune site NL42. Shorelines on both sides of Smith Point have been influenced by the channel jetties at the mouth of the Little Wicomico River. Site NL42, on the Chesapeake Bay side of Smith Point is a long low beach/dune system that is beginning to be impacted by the northward encroaching construction of groins. The shoreline along this subreach has experienced long-term accretion near the jetties and general recession toward the south end of the plate boundary. Long-term shore change is -1.5 ft/yr.

The shoreline along the Plate 13 coast was once a continuous beach/dune system that has significantly eroded with time, breached Owens Pond and left a string of isolated dunes sites. Site NL40 has evolved on an over wash into an adjacent unnamed pond between to groin fields. Dune site NL38 has developed at the mouth of Gaskin Pond that is controlled by wood jetties. Sites NL37and NL36 developed in small, low overwashes into adjacent small ponds. Dune sites NL35, NL34, and NL33 are small isolated pockets that developed after the breach into Owens Pond and the subsequent transport of sand onto the mainland coast. The erosion rates are quite variable as a result of the breach, but the net change rate was -5.9 ft/yr.

Plate 14 includes the shorelines in and adjacent to Taskmakers Creek. Dune sites NL32, NL31, and NL30 presently occur along a long low beach/dune coast that receded into its present day location. They are separated by short areas without dune features. In 1937, a long spit protected the present dune sites from direct bay wave attack. By 1953, the spit was gone, sand entered the newly created embayment, and the foundation for the dune sites was created. The long-term shoreline change patterns are therefore complex but yield a net average of -4.2 ft for the Plate 14 shorelines.

Three isolated dune sites occur on the Plate 15 including NL28, NL27, and NL26. Site NL28 is an erosional remnant of a spit feature that had developed in 1953 but only occurs as salient feature by 2002. Site NL27 evolved in a small embayment, and NL26 developed in a small protected washover. Shore change was variable along the Potomac River shoreline with mostly erosion along most of Bull Neck except for accretion at Fleeton Point. The overall net change for that subreach was -2.1 ft/yr.

Plate 16 depicts shorelines at the entrance to the Great Wicomico River. Sites NL27 and NL26 were discussed previously in Plate 15. Dune sites NL23A and NL23B on Hayne Point have been around since 1953 on a spit that has moved back and forth over the years.

D. Reach IV

Reach IV extends form The Great Wicomico River to Indian Creek and the county line with Lancaster County. It is a very convoluted and complex coast dissected by many modest sized tidal creeks and rivers. Much of the Bay fronting coast is low and marshy.

Ingram Bay shorelines are shown in Plate 17 and include dune sites NL22A, NL22, NL21, NL20 and NL19. Site NL22A was once part of a large sandy spit feature (1937) but is now a small isolated remnant. Dune site NL22 evolved on a washover into an unnamed pond on the south side of Sandy Point. Towles Creek had a narrow inlet and associated sandy dune shorelines on either side until it was dredged and stabilized with jetties sometime before 1969. Site NL20 now resides on the south side of the inlet. Dune site NL19 has resided in about the same place since 1937, in a small curvilinear embayment. Long-term average erosion for Plate 17 is -2.3 ft/yr.

Plate 18 includes two sites along the Dameron Marsh peninsula. Site NL17 did not come into existence until just before 1994 and occurs as a spit dune feature that continues to evolve. Dune site NL15 also became more prominent by 1994 in a long shallow embayment. It appears to have reached a state of dynamic equilibrium and will migrate as the adjacent headland coasts erode.

Four dune sites are shown on Plate 19. Dune site NL14 came into existence sometime before 1994 in a shallow cove. Site NL12 evolved across a small pond and can be seen as early as 1937. Sites NL11A and NL11 reside in two adjacent bays created by three marshy headlands. Erosion patterns are complex but headland and bay features tend to persist over time.

Plate 20 has three dune sites. Site NL10 was part of small spit feature in 1953 and 1969. The small tidal creek was all but closed off by 1994, more sand came into the embayment, and the site expanded alongshore. Site NL9 has been part of long curvilinear embayment on the north side of Hughlett Point since 1937, and today represents a significant dune field. A spit evolved up Dividing Creek as seen in 1994 imagery and became home for NL8. Site NL7 is also located on Dividing Creek. However, it is not shown on the plates. It is a delta-shaped spit that is exposed to a bimodel wind/wave climate along the north shore of Dividing Creek. Long-term shore change along the Chesapeake Bay coast of Plate 20 was -2.9 ft/yr.

Dune site NL6 on Plate 21 is an erosional remnant of a longer beach/dune feature seen in 1937 imagery. The shoreline from Jarvis Point to Bluff Point (plate 22) has had siginificant erosion with a long term rate of -8.8 ft/yr. Site NL4A is a small remainder of what was once a long barrier dune beach system about 1mile in length up until 1969. Then the barrier broke through leaving NL4 as a large washover into a large tidal pond.

Three isolated dune sites occur on Plate 22. Site NL3 evolved on a washover in 1969 and 1994 and is now a cove feature. Site NL2 was part of long spit but now resides as an erosional remnant. As Barnes Creek was opened up, NL1 evolved by 1994 on the south flank of the creek shore. Long-term erosion along the Bay coast of Plate 22 is -6.9 ft/yr.

V. DISCUSSION: NEAR FUTURE TRENDS OF DUNE SITES

The following discussion is a delineation of shoreline trends based on past performance. Ongoing shore development, shore stabilization and/or beach fill, and storms will have local impacts on the near term. “Near Future” is quite subjective and only implies a reasonable expectation for a given shore reach to continue on its historic course for the next 10 to 20 years. In addition, the basis for the predictions are the shorelines digitized on geo-rectified aerial photography which have an error associated with them (see Methods, Section III). Each site’s long-term and recent stability as well as a near future prediction are shown in a table in Appendix B. **This data is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.**

A. Reach I

Site NL78, the only dune site in Reach I, should remain stable as long as the supporting groinfield remains intact (Figure 7).

B. Reach II

Although located at the mouth of Presley Creek, an historically mobile inlet, the site NL73 may shift in response but should keep its general dimensions and integrity(Figure 8). Site NL70 at the mouth of Hull Creek has been in a state of decay for years and will most likely continue that trend. Site NL67 should remain stable as long as the groinfield is intact (Figure 8). Like other creek mouth dune sites, NL63 will remain a dune entity but may move in response to inlet dynamics (Figure 8). Site NL62 has been modified with beach fill and offshore breakwaters so the nature of the site has changed, but the beach and associated future dune should be relatively stable.

Even after Hurricane Isabel, sites NL61, NL59 and NL58 should be relatively stable in the near term (Figure 8). A slight erosional tendency occurs on the downriver end of NL58. Site NL55 should continue to evolve toward stability between the revetment boundaries (Figure 8). Sites NL54, NL52, and NL51 all lie within the confines of extensive groinfields and should be stable for the near term (Figure 8). Site NL 50 is eroding as the groinfield fails and the beach face retreats.

Dune sites NL49 and NL48 occur within old deteriorating wood groin field. The primary dune faces are often steep and slumping but the overall dune appears relatively stable for the near term. Further loss of groin structures may cause a recessional trend. Site NL47 is on the tangential section of spiral embayment bounded by groins and appears relatively stable. The large embayment where NL46 sits is also a stable beach shore planform (Figure 8). Site NL45 is a sparsely vegetated low dune that is receding into an adjacent pond. Sites 43B and 43A are, by nature, erosional as they are dredge disposal for material from the Little Wicomico River. Site 43, on the other hand, is the recipient of that material and will erode and accrete as a function of beach fill periodicity but will always retain a minimum shore position (Figure 8).

C. Reach III

Site NL42 has been historically accretionary and mobile, but the south boundary continues to be impacted by groin construction toward the jetties which may be causing localized erosion. Site NL40 has evolved into a relatively stable embayment. North of Gaskin Pond lies NL38 bounded by the channel jetty and a revetment (Figure 9). It should be stable for the near term as long as the north wood jetty remains intact. A small groin field has helped create and stabilize NL37 but NL36 is decaying as the low bank headland to the north erodes (Figure 9). Dune sites NL35, NL34 and NL33 are stable isolated pocket dunes on the mainland coast of Owens Pond (Figure 9).

Sites NL32, NL31 and NL30 share the same stable subreach north of Taskmakers Creek (Figure 9). Site NL28 is an erosional salient while NL27 and NL26 are small stable isolated features (Figure 9). Sites NL23A and 23B share and accreting sand spit that should continue grow and provide dune growth elements as long as sand is available within the littoral system (Figure 9).

D. Reach IV

Dune site NL22A is a small, relatively stable dune on the Great Wicomico River side of Sandy Point while NL22 resides in a groin field on the Ingram Bay side (Figure 10). Site NL21 is a small stable dune at the mouth of Cranes Creek. The south channel jetty into Towles Creek creates a stable north boundary for site NL20, and a revetment creates the south boundary. The dune at NL19 is a mostly erosional feature open to the Bay. Site NL17 is on a mobile spit that cannot be called stable while NL15 occupies a long, stable bay on the north side of Dameron Marsh.

Dune sties NL14 and NL12 are linear isolated dune features that are relatively stable but will migrate as the controlling marsh headland erode. Currently those marsh headlands appear relatively stable unlike the controlling marsh headlands bounding NL11A and NL11 (Figure 10). These marsh headlands are more erosive as they and sites NL11A and NL11 are on the exposed distal end of Ball Neck (Figure 10).

Site NL10 had evolved in a deep stable bay called Ingram Cove and NL9 although currently relatively stable as the bounding headland erode it will leave the site more exposed and erosive (Figure 10). Site NL8 resides on a mobile but stabilizing spit feature. Site NL7 is a small erosional isolated dune and NL6 has resides on stable coast bounded by revetments. Sites NL4A and NL4 are long low stable slightly embayed dune sites but subject to storm overwash (Figure 10). Sites NL3 and NL2 are isolated dunes that will migrate as the bounding peat substrate erodes and NL1 is on an accreting spit that goes into Barnes Creek.

Figure 7. Dune site NL78 in Reach I on Potomac River on 4 Nov 1999.

Figure 8. Photos of Northumberland's shoreline showing dune sites in Reach II.

Figure 9. Photos of Northumberland's shoreline showing dune sites in Reach III.

Figure 10. Photos of Northumberland's shoreline showing dune sites in Reach IV.

VI. SUMMARY

Shoreline change rates are based on aerial imagery taken at a particular point in time. We have attempted to portray the same shoreline feature for each date along the coast of Northumberland County. Every 500 feet along each baseline on each plate, the rate of change was calculated. The mean or average rate for each plate is shown in Table 2 for five time periods with the long-term rate determined between 1937 and 2002. The total average and standard deviation (Std Dev) for the entire data set of individual rates is also given. The standard deviation shows the relative spread of values about the mean or average. Larger standard deviation values relative to the mean indicates a wider scatter of erosion rates about the mean while lower standard deviation values indicates erosion rates are concentrated near the mean (*i.e.* all the rates calculated for the entire plate were similar).

The largest variability in mean shore change rates and standard deviations were recorded for the shoreline on Plate 21 with the rates of change and standard deviation reaching over 20 ft/yr. Plate 12A had standard deviations that were much larger than the average rate of change indicating that the overall rate is probably not indicative of the change which occurred on this section of shore. However, not all dates for this section of shore had mean shore change rates with large standard deviations. For 1959-1982, the standard deviation was half the mean shore change rate indicating that the shore change rates were relatively consistent for that time period.

When short time frames are used to determine rates of shoreline change, shore alterations may seem amplified. The rates based on short-time frames can modify the overall net rates of change. Hopefully, the shore change patterns shown in this report along with the aerial imagery will indicate how the coast will evolve based on past trends and can be used to provide the basis for appropriate shoreline management plans and strategies. Dunes and beaches are a valuable resource that should be either maintained, enhanced or created in order to abate shoreline erosion and provide sandy habitat.

Table 2. Summary shoreline rates of change and their standard deviation.

	Plate 2A		Plate 2B		Plate 3		Plate 4		Plate 5		Plate 6	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1953	-0.3	0.6	-0.2	0.6	-3.6	3.4	-0.6	1.9	-7.2	8.4	-5.2	2.7
1953-1969	-2.1	3.9	-4.7	3.5	-5.4	6.7	-1.4	2.1	-5.5	8.1	-4.8	3.8
1969-1994	-1.6	3.0	-0.3	0.8	-0.5	1.8	-0.3	0.7	-8.3	3.4	-0.5	3.0
1994-2002	-1.0	4.9	1.6	1.0	-1.1	4.1	1.1	1.0	-8.7	3.7	0.2	3.0
1937-2002	**-1.3**	**2.7**	**-1.1**	**1.0**	**-2.6**	**2.7**	**-0.5**	**0.7**	**-7.4**	**5.0**	**-2.6**	**1.9**

	Plate 7		Plate 8		Plate 9		Plate 10		Plate 11		Plate 12A		Plate 12B	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1953	-4.1	1.5	-1.0	2.3	0.2	1.5	-2.4	2.8	-4.1	8.0	2.2	13.6	0.4	3.9
1953-1969	-5.6	1.7	-2.7	1.4	-1.5	1.4	-1.1	1.7	-4.6	8.1	4.1	1.3	-4.2	4.2
1969-1994	-2.0	1.9	-0.6	1.4	0.4	1.1	0.0	1.2	-3.5	5.6	4.6	3.0	-1.2	3.4
1994-2002	-3.2	3.7	-1.9	2.1	-1.1	2.0	-0.7	1.8	-5.0	7.6	0.2	4.8	-1.0	5.8
1937-2002	**-3.6**	**1.2**	**-1.4**	**0.9**	**-0.3**	**0.4**	**-0.9**	**0.6**	**-4.1**	**2.8**	**3.4**	**4.8**	**-1.5**	**2.2**

	Plate 13		Plate 14		Plate 15		Plate 17		Plate 20		Plate 21		Plate 22	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1953	-2.5	1.9	-9.4	17.0	-0.3	10.7	-1.6	5.4	-2.4	3.9	-7.7	2.1	-11.0	3.2
1953-1969	-5.9	1.8	-4.4	5.8	-3.6	3.8	-2.4	3.6	-3.2	2.0	12.2	5.7	-7.6	4.4
1969-1994	-9.4	11.0	-1.4	4.2	-3.7	3.6	-2.5	6.6	-2.6	3.7	-18.5	7.7	-3.0	1.8
1994-2002	-1.6	3.9	-2.1	7.3	2.7	6.9	-3.5	2.8	-4.5	3.4	-22.3	23.2	-9.7	6.0
1937-2002	**-5.9**	**4.6**	**-4.2**	**3.7**	**-2.1**	**2.7**	**-2.3**	**2.9**	**-2.9**	**2.2**	**-8.8**	**3.0**	**-6.9**	**2.2**

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APPENDIX A

For each Plate shown on Figure 4, Appendix A contains orthorectified aerial photography flown in 1937, 1953, 1969, 1994, and 2002.
Also shown are the digitized shorelines, identified dune sites, and an arbitrarily created baseline.
A plot shows only the relative locations of the shorelines while another one depicts the rate of shore change between dates.
A summary of the average Plate rate of change in ft/yr as well as the standard deviation for each rate is also shown.

**This data is intended as a resource for coastal zone managers and homeowners;
it is not intended for use in determining legal jurisdictional limits.**

APPENDIX B

The data shown in the following tables were primarily collected as part of the Chesapeake Bay Dune: Evolution and Status report and presented in Hardaway *et al.* (2001) and Hardaway *et al.* (2003). Individual site characteristics may now be different due to natural or man-induced shoreline change.

An additional table presents the results of this analysis and describes each dune site's relative long-term, recent, and near-future predicted stability. This data results from the position of the digitized shorelines which have an error associated with them (see Methods, Section III).

Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

. Identified dune sites in Northumberland County as of 1999.

Dune Site No.	Location^ Easting (Feet)	Location^ Northing (Feet)	Date Visited	Dune Shore Length (Feet)	Primary Dune Site?	Secondary Dune Site?	*Public Ownership?
1	2,630,850	499,900	8/5/99	140	Yes		
2	2,634,800	501,100	8/5/99	210	Yes		
3	2,635,950	503,000	8/5/99	250	Yes		
4	2,634,300	507,000	8/5/99	710	Yes	Yes	
4A	2,633,300	509,700	8/5/99	580	Yes		
6	2,630,400	511,700	8/5/99	180	Yes		
7	2,629,500	518,750	8/5/99	320	Yes		
8	2,632,050	517,350	8/5/99	270	Yes		
9	2,633,700	518,350	8/5/99	2,200	Yes		
10	2,631,350	522,300	8/5/99	1,360	Yes		
11	2,633,300	528,200	9/14/99	200	Yes		
11A	2,633,500	528,550	9/14/99	400	Yes		
14	2,634,150	533,150	9/14/99	510	Yes		
15	2,635,750	535,500	9/14/99	1,360	Yes		Yes
17	2,633,200	536,200	9/14/99	250	Yes		Yes
19	2,632,200	538,900	9/14/99	1,050	Yes		
20	2,633,400	542,150	9/14/99	290	Yes		
21	2,632,250	547,380	4/29/99	170	Yes		
22	2,633,150	548,600	4/29/99	390	Yes		
22A	2,632,950	548,900	4/29/99	160	Yes		
23A	2,631,050	552,600	5/13/99	300	Yes		
23B	2,631,050	552,600	5/13/99	140	Yes		
26	2,637,150	550,000	5/13/99	120	Yes		
27	2,637,950	549,300	5/13/99	180	Yes		
28	2,641,050	546,150	5/13/99	480	Yes		
30	2,647,600	552,200	5/13/99	250	Yes		
31	2,648,100	552,850	4/29/99	620	Yes		
32	2,648,700	553,400	5/13/99	360	Yes		
33	2,649,300	558,000	5/13/99	180	Yes		
34	2,649,500	558,500	5/13/99	180	Yes		
35	2,649,600	560,100	5/13/99	280	Yes		
36	2,650,450	561,600	5/13/99	120	Yes		
37	2,650,550	562,300	5/13/99	240	Yes		
38	2,650,800	564,350	5/13/99	230	Yes		

Dune Site No.	Location^ Easting (Feet)	Location^ Northing (Feet)	Date Visited	Dune Shore Length (Feet)	Primary Dune Site?	Secondary Dune Site?	*Public Ownership?
40	2,650,900	566,800	4/29/99	600	Yes		
42	2,652,500	572,400	4/29/99	3,690	Yes	Yes	
43	2,651,150	575,100	6/3/99	2,750	Yes	Yes	
43A	2,650,000	575,950	6/3/99	870	Yes	Yes	
43B	2,649,100	576,650	6/3/99	400	Yes		
45	2,648,100	577,750	6/3/99	220	Yes		
46	2,647,500	578,750	6/3/99	650	Yes		
47	2,646,800	579,500	6/3/99	320	Yes		
48	2,643,500	582,450	6/3/99	200	Yes		
49	2,642,500	583,000	6/3/99	470	Yes		
50	2,641,700	583,450	6/3/99	160	Yes		
51	2,640,850	583,800	6/24/99	190	Yes		
52	2,640,150	584,150	6/24/99	300	Yes		
54	2,637,750	585,400	6/24/99	240	Yes		
55	2,633,700	587,700	6/24/99	250	Yes		
58	2,630,450	589,550	6/24/99	900	Yes	Yes	
59	2,629,200	590,300	6/24/99	1,680	Yes	Yes	
61	2,626,900	591,750	6/24/99	400	Yes		
62	2,620,600	594,850	11/4/99	970	Yes		
63	2,619,800	595,250	11/4/99	250	Yes		
67	2,615,150	596,750	11/4/99	90	Yes		
70	2,608,500	598,300	11/4/99	670	Yes		
73	2,599,600	601,950	11/4/99	750	Yes		
78	2,586,800	614,250	11/4/99	540	Yes		

*Public ownership includes governmental entities including local, state, and federal; otherwise ownership is by the private individual.
^Location is in Virginia State Plane South, NAD 1927
‘One site with variable alongshore dune conditions

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

Dune site measurements in Northumberland County as of 1999.

Dune Site Measurements

Site		Dune	Primary Dune			Secondary Dune		Distance From		
		Shore Length	Crest Elev	Distance from Crest landward to back base	Distance from Crest To MLW	2nd Dune Site	Crest Elev	Primary Crest to 2nd Crest	2nd Crest landward	2nd Crest seaward to 1st back base
	No.	(Feet)	(ft MLW)	(Feet)	(Feet)		(ft MLW)	(Feet)	(Feet)	(Feet)
NL	1	140	3.9	25	86					
NL	2	210	5.1	45	36					
NL	3	250	4.5	44	71					
NL	4	710	5.6	23	144	Yes	2.6	130	77	107
NL	4A	580	4.4	69	36					
NL	6	180	5.5	6	71					
NL	7	320	4.2	23	45					
NL	8	270	4.8	19	18					
NL	9	2,200	6.3	31	40					
NL	10	1,360	5.7	40	52					
NL	11	200	3.3	47	39					
NL	11A	400	4.3	22	66					
NL	12	450	6.8	17	56					
NL	14	510	5.5	37	41					
NL	15	1,360	6.1	44	38					
NL	17	250	3.5	81	20					
NL	19	1,050	5.4	33	39					
NL	20	290	5.8	50	38					
NL	21*	170								
NL	22	390	4.0	35	27					
NL	22A	160	3.5	10	35					
NL	23A	300	4.3	13	52					
NL	23B	140	4.1	16	51					
NL	26	120	5.0	16	45					
NL	27	180	4.6	14	34					
NL	28	480	4.5	15	30					
NL	30	250	5.6	45	85					
NL	31	620	4.5	39	48					
NL	32*	360								
NL	33	180	4.9	31	63					
NL	34	180	5.4	77	61					
NL	35	280	5.3	38	75					
NL	36	120	5.0	14	43					
NL	37	240	6.3	5	66					
NL	38	230	3.5	45	40					
NL	40	600	4.5	25	50					
NL	42	3,690	5.6	69	40	Yes	9.8	125	21	56
NL	43	2,750	8.8	23	48	Yes	7.5	41	56	18
NL	43a	870	8.2	29	34	Yes	6.0	54	26	25
NL	43b	400	2.9	32	28					
NL	45	220	3.2	36	35					

*Not profiled

Dune Site Measurements

Site		Dune	Primary Dune			Secondary Dune		Distance From		
		Shore Length	Crest Elev	Distance from Crest landward to back base	Distance from Crest To MLW	2nd Dune Site	Crest Elev	Primary crest to 2nd Crest	2nd Crest landward	2nd Crest seaward to 1st back base
	No.	(Feet)	(ft MLW)	(Feet)	(Feet)		(ft MLW)	(Feet)	(Feet)	(Feet)
NL	46	650	5.5	10	52					
NL	47	320	6.2	60	35					
NL	48	200	9.9	14	58					
NL	49	470	9.6	3	51					
NL	50	160	12.7	4	56					
NL	51	190	6.7	4	44					
NL	52	300	9.7	15	77					
NL	54	240	6.1	10	40					
NL	55	250	4.9	7	50					
NL	58	900	6.6	8	49	Yes	9.0	19	92	11
NL	59	1,680	8.2	7	52	Yes	11.3	40	6	33
NL	61	400	7.5	18	52					
NL	62	970	6.5	52	49					
NL	63	250	5.7	19	77					
NL	67	90	7.7	13	62					
NL	70	670	5.9	5	78					
NL	73	750	6.9	4	75					
NL	78	540	6.5	10	62					

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

Dune site parameters in Northumberland County as of 1999.

Dune Site Parameters

	Site No.	Type	Fetch Exposure A	Shoreline Direction of Face B	Nearshore Gradient C	Morphologic Setting D	Relative Stability E	Underlying Substrate F
NL	1	Natural	Open Bay	East	Shallow	Isolated, linear	Accretion	Marsh/CB
NL	2	Natural	Open Bay	South	Shallow Bars	Isolated, pocket	Stable	Marsh/CB
NL	3	Natural	Open Bay	Southeast	Shallow	Ck Mouth	Stable	Marsh/CB
NL	4	Natural	Open Bay	Northeast	Medium	Ck Mouth	Stable	Marsh/CB
NL	4A	Natural	Open Bay	Northeast	Medium	Spit	Stable	Marsh/CB
NL	6	Man Inf	Open Bay	Northeast	Steep	Isolated, bay	Stable	Upland
NL	7	Natural	Riverine	Southeast	Steep	Spit	Stable	Marsh/CB
NL	8	Natural	Riv-Bay	South	Steep	Spit	Accretion	Upland
NL	9	Natural	Open Bay	East	Medium	Dune Field, linear	Stable	Marsh/CB
NL	10	Natural	Open Bay	Northeast	Medium Bars	Dune Field, bay	Erosional	Marsh/CB
NL	11	Natural	Open Bay	East	Medium	Isolated, pocket	Erosional	Marsh/CB
NL	11A	Natural	Open Bay	East	Medium	Isolated, pocket	Erosional	Marsh/CB
NL	12	Natural	Open Bay	East	Medium	Ck Mouth	Stable	Marsh/CB
NL	14	Natural	Open Bay	East	Shallow	Isolated, pocket	Stable	Marsh/CB
NL	15	Natural	Open Bay	Northeast	Medium	Dune Field, bay	Stable	Marsh/CB
NL	17	Natural	Riv-Bay	Northwest	Steep	Spit	Erosional	Upland
NL	19	Natural	Open Bay	East	Steep	Dune Field, linear	Erosional	Upland
NL	20	Man Inf	Open Bay	East	Medium	Isolated, linear	Accretion	Upland
NL	21	Natural	Riv-Bay	East	Steep	Isolated, linear	Stable	Upland
NL	22	Man Inf	Riv-Bay	East	Medium	Ck Mouth	Stable	Marsh/CB
NL	22A	Natural	Riverine	Northwest	Steep	Spit	Stable	Upland
NL	23A	Natural	Riv-Bay	West	Steep	Spit	Accretion	Upland
NL	23B	Natural	Riverine	Southeast	Steep	Spit	Accretion	Upland
NL	26	Man Inf	Riverine	Southwest	Medium	Ck Mouth	Stable	Marsh/CB
NL	27	Natural	Riv-Bay	South	Shallow	Isolated, pocket	Stable	Upland
NL	28	Man Inf	Open Bay	South	Medium	Isolated, salient	Accretion	Upland
NL	30	Man Inf	Open Bay	Southeast	Shallow	Isolated, pocket	Stable	Upland
NL	31	Natural	Open Bay	Southeast	Shallow	Ck Mouth	Stable	Upland
NL	32	Man Inf	Open Bay	Southeast	Shallow	Ck Mouth	Stable	Upland
NL	33	Man Inf	Open Bay	East	Shallow Bars	Isolated, pocket	Stable	Upland
NL	34	Natural	Open Bay	East	Medium Bars	Isolated, pocket	Stable	Upland
NL	35	Man Inf	Open Bay	East	Medium Bars	Isolated, pocket	Stable	Upland
NL	36	Man Inf	Open Bay	East	Medium Bars	Isolated, pocket	Erosional	Marsh/CB

Dune Site Parameters

	Site No.	Type	Fetch Exposure A	Shoreline Direction of Face B	Nearshore Gradient C	Morphologic Setting D	Relative Stability E	Underlying Substrate F
NL	37	Man Inf	Open Bay	East	Medium Bars	Isolated, pocket	Accretion	Upland
NL	38	Man Inf	Open Bay	East	Medium Bars	Ck Mouth	Stable	Marsh/CB
NL	40	Natural	Open Bay	East	Medium Bars	Ck Mouth	Stable	Marsh/CB
NL	42	Man Inf	Open Bay	East	Medium	Dune Field, linear	Stable	Upland
NL	43	Man Inf	Open Bay	Northeast	Medium No Bars	Dune Field, linear	Stable	Marsh/CB
NL	43A	Man Inf	Open Bay	Northeast	Medium	Dune Field, linear	Erosional	Marsh/CB
NL	43B	Man Inf	Open Bay	Northeast	Medium	Ck Mouth	Erosional	Marsh/CB
NL	45	Man Inf	Open Bay	Northeast	Medium Bars	Ck Mouth	Erosional	Marsh/CB
NL	46	Man Inf	Open Bay	Northeast	Medium Bars	Dune Field, bay	Erosional	Upland
NL	47	Man Inf	Open Bay	Northeast	Medium Bars	Isolated, linear	Stable	Marsh/CB
NL	48	Man Inf	Open Bay	Northeast	Medium Bars	Isolated, linear	Stable	Upland
NL	49	Man Inf	Open Bay	Northeast	Medium Bars	Isolated, linear	Stable	Upland
NL	50	Man Inf	Open Bay	Northeast	Medium Bars	Isolated, linear	Erosional	Upland
NL	51	Man Inf	Open Bay	Northeast	Medium Bars	Isolated, linear	Stable	Upland
NL	52	Man Inf	Open Bay	Northeast	Medium Bars	Isolated, linear	Stable	Upland
NL	54	Man Inf	Open Bay	Northeast	Medium Bars	Isolated, linear	Stable	Upland
NL	55	Man Inf	Open Bay	Northeast	Medium Bars	Ck Mouth	Stable	Marsh/CB
NL	58	Man Inf	Open Bay	Northeast	Medium Bars	Dune Field, linear	Stable	Upland
NL	59	Man Inf	Open Bay	Northeast	Medium Bars	Dune Field, linear	Stable	Upland
NL	61	Man Inf	Open Bay	Northeast	Medium Bars	Isolated, linear	Stable	Upland
NL	62	Man Inf	Open Bay	Northeast	Shallow Bars	Ck Mouth	Erosional	Upland
NL	63	Man Inf	Open Bay	Northeast	Shallow Bars	Ck Mouth	Erosional	Marsh/CB
NL	67	Man Inf	Open Bay	North	Medium Bars	Ck Mouth	Erosional	Marsh/CB
NL	70	Man Inf	Riv-Bay	North	Medium Bars	Ck Mouth	Erosional	Marsh/CB
NL	73	Man Inf	Riv-Bay	Northeast	Medium Bars	Spit	Stable	Marsh/CB
NL	78	Man Inf	Riv-Bay	East	Medium No Bars	Isolated, linear	Erosional	Marsh/CB

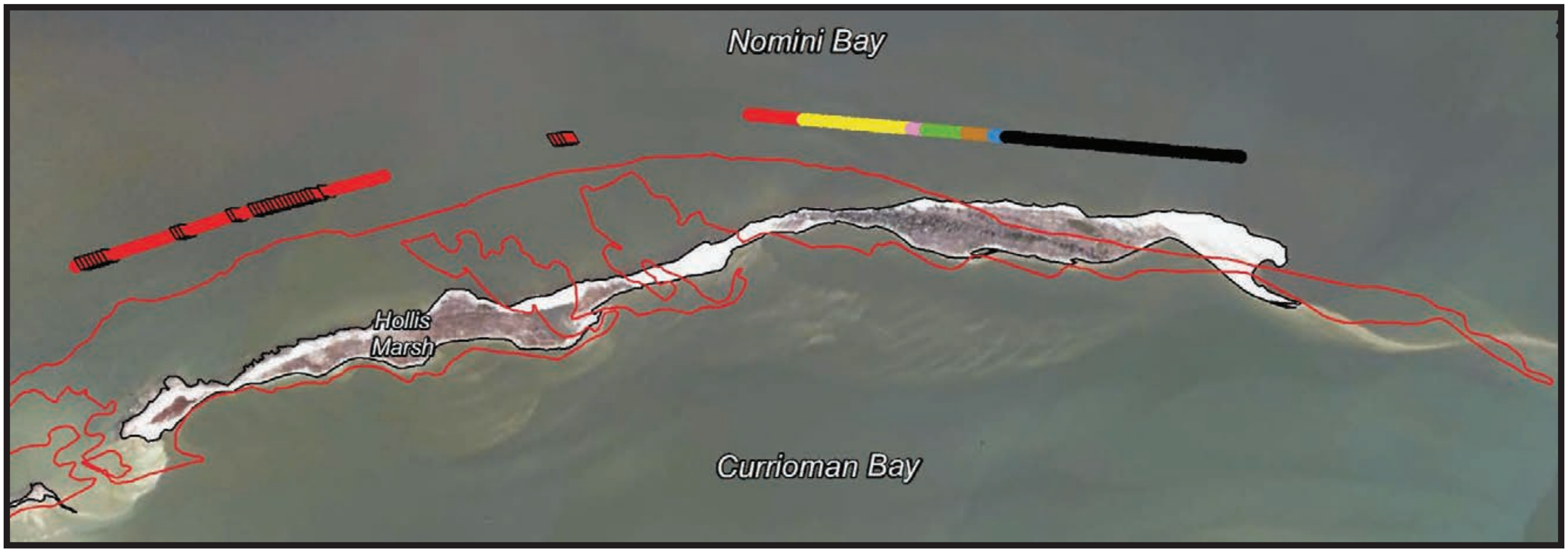
These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001).
Site characteristics may now be different due to natural or man-influenced shoreline change.

Long-term, recent stability and future predictions of shore erosion and accretion rates for dune sites in Northumberland County.

Site	No.	Long-Term Stability 1937-2002	Recent Stability 1994-2002	Near Future Prediction
NL	1	Erosional	Stable	Accretionary
NL	2	Erosional	Stable	Erosional
NL	3	Erosional	Erosional	Erosional
NL	4	Erosional	Accretionary	Stable
NL	4A	Erosional	Erosional	Stable
NL	6	Stable	Stable	Stable
NL	7	Accretionary	Erosional	Erosional
NL	8	Accretionary	Erosional	Stable/Accrete
NL	9	Stable	Stable	Erosional
NL	10	Accretionary	Stable	Stable
NL	11	Erosional	Erosional	Erosional
NL	11A	Erosional	Erosional	Erosional
NL	12	Stable	Stable	Stable
NL	14	Erosional	Erosional	Stable
NL	15	Erosional	Stable	Stable
NL	17	Accretionary	Erosional	Erosional
NL	19	Stable	Stable	Erosional
NL	20	Erosional	Stable	Stable
NL	21	Stable	Stable	Stable
NL	22	Erosional	Stable	Stable
NL	22A	Accretionary	Stable	Stable
NL	23A	No Data	Stable	Accretionary
NL	23B	No Data	Stable	Accretionary
NL	26	Erosional	Stable	Stable
NL	27	Erosional	Stable	Stable
NL	28	Accretionary	Accretionary	Erosional
NL	30	Erosional	Stable	Stable
NL	31	Accretionary	Accretionary	Stable
NL	32	Accretionary	Stable	Stable
NL	33	Erosional	Stable	Stable
NL	34	Erosional	Stable	Stable
NL	35	Erosional	Stable	Stable
NL	36	Erosional	Stable	Erosional
NL	37	Erosional	Stable	Stable
NL	38	Erosional	Stable	Stable
NL	40	Erosional	Stable	Stable
NL	42	Eros/Accete	Stable	Eros/Accete

Site	No.	Long-Term Stability 1937-2002	Recent Stability 1994-2002	Near Future Prediction
NL	43	Accretionary	Stable	Eros/Accete
NL	43A	Erosional	Erosional	Erosional
NL	43B	Erosional	Erosional	Erosional
NL	45	Erosional	Erosional	Erosional
NL	46	Erosional	Accretionary	Stable
NL	47	Erosional	Erosional	Stable
NL	48	Erosional	Stable	Stable
NL	49	Erosional	Stable	Stable
NL	50	Erosional	Stable	Erosional
NL	51	Erosional	Erosional	Stable
NL	52	Erosional	Stable	Stable
NL	54	Erosional	Stable	Stable
NL	55	Erosional	Stable	Stable
NL	58	Erosional	Stable	Stable
NL	59	Stable	Stable	Stable
NL	61	Stable	Stable	Stable
NL	62	Erosional	Erosional	Stable
NL	63	Erosional	Erosional	Stable
NL	67	Erosional	Stable	Stable
NL	70	Erosional	Erosional	Erosional
NL	73	Erosional	Accretionary	Stable
NL	78	Erosional	Accretionary	Stable

Shoreline Evolution:
Westmoreland County, Virginia
Potomac River and Rappahannock River Shorelines



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Gloucester Point, Virginia

September 2012

Shoreline Evolution:
Westmoreland County, Virginia
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Data Summary Report

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September 2012

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1 Introduction

Westmoreland County is situated along the Potomac River and Rappahannock River (Figure 1). Through time, the County's shoreline has evolved, and determining the rates and patterns of shore change provides the basis to know how a particular coast has changed through time and how it might proceed in the future. Along Chesapeake Bay's estuarine shores, winds, waves, tides and currents shape and modify coastlines by eroding, transporting and depositing sediments.

The purpose of this report is to document how the shore zone of Westmoreland County has evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year and can be used to assess the geomorphic nature of shore change. Aerial photos show how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man, through shore hardening or inlet stabilization, come to dominate a given shore reach. In addition to documenting historical shorelines, the change in shore positions along the rivers and larger creeks in Westmoreland County will be quantified in this report. The shorelines of very irregular coasts, small creeks around inlets, and other complicated areas will be shown but not quantified.

2 Methods

2.1 Photo Rectification and Shoreline Digitizing

An analysis of aerial photographs provides the historical data necessary to understand the suite of processes that work to alter a shoreline. Images of the Westmoreland County Shoreline from 1937, 1953, 1969, 1994, 2002 and 2009 were used in the analysis. The 1994, 2002 and 2009 images were available from other sources. The 1994 imagery was orthorectified by the U.S. Geological Survey (USGS) and the 2002 and 2009 imagery was orthorectified by the Virginia Base Mapping Program (VBMP). The 1937, 1953 and 1969 photos are part of the VIMS Shoreline Studies Program archives. The historical aerial images acquired to cover the entire shoreline were not always flown on the same day. The dates for each year are:
1937 - March 4, April 4, 7, and 17; May 7 and 31;
1953 - October 2, 3, 11, and 26; November 2 and 27
1969 - December 5 and 11;
The 2002 and 2009 were all flown in February, March, and April of their respective years. We could not ascertain the exact dates the 1994 images were flown.

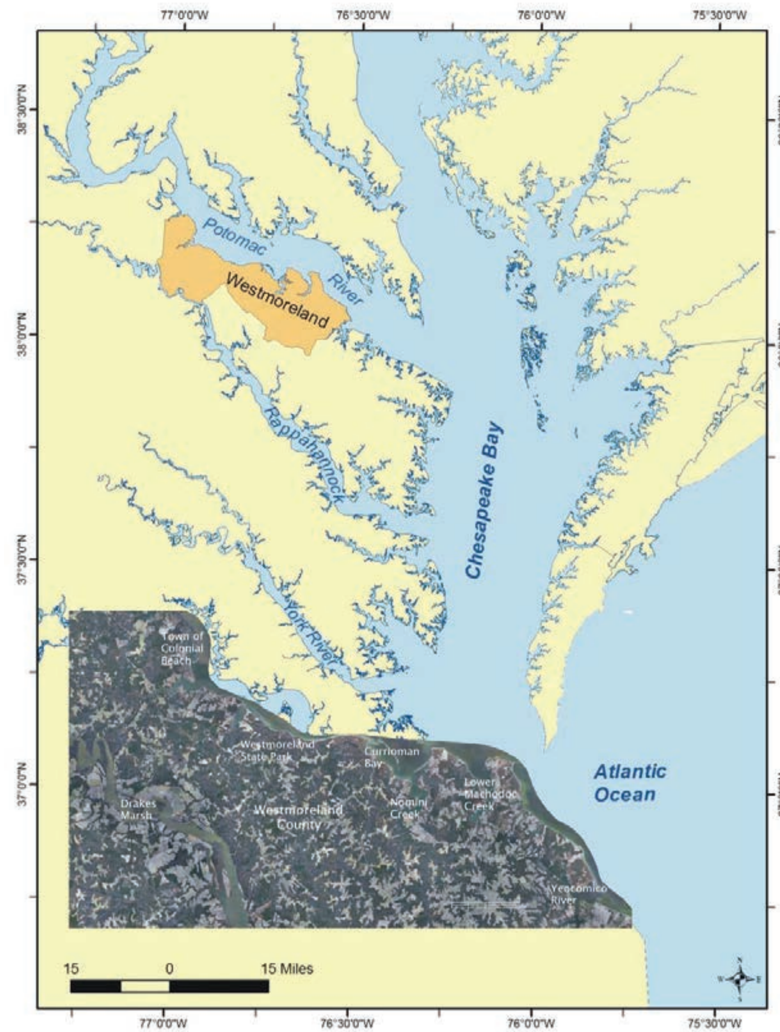

Figure 1. Location of Westmoreland County within the Chesapeake Bay estuarine system.

The 1937, 1953 and 1969 images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. These aerial photographs were orthographically corrected to produce a seamless series of aerial mosaics following a set of standard operating procedures. The 1994 Digital Orthophoto Quarter Quadrangles (DOQQ) from USGS were used as the reference images. The 1994 photos are used rather than higher quality, more recent aerials because of the difficulty in finding control points that match the earliest 1937 images.

ERDAS Orthobase image processing software was used to orthographically correct the individual flight lines using a bundle block solution. Camera lens calibration data were matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. The exterior and interior models were combined with a digital elevation model (DEM) from the USGS National Elevation Dataset to produce an orthophoto for each aerial photograph. The orthophotographs were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic .img format. To maintain an accurate match with the reference images, it is necessary to distribute the control points evenly, when possible. This can be challenging in areas given the lack of ground features and poor photo quality on the earliest photos. Good examples of control points were manmade features such as road intersections and stable natural landmarks such as ponds and creeks that have not changed much over time. The base of tall features such as buildings, poles, or trees can be used, but the base can be obscured by other features or shadows making these locations difficult to use accurately. Most areas of the County were particularly difficult to rectify, either due to the lack of development when compared to the reference images or due to no development in the historical and the reference images.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background. The morphologic toe of the beach or edge of marsh was used to approximate low water. High water limit of runup can be difficult to determine on the shoreline due to narrow or non-existent beaches against upland banks or vegetated cover. In areas where the shoreline was not clearly identifiable on the aerial photography, the location was estimated based on the experience of the digitizer. The displayed shorelines are in shapefile format. One shapefile was produced for each year that was mosaicked.

Horizontal positional accuracy is based upon orthorectification of scanned aerial photography against the USGS digital orthothophoto quadrangles. For vertical control, the USGS 30m DEM data was used. The 1994 USGS reference images were developed in accordance with National Map Accuracy Standards (NMAS) for Spatial Data Accuracy at the 1:12,000 scale. The 2002 and 2009 Virginia Base Mapping Program's orthophotography were developed in accordance with the National Standard for Spatial Data Accuracy (NSSDA). Horizontal root mean square error (RMSE) for historical mosaics was held to less than 20 ft.

2.2 Rate of Change Analysis

The Digital Shoreline Analysis System (DSAS) was used to determine the rate of change for the County's shoreline (Himmelstoss, 2009). All DSAS input data must be managed within a personal geodatabase, which includes all the baselines created for Westmoreland County and the digitized shorelines for 1937, 1953, 1969, 1994, 2002 and 2009. Baselines were digitized about 200 feet, more or less, depending on features and space, seaward of the 1937 shoreline and encompassed most of the County's main shorelines but generally did not include the smaller creeks. It also did not include areas that have unique shoreline morphology such as creek mouths and spits. DSAS generated transects perpendicular to the baseline about 33 ft apart, which were manually checked and cleaned up. For Westmoreland County, this method represented about 70 miles of shoreline along 11310 transects.

The End Point Rate (EPR) is calculated by determining the distance between the oldest and most recent shoreline in the data and dividing it by the number of years between them. This method provides an accurate net rate of change over the long term and is relatively easy to apply to most shorelines since it only requires two dates. This method does not use the intervening shorelines so it may not account for changes in accretion or erosion rates that may occur through time. However, Milligan *et al.* (2010a, 2010b, 2010c, 2010d) found that in several localities within the bay, EPR is a reliable indicator of shore change even when intermediate dates exist. Average rates were calculated along selected areas of the shore; segments are labeled in Appendix A and shown in Table 1.

Using methodology reported in Morton *et al.* (2004) and National Spatial Data Infrastructure (1998), estimates of error in orthorectification, control source, DEM and digitizing were combined to provide an estimate of total maximum shoreline position error. The data sets that were orthorectified (1937, 1959, and 1969) have an estimated total maximum shoreline position error of 20.0 ft, while the total maximum shoreline error for the four existing datasets are estimated at 18.3 ft for USGS and 10.2 ft for VBMP. The maximum annualized error for the shoreline data is $\pm$0.7 ft/yr. The smaller rivers and creeks are more prone to error due to their lack of good control points for photo rectification, narrower shore features, tree and ground cover and overall smaller rates of change. These areas are digitized but due to the higher potential for error, rates of change analysis are not calculated. Many areas of Westmoreland County have shore change rates that fall within the calculated error. Some of the areas that show very low accretion can be due to errors within the method described above.

The Westmoreland County shoreline was divided into 47 plates (Figure 2) in order to display that data in Appendices A and B. In Appendix A, the 2009 image is shown with only the 1937 and 2009 shorelines to show the long-term trends along. In Appendix B, one photo date and the associated shoreline is shown on each. These include the photos taken in 1937, 1953, 1969, 1994, 2002 and 2009.

3 Summary

The rates of change shown in Table 1 are averaged across large sections of shoreline and may not be indicative of rates at specific sites within the reach. Some areas of the County, where the shoreline change rates are categorized as accretion, have structures along the shoreline which results in a positive long-term rate of change due to the structures themselves. Some of the areas with very low accretion, particularly in the smaller creeks and rivers, may be the result of errors within photo rectification and digitizing wooded shorelines.

Hollis Marsh has the largest erosion rate in Westmoreland County. Other Potomac River shoreline is eroding, but much more slowly. This is likely do to the nature of the material. Hollis Marsh is a low, marsh and sand island that is easily overwashed in storms. Much of the main Potomac River shoreline which is exposed to the same wave climate consists of high, consolidated banks that slump when their base of ban erodes providing material to the shoreline. This results in a lower erosion rate because the shoreline accretes and the slump material must erode away before base of bank erosion occurs again.

This also occurs along Westmoreland's Rappahannock River shoreline. The relatively lower bank shorelines and marshes in segment T erode more quickly than the high banks in sections of shoreline.

Table 1. Average end point rate of change (ft/yr) between 1937 an d2009 for segments along Westmoreland County's shoreline. Segment locations are show on maps in Appendix A.

Segment Name	Location	Average Rate of Change (ft/yr)
A	Rosier Creek	-0.7
B	Potomac River, Mouth of Rosier Creek to Bluff Point	-0.1
C	Potomac River, Town of Colonial Beach	0.1
D	Monroe Bay	-0.2
E	Potomac River, Sebastian Point to Paynes Point	-0.7
F	Mouth of Mattox Creek, Wirt Wharf	-0.1
G	Potomac River, Church Point to Westmoreland State Park	-1.1
H	Potomac River, Westmoreland State Park to Haulover Inlet	-0.8
I	Nomini Bay, Hollis Marsh	-4.0
J	Currioman Bay, Haulover Inlet to Nomini Creek	-0.6
K	Nomini Creek including Buckner Creek	-0.3
L	Nomini Bay, White Point to Kingcopsico Point	-0.3
M	Lower Machodoc Creek	-0.8
N	Potomac River, Grapevine Point to Ragged Point	-1.1
O	Potomac River, Ragged Point to Jackson Creek	-0.9
P	Potomac River, Jackson Creek to Sandy Point	-2.2
Q	Potomac River, Sandy Point to Lynch Point	-1.4
R	Yeocomico River	-0.5
S	Rappahannock River, Richmond County Line to Layton Landing Rd.	-0.4
T	Rappahannock River, Layton Landing Rd. to Blind Point	-1.2
U	Rappahannock River, Blind Point to King George County Line	-0.4

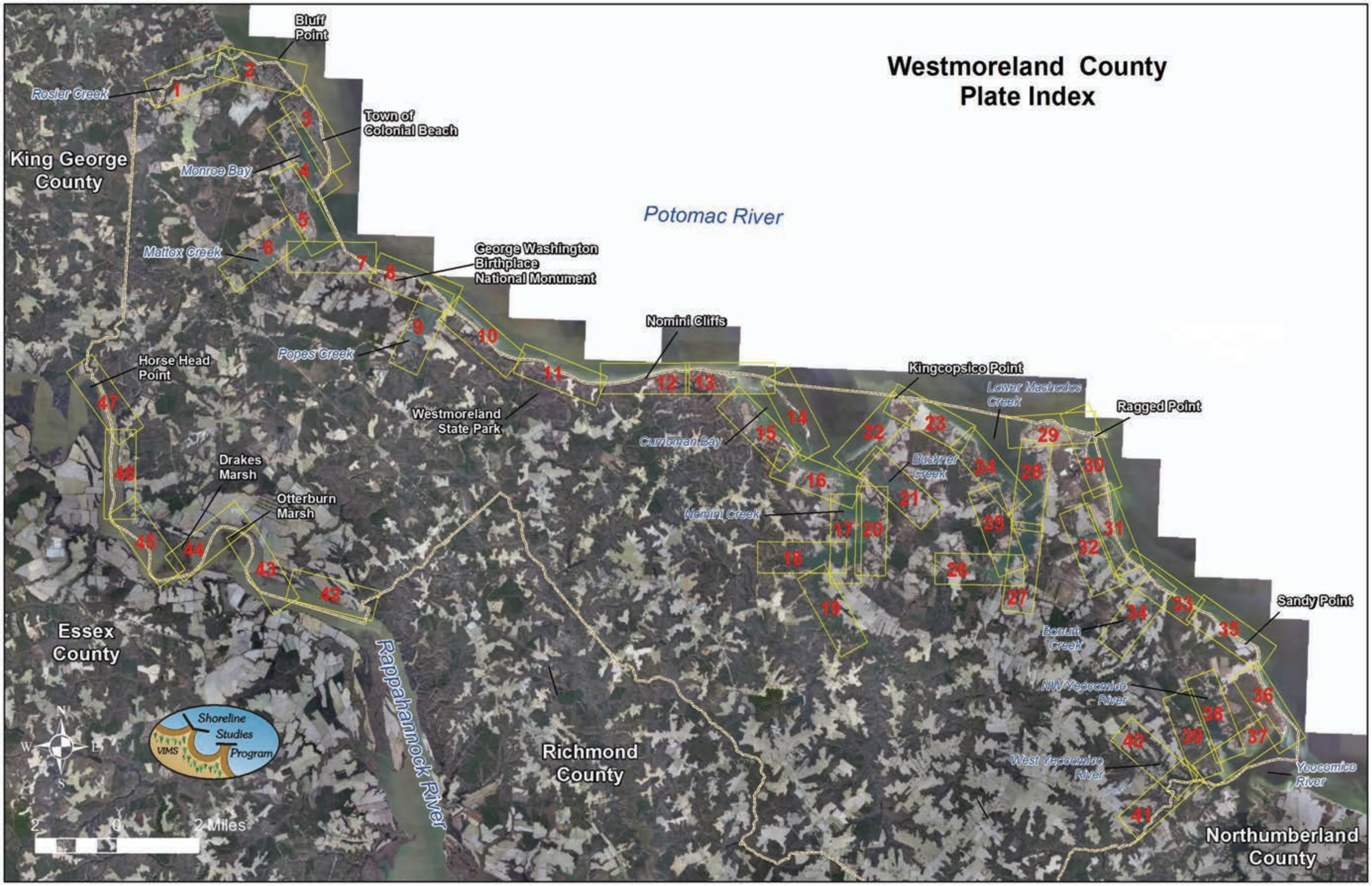

Figure 2. Index of shoreline plates.

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Appendix C: 2011 Mitigation Actions Update

The following tables provide detailed updates to the actions committed to by the participating jurisdictions in the 2011 Northern Neck PDC Hazard Mitigation Plan. The updates are provided by county in alphabetical order. Towns are included with their respective counties, also in alphabetical order.

Northern Neck PDC 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
PDC - 1	Strategy 4.1.1	Officially recognize the dual purpose of the Local Emergency Planning Committee as the Mitigation Advisory Committee. Use the Committee to review mitigation projects and coordinate multijurisdictional grant applications.	Localities	All		Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 2	Strategy 4.1.2	Develop recommendations for short-term and long-term revenue sources for mitigation, planning, and projects. These options could include grants and private sources.	Localities	All	High	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 3	Strategy 4.1.3	Incorporate mitigation principals into local comprehensive, emergency management, and recovery plans.	Localities	All	High	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 4	Strategy 4.2.1	Provide training opportunities to county/municipal enforcement staff. Educate them on GIS, damage assessment, mitigation techniques, and other related topics. Explore short term training opportunities (e.g., one day) that could be delivered in the region.	Localities	All		Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 5	Strategy 4.6.1	Provide information for citizenry about the SRL program.	Localities	Flood, Coastal	High	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 6	Strategy 4.6.2	Work in partnership with local, state, and federal agencies to implement SRL projects were appropriate.	Localities	Flood, Coastal	High	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC

Northern Neck PDC 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
							will provide support in achieving action.
PDC - 7	Strategy 5.1.1	Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day.)	Localities	All	Medium	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 8	Strategy 5.1.2	Partner with Parent Teacher Associations and local schools to implement seasonal hazard awareness weeks or days (e.g., Masters of Disaster, Risk Watch)	Localities	All	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 9	Strategy 5.1.3	Distribute packets to new residents to raise awareness regarding hazard risks in the Northern Neck.	Localities	All	Medium	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 10	Strategy 5.2.4	Work with the National Weather Service to promote the "Turn Around, Don't Drown" public education campaign.	Localities	Flood	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 11	Strategy 5.3.2	Investigate flood warning capabilities, including the identification of alternative safe routes.	Localities	Flood, Coastal	Medium	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.

Northern Neck PDC 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
PDC - 12	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 13	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 14	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 15	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 16	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.

Northern Neck PDC 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
PDC - 17	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 18	Strategy 6.3.2	Enforce the floodplain management ordinance by monitoring compliance and taking remedial action to correct violations.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.

Northern Neck PDC 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
PDC - 19	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 20	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 21	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.
PDC - 22	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Localities	Flood, Coastal	Low	Cancelled	Action is firmly within the purview of each locality to address and complete. NNPDC will provide support in achieving action.

Lancaster County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Lancaster - 1	Strategy 1.2.1	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Planning	Flood	High	Continued	Hazards continue, ordinances and policed updated to reflect new information
Lancaster - 2	Strategy 1.2.3	Encourage use of vegetation and revetments to reduce shoreline erosion.	Planning	Flood	High	Continued	Mandated by Chesapeake Bay Act
Lancaster - 3	Strategy 1.2.4	Require coordinated shoreline protection plans in new waterfront subdivisions.	Planning	Flood	Low	Continued	Not required, but encouraged
Lancaster - 4	Strategy 1.3.1	Consider using fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	Planning	Flood	Low	Continued	Conservation easement ordinance encourages this action
Lancaster - 5	Strategy 2.2.1	Identify existing flood prone structures that may benefit from mitigation measures such as elevation.	Planning	Flood	Low	Continued	Provide support for homeowners interested in the projects
Lancaster - 6	Strategy 2.2.3	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Planning	Flood	Med	Continued	Adjacent property owners are notified and actions encouraged
Lancaster - 7	Strategy 3.3.1	Identify funding opportunities to replace vulnerable or undersized culvert stream crossing with bridges or larger culverts to reduce flood hazards.	Not provided	Flood, Coastal		Canceled	No jurisdiction program support.
Lancaster - 8	Strategy 3.3.2	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	Planning	Flood	Med	Continued	BOS makes recommendations through the six year secondary road plan
Lancaster - 9	Strategy 3 .3. 7	Work with private property owners, VDOT, and private utilities to trim or remove trees that could down power lines.	Planning	Severe weather	Low	Continued	Ongoing efforts to communicate with VDOT, utilities and property owners

Lancaster County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Lancaster - 10	Strategy 4.2.2	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	IT	All	Med	Continued	As technology and resources allow, new opportunities are made available to staff to more effectively utilize GIS in emergency management planning, response and recovery
Lancaster - 11	Strategy 4.3.2	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	Emergency Services	All	High	Continued	Use of crisis track has been adopted and implemented
Lancaster - 12	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	Building Official	Flood	Low	Continued	Optional program, considering capabilities to support
Lancaster - 13	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Planning / Building Official	Flood	Med	Continued	Floodplain requirements must be met for building in the floodplain
Lancaster - 14	Strategy 5.1.5	Develop vegetative planting programs for public shoreline property to serve as a model for public education purposes.	Building and Grounds	Flood	Med	Continued	Placed vegetation in new public access projects
Lancaster - 15	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	Emergency Services	Flood	Med	Continued	Information provided to residents through outreach activities
Lancaster - 16	Strategy 5.2.2	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Emergency Services	Flood	Med	Continued	Information provided to residents through outreach activities
Lancaster - 17	Strategy 5.2.3	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	Emergency Services	Flood	Med	Continued	Information provided to residents through outreach activities

Lancaster County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Lancaster - 18	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities.	Emergency Services	Severe weather	High	Continued	All public facilities are so equipped; public encouraged through outreach activities
Lancaster - 19	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Building Official	Flood	High	Continued	Ordinances remain updated to maintain compliance
Lancaster - 20	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	IT / Planning	Flood	Med	Continued	Maps maintained by planning office and made available on County GIS website
Lancaster - 21	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Planning	Flood	High	Continued	Ordinances remain updated to maintain compliance
Lancaster - 22	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Planning	Flood	Med	Continued	Information is submitted to FEMA for review in a timely manner, as received
Lancaster - 23	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Planning	Flood	High	Continued	Required by ordinance
Lancaster - 24	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the	Planning	Flood	High	Continued	Required by ordinance, updated regularly as new information becomes available

Lancaster County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.					
Lancaster - 25	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Planning	Flood	High	Continued	Required by ordinance
Lancaster - 26	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning	Flood	High	Continued	Regulations meet or exceed minimum requirements
Lancaster - 27	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Emergency Services	Flood	Med	Continued	Information provided to residents through outreach activities
Lancaster - 28	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Emergency Services	Flood	Med	Continued	Information provided to residents through outreach activities

Lancaster County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Lancaster - 29	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Emergency Services	Flood	Low	Continued	Staff available to assist residents upon request

Town of Irvington 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Irvington - 1	Strategy 1.2.3	Encourage use of vegetation and revetments to reduce shoreline erosion. (also Goal #2)	Town Administrator	flood	medium	continue	Chesapeake Bay Restoration Act Requirements
Irvington - 2	Strategy 1.2.4	Require coordinated shoreline protection plans in new waterfront subdivisions.	Town Administrator	flood	low	continue	no new waterfront subdivisions
Irvington - 3	Strategy 2.2.3	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Town Administrator	flood	low	continue	as permits are requested
Irvington - 4	Strategy 3.2.1	Identify need for backup generators, communications and/or vehicles at critical public facilities. Develop means to address shortfall identified. (also Goal #4)	Town Administrator	all	low	continue	very limited facilities and funds
Irvington - 5	Strategy 3.2.2	Consider providing necessary electrical hook-up, wiring, and switches to allow readily accessible connections to emergency generators at selected critical public facilities.	Town Administrator	all	low	continue	very limited facilities and funds
Irvington - 6	Strategy 3.3.4	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	Town Administrator	all	medium	continue	continuing discussions with Aqua VA and Dominion power
Irvington - 7	Strategy 3.4.1	Initiate road clearing efforts early in wind and winter storms. Develop plan for quick deployment of road clearing support.	Town Administrator	all	medium	continue	VADOT responsible for road clearing and maintenance
Irvington - 8	Strategy 4.1.4	Develop a Continuity of Operations Plan.	town Administrator	all	low	continue	limited staff to coordinate
Irvington - 9	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	Town Administrator	flood	low	continue	already participate in FEMA floor Insurance and mapping plans
Irvington - 10	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Town Administrator	flood	medium	continue	done on an ongoing basis

Town of Irvington 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Irvington - 11	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	Town Administrator	flood	low	continue	limited flood plane properties
Irvington - 12	Strategy 5.2.2	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Town Administrator	flood	low	continue	limited properties in flood plane
Irvington - 13	Strategy 5.2.3	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	town Administrator	flood	low	continue	limited properties in flood plane
Irvington - 14	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	Town Administrator	flood /all	low	continue	only public facility is town hall and we have a NOAA radio
Irvington - 15	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Town Administrator	all	low	continue	we are involved in NFIP
Irvington - 16	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Town Administrator	flood	low	continue	we have copies of floodplain maps at town hall for public inspection
Irvington - 17	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Town Administrator	flood	low	continue	will do as items developed
Irvington - 18	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Town Administrator	flood /all	low	continue	will do as developed
Irvington - 19	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Town Administrator	flood	low	continue	will do as developed

Town of Irvington 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Irvington - 20	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	town Administrator	flood	low	continue	have town ordinance which adopts and incorporates Chesapeake Bay Restoration Act
Irvington - 21	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Town Administrator	flood	medium	continue	done on a regular basis
Irvington - 22	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that	Town Administrator	all	low	continue	We have very limited facilities with hazardous materials and building and zoning code takes care of residential housing.

Town of Irvington 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		prohibit any new residential or non-residential structures in the SFHA.					
Irvington - 23	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Town Administrator	flood	low	continue	we have very limited properties in flood planes
Irvington - 24	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Town Administrator	flood	low	continue	done on an as needed basis
Irvington - 25	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Town Administrator	all	low	continue	On all types of insurance?

Town of Kilmarnock 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Kilmarnock - 1	Strategy 1.1.1	Avoid establishing public service facilities and utilities, such as wastewater disposal facilities, within or near the floodplain where they might create a hazard if damaged during a storm.	Planning Department/ Public Works	flooding, water pollution	moderate	continued	continued avoidance
Kilmarnock - 2	Strategy 1.2.1	Incorporate hazard mitigation techniques into new community facilities to minimize damages. (See Goal #3)	Planning Department/ Public Works	all	moderate	continued	will continue to incorporate
Kilmarnock - 3	Strategy 3.1.1	Investigate all critical community facilities, such as county administrative offices, shelters (non-school buildings), fire stations, and police stations, to evaluate their resistance to flood and wind hazards. Particular attention will be given to the HY AC systems and structural integrity of the buildings. Prioritize facilities in known hazard areas (e.g., floodplains)	Planning Department/ Public Works	all	moderate	continued	town facilities are continually accessed
Kilmarnock - 4	Strategy 3.3.3	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Planning Department/ Public Works	flooding	moderate	continued	the town works with landowners and helps vdot keep streets clean
Kilmarnock - 5	Strategy 3.3.4	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	Planning Department/ Public Works	all	moderate	continued	discuss when possible
Kilmarnock - 6	Strategy 3.3.5	Replace traffic lights hung from wires with traffic lights hung from mast arms. Install all new traffic lights on mast arms. Ensure traffic light mechanisms are weather proof.	Planning Department/ Public Works	wind	moderate	continued	rely on vdot
Kilmarnock - 7	Strategy 3.3.6	Identify program of corrective actions to improve stormwater systems capacity to handle major rain events.	Planning Department/ Public Works	flooding	moderate	continued	need state cooperation
Kilmarnock - 8	Strategy 4.1.4	Develop a Continuity of Operations Plan.	Planning Department/ Public Works	all	low	continued	will consider

Town of Kilmarnock 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Kilmarnock - 9	Strategy 4.2.2	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	Planning Department/ Public Works	all	low	cancelled	rely on county
Kilmarnock - 10	Strategy 4.3.1	Develop a detailed building inventory for all structures in the jurisdiction, which catalogues information such as value of the structure, contents, age, location (latitude and longitude), etc.	Planning Department/ Public Works	all	low	cancelled	rely on county
Kilmarnock - 11	Strategy 4.3.2	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	Planning Department/ Public Works	all	low	cancelled	rely on county
Kilmarnock - 12	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	Planning Department/ Public Works	all	low	continued	considering
Kilmarnock - 13	Strategy 4.5.6	Include an assessment and associated mapping of the jurisdiction's vulnerability to location specific hazards, and make appropriate recommendations for the use of these hazard areas in the next comprehensive plan.	Planning Department/ Public Works	all	moderate	continued	considered during comp plan review
Kilmarnock - 14	Strategy 4.5.7	Investigate using non-conforming or substantial damage provision to require hazard retrofitting of existing development.	Planning Department/ Public Works	all	low	continued	will investigate
Kilmarnock - 15	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	Planning Department/ Public Works	all	moderate	continued	town will encourage
Kilmarnock - 16	Strategy 5.2.2	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Planning Department/ Public Works	all	moderate	continued	town will educate
Kilmarnock - 17	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	Planning Department/ Public Works	all	low	continued	town will encourage

Town of Kilmarnock 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Kilmarnock - 18	Strategy 5.3.3	Investigate, develop, or enhance a regional public notification system such as low power FM or AM radio.	Planning Department/ Public Works	all	low	cancelled	needs to be county wide not just town. Town has its own code red in place now but rely as well.
Kilmarnock - 19	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Planning Department/ Public Works	flooding	low	cancelled	town participates in the NFIP
Kilmarnock - 20	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Planning Department/ Public Works	flooding	low	continued	town does this
Kilmarnock - 21	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Planning Department/ Public Works	flooding	low	continued	town does this
Kilmarnock - 22	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Planning Department/ Public Works	flooding	low	continued	town does this
Kilmarnock - 23	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Planning Department/ Public Works	flooding	low	continued	town does this
Kilmarnock - 24	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres;	Planning Department/ Public Works	flooding	low	continued	Ordinance adopted and maintained

Town of Kilmarnock 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.					
Kilmarnock - 25	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Planning Department/ Public Works	flooding	low	continued	town does this now
Kilmarnock - 26	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning Department/ Public Works	flooding	low	continued	considered
Kilmarnock - 27	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Planning Department/ Public Works	flooding	low	continued	town does this
Kilmarnock - 28	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Planning Department/ Public Works	flooding	low	continued	town does this

Town of Kilmarnock 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Kilmarnock - 29	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Planning Department/ Public Works	flooding	low	continued	town provides when needed

Northumberland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Northumberland - 1	Strategy 1.1.2	Established special setback regulations where shoreline erosion has been documented, and due to periodic storms, represents a future threat to life and property.	Building and Zoning	Flood, Coastal Erosion	Low	cancelled	100 Foot CBPA RPA is considered an adequate hazard boundary
Northumberland - 2	Strategy 1.1.3	Established standards for construction which modify the shoreline, such as: bulkheads, piers, and boat house.	Building and Zoning	Flood, Coastal Erosion	Low	cancelled	Adjoining localities may have conflicting standards
Northumberland - 3	Strategy 1.2.1	Incorporate hazard mitigation techniques into new community facilities to minimize damages. (See Goal #3)	Building and Zoning	All	Med	continued	
Northumberland - 4	Strategy 1.2.2	Provide incentives for property owners to implement mitigation measures. (also Goals #2 & #5)	Building and Zoning	Flood, Coastal Erosion	Low	cancelled	Providing incentives is not possible at this time
Northumberland - 5	Strategy 1.2.3	Encourage use of vegetation and revetments to reduce shoreline erosion. (also Goal #2)	Building and Zoning	Coastal Erosion	Low	continued	Not appropriate everywhere
Northumberland - 6	Strategy 1.3.1	Consider using fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	Building and Zoning	Flood	Low	continued	
Northumberland - 7	Strategy 1.3.2	Consider implementing a wetlands acquisition and /or restoration program.	Building and Zoning	Flood	Low	continued	
Northumberland - 8	Strategy 2.1.1	Increase enforcement and education regarding the tie down of propane and other fuel tanks (also Goal # 1)	Building and Zoning	Flood, Wind	Low	continued	
Northumberland - 9	Strategy 2.2.1	Identify existing flood prone structures that may benefit from mitigation measures such as elevation.	Building and Zoning	Flood	Low	continued	
Northumberland - 10	Strategy 2.2.2	Investigate all manufactured homes and trailers to evaluate their resistance to winds and flood hazards.	Building and Zoning	Flood, Wind	Low	cancelled	Inadequate staffing levels to complete task

Northumberland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Northumberland - 11	Strategy 2.2.3	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Building and Zoning	Coastal Erosion	Med	continued	
Northumberland - 12	Strategy 3.1.1	Investigate all critical community facilities, such as county administrative offices, shelters (non-school buildings), fire stations, and police stations, to evaluate their resistance to flood and wind hazards. Particular attention will be given to the HY AC systems and structural integrity of the buildings. Prioritize facilities in known hazard areas (e.g., floodplains)	Building and Zoning; Admin. Office	All	Med	completed	We have identified our at risk critical community facilities
Northumberland - 13	Strategy 3.3.2	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	Building and Zoning	Flood	High	continued	Working with VDOT now
Northumberland - 14	Strategy 3.3.3	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Building and Zoning	Flood	Low	cancelled	This is VDOT's responsibility
Northumberland - 15	Strategy 4.3.1	Develop a detailed building inventory for all structures in the jurisdiction, which catalogues information such as value of the structure, contents, age, location (latitude and longitude), etc.	Building and Zoning	All	Low	cancelled	Inadequate staffing levels to complete task
Northumberland - 16	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Building and Zoning	Flood, Wind	Med	cancelled	County policy allows development in the floodplain provided the structure meets freeboard requirements

Northumberland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
							and /or foundation reinforcement
Northumberland - 17	Strategy 4.5.8	Investigate implementation of cumulative damage provision as part of floodplain ordinance.	Building and Zoning	Flood	Low	continued	
Northumberland - 18	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	Building and Zoning	Flood	Low	continued	
Northumberland - 19	Strategy 5.2.2	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Building and Zoning	Flood	Med	continued	
Northumberland - 20	Strategy 5.2.3	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	OEMS	Flood	Low	continued	Investigate adding to county website
Northumberland - 21	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	OEMS	All	Low	cancelled	NOAA Radios analog old school technology. Replace with automated phone call warning system - Code Red (see added strategy)
Northumberland - 22	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Building and Zoning	Flood	High	continued	
Northumberland - 23	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Building and Zoning	Flood	High	continued	
Northumberland - 24	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Building and Zoning	Flood	High	continued	

Northumberland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Northumberland - 25	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Building and Zoning	Flood	Med	continued	LOMA's sent to FEMA by individual
Northumberland - 26	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Building and Zoning	Flood	Low	continued	Assist surveyors, as county staff can't make official determination
Northumberland - 27	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Building and Zoning	Flood	Med	continued	
Northumberland - 28	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Building and Zoning	Flood	High	continued	

Northumberland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Northumberland - 29	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Building and Zoning	Flood	High	continued	Have flood ordinance that requires an extra 24 inches of freeboard
Northumberland - 30	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Building and Zoning	Flood	Med	continued	
Northumberland - 31	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Building and Zoning	Flood	Med	continued	Have held public meetings win conjunction with FEMA
Northumberland - 32	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Building and Zoning	All	High	continued	

Richmond County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Richmond - 1	Strategy 1.1.1	Avoid establishing public service facilities and utilities, such as wastewater disposal facilities, within or near the floodplain where they might create a hazard if damaged during a storm.	health department	Flood	Low	completed	state health department takes care of this
Richmond - 2	Strategy 1.1.2	Established special setback regulations where shoreline erosion has been documented, and due to periodic storms, represents a future threat to life and property.	land use	Flood, Coastal	Low	cancelled	not addressed
Richmond - 3	Strategy 1.1.3	Established standards for construction which modify the shoreline, such as: bulkheads, piers, and boat house.	VMRC	Coastal	Low	cancelled	handled by VMRC
Richmond - 4	Strategy 1.2.1	Incorporate hazard mitigation techniques into new community facilities to minimize damages. (See Goal #3)	land use	All	High	completed	
Richmond - 5	Strategy 1.2.3	Encourage use of vegetation and revetments to reduce shoreline erosion. (also Goal #2)	land use	Coastal	High	completed	
Richmond - 6	Strategy 1.2.4	Require coordinated shoreline protection plans in new waterfront subdivisions.	land use	Coastal	High	completed	
Richmond - 7	Strategy 1.3.1	Consider using fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	land use	Flood, Coastal	Low	completed	would be submitted by builder for profers to by approved by county
Richmond - 8	Strategy 1.3.2	Consider implementing a wetlands acquisition and /or restoration program.	NN Soil and Water Conservation District	Coastal	Moderate	continued	
Richmond - 9	Strategy 2.1.1	Increase enforcement and education regarding the tie down of propane and other fuel tanks (also Goal # 1)	land use	Wind, Flood	High	completed	

Richmond County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Richmond - 10	Strategy 2.2.3	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	land use	Coastal	High	continued	
Richmond - 11	Strategy 3.3.2	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	county administrator	Flood	Low	continued	
Richmond - 12	Strategy 3.3.4	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	Information not provided	Wind, Flood	Information not provided	cancelled	Information not provided
Richmond - 13	Strategy 4.2.2	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	IT	All	High	continued	
Richmond - 14	Strategy 4.2.3	Evaluate the floodplain manager's roles and responsibilities in each local jurisdiction.	land use	Flood, Coastal	High	continued	
Richmond - 15	Strategy 4.3.2	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	Emergency Management /IT	All	Low	continued	
Richmond - 16	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	land use	Flood, Coastal	Low	completed	
Richmond - 17	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	land use	Flood, Coastal	High	completed	
Richmond - 18	Strategy 4.5.4	Evaluate the potential costs versus benefits of implementing a freeboard requirement for all new structures within the 100 year floodplain.	land use	Flood, Coastal	Low	continued	
Richmond - 19	Strategy 4.5.8	Investigate implementation of cumulative damage provision as part of floodplain ordinance.	Emergency Management /IT	Flood, Coastal	Low	continued	

Richmond County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Richmond - 20	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	county administrator	All	High	completed	
Richmond - 21	Strategy 5.3.4	Work with VDOT to establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood prone areas.	land use	Flood, Coastal	Low	cancelled	
Richmond - 22	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	land use	Flood, Coastal	Low	completed	
Richmond - 23	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	land use	Flood, Coastal	Low	completed	
Richmond - 24	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	land use	Flood, Coastal	High	completed	
Richmond - 25	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	land use	Flood, Coastal	Low	continued	when new information is available
Richmond - 26	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	land use	Flood, Coastal	Low	completed	
Richmond - 27	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and	land use	Flood, Coastal	High	continued	

Richmond County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.					
Richmond - 28	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	land use	yes	yes	continued	
Richmond - 29	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	land use	Flood, Coastal	Low	completed	
Richmond - 30	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	land use	Flood, Coastal	Low	cancelled	up to FEMA

Richmond County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Richmond - 31	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	land use	Flood, Coastal	High	continued	
Richmond - 32	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	land use	Flood, Coastal	High	continued	

Westmoreland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Westmoreland - 1	Strategy 1.2.1	Incorporate hazard mitigation techniques into new community facilities to minimize damages. (See Goal #3)	planning	all	Not provided	continued	facilities are built to commercial standards
Westmoreland - 2	Strategy 1.3.1	Consider using fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	planning	flood	Not provided	continued	encourage for new development
Westmoreland - 3	Strategy 2.2.1	Identify existing flood prone structures that may benefit from mitigation measures such as elevation.	planning	flood	Not provided	continued	identified and some have been mitigated
Westmoreland - 4	Strategy 2.3.1	Evaluate built-upon areas within the floodplain or along the high erosion risk shoreline for possible relocation and/or buy-out. In particular, target FEMA's Repetitive Loss Properties throughout the Northern Neck for possible relocation and/or buy-out.	planning	flood	Not provided	continued	repitive loss properties have been identified through FEMA
Westmoreland - 5	Strategy 3.3.1	Identify funding opportunities to replace vulnerable or undersized culvert stream crossing with bridges or larger culverts to reduce flood hazards.	VDOT	flood	Not provided	continued	the county doesn’t maintain any roads
Westmoreland - 6	Strategy 3.3.2	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	VDOT	flood	Not provided	continued	The county will bring potential issues or concerns to the attention of VDOT.

Westmoreland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Westmoreland - 7	Strategy 3.3.4	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	planning	flood an wind events	Not provided	continued	all subdivisions are sent to electric utilitilies for their review prior to our approval planning, Other State Agencies are invited to attend meetings for some commercial projects.
Westmoreland - 8	Strategy 4.2.2	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	EM	all hazards	Not provided	continued	Emergency Management coordiantes training for staff.
Westmoreland - 9	Strategy 4.3.2	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	County Admin	all hazards	Not provided	continued	County Administration tracks and keeps file per FEMA Guidelines.
Westmoreland - 10	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	planning	flood	Not provided	continued	Planning staff has attended training on the CRS Program
Westmoreland - 11	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 12	Strategy 4.5.2	Review and revise, if required, existing Subdivision Ordinances to include hazard mitigation-related development criteria in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 13	Strategy 4.5.4	Evaluate the potential costs versus benefits of implementing a freeboard requirement for all new structures within the 100 year floodplain.	planning	flood	Not provided	continued	Freeboard was increased to 18 inches last spring
Westmoreland - 14	Strategy 4.5.5	Review and revise, if required the existing zoning ordinance to include separate zones or districts with appropriate development criteria for known hazard areas.	planning	All	Not provided	cancelled	

Westmoreland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Westmoreland - 15	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	planning	flood	Not provided	continued	this is discussed with landowners along with floodplain issues
Westmoreland - 16	Strategy 5.2.2	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	planning	flood	Not provided	continued	this is discussed with landowners along with floodplain issues
Westmoreland - 17	Strategy 5.2.3	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	planning	flood	Not provided	continued	Follow FEMA guidelines
Westmoreland - 18	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	planning	flood	Not provided	continued	ongoing process
Westmoreland - 19	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	planning	flood	Not provided	continued	citizens request copies of applicable floodplain maps
Westmoreland - 20	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 21	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 22	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 23	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development	planning	flood	Not provided	continued	ongoing process

Westmoreland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.					
Westmoreland - 24	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 25	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 26	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	planning	flood	Not provided	continued	ongoing process

Westmoreland County 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Westmoreland - 27	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	planning	flood	Not provided	continued	ongoing process
Westmoreland - 28	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	planning	flood	Not provided	cancelled	citizens are encouraged to speak with their insurance carrier

Town of Colonial Beach 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Colonial Beach - 1	Strategy 2.1.1	Increase enforcement and education regarding the tie down of propane and other fuel tanks (also Goal # 1)	Planning	wind, flood	Not provided	continued	creating brochure to give to homeowners concerning flood hazards
Colonial Beach - 2	Strategy 3.1.2	Evaluate exiting storm water system to determine if it is adequate for existing (or future) flood hazards.	Planning	flood	Not provided	continued	researching grants to develop a town-wide stormwater management plan
Colonial Beach - 3	Strategy 3.3.3	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Public Works	flood, wind	Not provided	continued	continual maintenance performed by Public Works
Colonial Beach - 4	Strategy 3.3.6	Identify program of corrective actions to improve stormwater systems capacity to handle major rain events.	Planning	flood	Not provided	continued	researching grants to develop a town-wide stormwater management plan
Colonial Beach - 5	Strategy 4.3.1	Develop a detailed building inventory for all structures in the jurisdiction, which catalogues information such as value of the structure, contents, age, location (latitude and longitude), etc.	Planning	all	Not provided	continued	General Zoning Log contains this information
Colonial Beach - 6	Strategy 4.5.1	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Planning	Flood	Not provided	continued	continual enforcement of Flood Plain Ordinance
Colonial Beach - 7	Strategy 4.5.2	Review and revise, if required, existing Subdivision Ordinances to include hazard mitigation-related development criteria in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.	Planning	flood	Not provided	completed	Floodplain Ordinance covers regulations in hazard areas
Colonial Beach - 8	Strategy 4.5.5	Review and revise, if required the existing zoning ordinance to include separate zones or districts with appropriate development criteria for known hazard areas.	Planning	all	Not provided	completed	Flood Plain ordinance and accomanied Flood Plain map
Colonial Beach - 9	Strategy 4.5.6	Include an assessment and associated mapping of the jurisdiction's vulnerability to location specific hazards, and make appropriate	Planning	all	Not provided	continued	2015 Flood maps adopted but not

Town of Colonial Beach 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
		recommendations for the use of these hazard areas in the next comprehensive plan.					included in current comprehensive plan
Colonial Beach - 10	Strategy 4.5.7	Investigate using non-conforming or substantial damage provision to require hazard retrofitting of existing development.	Planning	flood, coastal	Not provided	continued	any improvements to existing non conforming structures will need to be conforming according to hazard mitigation techniques
Colonial Beach - 11	Strategy 5.1.4	Publicize the location of local shelters and emergency phone numbers. Include a map of shelters in local phonebooks or on county websites.	Planning	all	Not provided	continued	need to develop list
Colonial Beach - 12	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	Planning	all	Not provided	continued	
Colonial Beach - 13	Strategy 5.3.3	Investigate, develop, or enhance a regional public notification system such as low power FM or AM radio.	Planning	all	Not provided	continued	
Colonial Beach - 14	Strategy 5.3.4	Work with VDOT to establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood prone areas.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 15	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 16	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 17	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Planning	flood, coastal	Not provided	continued	

Town of Colonial Beach 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Colonial Beach - 18	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 19	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 20	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 21	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Planning	flood, coastal	Not provided	continued	

Town of Colonial Beach 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Colonial Beach - 22	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 23	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Planning	flood, coastal	Not provided	continued	creating brochure to give to homeowners concerning flood hazards
Colonial Beach - 24	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Planning	flood, coastal	Not provided	continued	
Colonial Beach - 25	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Planning	flood, coastal	Not provided	continued	

Town of Montross 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Montross - 1	Strategy 4.1.4	Develop a Continuity of Operations Plan.	Westmoreland County	All	Medium	Continued	The Town does not have a formal continuity of operations plan, but does participate with the county in planning for emergencies
Montross - 2	Strategy 4.4.1	Consider participating in FEMA's Community Rating System (CRS).	Town Manager	Flood, Coastal	Not provided	Continued	The Town of Montross partners with the County of Westmoreland in the development of FEMA's Community Rating System
Montross - 3	Strategy 5.2.1	Encourage the purchase of flood and/or sewer back-up insurance.	Town Manager	Flood, Coastal	Not provided	Continued	The Town works with interested property owners to make recommendations and stresses the importance of proper insurance.
Montross - 4	Strategy 5.3.1	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities. (also Goal #4).	Town Manager	All	Not provided	Continued	The Town purchased three NOAA radios. These radios are accessible to key personnel.
Montross - 5	Strategy 6.1.1	Maintain a voluntary agreement with FEMA to participate in the NFIP	Westmoreland County	Flood, Coastal	Not provided	Continued	Town of Montross partners with Westmoreland County
Montross - 6	Strategy 6.2. l	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Town Manager	Flood, Coastal	High	Continued	Town of Montross will coordinate with Westmoreland County and assistance
Montross - 7	Strategy 6.2.2	Adopt the most current DFIRM or FIRM and FIS as they become available.	Westmoreland County	Flood, Coastal	Not provided	Continued	Town of Montross will coordinate with Westmoreland County

Town of Montross 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Montross - 8	Strategy 6.2.3	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Westmoreland County	Flood, Coastal	Not provided	Continued	Town of Montross partners with Westmoreland County
Montross - 9	Strategy 6.2.4	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Westmoreland County	Flood, Coastal	Not provided	Continued	Town of Montross partners with Westmoreland County
Montross - 10	Strategy 6.3 .1	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Westmoreland County	Flood, Coastal	Not provided	Continued	Town of Montross will review with Westmoreland County as the County would issue the permits
Montross - 11	Strategy 6.3.2	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Westmoreland County	Flood, Coastal	Not provided	Continued	The Westmoreland County would enforce this

Town of Montross 2011 Mitigation Actions Update

Community Number	Action Number	Action	Lead Office	Hazard Addressed	Priority	2017 Action Update (continued/cancelled /completed?)	Notes explaining status are required
Montross - 12	Strategy 6.3.3	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Town Manager	Flood, Coastal	Medium	Continued	Town of Montross will review with Westmoreland County as the County does
Montross - 13	Strategy 6.4.1	Educate community members about the availability and value of flood insurance.	Town Manager	Flood, Coastal	Not provided	Continued	The Town works with interested property owners to make recommendations and stresses the importance of proper insurance.
Montross - 14	Strategy 6.4.2	Inform community property owners about changes to the DFIRMIFIRM that may impact their insurance rates.	Town Manager	Flood, Coastal	High	Continued	Town will follow-up with Westmoreland County to see if they have anything in place
Montross - 15	Strategy 6.4.3	Provide general assistance to community members relating to insurance issues.	Town Manager	Flood, Coastal	Not provided	Continued	The Town works with interested property owners to make recommendations and stresses the importance of proper insurance.

Appendix D: 2017-2022 Mitigation Actions

The following tables provide detailed actions committed to by the participating jurisdictions in the 2017-2022 Northern Neck PDC Hazard Mitigation Plan. The actions are provided by county in alphabetical order. Towns are included with their respective counties, also in alphabetical order.

The Northern Neck PDC 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northern Neck - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Agency-wide	High	X	**X**	X	X	X	X	Hurricane, Flood, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	Staff, FEMA HMA Grants
Northern Neck - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Agency-wide	High	**X**	X	X	X	X	X	Hurricane, Flood, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	Staff, Member jurisdictions

The Northern Neck PDC 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northern Neck - 3	Promotion, education and implementation of nature-based resiliency practices. Eligible projects include but are not limited to: 1. Ecosystem restoration approaches such as ecological restoration or forest and wetland landscape restoration. 2. Issue-specific ecosystem related approaches such as ecosystem-based adaptation and mitigation, climate adaptation and ecosystem-based disaster risk reduction. 3. Infrastructure related approaches such as green and blue infrastructure. 4. Ecosystem-based management approaches such as integrated coastal zone and water resources management. 5. Ecosystem protection approaches such as area-based conservation and protected area management.	Agency-wide	High	X	**X**	X	X	X	X	Hurricane, Flood, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	Staff, State Agencies, Non-governmental Organizations
Northern Neck - 4	Promote and grow the Living Shoreline Initiative in both its Non-structural and Combined structural/non-structural aspects. Actions taken may include, but are not limited to, grading land away from eroding shoreline, maintain riparian bugger adjacent to shorelines, and complement with other stormwater management (rain barrels, rain garden, conservation landscaping).	Agency-wide	High	X	X	**X**	X	X	X	Flood, Coastal Erosion	Ongoing	Staff, Member jurisdictions, State Agencies, Non-governmental Organizations

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Lancaster - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Planning	Medium	X	**X**	X	X	X	X	Hurricane, Flood, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	County Staff
Lancaster - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Planning	Medium	**X**	X	X				Flood, Drought	Ongoing	County Staff
Lancaster - 3	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Planning	High	X	**X**		X			Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	**Action Strategy**	**Lead Office**	**Priority**	**Project Type - lead type in boldface**						**Hazard(s) Addressed**	**Timeframe**	**Resources**
				Prevention	**Property Protection**	**Natural Resource Protection**	**Structural**	**Emergency Services**	**Education & Outreach**			
Lancaster - 4	Encourage use of vegetation and revetments to reduce shoreline erosion.	Planning	High		X	**X**	X			Flood	Ongoing	County Staff
Lancaster - 5	Require coordinated shoreline protection plans in new waterfront subdivisions.	Planning	Low	X	**X**	X	X		X	Flood	Ongoing	County Staff
Lancaster - 6	Consider using free, simple, and/or permanent easement to prevent development in the highest priority undeveloped Floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	Planning	Low	X	X	**X**				Flood	Ongoing	County Staff
Lancaster - 7	Identify existing flood prone structures that may benefit from mitigation measures such as elevation.	Planning	Low	X	**X**			X	X	Flood	Ongoing	County Staff
Lancaster - 8	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Planning	Medium	X	X	**X**				Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Lancaster - 9	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	Planning	Medium	X	X		**X**			Flood	Ongoing	County Staff
Lancaster - 10	Work with private property owners, VDOT, and private utilities to trim or remove trees that could down power lines.	Planning	Low	X	**X**	X	X			Severe weather	Ongoing	County Staff
Lancaster - 11	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	IT	Medium					**X**		All	Ongoing	County Staff
Lancaster - 12	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	Emergency Services	High		X	**X**		X		All	Ongoing	County Staff
Lancaster - 13	Consider participating in FEMA's Community Rating System (CRS).	Building Official	Low	**X**				X	X	Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Lancaster - 14	Continue to enforce zoning and building codes to prevent construction within the Floodplain.	Planning / Building Official	Medium	**X**	X					Flood	Ongoing	County Staff
Lancaster - 15	Develop vegetative planting programs for public shoreline property to serve as a model for public education purposes.	Building and Grounds	Medium			**X**				Flood	Ongoing	County Staff
Lancaster - 16	Encourage the purchase of flood and/or sewer back-up insurance.	Emergency Services	Medium	**X**					X	Flood	Ongoing	County Staff
Lancaster - 17	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Emergency Services	Medium	X					**X**	Flood	Ongoing	County Staff
Lancaster - 18	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	Emergency Services	Medium	X	X			X	**X**	Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Lancaster - 19	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities.	Emergency Services	High	X				**X**	X	Severe weather	Ongoing	County Staff
Lancaster - 20	Maintain a voluntary agreement with FEMA to participate in the NFIP	Building Official	High	**X**						Flood	Ongoing	County Staff
Lancaster - 21	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	IT / Planning	Medium	**X**					X	Flood	Ongoing	County Staff
Lancaster - 22	Adopt the most current DFIRM or FIRM and FIS as they become available.	Planning	High	**X**						Flood	Ongoing	County Staff
Lancaster - 23	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Planning	Medium	**X**						Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Lancaster - 24	Assist with local floodplain determinations and maintain a record of approved changes to the local Floodplain.	Planning	High	**X**						Flood	Ongoing	County Staff
Lancaster - 25	Adopt or maintain a Floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from Flood to or above the Base Flood Elevation (BFE), including anchoring , using Flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Planning	High	**X**						Flood	Ongoing	County Staff
Lancaster - 26	Enforce the floodplain management ordinance by monitoring compliance and taking remedial action to correct violations.	Planning	High	**X**						Flood	Ongoing	County Staff

Lancaster County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Lancaster - 27	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally Floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning	High	**X**						Flood	Ongoing	County Staff
Lancaster - 28	Educate community members about the availability and value of Flood insurance.	Emergency Services	Medium	X					**X**	Flood	Ongoing	County Staff
Lancaster - 29	Inform community property owners about changes to the DFIRM/FIRM that may impact their insurance rates.	Emergency Services	Medium						**X**	Flood	Ongoing	County Staff
Lancaster - 30	Provide general assistance to community members relating to insurance issues.	Emergency Services	Low						**X**	Flood	Ongoing	County Staff

Town of Irvington 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Irvington - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Not Provided	Not Provided	X	**X**	X	X		X	Hurricane, Flood, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Not Provided	Not Provided
Irvington - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Not Provided	Not Provided	**X**	X	X	X	X	X	All	Not Provided	Not Provided

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	**Property Protection**	**Natural Resource Protection**	**Structural**	**Emergency Services**	**Education & Outreach**			
Kilmarnock - 1	Avoid establishing public service facilities and utilities, such as wastewater disposal facilities, within or near the Floodplain where they might create a hazard if damaged during a storm.	Public Works/ Planning Department	Medium	**X**	X					Flood, Water pollution	ongoing	Town Admin
Kilmarnock - 2	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Public Works/ Planning Department	Medium	**X**	X	X	X			All	ongoing	Town Admin
Kilmarnock - 3	Investigate all critical community facilities, such as county administrative offices, shelters (non-school buildings), fire stations, and police stations, to evaluate their resistance to flood and wind hazards. Particular attention will be given to the HY AC systems and structural integrity of the buildings. Prioritize facilities in known hazard areas (e.g., floodplains)	Public Works/ Planning Department	Medium	X	**X**					All	ongoing	Town Admin
Kilmarnock - 4	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Public Works/ Planning Department	Medium	**X**						Flood	ongoing	Town Admin, State

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Kilmarnock - 5	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	Public Works/ Planning Department	Medium	X	**X**					All	ongoing	Town Admin
Kilmarnock - 6	Replace traffic lights hung from wires with traffic lights hung from mast arms. Install all new traffic lights on mast arms. Ensure traffic light mechanisms are weather proof.	VDOT	Medium	**X**	X					Wind	0-5 years	VDOT
Kilmarnock - 7	Identify program of corrective actions to improve stormwater systems capacity to handle major rain events.	VDOT	Medium	X	X		**X**			Flood	ongoing	VDOT, Town Admin
Kilmarnock - 8	Develop a Continuity of Operations Plan.	Public Works/ Planning Department	Low				**X**	**X**		All	ongoing	Town Admin
Kilmarnock - 9	Consider participating in FEMA's Community Rating System (CRS).	Public Works/ Planning Department	Low	**X**				X	X	All	ongoing	Town Admin
Kilmarnock - 10	Include an assessment and associated mapping of the jurisdiction's vulnerability to location specific hazards, and make appropriate recommendations for the use of these hazard areas in the next comprehensive plan.	Public Works/ Planning Department	Medium	**X**						All	0-3 year	Town Admin

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Kilmarnock - 11	Investigate using non-conforming or substantial damage provision to require hazard retrofitting of existing development.	Public Works/ Planning Department	Low	**X**						All	ongoing	Town Staff
Kilmarnock - 12	Encourage the purchase of flood and/or sewer back-up insurance.	Public Works/ Planning Department	Medium						**X**	All	ongoing	Town Staff
Kilmarnock - 13	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Public Works/ Planning Department	Medium						**X**	All	ongoing	Town Staff
Kilmarnock - 14	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities.	Public Works/ Planning Department	Low					**X**	X	All	5 years	Town Admin
Kilmarnock - 15	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Public Works/ Planning Department	Low						**X**	Flood	ongoing	Town Staff
Kilmarnock - 16	Adopt the most current DFIRM or FIRM and FIS as they become available.	Public Works/ Planning Department	Low	**X**						Flood	ongoing	Town Staff
Kilmarnock - 17	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Public Works/ Planning Department	Low	**X**						Flood	ongoing	Town Staff

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Kilmarnock - 18	Assist with local floodplain determinations and maintain a record of approved changes to the local Floodplain.	Public Works/ Planning Department	Low	**X**						Flood	ongoing	Town Staff
Kilmarnock - 19	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base Flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from flood to or above the Base Flood Elevation (BFE), including anchoring , using Flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Public Works/ Planning Department	Low	**X**						Flood	5 years	Town Staff
Kilmarnock - 20	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Public Works/ Planning Department	Low	**X**						Flood	ongoing	Town Staff, Lancaster County

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Kilmarnock - 21	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Public Works/ Planning Department	Low	**X**				X		Flood	ongoing	Town Staff
Kilmarnock - 22	Educate community members about the availability and value of flood insurance.	Public Works/ Planning Department	Low						**X**	Flood	ongoing	Town Staff
Kilmarnock - 23	Inform community property owners about changes to the DFIRM/FIRM that may impact their insurance rates.	Public Works/ Planning Department	Low						**X**	Flood	ongoing	Town Staff
Kilmarnock - 24	Provide general assistance to community members relating to insurance issues.	Public Works/ Planning Department	Low						**X**	Flood	ongoing	Town Staff

Town of Kilmarnock 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Kilmarnock - 25	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Public Works/Planning Department	Low	X	**X**	X	X	X	X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	ongoing	Town Staff
Kilmarnock - 26	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Public Works/ Planning Department	Medium	**X**	X	X		X		All hazards	ongoing	Town Staff

Town of White Stone 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
White Stone -1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Town Manager with Town Council	Medium/ Medium High	X	**X**	X	X		X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	3-5 Years	Staff FEMA Grants Other Grants
White Stone -2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Town Manager with Town Council	Medium	**X**	X	X		X		All Hazards	3-5 Years	Staff FEMA Grants Other Grants
White Stone -3	Avoid establishing public service facilities and utilities, such as wastewater disposal facilities, within or near the floodplain where they might create a hazard if damaged during a storm.	Town Manager with Town Council	Medium/ Medium High	**X**	X					Flood	3-5 Years	Staff FEMA Grants Other Grants

Town of White Stone 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
White Stone -4	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Town Manager with Town Council	Medium/ Medium High	**X**	X					All	3-5 Years	Staff FEMA Grants Other Grants
White Stone -5	Investigate All critical community facilities, such as county administrative offices, shelters (non-school buildings), fire stations, and police stations, to evaluate their resistance to Flood and wind hazards. Particular attention will be given to the HVAC systems and structural integrity of the buildings. Prioritize facilities in known hazard areas (e.g., floodplains)	Town Manager with Town Council	Medium/ Medium High	X	**X**					All	3-5 Years	Staff FEMA Grants Other Grants
White Stone -6	Evaluate exiting storm water system to determine if it is adequate for existing (or future) flood hazards.	Town Manager with Town Council	Medium/ Medium High	**X**	X		X			Flood	3-5 Years	Staff FEMA Grants Other Grants
White Stone -7	Identify need for backup generators, communications and/or vehicles at critical public facilities. Develop means to address shortfalls identified.	Town Manager with Town Council	Medium/ Medium High	**X**	X		X	X		All	3-5 Years	Staff FEMA Grants Other Grants
White Stone -8	Consider providing necessary electrical hook-up, wiring, and switches to allow readily accessible connections to emergency generators at selected critical public facilities.	Town Manager with Town Council	Medium/ Medium High	**X**	X					All	3-5 Years	Staff FEMA Grants Other Grants
White Stone -9	Encourage the purchase of flood and/or sewer back-up insurance.	Town Manager with Town Council	Medium/ Medium High	X	**X**					Flood, Coastal	3-5 Years	Staff FEMA Grants Other Grants

Town of White Stone 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
White Stone -10	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Town Manager with Town Council	Medium	**X**	X		X			Flood, Coastal	3-5 Years	Staff FEMA Grants Other Grants
White Stone -11	Identify program of corrective actions to improve stormwater systems capacity to handle major rain events.	Town Manager with Town Council	Medium	**X**	X		X			Flood, Coastal	3-5 Years	Staff FEMA Grants Other Grants
White Stone -12	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Town Manager with Town Council	Medium	**X**	X					Flood, Coastal	3-5 Years	Staff FEMA Grants Other Grants

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northumberland - 1	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Building and Zoning	High	**X**	X					All	5 years	County Staff
Northumberland - 2	Encourage use of vegetation and revetments to reduce shoreline erosion.	Building and Zoning	Low			**X**				Coastal Erosion	5 years	County Staff
Northumberland - 3	Consider using fee simple and/or permanent easements to prevent development in the highest priority undeveloped Floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	Building and Zoning	Low	X	**X**	X			X	Flood	5 years	County Staff
Northumberland - 4	Consider implementing a wetlands acquisition and /or restoration program.	Building and Zoning	Low		X	**X**				Flood	5 years	County Staff
Northumberland - 5	Increase enforcement and education regarding the tie down of propane and other fuel tanks	Building and Zoning	Low	X	X				**X**	Flood, Wind	5 years	County Staff
Northumberland - 6	Identify existing flood prone structures that may benefit from mitigation measures such as elevation.	Building and Zoning	Low	X	**X**			X	X	Flood	5 years	County Staff
Northumberland - 7	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Building and Zoning	Medium	X		**X**			X	Coastal Erosion	5 years	County Staff

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northumberland - 8	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	Building and Zoning	High		**X**		X			Flood	5 years	County Staff
Northumberland - 9	Investigate implementation of cumulative damage provision as part of floodplain ordinance.	Building and Zoning	Medium	**X**						Flood	5 years	County Staff
Northumberland - 10	Encourage the purchase of flood and/or sewer back-up insurance.	Building and Zoning	Low	X			X		**X**	Flood	5 years	County Staff
Northumberland - 11	Educate residents about Flood insurance and ICC (Increased Cost of Compliance) Coverage.	Building and Zoning	Medium						**X**	Flood	5 years	County Staff
Northumberland - 12	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	Office of Emergency Services	Low					X	**X**	Flood	5 years	County Staff
Northumberland - 13	Maintain a voluntary agreement with FEMA to participate in the NFIP	Building and Zoning	High	**X**						Flood	5 years	County Staff
Northumberland - 14	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Building and Zoning	High	X					X	Flood	5 years	County Staff
Northumberland - 15	Adopt the most current FIRM maps and FIS as they become available.	Building and Zoning	High	**X**						Flood	5 years	County Staff

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northumberland - 16	Share with FEMA any new technical or scientific data that may result in map revisions within six months of creation or identification of new data.	Building and Zoning	Medium	**X**						Flood	5 years	County Staff
Northumberland - 17	Assist with local floodplain determinations and maintain a record of approved changes to the local Floodplain.	Building and Zoning	High	**X**					X	Flood	5 years	County Staff
Northumberland - 18	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep all new and substantially improved construction reasonably safe from Flood to or above the Base Flood Elevation (BFE), including anchoring , using Flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Building and Zoning	High	**X**						Flood	5 years	County Staff
Northumberland - 19	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Building and Zoning	High	**X**						Flood	5 years	County Staff

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Northumberland - 20	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally Floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Building and Zoning	High	**X**						Flood	5 years	County Staff
Northumberland - 21	Educate community members about the availability and value of Flood insurance.	Building and Zoning	High						**X**	Flood	5 years	County Staff
Northumberland - 22	Provide general assistance to community members relating to insurance issues.	Building and Zoning	High						**X**	All	5 years	County Staff

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northumberland - 23	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Administrator's Office	Low	X	**X**	X	X	X	X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	5 years	County Staff
Northumberland - 24	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Administrator's Office	Low	**X**	X	X	X	X	X	All	5 years	County Staff

Northumberland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Northumberland - 25	Maintain an Emergency Notification System for citizens (Code Red) which upon voluntary subscription, will notify if a NWS severe weather alert is activated within the County.	Administrator's Office	High	X	X				**X**	Flood, Wind	5 years	County Staff

Richmond County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Richmond - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Land Use, Admin.	High	X	**X**	X	X		X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	
Richmond - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Land Use, Admin.	High	**X**	X	X		X		All	2018-2019	
Richmond - 3	Consider implementing a wetlands acquisition and /or restoration program.	Soil & Water Conservation District	Low			**X**				Coastal, Flood		

Richmond County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Richmond - 4	Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.	Land use	High	**X**		X	X		X	Coastal, Flood	Ongoing	
Richmond - 5	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	County Admin.	High	X			**X**			Flood, Coastal	Ongoing	
Richmond - 6	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	IT	High	**X**						All	Ongoing	
Richmond - 7	Evaluate the floodplain manager's roles and responsibilities in each local jurisdiction.	land use	High	**X**							Ongoing	
Richmond - 8	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	Emergency Management/ IT	Low	**X**						All		
Richmond - 9	Evaluate the potential costs versus benefits of implementing a freeboard requirement for all new structures within the 100 year floodplain.	Land use	Low	**X**	X					Flood, Coastal		
Richmond - 10	Investigate implementation of cumulative damage provision as part of Floodplain ordinance.	Emergency Management/ IT	Low	**X**						Flood, Costal		
Richmond - 11	Share with FEMA any new technical or scientific data that may result in map revisions within six months of creation or identification of new data.	Land use	Low	**X**						Flood, Coastal		

Richmond County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Richmond - 12	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base Flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from Flood to or above the Base Flood Elevation (BFE), including anchoring , using Flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Land use	High	**X**						Flood, Coastal	Ongoing	
Richmond - 13	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Land use	High	**X**						Flood, Coastal	Ongoing	
Richmond - 14	Inform community property owners about changes to the FIRM that may impact their insurance rates.	Land use	High						**X**	Flood, Coastal	Ongoing	

Richmond County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Richmond - 15	Provide general assistance to community members relating to insurance issues.	Land use	High						**X**	Flood, Coastal	Ongoing	

Town of Warsaw 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Warsaw - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Not Provided	Not Provided	X	**X**	X	X		X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Not Provided	Not Provided
Warsaw - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Not Provided		**X**	X	X		X		All	Not Provided	Not Provided

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Westmoreland - 1	Incorporate hazard mitigation techniques into new community facilities to minimize damages.	Planning	High	**X**	X		X			All	Ongoing	Staff
Westmoreland - 2	Consider using fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Use these areas as public open space for passive recreational uses including water access.	Planning	Medium	**X**		X				Flood	Ongoing	Staff
Westmoreland - 3	Identify existing floodprone structures that may benefit from mitigation measures such as elevation.	Planning	Medium	X	**X**				X	Flood	Ongoing	Staff
Westmoreland - 4	Evaluate built-upon areas within the floodplain or along the high erosion risk shoreline for possible relocation and/or buy-out. In particular, target FEMA's Repetitive Loss Properties throughout the Northern Neck for possible relocation and/or buy-out.	Planning	Medium	X	**X**	X				Flood	Ongoing	Staff
Westmoreland - 5	Identify funding opportunities to replace vulnerable or undersized culvert stream crossing with bridges or larger culverts to reduce food hazards.	VDOT	Medium		X		**X**			Flood	Ongoing	VDOT

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Westmoreland - 6	Work with VDOT to evaluate at-risk roads and implement mitigation measures (e.g., elevation, redesign)	VDOT	Medium	X	X		**X**			Flood	Ongoing	Staff - VDOT
Westmoreland - 7	Initiate discussion with private utility companies to incorporate mitigation measures into new and existing development and any infrastructure repairs.	Planning	Low	X	X		**X**			Flood, Wind	Ongoing	Staff
Westmoreland - 8	Identify training opportunities for staff to enhance ability to use GIS for emergency management needs.	Emergency Management	High	X				**X**		All	1-3 years	Staff
Westmoreland - 9	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury, and/or property damage.	County Admin.	High	X				**X**		All	1-3 years	Staff - VDEM
Westmoreland - 10	Consider participating in FEMA's Community Rating System (CRS).	Planning	High	**X**						Flood, Coasta	1-3 Years	Staff - VDEM
Westmoreland - 11	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Planning	Medium	**X**						Flood, Coastal	Ongoing	Staff
Westmoreland - 12	Review and revise, if required, existing Subdivision Ordinances to include hazard mitigation-related development criteria in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.	Planning	Medium	**X**						Flood, Coastal	Ongoing	Staff

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Westmoreland - 13	Evaluate the potential costs versus benefits of continuing the freeboard requirement for all new structures within the 100 year floodplain.	Planning	Low	**X**						Flood, Coastal	Ongoing	Staff
Westmoreland - 14	Encourage the purchase of flood and/or sewer back-up insurance.	Planning	Medium	**X**	X				X	Flood	Ongoing	Staff - Grants
Westmoreland - 15	Educate residents about flood insurance and ICC (Increased Cost of Compliance) Coverage.	Planning	Medium						**X**	Flood	Ongoing	Staff
Westmoreland - 16	Prepare an advisory pamphlet and distribute to occupants of housing units or businesses known to be in the floodplain advising them of the potential hazards in the area and of evacuation plans in the event of an emergency.	Planning	Low					X	**X**	Flood	Ongoing	Staff
Westmoreland - 17	Maintain a voluntary agreement with FEMA to participate in the NFIP	Planning	High	**X**						Flood	Ongoing	Staff
Westmoreland - 18	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Planning	Low	**X**					X	Flood	1-3 years	Staff
Westmoreland - 19	Adopt the most current DFIRM or FIRM and FIS as they become available.	Planning	Low	**X**						Flood	1-3 Years	Staff

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Westmoreland - 20	Share with FEMA any new technical or scientific data that may result in map revisions within six months of creation or identification of new data.	Planning	Medium	**X**						Flood	Ongoing	Staff
Westmoreland - 21	Assist with local floodplain determinations and maintain a record of approved changes to the local Floodplain.	Planning	Low	**X**					X	Flood	Ongoing	Staff
Westmoreland - 22	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base Flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from Flood to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Planning	Medium	**X**						Flood	Ongoing	Staff

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Westmoreland - 23	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Planning	Medium	**X**						Flood	Ongoing	Staff
Westmoreland - 24	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning	Low	**X**						Flood	Ongoing	Staff
Westmoreland - 25	Educate community members about the availability and value of flood insurance.	Planning	Medium						**X**	Flood	Ongoing	Staff
Westmoreland - 26	Inform community property owners about changes to the DFIRM/FIRM that may impact their insurance rates.	Planning	Medium						**X**	Flood	Ongoing	Staff

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Westmoreland - 27	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. Wastewater and water supply system hardening and mitigation.	Planning	High	X	**X**	X	X	X	X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	Staff
Westmoreland - 28	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Planning	Medium	**X**	X	X		X		All	Ongoing	Staff

Westmoreland County 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Westmoreland – 29	Evaluate mitigation funding programs to seek a solution to and funding sources to address Stratford Hall area erosion and cliff failure issues.	Planning; Emergency Management	High		**X**					Hurricane, Flooding, Coastal Erosion	Ongoing	Staff
Westmoreland – 30	Work with VDOT and the Town of Colonial Beach to seek ingress and egress access issue solutions.	Planning, Emergency Management; Town of Colonial Beach; VDOT	High	**X**			X	X		Hurricane, Flooding	Ongoing	Staff

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 1	Increase enforcement and education regarding the tie down of propane and other fuel tanks	Planning Department	High	X	X				**X**	Flood, Coastal, Wind	0-3 years	Staff
Colonial Beach - 2	Evaluate exiting storm water system to determine if it is adequate for existing (or future) flood Hazards.	Planning Department	Medium	**X**						Flood, Coastal	3-5 years	Staff
Colonial Beach - 3	Develop and implement a ditch maintenance program consisting of routine inspections and subsequent debris removal.	Public Works Department	High	**X**	X					Flood, Coastal	Ongoing	Staff
Colonial Beach - 4	Identify program of corrective actions to improve stormwater systems capacity to handle major rain events.	Planning Department	Medium	**X**						Flood, Coastal	2-3 years	FEMA Grant or similar
Colonial Beach - 5	Develop a detailed building inventory for all structures in the jurisdiction, which catalogues information such as value of the structure, contents, age, location (latitude and longitude), etc.	Planning Department	High	**X**						All	Ongoing	Staff
Colonial Beach - 6	Continue to enforce zoning and building codes to prevent construction within the floodplain.	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 7	Include an assessment and associated mapping of the jurisdiction's vulnerability to location specific hazards, and make appropriate recommendations for the use of these hazard areas in the next comprehensive plan.	Planning Department	Medium	**X**						All	3 years	Technical Consulting

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 8	Investigate using non-conforming or substantial damage provision to require hazard retrofitting of existing development.	Planning Department	Medium	X	**X**					Flood, Coastal	Ongoing	Staff
Colonial Beach - 9	Publicize the location of local shelters and emergency phone numbers. Include a map of shelters in local phonebooks or on county websites.	Planning Department	Low						**X**	All	Ongoing	Staff
Colonial Beach - 10	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities.	Planning Department	Low					**X**	X	All	5 years	Regional Collaboration
Colonial Beach - 11	Investigate, develop, or enhance a regional public notification system such as low power FM or AM radio.	Planning Department	Low	X				X	**X**	All	5 years	Regional Collaboration
Colonial Beach - 12	Work with VDOT to establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood prone areas.	Planning Department	Low	X					X	Flood, Coastal	Ongoing	Staff
Colonial Beach - 13	Maintain a voluntary agreement with FEMA to participate in the NFIP	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 14	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Planning Department	Low	**X**					X	Flood, Coastal	Ongoing	Staff

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 15	Adopt the most current FIRM or FIRM and FIS as they become available.	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 16	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 17	Assist with local floodplain determinations and maintain a record of approved changes to the local Floodplain.	Planning Department	High	**X**					X	Flood, Coastal	Ongoing	Staff, Appropriate Agencies

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 18	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for all proposed developments in the SFHA, Obtain, review, and utilize any base Flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from flood to or above the Base Flood Elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 19	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Planning Department	High	**X**						Flood, Coastal	Ongoing	Staff

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 20	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally Floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Planning Department	Low	**X**						Flood, Coastal	Ongoing	Staff
Colonial Beach - 21	Educate community members about the availability and value of flood insurance.	Planning Department	High						**X**	Flood, Coastal	Ongoing	Staff
Colonial Beach - 22	Inform community property owners about changes to the FIRM that may impact their insurance rates.	Planning Department	High						**X**	Flood, Coastal	Ongoing	Staff
Colonial Beach - 23	Provide general assistance to community members relating to insurance issues.	Planning Department	Medium						**X**	Flood, Coastal	Ongoing	Staff

Town of Colonial Beach 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Colonial Beach - 24	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Planning Department, Admin.	High	X	**X**	X	X		X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	Ongoing	Staff
Colonial Beach - 25	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Planning Department, Admin.	High	**X**	X	X		X		All	Ongoing	Staff

Town of Montross 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Montross - 1	Support mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include but are not limited to: 1. Acquisition of Floodprone property 2. Elevation of Floodprone structures 3. Minor structural flood control projects 4. Relocation of structures from hazard prone areas 5. Retrofitting of existing buildings, facilities and infrastructure 6. Retrofitting of existing buildings and facilities for shelters 7. Critical infrastructure protection measures 8. Stormwater management improvements 9. Advanced warning systems and hazard gauging systems (weather radios, reverse-911, stream gauges, I-flows) 10. Targeted hazard education 11. wastewater and water supply system hardening and mitigation	Town Manager	Medium	X	**X**	X	X		X	Hurricane, Flooding, Winter Storm, Coastal Erosion, Coastal Storm, Tornado, Wildfire, Earthquake	0-5 years	Town Staff
Montross - 2	Integrate mitigation plan requirements and actions into other appropriate planning mechanisms such as comprehensive plans and capital improvement plans.	Town Manager	Medium	**X**	X	X		X		All	Ongoing	Town Staff
Montross - 3	Develop a Continuity of Operations Plan.	Westmoreland County	Medium					**X**		All	0-5 years	Town Staff
Montross - 4	Consider participating in FEMA's Community Rating System (CRS).	Town Manager	Low	**X**						Flood, Coastal	0-5 years	Town Staff

Town of Montross 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Montross - 5	Encourage the purchase of flood and/or sewer back-up insurance.	Town Manager	Medium	X					**X**	Flood, Coastal	0-5 years	Town Staff
Montross - 6	Encourage the purchase and training on the use of NOAA radios. Provide NOAA radios to public facilities.	Town Manager	High					**X**	X	All	0-5 years	Town Staff
Montross - 7	Maintain a voluntary agreement with FEMA to participate in the NFIP	Westmoreland County	High	**X**						All	0-5 years	Town Staff
Montross - 8	Maintain a publicly available copy of the effective Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Support local requests for map updates when available.	Town Manager	High	**X**					X	Flood, Coastal	0-5 years	Town Staff
Montross - 9	Adopt the most current DFIRM or FIRM and FIS as they become available.	Westmoreland County	Low	**X**						Flood, Coastal	0-5 years	Town Staff
Montross - 10	Share with FEMA any new technical or scientific data that may result in map revisions within six (6) months of creation or identification of new data.	Westmoreland County	Low	**X**						Flood, Coastal	0-5 years	Town Staff
Montross - 11	Assist with local floodplain determinations and maintain a record of approved changes to the local floodplain.	Westmoreland County	Low	**X**						Flood, Coastal	0-5 years	Town Staff

Town of Montross 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface: Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach	Hazard(s) Addressed	Timeframe	Resources
Montross - 12	Adopt or maintain a floodplain management ordinance that at a minimum regulates the following: Issue permits for All proposed developments in the SFHA, Obtain, review, and utilize any base flood elevation and Floodway data, and require BFE data for subdivisions proposals and other development proposals larger than 50 lots or 5 acres; Identify measures to keep All new and substantially improved construction reasonably safe from Flood to or above the base flood elevation (BFE), including anchoring , using flood resistant materials, designing or locating utilities, and service facilities to prevent water damage; Document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures.	Westmoreland County	Medium	X						Flood, Coastal	0-5 years	Town Staff
Montross - 13	Enforce the ordinance by monitoring compliance and taking remedial action to correct violations.	Westmoreland County	Medium	X						Flood, Coastal	0-5 years	Town Staff

Town of Montross 2017 to 2022 Mitigation Actions

Action Number	Action Strategy	Lead Office	Priority	Project Type - lead type in boldface						Hazard(s) Addressed	Timeframe	Resources
				Prevention	Property Protection	Natural Resource Protection	Structural	Emergency Services	Education & Outreach			
Montross - 14	Consider adoption of activities that extend beyond the minimum requirements, including those identified for participation in the Community Rating System, freeboard, prohibition of production or storage of chemicals in SFHA, prohibition or certain types of structures such as: hospitals, nursing homes, jails, prohibition of certain types of residential housing such as manufactured homes, and finally floodplain ordinances, that prohibit any new residential or non-residential structures in the SFHA.	Town Manager	Medium	X						Flood, Coastal	0-5 years	Town Staff
Montross - 15	Educate community members about the availability and value of flood insurance.	Town Manager	Medium						X	Flood, Coastal	0-5 years	Town Staff
Montross - 16	Inform community property owners about changes to the DFIRM/FIRM that may impact their insurance rates.	Town Manager	High						X	Flood, Coastal	0-5 years	Town Staff
Montross - 17	Provide general assistance to community members relating to insurance issues.	Town Manager	Medium						X	Flood, Coastal	0-5 years	Town Staff

Appendix E: Record of Changes

Record of Changes

2017 Plan Section	Heading Section	Changes Made
SECTION I. EXECUTIVE SUMMARY	1.1 Hazard Mitigation	Expanded narrative to discuss the background about hazard mitigation.
	1.2 Authority	Expanded narrative to discuss the authority for this hazard mitigation plan update.
	1.3 Planning Area	Added section to highlight the planning area.
	1.4 Planning Committee Membership	Added section to summarize the planning committee membership.
	1.5 Hazard Identification and Risk Assessment	Updates and edits to section, including Table 1-2. Northern Neck Hazard Planning Consideration Levels to summarize 2017 plan update hazard rankings.
	1.6 Mitigation Goals and Strategies	Updates and edits to revise goals and describe new mitigation strategy groupings.
	1.7 Capability, Implementation, and Maintenance	Updates and edits to expand narrative about community capabilities in Table 1-3 and update how HMP will be implemented and maintained.
	1.8 Acknowledgements	Updated
	1.9 Conclusion	Updated
	1.10 Plan Organization	Added section
SECTION II. INTRODUCTION and PLANNING PROCESS	2.1 Introduction	Combined previous plan sections 2.0 and 3.0 into one section. Updating introduction narrative.
	2.1.1. The Local Mitigation Planning Impetus	Expanded history of legislative and regulatory federal mitigation planning requirements to include discussion of the 2013 Local Hazard Mitigation Plan Review Tool.
	2.2. Planning Process	Updated to include all participating jurisdictions.
	2.2.1. The Hazard Mitigation Technical Advisory Committee (HMTAC)	Updated to explain organization of the LEPC and updated Table 2-1 Northern Neck Mitigation Advisory Committee.
	2.2.2. Documentation of the Planning Process	Expanded discussion of planning process and updated Table 2-2 Mitigation Advisory Committee Meeting Dates.
	2.2.3. Public Participation and Stakeholder Input	Updated
	2.2.4. Incorporation of Existing Plans and Studies	Updated to list major plans and datasets used in update. Specific information references Sections 3.0, 4.0, and 6.0 and are documented in Section 9.0.
SECTION III. COMMUNITY PROFILE	4.1 Introduction	No Change
	4.2 Physiography	No Change
	4.3 Hydrology	No Change
	4.4 Climate	No Change
	4.5 Land Use and Development Trends	Updated to reflect land use as of the publication date of each community's Comprehensive Plan.

Record of Changes

2017 Plan Section	Heading Section	Changes Made
SECTION III. COMMUNITY PROFILE	4.6 Population	Updated sections and tables to reflect new 2015/2016 U.S. Census Bureau QuickFacts data based on the Population Estimates Program (PEP)
	4.7 Housing	Updated sections and tables to reflect new 2015/2016 U.S. Census Bureau QuickFacts data based on the Population Estimates Program (PEP)
	4.8 Business and Labor	Updated sections based on 2017 Virginia Community Profiles for each county, from the Virginia Employment Commission (VEC). Updated agriculture data based on the 2012 Agricultural U.S. Census data.
	4.9 Transportation	Updated Section with edits.
	4.10 Infrastructure	Updated Section with edits.
SECTION IV. HAZARD IDENTIFICATION AND RISK ASSESSMENT	5.1 Introduction	Minor Edits
	5.2 Hazard Identification	Hazards types updated. Information about the NCEI Storm Events database added. A NCEI Events table for the Northern Neck was created listing property damage, crop damage, deaths, and injuries. Presidential Disaster Declarations section and table updated. Data Limitation section changed to Hazard-Specific Datasets, with a table listing source material.
	5.3 Risk Assessment	Section added. Explanation for how each hazard was ranked.
	5.4 Vulnerability Assessment Overview	Critical Facilities data redacted.
	5.5 Riverine Flooding	Sub-sections standardized, and text updated to reflect new and expanded information. Maps updated. Hazard History tables updated. Repetitive Loss tables updated and simplified. Added annualized Damages table. New analysis for exposure generated.
	5.6 Coastal Flooding	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.
	5.7 Coastal Erosion	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added. Updated section to include information from coastal erosion shoreline studies for each county.
	5.8 Hurricanes	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.
	5.9 Severe Weather	Hazard added. Sub-sections standardized. Maps created. Hazard History tables added. Annualized Damages table added.
	5.10 Tornado	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.
	5.11 Winter Storm	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.

Record of Changes

2017 Plan Section	Heading Section	Changes Made
SECTION IV. HAZARD IDENTIFICATION AND RISK ASSESSMENT	5.12 Drought	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.
	5.13 Wildfire	Sub-sections standardized. Data, text, and maps updated. Hazard History tables updated. Annualized Damages table added.
	5.14 Earthquakes	Hazard added. Sub-sections standardized. Data, text, and maps added.
	5.15 Summary/Conclusions on Vulnerability Assessment	Updated based on new calculated risk assessment matrix.
SECTION V. MULTIPLE HAZARD MITIGATION STRATEGY	4.1 Introduction	Updated
	4.2 Existing Authorities, Policies, Programs and Resources for Mitigation	Updated
	4.3 Selecting Mitigation Goals	Updated with revised 2017-2022 goals; resiliency added
	4.4 Selecting Mitigation Actions	Updated to a goal-action mitigation strategy structure. Review of 2011 mitigation goals, objectives, and strategies May 31, 2017 MAC meeting discussion. 2017 - 2022 actions per six broad mitigation categories.
	4.5 Developing a Mitigation Action Plan	Minor Edits
SECTION VII. CAPABILITIES, PLAN IMPLEMENTATION AND MAINTENANCE PROCESS	5.1 Capability Assessment Introduction	Minor Edits
	5.1.1 Administrative Capability	Updated
	5.1.2 Technical Capability	Updated Table 5-2 Technical Capability Matrix by Jurisdiction; added PDC-wide programs, studies and initiatives. Completed expanded capability matrix table in new Appendix I - Capability Assessment matrix table format including the NNPDC, four participating counties and the Town of Colonial Beach.
	5.1.3 Fiscal Capability	Updated Table 5-3 Fiscal Capability Matrix by Jurisdiction.
	5.1.4 Policy and Program Capability	Updated Table 5-4 Local Planning Mechanisms and Their Relationship to Hazard Mitigation. Updated sections with new policy and program capability information.
	5.1.5 Legal Authority	Updated Table 5-6 Availability of Ordinances and their Support for Hazard Mitigation. Updated sections with new legal authority information.
	5.1.6 Other Relevant Plans and Studies	Integrated NNPDC SLR study, USACE Atlantic Coastal Study, and other local business revitalization plans.
	5.2 Implementation	Minor Edits
	5.3 Maintenance	Added Table 8-1 Plan Update Maintenance Schedule

Record of Changes

2017 Plan Section	Heading Section	Changes Made
SECTION VIII. PLAN ADOPTION	6.0 Plan Adoption	Minor Edits

Appendix F: Sample Adoption Resolution

The following resolution can be used by local jurisdictions to adopt the regional hazard mitigation plan per FEMA requirements.

Contents:

Northern Neck Regional Hazard Mitigation Plan 2017 Update

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop, adopt, and update natural hazard mitigation plans to receive certain federal assistance, and

WHEREAS, a Mitigation Advisory Committee ("MAC"), a subcommittee of the Northern Neck Local Emergency Planning Committee comprised of representatives from the Counties of Lancaster, Northumberland, Richmond, and Westmoreland, and the Towns of Colonial Beach, Irvington, Kilmarnock, Montross, Warsaw, and White Stone was convened to study the Northern Neck Planning District Commission region's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on this region; and

WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the HMTAC to update the *Northern Neck Regional Hazard Mitigation Plan 2011 Update* for the Northern Neck Planning District Commission and it's jurisdictions; and

WHEREAS, the efforts of the MAC members and the consulting firm Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in an update of the *Northern Neck Regional Hazard Mitigation Plan 2011 Update*, including (*local jurisdiction name*) during the planning process.

NOW THEREFORE, BE IT RESOLVED by the (*governing body name*) that the *Northern Neck Multi-Jurisdictional Hazard Mitigation Plan 2017 Update* dated (   ) is hereby approved and adopted for (*jurisdiction name*).

ADOPTED by the (jurisdiction) this ___ day of ___________________, 2017.

APPROVED:

____
(Jurisdiction head of governing body)

ATTEST:

____
(Jurisdiction Clerk)

Affix Clerk's Seal

Appendix G: Redacted Materials

G.1 Repetitive Loss Properties

G.2 Critical Facilities Maps by Type

G.3 Critical Facilities Maps by County

G.4 Critical Facilities Maps by Summary

G.1 Repetitive Loss Properties

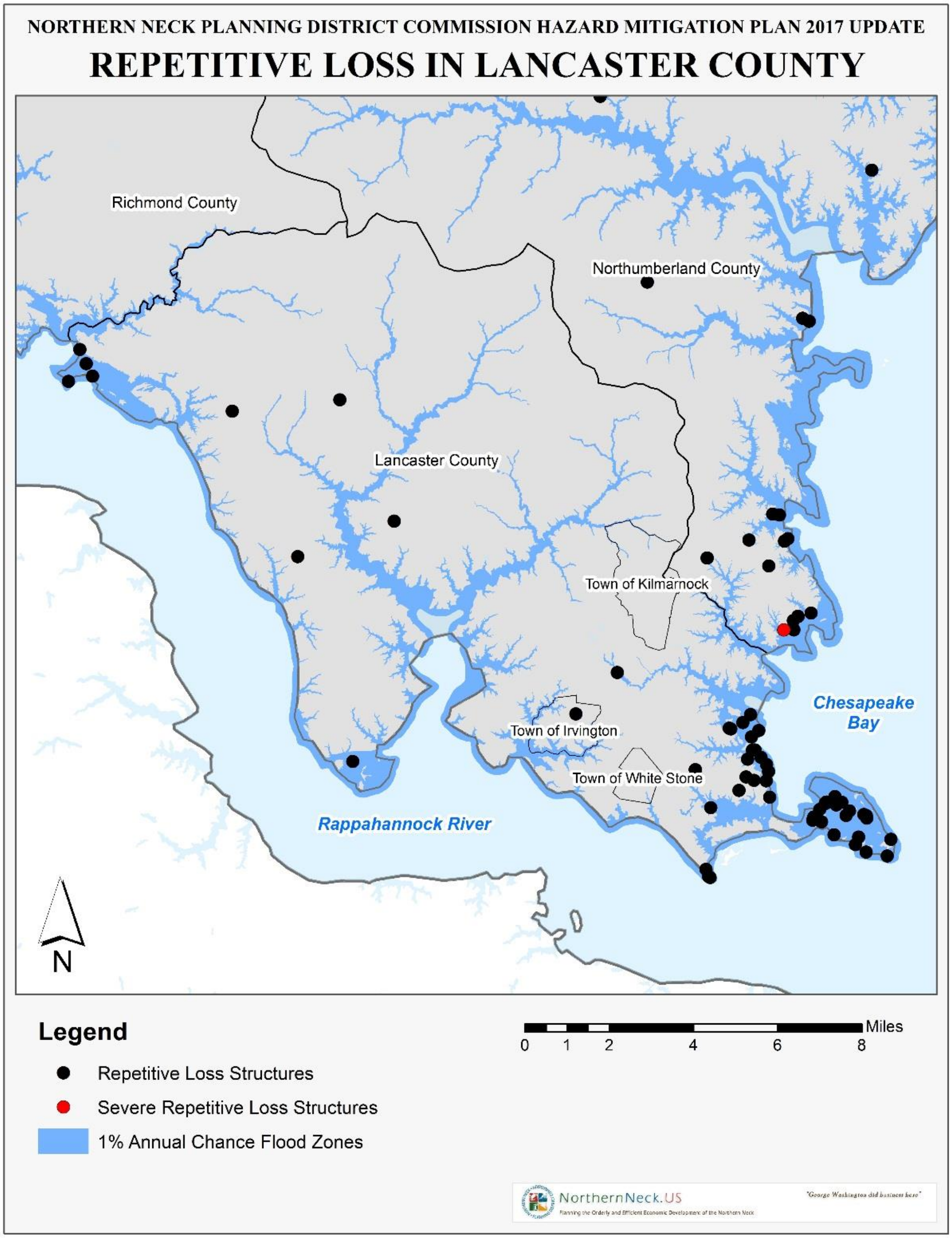

Figure Error! No text of specified style in document.**-1. Repetitive Loss Properties in Lancaster County**

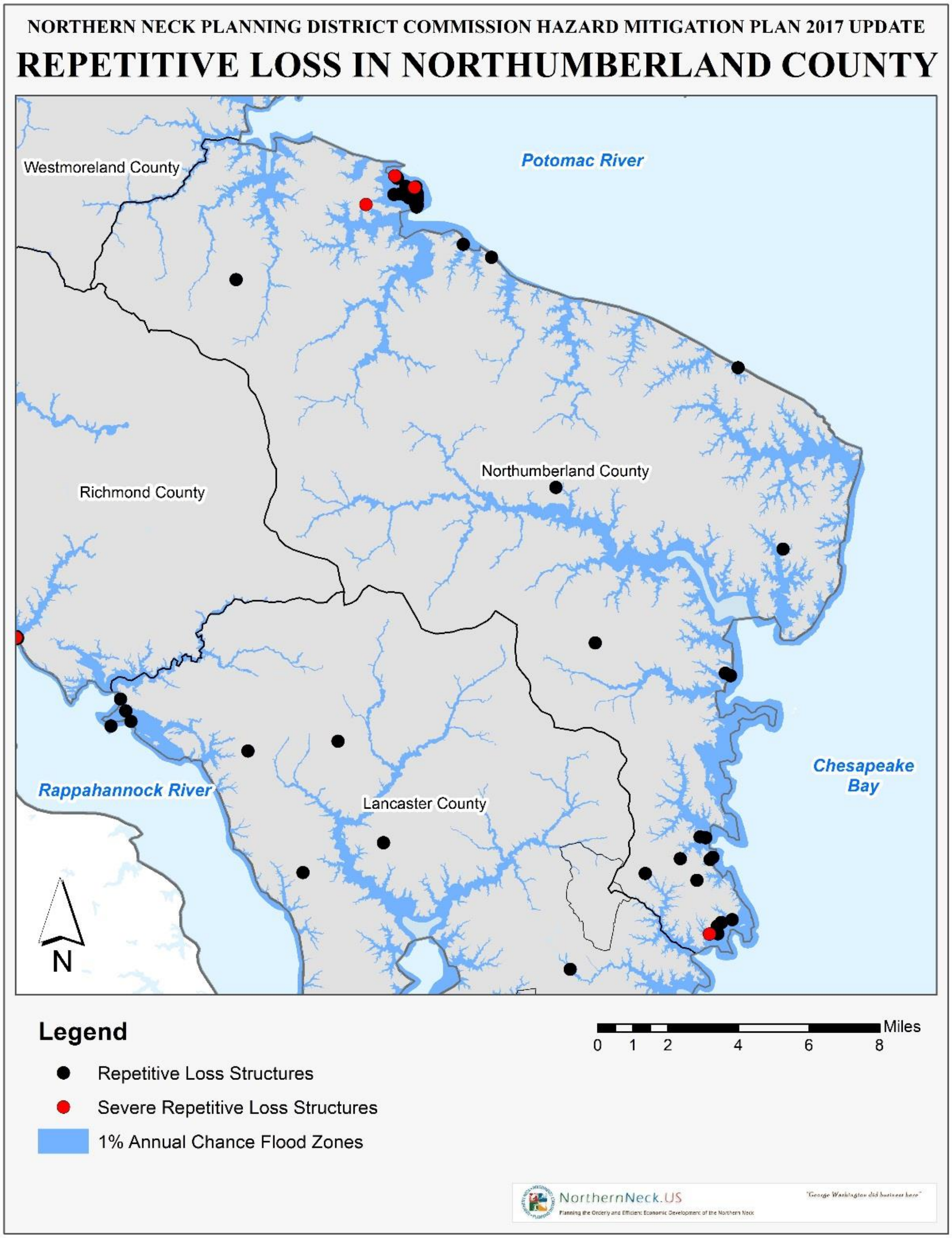

Figure Error! No text of specified style in document.**-2. Repetitive Loss Properties in Northumberland County**

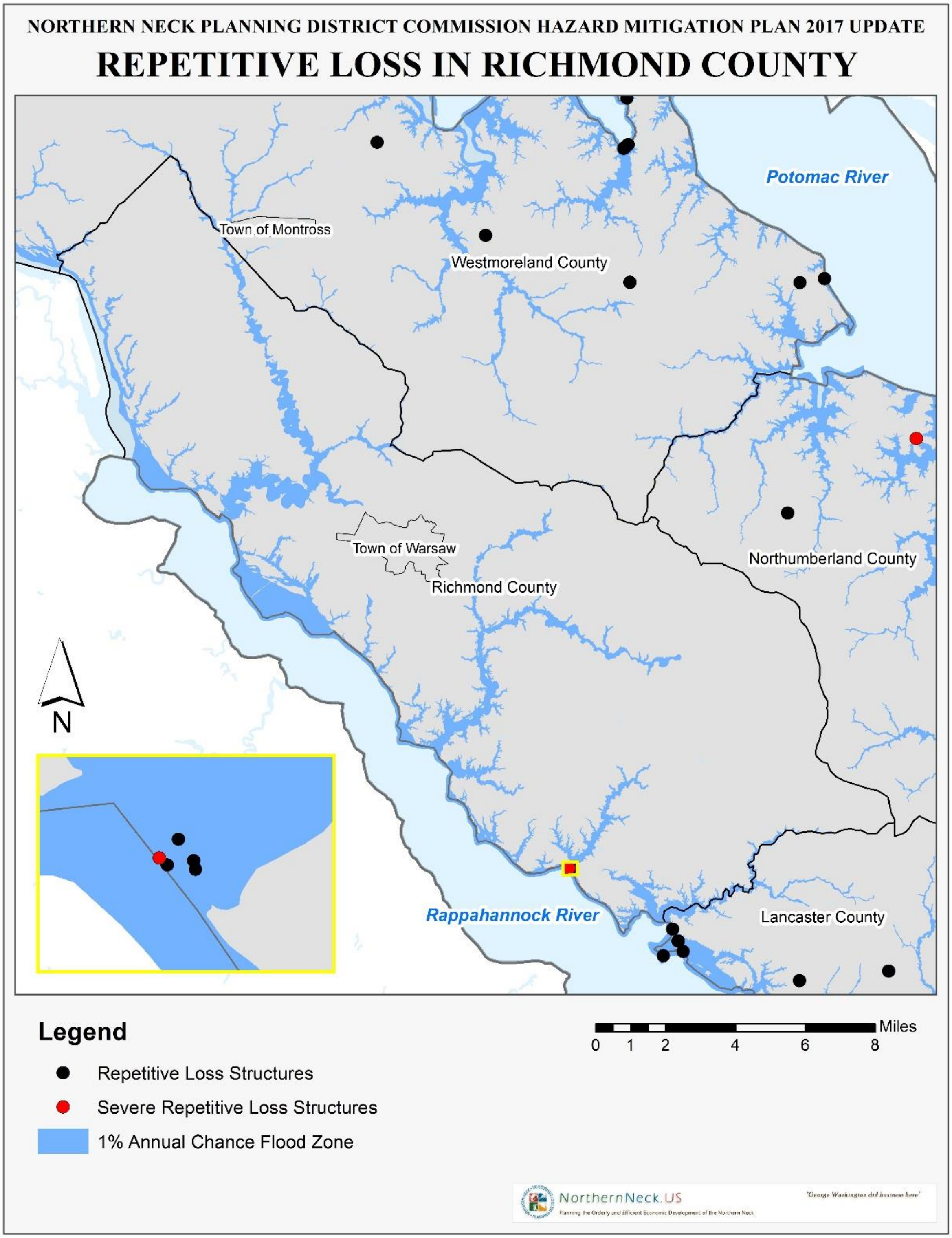

Figure Error! No text of specified style in document.**-3. Repetitive Loss Properties in Richmond County**

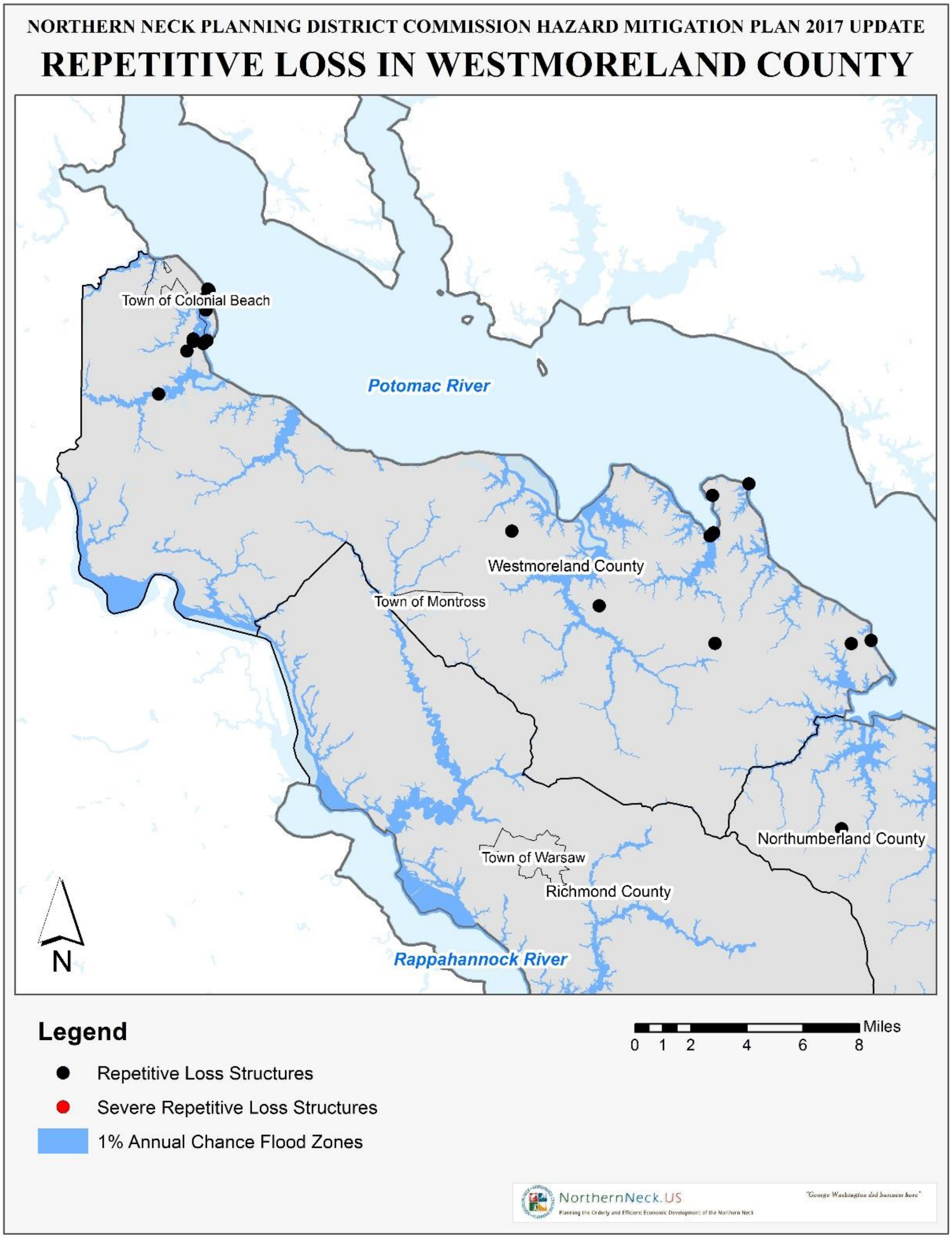

Figure Error! No text of specified style in document.**-4. Repetitive Loss Properties in Westmoreland County**

G.2 Critical Facilities Maps by Type

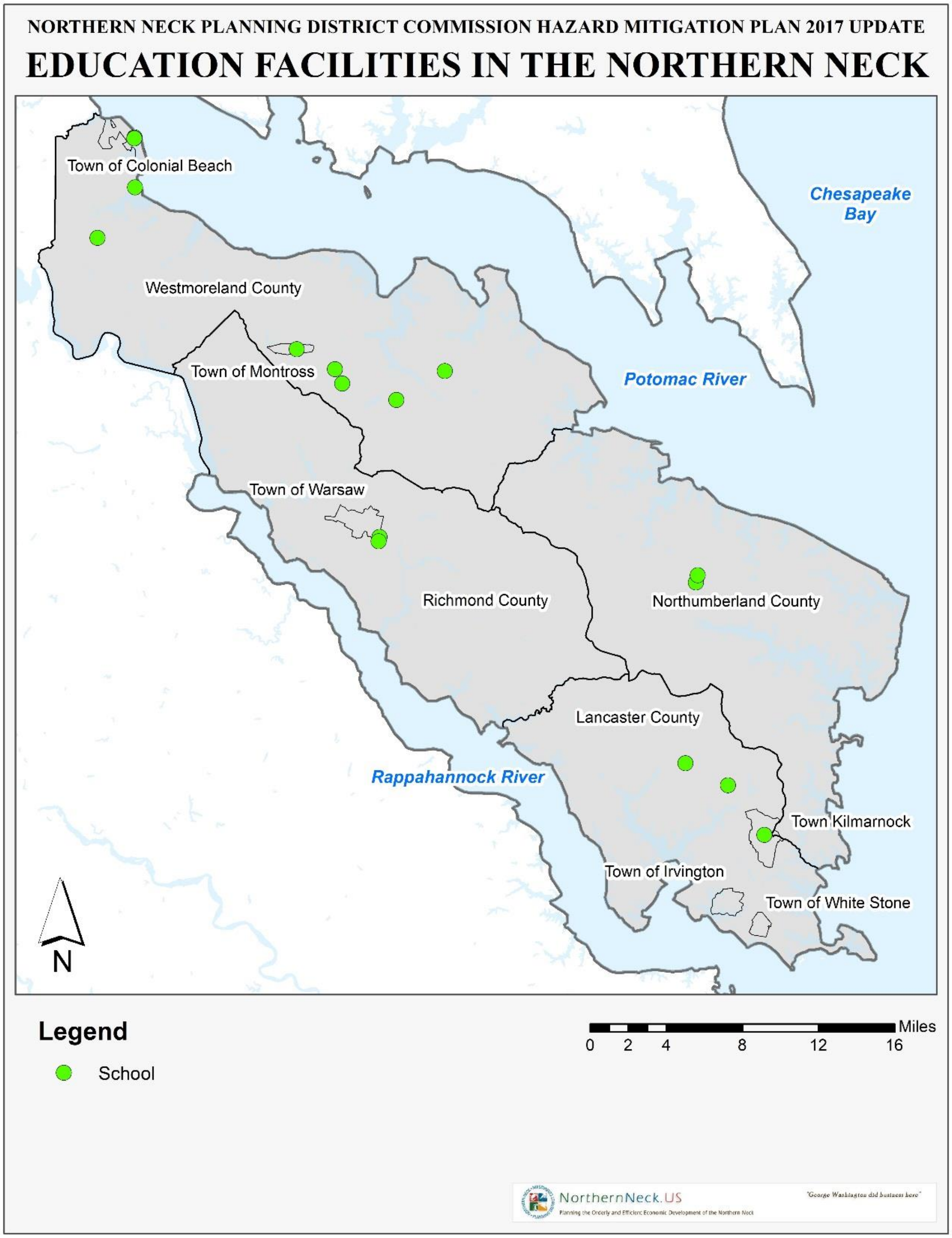

Figure Error! No text of specified style in document.**-5. Education Facilities in the Northern Neck**

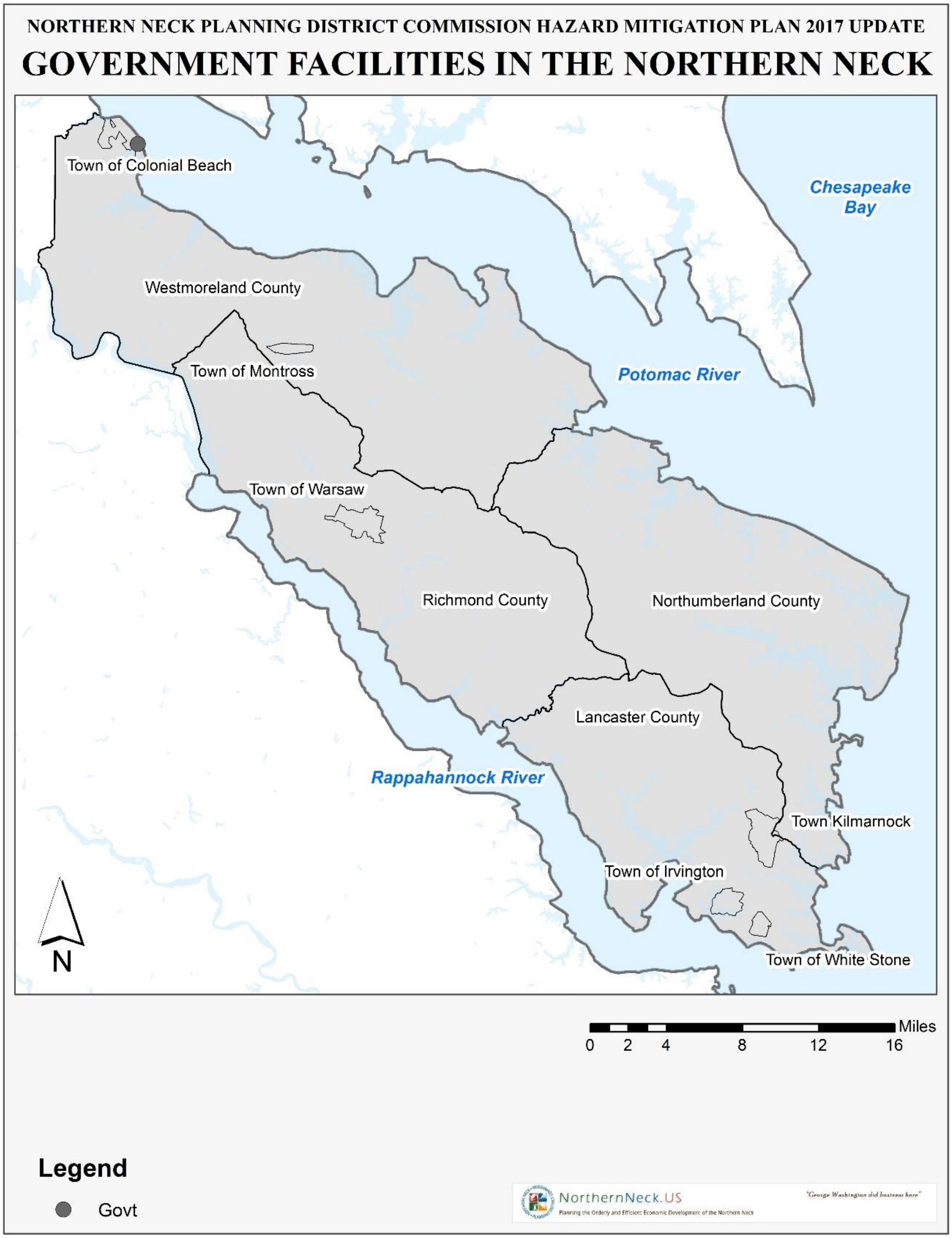

Figure Error! No text of specified style in document.**-6. Government Facilities in the Northern Neck**

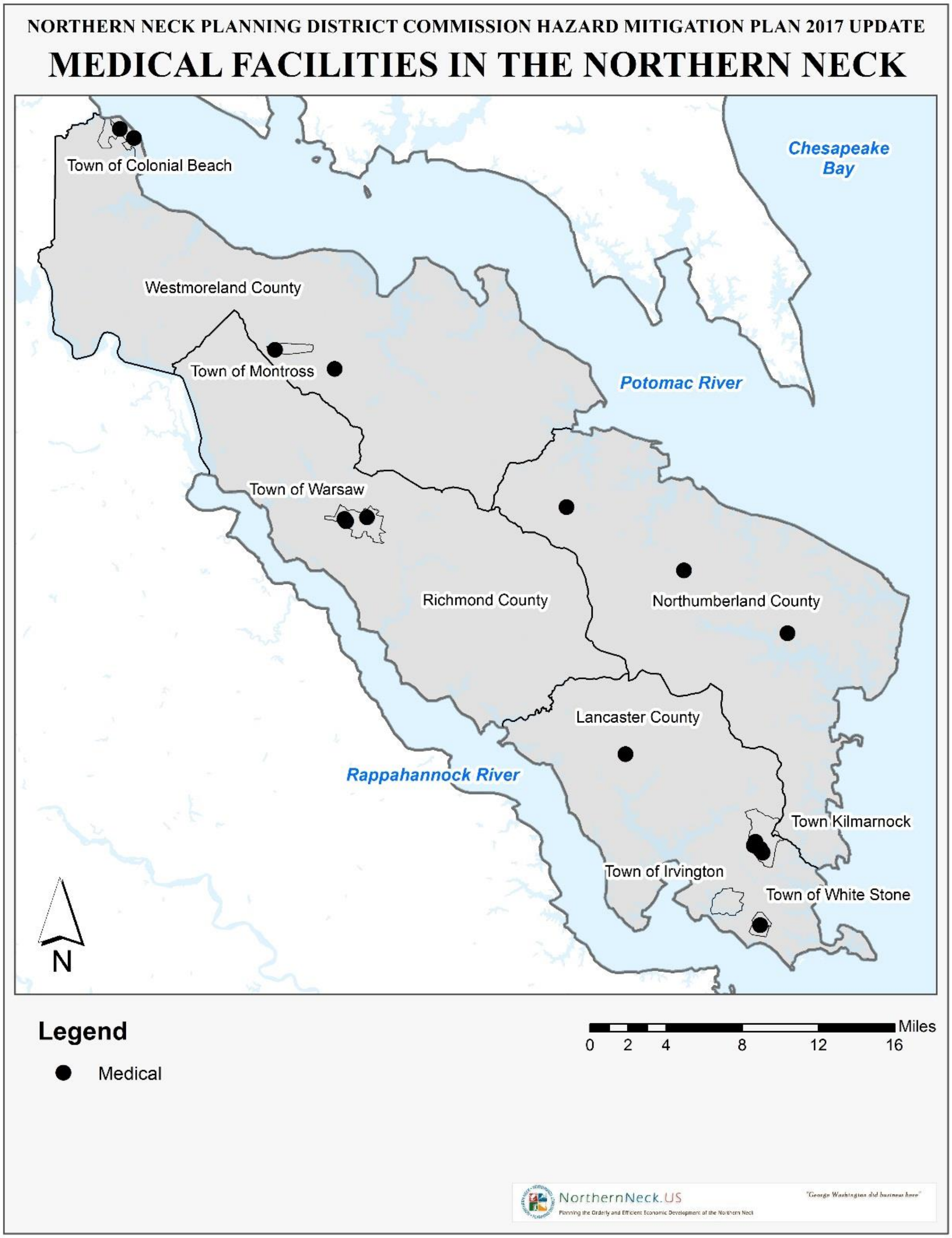

Figure Error! No text of specified style in document.**-7. Medical Facilities in the Northern Neck**

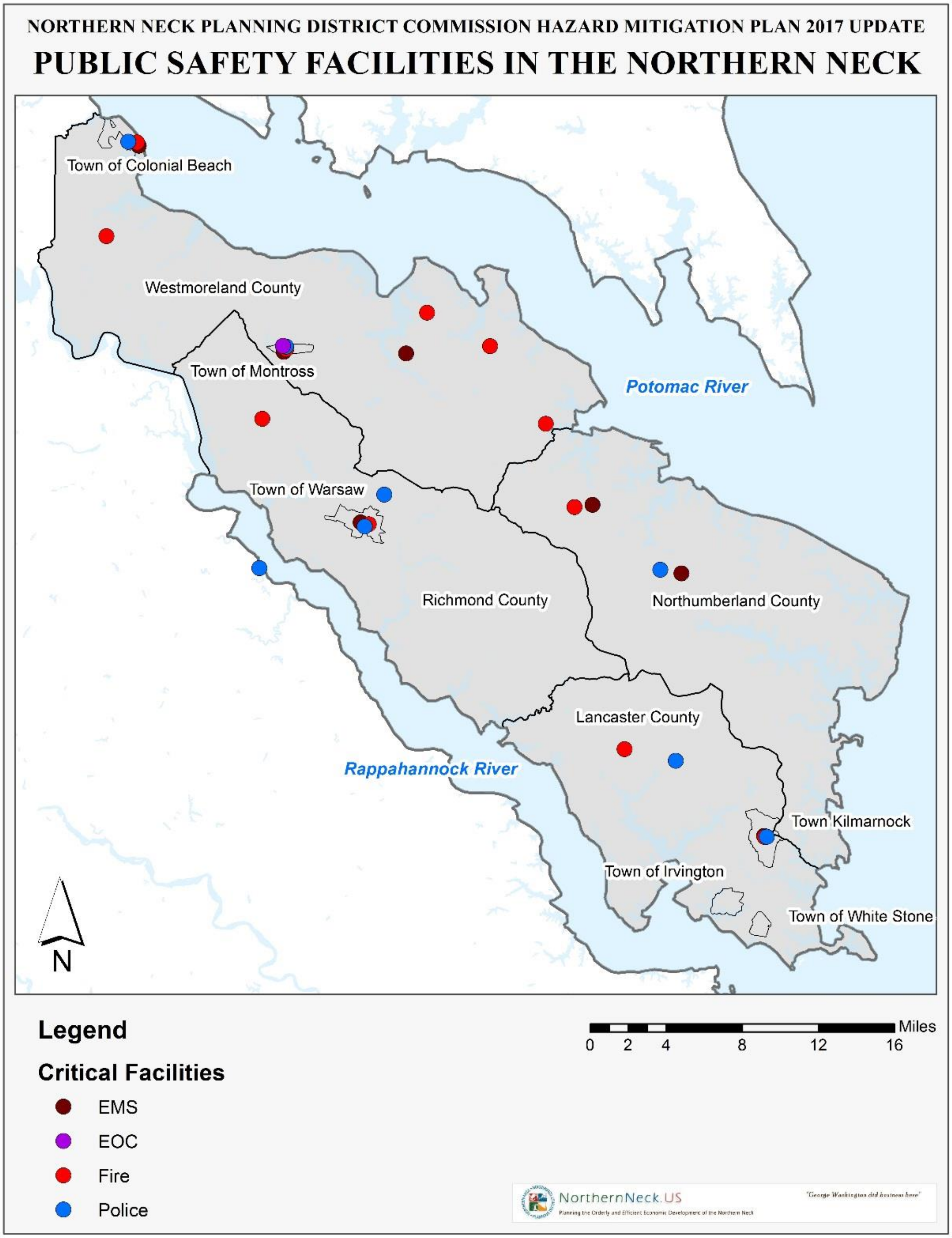

Figure Error! No text of specified style in document.**-8. Public Safety Facilities in the Northern Neck**

Figure Error! No text of specified style in document.**-9. Utility Facilities in the Northern Neck**

G.3 Critical Facilities Maps by County

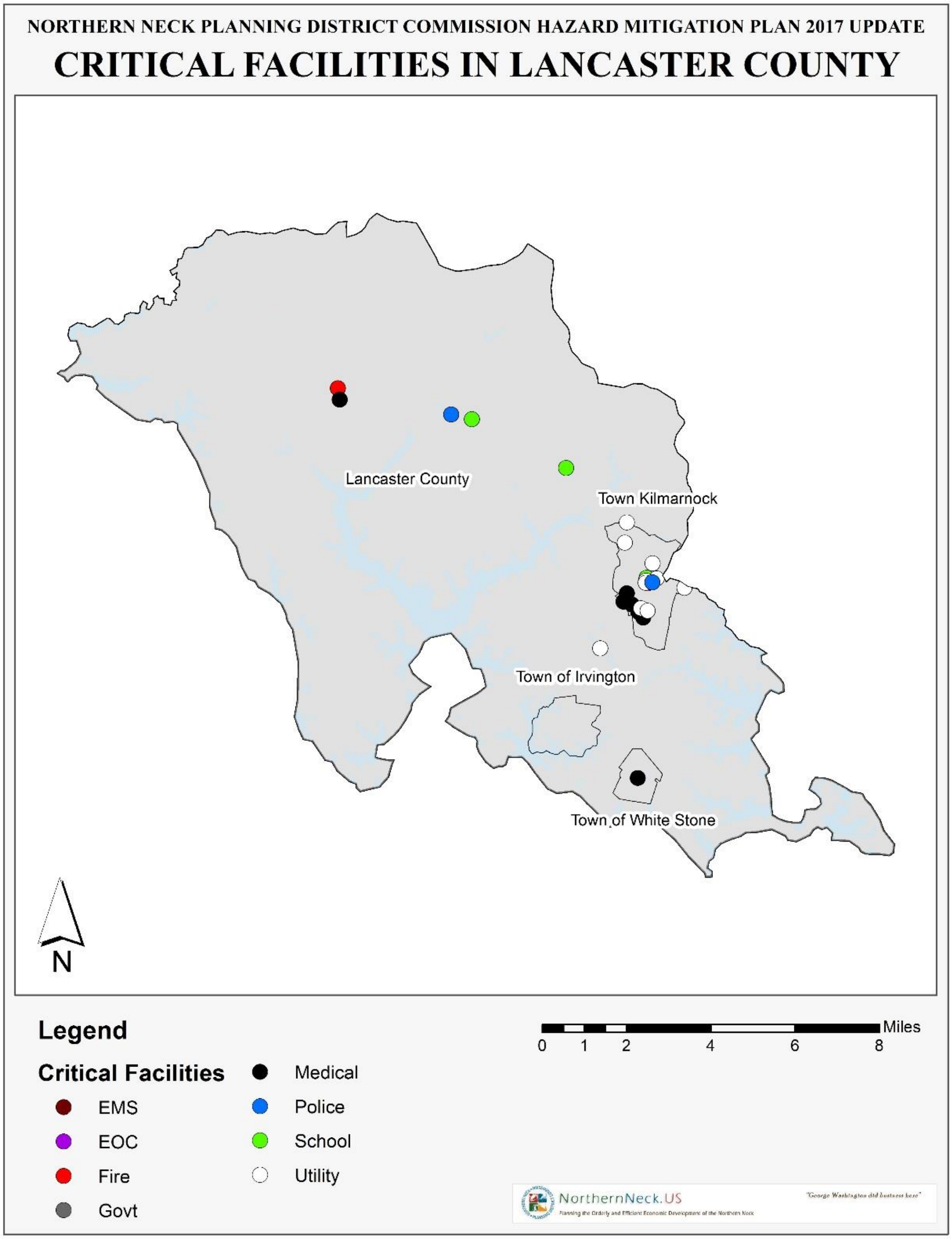

Figure Error! No text of specified style in document.**-10. Critical Facilities in Lancaster County**

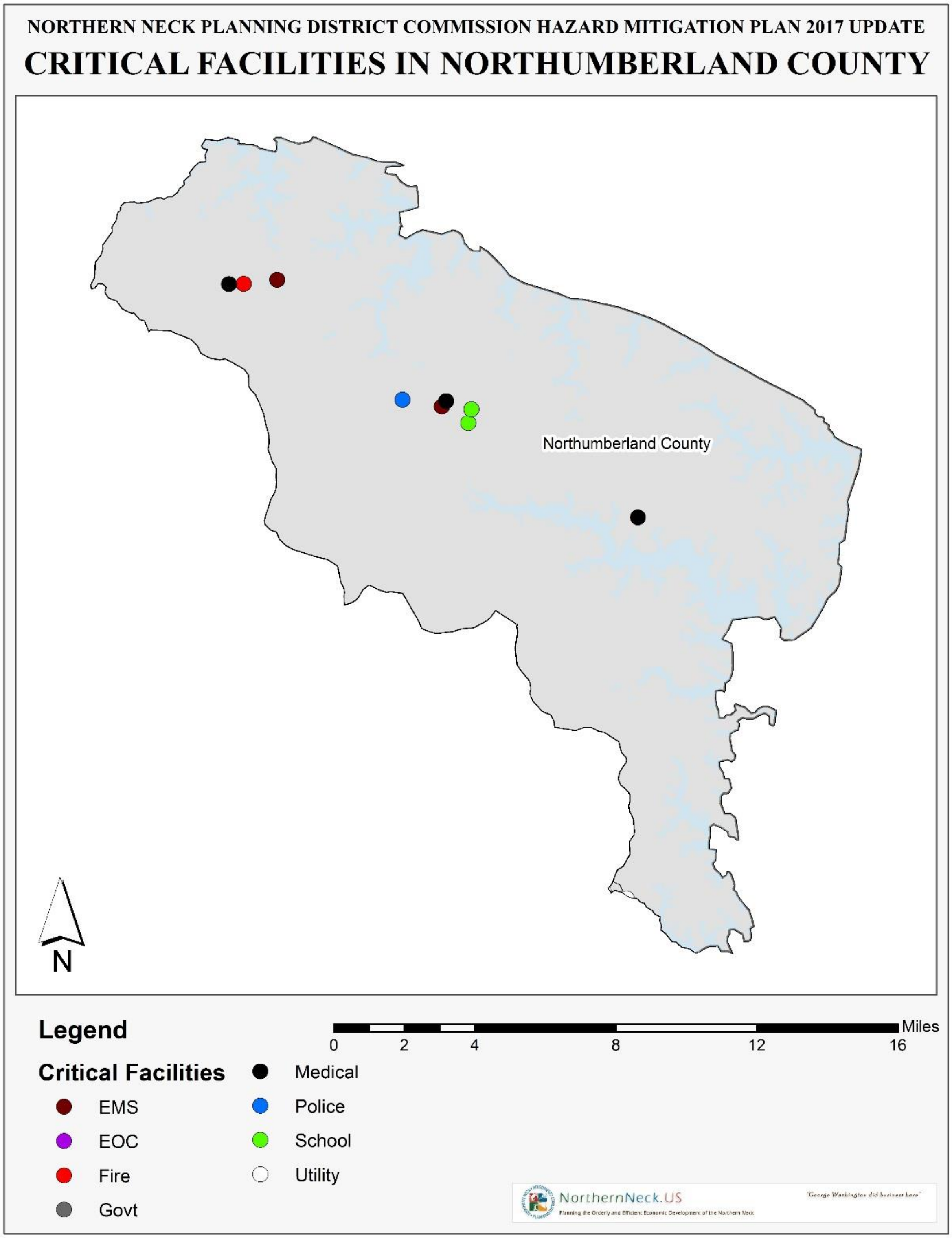

Figure Error! No text of specified style in document.**-11. Critical Facilities in Northumberland County**

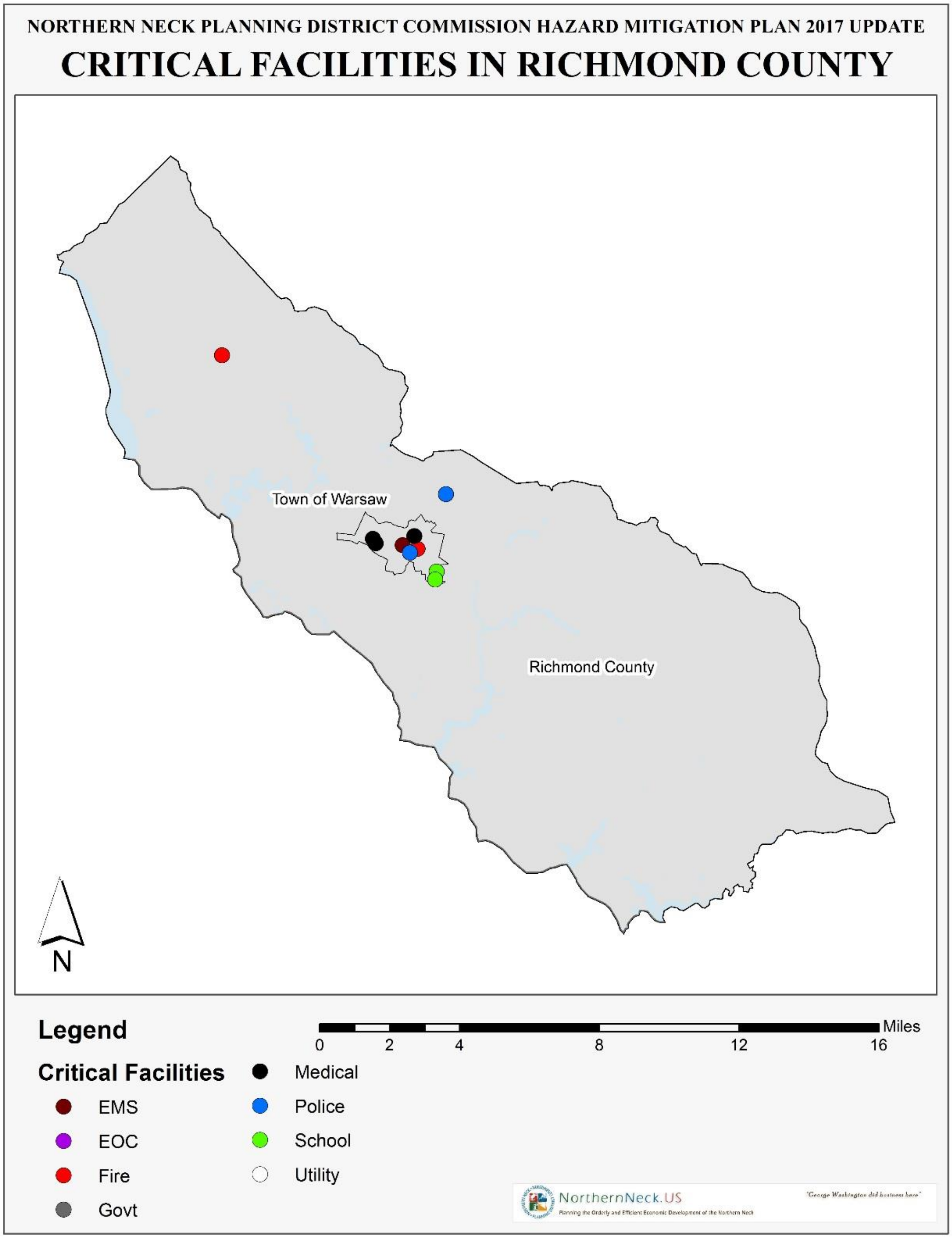

Figure Error! No text of specified style in document.**-12. Critical Facilities in Richmond County**

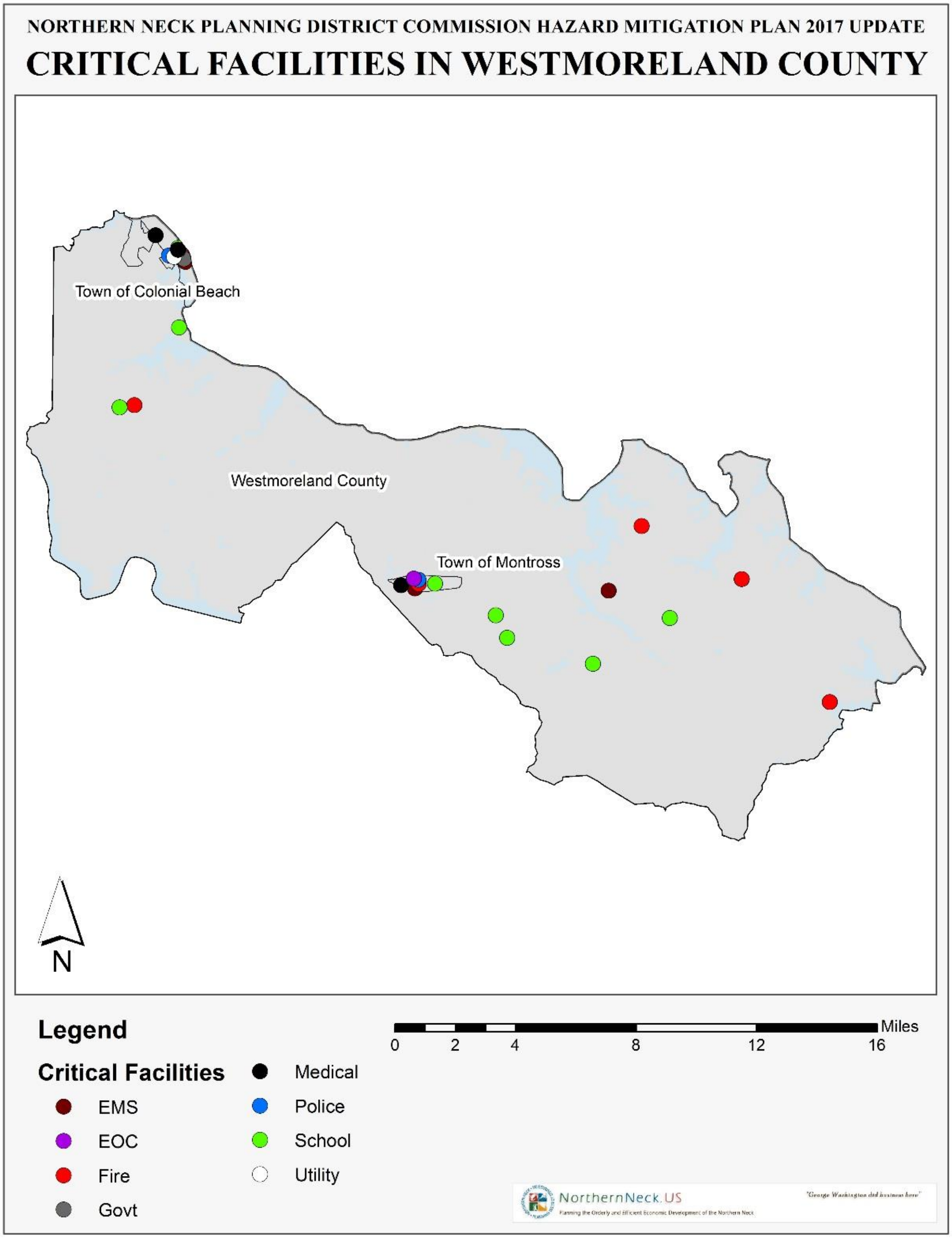

Figure Error! No text of specified style in document.**-13. Critical Facilities in Westmoreland County**

G.4 Critical Facilities Summary

Table 1. Critical Facilities Hazard Exposure Summary

Name	Address	Facility Type	FEMA Flood Zone	Wildland Urban Interface Zone
Callao Medical Arts	17452 Richmond Rd, Callao, VA 22435	Medical	X	Intermix
Callao Rescue Squad Inc	1348 Northumberland Hwy, Callao, VA 22435	EMS	X	Non-Vegetated
Callao Volunteer Fire Department	314 Northumberland Hwy, Callao, VA 22435	Fire	X	Intermix
Carousel Physical Therapy - Kilmarnock, VA	500 Irvington Rd, Kilmarnock, VA 22482	Medical	X	Intermix
Chesapeake Medical Group	95 Harris Rd, Kilmarnock, VA 22482	Medical	X	Intermix
Chesapeake Medical Group	95 Harris Rd, Kilmarnock, VA 22482	Medical	X	Intermix
Chesapeake Medical Group Kilmarnock Family Practice	86 Harris Rd, Kilmarnock, VA 22482	Medical	X	Interface
Chesapeake Medical Group: Daniel Bonnie E MD	8152 Northumberland Hwy, Heathsville, VA 22473	Medical	X	Intermix
Christine Collins, NP - Bon Secours Lively Medical Center	22507, 36 Lively Oaks Rd, Lively, VA 22507	Medical	X	Intermix
Colonial Beach Elementary School	102 First Street, Colonial Beach, VA 22443	School	X	Interface
Colonial Beach High School	100 First Street, Colonial Beach, VA 22443	School	X	Interface
Colonial Beach Medical Center: Dunn Richard MD	16 Delfae Dr, Warsaw, VA 22572	Medical	X	Interface
Colonial Beach Police Department	907 McKinney Blvd, Colonial Beach, VA 22443	Police	X	Interface
Colonial Beach Rescue Squad	225 Dennison St, Colonial Beach, VA 22443	EMS	AE	Interface
Colonial Beach Vol. Fire Department	312 Colonial Ave, Colonial Beach, VA 22443	Fire	X	Interface
Complete Care Medical Group	41, Peach Grove Ln, Montross, VA 22520	Medical	X	Intermix
Cople District Volunteer Fire Dept. Substation	5238 Tucker Hill Road, Hague, VA 22469	Fire	X	Non-Vegetated
Cople Elementary School	7114 Cople Highway, Hague, VA 22469	School	X	Intermix
Daymark Recovery Services	360917 VA-3, White Stone, VA 22578	Medical	X	Intermix
Gateway Private School	2054 Neenah Rd, Colonial Beach, VA 22443	School	X	Interface
Johnson High School	18849 Kings Hwy, Montross, VA 22520	School	X	Intermix
Kilmarnock Volunteer Fire Department	71 School St, Kilmarnock, VA 22482	Fire	X	Interface
Kilmarnock Volunteer Rescue Squad	Harris Rd, Kilmarnock, VA 22482	EMS	X	Interface
Kinsale Fire Department	123 Yeocomico Ln, Kinsale, VA 22488	Fire	X	Intermix

Name	Address	Facility Type	FEMA Flood Zone	Wildland Urban Interface Zone
Lancaster County Sheriff	8293 Mary Ball Rd, Lancaster, VA 22503	Police	X	Vegetated
Lancaster High School	8815 Mary Ball Rd, Lancaster, VA 22503	School	X	Vegetated
Lancaster Middle School	191 School St, Kilmarnock, VA 22482	School	X	Intermix
Lancaster Primary	36 Primary School Cir, Lancaster, VA 22503	School	X	Interface
Mary Washington Health Center	2400 McKinney Blvd., Colonial Beach, VA 22443	Medical	X	Interface
Mid-County Rescue Squad	7990 Northumberland Hwy, Heathsville, VA 22473	EMS	X	Intermix
Middle Peninsula Northern Neck	414 Main St, Warsaw, VA 22572	Medical	X	Interface
Middlesex County Volunteer Rescue Squad	17684 General Puller Hwy, Deltaville, VA 23043	EMS	NA	Intermix
Monroe Bay Christian Academy	903 Holly Vista, Colonial Beach, VA 22443	School	X	Interface
Montross Middle School	8884 Menokin Road, Montross, VA 22520	School	X	Intermix
Montross Volunteer Rescue Squad	72 Lyells St, Montross, VA 22520	EMS	X	Intermix
Northern Neck - Middlesex Free Health Clinic	51 William B Graham Ct, Kilmarnock, VA 22482	Medical	X	Intermix
Northumberland Elementary School	757 Academic Ln, Heathsville, VA 22473	School	X	Intermix
Northumberland High School	201 Academic Ln, Heathsville, VA 22473	School	X	Intermix
Northumberland Sheriff Office	76 Judicial Place, Heathsville, VA 22473	Police	X	Intermix
Oak Grove Volunteer Fire Department	121 James Monroe Hwy, Colonial Beach, VA 22443	Fire	X	Vegetated
Rappahannock General Hospital	101 Harris Rd, Kilmarnock, VA 22482	Medical	X	Intermix
Rappahannock High School	6914 Richmond Road, Warsaw, VA 22572	School	X	Interface
Richmond County Elementary/Middle School	361 Walnut Street, Warsaw, VA 22572	School	X	Interface
Richmond County Rescue Squad	Main Street, Warsaw, VA 22572	EMS	X	Interface
Richmond County Sheriff's Office/Animal Control	106 Wallace St, Warsaw, VA 22572	Police	X	Non-Vegetated
Richmond County Volunteer Fire	587 County Bridge Rd, Warsaw, VA 22572	Fire	X	Vegetated
Richmond County Volunteer Fire Department, Engine Company 1	123 Pine St, Warsaw, VA 22572	Fire	X	Interface
Riverside Bay Harbor Medical Center	Burgess, VA 22432	Medical	X	Vegetated
Riverside Warsaw Medical Arts	16 Delfae Dr, Warsaw, VA 22572	Medical	X	Interface
Tappahannock Police Department	315 Duke St, Tappahannock, VA 22560	Police	NA	Non-Vegetated

Name	Address	Facility Type	FEMA Flood Zone	Wildland Urban Interface Zone
Town of Colonial Beach Cell Tower	2301 McKinney Bldv., Colonial Beach, VA 22443	Utility	X	Interface
Town of Colonial Beach Fuel Tanks	700 Colonial Ave., Colonial Beach, VA 22443	Utility	X	Interface
Town of Colonial Beach Town Hall	315 Douglas Ave., Colonial Beach, VA 22443	Govt	X	Interface
Town of Colonial Beach Wastewater Treatment Plant	2301 McKinney Bldv., Colonial Beach, VA 22443	Utility	X	Interface
Town of Kilmarnock Police Department	1 N. Main ST, Kilmarnock, VA 22482	Police	X	Interface
Town of Kilmarnock Sewer Pump Station, Grace Hill	638 Pleasants Ln, Kilmarnock, VA 22482	Utility	X	Interface
Town of Kilmarnock Sewer Pump Station, Harvey	285 Fox Hill Dr, Kilmarnock, VA 22482	Utility	X	Intermix
Town of Kilmarnock Sewer Pump Station, Hills Qrtrs	552 Middle Gate, Irvington, VA 22480	Utility	X	Intermix
Town of Kilmarnock Sewer Pump Station, Norris pond	770 N. Main ST, Kilmarnock, VA 22482	Utility	X	Non-Vegetated
Town of Kilmarnock Sewer Pump Station, School ST	85 School ST, Kilmarnock, VA 22482	Utility	X	Intermix
Town of Kilmarnock Sewer Pump Station, Wiggins	186 Wiggins Ave, Kilmarnock, VA 22482	Utility	X	Intermix
Town of Kilmarnock Wastewater Treatment Plant	161 Mac's Pond Ln, Kilmarnock, VA 22482	Utility	X	Intermix
Town of Kilmarnock Water Tank and Well #2 Church ST	79 E. Church ST, Kilmarnock, VA 22482	Utility	X	Interface
Town of Kilmarnock Water Tank and Well #3 RGH	99 Harris RD, Kilmarnock, VA 22482	Utility	X	Intermix
Town of Kilmarnock Water Tank and Well #4 Radio	215 Hawthorne Ave, Kilmarnock, VA 22482	Utility	X	Non-Vegetated
U.S. Renal Care - Warsaw Dialysis & Home Dialysis	4709 Richmond Rd, Warsaw, VA 22572	Medical	X	Non-Vegetated
Upper lancaster vol fire dept	5123 Mary Ball Rd, Lancaster, VA 22503	Fire	X	Intermix
Virginia State Police	16835 History Land Hwy, Warsaw, VA 22572	Police	X	Non-Vegetated
Virginia Women's Center	102 DMV Dr, Kilmarnock, VA 22482	Medical	X	Intermix
Washington & Lee High School	16380 Kings Highway, Montross, VA 22520	School	X	Interface
Washington District Elementary School	454 Oak Grove Road, Colonial Beach, VA 22443	School	X	Intermix
Westmoreland County Administration/George D. English Building	111 Polk Street Montross, VA 22520	EOC	X	Interface
Westmoreland County Jail	105 Court Square, Montross, VA 22520	Police	X	Interface

Name	Address	Facility Type	FEMA Flood Zone	Wildland Urban Interface Zone
Westmoreland County Rescue	65 Mt Holly Rd, Mt Holly, VA 22524	EMS	X	Intermix
Westmoreland County Sheriff's Office	111 Polk St, Montross, VA 22520	Police	X	Interface
Westmoreland Fire Dept	52 Rectory Rd, Montross, VA 22520	Fire	X	Interface
Westmoreland Medical Center	18849 Kings Hwy, Montross, VA 22520	Medical	X	Intermix
Westmoreland Rehabilitation & Healthcare	2400 McKinney Blvd, Colonial Beach, VA 22520	Medical	X	Interface
Westmoreland Volunteer Fire Dept Substation	2429 Mt. Holly Road Montross, VA 22520	Fire	X	Intermix
Woodland Academy	2054 Neenah Rd, Montross, VA 22520	School	X	Interface

Appendix H: List of Abbreviated Terms

List of Abbreviations

BFE	Base Flood Elevation
CIP	Capital Improvement Program
COOP	Continuity of Operations
CRS	Community Rating System
DFIRM	Digital Flood Insurance Rate Map
DMA	Disaster Mitigation Act
EAS	Emergency Alert System
EF Scale	Enhanced Fujita Scale
EMS	Emergency Medical Services
EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Maps
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
HAZUS-MH	FEMA's loss estimating software for floods, earthquakes, and hurricane winds
HIRA	Hazard Identification and Risk Assessment
HMGP	Hazard Mitigation Grant Program
MAC	Mitigation Advisory Committee
NCDC	National Climatic Data Center
NFHL	National Flood Hazard Layer
NFIP	National Flood Insurance Program
NLCD	National Land Cover Data
NOAA	National Oceanic Atmospheric and Atmospheric Administration
NWS	National Weather Service
PDC	Planning District Commission
PRISM	Parameter-elevation Regressions on Independent Slopes Model
Risk MAP	Risk Mapping, Assessment, and Planning
RL	repetitive loss
SFHA	Special Flood Hazard Area
SRL	severe repetitive loss
STAPLE/E	Social, Technical, Administrative, Political, Legal, Economic, and Environmental
UASI	Urban Areas Security Initiative
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VA DCR	Virginia Department of Conservation and Recreation
VDEM	Virginia Department of Emergency Management
VDOF	Virginia Department of Forestry
VDOT	Virginia Department of Transportation

Appendix I: Capability Assessment Summary

Northern Neck Planning District Commission Mitigation Capability Matrix						
Programs and Capabilities	**NNPDC**	**Lancaster County**	**Northumberland County**	**Richmond County**	**Westmoreland County**	**Town of Colonial Beach**
Comprehensive Plan		Y	Y	Y	Y	Y
With Hazard Mitigation Element	Advisor	Y	Y	Y	Y	Y
Adoption		Oct. 2013	Nov.2016	Jul. 2013	Dec.2010	May 2017
With Coastal Protection Element		Y	Y	Y	Y	Y
Capital Improvement Plan	Advisor	Y	Y	Y	Y	Y
Economic Development Plan (2013 - 2018)	Y	N	Y	N	N	Y
Downtown Development/Re-Development Authority Plans	Advisor	Y		Y	Y	Y
Enterprise Zones	Advisor	Y		Y		
Transportation Planning	VDOT/PDC	N/A	N/A	N/A	N/A	N/A
Subdivision Regulations	N/A	Y	Y	Y	Y	Y
Zoning Ordinance	N/A	Y	Y	Y	Y	Y
Site Plan Review Procedures		Y	Y	Y	Y	Y
Building Code (or ordinance) addresses flood	N/A	Y	Y	Y	Y	Y
Designated Building Official		Y	Y	Y	Y	Y
Regular Inspection Protocols		Y	Y	Y	Y	Y
Mitigation Projects						
Private Residential Elevations (self-financed)	N/A	Y	Y	Y	Y	Y
Resident and Community Outreach Inc. Ready.gov	Y	Y	Y	Y	Y	Y
Exclude critical infrastructure from SFHA	N/A	Y	Y	Y	Y	Y
Elevate Residences or Property Protection through HMA grants	Y	Y	Y	Y[1]	N/A	N/A
Natural Systems Protection						
Natural or Cultural Resources Inventory		Y	Y	Y	Y	Y
Open Space	N/A	Y	Y		Y	Y
Parks and Recreation		Y	Y	Y	Y	Y
Living Shorelines Program	Y	Y	Y	Y	Y	Y
Stormwater Management and Water Quality Programs	N/A					Y
Total Daily Maximum Load (TMDL) Stream Segments**		Y[2]	Y[3]	Y	Y	Y[4]
Watershed Improvement Plans***	Y	Y	Y	Y	Y	Y
Erosion or Sediment Control Program	N/A	Y	Y	Y	Y	Y
Erosion and Sediment Control Ordinances		Y	Y	Y	Y	Y
Floodplain Management	N/A					
Floodplain Administrator		Y	Y	Y	Y	Y
Participates in NFIP		Y	Y	Y	Y	Y
Year Joined NFIP		3/4/1988	7/4/1989	3/16/1989	9/18/1987	9/18/1987
Effective FIRM Date		10/2/2014	2/18/2015	4/16/2015	4/16/2015	4/16/2015
Additional Freeboard Requirements (inches)		N/A	12" *	N/A	18"	12"
LiMWA standards in High Hazard Coastal Areas		Y	Y			
Participates in CRS		N	N	N	N	N
Emergency Operations Management	LEPC	Y	Y	Y	Y	Y
Emergency Operations Plan	2011	Y	Y	Y	Y	Y

Northern Neck Planning District Commission Mitigation Capability Matrix						
Programs and Capabilities	**NNPDC**	**Lancaster County**	**Northumberland County**	**Richmond County**	**Westmoreland County**	**Town of Colonial Beach**
Local Government EOPs	VDEM advisor	Y	Y	Y	Y	Y
Warning Sirens or warning alert systems		Y	Y	Y	Y	Y
Evacuation Plans		Y	Y	Y	Y	Y
Shelter and Family Re-Unification Plan		Y	Y	Y	Y	Y
Special Needs Population Emergency Planning		Y	Y	Y	Y	Y
Companion Animal Sheltering and Re-Unification Plan		Y	Y	Y	Y	Y
Dedicated Emergency Management Website	Y	Y	Y	Y	Y	Y
Education Programs	N/A	Y	Y	Y	Y	Y
School Facility Emergency Operations Plans		unknown	Y	Y	Y	unknown
School Emergency Notification, Evacuation and Emergency Planning		N	Y	unknown	Y	unknown
College Campus Plans		Y	N/A	Y	N/A	N/A
College/University Emergency Notification, Evacuation and Emergency Planning		Y	N/A	Y	N/A	N/A
Tourism	Y[5]	Y	Y	Y	Y	Y
Additional Capabilities			Debris Mgmt. Plan		Debris Mgmt. Plan	

Note: many functions for towns are performed by their County

N/A - not applicable.

1. Richmond County FY16 FMA application in progress.
2. Greenvale, Paynes, and Beach Creeks (Bacteria) TMDL study completed and implementation plan approved.
3. Coan Mill Stream (Dissolved Oxygen) listed as needing a TMDL study.
4. Monroe Creek identified as impaired stream segment as part of a baseline and TMDL PDB loads study.
5. Includes historic preservation protection; promotion of historic and natural site visitation.

* Northumberland County VE zone Freeboard is 24".

**All stream segments in each county are a part of the Chesapeake Bay Total Daily Maximum Load (TMDL) monitoring area.

***All stream segments part of the Chesapeake Bay WIP.

Article 23, Lancaster County Zoning Ordinance

AN ORDINANCE AMENDING Article 23, THE ZONING ORDINANCE OF Lancaster County VIRGINIA, BY ESTABLISHING FLOODPLAIN DISTRICTS, BY REQUIRING THE ISSUANCE OF PERMITS FOR DEVELOPMENT, AND BY PROVIDING FACTORS AND CONDITIONS FOR VARIANCES TO THE TERMS OF THE ORDINANCES.

BE IT ENACTED AND ORDAINED BY Lancaster County, Virginia, as follows:

ARTICLE I - GENERAL PROVISIONS

Section 1.1 – Statutory Authorization and Purpose [44 CFR 59.22(a)(2)]

Va. **Code** § 15.2-2283 specifies that zoning ordinances shall be for the general purpose of promoting the health, safety, or general welfare of the public and of further accomplishing the objectives of § 15.2-2200 which encourages localities to improve the public health, safety, convenience, and welfare of their citizens. To these ends, flood ordinances shall be designed to provide for safety from flood, to facilitate the provision of flood protection, and to protect against loss of life, health, or property from flood.

In accordance with these directed provisions, this ordinance is specifically adopted pursuant to the authority granted to localities by Va. **Code** § 15.2 - 2280.

The purpose of these provisions is to prevent: the loss of life, health, or property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

A. Regulating uses, activities, and development which, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

B. Restricting or prohibiting certain uses, activities, and development from locating within districts subject to flooding;

C. Requiring all those uses, activities, and developments that do occur in flood-prone districts to be protected and/or floodproofed against flooding and flood damage; and,

D. Protecting individuals from buying land and structures which are unsuited for intended purposes because of flood hazards.

Section 1.2 – Applicability

These provisions shall apply to all privately and publicly owned lands within the jurisdiction of Lancaster County and identified as areas of special flood hazard identified by the community or shown on the flood insurance rate map (FIRM) or included in the flood insurance study (FIS) that are provided to Lancaster County by FEMA.

Section 1.3 - Compliance and Liability

A. No land shall hereafter be developed and no structure shall be located, relocated, constructed, reconstructed, enlarged, or structurally altered except in full compliance with the terms and provisions of this ordinance and any other applicable ordinances and regulations which apply to uses within the jurisdiction of this ordinance.

B. The degree of flood protection sought by the provisions of this ordinance is considered reasonable for regulatory purposes and is based on acceptable engineering methods of study, but does not imply total flood protection. Larger floods may occur on rare occasions. Flood heights may be increased by man-made or natural causes, such as ice jams and bridge openings restricted by debris. This ordinance does not imply that districts outside the floodplain district or land uses permitted within such district will be free from flooding or flood damages.

C. This ordinance shall not create liability on the part of Lancaster County or any officer or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made thereunder.

Section 1.4 – Records [44 CFR 59.22(a)(9)(iii)]

Records of actions associated with administering this ordinance shall be kept on file and maintained by or under the direction of the Floodplain Administrator in perpetuity.

Section 1.5 - Abrogation and Greater Restrictions [44 CFR 60.1(b)]

To the extent that the provisions are more restrictive, this ordinance supersedes any ordinance currently in effect in flood-prone districts. To the extent that any other existing law or regulation is more restrictive or does not conflict it shall remain in full force and effect.

These regulations are not intended to repeal or abrogate any existing ordinances including subdivision regulations, zoning ordinances, or building codes. In the event of a conflict between these regulations and any other ordinance, the more restrictive shall govern.

Section 1.6 - Severability

If any section, subsection, paragraph, sentence, clause, or phrase of this ordinance shall be declared invalid for any reason whatever, such decision shall not affect the remaining portions of this ordinance. The remaining portions shall remain in full force and effect; and for this purpose, the provisions of this ordinance are hereby declared to be severable.

Section 1.7 - Penalty for Violations [44 CFR 60.2(e)]

Any person who fails to comply with any of the requirements or provisions of this article or directions of the director of planning or any authorized employee of Lancaster County shall be guilty of the appropriate violation and subject to the penalties thereof.

The VA USBC addresses building code violations and the associated penalties in Section 104 and Section 115. Violations and associated penalties of the Zoning Ordinance of Lancaster County are addressed in Article 15 of the Zoning Ordinance.

In addition to the above penalties, all other actions are hereby reserved, including an action in equity for the proper enforcement of this article. The imposition of a fine or penalty for any violation of, or noncompliance with, this article shall not excuse the violation or noncompliance or permit it to continue; and all such persons shall be required to correct or remedy such violations within a reasonable time. Any structure constructed, reconstructed, enlarged, altered or relocated in noncompliance with this article may be declared by Lancaster County to be a public nuisance and abatable as such. Flood insurance may be withheld from structures constructed in violation of this article.

ARTICLE II - ADMINISTRATION

Section 2.1 - Designation of the Floodplain Administrator [44 CFR 59.22(b)]

The Floodplain Administrator is hereby appointed to administer and implement these regulations and is referred to herein as the Floodplain Administrator. The Floodplain Administrator may:

A. Do the work themselves. In the absence of a designated Floodplain Administrator, the duties are conducted by the Lancaster County Land Use Ordinances Enforcement Officer or chief executive officer.

B. Delegate duties and responsibilities set forth in these regulations to qualified technical personnel, plan examiners, inspectors, and other employees.

C. Enter into a written agreement or written contract with another community or private sector entity to administer specific provisions of these regulations. Administration of any part of these regulations by another entity shall not relieve the community of its responsibilities pursuant to the participation requirements of the National Flood Insurance Program as set forth in the Code of Federal Regulations at 44 C.F.R. Section 59.22.

Section 2.2 - Duties and Responsibilities of the Floodplain Administrator [44 CFR 60.3]

The duties and responsibilities of the Floodplain Administrator shall include but are not limited to:

A. Review applications for permits to determine whether proposed activities will be located in the Special Flood Hazard Area (SFHA).

B. Interpret floodplain boundaries and provide available base flood elevation and flood hazard information.

C. Review applications to determine whether proposed activities will be reasonably safe from flooding and require new construction and substantial improvements to meet the requirements of these regulations.

D. Review applications to determine whether all necessary permits have been obtained from the Federal, State, or local agencies from which prior or concurrent approval is required; in particular, permits from state agencies for any construction, reconstruction, repair, or alteration of a dam, reservoir, or waterway obstruction (including bridges, culverts, structures), any alteration of a watercourse, or any change of the course, current, or cross section of a stream or body of water, including any change to the 100-year frequency floodplain of free-flowing non-tidal waters of the State.

E. Verify that applicants proposing an alteration of a watercourse have notified adjacent communities, the Department of Conservation and Recreation (Division of Dam Safety and Floodplain Management), and other appropriate agencies (VADEQ, USACE), and have submitted copies of such notifications to FEMA.

F. Advise applicants for new construction or substantial improvement of structures that are located within an area of the Coastal Barrier Resources System established by the Coastal Barrier Resources Act that Federal flood insurance is not available on such structures; areas subject to this limitation are shown on Flood Insurance Rate Maps as Coastal Barrier Resource System Areas (CBRS) or Otherwise Protected Areas (OPA).

G. Approve applications and issue permits to develop in flood hazard areas if the provisions of these regulations have been met, or disapprove applications if the provisions of these regulations have not been met.

H. Inspect or cause to be inspected, buildings, structures, and other development for which permits have been issued to determine compliance with these regulations or to determine if non-compliance has occurred or violations have been committed.

I. Review Elevation Certificates and require incomplete or deficient certificates to be corrected.

J. Submit to FEMA, or require applicants to submit to FEMA, data and information necessary to maintain FIRMs, including hydrologic and hydraulic engineering analyses prepared by Lancaster County, within six months after such data and information becomes available if the analyses indicate changes in base flood elevations.

K. Maintain and permanently keep records that are necessary for the administration of these regulations, including:

1. Flood Insurance Studies, Flood Insurance Rate Maps (including historic studies and maps and current effective studies and maps), and Letters of Map Change; and

2. Documentation supporting issuance and denial of permits, Elevation Certificates, documentation of the elevation (in relation to the datum on the FIRM) to which structures have been floodproofed, inspection records, other required design certifications, variances, and records of enforcement actions taken to correct violations of these regulations.

L. Enforce the provisions of these regulations, investigate violations, issue notices of violations or stop work orders, and require permit holders to take corrective action.

M. Advise the Board of Zoning Appeals regarding the intent of these regulations and, for each application for a variance, prepare a staff report and recommendation.

N. Administer the requirements related to proposed work on existing buildings:

1. Make determinations as to whether buildings and structures that are located in flood hazard areas and that are damaged by any cause have been substantially damaged.

2. Make reasonable efforts to notify owners of substantially damaged structures of the need to obtain a permit to repair, rehabilitate, or reconstruct. Prohibit the non-compliant repair of substantially damaged buildings except for temporary emergency protective measures necessary to secure a property or stabilize a building or structure to prevent additional damage.

O. Undertake, as determined appropriate by the Floodplain Administrator due to the circumstances, other actions which may include but are not limited to: issuing press releases, public service announcements, and other public information materials related to permit requests and repair of damaged structures; coordinating with other Federal, State, and local agencies to assist with substantial damage determinations; providing owners of damaged structures information related to the proper repair of damaged structures in special flood hazard areas; and assisting property owners with documentation necessary to file claims for Increased Cost of Compliance coverage under NFIP flood insurance policies.

P. Notify the Federal Emergency Management Agency when the corporate boundaries of Lancaster County have been modified and:

1. Provide a map that clearly delineates the new corporate boundaries or the new area for which the authority to regulate pursuant to these regulations has either been assumed or relinquished through annexation; and

2. If the FIRM for any annexed area includes special flood hazard areas that have flood zones that have regulatory requirements that are not set forth in these regulations, prepare amendments to these regulations to adopt the FIRM and appropriate requirements, and submit the amendments to the governing body for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended regulations shall be provided to Department of Conservation and Recreation (Division of Dam Safety and Floodplain Management) and FEMA.

Q. Upon the request of FEMA, complete and submit a report concerning participation in the NFIP which may request information regarding the number of buildings in the SFHA, number of permits issued for development in the SFHA, and number of variances issued for development in the SFHA.

R. It is the duty of the Community Floodplain Administrator to take into account flood, mudslide and flood-related erosion hazards, to the extent that they are known, in all official actions relating to land management and use throughout the entire jurisdictional area of the Community, whether or not those hazards have been specifically delineated geographically (e.g., via mapping or surveying).

Section 2.3 - Use and Interpretation of FIRMs [44 CFR 60.3]

The Floodplain Administrator shall make interpretations, where needed, as to the exact location of special flood hazard areas, floodplain boundaries, and floodway boundaries. The following shall apply to the use and interpretation of FIRMs and data:

A. Where field surveyed topography indicates that adjacent ground elevations:

1. Are below the base flood elevation in riverine SFHAs, or below the 1% storm surge elevation in coastal SFHAs, even in areas not delineated as a special flood hazard area on a FIRM, the area shall be considered as special flood hazard area and subject to the requirements of these regulations;

2. Are above the base flood elevation and the area is labelled as a SFHA on the FIRM, the area shall be regulated as special flood hazard area unless the applicant obtains a Letter of Map Change that removes the area from the SFHA.

B. In FEMA-identified special flood hazard areas where base flood elevation and floodway data have not been identified and in areas where FEMA has not identified SFHAs, any other flood hazard data available from a Federal, State, or other source shall be reviewed and reasonably used.

C. Base flood elevations and designated floodway boundaries on FIRMs and in FISs shall take precedence over base flood elevations and floodway boundaries by any other sources if such sources show reduced floodway widths and/or lower base flood elevations.

D. Other sources of data shall be reasonably used if such sources show increased base flood elevations and/or larger floodway areas than are shown on FIRMs and in FISs.

E. If a Preliminary Flood Insurance Rate Map and/or a Preliminary Flood Insurance Study has been provided by FEMA:

1. Upon the issuance of a Letter of Final Determination by FEMA, the preliminary flood hazard data shall be used and shall replace the flood hazard data previously provided from FEMA for the purposes of administering these regulations.

2. Prior to the issuance of a Letter of Final Determination by FEMA, the use of preliminary flood hazard data shall be deemed the best available data pursuant to Article III, Section 3.1.A.3 and used where no base flood elevations and/or floodway areas are provided on the effective FIRM.

3. Prior to issuance of a Letter of Final Determination by FEMA, the use of preliminary flood hazard data is permitted where the preliminary base flood elevations or floodway areas exceed the base flood elevations and/or designated floodway widths in existing flood hazard data provided by FEMA. Such preliminary data may be subject to change and/or appeal to FEMA.

Section 2.4 - Jurisdictional Boundary Changes [44 CFR 59.22, 65.3]

The County floodplain ordinance in effect on the date of annexation shall remain in effect and shall be enforced by the municipality for all annexed areas until the municipality adopts and enforces an ordinance which meets the requirements for participation in the National Flood Insurance Program. Municipalities with existing floodplain ordinances shall pass a resolution acknowledging and accepting responsibility for enforcing floodplain ordinance standards prior to annexation of any area containing identified flood hazards. If the FIRM for any annexed area includes special flood hazard areas that have flood zones that have regulatory requirements that are not set forth in these regulations, the governing body shall prepare amendments to these regulations to adopt the FIRM and appropriate requirements, and submit the amendments to the governing body for adoption; such adoption shall take place at the same time as or prior to the date of annexation and a copy of the amended regulations shall be provided to Department of Conservation and Recreation (Division of Dam Safety and Floodplain Management) and FEMA.

In accordance with the Code of Federal Regulations, Title 44 Subpart (B) Section 59.22(a)(9)(v) all NFIP participating communities must notify the Federal Insurance Administration and optionally the State Coordinating Office in writing whenever the boundaries of the community have been modified by annexation or the community has otherwise assumed or no longer has authority to adopt and enforce floodplain management regulations for a particular area.

In order that all Flood Insurance Rate Maps accurately represent the community's boundaries, a copy of a map of the community suitable for reproduction, clearly delineating the new corporate limits or new area for which the community has assumed or relinquished floodplain management regulatory authority must be included with the notification.

Section 2.5 - District Boundary Changes

The delineation of any of the Floodplain Districts may be revised by Lancaster County where natural or man-made changes have occurred and/or where more detailed studies have been conducted or undertaken by the U. S. Army Corps of Engineers or other qualified agency, or an individual documents the need for such change. However, prior to any such change, approval must be obtained from the Federal Emergency Management Agency. A completed LOMR is a record of this approval.

Section 2.6 - Interpretation of District Boundaries

Initial interpretations of the boundaries of the Floodplain Districts shall be made by the Zoning Officer. Should a dispute arise concerning the boundaries of any of the Districts, the Board of Zoning Appeals shall make the necessary determination. The person questioning or contesting the location of the District boundary shall be given a reasonable opportunity to present his case to the Board and to submit his own technical evidence if he so desires.

Section 2.7 – Submitting Model Backed Technical Data [44 CFR 65.3]

A community's base flood elevations may increase or decrease resulting from physical changes affecting flooding conditions. As soon as practicable, but not later than six months after the date such information becomes available, a community shall notify the Federal Emergency Management Agency of the changes by submitting technical or scientific data. The community may submit data via a LOMR. Such a submission is necessary so that upon confirmation of those physical changes affecting flooding conditions, risk premium rates and floodplain management requirements will be based upon current data.

Section 2.8 – Letters of Map Revision

When development in the floodplain will cause or causes a change in the base flood elevation, the applicant, including state agencies, must notify FEMA by applying for a Conditional Letter of Map Revision and then a Letter of Map Revision.

Example cases:

- Any development that causes a rise in the base flood elevations within the floodway.
- Any development occurring in Zones A1-30 and AE without a designated floodway, which will cause a rise of more than one foot in the base flood elevation.
- Alteration or relocation of a stream (including but not limited to installing culverts and bridges) *44 Code of Federal Regulations §65.3 and §65.6(a)(12).*

ARTICLE III - ESTABLISHMENT OF ZONING DISTRICTS

Section 3.1 - Description of Special Flood Hazard Districts [44 CFR 59.1, 60.3]

A. Basis of Districts

The various special flood hazard districts shall include the SFHAs. The basis for the delineation of these districts shall be the FIS and the FIRM for Lancaster County prepared by the Federal Emergency Management Agency, Federal Insurance Administration, dated July 5, 2022, and any subsequent revisions or amendments thereto.

Lancaster County may identify and regulate local flood hazard or ponding areas that are not delineated on the FIRM. These areas may be delineated on a "Local Flood Hazard Map" using best available topographic data and locally derived information such as flood of record, historic high-water marks, or approximate study methodologies.

The boundaries of the SFHA Districts are established as shown on the FIRM which is declared to be a part of this ordinance and which shall be kept on file at the Lancaster County offices.

1. The **Floodway District** is in an **AE Zone** and is delineated, for purposes of this ordinance, using the criterion that certain areas within the floodplain must be capable of carrying the waters of the one percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point. The areas included in this District are specifically defined in Table 1 of the above-referenced FIS and shown on the accompanying FIRM.

   The following provisions shall apply within the Floodway District of an AE zone [44 CFR 60.3(d)]:

a. Within any floodway area, no encroachments, including fill, new construction, substantial improvements, or other development shall be permitted unless it has been demonstrated through hydrologic and hydraulic analysis performed in accordance with standard engineering practice that the proposed encroachment will not result in any increase in flood levels within the community during the occurrence of the base flood discharge. Hydrologic and hydraulic analyses shall be undertaken only by professional engineers or others of demonstrated qualifications, who shall certify that the technical methods used correctly reflect currently-accepted technical concepts. Studies, analyses, computations, etc., shall be submitted in sufficient detail to allow a thorough review by the Floodplain Administrator.

   Development activities which increase the water surface elevation of the base flood may be allowed, provided that the applicant first applies – with Lancaster County endorsement – for a Conditional Letter of Map Revision (CLOMR), and receives the approval of the Federal Emergency Management Agency.

   If Article III, Section 3.1.A.1.a is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Article 4.

b. The placement of manufactured homes (mobile homes) is prohibited, except in an existing manufactured home (mobile home) park or subdivision. A replacement manufactured home may be placed on a lot in an existing manufactured home park or subdivision provided the anchoring, elevation, and encroachment standards are met.

2. The **AE, or AH Zones** on the FIRM accompanying the FIS shall be those areas for which one-percent annual chance flood elevations have been provided and the floodway has **not** been delineated. The following provisions shall apply within an AE or AH zone [44 CFR 60.3(c)] where FEMA has provided base flood elevations:

   Until a regulatory floodway is designated, no new construction, substantial improvements, or other development (including fill) shall be permitted within the areas of special flood hazard, designated as Zones A1-30, AE, or AH on the FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within Lancaster County.

Development activities in Zones Al-30, AE, or AH on the Lancaster County FIRM which increase the water surface elevation of the base flood by more than one foot may be allowed, provided that the applicant first applies – with Lancaster County endorsement – for a Conditional Letter of Map Revision, and receives the approval of the Federal Emergency Management Agency.

3. The **A Zone** on the FIRM accompanying the FIS shall be those areas for which no detailed flood profiles or elevations are provided, but the one percent annual chance floodplain boundary has been approximated. For these areas, the following provisions

shall apply [44 CFR 60.3(b)]:

The Approximated Floodplain District shall be that floodplain area for which no detailed flood profiles or elevations are provided, but where a one percent annual chance floodplain boundary has been approximated. Such areas are shown as Zone A on the maps accompanying the FIS. For these areas, the base flood elevations and floodway information from Federal, State, and other acceptable sources shall be used, when available. Where the specific one percent annual chance flood elevation cannot be determined for this area using other sources of data, such as the U. S. Army Corps of Engineers Floodplain Information Reports, U. S. Geological Survey Flood-Prone Quadrangles, etc., then the applicant for the proposed use, development and/or activity shall determine this base flood elevation. For development proposed in the approximate floodplain the applicant must use technical methods that correctly reflect currently accepted practices, such as point on boundary, high water marks, or detailed methodologies hydrologic and hydraulic analyses. Studies, analyses, computations, etc., shall be submitted in sufficient detail to allow a thorough review by the Floodplain Administrator.

The Floodplain Administrator reserves the right to require a hydrologic and hydraulic analysis for any development. When such base flood elevation data is utilized, the bottom of the lowest horizontal structural member of the lowest floor shall be elevated to or above the base flood level.

During the permitting process, the Floodplain Administrator shall obtain:

a. The elevation of the lowest floor (in relation to mean sea level), including the basement, of all new and substantially improved structures; and,

b. If the structure has been floodproofed in accordance with the requirements of this article, the elevation (in relation to mean sea level) to which the structure has been floodproofed.

Base flood elevation data shall be obtained from other sources or developed using detailed methodologies comparable to those contained in a FIS for subdivision proposals and other proposed development proposals (including manufactured home parks and subdivisions) that exceed fifty lots or five acres, whichever is the lesser.

4. The **AO Zone** on the FIRM accompanying the FIS shall be those areas of shallow flooding identified as AO on the FIRM. For these areas, the following provisions shall apply [44 CFR 60.3(c)]:

   a. All new construction and substantial improvements of residential structures shall have the lowest floor, including basement, elevated to or above the flood depth specified on the FIRM, above the highest adjacent grade at least as high as the depth number specified in feet on the FIRM. If no flood depth number is specified, the lowest floor, including basement, shall be elevated no less than two feet above the highest adjacent grade.

   b. All new construction and substantial improvements of non-residential structures shall

(1) Have the lowest floor, including basement, elevated to or above the flood depth specified on the FIRM, above the highest adjacent grade at least as high as the depth number specified in feet on the FIRM. If no flood depth number is specified, the lowest floor, including basement, shall be elevated at least two feet above the highest adjacent grade; or,

(2) Together with attendant utility and sanitary facilities be completely floodproofed to the specified flood level so that any space below that level is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy.

c. Adequate drainage paths around structures on slopes shall be provided to guide floodwaters around and away from proposed structures.

5. The **Coastal A Zone** is labelled as AE on the FIRM; it is those areas that are seaward of the limit of moderate wave action (LiMWA) line. As defined by the VA USBC, these areas are subject to wave heights between 1.5 feet and 3 feet. For these areas, the following provisions shall apply:

   Buildings and structures within this zone shall have the bottom of the lowest horizontal structural member of the lowest floor elevated to or above the base flood elevation plus eighteen inches of freeboard, and must comply with the provisions in Article III, Section 3.1.A.2 and Article IV, Sections 4.2 and 4.3.

6. The **VE or V Zones** on FIRMs accompanying the FIS shall be those areas that are known as Coastal High Hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast or other areas subject to high velocity waves. For these areas, the following provisions shall apply [44 CFR 60.3(e)]:

   a. All new construction and substantial improvements in Zones V and VE, including manufactured homes, shall be elevated on pilings or columns so that:

   (1) The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to or above the base flood level plus eighteen inches if the lowest horizontal structural member is parallel to the direction of wave approach or elevated at least two feet above the base flood level if the lowest horizontal structural member is perpendicular to the direction of wave approach; and,

   (2) The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one percent chance of being equaled or exceeded in any given year (one-percent annual chance).

   b. A registered professional engineer or architect shall develop or review the structural design, specifications and plans for the construction, and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of Article III, Section A.6.a.

c. The Floodplain Administrator shall obtain the elevation (in relation to mean sea level) of the bottom of the lowest horizontal structural member of the lowest floor (excluding pilings and columns) of all new and substantially improved structures in Zones V and VE. The Floodplain Management Administrator shall maintain a record of all such information.

d. All new construction shall be located landward of the reach of mean high tide.

e. All new construction and substantial improvements shall have the space below the lowest floor either free of obstruction or constructed with non-supporting breakaway walls, open wood-lattice work, or insect screening intended to collapse under wind and water loads without causing collapse, displacement, or other structural damage to the elevated portion of the building or supporting foundation system. For the purpose of this Section, a breakaway wall shall have a design safe loading resistance of not less than 10 and no more than 20 pounds per square foot. Use of breakaway walls which exceed a design safe loading resistance of 20 pounds per square foot (either by design or when so required by local codes) may be permitted only if a registered professional engineer or architect certifies that the designs proposed meet the following conditions:

    (1) Breakaway wall collapse shall result from water load less than that which would occur during the base flood; and

    (2) The elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement, or other structural damage due to the effects of wind and water loads acting simultaneously on all building components (structural and nonstructural). Maximum wind and water loading values to be used in this determination shall each have a one percent chance of being equaled or exceeded in any given year.

f. The enclosed space below the lowest floor shall be used solely for parking of vehicles, building access, or storage. Such space shall not be partitioned into multiple rooms, temperature-controlled, or used for human habitation.

g. The use of fill for structural support of buildings is prohibited. When non-structural fill is proposed in a coastal high hazard area, appropriate engineering analyses shall be conducted to evaluate the impacts of the fill prior to issuance of a permit.

h. The man-made alteration of sand dunes, which would increase potential flood damage, is prohibited.

<u>Section 3.2 - Overlay Concept</u>

The Floodplain Districts described above shall be overlays to the existing underlying districts as shown on the Official Zoning Ordinance Map, and as such, the provisions for the floodplain districts shall serve as a supplement to the underlying district provisions.

If there is any conflict between the provisions or requirements of the Floodplain Districts and those of any underlying district, the more restrictive provisions and/or those pertaining to the floodplain districts shall apply.

In the event any provision concerning a Floodplain District is declared inapplicable as a result of any legislative or administrative actions or judicial decision, the basic underlying provisions shall remain applicable.

ARTICLE IV - DISTRICT PROVISIONS [44 CFR 59.22, 60.2, 60.3]

Section 4.1 – Permit and Application Requirements

A. Permit Requirement

All uses, activities, and development occurring within any floodplain district, including placement of manufactured homes, shall be undertaken only upon the issuance of a permit. Such development shall be undertaken only in strict compliance with the provisions of this Ordinance and with all other applicable codes and ordinances, as amended, such as the Virginia Uniform Statewide Building Code (VA USBC) and the Lancaster County Subdivision Regulations. Prior to the issuance of any such permit, the Floodplain Administrator shall require all applications to include compliance with all applicable State and Federal laws and shall review all sites to assure they are reasonably safe from flooding. Under no circumstances shall any use, activity, and/or development adversely affect the capacity of the channels or floodways of any watercourse, drainage ditch, or any other drainage facility or system.

B. Site Plans and Permit Applications

All applications for development within any floodplain district and all permits issued for the floodplain shall incorporate the following information:

1. The elevation of the Base Flood at the site.
2. For structures to be elevated, the elevation of the lowest floor (including basement) or, in V zones, the lowest horizontal structural member.
3. For structures to be floodproofed (non-residential only), the elevation to which the structure will be floodproofed.
4. Topographic information showing existing and proposed ground elevations.

Section 4.2 - General Standards

The following provisions shall apply to all permits:

A. New construction and substantial improvements shall be built according to this ordinance and the VA USBC, and anchored to prevent flotation, collapse, or lateral movement of the structure.

B. Manufactured homes shall be anchored to prevent flotation, collapse, or lateral movement. Methods of anchoring may include, but are not limited to, use of over-the-top or frame ties to ground anchors. This standard shall be in addition to and consistent with applicable state anchoring requirements for resisting wind forces.

C. New construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage.

D. New construction or substantial improvements shall be constructed by methods and practices that minimize flood damage.

E. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities, including duct work, shall be designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

F. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

G. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters.

H. On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.

In addition to provisions A – H above, in all special flood hazard areas, the additional provisions shall apply:

I. Prior to any proposed alteration or relocation of any channels or of any watercourse, stream, etc., within this jurisdiction a permit shall be obtained from the U. S. Corps of Engineers, the Virginia Department of Environmental Quality, and the Virginia Marine Resources Commission (a joint permit application is available from any of these organizations). Furthermore, in riverine areas, notification of the proposal shall be given by the applicant to all affected adjacent jurisdictions, the Department of Conservation and Recreation (Division of Dam Safety and Floodplain Management), other required agencies, and the Federal Emergency Management Agency.

J. The flood carrying capacity within an altered or relocated portion of any watercourse shall be maintained.

Section 4.3 - Elevation and Construction Standards [44 CFR 60.3]

In all identified flood hazard areas where base flood elevations have been provided in the FIS or generated by a certified professional in accordance with Article III, Section 3.1.A.3 the following provisions shall apply:

A. Residential Construction

New construction or substantial improvement of any residential structure (including manufactured homes) in Zones A1-30, AE, AH, and A with detailed base flood elevations shall have the bottom of the lowest horizontal structural member of the lowest floor, including basement, elevated to or above the base flood level. See Article III, Section 3.1.A.5 and Article III, Section 3.1.A.6 for requirements in the Coastal A, VE, and V zones.

B. Non-Residential Construction

1. New construction or substantial improvement of any commercial, industrial, or non-residential building (or manufactured home) shall have the bottom of the lowest horizontal structural member of the lowest floor, including basement, elevated to or above the base flood level. See Article III, Section 3.1.A.5 and Article III, Section 3.1.A.6 for requirements in the Coastal A, VE, and V zones.

2. Non-residential buildings located in all A1-30, AE, and AH zones may be floodproofed in lieu of being elevated provided that all areas of the building components below the elevation corresponding to the BFE plus one foot are water tight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A registered professional engineer or architect shall certify that the standards of this subsection are satisfied. Such certification, including the specific elevation (in relation to mean sea level) to which such structures are floodproofed, shall be maintained by (title of community administrator).

C. Space Below the Lowest Floor

In zones A, AE, AH, AO, and A1-A30, fully enclosed areas, of new construction or substantially improved structures, which are below the regulatory flood protection elevation shall:

1. Not be designed or used for human habitation, but shall be used solely for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. Access to the enclosed area shall be the minimum necessary to allow for parking of vehicles (garage door) or limited storage of maintenance equipment (standard exterior door), or entry to the living area (stairway or elevator).

2. Be constructed entirely of flood resistant materials below the regulatory flood protection elevation;

3. Include measures to automatically equalize hydrostatic flood forces on walls by allowing for the entry and exit of floodwaters. To meet this requirement, the openings must either be certified by a professional engineer or architect or meet the following minimum design criteria:

   a. Provide a minimum of two openings on different sides of each enclosed area subject to flooding.

b. The total net area of all openings must be at least one (1) square inch for each square foot of enclosed area subject to flooding.

c. If a building has more than one enclosed area, each area must have openings to allow floodwaters to automatically enter and exit.

d. The bottom of all required openings shall be no higher than one (1) foot above the adjacent grade.

e. Openings may be equipped with screens, louvers, or other opening coverings or devices, provided they permit the automatic flow of floodwaters in both directions.

f. Foundation enclosures made of flexible skirting are not considered enclosures for regulatory purposes, and, therefore, do not require openings. Masonry or wood underpinning, regardless of structural status, is considered an enclosure and requires openings as outlined above.

D. Accessory Structures

1. Accessory structures in the SFHA shall comply with the elevation requirements and other requirements of Article IV, Section 4.3.B or, if not elevated or dry floodproofed, shall:

   a. Not be used for human habitation;

   b. Be limited to no more than 600 square feet in total floor area;

   c. Be useable only for parking of vehicles or limited storage;

   d. Be constructed with flood damage-resistant materials below the base flood elevation;

   e. Be constructed and placed to offer the minimum resistance to the flow of floodwaters;

   f. Be anchored to prevent flotation;

   g. Have electrical service and mechanical equipment elevated to or above the base flood elevation;

   h. Shall be provided with flood openings which shall meet the following criteria:

      (1) There shall be a minimum of two flood openings on different sides of each enclosed area; if a building has more than one enclosure below the lowest floor, each such enclosure shall have flood openings on exterior walls.

      (2) The total net area of all flood openings shall be at least 1 square inch for each

square foot of enclosed area (non-engineered flood openings), or the flood openings shall be engineered flood openings that are designed and certified by a licensed professional engineer to automatically allow entry and exit of floodwaters; the certification requirement may be satisfied by an individual certification or an Evaluation Report issued by the ICC Evaluation Service, Inc.

(3) The bottom of each flood opening shall be 1 foot or less above the higher of the interior floor or grade, or the exterior grade, immediately below the opening.

(4) Any louvers, screens or other covers for the flood openings shall allow the automatic flow of floodwaters into and out of the enclosed area.

E. Standards for Manufactured Homes and Recreational Vehicles

1. In zones A, AE, AH, and AO, all manufactured homes placed, or substantially improved, on individual lots or parcels, must meet all the requirements for new construction, including the elevation and anchoring requirements in Article III, Section 3.1.A.6 and Article IV, Sections 4.2 and 4.3.

2. All recreational vehicles placed on sites must either:

   a. Be on the site for fewer than 180 consecutive days, be fully licensed and ready for highway use (a recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices and has no permanently attached additions); or

   b. Meet all the requirements for manufactured homes in Article IV, Section 4.3.E.1.

<u>Section 4.4 - Standards for Subdivision Proposals</u>

A. All subdivision proposals shall be consistent with the need to minimize flood damage;

B. All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize flood damage;

C. All subdivision proposals shall have adequate drainage provided to reduce exposure to flood hazards, and

D. Base flood elevation data shall be obtained from other sources or developed using detailed methodologies, hydraulic and hydrologic analysis, comparable to those contained in a Flood Insurance Study for subdivision proposals and other proposed development proposals (including manufactured home parks and subdivisions) that exceed fifty lots or five acres, whichever is the lesser.

ARTICLE V – EXISTING STRUCTURES IN FLOODPLAIN AREAS

Any structure or use of a structure or premises must be brought into conformity with these provisions when it is changed, repaired, or improved unless one of the following exceptions is established before the change is made:

A. The floodplain manager has determined that:

   1. Change is not a substantial repair or substantial improvement AND

   2. No new square footage is being built in the floodplain that is not compliant AND

   3. No new square footage is being built in the floodway AND

   4. The change complies with this ordinance and the VA USBC AND

   5. The change, when added to all the changes made during a rolling 5-year period does not constitute 50% of the structure's value.

B. The changes are required to comply with a citation for a health or safety violation.

C. The structure is a historic structure and the change required would impair the historic nature of the structure.

ARTICLE VI - VARIANCES: FACTORS TO BE CONSIDERED [44 CFR 60.6]

Variances shall be issued only upon (i) a showing of good and sufficient cause, (ii) after the Board of Zoning Appeals has determined that failure to grant the variance would result in exceptional hardship to the applicant, and (iii) after the Board of Zoning Appeals has determined that the granting of such variance will not result in (a) unacceptable or prohibited increases in flood heights, (b) additional threats to public safety, (c) extraordinary public expense; and will not (d) create nuisances, (e) cause fraud or victimization of the public, or (f) conflict with local laws or ordinances.

While the granting of variances generally is limited to a lot size less than one-half acre, deviations from that limitation may occur. However, as the lot size increases beyond one-half acre, the technical justification required for issuing a variance increases. Variances may be issued by the Board of Zoning Appeals for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, in conformance with the provisions of this Section.

Variances may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that the criteria of this Section are met, and the structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

In passing upon applications for variances, the Board of Zoning Appeals shall satisfy all relevant factors and procedures specified in other sections of the zoning ordinance and consider the following additional factors:

A. The danger to life and property due to increased flood heights or velocities caused by encroachments. No variance shall be granted for any proposed use, development, or activity within any Floodway District that will cause any increase in the one percent (1%) chance flood elevation.

B. The danger that materials may be swept on to other lands or downstream to the injury of others.

C. The proposed water supply and sanitation systems and the ability of these systems to prevent disease, contamination, and unsanitary conditions.

D. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owners.

E. The importance of the services provided by the proposed facility to the community.

F. The requirements of the facility for a waterfront location.

G. The availability of alternative locations not subject to flooding for the proposed use.

H. The compatibility of the proposed use with existing development and development anticipated in the foreseeable future.

I. The relationship of the proposed use to the comprehensive plan and floodplain management program for the area.

J. The safety of access by ordinary and emergency vehicles to the property in time of flood.

K. The expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters expected at the site.

L. The historic nature of a structure. Variances for repair or rehabilitation of historic structures may be granted upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.

M. No variance shall be granted for an accessory structure exceeding 600 square feet. (Note: See Article IV, Section 4.3.D.2).

N. Such other factors which are relevant to the purposes of this Ordinance.

The Board of Zoning Appeals may refer any application and accompanying documentation pertaining to any request for a variance to any engineer or other qualified person or agency for technical assistance in evaluating the proposed project in relation to flood heights and velocities, and the adequacy of the plans for flood protection and other related matters.

Variances shall be issued only after the Board of Zoning Appeals has determined that the granting of such will not result in (a) unacceptable or prohibited increases in flood heights, (b) additional threats to public safety, (c) extraordinary public expense; and will not (d) create nuisances, (e) cause fraud or victimization of the public, or (f) conflict with local laws or ordinances.

Variances shall be issued only after the Board of Zoning Appeals has determined that the variance will be the minimum required to provide relief.

The Board of Zoning Appeals shall notify the applicant for a variance, in writing that the issuance of a variance to construct a structure below the one percent (1%) chance flood elevation (a) increases the risks to life and property and (b) will result in increased premium rates for flood insurance.

A record shall be maintained of the above notification as well as all variance actions, including justification for the issuance of the variances. Any variances that are issued shall be noted in the annual or biennial report submitted to the Federal Insurance Administrator.

ARTICLE VII - GLOSSARY [44 CFR 59.1]

A. Appurtenant or accessory structure - A non-residential structure which is on the same parcel of property as the principal structure and the use of which is incidental to the use of the principal structure. Accessory structures are not to exceed 600 square feet.

B. Base flood - The flood having a one percent chance of being equalled or exceeded in any given year.

C. Base flood elevation - The water surface elevations of the base flood, that is, the flood level that has a one percent or greater chance of occurrence in any given year. The water surface elevation of the base flood in relation to the datum specified on the community's Flood Insurance Rate Map. For the purposes of this ordinance, the base flood is the 1% annual chance flood.

D. Basement - Any area of the building having its floor sub-grade (below ground level) on all sides.

E. Board of Zoning Appeals - The board appointed to review appeals made by individuals with regard to decisions of the Zoning Administrator in the interpretation of this ordinance.

F. Coastal A Zone - Flood hazard areas that have been delineated as subject to wave heights between 1.5 feet and 3 feet.

G. Development - Any man-made change to improved or unimproved real estate, including, but not limited to, buildings or other structures, temporary structures, mining, dredging, filling, grading, paving, excavation, drilling or other land-disturbing activities or permanent or temporary storage of equipment or materials.

H. Elevated building - A non-basement building built to have the lowest floor elevated above the ground level by means of solid foundation perimeter walls, pilings, or columns (posts and piers).

I. <u>Encroachment</u> - The advance or infringement of uses, plant growth, fill, excavation, buildings, permanent structures or development into a floodplain, which may impede or alter the flow capacity of a floodplain.

J. <u>Existing construction</u> - For the purposes of the insurance program, structures for which the "start of construction" commenced before the effective date of the FIRM or before January 1, 1975 for FIRMs effective before that date. "Existing construction" may also be referred to as "existing structures" and "pre-FIRM."

K. <u>Flood or flooding</u> -

1. A general or temporary condition of partial or complete inundation of normally dry land areas from:
   a. The overflow of inland or tidal waters; or,
   b. The unusual and rapid accumulation or runoff of surface waters from any source.
   c. Mudflows which are proximately caused by flooding as defined in paragraph (1)(b) of this definition and are akin to a river of liquid and flowing mud on the surfaces of normally dry land areas, as when earth is carried by a current of water and deposited along the path of the current.
2. The collapse or subsidence of land along the shore of a lake or other body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels or suddenly caused by an unusually high water level in a natural body of water, accompanied by a severe storm, or by an unanticipated force of nature such as flash flood or an abnormal tidal surge, or by some similarly unusual and unforeseeable event which results in flooding as defined in paragraph 1 (a) of this definition.

L. <u>Flood Insurance Rate Map (FIRM)</u> - an official map of a community, on which the Federal Emergency Management Agency has delineated both the special hazard areas and the risk premium zones applicable to the community. A FIRM that has been made available digitally is called a Digital Flood Insurance Rate Map (DFIRM).

M. <u>Flood Insurance Study (FIS)</u> - a report by FEMA that examines, evaluates and determines flood hazards and, if appropriate, corresponding water surface elevations, or an examination, evaluation and determination of mudflow and/or flood-related erosion hazards.

N. <u>Floodplain or flood-prone area</u> - Any land area susceptible to being inundated by water from any source.

O. <u>Floodproofing</u> - any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents.

P. <u>Floodway</u> - The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot at any point within the community.

Q. <u>Freeboard</u> - A factor of safety usually expressed in feet above a flood level for purposes of floodplain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization in the watershed.

R. Functionally dependent use - A use which cannot perform its intended purpose unless it is located or carried out in close proximity to water. This term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and shipbuilding and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

S. Highest adjacent grade - the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

T. Historic structure - Any structure that is:

1. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
2. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
3. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of the Interior; or,
4. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
   a. By an approved state program as determined by the Secretary of the Interior; or,
   b. Directly by the Secretary of the Interior in states without approved programs.

U. Hydrologic and Hydraulic Engineering Analysis - Analyses performed by a licensed professional engineer, in accordance with standard engineering practices that are accepted by the Virginia Department of Conservation and Recreation and FEMA, used to determine the base flood, other frequency floods, flood elevations, floodway information and boundaries, and flood profiles.

V. Letters of Map Change (LOMC) - A Letter of Map Change is an official FEMA determination, by letter, that amends or revises an effective Flood Insurance Rate Map or Flood Insurance Study. Letters of Map Change include:

Letter of Map Amendment (LOMA) - An amendment based on technical data showing that a property was incorrectly included in a designated special flood hazard area. A LOMA amends the current effective Flood Insurance Rate Map and establishes that a land as defined by meets and bounds or structure is not located in a special flood hazard area.

Letter of Map Revision (LOMR) - A revision based on technical data that may show changes to flood zones, flood elevations, floodplain and floodway delineations, and planimetric features. A Letter of Map Revision Based on Fill (LOMR-F), is a determination that a structure or parcel of land has been elevated by fill above the base flood elevation and is, therefore, no longer exposed to flooding associated with the base flood. In order to qualify for this determination, the fill must have been permitted and placed in accordance with the community's floodplain management regulations.

Conditional Letter of Map Revision (CLOMR) - A formal review and comment as to whether a proposed flood protection project or other project complies with the minimum NFIP requirements for such projects with respect to delineation of special flood hazard areas. A CLOMR does not revise the effective Flood Insurance Rate Map or Flood Insurance Study.

W. Lowest adjacent grade - the lowest natural elevation of the ground surface next to the walls of a structure.

X. Lowest floor - The lowest floor of the lowest enclosed area (including basement). An unfinished or flood-resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area is not considered a building's lowest floor; provided, that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of Federal Code 44CFR §60.3.

Y. Manufactured home - A structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. For floodplain management purposes the term "manufactured home" also includes park trailers, travel trailers, and other similar vehicles placed on a site for greater than 180 consecutive days.

Z. Manufactured home park or subdivision - a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

AA. Mean Sea Level – for purposes of the National Flood Insurance Program, the National Geodetic Vertical Datum (NGVD) of 1929 or the North American Vertical Datum (NAVD) of 1988 to which base flood elevations shown on a community's FIRM are referenced.

BB. New construction - For the purposes of determining insurance rates, structures for which the "start of construction" commenced on or after March 4, 1988, and includes any subsequent improvements to such structures. For floodplain management purposes, new construction means structures for which the start of construction commenced on or after the effective date of a floodplain management regulation adopted by a community and includes any subsequent improvements to such structures.

CC. Post-FIRM structures - A structure for which construction or substantial improvement occurred on or after March 4, 1988

DD. Pre-FIRM structures - A structure for which construction or substantial improvement occurred before March 4, 1988.

EE. Primary frontal dune - a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms.

FF. Recreational vehicle - A vehicle which is:

1. Built on a single chassis;
2. 400 square feet or less when measured at the largest horizontal projection;
3. Designed to be self-propelled or permanently towable by a light duty truck; and,
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational camping, travel, or seasonal use.

GG. Repetitive Loss Structure - A building covered by a contract for flood insurance that has incurred flood-related damages on two occasions in a 10-year period, in which the cost of the repair, on the average, equalled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

HH. Severe repetitive loss structure - a structure that: (a) Is covered under a contract for flood insurance made available under the NFIP; and (b) Has incurred flood related damage - (i) For which 4 or more separate claims payments have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or (ii) For which at least 2 separate claims payments have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

II. Shallow flooding area - A special flood hazard area with base flood depths from one to three feet where a clearly defined channel does not exist, where the path of flooding is unpredictable and indeterminate, and where velocity flow may be evident. Such flooding is characterized by ponding or sheet flow.

JJ. Special flood hazard area - The land in the floodplain subject to a one (1%) percent or greater chance of being flooded in any given year as determined in Article 3, Section 3.1 of this ordinance.

KK. Start of construction - For other than new construction and substantial improvement, under the Coastal Barriers Resource Act (P.L. – 97-348), means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, substantial improvement or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of the construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

LL. Structure - for floodplain management purposes, a walled and roofed building, including a gas or liquid storage tank, that is principally above ground, as well as a manufactured home.

MM. Substantial damage - Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. It also means flood-related damages sustained by a structure on two occasions in a 10-year period, in which the cost of the repair, on the average, equals or exceeds 25 percent of the market value of the structure at the time of each such flood event.

NN. Substantial improvement - Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement. The term does not, however, include either:

1. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions, or
2. Any alteration of a historic structure, provided that the alteration will not preclude the structure's continued designation as a historic structure.
3. Historic structures undergoing repair or rehabilitation that would constitute a substantial improvement as defined above, must comply with all ordinance requirements that do not preclude the structure's continued designation as a historic structure. Documentation that a specific ordinance requirement will cause removal of the structure from the National Register of Historic Places or the State Inventory of Historic places must be obtained from the Secretary of the Interior or the State Historic Preservation Officer. Any exemption from ordinance requirements will be the minimum necessary to preserve the historic character and design of the structure.

OO. Violation - the failure of a structure or other development to be fully compliant with the community's floodplain management regulations. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance required in this ordinance is presumed to be in violation until such time as that documentation is provided.

PP. Watercourse - A lake, river, creek, stream, wash, channel or other topographic feature on or over which waters flow at least periodically. Watercourse includes specifically designated areas in which substantial flood damage may occur.

ARTICLE VIII – ENACTMENT

Enacted and ordained this 26th day of May, 2022. This ordinance, Article 23 of Lancaster County, Virginia, Zoning Ordinance, shall become effective upon passage.

County Administrator
Title

Dan H. Mell
Signature

COUNTY OF LANCASTER

FOUNDED 1651 IN VIRGINIA

LANCASTER COURTHOUSE
8311 MARY BALL ROAD
LANCASTER, VIRGINIA 22503

804-462-5129
804-462-0031 (FAX)
www.lancova.com

Don G. Gill
County Administrator

BOARD OF SUPERVISORS
Craig H. Giese, 1st District
Ernest W. Palin, Jr., 2nd District
Jason D. Bellows, 3rd District
William R. Lee, 4th District
William C. Smith, 5th District

November 9, 2023

Virginia Department of Conservation & Recreation
2023 Virginia Community Flood Preparedness Fund – Project Grants
600 East Main Street, 4th Floor
Richmond, VA 23219
Attn: CFPF/RVRF Grant Submittal

RE: Pledge of Agreement for Westland Beach – Windmill Point Shoreline Stabilization Project

To whom it may concern:

The County of Lancaster, which is the applicant organization, is submitting this *Pledge of Agreement* to support its *2023 Virginia Community Flood Preparedness Fund – Project Grants* proposal, Westland Beach – Windmill Point Shoreline Stabilization Project.

The County of Lancaster is committing project funding in cash, in the amount of $659,735.70, from the Lancaster County FY23 Adopted Capital Improvement Budget Project. The $659,735.70 is 30% of the total project amount ($2,319,119.00). The County is requesting $1,623,383.30 in grant funding. Lancaster County will pay the match contribution during the agreement period.

Thank you for considering our *2023 Virginia Community Flood Preparedness Fund – Project Grants* proposal.

Sincerely,

Don G. Gill

Don G. Gill
County Administrator

COUNTY OF LANCASTER

FOUNDED 1651 IN VIRGINIA

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Virginia Department of Conservation & Recreation
2023 Virginia Community Flood Preparedness Fund – Project Grants
600 East Main Street, 4th Floor
Richmond, VA 23219
Attn: CFPF/RVRF Grant Submittal

RE: Pledge of Agreement for Westland Beach – Windmill Point Shoreline Stabilization Project

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Thank you for considering our *2023 Virginia Community Flood Preparedness Fund – Project Grants* proposal.

Sincerely,

Don G. Gill
County Administrator

VDEM - Lancaster County- Westland Beach - Windmill Point Shoreline

BENEFIT COST ANALYSIS REPORT

BRIC 2022

Contents

BCA SUMMARY

SUB APPLICANT
Lancaster County

LAT/LON
37.6158609, -76.2919770

PROPERTY TYPE
Roads and Bridges

HAZARD TYPE
Coastal V Flood

MITIGATION TYPE
Floodplain and Stream Restoration

DAMAGE AND FREQUENCY
Professional Expected Damages

The Westland Beach-Windmill Point Shoreline Stabilization project will use a multi-faceted approach of armor stone breakwaters, armor spurs and nature-based solutions, including beach nourishment and beach and dune vegetation planting to stabilize 1,324 feet or eroding shoreline along the Rappahannock River.

The project will include the construction of five armor stone breakwaters (180', 240', 220', 90', and 110'), two armor spurs (60' and 50'), and the installation of 18,000 cubic yards of beach nourishment with 42,000 square feet of beach and dune vegetation plantings. All existing concrete debris and stone groins (located channel ward of breakwaters) will be removed to allow for restoration of the beach and a more comprehensive approach to stabilization of the shoreline. The vegetation plantings will include salt meadow cordgrass (spartina patens), American beach grass and Atlantic coastal panic grass. The cost of this stabilization project is estimated to be ~~$2,178,000.00.~~ $2,319,000.00.

Estimated Benefits (B) = $ 7,458,373
Estimated Costs (C) = $ ~~2,178,000.00~~ Estimated Costs updated on November 7, 2023 = $2,319,119.00
BCR (B/C) = ~~3.40~~ Updated BCR (C/C) = 3.22

Benefit-Cost Analysis

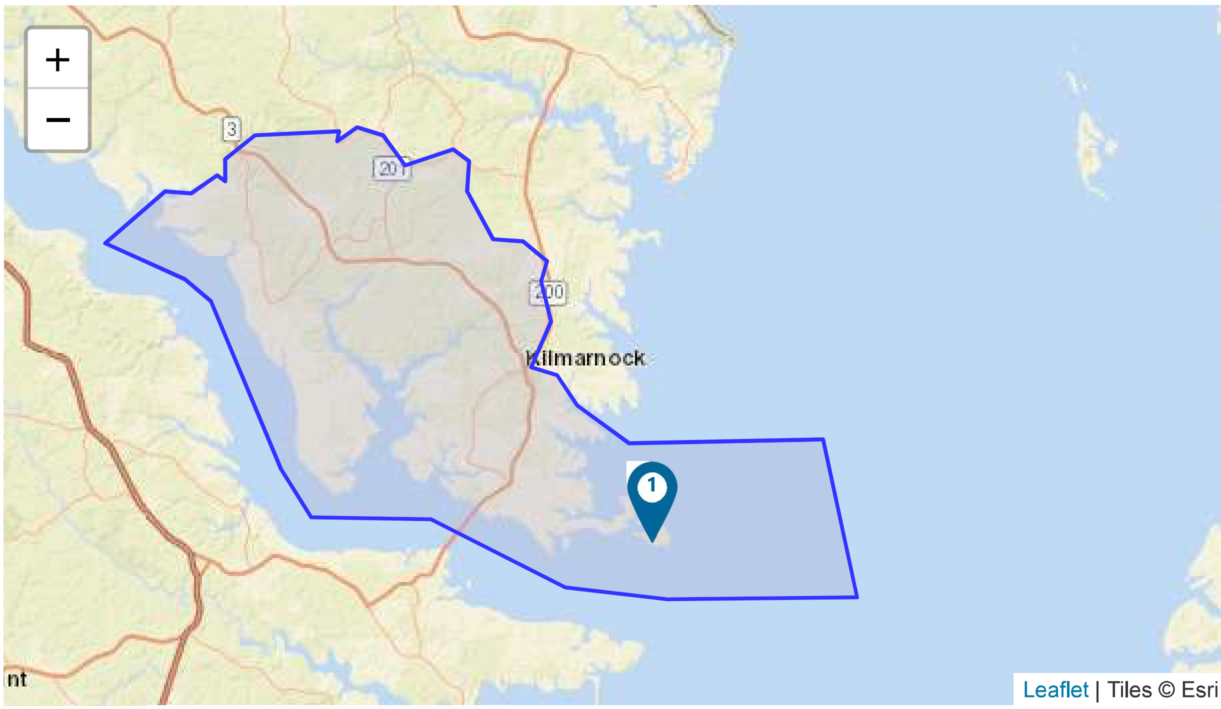
FEMA

Benefit-Cost Calculator

V.6.0 (Build 20221028.1600 | Release Notes)

Benefit-Cost Analysis

Project Name: Lancaster County - Westland Beach - Windmill Point Shoreline



				Using 7% Discount Rate			Using 3% Discount Rate (For FY22 BRIC and FMA only)		
Map Marker ▲	Mitigation Title	Property Type	Hazard	Benefits (B)	Costs (C)	BCR (B/C)	Benefits (B)	Costs (C)	BCR (B/C)
1	Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578		DFA - Coastal V Flood	$ 7,458,373	$2,319,119.00 ~~$ 2,195,299~~	3.22 ~~3.40~~	~~$ 9,347,049~~	~~$ 2,199,680~~	~~4.25~~
TOTAL (SELECTED)				$ 7,458,373	~~$ 2,195,299~~	~~3.40~~	~~$ 9,347,049~~	~~$ 2,199,680~~	~~4.25~~
TOTAL				$ 7,458,373	~~$ 2,195,299~~	~~3.40~~	~~$ 9,347,049~~	~~$ 2,199,680~~	~~4.25~~

Property Configuration

Property Title:	Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578
Property Location:	22578, Lancaster, Virginia
Property Coordinates:	37.61586099752033, -76.291977007078
Hazard Type:	Coastal V Flood
Mitigation Action Type:	Floodplain and Stream Restoration
Property Type:	Roads & Bridges
Analysis Method Type:	Professional Expected Damages

Cost Estimation

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Project Useful Life (years):	12
Project Cost:	$2,178,000
Number of Maintenance Years:	12 Use Default:Yes
Annual Maintenance Cost:	$2,178

Comments

-

Project Useful Life:

Project-specific, the PUL and event RI should be the same to show the complete loss of the asset being protected by the project.

-

Mitigation Project Cost:

Construction costs for the shoreline stabilization project. Design and construction costs for pier. Floodplain and Stream Restoration (FSR) projects are used primarily to reduce flood risk and erosion by providing stable reaches but can also be used to help mitigate drought. These projects restore and enhance the floodplain, stream channel and riparian ecosystem’s natural function. They provide baseflow recharge, water supply augmentation, floodwater storage, water quality renovation, terrestrial and aquatic wildlife habitat, and recreation opportunities, by restoring the site’s soil, hydrology and vegetation conditions that mimic the pre-development, or pre-alteration natural channel/floodplain connectivity.

-

Annual Maintenance Cost:

Based on 1% of the project costs.

Damage Analysis Parameters - Damage Frequency Assessment

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Year of Analysis was Conducted:	2022
Year Property was Built:	1961
Analysis Duration:	62 Use Default:Yes

Roads and Bridges Properties

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Estimated Number of One-Way Traffic Detour Trips per Day:	1,000
Additional Time per One-Way Detour Trip (minutes):	60
Number of Additional Miles:	1
Federal Rate ($):	0.625 Use Default:Yes
Economic Loss Per Day of Loss of Function ($):	36,225

Comments

- **Number of Trips:**
  A minimum of 1,000 cars were assumed as this location is a tourist-attraction.
- **Time per Trip:**
  Dead End Road: 60-minute input was used.
- **Number of Miles:**
  Assumed additional 1 mile of detour since this is a dead end road.

Professional Expected Damages Before Mitigation

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

	ROADS AND BRIDGES	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Impact (days)	Facility and Revenue Loss	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
12.75	365	500,000	0	0	0	0	13,722,125

Comments

-

Damages Before Mitigation:

This 56-year event was used as the baseline for damages before mitigation for this site. This baseline was developed assuming a constant erosion rate based on the 2019-2022 erosion rate estimate, which could reach the roadway shoulder/bridge in 12.75 years (102-ft divided by 8 ft/year = 12.75 years), or about a 7.8-percent annual chance event (1 event or 100% divided by 12.75 years = 7.8%). While this assumption was used for the BCA, field conditions demonstrate that the erosion risk and impacts can change quickly due to one flood. These changes to the river alignment due to a single high flow event highlight the erosion susceptibility of this coast, in proximity to the subject roads and facilities. Optional Damages for potential revenue loss, road damages and total loss to the World Marina structure, and contents.

Annualized Damages Before Mitigation

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
12.75	13,722,125	1,076,244
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	13,722,125	1,076,244

Professional Expected Damages After Mitigation

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

	ROADS AND BRIDGES	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Impact (days)	Facility and Revenue Loss	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
100	365	500,000	0	0	0	0	13,722,125

Comments

-

Damages After Mitigation:

Design of the improvements is intended to provide stream stability and flood damage reduction up to the 100-year recurrence interval event (1-percent annual chance) without significant damage to the improvements.

Annualized Damages After Mitigation

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
100	13,722,125	137,220
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	13,722,125	137,220

Standard Benefits - Ecosystem Services

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

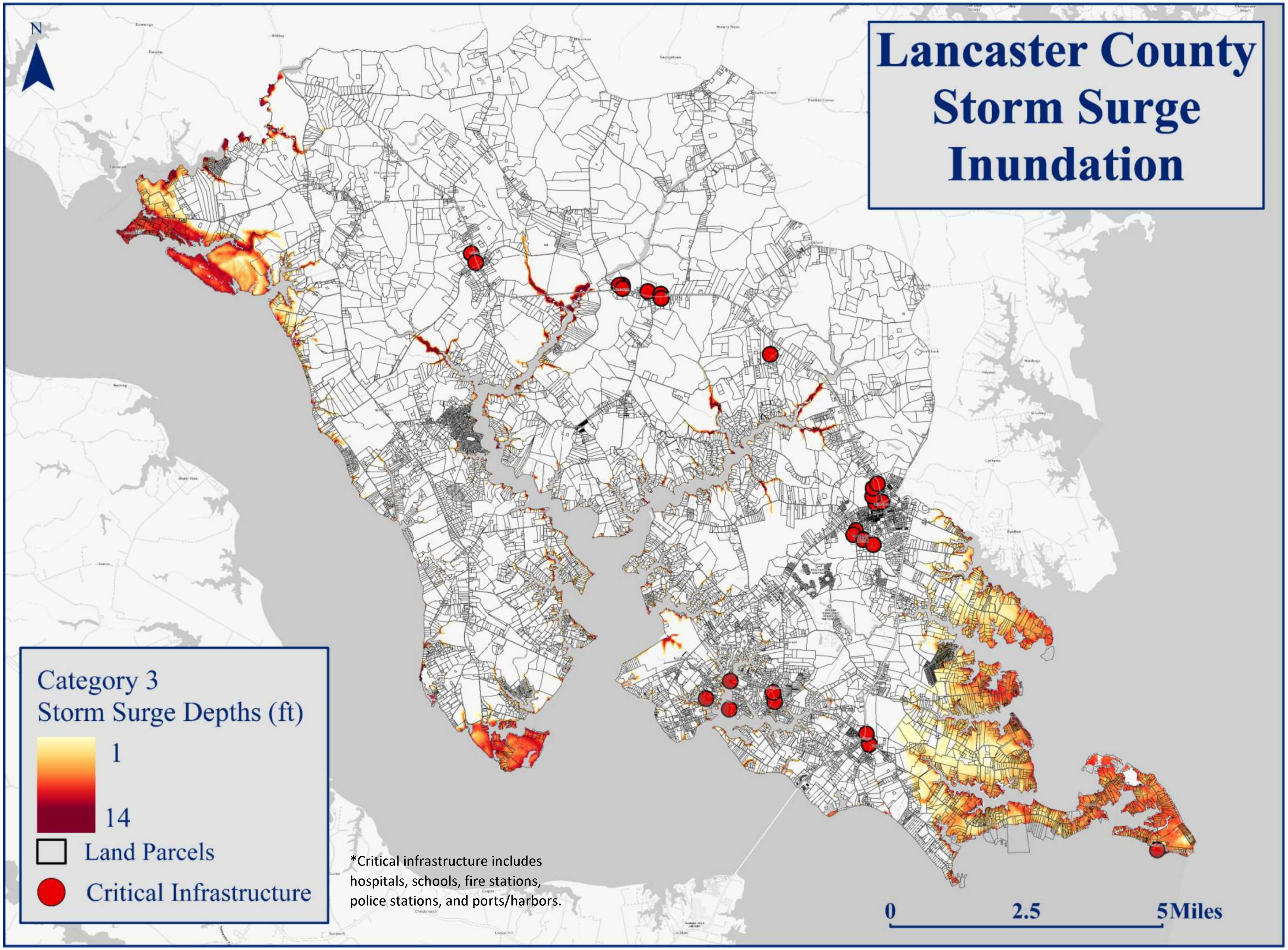
Total Project Area (acres):	0
Percentage of Urban Green Open Space:	0.00%
Percentage of Rural Green Open Space:	0.00%
Percentage of Riparian:	0.00%
Percentage of Coastal Wetlands:	0.00%
Percentage of Inland Wetlands:	0.00%
Percentage of Forests:	0.00%
Percentage of Coral Reefs:	0.00%
Percentage of Shellfish Reefs:	0.00%
Percentage of Beaches and Dunes:	0.00%
Expected Annual Ecosystem Services Benefits:	$0

Benefits-Costs Summary

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Total Standard Mitigation Benefits:	$7,458,373
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$7,458,373
Total Mitigation Project Cost:	~~$2,195,299~~ $2,319,119.00
Benefit Cost Ratio - Standard:	~~3.40~~ 3.22
Benefit Cost Ratio - Standard + Social:	~~3.40~~ 3.22

Appendix A - Storm Surge



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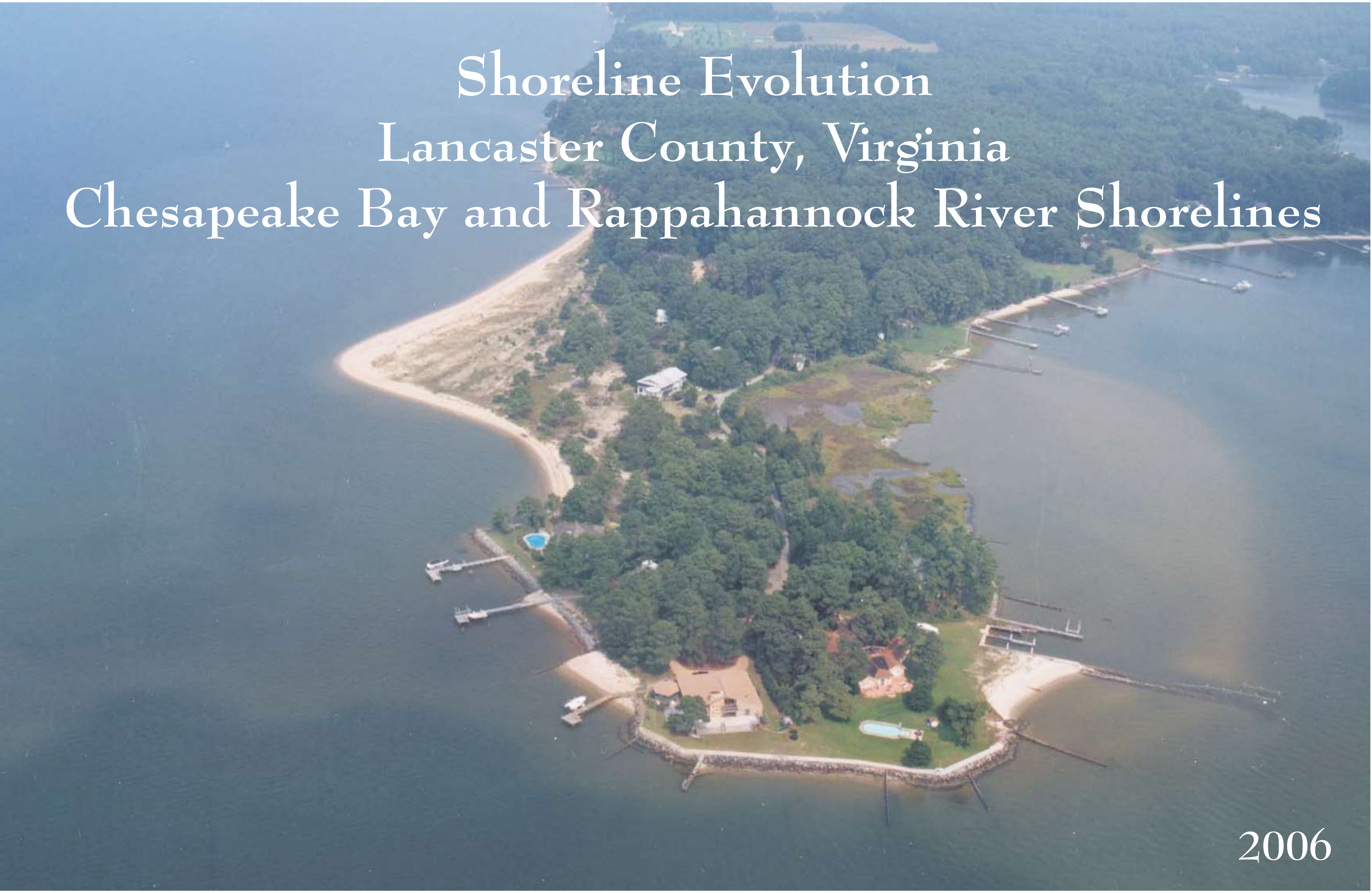
Appendix B - Shoreline Evolution



Shoreline Evolution
Lancaster County, Virginia
Chesapeake Bay and Rappahannock River Shorelines

2006

Shoreline Evolution
Lancaster County, Virginia
Chesapeake Bay and Rappahannock River Shorelines

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2006

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Cover Photo: Photograph of Mosquito Point in Lancaster County. Photo taken by Shoreline Studies Program on 15 August 2003.

I. INTRODUCTION

A. General Information

Shoreline evolution is the change in shore position through time. In fact, it is the material resistance of the coastal geologic underpinnings against the impinging hydrodynamic (and aerodynamic) forces. Along the shores of Chesapeake Bay and Rappahannock River, it is a process-response system. The processes at work include winds, waves, tides and currents, which shape and modify coastlines by eroding, transporting and depositing sediments. The shore line is commonly plotted and measured to provide a rate of change but it is as important to understand the geomorphic patterns of change. Shore analysis provides the basis to know how a particular coast has changed through time and how it might proceed in the future.

The purpose of this report is to document how the dunes along the Bay and river shores of Lancaster (Figure 1) have evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year, and it is this imagery that allows one to assess the geomorphic nature of shore change. Aerial imagery shows how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man through shore hardening or inlet stabilization come to dominate a given shore reach. Most of the change in shore positions will be quantified in this report. Others, particularly very irregular coasts, around inlets, and other complicated areas will be subject to interpretation.

B. Chesapeake Bay Dunes

The primary reason for developing this Shoreline Evolution report is to be able to determine how dunes and beaches along the Bay and river coast of Lancaster have and will evolve through time. The premise is that, in order to determine future trends of these important shore features, one must understand how they got to their present state. Beaches and dunes are protected by the Coastal Primary Sand Dune Protection Act of 1980 (Act)[1]. Research by Hardaway *et al.* (2001) located, classified and enumerated jurisdictional dunes and dune fields within the eight localities listed in the Act. These include the counties of Accomack, Lancaster, Mathews, Northampton and Northumberland and the cities of Hampton, Norfolk and Virginia Beach (Figure 2). Only Chesapeake Bay and river sites were considered in that study.

In 2004, Hardaway *et al*. created the Lancaster County Dune Inventory. That report detailed the location and nature of the jurisdictional primary dunes along the Bay shore of Lancaster County and those results appear in Appendix B. For this study, the positions of the dune sites are presented using the latest imagery in order to see how the sites sit in the context of past shoreline positions. The dune location information has not been field verified since the original visits in 2000. This information is not intended to be used for jurisdictional determinations regarding dunes.

[1]The General Assembly of Virginia enacted the Coastal Primary Sand Dune Protection Act (the Dune Act) in 1980. The Dune Act was originally codified in § 62.1-13.21 to -13.28. The Dune Act is now recodified as Coastal Primary Sand Dunes and Beaches in § 28.2-1400 to -1420.

II. SHORE SETTING

A. Physical Setting

The Bay shoreline of the Lancaster includes about 12 miles of shoreline from Windmill Point to Indian Creek which is the border with Northumberland County. The Rappahannock River shoreline extends from Windmill Point to Morattico Creek which is the border with Richmond County. This includes about 40 miles of tidal shoreline on the Rappahannock River and Corrotoman River. The shorelines along Chesapeake Bay are mostly low sandy banks and marsh. Historic shore change rates vary from 0 ft/yr (inside Little Bay) to -8 ft/yr (Windmill Point) for shore recession along the Bay coast (Byrne and Anderson, 1978). The open Bay coasts have the highest erosion rates. Up the Rappahannock River, shore erosion and accretion rates are highly variable. The point at Morrattico Creek had an erosion rate of -3.1 ft/yr. The shore along the Corrotoman River has erosion and accretion rates between -5 ft/yr and +2 ft/yr. Between the Corrotoman River and Mosquito Point, erosion and accretion occurred between +2.4 ft/yr (Mosquito Point) and -1.6 ft/yr (farther upriver). Some areas showed no change (Byrne and Anderson, 1978). The shore along the Rappahannock River includes high and low sandy banks and occasional marshes.

The coastal geomorphology of the County is a function of the underlying geology and the hydrodynamic forces operating across the land/water interface, the shoreline. The Chesapeake Bay coast of Lancaster County varies between Holocene marsh and Holocene beach sands (Figure 3). Both sediment types overlie the Lynnhaven Member of the Tabb Formation (Late Pleistocene). Along the Rappahannock River, the Sedgefield Member, Shirley Formation and Lynnhaven Member outcrop along the shoreline. In addition, Quaternary alluvium was deposited at Towles Point. The Atlantic Ocean has come and gone numerous times over the Virginia coastal plain over the past million years or so. The effect has been to rework older deposits into beach and lagoonal deposits at the time of the transgressions. The last low stand found the ocean coast about 60 miles to the east when sea level about 300 feet lower than today and the coastal plain was broad and low. The current estuarine system was a meandering series of rivers working their way to the coast. About 15,000 years ago, sea level began to rise and the coastal plain watersheds began to flood. Shorelines began to recede. The slow rise in sea level is one of two primary long-term processes which cause the shoreline to recede; the other is wave action, particularly during storms. As shorelines recede or erode the bank material provides the sands for the offshore bars, beaches and dunes.

Sea level is continuing to rise in the Chesapeake Bay Region. Tide data collected at Gloucester Point on the York River showed that sea level has risen 3.95 mm/yr or 1.3 ft/century (http://www.co-ops.nos.noaa.gov/). Lewisetta on the Potomac River rose 4.85 mm/yr or 1.59 ft/century. Windmill Point and the Rappahannock River are between these two guages. The amount of sea level rise directly effects the reach of storms and their impact on shorelines. Anecdotal evidence of storm surge during Hurricane Isabel, which impacted North Carolina and Virginia on September 18, 2003, put it on par with the storm surge from the "storm of the century" which impacted the lower Chesapeake Bay in August 1933. Boon (2003) showed that even though the tides during the storms were very similar, the difference being only 4 cm or about an inch and a half, the amount of surge was different. The 1933 storm produced a storm surge that was greater than Isabel's by slightly more than a foot. However, analysis of the mean water levels for the months of both August 1933 and September 2003 showed that sea level has risen by 41 cm (1.35 ft) at Hampton Roads in the seventy years between these two storms (Boon, 2003). This is the approximate time span between our earliest aerial imagery (1937) and our most recent (2002), which means the impact of sea level rise to shore change is significant. The beaches, dunes, and nearshore sand bars try to keep pace with the rising sea levels. Five shore reaches are described along the coast of Lancaster County (Figure 4). Reaches I, III, and IV are on the north shore of the Rappahannock River. Reach II is on the Corrotoman River, and Reach V is on the open Chesapeake Bay.

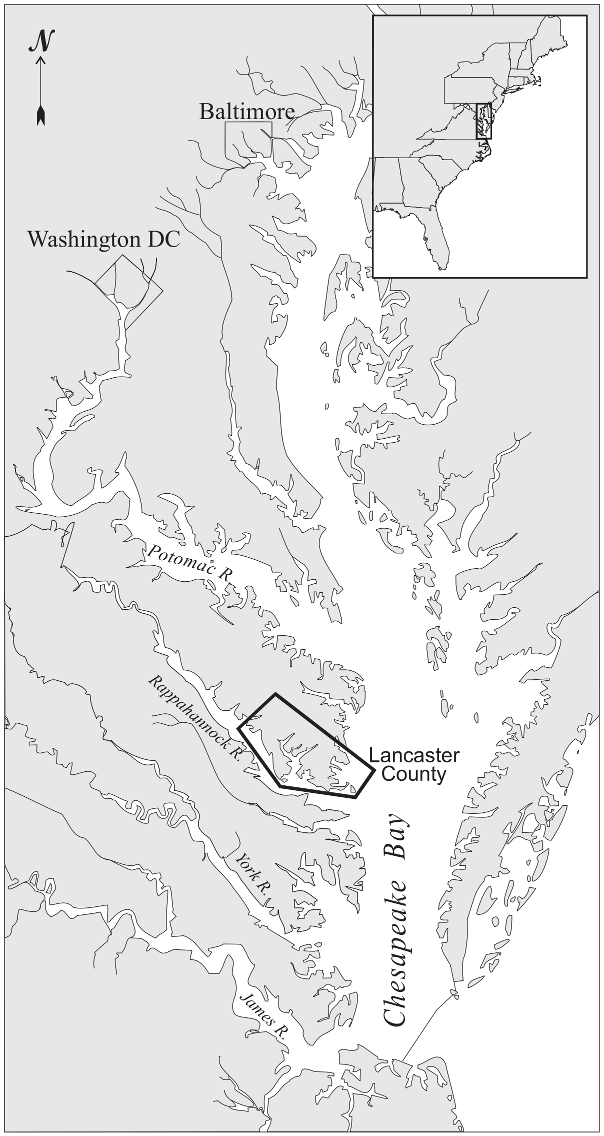


Figure 1. Location of Lancester County within the Chesapeake Bay estuarine system.

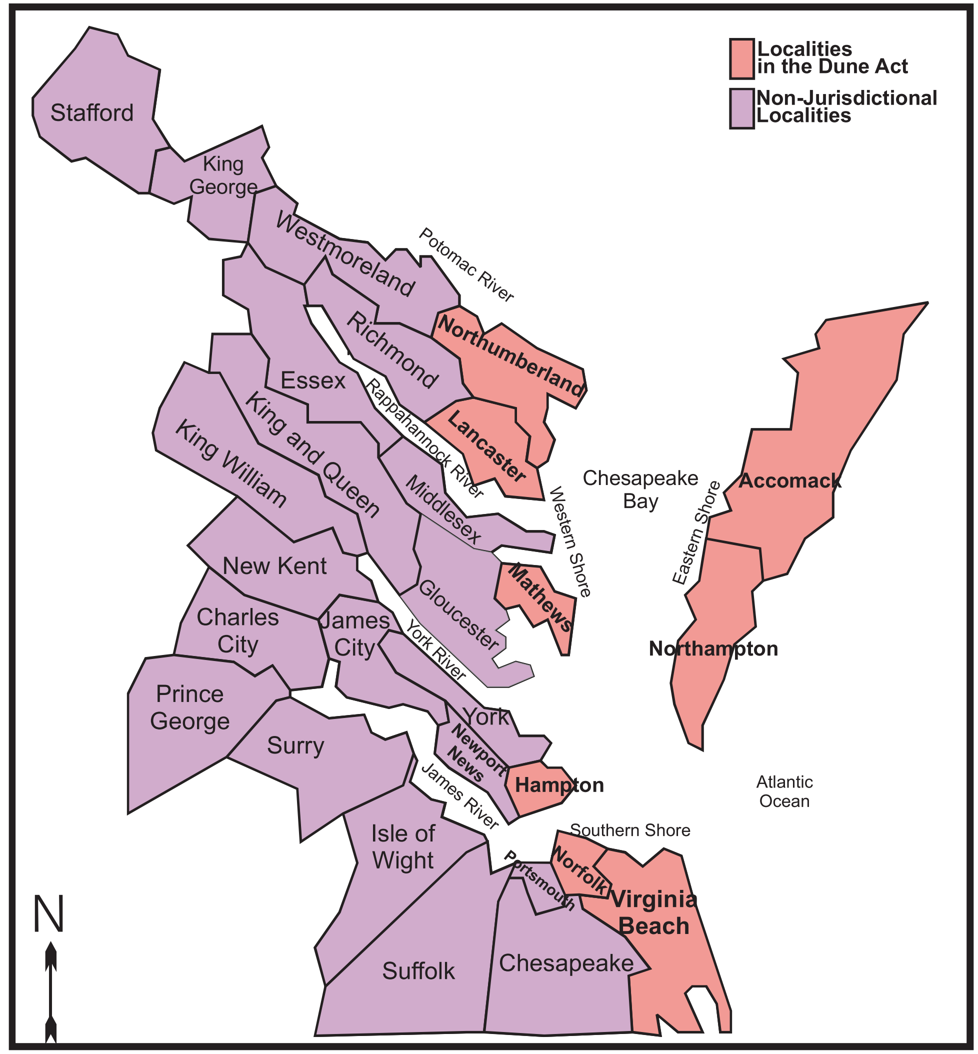
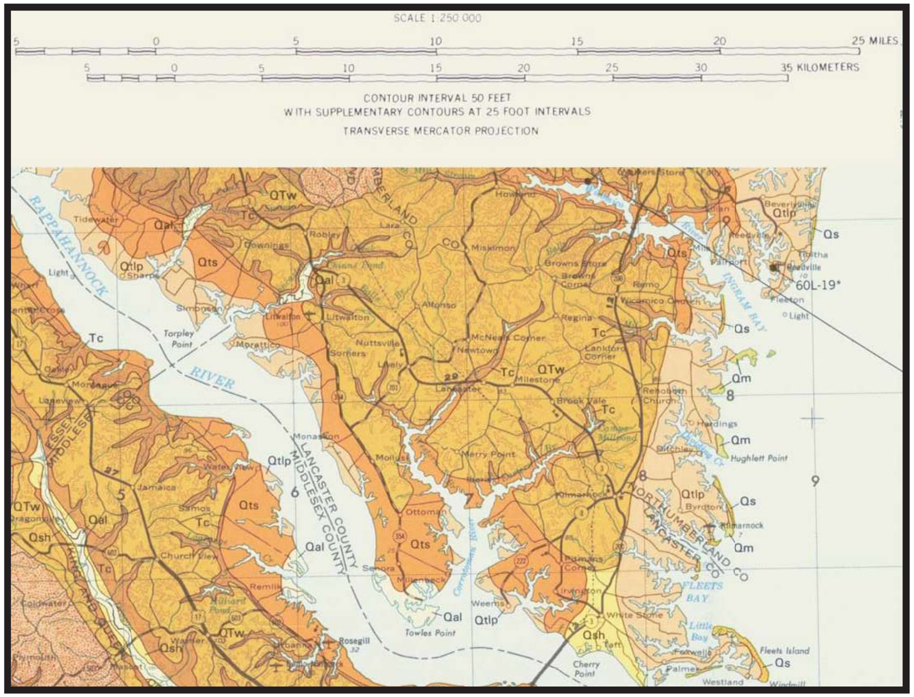


Figure 2. Location of localities in the Dune Act with jurisdictional and non-jurisdictional localities noted.



Qm **Holocene Soft Mud** - Medium to dark-gray, and peat, grayish brown. Comprises sediment of marshes in coastal areas and Chesapeake Bay. Thickness is 0-10 ft.

Qs **Holocene Sand** - Pale gray to light-yellowish gray, fine to coarse, poorly sorted to well sorted, shelly in part; contains angular to rounded fragments and whole valves of mollusks. Comprises deposits of coastal barrier islands and narrow beach-dune ridges bordering brackish-water marshes of Chesapeake Bay. As much as 40 ft in thickness.

Qtlp **Lynnhaven and Poquoson Members, undifferentiated.**

Qts **Sedgefield Member** - Pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt; locally, channel fill at base of unit includes as much as 50 ft of fine to coarse, crossbedded sand and clayey silt and peat containing in situ tree stumps. Sandy bay facies commonly contains Crassostrea biostromes, Mercenaria, Anadara, Polynices, Ensis, and other mollusks. Specimes of the coral Astrangia have yielded estimated uranium-series ages averaging 71,000 +/- 7,000 yrs B.P. (Mixon and others, 1982). Unit constitutes surficial deposit of river- and coast-parallel plains (alt. 20-30 ft) bounded on landward side by Suffolk and Harpersville scarps. Thickness is 0-50 ft.

Qal **Alluvium** - Fine to coarse gravelly sand and sandy gravel, silt, and clay, light- to medium- gray and yellowish-gray. Deposited mainly in channel, point-bar, and flood-plain environments; includes sandy deposits of narrow estuarine beaches, and mud, muddy sand, and peat in swamps and in fresh- and brackish-water marshes bordering tide-water rivers. Grades into colluvium along steeper valley walls at margins of unit. Mostly Holocene but, locally, includes low-lying Pleistocene(?) Terrace deposits. As much as 80 ft thick along major streams.

QTw **Windsor Formation (lower Pleistocene or upper Pliocene)** - Gray and yellow to reddish-brown sand, gravel, silt, and clay. Constitutes surficial deposits if extensive plain (alt. 85-95 ft) seaward of Surry scarp and coeval, fluvial-estuarine terrace west of scarp. Fining-upward sequence beneath plain consists of basal pebbly sand grading upward into crossbedded, quartzose Sand and massive, clayey silt and silty clay; lower and upper parts of sequence were deposited, repectively, in shallow-marine or open-bay and restricted-bay or lagoonal environments. In terraces west of Surry scarp, fluvial-estuarine deposit comprise muddy, coarse, trough-crossbedded sand and gravel grading upward to sandy silt and clay. Unit is 0-40 ft thick.

Qsh **Shirley Formation (middle Pleistocene)** - Light-to dark-gray and brown sand, gravel, silt, clay, and peat. Constitutes surficial deposits of riverine terraces and relict baymouth barriers and bay-floor plains (alt. 35-45 ft) inset below depositional surfaces of the Chuckatuck Formation (Johnson and Peebles, 1984). Upper part of unit is truncated on the east by the Suffolk and Harpersville scarps; locally, lower part extends east of scarps. Fluvial-estuarine facies comprises (1) a lower pebble to boulder sand overlain by (2) fine to coarse sand interbedded with peat and clayey silt rich in organic material, including in situ tree stumps and leaves and seeds of cypress, oak, and hickory, which grades upward to (3) medium- to thick-bedded, clayey and sandy silt and silty clay. Marginal-marine facies in lower James River and lowermost Rappahannock River areas is silty fine sand and sandy silt containing *Crassostrea virginica*, *Mulinia*, *Noetia*, *Mercenaria*, and other mollusks. *Astrangia* from lower Rappahannock River area has yielded a uranium-series age of 184,000 +/- 20,000 years B.P. (Mixon and other, 1982). Thickness is 0-80 ft.

Tc **Chesapeake Group (upper Pliocene to lower Miocene)** - Fine to coarse, quartzose sand, silt, and clay; variably shelly and diatomaceous, deposited mainly in shallow, inner- and middle-shelf waters. Ages of units based in studies of foraminiferal, nannofossil, diatom, and molluscan assemblages in Virginia and adjacent states (Andrews, 1988; Gibson, 1983; Gibson and others, 1980; Poag, 1989; Ward and Blackwelder, 1980; Ward and Krafft, 1984), Includes the following formations (see also sheet 2, figure 1), from youngest to oldest; Chowan River Formation (upper Pliocene), Yorktown Formation (lower upper and lower Pliocene), Eastover Formation (upper Miocene), St. Mary's Formation (upper and middle Miocene), Choptank Formation (middle Miocene), and Calvert Formation (middle and lower Miocene).

Figure 3. Geologic map of Lancaster County (from Mixon *et al*., 1989).

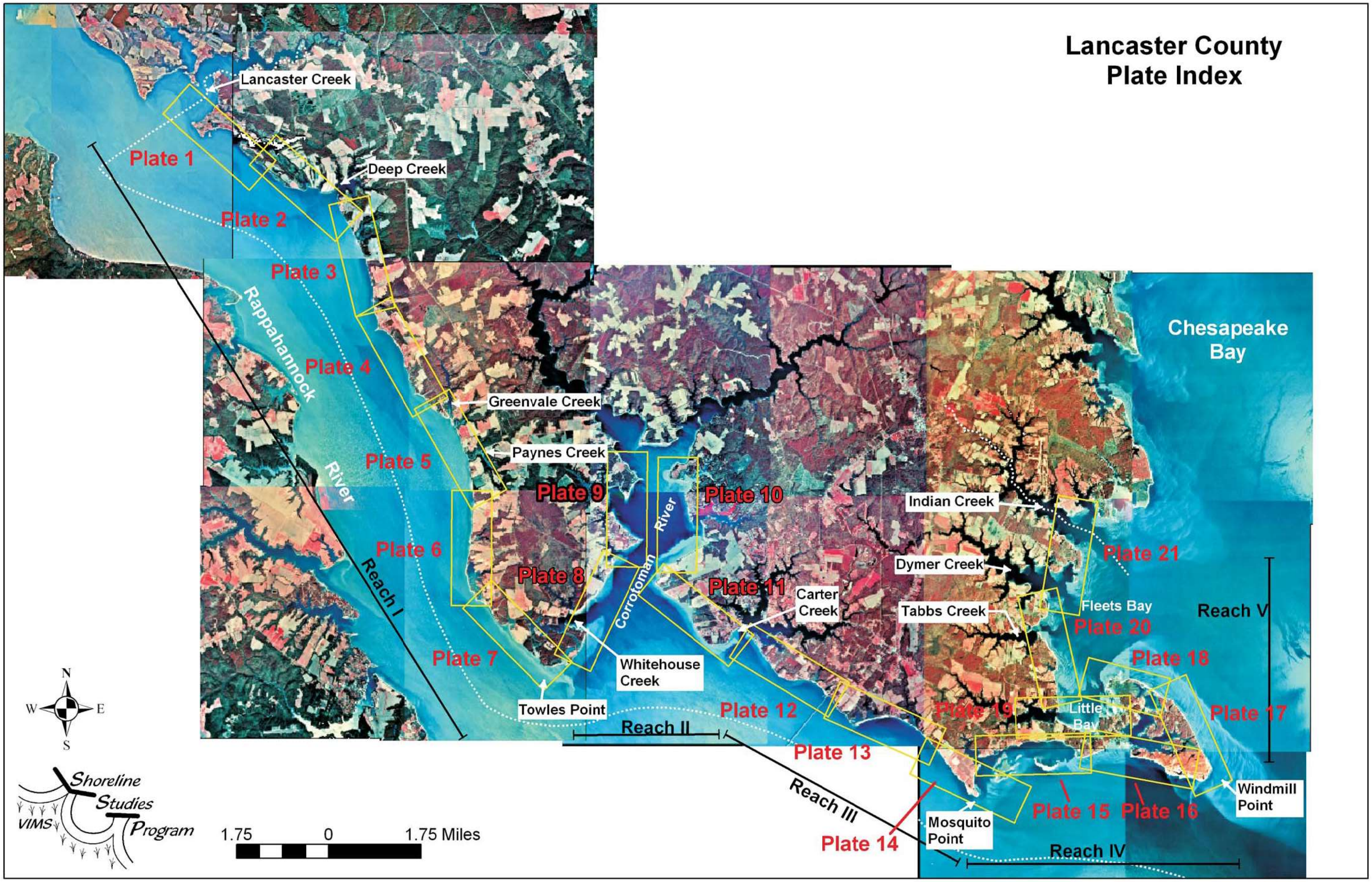


Figure 4. Index of shoreline plates.

B. Hydrodynamic Setting

Mean tide range at Windmill Point in Lancaster County is 1.2 ft (1983-2001). Up the Rappahannock River, mean tide range is 1.3 ft on the Corrotoman River, and 1.6 ft at Bayport which is across the river from Morattico Creek. The wind/wave climate impacting the Bay coast is defined by large fetch exposures to the northeast, east and southeast across Chesapeake Bay. Wind data from Norfolk International Airport reflect the frequency and speeds of wind occurrences from 1960 to 1990 (Table 1). Northeasters can be particularly significant in terms of the impacts of storm surge and waves on beach and dune erosion. The Rappahannock River is more fetch-limited. With the exception of the shore between Mosquito Point and Windmill Point, the coast is impacted by waves from the southwest, south, and southeast across limited open water.

Hurricanes, depending on their proximity and path can also have an impact to the Lancaster County Bay coast. On September 18, 2003, Hurricane Isabel passed through the Virginia coastal plain. The main damaging winds began from the north and shifted to the east then south. Beach and dune erosion were significant. Storm surge and wave action combined to create wrack lines measuring up to 8 ft above MLW around much of the Bay and up the rivers.

Table 1. Summary wind conditions at Norfolk International Airport from 1960-1990.

		WIND DIRECTION								
Wind Speed (mph)	**Mid Range (mph)**	**South**	**South west**	**West**	**North west**	**North**	**North east**	**East**	**South east**	**Total**
< 5	3	5497* 2.12+	3316 1.28	2156 0.83	1221 0.47	35748 13.78	2050 0.79	3611 1.39	2995 1.15	56594 21.81
5-11	8	21083 8.13	15229 5.87	9260 3.57	6432 2.48	11019 4.25	13139 5.06	9957 3.84	9195 3.54	95314 36.74
11-21	16	14790 5.70	17834 6.87	10966 4.23	8404 3.24	21816 8.41	16736 6.45	5720 2.20	4306 1.66	100572 38.77
21-31	26	594 0.23	994 0.38	896 0.35	751 0.29	1941 0.75	1103 0.43	148 0.06	60 0.02	6487 2.5
31-41	36	25 0.01	73 0.03	46 0.02	25 0.01	162 0.06	101 0.04	10 0.00	8 0.00	450 0.17
41-51	46	0 0.00	0 0.00	0 0.00	1 0.00	4 0.00	4 0.00	1 0.00	0 0.00	10 0.00
Total		41989 16.19	37446 14.43	23324 8.99	16834 6.49	70690 27.25	33133 12.77	19447 7.50	16564 6.38	259427 100.00

*Number of occurrences +Percent

III. METHODS

A. Photo Rectification and Shoreline Digitizing

Recent and historic aerial photography was used to estimate, observe, and analyze past shoreline positions and trends involving shore evolution for Lancaster County. Some of the photographs were available in fully geographically referenced (georeferenced) digital form, but most were scanned and orthorectified for this project.

Aerial photos from VIMS Shoreline Studies and Submerged Aquatic Vegetation (SAV) Programs, as well as from United States Geological Survey (USGS) archives were acquired. The years used for the shoreline change analysis included 1937, 1959, 1982, 1994, and 2002. Color aerials were obtained for 1982 and 1994. The 1994 imagery was processed and mosaicked by USGS, while the imagery from 2002 was mosaicked by the Submerged Aquatic Vegetation Program. The aerial photography for the remaining years were mosaicked by the VIMS Shoreline Study Program.

The images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. They were orthorectified to a reference mosaic, the 1994 Digital Orthophoto Quarterquadrangles (DOQQ) from USGS. The original DOQQs were in MrSid format but were converted into .img format as well. ERDAS Orthobase image processing software was used to orthographically correct the individual flightlines using a bundle block solution. Camera lens calibration data was matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. A minimum of four ground control points were used per image, allowing two points per overlap area. The exterior and interior models were combined with a 30-meter resolution digital elevation model (DEM) from the USGS National Elevation Dataset (NED) to produce an orthophoto for each aerial photograph. The orthophotographs that cover each USGS 7.5 minute quadrangle area were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic also in an .img format.

To maintain an accurate match with the reference images, it was necessary to distribute the control points evenly. This can be challenging in areas with little development. Good examples of control points are permanent features such as manmade features and stable natural landmarks. The maximum root mean square (RMS) error allowed is 3 for each block.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background to help delineate and locate the shoreline. For Lancaster' coast, an approximation to mean low water (MLW) was digitized. This often was defined as the "wetted perimeter" on the beach sand as the last high water location. In areas where the shoreline was not clearly delineated on the aerial photography, the location was estimated based on the experience of the digitizer. Digitizing the shoreline brings in, perhaps, the greatest amount of potential error because of the problems of image clarity and definition of shore features. A series of Lancaster dune site profiles are displayed in Figure 5 which shows beach/dune variability. Figure 6 shows the relationship of MHW, MLW and beach/dune system components.

B. Rate of Change Analysis

A custom Arcview extension called "shoreline" was used to analyze shoreline rate of change. A straight, approximately shore parallel baseline is drawn landward of the shoreline. The extension creates equally-spaced transects along the baseline and calculates distance from the baseline at that location to each year's shoreline. The output from the extension are perpendicular transects of a length and interval specified by the user. The extension provides the transect number, the distance from beginning baseline to each transect, and the distance from the baseline to each digitized shoreline in an attribute table. The attribute table is exported to a spreadsheet, and the distances of the digitized shoreline from the baseline are used to determine the rates of change. The rates of change are summarized as mean or average rates and standard deviations for each Plate.

It is very important to note that this extension is only useful on relatively straight shorelines. In areas that have unique shoreline morphology, such as creek mouths and spits, the data collected by this extension may not provide an accurate representation of true shoreline change. The shore change data was manually checked for accuracy. However, where the shoreline and baseline are not parallel, the rates may not give a true indication of the rate of shoreline change.

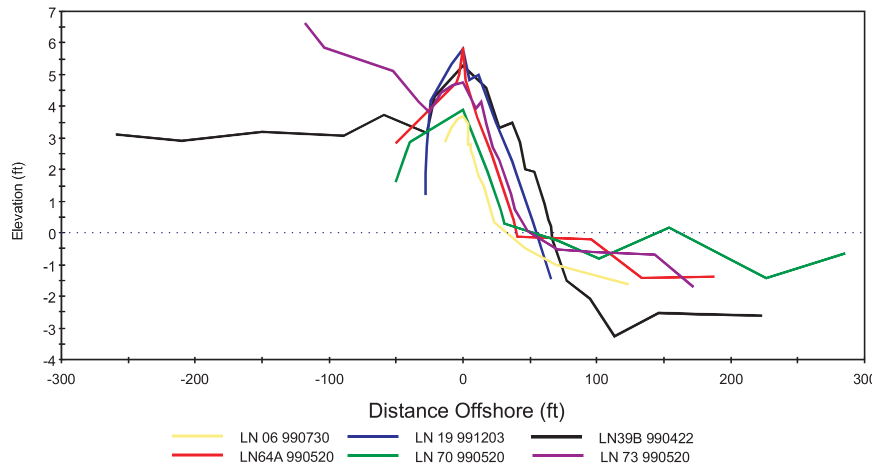


Figure 5. Variability of dune and beach profiles in Lancaster County.

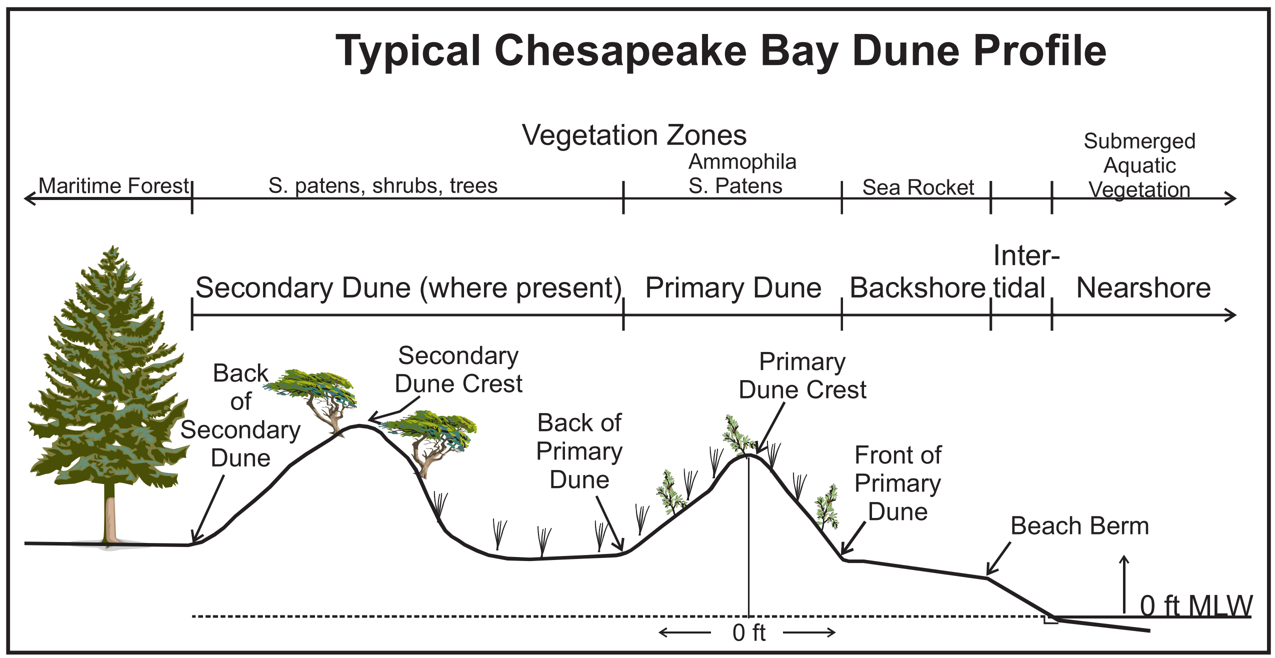


Figure 6. Typical profile of a Chesapeake Bay dune system (from Hardaway *et al.*, 2001).

IV. RESULTS

The Plates referenced in the following sections are in Appendix A. Dune locations are shown on all photo dates for reference only. Dune sites and lengths are positioned accurately on the 2002 photo. Because of changes in coastal morphology, the actual dune site might not have existed earlier. Site information tables are in Appendix B. More detailed information about Chesapeake Bay dunes and individual dune sites in Lancaster County can be found in Hardaway *et al.* (2001) and Hardaway *et al.* (2004). Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits. Some Plates did not have dunes identified on them, but the shore change information can still be valuable from a shoreline management perspective.

A. Reach I

Reach I occurs along the Rappahanock River and extends from the upriver county line at Lancaster Creek down to Towles Point and includes Plates 1 thru 7. The dune sites along Reach I are riverine dunes and generally face southwest. Plates 1 and 2 have no identified dune sites. The long-term trend for shore change (1937-2002) is negative on all three baselines on Plate 1. Baseline 1C has the highest due to its open exposure along the Rappahannock River. Shore trend is erosional along the single baseline on Plate 2.

Plate 3 contains dune sites LN3, LN4 and LN5. Site LN3 came into its present day form by 1994 and is maintained by a series of low groins. Sites LN4 and LN5 have evolved around respective small creek inlets since 1937 and are likely to continue change as the inlet spits and shoals do but stay in the same geomorphic setting. The overall shore change for Plate 3 is slightly erosional.

Plate 4 contains dune sites LN6, LN7, LN8, LN10 and LN11. Sites LN6, LN7 and LN8 reside along a relatively stable curvilinear coast protected on the upriver end by an unnamed point at Monaskon where the remains of an old pier help hold the headland. The sites are separated by breaks in the semi-continuos beach/dune system. Site LN10 and LN11 sit on either side of a man-made point (fill) that has eroded back over the years. Site LN11 has a secondary dune. The advance of these points can be seen in the shore change rates from 1937 to 1959. The long-term shore change trend along Plate 4 is slightly erosional.

Dune sites LN12, LN13, LN15 and LN16 are shown on Plate 5. Site LN12 is very small and developed as an overwash into a small tidal pond. Site LN 13 has been some type of beach feature since 1937 as it resides just upriver of Greenvale Creek. Dredging of Greenvale Creek was first performed in 1965 and sporadically since. Much of the material was placed just downstream of the entrance where it formed a large sandy headland. This headland has eroded away, but it has provided material for a small spit dune site, LN15, at its distal end. Dune site LN16 is a small dune on a spit across the mouth of Payne's Creek. The shoreline along Plate 5 has been relatively stable over time except for an advance and subsequent recession spike at the mouth of Greenvale Creek associated with dredge material disposal.

Plate 6 is the home of nine isolated dune sites labeled LN17 thru LN25. Sites LN17 and LN18 sit on either side of Bulls Creek as creek mouth dunes. Dune sites LN19 to LN24 are erosional remnants of a once more continuous beach/dune shoreline that fronts a marsh spit separating Beach Creek from the Rappahannock River. Most likely this is why this creek got its name. Dune site LN25 was formed as the distal end of the spit as it continued to lengthen. Channel dredging can be seen at the distal end of the spit since 1937 just downriver of LN24. The material was placed downriver which sealed up the natural channel. Site LN25 is attached to land on its downriver end. Grass became established, and a riverine dune developed. The shoreline rates of change are quite variable but show a long-term erosional trend for the baseline shown. The high variability of shore change along the Beach Creek spit is not quantified but can be seen pictorially.

Dune sites LN24 and LN25 also are shown on Plate 7, but no other sites occur. Shoreline change is minimal but slightly erosional. The shore attachment of the Beach Creek spit and its subsequent accretion is reflected between stations 0 and 1000.

B. Reach II

Reach II includes Plates 8, 9 and 10; no identified dune sites exist along this reach. These plates cover the main trunk of the Corrotoman River. Plate 8 has two baselines both showing erosional trends. Baseline 9A on Plate 9 shows a stable coast while baseline 9B is slightly erosional. The short single baseline on Plate 10 is also erosional.

C. Reach III

Reach III extends from the downstream side of the entrance to the Corrotoman River to Mosquito Point. This coast is a series of headland and embayments where the subreaches alternate riverine fetch exposures from the southwest then south. Reach III includes Plates 11 thru 14.

Plate 11 had dune site LN28 and LN29 (discussed in next plate). Site LN28 is a small isolated dune that resides in a small coastal embayment. This embayment can be seen in the imagery as early as 1937. The overall long-term shore trend from Corrotoman Point to Orchard Point has been stable.

Plate 12 has dune sites LN29 and LN32. Site LN29 has resided against the jetty at Crab Point since at least 1959. Site LN32 has developed on the upstream side of the Norris Bridge approach abutment since it was installed in the 1950s. It has developed a series of secondary dune ridges. Long-term shoreline trends along the Plate 12 coast are erosional becoming stable to accretional toward the Norris Bridge, then erosional on the downriver side.

Two dune sites occur along the Plate 13 shoreline, LN34 and LN36. They are the dune segments of a long curvilinear sandy embayment on the downstream side of Cherry Point. Portions of the beach are known locally as White Stone Beach. This is a relatively stable coast as reflected in the near zero net shore change rate for that shore segment. The Plate 13 shoreline is the upsteam, spiral bay section of a larger embayment that extends from Cherry Point downriver to Mosquito Point. Site LN34 is the longer site on Plate 13 and has had a tidal creek near its center breach intermittently over the years. This would cause an ebb shoal to form at its exit. The inlet's position can be seen in 1937 and 1959 imagery, but then the shoal moves downriver forcing the channel alongshore where it exits again and shoals as seen in 1982, 1994 and 2002.

The Plate 14 shoreline is the dowriver extension of the Plate 13 shoreline; it is the tangential section of the embayed shoreline from Cherry Point to Mosquito Point. It has one continuous dune site but with two wind/wave fetch exposures. Site LN39A faces west-southwest up the Rappahannock River while LN39B faces the open Bay. The dune crests vary accordingly with the higher one on LN39B (Bay Influenced) and the lower

one along LN39A (Riverine). Mosquito Point dunes are also a VIMS monitoring site (http://www.vims.edu/physical/research/shoreline). They have evolved over time as Mosquito Point has moved upriver. Most of the Plate 14 shoreline on the Rappahannock River has been slightly erosional over time.

D. Reach IV

Reach IV includes Plate 15 and 16 and extends from Mosquito Point to Windmill Point. The coast includes several island complexes and faces generally southerly. Plate 15 includes the small isolated dune site LN40A along the sheltered mainland coast. LN40A resides against a protruding bulkhead and has been there since 1937. A long spit ending at Deep Hole Point with dune signature existed until 1982. This spit was actually an island in 1937 which became shore connected in 1959 and 1982. The spit was significantly breached by 1994 leaving the distal end an island that has advanced upriver into Deep Hole. Shoreline change rates are for the sheltered embayed coast showing it to be very stable.

The Deep Hole Island spit extended to Windmill Point Creek in 1937 and was an island (Plate 16). The island attached by 1959 creating two spits with one going to Deep Hole Point and the other ending at Windmill Point Creek. This spit receded landward and connected to the mainland by 1982 creating the foundation for site LN43 and has persisted since. Other dune sites along the Plate 16 coast include LN47, LN50, LN51 and LN52. These are all isolated erosional remnants that were once part of a continuous beach/dune system along the south side of Fleet's Island from Windmill Point Creek to Windmill Point (Plate 17). Numerous groins, large and small have been installed over the years, and each of the dune sites resides within a groin field.

E. Reach V

From Windmill Point north to the county line is designated Reach V and includes Plates 17, 18, 19, 20 and 21. This is mostly open bay shoreline that is broken by four smaller tidal creeks including Little Bay, Tabbs Creek, Dymer Creek and Indian Creek. Plate 17 includes Fleets Island with no identified dune sites. Historical erosion is significant at an average of 7 ft/yr. In order to abate erosion, a series of breakwaters were placed along the shoreline between 1994 and 2002. Plate 18 has no dune sites identified either and is also very erosive at about 5 ft/yr. The erosion of Fleets Island has provided sediments to upriver shorelines, particularly the Rappahannock River coast, where spits, islands, beach and dune have evolved and decayed over time. Plate 19 has no dune sites identified and was too irregular to apply the straight line shore change model.

Plate 20 contains dune sites LN64A, LN65, LN66 LN67 and LN68 which all occur along the distal end of Poplar Neck between Dymer Creek and Poplar Creek. These sites evolved and were created as the Bay-exposed end of Poplar Neck eroded. Dune sites LN64A and LN65 were not in existence in 1937. Site LN64 evolved by 1982 between two groins. A pond existed in 1937 and 1959, but it had completely breached by 1982. By 1959, LN65 had found a niche at a small washover into the pond and stabilized. Dune sites LN66 and LN67 evolved as isolated dunes on the mainland side of the old pond shoreline after the pond was breached as seen in 1982 imagery. Site LN68 resides as a small pocket beach bounded by a marsh headland and stone revetment.

Plate 21 shows the end of Fleets Neck which lies between Rones Bay and Indian Creek. Five dune sites occur on Fleets Neck including LN69, LN70, LN71, LN72 and LN73. They were all part of more extensive dune/beach coast in 1937. Over time, shore recession and development fragmented the coast. Each site settled into its own isolated geomorphic setting. Erosion has been most severe on the distal end on the Neck, and Grogg Island has been reduced to almost non-existence.

V. DISCUSSION: NEAR FUTURE TRENDS OF DUNE SITES

The following discussion is a delineation of shoreline trends based on past performance. Ongoing shore development, shore stabilization and/or beach fill, and storms will have local impacts on the near term. "Near Future" is quite subjective and only implies a reasonable expectation for a given shore reach to continue on its historic course for the next 10 to 20 years. In addition, the basis for the predictions are the shorelines digitized on geo-rectified aerial photography which have an error associated with them (see Methods, Section III). Each site's long-term and recent stability as well as a near future prediction are shown in a table in Appendix B. **This data is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.**

A. Reach I

Dune site LN3 has been stable for the last 30 years or so and should remain so for the near term (Figure 7). Site LN4 that occurs across a creek mouth has advanced and receded over time and will most likely continue that trend so it might be deemed erosional in that regard. Site LN5 appears stable as long as the bounding marsh headlands remain intact.

Site LN6 has lost much of its beach and the *Spartina patens* is eroding. The upriver headland also is eroding so this site will continue to recede. Site LN7 resides in a relatively stable coastal setting (Figure 7), and LN8 is reasonably secure within its groinfield. Site LN10 is in an erosional trend, and LN11 appears stable as it resides on the "sheltered" side of the adjacent upriver headland.

Dune site LN12 appears to be in a stable setting with the potential to advance and recede as the creek mouth opens and closes (Figure 7). Site LN13 is fairly stable within the existing groinfield. Although relatively stable now, LN15 may face potential long-term impacts as the bounding marsh headland recede. Site LN16 will most likely continue to recede.

Dune sites LN17 and LN18 are generally receding while LN19 resides in a relatively stable groinfield. Dune sites LN20, LN21, LN22 and LN23 are isolated dune features along a decaying shoreline while LN24 might be stable against the old jetty for the near term. Dune site LN25 will probably maintain its existence as the spit recedes to the mainland.

B. Reach II

No dune sites exist along this reach.

C. Reach III

Site LN28 and LN29 appear stable for the near term in their isolated geomorphic settings.
The Norris bridge has provided a stable coastal setting for LN32 (Figure 8). Dune sites LN34 and LN36 also occur along a stable beach planform though their vegetative extent may transition alongshore (Figure 8). The Mosquito Point dunes, LN39A and LN39B will continue to exist as mobile features an the point migrates upriver (Figure 8).

D. Reach IV

Site LN40A is in a stable setting. Dune site LN43 is transgressing landward while LN47 is stable within its groinfield (Figure 9). Site LN50 is stable to accretionary, and LN51 and LN52 appear stable on either side of the old wharf/groin (Figure 9).

E. Reach V

Along the end of Poplar Neck, LN64A and LN65 appear to be in an erosional/transgressive state while LN66 is stable if not advancing. Site LN67 is presently in a stable configuration but will recede as the adjacent headland erodes, and LN68 appears stable to accretionary for the near term (Figure 9).

Site LN69 is stable between groins, and LN70 is still mobile between a revetment and breakwater but might become stable over time as it evolves between these man-made headlands. A groinfield helps maintain the stability of LN71 and LN72 in a stable embayment. Site LN73 also appears stable between a jetty and groin (Figure 9).

Figure 7. Selected dune site ground photos in Reach I.

Figure 8. Selected dune site ground photos in Reach III.

Figure 9. Selected dune site ground photos in Reach IV and V.

VI. SUMMARY

Shoreline change rates are based on aerial imagery taken at a particular point in time. We have attempted to portray the same shoreline feature for each date along the coast of Lancaster County. Every 500 feet along each baseline on each plate, the rate of change was calculated. The mean or average rate for each plate is shown in Table 2 for five time periods with the long-term rate determined between 1937 and 2002. The total average and standard deviation (Std Dev) for the entire data set of individual rates is also given. The standard deviation shows the relative spread of values about the mean or average. Larger standard deviation values relative to the mean indicates a wider scatter of erosion rates about the mean while lower standard deviation values indicates erosion rates are concentrated near the mean (*i.e.* all the rates calculated for the entire plate were similar).

The largest variability in mean shore change rates and standard deviations were recorded for the shoreline described by baseline 16A. For instance, between 1982 and 1994, the standard deviation was larger than the average rate of change indicating that the overall rate is probably not indicative of the change which occurred on this section of shore. However, not all of the dates for this section of shore had mean shore change rates with large standard deviations. In fact, many standard deviations were equal to or significantly less than the average rate of change, indicating that the shore change rates were relatively consistent for those time periods. In general, the plates influenced by the Chesapeake Bay wave climate (Plates 16-21) had the largest rates of change.

When short time frames are used to determine rates of shoreline change, shore alterations may seem amplified. The rates based on short-time frames can modify the overall net rates of change. Hopefully, the shore change patterns shown in this report along with the aerial imagery will indicate how the coast will evolve based on past trends and can be used to provide the basis for appropriate shoreline management plans and strategies. Dunes and beaches are a valuable resource that should be either maintained, enhanced or created in order to abate shoreline erosion and provide sandy habitat.

Table 2. Summary average shoreline rates of change and their standard deviation for Lancaster County.

	Plate 1A		Plate 1B		Plate 1C		Plate 2		Plate 3		Plate 4		Plate 5		Plate 6	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	-0.3	0.7	0.3	0.7	-0.5	1.4	-0.4	0.9	-0.2	2.8	0.2	4.4	-0.8	1.9	-0.5	1.6
1959-1982	-1.0	0.7	-0.4	0.6	-2.6	1.3	-2.3	1.3	-1.0	1.4	0.1	2.3	1.2	5.9	0.0	1.4
1982-1994	-0.1	0.7	-0.6	0.8	-5.0	3.7	-2.8	1.2	-1.5	2.6	-0.7	2.7	-1.6	2.1	-0.4	2.2
1994-2002	-3.8	1.3	-0.4	0.8	-4.3	4.8	-3.3	2.8	-0.6	3.7	-1.9	4.8	-1.8	4.9	-3.3	1.9
1937-2002	**-0.9**	**0.4**	**-0.2**	**0.3**	**-2.6**	**0.8**	**-1.9**	**0.8**	**-0.8**	**1.0**	**-0.7**	**2.0**	**-0.3**	**1.3**	**-0.9**	**1.4**

	Plate 7		Plate 8A		Plate 8B		Plate 9A		Plate 9B		Plate 10		Plate 11		Plate 12	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	0.3	1.7	-3.4	3.4	-3.0	2.2	0.9	0.6	4.5	1.1	-0.7	1.5	-1.2	1.7	0.0	2.4
1959-1982	-1.8	1.6	-0.7	0.9	-0.7	1.1	-1.9	0.7	-5.9	2.3	-1.3	0.4	-0.4	0.9	-1.2	2.1
1982-1994	1.2	9.7	-1.3	1.5	0.0	1.6	0.1	0.3	3.3	2.6	-0.4	0.7	-0.8	1.4	-0.6	3.5
1994-2002	-3.7	5.6	-1.7	0.9	-1.6	1.7	-0.5	0.6	-4.8	3.1	-1.6	2.6	-0.6	2.4	0.1	1.7
1937-2002	**-0.7**	**1.7**	**-1.9**	**1.3**	**-1.4**	**1.0**	**-0.4**	**0.3**	**-0.6**	**0.5**	**-1.0**	**0.5**	**-0.8**	**0.6**	**-0.5**	**1.0**

	Plate 13		Plate 14		Plate 15		Plate 16A		Plate 16B		Plate 17		Plate 18		Plate 20	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	-0.7	1.0	-0.2	5.5	0.5	0.9	-5.7	8.6	-2.1	5.0	-9.6	1.3	-3.3	4.3	-2.9	2.8
1959-1982	-1.2	1.6	-0.4	3.5	-0.6	0.9	-14.4	7.4	-0.7	3.4	-6.8	3.6	-4.3	3.6	-3.0	2.4
1982-1994	-1.8	2.4	-2.0	4.8	-0.9	1.7	-20.1	27.7	-1.0	2.1	-4.3	7.1	-9.3	11.7	-1.4	3.9
1994-2002	0.9	2.6	2.7	4.1	1.1	3.4	-3.0	1.8	-0.4	2.3	-1.8	5.2	-1.6	9.9	-1.8	2.5
1937-2002	**-0.9**	**1.0**	**-0.3**	**1.7**	**-0.1**	**0.6**	**-11.1**	**4.5**	**-1.2**	**1.5**	**-6.7**	**2.0**	**-4.6**	**2.4**	**-2.5**	**1.8**

VII. REFERENCES

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APPENDIX A

For each Plate shown on Figure 4 (Page 4), Appendix A contains orthorectified aerial photography flown in 1937, 1959, 1982, 1994, and 2002. Also shown are the digitized shorelines, identified dune sites, and an arbitrarily created baseline. A plot shows only the relative locations of the shorelines while another one depicts the rate of shore change between dates. A summary of the average Plate rate of change in ft/yr as well as the standard deviation for each rate is also shown.

This data is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

Plate 1	**Plate 8**	**Plate 15**
Plate 2	**Plate 9**	**Plate 16**
Plate 3	**Plate 10**	**Plate 17**
Plate 4	**Plate 11**	**Plate 18**
Plate 5	**Plate 12**	**Plate 19**
Plate 6	**Plate 13**	**Plate 20**
Plate 7	**Plate 14**	**Plate 21**

APPENDIX B

The data shown in the following tables were primarily collected as part of the Chesapeake Bay Dune: Evolution and Status report and presented in Hardaway *et al.* (2001) and Hardaway *et al.* (2004). Individual site characteristics may now be different due to natural or man-induced shoreline change.

An additional table presents the results of this analysis and describes each dune site's relative long-term, recent, and near-future predicted stability. This data results from the position of the digitized shorelines which have an error associated with them (see Methods, Section III).

Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

Identified dune sites in Lancaster County as of 2000.

Dune Site No.	Location^ Easting (Feet)	Northing (Feet)	Date Visited	Dune Shore Length (feet)	Primary Dune Site?	Secondary Dune Site?	*Public Ownership?
3	2,555,400	525,350	30-Jul-1999	250	Yes	No	No
4	2,555,750	524,600	30-Jul-1999	210	Yes	No	No
5	2,557,700	518,400	30-Jul-1999	130	Yes	No	No
6	2,558,750	515,750	30-Jul-1999	670	Yes	No	No
7	2,559,900	514,900	30-Jul-1999	1,025	Yes	No	No
8	2,560,450	514,150	30-Jul-1999	580	Yes	No	No
10	2,562,200	509,650	30-Jul-1999	110	Yes	No	No
11	2,562,800	509,450	30-Jul-1999	990	Yes	Yes	No
12	2,564,500	507,800	30-Jul-1999	190	Yes	No	No
13	2,565,400	507,250	30-Jul-1999	300	Yes	No	No
15	2,566,000	507,200	30-Jul-1999	150	Yes	No	No
16	2,567,750	503,350	30-Jul-1999	125	Yes	No	No
17'	2,568,300	495,050	30-Jul-1999	120	Yes	No	No
18	2,568,350	494,750	30-Jul-1999	310	Yes	No	No
19	2,568,050	492,350	30-Jul-1999	200	Yes	No	No
20'	2,568,150	491,450	03-Dec-1999	140	Yes	No	No
21'	2,568,200	491,200	03-Dec-1999	160	Yes	No	No
22'	2,568,550	490,250	03-Dec-1999	100	Yes	No	No
23'	2,568,950	489,800	03-Dec-1999	170	Yes	No	No
24'	2,569,200	489,150	03-Dec-1999	240	Yes	No	No
25	2,570,000	488,750	03-Dec-1999	420	Yes	No	No
28'	2,593,600	485,650	03-Dec-1999	120	Yes	No	No
29'	2,596,400	486,600	03-Dec-1999	150	Yes	No	No
32	2,604,050	481,450	22-Apr-1999	900	Yes	Yes	No
34	2,608,900	478,650	22-Apr-1999	1,200	Yes	No	No
36	2,610,700	479,100	22-Apr-1999	140	Yes	No	No
39A	2,619,050	471,800	22-Apr-1999	850	Yes	Yes	No
39B	2,619,050	471,800	22-Apr-1999	600	Yes	No	No
40A	2,623,930	476,750	22-Apr-1999	320	Yes	No	No
43	2,631,650	476,200	22-Apr-1999	820	Yes	No	No
47	2,636,250	475,750	22-Apr-1999	360	Yes	No	No
50	2,638,500	474,850	22-Apr-1999	580	Yes	No	No
51	2,638,750	747,350	22-Apr-1999	250	Yes	No	No
52	2,639,000	474,150	22-Apr-1999	100	Yes	No	No
64A	2,626,220	489,950	20-May-1999	200	Yes	No	No
65	2,626,300	490,350	20-May-1999	150	Yes	No	No
66	2,626,100	490,600	20-May-1999	170	Yes	No	No
67	2,625,750	491,250	20-May-1999	140	Yes	No	No
68	2,625,350	491,900	20-May-1999	250	Yes	Yes	No
69	2,628,800	494,300	20-May-1999	100	Yes	No	No
70	2,628,550	496,450	20-May-1999	100	Yes	No	No
71	2,628,250	496,850	20-May-1999	300	Yes	No	No
72	2,627,400	497,650	20-May-1999	570	Yes	Yes	No
73	2,626,700	498,050	20-May-1999	300	Yes	Yes	No

*Public ownership includes governmental entities including local, state, and federal; otherwise ownership is by the private individual.
^Location is in Virginia State Plane South, NAD 1927
'Sites were noted as dunes but were not photographed or surveyed

Dune site measurements in Lancaster County as of 2000.

Dune Site Measurements									
		Primary Dune			Secondary Dunes				
			Distance from Crest				Distance From		
Site No.	Dune Shore Length (feet)	Crest Elev (ftMLW)	landward to back base (feet)	To MLW (feet)	2nd Dune Site	Crest Elev (ftMLW)	Primary Crest to 2nd Crest (feet)	2ndCrest landward (feet)	2nd Crest seaward to 1st back base (feet)
3	250	5	18	35					
4	210	3.94	21	44					
5	130	3.44	32	45					
6	670	3.67	14	33					
7	1025	5	6	53					
8	580	4.81	39	40					
10	110	4.06	12	32					
11	990	3.53	3	28	Yes	3.27	29	3	26
12	190	3.87	9	47					
13	300	4.58	23	28					
15	150	3.75	19	35					
16	125	2.77	13	23					
17'	120								
18	310	5.09	18	27					
19	200	5.83	24	54					
20'	140								
21'	160								
22'	100								
23'	170								
24'	240								
25	420	4.59	15	50					
26	240								
27'	360								
28'	120								
29	150								
32	900	4.52	18	45	Yes	4.41	61	29	43
34	1200	5.54	28	60					
36	140								
39A	850	3.7	32	61	Yes	3.44	143	86	25
39B	600	5.28	27	65					
40A	320	5.5	20	45					
43	820	5	20	30					
47	360	5	50	41					
50	580	4.34	15	60					
51	250	5	40	28					
52	100	7.15	32	63					
64A	200	5.84	50	40					
65	150	4.86	44	48					
66	170	3.74	7	42					
67	140	5.13	63	50					
68	250	3.63	18	79	Yes	3.42	60	13	42
69	100	5.41	25	65					
70	100	3.91	50	52					
71	300	5.25	4	44					
72	570	3.39	18	29	Yes	3.03	40	18	4
73	300	4.74	25	50	Yes	5.11	104	52	27

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

Dune site parameters in Lancaster County as of 2000.

Site No.	Type	Fetch Exposure A	Shoreline Direction of Face B	Nearshore Gradient C		Morphologic Setting D	Relative Stability E	Underlying Substrate F	Structure or Fill G
3	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Pocket	Stable	Upland	Groin
4	Natural	Riverine	Southwest	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	
5	Natural	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	
6	Natural	Riverine	South	Steep	No Bars	Isolated, Shallow Bay	Erosional	Upland	
7	Natural	Riverine	Southwest	Steep	No Bars	Dune Field, Linear	Stable	Upland	
8	Man Inf	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
10	Natural	Riverine	West	Steep	No Bars	Isolated, Linear	Erosional	Upland	
11	Natural	Riverine	Southwest	Medium	No Bars	Dune Field, Shallow Bay	Stable	Upland	
12	Man Inf	Riverine	Southwest	Medium	No Bars	Ck Mouth Barrier/Spit	Accretionary	Marsh	Revet/Bulkhead
13	Man Inf	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
15	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Linear	Erosional	Marsh	Beach Fill
16	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
17	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
18	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
19	Man Inf	Riverine	West	Medium	No Bars	Isolated, Linear	Stable	Upland	Groin
20	Man Inf	Riverine	West	Medium	No Bars	Isolated, Linear	Erosional	Marsh	Groin
21	Natural	Riverine	West	Medium	No Bars	Isolated, Linear	Erosional	Marsh	
22	Natural	Riverine	Southwest	Steep	No Bars	Isolated, Pocket	Erosional	Marsh	
23	Natural	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Erosional	Marsh	
24	Man Inf	Riverine	West	Steep	No Bars	Ck Mouth Barrier/Spit	Accretionary	Marsh	Jetty
25	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Linear	Stable	Marsh	Beach Fill
26	Natural	Riverine	Southwest	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	
27	Man Inf	Riverine	Southeast	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
28	Natural	Riverine	South	Steep	No Bars	Isolated, Pocket	Stable	Marsh	
29	Man Inf	Riverine	Southwest	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Upland	Jetty
32	Man Inf	Riverine	Southwest	Steep	No Bars	Dune Field, Linear	Stable	Upland	Jetty
34	Man Inf	Riverine	South	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	Groin
36	Man Inf	Riverine	South	Steep	No Bars	Isolated, Shallow Bay	Stable	Upland	Groin
39A	Natural	Riverine	West	Steep	No Bars	Dune Field, Salient	Accretionary	Upland	
39B	Natural	River, Bay Inf	South	Steep	No Bars	Dune Field, Salient	Erosional	Upland	
40A	Man Inf	River, Bay Inf	Southeast	Shallow	No Bars	Isolated, Shallow Bay	Stable	Upland	Revet/Bulkhead
43	Natural	River, Bay Inf	Southeast	Medium	Bars	Dune Field, Linear	Erosional	Upland	
47	Man Inf	River, Bay Inf	South	Medium	Bars	Isolated, Linear	Stable	Upland	Groin
50	Man Inf	River, Bay Inf	Southwest	Medium	No Bars	Dune Field, Shallow Bay	Stable	Upland	Groin
51	Man Inf	River, Bay Inf	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
52	Man Inf	River, Bay Inf	South	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
64A	Man Inf	Open Bay	East	Medium	Bars	Isolated, Linear	Erosional	Upland	Beach Fill
65	Man Inf	Open Bay	East	Medium	Bars	Isolated, Pocket	Erosional	Upland	Revet/Bulkhead
66	Natural	Riverine	Northeast	Shallow	No Bars	Isolated, Salient	Accretionary	Upland	
67	Natural	River, Bay Inf	East	Medium	Bars	Isolated, Pocket	Erosional	Marsh	
68	Natural	River, Bay Inf	North	Steep	No Bars	Isolated, Salient	Accretionary	Upland	
69	Man Inf	River, Bay Inf	South	Steep	Bars	Isolated, Pocket	Erosional	Upland	Groin
70	Man Inf	River, Bay Inf	Northeast	Steep	Bars	Isolated, Linear	Erosional	Marsh	Breakwaters
71	Man Inf	River, Bay Inf	Northeast	Steep	Bars	Isolated, Linear	Stable	Upland	Groin
72	Natural	River, Bay Inf	North	Steep	No Bars	Dune Field, Shallow Bay	Stable	Upland	
73	Man Inf	River, Bay Inf	Northeast	Steep	No Bars	Isolated, Salient	Stable	Upland	Jetty

Long-term, recent stability and future predictions of shore erosion and accretion rates for dune sites in Lancaster County.

	Site No.	Long-Term Stability 1937-2002	Recent Stability 1994-2002	Near Future Prediction
LN	3	Erosional	Stable	Stable
LN	4	Stable	Erosional	Erosional
LN	5	Erosional	Erosional	Stable
LN	6	Erosional	Erosional	Erosional
LN	7	Accretionary	Erosional	Stable
LN	8	Accretionary	Stable	Stable
LN	10	Accretionary	Erosional	Erosional
LN	11	Accretionary	Stable	Stable
LN	12	Erosional	Accretionary	Stable
LN	13	Stable	Stable	Stable
LN	15	Erosional	Stable	Erosional
LN	16	Erosional	Erosional	Erosional
LN	17	Erosional	Erosional	Erosional
LN	18	Accretionary	Erosional	Erosional
LN	19	Accretionary	Stable	Stable
LN	20	Erosional	Erosional	Erosional
LN	21	Erosional	Erosional	Erosional
LN	22	Erosional	Erosional	Erosional
LN	23	Erosional	Erosional	Erosional
LN	24	Accretionary	Erosional	Stable
LN	25	Accretionary	Erosional	Erosional
LN	28	Erosional	Stable	Stable
LN	29	Stable	Stable	Stable
LN	32	Accretionary	Stable	Stable
LN	34	Erosional	Stable	Stable
LN	36	Erosional	stable	Stable
LN	39A	Accretionary	Accretionary	Accretionary
LN	39B	Accretionary	Erosional	Erosional
LN	40A	Accretionary	Accretionary	Stable
LN	43	Accretionary	Erosional	Erosional
LN	47	Erosional	Stable	Stable
LN	50	stable	Stable	Stable
LN	51	Erosional	stable	Stable
LN	52	Erosional	Stable	Stable
LN	64A	Erosional	Erosional	Erosional
LN	65	Erosional	Erosional	Erosional
LN	66	Erosional	stable	Accretionary
LN	67	Erosional	Accretionary	Stable
LN	68	Accretionary	Stable	Stable
LN	69	Stable	Stable	Stable
LN	70	Erosional	Erosional	Erosional
LN	71	Erosional	Stable	Stable
LN	72	Accretionary	Stable	Stable
LN	73	Accretionary	Stable	Stable

WESTLAND BEACH – WINDMILL POINT AREA
AERIAL COMPARISON FROM 2006 - 2022

Westland Beach - Windmill Point Aerial 2006

October 7, 2022

Virginia Administrative Boundaries - Cities/Counties

Shoreline

1:2,257

0 0.0125 0.025 0.05 mi

0 0.02 0.04 0.08 km

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Virginia Geographic Information Network (VGIN)

Created from the Lancaster County 2015 Comprehensive Map Viewer

Westland Beach - Windmill Point Aerial 2022

October 7, 2022

Virginia Administrative Boundaries - Cities/Counties

Shoreline

1:2,257

0 0.0125 0.025 0.05 mi

0 0.02 0.04 0.08 km

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Center for Coastal Resources Management, Virginia Institute of Marine Science, Gloucester

Created from the Lancaster County 2015 Comprehensive Map Viewer

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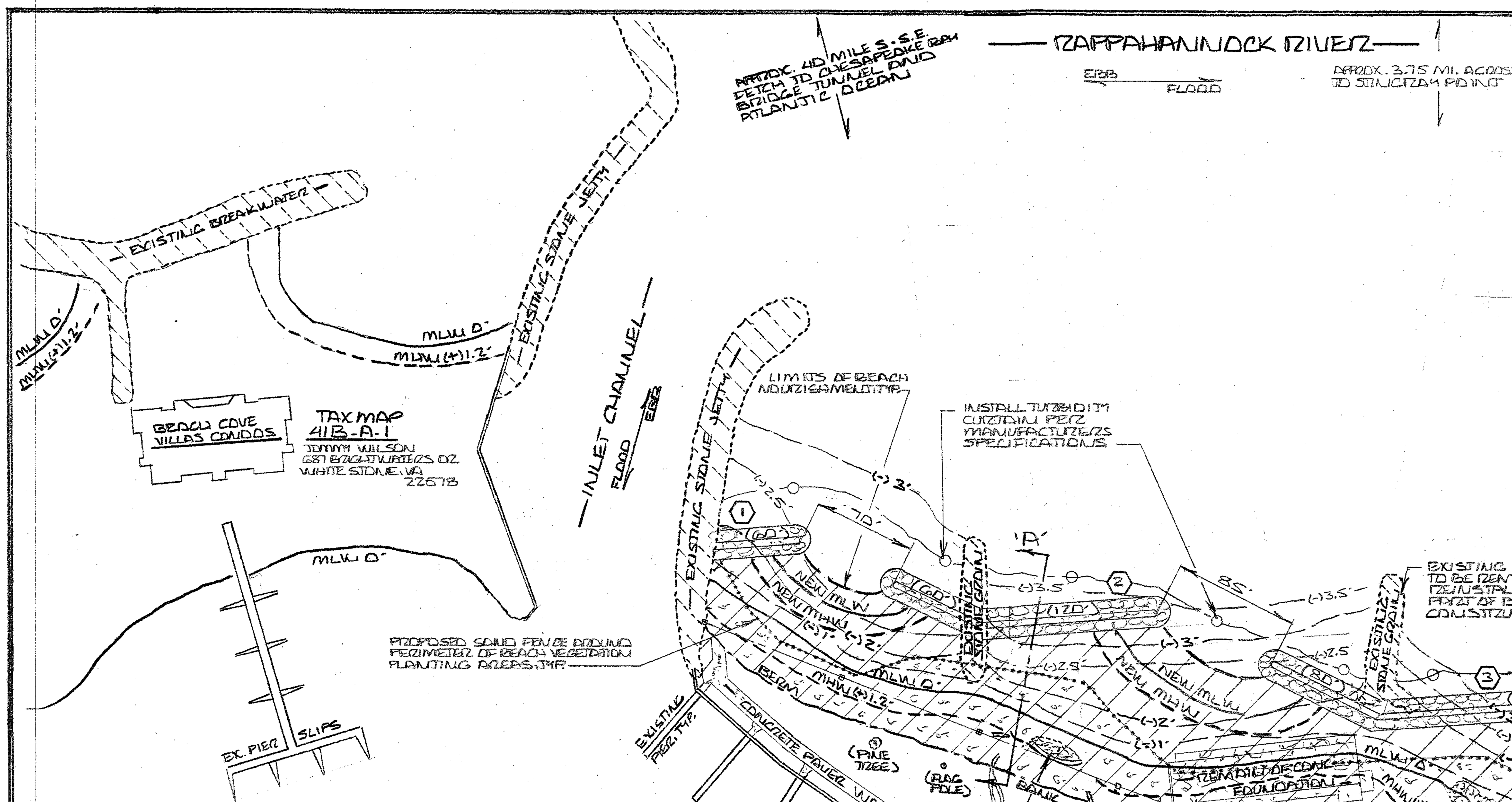
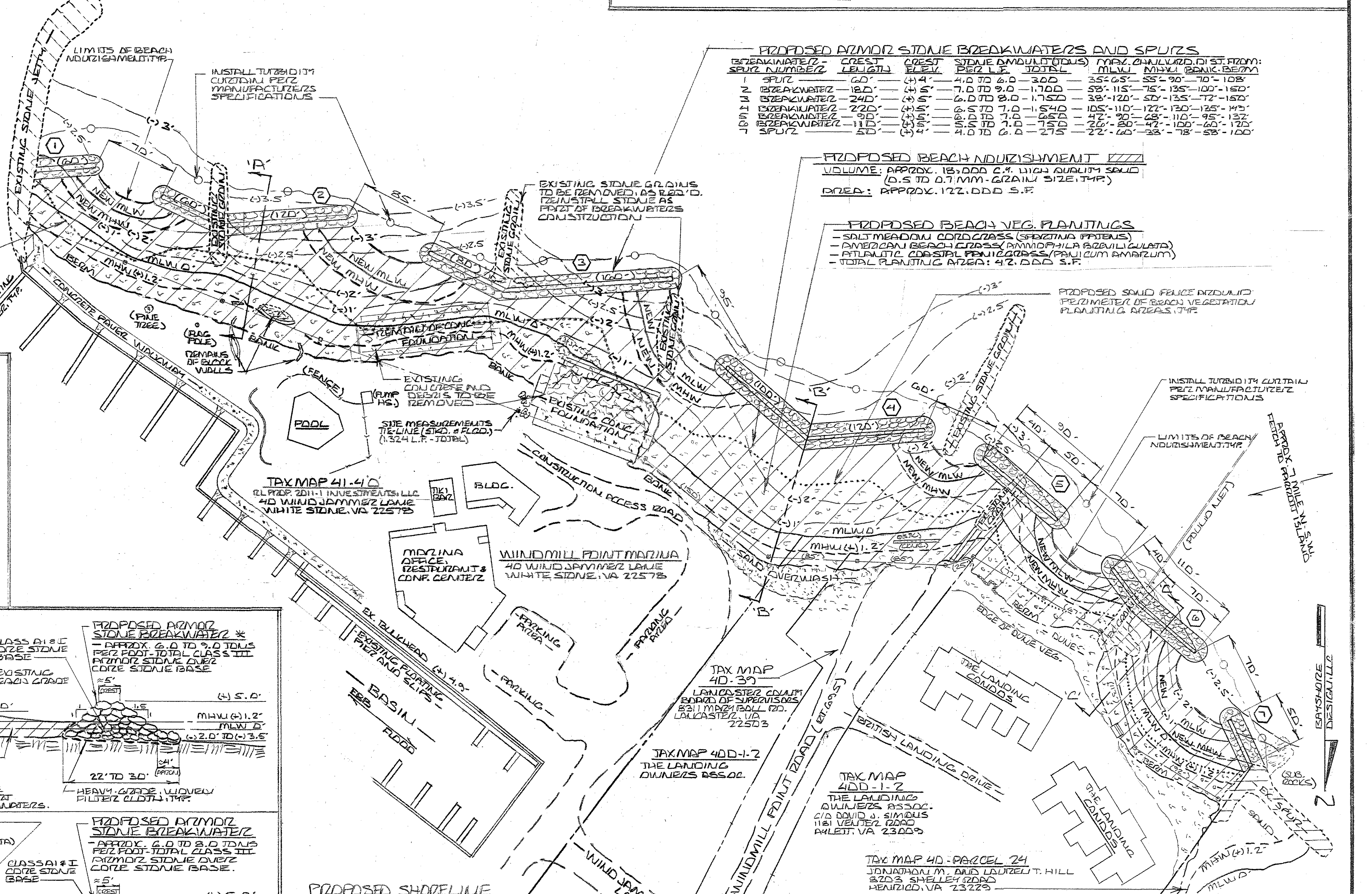
DATE: 7-22-22
DRAWN BY: PALUBINSKI
SCALE: AS NOTED
SHEET: 1 OF 2

PROPOSED SHORELINE STABILIZATION PROJECT

WINDMILL POINT MARINA AND WESTLAND BEACH
WINDMILL POINT - FLEETS ISLAND
LANCASTER COUNTY, VIRGINIA

PROPOSED ARMOR STONE BREAKWATERS AND SPURS

BREAKWATER-SPUR NUMBER		CREST LENGTH	CREST ELEV.	STONE AMOUNT (TONS) PER L.F.	STONE AMOUNT (TONS) TOTAL	MAX. CHANNELWARD DIST. FROM: MLW	MHW	BANK-BERM
1	SPUR	60'	(+)4'	4.0 TO 6.0	300	35'-65'	55'-90'	70'-108'
2	BREAKWATER	180'	(+)5'	7.0 TO 9.0	1,700	58'-115'	75'-135'	100'-150'
3	BREAKWATER	240'	(+)5'	6.0 TO 8.0	1,750	38'-120'	50'-135'	72'-150'
4	BREAKWATER	220'	(+)5'	6.5 TO 7.0	1,540	105'-110'	122'-130'	135'-143'
5	BREAKWATER	90'	(+)5'	6.0 TO 7.0	650	47'-90'	68'-110'	95'-132'
6	BREAKWATER	110'	(+)5'	5.5 TO 7.0	750	26'-80'	42'-100'	60'-120'
7	SPUR	50'	(+)4'	4.0 TO 6.0	275	22'-60'	38'-78'	58'-100'

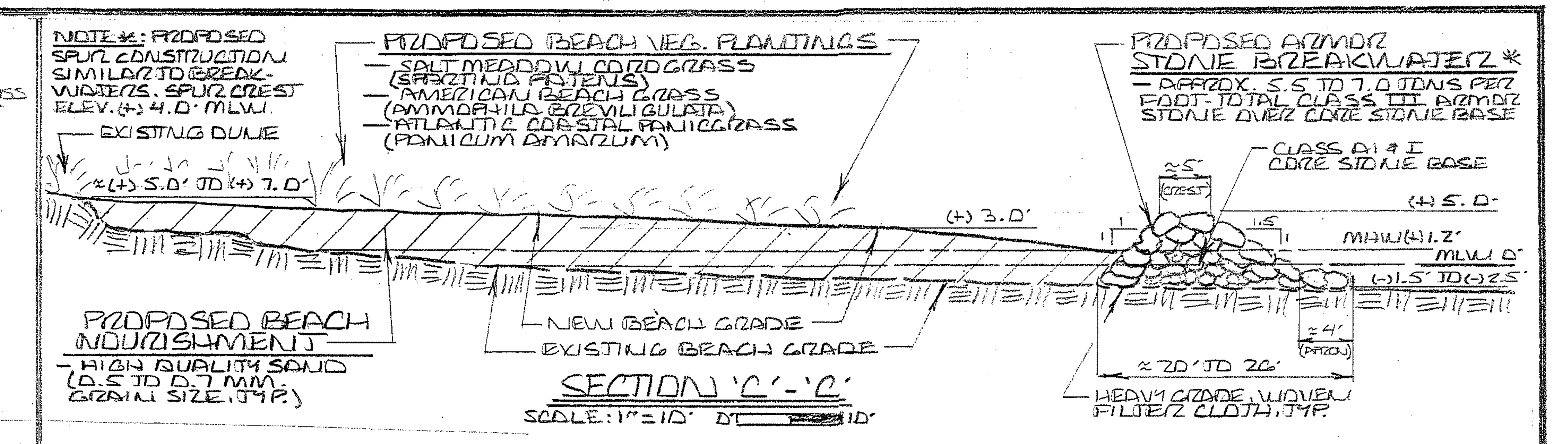
PROPOSED BEACH NOURISHMENT

VOLUME: APPROX. 18,000 C.Y. HIGH QUALITY SAND (0.5 TO 0.7 MM - GRAIN SIZE, TYP.)

AREA: APPROX. 122,000 S.F.

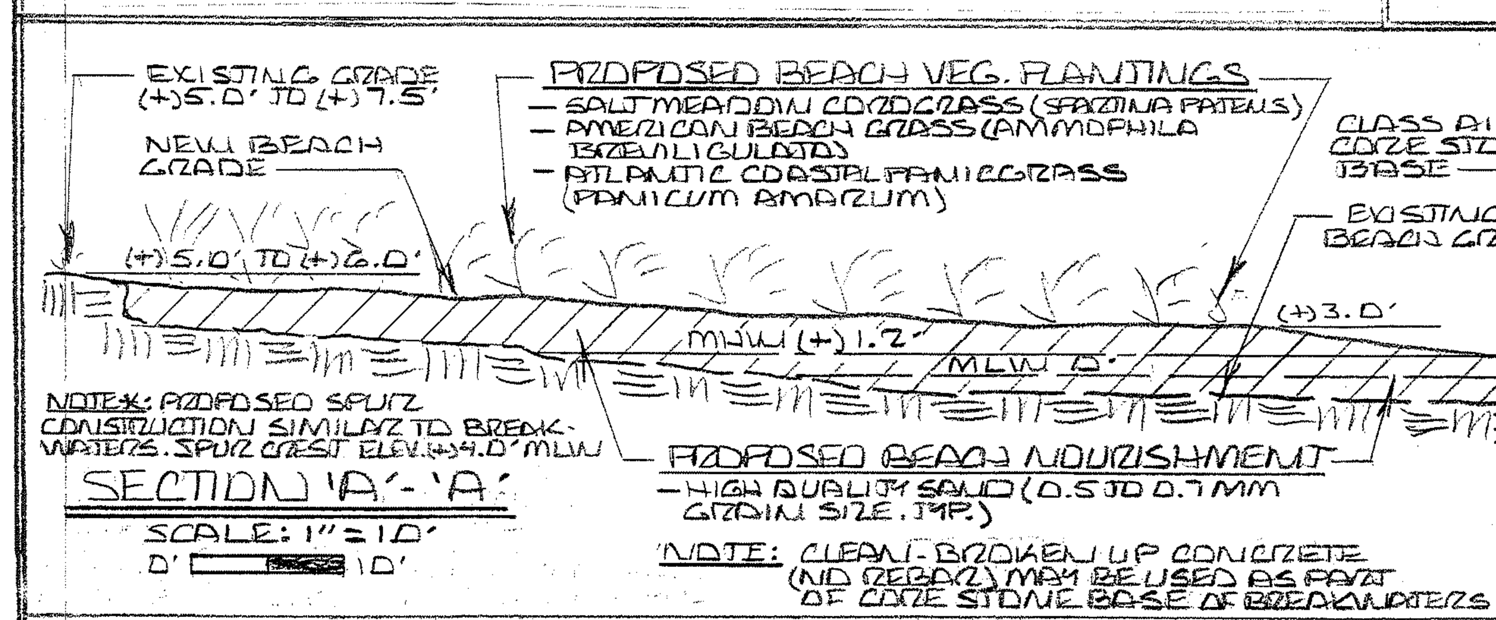
PROPOSED BEACH VEG. PLANTINGS

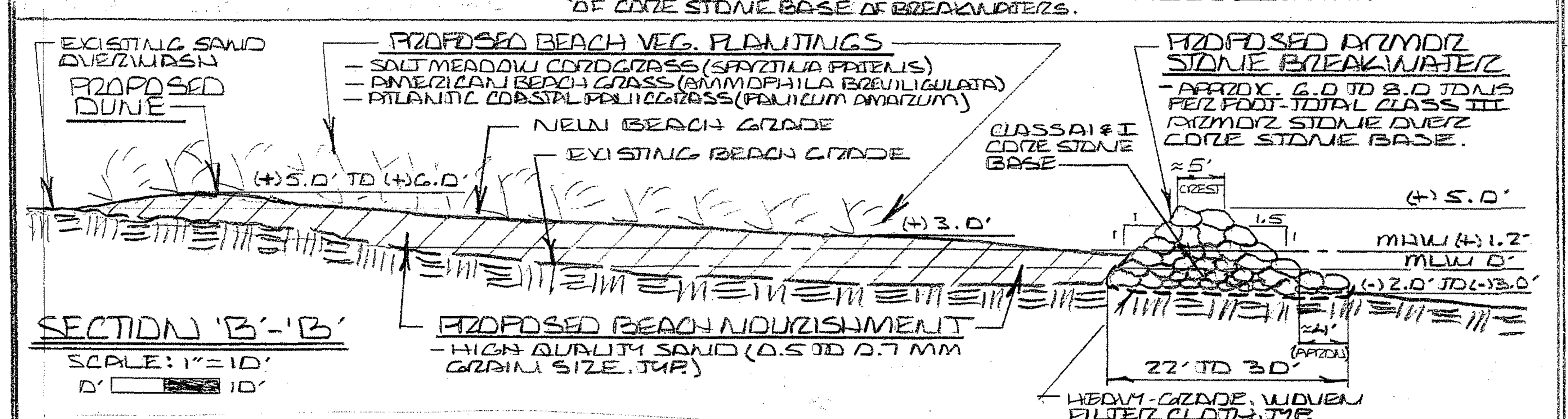
- SALT MEADOW CORDGRASS (SPARTINA PATENS)
- AMERICAN BEACH GRASS (AMMOPHILA BREVILIGULATA)
- ATLANTIC COASTAL PANICGRASS (PANICUM AMARUM)
- TOTAL PLANTING AREA: 42,000 S.F.



BEACH NOURISHMENT - VEGETATION PLANTING NOTES

1. SALT MEADOW CORDGRASS (SPARTINA PATENS), AMERICAN BEACH GRASS (AMMOPHILA BREVILIGULATA), AND ATLANTIC COASTAL PANICGRASS (PANICUM AMARUM) TO BE PLANTED 18" APART, FROM (+) 3.0' MLW - BEACH ELEVATION TO THE LANDWARD LIMITS OF BEACH NOURISHMENT.
2. SALT MEADOW CORDGRASS SHOULD BE PLANTED FROM LATE FEBRUARY THROUGH EARLY JUNE OR PER INSTRUCTION INSTRUCTION FROM THE VEGETATION CONTRACTOR OR SUPPLIER.
3. AMERICAN BEACH GRASS AND ATLANTIC COASTAL PANICGRASS SHOULD BE PLANTED FROM LATE OCTOBER THROUGH APRIL OR PER INSTRUCTION FROM THE VEGETATION CONTRACTOR OR SUPPLIER.
4. FERTILIZING IS RECOMMENDED AT THE TIME OF PLANTING. USE APPROX. ONE (1) OUNCE PER PLANT OF SLOW RELEASE OSOMOCOTE FERTILIZER (TO BE PLACED IN HOLE WITH PLANT), PER INSTRUCTION FROM CONTRACTOR OR SUPPLIER.
5. ANY DEBRIS AND TRASH THAT MAY ACCUMULATE IN THE PLANTING AREAS SHOULD BE PERIODICALLY REMOVED AND DISPOSED OF PROPERLY.
6. ADDITIONAL VEGETATION TO BE PLANTED, AS REQUIRED, TO REPLACE ANY PLANTS THAT DO NOT SURVIVE AND PROLIFERATE.
7. ANY APPEARANCE OF PHRAGMITES AUSTRALIS (REED GRASS) WITHIN PLANTING AREAS TO BE ERADICATED PER INSTRUCTION FROM WETLANDS PROFESSIONAL.





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DATE:	7-22-22
DRAWN BY:	PAUBINSKI
SCALE:	AS NOTED
SHEET:	2 OF 2

PROPOSED SHORELINE STABILIZATION PROJECT

WINDMILL POINT MARINA AND WESTLAND BEACH
WINDMILL POINT - FLEETS ISLAND
LANCASTER COUNTY, VIRGINIA

BAYSHORE DESIGN, LLC

National Flood Hazard Layer FIRMette

FEMA

76°17'57"W 37°37'10"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

76°17'19"W 37°36'42"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/10/2022 at 2:41 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Building Resilient Infrastructure and Communities: Qualitative Evaluation Criteria Application

Name of Your Community:

Lancaster County

Description of the Project and Issue to Be Solved:

Westland Beach-Windmill Point has lost 110 feet of beach shoreline in the past decade. This public/private partnership between the County of Lancaster and the Windmill Point Marina owner will provide the marina with a stabilized shoreline, protecting the marina infrastructure and buildings while also providing public access by expanding and protecting the County's only public beach. The Marina tenants and guests will benefit from this shoreline stabilization project through its protection against erosion of the beach and the protection of Marina infrastructure against property damage related to erosion and storm damage. This project will also include shoreline protection for the neighboring community, The Landing Townhomes at Windmill Point. There are eight townhomes adjacent to this project that will benefit from stabilization of their shoreline. In addition to protection of the private infrastructures (including critical infrastructure (the Windmill Point Marina)), the shoreline (including public beach access and private beach), and VDOT infrastructure (Windmill Point Road) will also be better protected from storm damage, continued erosion and the subsequent migration of mean high water.

The Westland Beach-Windmill Point Shoreline Stabilization project will use a multi-faceted approach of armor stone breakwaters, armor spurs and nature-based solutions, including beach nourishment and beach and dune vegetation planting to stabilize 1,324 feet or eroding shoreline along the Rappahannock River. The project will include the construction of five armor stone breakwaters (180', 240', 220', 90', and 110'), two armor spurs (60' and 50'), and the installation of 18,000 cubic yards of beach nourishment with 42,000 square feet of beach and dune vegetation plantings. All existing concrete debris and stone groins (located channel ward of breakwaters) will be removed to allow for restoration of the beach and a more comprehensive approach to stabilization of the eroded shoreline. In the past, individualized approaches using hardening structures only have failed to stabilize this shoreline.

Lancaster County historically had only 50 feet of beach area suitable for swimming in the total 330 miles of waterfront, and that 50 feet of beach has been mostly lost due to erosion. In addition to the Westland beach area at the end of Windmill Point Road, Belle Isle State Park is the only publicly owned land that has area available for the development of beach and swimming areas. Due to the limited area for beach development, Belle Isle State Park Master Plan indicates development of a swimming area away from the waterfront. The vast majority of land suitable for public beaches is in private ownership.

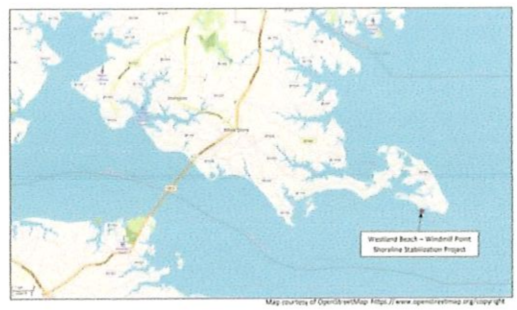
This situation has severely limited the options for public beaches in Lancaster County and will only become worse with each passing year.

Upload Image:

Westland Beach - Windmill Point Aerial 2022

Upload Map:

WESTLAND BEACH – WINDMILL POINT SHORELINE STABILIZATION PROJECT LOCATION MAP



Map courtesy of OpenStreetMap https://www.openstreetmap.org/copyright

Check the appropriate box(es) of applicable [Federal Emergency Management Agency Community Lifelines]() this project will support:

Safety and Security	Food, Water, Shelter	Health and Medical	Energy (Power&Fuel)	Communications	Transportation	Hazardous Materials
	X	X	☐	☐	☐	☐

Qualitative Evaluation Criterion 1: Risk Reduction/Resilience Effectiveness (35 possible points)

Reducing Risk

The subapplication should detail how the project will reduce risk. The details should identify the risk being reduced and state what action will reduce the identified risk. FEMA encourages alternative explanations of risk reduction here. How will the proposed project reduce risk(s), and to what level?

If no action is taken, the Westland Beach - Windmill Point project area will continue to erode at an alarming rate, facing the risk of ongoing erosion of the shoreline and vulnerability to unbridled wave action and destructive wave energy. Both public and private property and infrastructure will be at risk of loss and damage. Continued erosion of the shoreline will eventually result in total loss of the 50' public beach access, which is the only public beach access in Lancaster County. Continued erosion will also result in the loss of private beaches and dunes (both at the Windmill Point Marina and at The Landing Owners Association property). Windmill Point Road (VDOT infrastructure) will continue to be damaged. Continued erosion of the shoreline will put Windmill Point Marina infrastructure at risk, including critical infrastructure.

Furthermore, continued loss of the beach area will result in the potential sedimentation of the nearby oyster beds and underwater habitats of the Rappahannock River, causing habitat loss both on land and underwater. Without the breakwater structures, there will be no improvement in habitat functions and values, supporting local ecosystems through the creation and improvement of near shore and coastal habitat.

Breakwaters are elongate structures, typically of stone, built just seaward of the shoreline to be protected. They work by disrupting waves before they reach land and are capable of significantly reducing wave action. Based on the documented research by VIMS scientists, we believe this breakwater system and nature-based solution will be effective in reducing the risk of continued erosion, loss of property and damage to property. In "A brief history of headland breakwaters for shore protection in Chesapeake Bay, USA", written by C. Scott Hardaway Jr., Coastal Geologist, Virginia Institute of Marine Science & James R. Gunn, President, Coastal Design and Construction, Inc., they concluded the following: "The documented, long-term performance of headland breakwater systems in Chesapeake Bay is testimony to the predictable durability of these systems. Through numerous storm events, these systems have remained intact with no significant shore erosion or changes in shore planform over time, some for as long as 25 years.". This paper is attached to the application as supporting documentation. Stabilizing this shoreline will reduce the risk of erosion due to storm surge and wave action which ultimately protects against the loss of property. Habitat will be provided on land through the beach/dune areas and vegetative plantings. The breakwaters will also provide habitat for aquatic organisms. Stabilization of the shoreline will help prevent sedimentation of the Rappahannock River in this area and the nearby oyster beds and aquatic ecosystem, thus improving water quality. A stabilized shoreline will be more resilient against the 100-year storm and will be better equipped to weather the changing climate, including resilience to increased storm frequency, increased high tide flood events and rising sea levels.

Increase Resilience

The subapplication should indicate how the proposed project will improve resilience. Resilience refers to the ability to prepare for anticipated hazards, adapt to changing conditions, and withstand and recover rapidly from disruption. The details should identify the aspects of resilience being increased and state what action will increase the identified resilience.

This breakwater system will provide a more comprehensive solution to the erosion of the shoreline which has not been successfully mitigated by previous attempts utilizing only hardening structures. Mean low and high water will be moved further channelward, the beach nourished and 42,000 sq ft of vegetation plantings will be installed on the beach and dune areas. Based on the success of other breakwater systems, in the Chesapeake Bay, it is our hope that this approach will provide a more long-term solution for shoreline stabilization. In "A brief history of headland breakwaters for shore protection in Chesapeake Bay, USA", written by C. Scott Hardaway Jr., Coastal Geologist, Virginia Institute of Marine Science & James R. Gunn, President, Coastal Design and Construction, Inc., they concluded the following: "The documented, long-term performance of headland breakwater systems in Chesapeake Bay is testimony to the predictable durability of these systems. Through numerous storm events, these systems have remained intact with no significant shore erosion or changes in shore planform over time, some for as long as 25 years." This document is attached to the application.

Habitat will be provided on land through the beach/dune areas and vegetative plantings. The breakwaters will also provide habitat for aquatic organisms. Stabilization of the shoreline will help prevent sedimentation of the Rappahannock River in this area and the nearby oyster beds and aquatic ecosystem, thus improving water quality. A stabilized shoreline will be more resilient against the 100-year storm and will be better equipped to weather the changing climate, including resilience to increased storm frequency, increased high tide flood events and rising sea levels.

Ancillary Benefits

Ancillary benefits are benefits related to water/air quality, habitat creation, energy efficiency, economic opportunity, reduced social vulnerability, reduced carbon emissions, cybersecurity, cultural resources, public health, mental health, mission areas of non-governmental organizations (NGOs), community-based groups, other partners, and so on. Subapplicants should consider the following questions: What ancillary benefits will the project provide, and how? Does the project consider multiple hazards (e.g., wind/storm surge, wildfire/mudslides) to address risks beyond the proposal's primary risk reduction objective? Ancillary benefits should include how a project will lead to equitable outcomes and provide the greatest support to those with greatest need. Ancillary benefits could also address climate-related benefits.

Ancillary benefit to this project includes the potential for improved public health, (both mental and physical) as 100% of Lancaster County's population will benefit from County's only public beach access. Calmer waters resulting from the breakwaters will provide opportunities for the community to fish, view the waterfront, wade, swim, nature bathe (eco therapy based on Shinrin-Yoku), paddle, baptize, and perform other beach and water activities. This public access will include a fishing pier. The fishing pier will provide a place for residents and visitors to catch fish either recreationally or to supplement their diets. Lancaster County plans to obtain a fishing license for the pier to maximize equitability of use and access.

The County also has plans to purchase the adjacent existing oyster lease with the intent to establish a legacy oyster bed for the cultivation and restoration of oysters for environmental and educational purposes.

Breakwater structures will also enhance habitat functions and values, supporting local ecosystems through the creation and improvement of near shore and coastal habitat. Habitat will be provided on land through the beach/dune areas and vegetative plantings. The breakwaters will also provide habitat for aquatic organisms. Stabilization of the shoreline will help prevent sedimentation of the Rappahannock River in this area and the nearby oyster beds and aquatic ecosystem, thus improving water quality. A stabilized shoreline will be more resilient against the 100-year storm and will be better equipped to weather the changing climate, including resilience to increased storm frequency, increased high tide flood events and rising sea levels.

Leveraging Innovation

How does the project leverage or demonstrate innovation for the community? What new ideas or approaches does the project incorporate? Does the project leverage collaborations and resources with NGOs, community-based groups, and other partners? The details should be clear and reasonable.

Individualized past attempts to stabilize the shoreline with hardening measures have failed. Leveraging the cooperation and support of the marina, townhomes, and the local government will provide an innovative comprehensive response to the continued erosion of the coastline. The Westland Beach-Windmill Point Shoreline Stabilization Project will combine armor breakwaters and spurs with nature-based solutions such as beaches and dunes as effective storm buffers, helping to protect critical infrastructure from risk of erosion, damage, and loss. Structures will also enhance habitat functions and values, supporting local ecosystems through the creation and improvement of near shore and coastal habitat.

Qualitative Evaluation Criterion 2: Climate Change and Other Future Conditions (20 possible points)

Anticipated Future Conditions

Examples of future conditions include, but are not limited to, the following: expected population changes, land use and development shifts, aging population, shifts in income or employment, changes in housing needs, increasing temperatures, increased wildfire risk, sea level rise, more frequent high tide flooding, more intense rainfall events, increasing storm frequency, persistent and prolonged droughts, and changing groundwater tables.

We anticipate that sea levels will continue to rise, more frequent high tide flooding, more intense rainfall events, increasing storm frequency, persistent and prolonged droughts, and changing groundwater tables. This project is a nature-based solution intended to address the impacts to the eroded coastline which are directly related to climate change impacts.

This breakwater system will provide a more comprehensive solution to the erosion of the shoreline which has not been successfully mitigated by previous attempts utilizing only hardening structures. Mean low and high water will be moved further channel ward, the beach nourished and 42,000 sq ft of vegetation plantings will be installed on the beach and dune areas. Based on the success of other breakwater systems, in the Chesapeake Bay, it is our hope that this approach will provide a more long-term solution for shoreline stabilization.

Responsive to Anticipated Changes

How is the project responsive to any identified anticipated changes? Does the project integrate the consideration of future conditions into design, planning, and operations workflows?

The Northern Neck region is subject to changes to our coastline and community infrastructure due to sea level rise, increased storm frequency, and other factors related to climate change. Sea level rise remains a serious concern. Based on sea level rise, it may be necessary, in the future, the increase the height of the breakwaters to prolong their functionality. This project is a nature-based solution intended to address the impacts to the eroded coastline which are directly related to climate change impacts.

Informed by Planning Efforts

How was the project informed by, or connected to, plans and planning efforts and the assessment of future conditions? Relevant plans may include Hazard Mitigation Plans, Comprehensive Plans, Climate Adaptation Plans, Long-Range Transportation Plans, Small Area Plans, Coastal Zone Management Plans, Capital Improvement Plans, and so on.

In assessing access to the water in Lancaster County it is evident that the supply of access is also in transition. In the past, much of the general public was able to access state waters through informal arrangement. That is no longer the case. Access has become very limited for non-waterfront residents, and the rest of the general public (visitors). These people can dine near the water, charter boats, or keep their own boat at a marina, but their options are limited by a lack of variety and financial constraints. Future opportunities to expand the variety and number of public access sites in Lancaster County are jeopardized by the expanding use of shoreline for residential purposes, and could very well become nonexistent in the near future.

The Lancaster County Comprehensive plan includes three goals related to shoreline protection: (1) Actively encourage shoreline protection measures that are equal to the erosion potential at a particular site; (2) Encourage vegetative enhancement of Resource Protection Area (RPA) sections; and (3) Encourage coordinated shoreline protection efforts in existing waterfront communities and in new subdivisions. The County's Comprehensive Plan encourages setting aside open space for conservation purposes. The Westland Beach - Windmill Point Shoreline Stabilization Project will protect the eroding shoreline, add vegetation plantings, and set an example of a coordinated shoreline protection strategy through a public/private partnership.

In 2002 a Citizens Advisory Group was formed to address the need for public access to state waters in Lancaster County. Their report contained specific recommendations for expansion of public access to the state waters while acknowledging obstacles. In 2005, the Virginia General Assembly enabled the formation of the Northern Neck Chesapeake Bay Public Access Authority (NNCBPAA). On September 12, 2006, three counties in the Northern Neck - Lancaster, Northumberland and Westmoreland executed the operating agreement to form the Northern Neck Chesapeake Bay Public Access Authority to enhance public access within their jurisdictions. There are seven duties that the authority is charged with undertaking: 1. Identify land, either owned by the Commonwealth or private holdings that can be secured for use by the general public as a public access site, 2. Research and determine ownership of all identified sites, 3. Determine appropriate public use level of identified access sites, 4. Develop appropriate mechanisms for transferring title of Commonwealth or private holdings to the Authority, 5. Develop appropriate acquisition and site management plans for public access usage, 6. Determine which holdings should be sold to advance the mission of the Authority, 7. Perform other duties required to fulfill the mission of the Northern Neck Chesapeake Bay Access Authority. In October 2007 at the seventh meeting of the Northern Neck Chesapeake Bay Public Access Authority, Lancaster County representatives requested funding from the NNCBPAA to conduct environmental studies on a potential access site on a tributary to the Chesapeake Bay within Lancaster County. The NNCBPAA granted this request for funding to be used by Lancaster County in assessing the suitability of the parcel for public water access. This assessment determined the need for public access sites with the following types of access: natural area access, beaches and swimming access, and pier fishing access. This project is directly in-line with the access deemed needed by the Lancaster County's Comprehensive Plan and provides these three access types and also accomplishes the Comprehensive Plan goals for shoreline stabilization.

Lancaster County participated in creating the 2017 Northern Neck Hazard Mitigation Plan. One of the County's goals associated with the Hazard Mitigation Plan is to support Mitigation projects that will result in the protection of public or private property from natural hazards. The Westland Beach - Windmill Point Shoreline Stabilization project will protect critical infrastructure, including public and private property from natural hazards.

According to the findings of the 2018 Virginia Outdoors Plan, Lancaster experiences disparities specific to outdoor recreation. Its per capita spending is only 9 to 10% of the state average, according to the 2018 Virginia Outdoors Plan (attached (page 13.103)). Only 50% of its people say they have adequate access to outdoor physical activity, compared to 81% statewide (2018 VOP page 13.104). This project will help to address these Environmental Justice concerns, bringing more opportunities for outdoor recreation and physical activity to the community.

Data Sources

What data sources and assumptions are used to guide the project? For example, when citing a sea level rise projection, what time period and what scenario of sea level rise are assumed?

This project provides protection against the 100-year (1%) storm event.

This breakwater system will provide a more comprehensive solution to the erosion of the shoreline which has not been successfully mitigated by previous attempts utilizing only hardening structures. Mean low and high water will be moved further channel ward, the beach nourished and 42,000 sq ft of vegetation plantings will be installed on the beach and dune areas. Based on the success of other breakwater systems, in the Chesapeake Bay, it is our hope that this approach will provide a more long-term solution for shoreline stabilization. In "A brief history of headland breakwaters for shore protection in Chesapeake Bay, USA", written by C. Scott Hardaway Jr., Coastal Geologist, Virginia Institute of Marine Science & James R. Gunn, President, Coastal Design and Construction, Inc., they concluded the following: "The documented, long-term performance of headland breakwater systems in Chesapeake Bay is testimony to the predictable durability of these systems. Through numerous storm events, these systems have remained intact with no significant shore erosion or changes in shore planform over time, some for as long as 25 years." This study is attached to the application. We anticipate this solution lasting 50 years. Breakwater height will be raised in the future, when deemed necessary by rising sea levels.

Qualitative Evaluation Criterion 3: Implementation Measures (15 possible points)

Challenges

What potential implementation challenges and obstacles are identified (e.g., technical, political, financial, public support, environmental/permitting, constructability), and what implementation solutions are proposed to address these challenges?

Currently the project has one public comment of opposition from community member and oysterman, Mr. Shawn Rose. The County has worked diligently to address Mr. Rose's concerns. Mr. Rose owns an oyster lease adjacent to this project and he is concerned that the construction might negatively affect his oyster grounds. The county is actively working to address the concerns of Mr. Shawn Rose regarding his adjacent oyster lease, and hopes to purchase this lease from Mr. Rose to remove the risk that construction may pose to his livelihood as an oysterman. The county hopes to turn this potential negative impact into a positive for Mr. Rose (through purchase of the lease) and the entire community and ecosystem through the addition of a legacy oyster bed. A legacy oyster bed will provide habitat, learning opportunities for the community, and water quality improvement through the filtering benefits that oysters can provide.

The Joint Permit Application Process is going well, agency comments regarding the project are attached to the permit application. There are currently no known permitting or constructability challenges.

Costs/Schedule

Are the proposed project costs and schedule realistic? How do project cost estimates and the schedule identify and address potential challenges and obstacles?

Lancaster County feels our cost estimates are realistic; however, we understand that the cost of construction materials is rising. Based on the potential for this trend to continue, we are exploring the possibility of using a more affordable manufactured stone product as a substitute to granite rip rap for the breakwater structures. This innovative product is hurricane tested and currently in use in the United States (including Maryland, North Carolina and Louisiana).

Monitoring Strategies

What pre- and post-implementation monitoring strategies are proposed for the project? What specific evaluation elements are proposed to measure progress and ensure the project is executed as designed?

The county plans to use third party inspections to ensure protection of the environment during construction and obtain as-built certifications to ensure the project is properly constructed as engineered/designed. County staff will also regularly inspect the project for environmental compliance. Management costs of 5% are included in this grant to account for the potential need for additional assistance in grant management and implementation.

Resources

What technical and managerial staff and resources are available to successfully implement the project? How will anticipated staff and resource gaps be filled?

Are strong labor standards incorporated? For example, the use of project labor agreements (PLAs), requiring workers to be paid wages at or above the prevailing rate; use of local hire provisions; use of a directly employed workforce (as opposed to a subcontracted workforce); use of an appropriately skilled workforce (e.g., through registered apprenticeships or other joint labor-management training programs that serve all workers, particularly those underrepresented or historically excluded); and use of an appropriately credentialed workforce (i.e., satisfying requirements for appropriate and relevant preexisting occupational training, certification, and licensure).

The county plans to use third party inspections to ensure protection of the environment during construction and obtain as-built certifications to ensure the project is properly constructed as engineered/designed. County staff will also regularly inspect the project for environmental compliance. Management costs of 5% are included in this grant to account for the potential need for additional assistance in grant management and implementation.

Lancaster County is an equal opportunity employer. We celebrate diversity and are committed to creating an inclusive environment for all employees. The selection of the requested services shall be made per the competitive negotiation process under the Virginia Public Procurement Act. The preference to use local skilled labor is always communicated to successful bidders when contracts are awarded.

Past Project Performances

Are examples of successfully completed projects included to demonstrate effective implementation measures?

Lancaster County completed the installation of a Public Boat Ramp at Windmill Point in 2016. This project was funded in part with a "Large Power Boating Access Grant" in the amount of $150,000.00 through the Virginia Department of Game and Inland Fisheries. Initial planning for the project began in 2014 and originally the County was up against opposition from the community, as there were concerns regarding access to the ramp using an existing community access road. The county worked with the local community to resolve this concern. Ultimately, the County installed a separate and improved access road for the community, thus removing their opposition to the project. A joint permit application was submitted to the Virginia Marine Resources Commission, the Virginia Department of Environmental Quality, and the Army Corps of Engineers for review. All permitting requirements were met (including nonpoint nutrient offset credit and phragmites eradication plan) and approved February 2016. Final site plans were prepared March 2016 and requests for bid and award of base bid occurred in April of 2016. Change orders totaled $91,555.00 for a final construction cost of $413,962.00. Construction began May 16, 2016 and was completed on time and under the Capital Improvement budgeted amount. VDGIF approved final construction and authorized $150,000.00 in grant reimbursement on September 19, 2016. This boat ramp and courtesy pier were named in honor of Frederick H. Ajootian, past chairman of the Lancaster County Wetlands Board, who was a lifelong advocate for public access in Lancaster County. This public access to the Rappahannock River continues to be well used and loved by the community and in addition to recreational and commercial boating, the ramp serves as a launching spot for marine emergency services.

Qualitative Evaluation Criterion 4: Population Impacted (25 possible points) Community-Wide Benefits

Community size, scale, and definition can look very different in different local contexts. Explain what "community-wide" means in the context of the proposed project. A disadvantaged community may be characterized by variables including, but not limited to: low income, high and/or persistent poverty, high unemployment and/or underemployment, racial and/or ethnic segregation, linguistic isolation, high housing cost burden and/or substandard housing, distressed neighborhoods, high transportation cost burden and/or low transportation access, disproportionate environmental burden and/or high cumulative impacts, limited water/sanitation access and/or affordability, disproportionate climate impacts, high energy cost burden and/or low energy access, and all geographic areas within tribal jurisdictions.

This project provides community-wide benefits for all Lancaster County residents and the countless visitors that will enjoy the restored and expanded public beach access.

According to the CDC, the 2018 overall social vulnerability index for the area including the Westland Beach-Windmill Point Shoreline Stabilization Project was 0.431, which is a low to moderate level of vulnerability. However, this index does not apply to all of Lancaster County. There are areas of the County with a social vulnerability index of 0.6168, which is a moderate to high level of vulnerability (see attached 2018 Social Vulnerability Index Map for Lancaster County). According to the US Census Bureau, compared to Virginia averages, Lancaster's population is notably older (36.7% versus 16.3% aged 65+), in poorer health (11.4% versus 8.0% of people under 65 having a disability), less connected to modern amenities (80.2% versus 92.3% with a home computer), and lower in median household income ($59,736 versus $76,398, only 78% of the statewide average). The Virginia Department of Health ranks Lancaster County with a low overall health opportunity index: 96 out of 134 localities (see attached VDH Health Opportunity Index Map). Of Lancaster County's elementary school aged children, 75% qualify for free or reduced-price lunch at school (VDOE documentation attached). Lancaster also experiences disparities specific to outdoor recreation. Its per capita spending is only 9 to 10% of the state average, according to the 2018 Virginia Outdoors Plan (attached (page 13.103)). Only 50% of its people say they have adequate access to outdoor physical activity, compared to 81% statewide (2018 VOP page 13.104). VOP document is attached to application.

Percent of Population

Describe what quantity (e.g., percentage) of the population will directly benefit from the project (i.e., experience direct community-wide benefits) and how the estimate was calculated. The subapplication should include percentages of the community's population that will directly and indirectly benefit from the project.

100% of Lancaster County's population, which the US Census Bureau estimates is 10,928 people, and countless visitors will benefit from this project because the project will expand public access from 50 feet to over 410 feet while protecting the County's only public beach.

This public/private partnership between the County of Lancaster and the Windmill Point Marina owner will provide the marina with a stabilized shoreline, protecting the marina infrastructure and buildings while also providing public access by expanding and protecting the County's only public beach. The Marina tenants and guests will benefit from this shoreline stabilization project through its protection against erosion of the beach and the protection of Marina infrastructure against property damage related to erosion and storm damage. This project will also include shoreline protection for the neighboring community, The Landing Townhomes at Windmill Point. There are eight townhomes adjacent to this project that will benefit from stabilization of their shoreline. In addition to protection of the private infrastructures (including critical infrastructure (the Windmill Point Marina)), the shoreline (including public beach access and private beach), and VDOT infrastructure (Windmill Point Road) will also be better protected from storm damage, continued erosion and the subsequent migration of mean high water.

Maximize Positive Impacts and Minimize Negative Impacts

Who are the most vulnerable community members where the project is proposed, and how will the project maximize positive impacts and minimize negative impacts to disadvantaged members of the community?

In assessing access to the water in Lancaster County it is evident that the supply of access is also in transition. In the past, much of the general public was able to access state waters through informal arrangement. That is no longer the case. Access has become very limited for non-waterfront residents, and the rest of the general public (visitors). These people can dine near the water, charter boats, or keep their own boat at a marina, but their options are limited by a lack of variety and financial constraints. Future opportunities to expand the variety and number of public access sites in Lancaster County are jeopardized by the expanding use of shoreline for residential purposes, and could very well become nonexistent in the near future.

Of Lancaster County's elementary school aged children, 75% qualify for free or reduced-price lunch at school (VDOE documentation attached); which means food insecurity is a community concern. Lancaster also experiences disparities specific to outdoor recreation. Its per capita spending is only 9 to 10% of the state average, according to the 2018 Virginia Outdoors Plan (attached (page 13.103)). Only 50% of its people say they have adequate access to outdoor physical activity, compared to 81% statewide (2018 VOP page 13.104).

The fishing pier will provide a place for residents and visitors to catch fish either recreationally or to supplement their diets to address the problem of food insecurity. Lancaster County plans to obtain a fishing license for the pier to maximize equitability of use and access.

The beach and natural area will provide public access (with no fee) to the waterfront for community members and visitors.

Stabilization of the eroded shoreline will benefit 100% of Lancaster County members, the adjacent townhome community, the marina community and countless visitors.

The county is actively working to address the concerns of Mr. Shawn Rose regarding his adjacent oyster lease, and hopes to purchase this lease from Mr. Rose to remove the risk that construction may pose to his livelihood as an oysterman. The county hopes to turn this potential negative impact into a positive for Mr. Rose (through purchase of the lease) and the entire community and ecosystem through the addition of a legacy oyster bed. A legacy oyster bed will provide habitat, learning opportunities for the community, and water quality improvement through the filtering benefits that oysters can provide.

Impacts to Disadvantaged Communities

Explain whether the project will maximize positive impacts to disadvantaged members of the community, as indicated below. Impacts can be directly related to the risk reduction activity, or indirectly related, such as with ancillary impacts (i.e., social, environmental, and economic *impacts). Subapplicants are encouraged to document their designation as an Economically Disadvantaged Rural Community (as referenced in 42 U.S.C. § 5133(a) as a small impoverished community) and indicate if their community has a [Centers for Disease Control and Prevention Social Vulnerability Index (SVI)](#) of 0.6 or higher.*

According to the CDC, the 2018 overall social vulnerability index for the area including the Westland Beach-Windmill Point Shoreline Stabilization Project was 0.431, which is a low to moderate level of vulnerability. However, this index does not apply to all of Lancaster County. There are areas of the County with a social vulnerability index of 0.6168, which is a moderate to high level of vulnerability (see attached 2018 Social Vulnerability Index Map for Lancaster County). According to the US Census Bureau, compared to Virginia averages, Lancaster's population is notably older (36.7% versus 16.3% aged 65+), in poorer health (11.4% versus 8.0% of people under 65 having a disability), less connected to modern amenities (80.2% versus 92.3% with a home computer), and lower in median household income ($59,736 versus $76,398, only 78% of the statewide average). The Virginia Department of Health ranks Lancaster County with a low overall health opportunity index: 96 out of 134 localities (see attached VDH Health Opportunity Index Map). Of Lancaster County's elementary school aged children, 75% qualify for free or reduced-price lunch at school (VDOE documentation attached). Lancaster also experiences disparities specific to outdoor recreation. Its per capita spending is only 9 to 10% of the state average, according to the 2018 Virginia Outdoors Plan (attached (page 13.103)). Only 50% of its people say they have adequate access to outdoor physical activity, compared to 81% statewide (2018 VOP page 13.104). The VOP report is attached to the application.

Qualitative Evaluation Criterion 5: Community Engagement and Other Outreach Activities (5 possible points)

Outreach Strategy to Advance Hazard Mitigation

What activities were conducted to advance the hazard mitigation outreach program to stakeholders during blue skies and during disasters?

Lancaster County is currently participating in the Northern Neck Hazard Mitigation Plan update. Lancaster County Emergency Services maintains an informational website for the public called [Ready Lancaster](#). Lancaster County Emergency Services was established in 2004 to provide emergency medical services (EMS) staffing to support the county's two volunteer rescue squads; this remains the core of our mission today. Our staff of EMTs and Paramedics work closely with [Kilmarnock-Lancaster County Volunteer Rescue Squad](#) and [Upper Lancaster Volunteer Rescue Squad](#) to ensure that Lancaster County has 24/7 coverage. The department is also responsible for coordinating emergency management activities for Lancaster County. These activities require collaboration with the volunteer fire departments, volunteer rescue squads, the Lancaster County Sheriff's Office, county departments and community groups. Lancaster County Emergency Services is responsible for maintaining the county's emergency operations plan, hazardous materials response plan and working with the Northern Neck Planning District Commission to maintain the regional hazard mitigation plan. Additionally, the department has appointed two hazardous materials officers to manage incidents in which hazardous materials present a threat to the environment or public health and safety. The department manages several community programs, including: the Community Emergency Response Team (C.E.R.T.), the Community Animal Response Team (C.A.R.T.), the Lancaster Amateur Radio Emergency Services (ARES) Group, and work with the Lancaster County Sheriff's Office and the Lancaster County TRIAD to provide the Yellow Dot program. These programs support the efforts of first responders and local officials in managing emergencies.

Lancaster County has contracted with Emergency Communications Network to provide emergency alerts to its citizens in the form of recorded telephone messages through a product known as CodeRED. The system was put in place prior to Hurricane Irene and was used to provide evacuation and shelter information during the event.

The CodeRED database used during Irene consisted of published telephone numbers only. Efforts to improve the CodeRED database to include unlisted numbers and cell phone numbers are ongoing. Lancaster County citizens can assist this endeavor by navigating to the CodeRED web site and reviewing/updating their contact information.

Lancaster County utilizes the following media outlets to release public information pertaining to hurricanes and other severe weather threats:

Radio Stations

- WKWI - 101.7 FM Kilmarnock
- WIGO - 104.9 FM Kilmarnock
- WRAR - 105.5 FM Tappahannock
- WNNT - 107.5 FM Warsaw
- WCNV - 98.1 FM Richmond/Heathsville

Television Stations

- WTVR - Channel 6 Richmond
- WRIC - Channel 8 Richmond
- WWBT - Channel 12 Richmond
- Metrocast Cable - Channel 7 Saluda

Lancaster County Department of Emergency Services operates a program geared towards preparing the county's senior population for safety and preparedness.

The program is designed as a follow-up with citizens who are 65 years and older and have received transport by the county rescue squads.

The department's staff will cover such topics as home safety, driving safety, and disaster preparedness. In addition, county emergency services staff members will check smoke detectors and give information on the programs available throughout the county.

Types of Community Planning Processes Leveraged

What planning processes were leveraged during the development of the project proposal to advance mitigation? How did the project planning process ensure that the disadvantaged in the community were involved in the planning and decision-making processes?

The County's Comprehensive Plan and the Northern Neck Hazard Mitigation Plan both informed and guided the development of this project. The County's Workgroup for Access to Public Waters, which is made up of a diverse group of stakeholders, was also instrumental in the development of this project. The purpose of the County's Workgroup for Access to Public Waters is to provide equitable access to Lancaster County's coastal resources for all community members, especially those who are economically disadvantaged and unable to pay for access.

In 2002 a Citizens Advisory Group was formed to address the need for public access to state waters in Lancaster County. Their report contained specific recommendations for expansion of public access to the state waters while acknowledging obstacles. In 2005, the Virginia General Assembly enabled the formation of the Northern Neck Chesapeake Bay Public Access Authority (NNCBPAA). On September 12, 2006, three counties in the Northern Neck - Lancaster, Northumberland and Westmoreland executed the operating agreement to form the Northern Neck Chesapeake Bay Public Access Authority to enhance public access within their jurisdictions. There are seven duties that the authority is charged with undertaking: 1. Identify land, either owned by the Commonwealth or private holdings that can be secured for use by the general public as a public access site, 2. Research and determine ownership of all identified sites, 3. Determine appropriate public use level of identified access sites, 4. Develop appropriate mechanisms for transferring title of Commonwealth or private holdings to the Authority, 5. Develop appropriate acquisition and site management plans for public access usage, 6. Determine which holdings should be sold to advance the mission of the Authority, 7. Perform other duties required to fulfill the mission of the Northern Neck Chesapeake Bay Access Authority. In October 2007 at the seventh meeting of the Northern Neck Chesapeake Bay Public Access Authority, Lancaster County representatives requested funding from the NNCBPAA to conduct environmental studies on a potential access site on a tributary to the Chesapeake Bay within Lancaster County. The NNCBPAA granted this request for funding to be used by Lancaster County in assessing the suitability of the parcel for public water access. This assessment determined the need for public access sites with the following types of access: natural area access, beaches and swimming access, and pier fishing access. This project is directly in-line with the access deemed needed by the Lancaster County's Comprehensive Plan and provides these three access types and also accomplishes the Comprehensive Plan goals for shoreline stabilization.

Project Conception and Design Input from a Diverse Range of Stakeholders

To what extent did stakeholders and/or stakeholder groups contribute to this project? What stakeholder collaboration activities occurred? What information regarding outreach has been included in the subapplication?

In 2002 a Citizens Advisory Group was formed to address the need for public access to state waters in Lancaster County. Their report contained specific recommendations for expansion of public access to the state waters while acknowledging obstacles. In 2005, the Virginia General Assembly enabled the formation of the Northern Neck Chesapeake Bay Public Access Authority (NNCBPAA). On September 12, 2006, three counties in the Northern Neck - Lancaster, Northumberland and Westmoreland executed the operating agreement to form the Northern Neck Chesapeake Bay Public Access Authority to enhance public access within their jurisdictions. In October 2007 at the seventh meeting of the Northern Neck Chesapeake Bay Public Access Authority, Lancaster County representatives requested funding from the NNCBPAA to conduct environmental studies on a potential access site on a tributary to the Chesapeake Bay within Lancaster County. The NNCBPAA granted this request for funding to be used by Lancaster County in assessing the suitability of the parcel for public water access. This assessment determined the need for public access sites with the following types of access: natural area access, beaches and swimming access, and pier fishing access. This project is directly in-line with the access deemed needed by the Lancaster County's Comprehensive Plan and provides these three access types and also accomplishes the Comprehensive Plan goals for shoreline stabilization.

This project was heard at the October 13, 2022 Public Hearing of the Lancaster County Wetlands Board (meeting minutes attached). There are 25 public comments regarding the project (24 in favor and 1 opposition) and these are included in the application. The Wetlands Board voted unanimously to permit the project. The wetland permit application is also attached to the application. The October Public Hearing was advertised in the local newspaper, The Rappahannock Record, and notifications were sent out to adjacent property owners prior to the Public Hearing. These notices generated many of the attached 25 public comments.

Community Planning and Stakeholder Input Directs Project Execution

What information (e.g., resilience goals and outcomes, partnership opportunities, project implementation progress) will be shared with the public? What public outreach and engagement strategies will be used to disseminate project information to and gather feedback from stakeholders and members of the community?

This project was presented to the public at the October 13, 2022 Public Hearing of the Lancaster County Wetlands Board. Adjacent property owners were notified of the hearing with letters and the general public was notified of the hearing with a notice in the local newspaper, The Rappahannock Record. This outreach produced a public response of 25 public comments, 24 in favor and 1 in opposition. As mentioned above, the County is diligently working to equitably address the opposition.

The County plans to develop a webpage for Public Access which will provide regular updates on the status of this project and all other pertinent information.

Qualitative Evaluation Criterion 6: Leveraging Partners (15 possible points)

Partnerships Ensuring the Project Meets Community Needs

What partners were involved in the project design? How did partners contribute to the application? What partners will contribute to the implementation of the project? Partnerships can take many different forms. For example, partners may contribute financially, support and promote the proposed project, help generate community-wide awareness of the risks the proposal is designed to address, and so on.

Lancaster County hopes to partner with the Friends of the Rappahannock for the installation of the vegetative plantings associated with this project. We also plan to partner with either the Virginia Commonwealth University Oyster Shell Recycling program or the Friends of the Rappahannock on the establishment and maintenance of the planned legacy oyster bed.

This shoreline stabilization project is a public/private partnership between multiple community partners, which include: Lancaster County, the Windmill Point Marina, and the Landing Townhomes at Windmill Point. This project also involves countless stakeholders, including all Lancaster County residents and visitors, who all stand to gain additional public access in the form of beach access, natural area access and fishing pier access.

As mentioned above, 24 public comments were made in favor of this project. The lone public comment in opposition has generated a response from the County which will benefit all stakeholders. The County's Workgroup for Access to Public Waters will continue to support this project in any way they can to ensure that this project meets the communities need for public access.

How These Partnerships Benefit Disadvantaged Communities

To what extent were non-governmental organizations—including those organizations that represent disadvantaged groups, universities, or other government entities—consulted for advice or assistance? How has collaboration with surrounding jurisdictions supported project development?

It is our goal to work with both the Virginia Commonwealth Oyster Shell Recycling Program for establishment of a legacy oyster bed and the Friends of the Rappahannock on the vegetative plantings for this project.

This project will allow public access to our waterways for our disadvantaged communities. Including a no-fee public beach and nature access use area and a fishing pier. The fishing pier will provide a place for residents and visitors to catch fish either recreationally or to supplement their diets. Lancaster County plans to obtain a fishing license for the pier to maximize equitability of use and access.

Project implementation includes submittal of a Joint Permit Application to VMRC, AOCE, VDEQ, NOAA and VIMS for review. This application has been submitted and is currently under review. Some of these agencies have already filed comments on the project and those are attached to the application. These organizations input, advice and assistance are invaluable and will be used to guide and inform this project.

The Northern Neck Chesapeake Bay Public Access Authority (NNCBPAA) has supported the development of public access from its inception and this project implements recommendations developed from an assessment paid for by the NNCBPAA. The assessment determined the need for public access sites with the following types of access: natural area access, beaches and swimming access, and pier fishing access. This project is directly in-line with the access deemed needed by the Lancaster County's Comprehensive Plan and provides these three access types and also accomplishes the Comprehensive Plan goals for shoreline stabilization.

Anticipated Outcome from Partnerships

How have partnerships been used to increase community resilience? What community groups will participate in this project? What potential exists for partnerships to continue beyond implementation of the project?

To what extent have other federal programs or funding sources been leveraged for the project? To what extent have partners provided funding that increases the non-federal cost share?

It is our goal to work with both the Virginia Commonwealth University's Oyster Shell Recycling Program for establishment of a legacy oyster bed and the Friends of the Rappahannock on the vegetative plantings for this project. Both of these activities will be maintained as necessary and it is our hope to partner and utilize the expertise of these groups to assist us in maintaining a healthy legacy oyster bed in the water and healthy vegetative plantings on land.

NNPDC continues to work tirelessly to assist us in identifying potential funding sources for regional public access goals. We continue to pursue partnerships and potential funding sources.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Virginia Ecological Services Field Office
6669 Short Lane
Gloucester, VA 23061-4410
Phone: (804) 693-6694 Fax: (804) 693-9032

October 14, 2022

In Reply Refer To:
Project Code: 2022-0063054
Project Name: Windmill Point Road Pre-application

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Any activity proposed on National Wildlife Refuge lands must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2) (c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/birds/policies-and-regulations.php.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/birds/policies-and-regulations/executive-orders/e0-13186.php.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Project Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Virginia Ecological Services Field Office
6669 Short Lane
Gloucester, VA 23061-4410
(804) 693-6694

Project Summary

Project Code: 2022-0063054
Project Name: Windmill Point Road Pre-application
Project Type: Beach nourishment
Project Description: Breakwaters and Beach Nourishment
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@37.615448400000005,-76.29330951491603,14z

Counties: Lancaster County, Virginia

Endangered Species Act Species

There is a total of 2 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Insects

NAME	STATUS
Northeastern Beach Tiger Beetle *Habroscelimorpha dorsalis dorsalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8105	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
American Oystercatcher *Haematopus palliatus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8935	Breeds Apr 15 to Aug 31
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Oct 15 to Aug 31

NAME	BREEDING SEASON
Black Skimmer *Rynchops niger* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5234	Breeds May 20 to Sep 15
Chimney Swift *Chaetura pelagica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 25
Eastern Whip-poor-will *Antrostomus vociferus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 1 to Aug 20
Gull-billed Tern *Gelochelidon nilotica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9501	Breeds May 1 to Jul 31
Prairie Warbler *Dendroica discolor* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 1 to Jul 31
Red-headed Woodpecker *Melanerpes erythrocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10
Ruddy Turnstone *Arenaria interpres morinella* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
Short-billed Dowitcher *Limnodromus griseus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Willet *Tringa semipalmata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Apr 20 to Aug 5
Wood Thrush *Hylocichla mustelina* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Aug 31

Probability Of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

No Data (—)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

■ probability of presence ■ breeding season | survey effort — no data

Additional information can be found using the following links:

- Birds of Conservation Concern https://www.fws.gov/program/migratory-birds/species
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf

Migratory Birds FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?
Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects
For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?
If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report
The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no

data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

IPaC User Contact Information

Agency:	Army Corps of Engineers
Name:	Nancy Davis
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State:	VA
Zip:	23510
Email	nancy.p.davis@usace.army.mil
Phone:	7572017044

Species Conclusions Table

Project Manager: Nancy Davis	Project Name: Windmill Point (Westland Beach) Breakwaters and Beach Nourishment
Date: 11/2/2022	Project Number: NAO-2019-01193 (22-V2229)

Project Description: The applicant proposes to remove concrete debris and portions of existing stone groins; construct five armor stone breakwaters, two armor stone spurs, beach nourishment; and add new plantings. The project would result in the loss of 0.57 acre of subaqueous bottom and 0.02 acre of tidal non-vegetated wetlands (covering existing stone groins). In addition, the ecological restoration would include 2.81 acres of beach nourishment and 0.96 acre of new beach and dune plantings.

Species Under the Jurisdiction of FWS:

Species/Resource Name	Habitat/Species Presence in Action Area	ESA Section 7 Determination	Sources of Info	Project Elements that Support Determination
Northern long-eared bat (Myotis septentrionalis)	No suitable habitat present	No effect	"Northern long-eared bats spend winter hibernating in caves and mines, called hibernacula. They typically use large caves or mines with large passages and entrances; constant temperatures; and high humidity with no air currents. Specific areas where they hibernate have very high humidity, so much so that droplets of water are often seen on their fur. Within hibernacula, surveyors find them in small crevices or cracks, often with only the nose and ears visible. During summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat seems opportunistic in selecting roosts, using tree species based on suitability to retain bark or provide cavities or crevices. It has also been found, rarely, roosting in structures like barns and sheds."	No trees or other suitable habitat present

Species Conclusions Table

Date: 11/2/2022	Project Number: NAO-2019-01193 (22-V2229)

Northeastern beach tiger beetle (Cicindela dorsalis dorsalis)	Suitable habitat present, species not present	Not likely to adversely affect	"Historically, the northeastern beach tiger beetle was common on coastal beaches from Massachusetts to central New Jersey, and along the Chesapeake Bay in Maryland and Virginia. Currently, the only populations known to exist along the Atlantic Coast are in New Jersey and southeastern Massachusetts. The majority of populations occur in the Chesapeake Bay." "Adult and larval tiger beetles are found on long, wide, dynamic beaches that have little human and vehicular activity, fine sand-particle size, and a high degree of exposure to tidal action."	The following comments were provided by FWS on 8/19/2021 for this site under VMRC#21-1029: "Based on the 2021 survey results provided by Barry Kinsley to the Service via email on August 16, 2021, no adults and no apparent habitat have been found in the action area or areas directly adjacent to the action area. Adults have been documented within 1-mile of the action area. Because adult tiger beetles can fly more than a mile to colonize a beach, a time-of-year restriction (May 15-October 1) is recommended. The applicant has agreed to adhere to this time-of-year restriction, therefore, we believe any effects of the project on the northeastern beach tiger beetle will be insignificant and discountable, and that the project, as proposed, is not likely to adversely affect this species." The TOYR restriction will be added to the permit letter as a special condition.
Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus)	No critical habitat present	Not likely to adversely affect	Atlantic sturgeon are "anadromous"; adults spawn in freshwater in the spring and early summer and migrate into "estuarine" and marine waters where they spend most of their lives. In some southern rivers a fall spawning migration may also occur. They spawn in moderately flowing water (46-76	A turbidity curtain will be installed and maintained throughout the construction process to minimize any sedimentation and bottom disturbance outside of the construction area.
Shortnose sturgeon (Acipenser brevirostrum)	No critical habitat present	Not likely to adversely affect	All life stages; shortnose sturgeon occur in large coastal rivers of eastern North America, from New Brunswick to Florida (Dadswell et al. 1984). In the Gulf of Maine important numbers of shortnose	A turbidity curtain will be installed and maintained throughout the construction process to minimize any sedimentation and bottom disturbance outside of the construction area.
Green Sea Turtle (Chelonia mydas)	No critical habitat present	Not likely to adversely affect	Adult females migrate from foraging areas to mainland or island nesting beaches and may travel hundreds or thousands of kilometers each way. After emerging from the nest, hatchlings swim to offshore areas, where they are believed to live for several years, feeding close to the surface on a	A turbidity curtain will be installed and maintained throughout the construction process to minimize any sedimentation and bottom disturbance outside of the construction area.
Loggerhead Sea Turtle (Caretta caretta)	No critical habitat present	Not likely to adversely affect	Loggerheads nest on ocean beaches, generally preferring high energy, relatively narrow, steeply sloped, coarse-grained beaches. Immediately after hatchlings emerge from the nest, they begin a period of frenzied activity. During this active period, hatchlings move from their nest to the surf,	A turbidity curtain will be installed and maintained throughout the construction process to minimize any sedimentation and bottom disturbance outside of the construction area.

Species Conclusions Table

Date: 11/2/2022	Project Number: NAO-2019-01193 (22-V2229)

Leatherback Sea Turtle (Dermochelys coriacea)	No critical habitat present	Not likely to adversely affect	The Eastern Pacific Leatherback subpopulation nests along the Pacific coast of the Americas from Mexico to Ecuador, and marine habitats extend from the coastline westward to approximately 130°W and south to approximately 40°S. This subpopulation is genetically distinct from all other Leatherback subpopulations, despite having some areas of overlap with the Western Pacific subpopulation (Dutton et al. 1999). In the Atlantic nesting female leatherbacks tagged in French Guiana have been found along the east tracked, using satellite transmitters, to the west coast of North America as far north as Newfoundland. Atlantic Canada supports one of the largest seasonal foraging populations of leatherbacks in the Atlantic. Leatherbacks have also been tagged with satellite transmitters at sea off Nova Scotia (James et al., 2005). Adult leatherbacks are capable of tolerating a wide range of water temperatures and have been sighted along the entire continental east coast of the United States as far north as the Gulf of Maine and south to Puerto Rico, the U.S. Virgin Islands, and into the Gulf of Mexico.	A turbidity curtain will be installed and maintained throughout the construction process to minimize any sedimentation and bottom disturbance outside of the construction area.
Kemp's Ridley Sea Turtle (Lepidochelys kempii)	No critical habitat present	Not likely to adversely affect	Adult Kemp's primarily occupy "neritic" habitats. Neritic zones typically contain muddy or sandy bottoms where prey can be found. Their diet consists mainly of swimming crabs, but may also include fish, jellyfish, and an array of mollusks.	A turbidity curtain will be installed and maintained throughout the construction process to minimize any sedimentation and bottom disturbance outside of the construction area.
NOAA Fisheries				
Essential Fish Habitat	Present	Not likely to adversely affect	Little Skate, Atlantic Herring, Red Hake, Winter Hake, Clearnose Skate, Windowpane Flounder, Sandbar Shark, Bluefish, Summer Flounder	The waterway width of the Rappahannock River is approximately four miles at the project site and should allow safe passage. A turbidity curtain will be installed and maintained throughout the construction process to minimize any sedimentation and bottom disturbance outside of the construction area.

Species Conclusions Table

Date: 11/2/2022	Project Number: NAO-2019-01193 (22-V2229)

Anadromous Fish Use Area	Present	Not likely to adversely affect	Identified as an anadromous fish use area on the Regulatory Report	The waterway width of the Rappahannock River is approximately four miles at the project site and should allow safe passage. A turbidity curtain will be installed and maintained throughout the construction process to minimize any sedimentation and bottom disturbance outside of the construction area.
SAV Beds	Present	Not likely to adversely affect	VIMS SAV website	The five-year composite from the Virginia Institute of Marine Science submerged aquatic vegetation website indicates that the project will be outside of intermittent submerged aquatic vegetation on the west end and within intermittent submerged aquatic vegetation on the east end, however, these beds have not been observed since the 2018 survey. A turbidity curtain will be installed and maintained throughout the construction process to minimize any sedimentation and bottom disturbance outside of the construction area.
Other (species not listed above)				

COUNTY OF LANCASTER

FOUNDED 1651 IN VIRGINIA

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Don G. Gill
County Administrator

WETLANDS BOARD
COUNTY OF LANCASTER, VIRGINIA
WETLANDS PERMIT

Pursuant to chapter 2.1 of the Code of Virginia (1950) as amended, the Commonwealth of Virginia, Lancaster County Wetlands Board, hereinafter referred to as the Board, hereby authorizes the construction project described below.

1. **Permittee, Project, Special Conditions, And Board-Required Revisions Bearing the Date of September 20, 2022: Lancaster County Board of Supervisors et Al. c/o Craig Palubinski, 9 Steamboat Landing, Kinsale, VA 22488; requests permission to install five armor stone breakwaters (180', 240', 220', 90', & 110'), two armor stone spurs (60' & 50'), and 18,000 cubic yards of beach nourishment with 42,000 square feet of beach and dune vegetation plantings along the shoreline of the Rappahanock River. Located off VSH 695 (Windmill Point Road) at the end of Windmill Point Road. Tax Map #41-4-0, 40D-1-2 & 40-39. VMRC #22-2229.**
   Approved as submitted.
2. **The official and complete description of this project is contained in the permittee's application for wetlands permit as approved by this Board on this date and is made a part hereof.**
3. **The granting of this permit shall not relieve the permittee of the responsibility of obtaining any and all other permits or authority required for the project.**
4. **DATES:** The project shall not be started before **October 24, 2022**, and must be completed prior to **October 24, 2025.** **NOTE: No extensions shall be granted beyond these dates without application for extension, in writing, to the wetlands board prior to the permit expiration date.**
5. **GENERAL CONDITIONS: This Permit Is Granted Subject To The Following Terms And Conditions:**
   a. Except as hereinafter provided, all phases of the project shall conform in all particulars to the permittee's application for wetlands permit. The duly authorized agents of the Board shall have the right to enter the premises at any reasonable time for the purpose of inspecting the work being done pursuant to this permit.
   b. The permittee shall, to the greatest extent practicable, minimize the adverse effects of the project upon adjacent properties and wetlands and upon the natural resources of the Commonwealth. (Such other terms and conditions peculiarly applicable to the particular project being permitted in order to promote to the greatest extent possible the public policy expressed in the Act and to minimize the impact of the project upon the rights and property of others and upon the ability of the local government to provide governmental services.)
   c. This permit shall not be transferred without the prior written approval of the Board.
   d. Permittee shall comply with all applicable laws, ordinances, rules and regulations affecting the conduct of this project.
   e. Permittee shall adhere to proper E & S controls during wetlands construction and acquire the necessary county E & S permits for work landward of mean high water.
   f. This permit shall be revoked at any time by the Board upon failure of the permittee to comply with any of the terms and conditions hereof.

IN WITNESS, WHEREOF, the County of Lancaster, Virginia, Wetlands Board has caused these presents to be executed in its behalf by the Chairman, whose signature is affixed hereto as evidence of his acceptance of the terms and conditions hereof.

Commonwealth of Virginia
County of Lancaster
Wetlands Board:

By Elna Reuse
Board Chairman
Affirmed before me this 26th day of October, 2022
By the Chairman, Lancaster Co. Wetlands Board

Crystal Lynn Whay
Notary Public
My commission expires 11/30/23
Notary #:
7362746

CRYSTAL LYNN WHAY
Notary Public
Commonwealth of Virginia
Registration Number 7362746
COMM. EXPIRES: NOVEMBER 30, 2023

Permittee: Don G. Gill

City/County of Lancaster
Commonwealth of Virginia
The foregoing instrument was acknowledged before me this 26th day of October, 2022

By Don G. Gill
Crystal Lynn Whay
Notary Public (authentication & seal).
My commission expires 11/30/23
Notary #: 7362746

CRYSTAL LYNN WHAY
Notary Public
Commonwealth of Virginia
Registration Number 7362746
COMM. EXPIRES: NOVEMBER 30, 2023

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
FORT NORFOLK
803 FRONT STREET
NORFOLK VA 23510-1011

March 31, 2023

Northern Virginia Regulatory Section
NAO-2019-01193 / VMRC# 22-V2229 (Rappahannock River)

Don G. Gill, County Administrator - Lancaster County Board of Supervisors;
Peter D. Anzo, Manager - RL PROP. 2011 Investments, LLC; and
David J. Simons, Member - The Landing Owners Association
c/o Craig Palubinski – Bayshore Design, LLC
9 Steamboat Landing
Kinsale, VA 22488

Dear Sirs:

Enclosed is an electronic copy of a Department of the Army permit authorizing you to perform certain work in waters of the United States. The permit must be signed by the applicants in the spaces provided for the permittees signatures and returned to the address below or emailed to nancy.p.davis@usace.army.mil, if returned electronically. Upon receipt, the district engineer or his authorized representative will sign the permit and return it to you. **The permit is not valid until signed by both parties.**

This letter contains an initial proffered permit for your proposed project. If you object to this decision, you may request an administrative appeal under Corps regulations at 33 CFR part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and Request for Appeal (RFA) form. If you request to appeal this decision you must submit a completed RFA form to the Norfolk District Office at the following address: United States Army Corps of Engineers, CENAO-WR-R, Andrew Beaudet, Acting Chief, Regulatory Branch, 803 Front Street, Norfolk, VA 23510-1011.

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR part 331.5, and that it has been received by the District Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be received at the above address within **60 days** from the date of this letter. It is not necessary to submit an RFA form to the District office if you do not object to the decision in this letter.

Please take note of project specific special conditions and general conditions incorporated in this permit. Enclosed is a "compliance certification" form, which must be signed and returned within 30 days of completion of the project, including any required mitigation. Your signature on this form certifies that you have completed the work in accordance with the permit terms and conditions.

Received by VMRC July 25, 2023 /blh

If any material change in the plan of the work is found necessary, revised plans must be submitted and approved before any work is begun.

If you have any questions, you may call Nancy Davis at (757) 677-6298 or nancy.p.davis@usace.army.mil.

Sincerely,

M Tucker Smith

Tucker Smith
Chief, Northern Virginia
Regulatory Section

Enclosure(s)

U.S. Army Corps
Of Engineers
Norfolk District

Fort Norfolk, 803 Front Street
Norfolk, Virginia 23510-1096

DEPARTMENT OF THE ARMY PERMIT

Permittees:

1) Don G. Gill, County Administrator - Lancaster County Board of Supervisors;
2) Peter D. Anzo, Manager - RL PROP. 2011 Investments, LLC; and
3) David J. Simons, Member - The Landing Owners Association

Permit No.: **NAO-2019-01193 / VMRC# 22-V2229**

Issuing Office: **U.S. Army Corps of Engineers Norfolk District Regulatory Branch (CENAO-WR-R)**

Note: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below pursuant to:

- ☒ Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).
- ☒ Section 404 of the Clean Water Act (33 U.S.C. 1344).
- ☐ Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

Project Description:

The permittees are hereby authorized to restore approximately 1,324 linear feet of eroding shoreline and construct five (5) armor stone breakwaters, two (2) armor stone spurs, and 2.80 acres of beach nourishment with 0.96 acre of new dune plantings. All work will be performed on the Rappahannock River at Westland Beach, Windmill Point Marina, and the Landing Owners Association at the end of Windmill Point Road, in Lancaster County, Virginia as described above and depicted on the attached drawings titled, "**Proposed Shoreline Stabilization Project, Windmill Point Marina and Westland Beach, Windmill Point-Fleets Island, Lancaster County, Virginia**" prepared by Bayshore Design, LLC and stamped as received by this office on September 20, 2022, October 11, 2022, and January 9, 2023.

Received by VMRC July 25, 2023 /blh

Project Location: The project is located on the Rappahannock River at Westland Beach, Windmill Point Marina, and the Landing Owners Association at the end of Windmill Point Road, in Lancaster County, Virginia.
Latitude 37.6157°, Longitude -76.2935°

Project Specific Special Conditions:

1. Prior to the commencement of any work authorized by this permit, you shall advise the project manager, Nancy Davis, at nancy.p.davis@usace.army.mil, at least two weeks in advance of starting work authorized by this permit. Alert the project manager of the anticipated start date of the authorized activity and the name and telephone number of all contractors or other persons performing the work. A copy of this permit and drawings must be provided to the contractor and kept on site at all times, available to any regulatory representative during an inspection of the project site.

2. The time limit for completing the work authorized ends on **March 31, 2028**. Should you be unable to complete the authorized activity in the time limit provided, you must submit your request for a time extension to this office for consideration at least one month before the permit expiration date.

3. Enclosed is a "compliance certification" form, which must be signed and returned within 30 days of completion of the project, including any required mitigation. Your signature on this form certifies that you have completed the work in accordance with the permit terms and conditions.

4. In compliance with the Endangered Species Act, work may not take place on the beach from May 15 to October 1 of any given year to protect the Northeastern beach tiger beetle (*Habroscelimorpha dorsalis dorsalis*).

5. The material used for beach nourishment and wetlands planting shall be of similar type and composition as the existing sand present along the shoreline with an average grain size of 0.5mm to 0.7mm.

6. Existing concrete debris and rubble will be removed and disposed of in an approved upland location. Only clean broken concrete, free of any rebar and wire mesh, may be used as part of the core base for the breakwaters. The existing failed stone groins will be removed and the stone will also be reused as part of the core base for the breakwaters.

7. MONITORING REQUIREMENTS: The applicant will provide a written monitoring report at the end of the first full growing season following planting, and after the second year of establishment. The monitoring should be undertaken between June and September of each year and should include at a minimum: the project location, the Corps project number, representative photos of the site, and a brief statement on the success of the project.

Received by VMRC July 25, 2023 /blh

8. The permittee shall use appropriate erosion and sediment controls, including the use of turbidity curtains during construction.

9. Destruction or alteration of waters of the U.S. (including wetlands) other than those impacts authorized under this permit are prohibited.

10. If a project specific condition of this permit cannot be met, then you must apply for a permit modification. Any proposed permit modification will be coordinated with the Virginia Department of Environmental Quality, NOAA, USFWS, Lancaster County, and the Environmental Protection Agency Region III.

General Conditions:

1. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition **3** below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

2. If you discover any previously unknown historic or archaeological remains while accomplishing the activity authorized by this permit, you must immediately stop work and notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

3. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

4. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit.

5. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

6. No discharge of dredged or fill material may consist of unsuitable material (e.g.: trash, debris, car bodies, asphalt etc.) and material discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. Any temporary fills must be removed in their entirety and the affected areas returned to their preexisting elevation.

8. Appropriate erosion and siltation controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date.

9. The construction or work authorized by this permit will be conducted in a manner so as to minimize any degradation of water quality and/or damage to aquatic life. Also, you will employ measures to prevent or control spills of fuels or lubricants from entering the waterway.

10. Any heavy equipment working in wetlands other than those permitted for permanent impact must be placed on mats or other measures must be taken to minimize soil disturbance.

11. Failure to comply with the terms and conditions of this permit can result in enforcement actions against the permittee and/or contractor.

12. In granting an authorization pursuant to this permit, the Norfolk District has relied on the information and data provided by the permittee. If, subsequent to notification by the Corps that a project qualifies for this permit, such information and data prove to be materially false or materially incomplete, the authorization may be suspended or revoked, in whole or in part, and/or the Government may institute appropriate legal proceedings.

13. All dredging and/or filling will be done so as to minimize disturbance of the bottom or turbidity increases in the water which tend to degrade water quality and damage aquatic life.

14. Your use of the permitted activity must not interfere with the public's right to reasonable navigation on all navigable waters of the United States.

15. The permittee understands and agrees that if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army of his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required upon due notice from the Corps of Engineers to remove, relocate, or alter the structural work or obstructions caused thereby without expense to the United States. No claim shall be made against the United States on account of any such removal or alternation.

Further Information:

1. Limits of this authorization:
   a. This permit does not obviate the need to obtain other Federal, state or local authorizations required by law.
   b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.
d. This permit does not authorize interference with any existing or proposed Federal projects.

2. Limits of Federal Liability: In issuing this permit, the Federal Government does not assume any liability for the following:
   a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.
   b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.
   c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.
   d. Design or construction deficiencies associated with the permitted work.
   e. Damage claims associated with any future modification, suspension, or revocation of this permit.

3. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

4. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:
   a. You fail to comply with the terms and conditions of this permit.
   b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 3 above).
   c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

   Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

5. Extensions: Project Specific Condition #2 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit. Dredging authorization shall not exceed 10 years (33 CFR 325.6(e) and further authorization would require a new application.

Your signatures below, as the permittees, indicate that you accept and agree to comply with the terms and conditions of this permit.

Don G. Gill (Permittee)
County Administrator - Lancaster County Board of Supervisors

7/24/23
(Date)

Peter D. Anzo (Permittee)
Manager - RL PROP. 2011 Investments, LLC

7/24/23
(Date)

David J. Simons (Permittee)
Member - The Landing Owners Association

7/24/23
(Date)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

For Brian P. Hallberg, PMP
Colonel, U.S. Army
Commanding

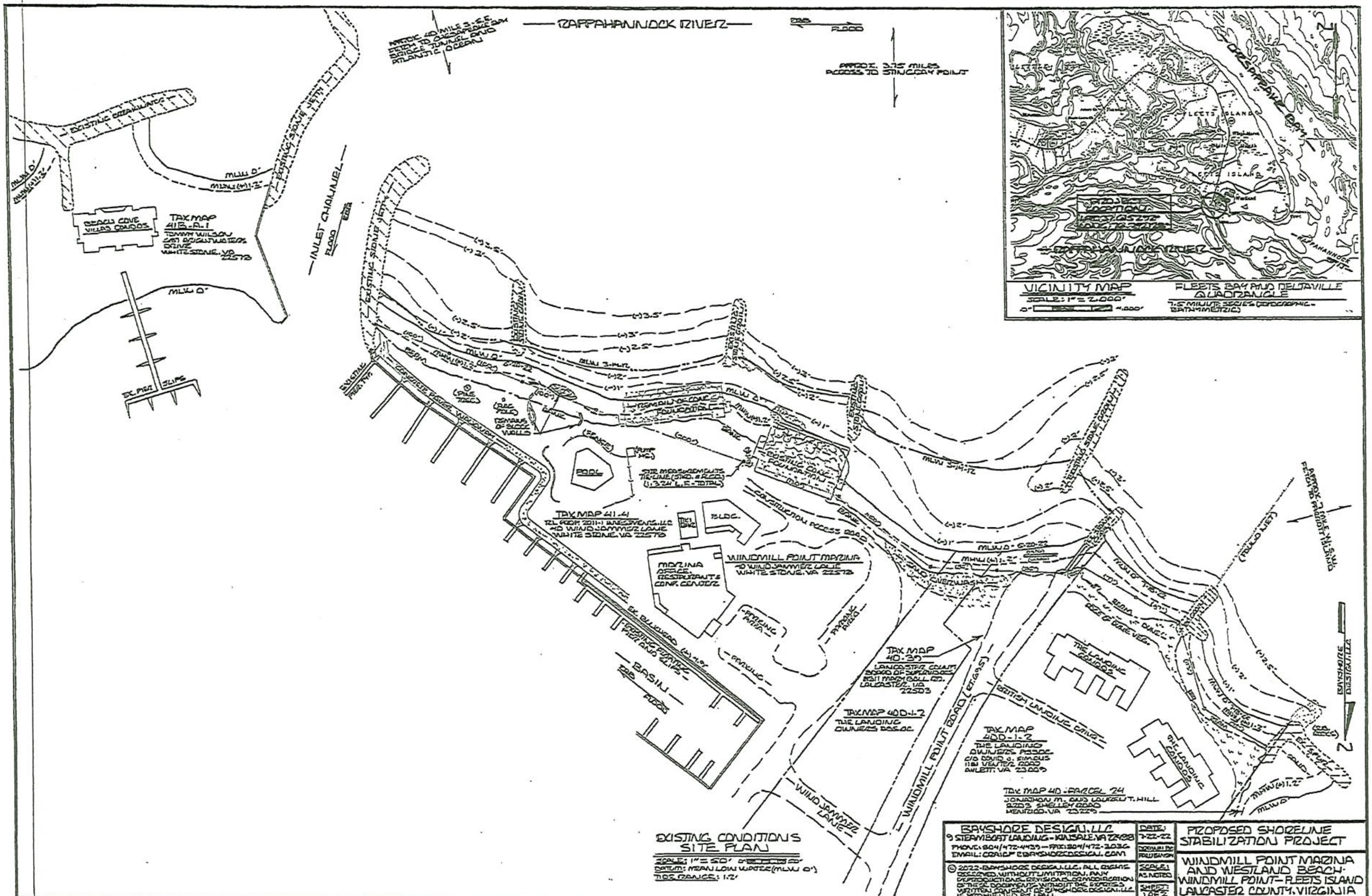
July 25, 2023
(Date)

Received by VMRC July 25, 2023 /blh

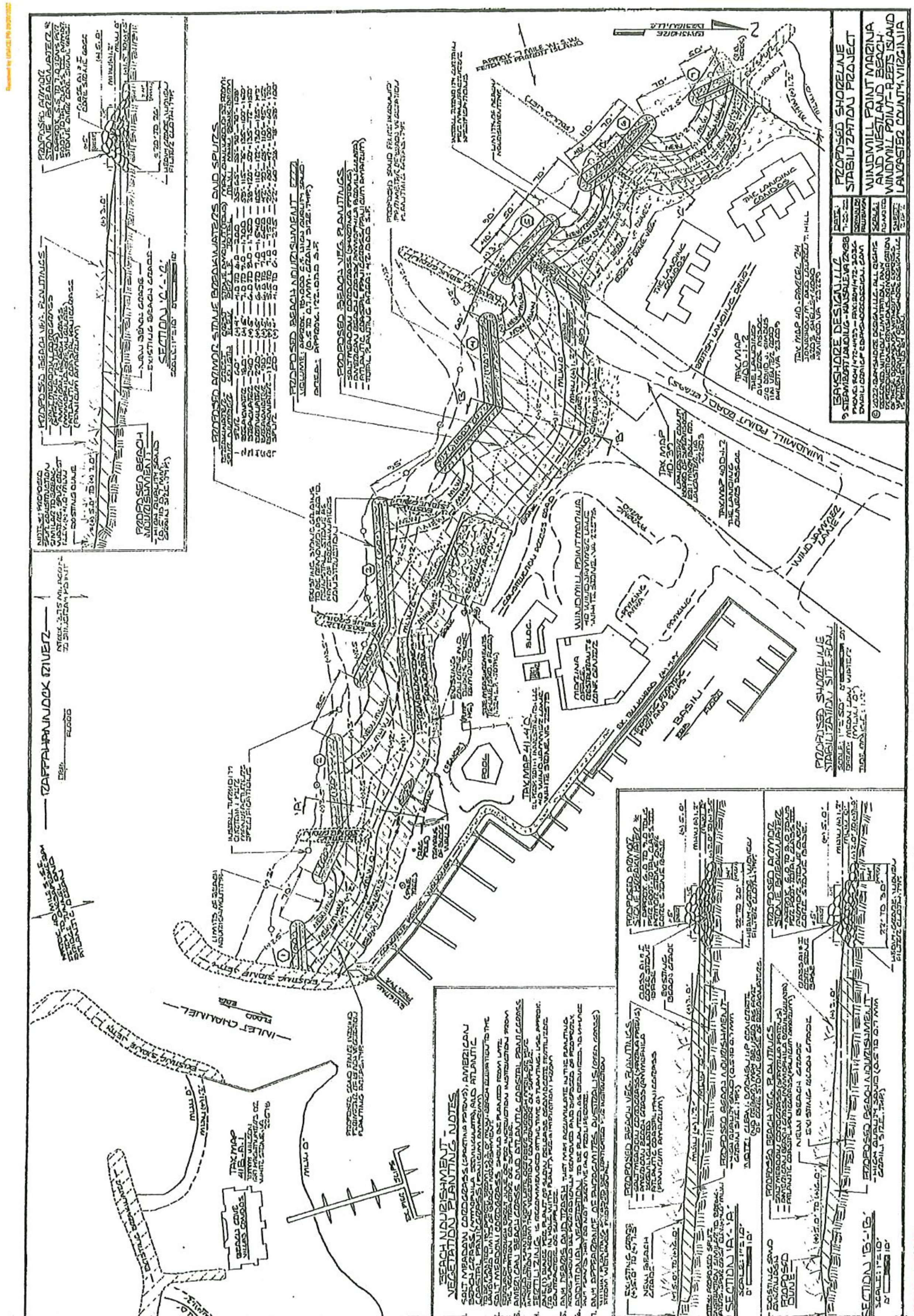
When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

____
(Transferee)

____
(Date)

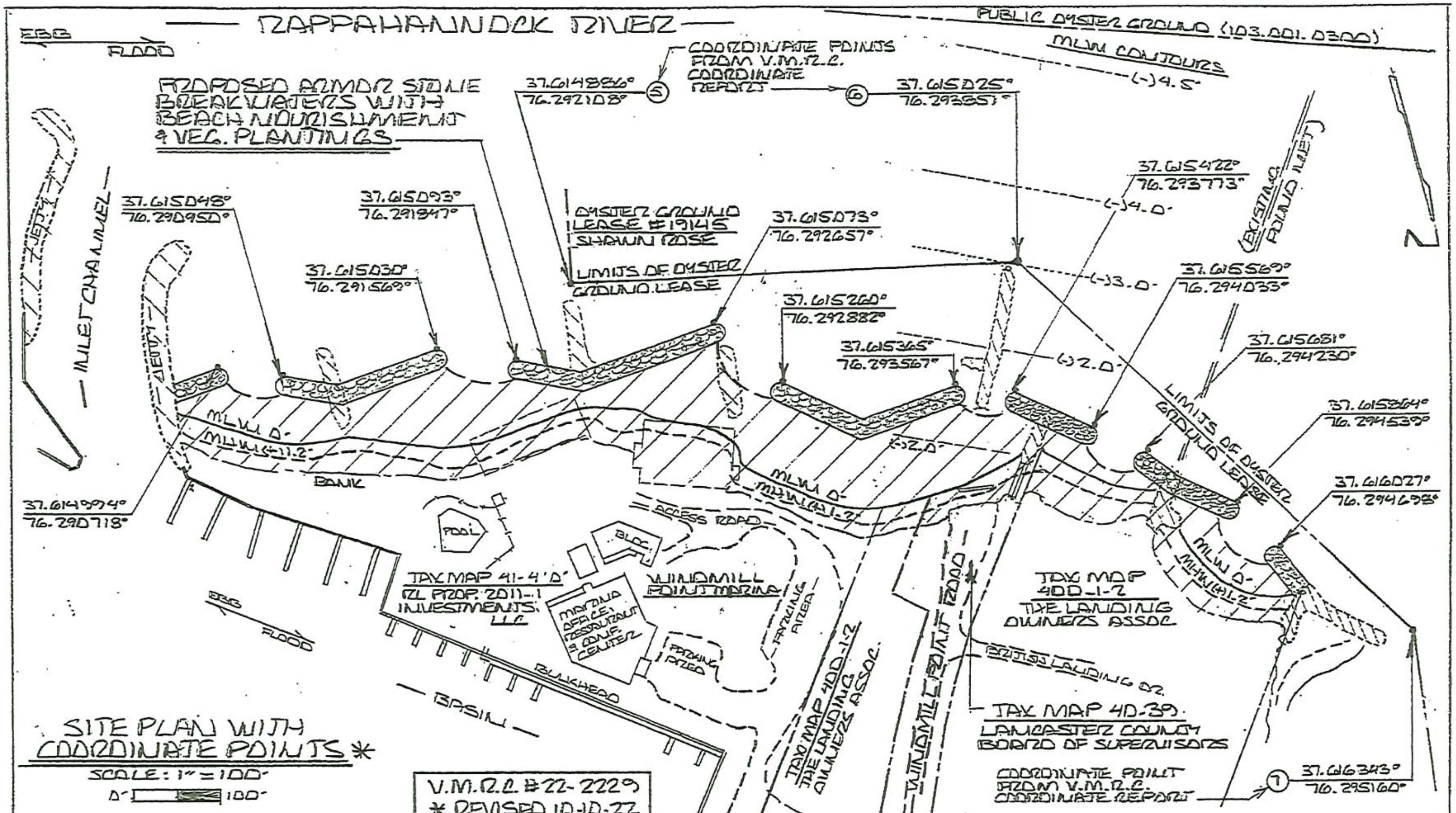


Received by VMRC July 25, 2023 /blh



Received by VMRC July 25, 2023 /blh

USACE received October 11, 2022



SITE PLAN WITH COORDINATE POINTS *

SCALE: 1" = 100'

0' 100'

V.M.R.C. #22-2229
* REVISED 10-10-22

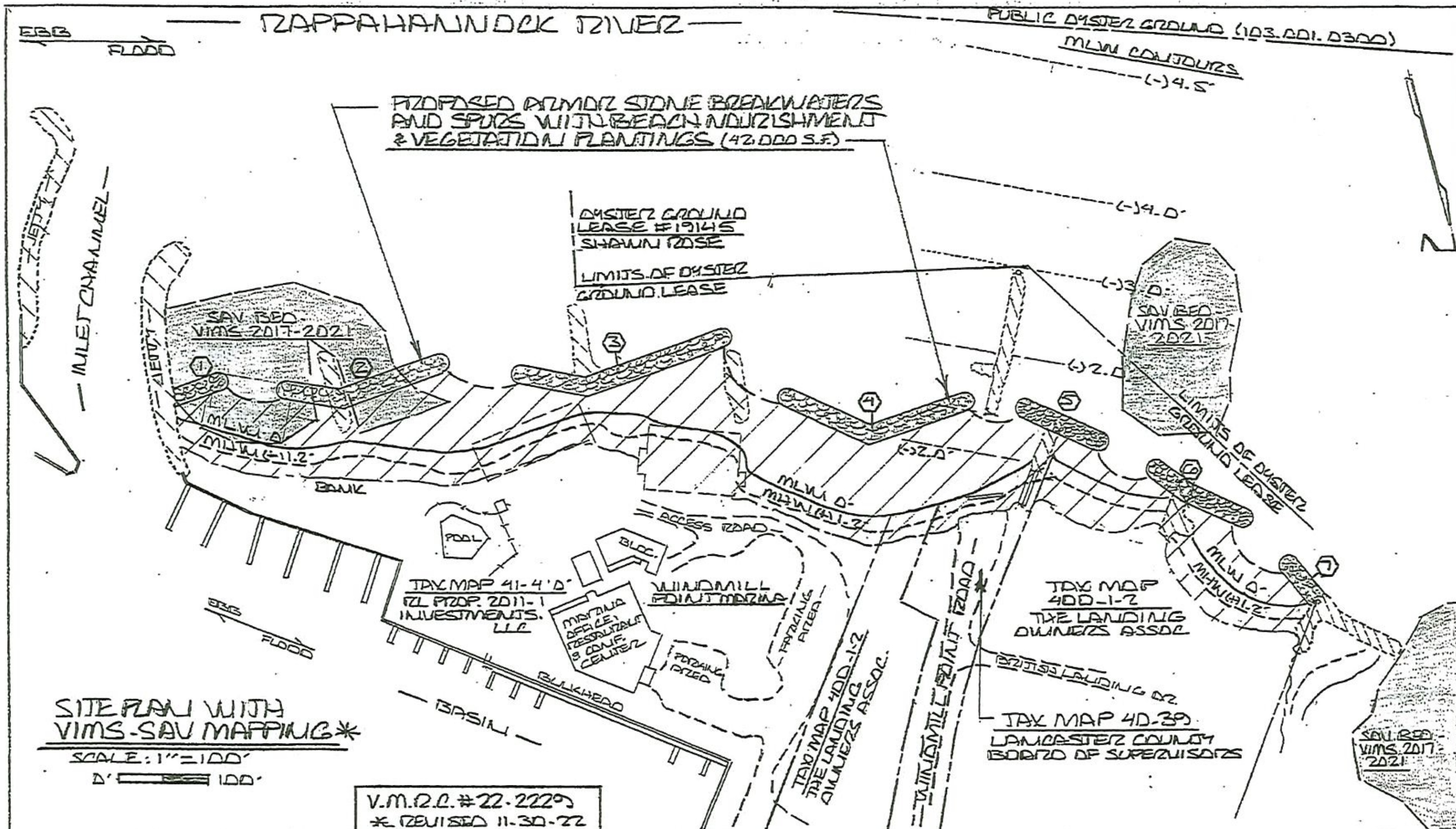
PROPOSED SHORELINE STABILIZATION PROJECT LANCASTER CO. BOARD OF SUPERVISORS, ETAL 8311 MARY BALL ROAD LANCASTER, VIRGINIA 22503	©-2022-BAYSHORE DESIGN, LLC. ALL RIGHTS RESERVED. WITHOUT LIMITATION, ANY REPRODUCTIONS, REVISIONS OR MODIFICATION OF THESE DOCUMENTS WITHOUT THE EXPRESS WRITTEN CONSENT OF BAYSHORE DESIGN, LLC IS PROHIBITED BY LAW.	LOCATION: WINDMILL POINT MARINA, WESTLAND BEACH & THE LANDING CONDOS, LANCASTER COUNTY, VIRGINIA SHT.: 1 OF 1 DATE: 10-10-22 BAYSHORE DESIGN, LLC

Additional Information/Revision Received by VMRC October 11, 2022 / lra

Received by VMRC July 25, 2023 /blh

Received by VMRC July 25, 2023 /blh

USACE received January 9, 2023



PROPOSED SHORELINE STABILIZATION PROJECT LANCASTER CO. BOARD OF SUPERVISORS, ETAL 8311 MARY BALL ROAD LANCASTER, VIRGINIA 22503	©-2022-BAYSHORE DESIGN, LLC, ALL RIGHTS RESERVED, WITHOUT LIMITATION. ANY REPRODUCTIONS, REVISIONS OR MODIFICATION OF THESE DOCUMENTS WITHOUT THE EXPRESS WRITTEN CONSENT OF BAYSHORE DESIGN, LLC IS PROHIBITED BY LAW.	LOCATION: WINDMILL POINT MARINA, WESTLAND BEACH & THE LANDING CONDOS, LANCASTER COUNTY, VIRGINIA SHT: 1 OF 1 DATE: 11-30-22 BAYSHORE DESIGN, LLC

Additional Information/Revision Received by VMRC January 9, 2023 / lra

U.S. Army Corps
Of Engineers
Norfolk District

CERTIFICATE OF COMPLIANCE
WITH
ARMY CORPS OF ENGINEERS PERMIT

Permit Number: NAO-2019-01193 / VMRC# 22-V2229

Corps Contact: Nancy P. Davis

Name of Permittees: Don G. Gill, County Administrator - Lancaster County Board of Supervisors; Peter D. Anzo, Manager - RL PROP. 2011 Investments, LLC; and David J. Simons, Member - The Landing Owners Association

Date of Issuance: March 31, 2023

Permit Type: Individual Permit

Within 30 days of completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

US Army Corps of Engineers - Norfolk District
CENAO-WR-R
Attn: Nancy P. Davis
803 Front Street
Norfolk, VA 23510-1096

Or scan and send via email to nancy.p.davis@usace.army.mil

Please note that your permitted activity is subject to a compliance inspection by a U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation has been completed in accordance with the permit conditions.

______________________________ ______________________________
Signature of Permittee Date

Received by VMRC July 25, 2023 /blh

MRC 30-317

VMRC# 2022-2229
Applicant: Lancaster County Board of Sup

COMMONWEALTH OF VIRGINIA
MARINE RESOURCES COMMISSION
PERMIT

The Commonwealth of Virginia, Marine Resources Commission, hereinafter referred to as the Commission, on this 24th day of January 2023 hereby grants unto:

Lancaster County Board of Supervisors	**Peter D. Anzo**	**David J. Simmons**
8311 Mary Ball Road	**40 Windjammer Lane**	**1181 Venter Road**
Lancaster, VA 22503	**White Stone, VA 22578**	**Aylett, VA 23009**

hereinafter referred to as the Permittee, permission to:

X Encroach in, on, or over State-owned subaqueous bottoms pursuant to Chapter 12, Subtitle III, of Title 28.2 of the Code of Virginia.

___ Use or develop tidal wetlands pursuant to Chapter 13, Subtitle III, of Title 28.2 of the Code of Virginia.

Permittees are hereby authorized to construct five (5) stone breakwaters and two (2) stone spurs, with associated clean sand beach nourishment and wetland plantings to create a public beach and living shoreline at end of State Route 695, Windmill Point Road in Lancaster County. All activities authorized herein shall be accomplished in conformance with the plans and drawings dated received September 20, 2022, and revised drawings dated received October 1, 2022, which are attached and made a part of this permit.

This permit is granted subject to the following conditions:

(1) The work authorized by this permit is to be completed by **January 24th, 2028.** The Permittee shall notify the Commission when the project is completed. The completion date may be extended by the Commission in its discretion. Any such application for extension of time shall be in writing prior to the above completion date and shall specify the reason for such extension and the expected date of completion of construction. All other conditions remain in effect until revoked by the Commission or the General Assembly.

(2) This permit grants no authority to the Permittee to encroach upon the property rights, including riparian rights, of others.

(3) The duly authorized agents of the Commission shall have the right to enter upon the premises at reasonable times, for the purpose of inspecting the work being done pursuant to this permit.

(4) The Permittee shall comply with the water quality standards as established by the Department of Environmental Quality, Water Division, and all other applicable laws, ordinances, rules and regulations affecting the conduct of the project. The granting of this permit shall not relieve the Permittee of the responsibility of obtaining any and all other permits or authority for the projects.

(5) This permit shall not be transferred without written consent of the Commissioner.

(6) This permit shall not affect or interfere with the right vouchsafed to the people of Virginia concerning fishing, fowling and the catching of and taking of oysters and other shellfish in and from the bottom of acres and waters not included within the terms of this permit.

(7) The Permittee shall, to the greatest extent practicable, minimize the adverse effects of the project upon adjacent properties and wetlands and upon the natural resources of the Commonwealth.

(8) This permit may be revoked at any time by the Commission upon the failure of the Permittee to comply with any of the terms and conditions hereof or at the will of the General Assembly of Virginia.

(9) There is expressly excluded from the permit any portion of the waters within the boundaries of the Baylor Survey.

(10) This permit is subject to any lease of oyster planting ground in effect on the date of this permit. Nothing in this permit shall be construed as allowing the Permittee to encroach on any lease without the consent of the leaseholder. The Permittee shall be liable for any damages to such lease.

(11) The issuance of this permit does not confer upon the Permittee any interest or title to the beds of the waters.

(12) All structures authorized by this permit, which are not maintained in good repair, shall be completely removed from State-owned bottom within three (3) months after notification by the Commission.

(13) The Permittee agrees to comply with all of the terms and conditions as set forth in this permit and that the project will be accomplished within the boundaries as outlined in the plans attached hereto. Any encroachment beyond the limits of this permit shall constitute a Class 1 misdemeanor.

(14) This permit authorizes no claim to archaeological artifacts that may be encountered during the course of construction. If, however, archaeological remains are encountered, the Permittee agrees to notify the Commission, who will, in turn notify the Department of Historic Resources. The Permittee further agrees to cooperate with agencies of the Commonwealth in the recovery of archaeological remains if deemed necessary.

(15) The Permittee agrees to indemnify and save harmless the Commonwealth of Virginia from any liability arising from the establishment, operation or maintenance of said project.

The following special conditions are imposed on this permit:

(16) The placard accompanying this permit document must be conspicuously displayed at the work site.

(17) Permittee agrees to notify the Commission upon the start of the activities authorized by this permit.

(18) The material used for beach nourishment and wetlands planting fill shall be comprised of at least 90% sand.

(19) The nourished area landward of the breakwater/sill shall be planted with appropriate wetland vegetation in conformance with the attached planting plan and schedule.

Description of Fees	Amount	Unit of Measure	Rate	Total	Frequency	After-The-Fact
Permit Fee				$600.00	One-Time	
Total Permit Fees				**$600.00**		

This permit consists of 7 Pages

PERMITTEE(S)

[X] BY CHECKING THIS BOX, I certify that I am the Permittee OR the certified agent acting on behalf of all Permittees, that I have read and understood the permit as drafted and accept all of the terms and conditions herein. I agree and understand that checking the box has the same legal authority as a written signature. The provisions of the permit authorization shall be binding on any assignee or successor in interest of the original Permittee(s). In cases where the Permittee is a corporation, agency or political jurisdiction, I certify I have proper authorization to bind the organization to the financial and performance obligations which result from activity authorized by this permit.

PERMITTEE OR CERTIFIED AGENT

Craig Palubinski - Agent
Print Your Name Here

DATE TERMS ACCEPTED

January 26, 2023

PERMITEE
Lancaster County Board of Supervisors, et al
8311 Mary Ball Road
Lancaster, VA 22503

PERMITEE 2
Peter D. Anzo
40 Windjammer Lane
White Stone, VA 22578

PERMITEE 3
David J. Simmons
1181 Venter Road
Aylett, VA 23009

AGENT
Bayshore Design
Craig Palubinski
Post Office Box 339
Kinsale, VA 22488

COMMISSION

This permit is executed on behalf of the Commonwealth of Virginia, Marine Resources Commission by the undersigned:

Justin T. Worrell

Justin Worrell
Deputy Chief, Habitat Management Division

DATE SIGNED
9th day of February 2023

From:	Woodward, Jay (MRC)
To:	MRC - jpa Permits
Subject:	FW: Notification of No Permit Required: JPA 22-2229 Windmill Point Marina Breakwaters and Beach Nourishment
Date:	Monday, December 19, 2022 8:26:03 AM
Attachments:	20221216_22-001763_VWP NPR Letter.pdf

DEQ comments,
thx

Jay Woodward
Environmental Engineer, Sr.
Habitat Management Division
Virginia Marine Resources Commission
380 Fenwick Road
Fort Monroe, VA 23651
Office (757) 247-8032
Mobile (757) 504-7009
Jay.woodward@mrc.virginia.gov
Website www.mrc.virginia.gov

WATER IS LIFE

From: Jones, Bryan <bryan.jones@deq.virginia.gov>
Sent: Friday, December 16, 2022 4:24 PM
To: Don Gill <dgill@lancova.com>
Cc: craigp@bayshoredesign.com; Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil>; Woodward, Jay (MRC) <Jay.Woodward@mrc.virginia.gov>
Subject: Notification of No Permit Required: JPA 22-2229 Windmill Point Marina Breakwaters and Beach Nourishment

Dear Mr. Gill,

Please find the attached notification regarding the Windmill Point Marina Breakwaters and Beach Nourishment project in Lancaster County, VA.

Feel free to contact me if you have any questions or concerns.

Respectfully,

Bryan Jones
Virginia Water Protection Program Manager
Department of Environmental Quality | Piedmont Region
4949-A Cox Road | Glen Allen, VA 23060
P: (804) 712-4001 | F: (804) 698-4178* | E: Bryan.Jones@deq.virginia.gov
www.deq.virginia.gov

*Please note that all faxes must contain the following information:

Received by VMRC December 19, 2022 / lra

DEQ recipient's first and last name

- Sender's name
- Sender's contact phone number

Commonwealth of Virginia
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
PIEDMONT REGIONAL OFFICE
4949-A Cox Road, Glen Allen, Virginia 23060
(804) 527-5020 FAX (804) 698-4178
www.deq.virginia.gov

Travis A. Voyles
Acting Secretary of Natural and Historic Resources

Michael S. Rolband, PE, PWD, PWS Emeritus
Director
(804) 698-4020

Jerome A. Brooks
Regional Director

December 16, 2022

SENT VIA E-MAIL: dgill@lancova.com

Re: Notification that a Virginia Water Protection (VWP) Individual Permit or General Permit Coverage is Not Required
NP No. 22-001763 / JPA No. 22-2229
Windmill Point Marina Breakwaters and Beach Nourishment

The Virginia Department of Environmental Quality (DEQ) has received your JPA, PCN, and/or project notification. Based on the information provided, the project meets one of the following criteria, and therefore, will not require a VWP individual permit or general permit coverage:

☐ The project is not proposing impacts to surface waters.

☐ The project qualifies for an exclusion from the permitting requirements per 9VAC25-210-60 and/or the provisions noted:

- ☐ Discharges of dredged or fill material into state waters, except wetlands, which are addressed under a U.S. Army Corps of Engineers (USACE) Regional, General or Nationwide Permit, and for which no § 401 Water Quality Certificate is required.

- ☐ Any stormwater discharge from municipal separate storm sewer systems or land disturbing activities authorized by 9VAC25-870, or discharges authorized by a Virginia Pollutant Discharge Elimination System (VPDES) permit in accordance with 9VAC25-31 or a Virginia Pollution Abatement (VPA) permit in accordance with 9VAC25-32.

- ☐ Any activity in a wetland governed under Chapter 13 (§ 28.2-1300 et seq.) of Title 28.2 of the Code of Virginia, unless state certification is required by § 401 of the Clean Water Act. Even where such certification is required due to a pending USACE permit action, such certification is waived if the activity meets the provisions of subdivision 10.a of 9VAC25-210-60 - see below. (§ 62.1-44.15:21.G; 9VAC25-210-220.C)

Received by VMRC December 19, 2022 / lra

(9VAC25-210-60.10.a) Construction or maintenance of farm ponds or impoundments, stock ponds or impoundments, or irrigation ditches that are operated for normal agricultural or silvicultural purposes, and are less than 25 feet in height or create a maximum impoundment capacity smaller than 100 acre-feet.

☐ Normal residential gardening and lawn and landscape maintenance in a wetland. (§ 62.1-44.15:21.G)

☐ Maintenance of currently serviceable structures.

☐ Impacts to open waters that do not have a detrimental effect on public health, animal life, or aquatic life or to the designated uses of such waters.

☐ Flooding or back-flooding impacts to surface waters resulting from the construction of temporary sedimentation basins on a construction site.

☐ Normal agriculture and silviculture activities in a wetland. (§ 62.1-44.15:21.G)

☐ Construction or maintenance of farm ponds or impoundments, stock ponds or impoundments, or irrigation ditches, or the maintenance (but not construction) of drainage ditches, provided the following:

- no surface water withdrawal is proposed;
- the final dimensions of the maintained ditch do not exceed the average dimensions of the original ditch; and,
- the farm or stock pond or impoundment does not fall under the authority of the Virginia Soil and Water Conservation Board pursuant to Article 2 (§ 10.1-604 et seq.) of Chapter 6 pursuant to normal agricultural or silvicultural activities. (§ 62.1-44.15:21.H)

☐ Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining equipment.

☐ Wetland and open water impacts to a stormwater management facility that was created on dry land for the purpose of conveying, treating, or storing stormwater. (§ 62.1-44.15:21.I)

☐ The activities cause impacts to an isolated wetland of minimal ecological value as defined in 9VAC25-210-10 (§ 62.1-44.15:21.D; 9VAC25-210-220.A).

☒ The activity does not impact instream flows; qualifies for a permit issued by the USACE; and receives a permit from the Virginia Marine Resources Commission or wetlands boards, pursuant to Chapter 12 (§ 28.2-1200 et seq.) or Chapter 13 (§ 28.2-1300 et seq.) of Title 28.2 of the Code of Virginia (9VAC25-210-220.B).

☐ Provided that the project is authorized by the USACE under a Regional permit and meets any applicable § 401 Certification Conditions, a VWP individual permit or general permit coverage will not be required for this project.

Received by VMRC December 19, 2022 / lra

☐ Provided that the project is authorized by the USACE under a Nationwide permit and the applicant has certified that the project complies or will comply with all of VDEQ's General § 401 Water Quality Certification Conditions (A.1-A.12 listed in Appendix A - Norfolk District's Final Regional Conditions for the 2021 Nationwide permits, issued February 25, 2022) and any NWP-specific, General § 401 Water Quality Certification Conditions, if applicable, a VWP individual permit or general permit coverage will not be required for this project.

DEQ waives the issuance of a Virginia Water Protection (VWP) individual permit or general permit coverage for one or more of the reasons listed above. This letter also serves as a waiver of individual § 401 water quality certification for purposes of the USACE Nationwide Permits, when applicable.

Should the size or scope of the project change, a VWP individual permit or general permit coverage may be required.

If unauthorized impacts occur, you **must** contact DEQ at pro.vwpcompliance@deq.virginia.gov or 804-527-5020 (PRO) or fax 804-698-4178 within 24 hours of discovery. Any fish kills or spills of fuels or oils shall be reported to DEQ immediately upon discovery at 804-527-5020 (PRO). If DEQ cannot be reached, the spill or fish kill shall be reported to the Virginia Department of Emergency Management (VDEM) at 1-800-468-8892 or the National Response Center (NRC) at 1-800-424-8802. Any spill of oil as defined in § 62.1-44.34:14 of the Code of Virginia that is less than 25 gallons and that reaches, or that is expected to reach, land only is not reportable, if recorded per § 62.1-44.34:19.2 of the Code of Virginia and if properly cleaned up.

Please contact DEQ at pro.vwpcompliance@deq.virginia.gov or 804-527-5020 (PRO) if you have any questions.

Respectfully,

Bryan Jones
Regional VWPP Program Manager

cc: Authorized Agent(s)
U.S. Army Corps of Engineers
Virginia Marine Resources Commission

Received by VMRC December 19, 2022 / lra

From: Woodward, Jay (MRC)
To: Davis, Nancy P CIV USARMY CENAO (USA); Craig Palubinski
Cc: ohall@lancova.com; MRC - jpa Permits; Emily A. Hein
Subject: Re: Lancaster County/Windmill Point Marina/Landing HOA, breakwaters; NAO-2019-01193 / #22-V2229
Date: Thursday, December 1, 2022 8:54:58 AM

Nancy, VIMS notes SAV near the eastern end, recommends compensation. We will likely not require it as this is a living shoreline and good design. Similar to Carneal and Crutchfield a few years ago. Comments are in our database. Hope to have this on the January Commission agenda, protested by Oyster leaseholder and over $500k.
Just fyi…

Get Outlook for iOS

From: Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil>
Sent: Thursday, December 1, 2022 6:25:08 AM
To: Craig Palubinski <craigp@bayshoredesign.com>
Cc: Woodward, Jay (MRC) <Jay.Woodward@mrc.virginia.gov>; ohall@lancova.com <ohall@lancova.com>; MRC - jpa Permits <jpa.permits@mrc.virginia.gov>; Emily A. Hein <eahein@vims.edu>
Subject: Lancaster County/Windmill Point Marina/Landing HOA, breakwaters; NAO-2019-01193 / #22-V2229

Good morning, Craig:

Please see NOAA Fisheries Service comments below. Dave is not recommending any design changes so no action required at this point. I am still waiting for comments from other reviewing agencies and will keep you posted as I receive them.

Regards,

Nancy P. Davis
Environmental Scientist
U.S. Army Corps of Engineers
803 Front Street, Norfolk, VA 23518
Office: (757)201-7044
Email: Nancy.P.Davis@usace.army.mil
Website: http://www.nao.usace.army.mil/Missions/Regulatory.aspx

The Norfolk District is committed to providing the highest level of support to the public. In order for us to better serve you, please complete our Customer Satisfaction Survey at:
https://regulatory.ops.usace.army.mil/customer-service-survey/

From: David OBrien - NOAA Federal <david.l.obrien@noaa.gov>
Sent: Wednesday, November 30, 2022 2:45 PM

Received by VMRC December 1, 2022 / lra

To: Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil>
Subject: [URL Verdict: Neutral][Non-DoD Source] Lancaster County/Windmill Point Marina/Landing HOA, breakwaters; NAO-2019-01193 / #22-V2229

Hello Nancy,

I have reviewed the coordination materials you sent regarding the proposed breakwater project located along the Rappahannock River in Lancaster Count, Virginia. As you know, the Rappahannock River is designated as essential fish habitat (EFH) for 7 federally managed species and is also designated an anadromous fish use area by the Virginia Department of Wildlife Resources (DWR). Submerged aquatic vegetation (SAV) has also been documented in the immediate vicinity of the project by the VIMS SAV monitoring and restoration program. A small area of very sparse density (0-10% cover) SAV was mapped in the 2018 survey in the vicinity of proposed breakwater 6; the only year in the last five (5) years of available data (VIMS, 2017-2021 data).

The project includes removing several existing stone spurs to be incorporated as stone base material for the construction of new Class III stone offshore breakwaters and beach nourishment resulting in the loss of 0.57 acre of subaqueous bottom and 0.02 acre of tidal non-vegetated wetlands that cover the existing stone groins. The purpose of the project is to stabilize approximately 1.324 linear ft. of eroding shoreline, beach and dune habitats. The upper portions of the sand nourishment will be planted 18-inches on-center with various native high marsh species. The high energy shoreline has a fetch of >40 miles to the south-southeast across Chesapeake Bay and has experienced approximately 110 ft. of landward shoreline erosion over the past 10-yr. period (as stated per JPA and PN).

NOAA Fisheries Service concurs with your determination that the proposed breakwater and beach nourishment project will not substantially adversely affect essential fish habitat (EFH) or SAV and is of the opinion given the scope of the construction, a time of year restriction to help protect the migration and spawning of anadromous fish is not warranted.

Please note this EFH determination does not address threatened and endangered species under the purview of NOAA Fisheries Service. Therefore, please complete the GARFO ESA Section 7: 2017 NLAA Program Verification Form or contact Mr. Brian Hopper, NOAA Protected Resources Division (brian.d.hopper@noaa.gov) to discuss your project regarding federally listed shortnose and Atlantic sturgeon.

Thank you for the opportunity to comment on this project. Please feel free to contact me if you have any questions. If this project is authorized, I would appreciate a copy of your permit for my files.

Regards,
Dave

David L. O'Brien
Fisheries Biologist
NOAA Fisheries Service
P.O. Box 1346
1370 Greate Rd.

Received by VMRC December 1, 2022 / lra

Gloucester Point, VA 23062
804-684-7828
david.l.obrien@noaa.gov

On Mon, Nov 28, 2022 at 2:18 PM Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil> wrote:

> Hey, Dave,
>
> I wanted to make sure you saw these comments from VIMS. The public notice for this project can be accessed here: https://www.nao.usace.army.mil/Media/Public-Notices/Article/3212722/nao-2019-01193/
>
> I have also attached the species conclusion table (also available on the public notice) and SAV snapshots I pulled earlier.
>
> Thanks!
> Nancy
>
> Nancy P. Davis
> Environmental Scientist
> U.S. Army Corps of Engineers
> 803 Front Street, Norfolk, VA 23518
> Office: (757)201-7044
> **Email: Nancy.P.Davis@usace.army.mil**
> Website: http://www.nao.usace.army.mil/Missions/Regulatory.aspx
>
>
>
> **From:** Emily A. Hein <eahein@vims.edu>
> **Sent:** Monday, November 28, 2022 1:59 PM
> **To:** Jay Woodward <jay.woodward@mrc.virginia.gov>
> **Cc:** Advisory <advisory@vims.edu>; Beth.Howell@mrc.virginia.gov; Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil>
> **Subject:** [URL Verdict: Neutral][Non-DoD Source] Lancaster Board of Supervisors 22-2229
>
> Good afternoon, Jay,
>
> Attached are our comments for the Lancaster Board of Supervisors et al. project in Lancaster

Received by VMRC December 1, 2022 / lra

County (VMRC #22-2229). Please let me know if you have any additional questions.

Best,

Emily

Upcoming out of office dates:
19 December – 9 January

Emily Hein
Pronouns: she/her
Assistant Director for Advisory Services
VIMS Research and Advisory Services
eahein@vims.edu, 804-684-7482
VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

Received by VMRC December 1, 2022 / lra

From:	Davis, Nancy P CIV USARMY CENAO (USA)
To:	Craig Palubinski
Cc:	Woodward, Jay (MRC); ohall@lancova.com; MRC - jpa Permits; Emily A. Hein
Subject:	Lancaster County/Windmill Point Marina/Landing HOA, breakwaters; NAO-2019-01193 / #22-V2229
Date:	Thursday, December 1, 2022 6:25:41 AM

Good morning, Craig:

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Received by VMRC December 1, 2022 / Ira

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Pronouns: she/her
Assistant Director for Advisory Services
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Received by VMRC December 1, 2022 / Ira

VIMS | WILLIAM & MARY
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Lancaster County, Virginia

MEMORANDUM

MAINTENANCE AGREEMENT

The County of Lancaster, accepts responsibility, at its own expense, if necessary, for the routine maintenance of any property, structures, equipment or facilities acquired or constructed as a result of such grant funded aid. Routine maintenance shall include, but not be limited to, such responsibilities as keeping vacant land clear of debris, maintaining beach nourishment and vegetative plantings, and maintenance of breakwaters as necessary.

By signing this agreement, the Applicant acknowledges and accepts maintenance responsibility to preserve the long-term mitigation effectiveness of the project. It does not replace supersede, or add to any other maintenance responsibilities imposed by Federal or State laws or regulations which are in fore on the date of the project award.

Thank you for considering our *2023 Virginia Community Flood Preparedness Fund – Project Grants* proposal.

Name of Designated Agent: Don G. Gill

Signature of Designated Agent: ____________________

County Administrator

Date: 11/9/23

Lancaster County, Virginia

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Maintenance of the project will continue to be funded annually through the County's General Fund as part the Department of Parks budget. A new position has been created to oversee the maintenance of Parks. This job has been advertised and is in the hiring process. Sea level rise remains a serious concern. Based on sea level rise, it may be necessary, in the future, to increase the height of the breakwaters to prolong their functionality. These breakwaters will continue to be monitored and stone added as needed to maintain functionality.

Lancaster County, Virginia

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Westland Beach – Windmill Point Shoreline Stabilization Project

Scope of Work

This public/private partnership between the County of Lancaster and the Windmill Point Marina owner will provide the marina with a stabilized shoreline, protecting the marina infrastructure and buildings while also providing public access by expanding and protecting the County's only public beach. The Marina tenants and guests will benefit from this shoreline stabilization project through its protection against erosion of the beach and the protection of Marina infrastructure against property damage related to erosion and storm damage. This project will also include shoreline protection for the neighboring community, The Landing Townhomes at Windmill Point. There are eight townhomes adjacent to this project that will benefit from stabilization of their shoreline. In addition to protection of the private infrastructures (including critical infrastructure (the Windmill Point Marina)), the shoreline (including public beach access and private beach), VDOT infrastructure (Windmill Point Road) will also be better protected from storm damage, continued erosion and the subsequent migration of mean high water.

100% of Lancaster County's population and visitors will benefit from this project as the project will expand public access from 50 feet to over 410 feet while protecting the County's only public beach. The expanded beach access will provide recreational opportunities for Lancaster residents and visitors, including wading/swimming, sunbathing, exercising, nature gazing, wildlife/bird watching, relaxing, etc. This expanded public access also has cultural significance, providing space for baptisms in the Rappahannock River. The fishing pier will provide a place for residents and visitors to catch fish either recreationally or to supplement their diets. Lancaster County plans to obtain a fishing license for the pier to maximize equitability of use and access. The fishing pier is not included in this grant request for funding and will be funded by the Lancaster County FY2023 Capital Improvement Budget.

This breakwater system will provide a more comprehensive solution to the erosion of the shoreline which has not been successfully mitigated by previous attempts utilizing only hardening structures. Mean low and high water will be moved further channelward, the beach nourished and 42,000 sq ft of vegetation plantings will be installed on the beach and dune areas. Based on the success of other breakwater systems, in the Chesapeake Bay, it is our hope that this approach will provide a more long-term solution for shoreline stabilization. In "A brief history of headland breakwaters for shore protection in Chesapeake Bay, USA", written by C. Scott Hardaway Jr., Coastal Geologist, Virginia Institute of Marine Science & James R. Gunn, President, Coastal Design and Construction, Inc., they concluded the following: "The documented, long-term performance of headland breakwater systems in Chesapeake Bay is testimony to the predictable durability of these systems. Through numerous storm events, these systems have remained intact with no significant shore erosion or changes in shore planform over time, some for as long as 25 years.". This paper is attached as supporting documentation.

Appendix B: Budget Narrative Template

Applicant Name: Lancaster County Community Flood Preparedness Fund & Resilient Virginia Revolving Loan Fund Detailed Budget Narrative Period of Performance: 11/10/2023 through 12/31/2023 Submission Date: 11/10/2023	
Grand Total State Funding Request	$ 1,623,383.30
Grand Total Local Share of Project	$ 695,735.70
Federal Funding (if applicable)	$ 0.00
Project Grand Total	$ 2,319,119.00
Locality Cost Match	% 30

Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)									0.00
Local Share					218,398.20			477,337.50	695,735.70
State Share					509,595.80			1,113,787.50	1,623,383.30
Pre-Award/Startup									
Maintenance									
Total	$	$	$	$	$ 727,994.00	$	$	$ 1,591,125.00	$ 2,319,119.00

VDEM - Lancaster County- Westland Beach - Windmill Point Shoreline

BENEFIT COST ANALYSIS REPORT

BRIC 2022

Contents

BCA SUMMARY

SUB APPLICANT
Lancaster County

LAT/LON
37.6158609, -76.2919770

PROPERTY TYPE
Roads and Bridges

HAZARD TYPE
Coastal V Flood

MITIGATION TYPE
Floodplain and Stream Restoration

DAMAGE AND FREQUENCY
Professional Expected Damages

The Westland Beach-Windmill Point Shoreline Stabilization project will use a multi-faceted approach of armor stone breakwaters, armor spurs and nature-based solutions, including beach nourishment and beach and dune vegetation planting to stabilize 1,324 feet or eroding shoreline along the Rappahannock River.

The project will include the construction of five armor stone breakwaters (180', 240', 220', 90', and 110'), two armor spurs (60' and 50'), and the installation of 18,000 cubic yards of beach nourishment with 42,000 square feet of beach and dune vegetation plantings. All existing concrete debris and stone groins (located channel ward of breakwaters) will be removed to allow for restoration of the beach and a more comprehensive approach to stabilization of the shoreline. The vegetation plantings will include salt meadow cordgrass (spartina patens), American beach grass and Atlantic coastal panic grass. The cost of this stabilization project is estimated to be ~~$2,178,000.00.~~ $2,319,000.00.

Estimated Benefits (B) = $ 7,458,373
Estimated Costs (C) = $ ~~2,178,000.00~~ Estimated Costs updated on November 7, 2023 = $2,319,119.00
BCR (B/C) = ~~3.40~~ Updated BCR (C/C) = 3.22

Benefit-Cost Analysis

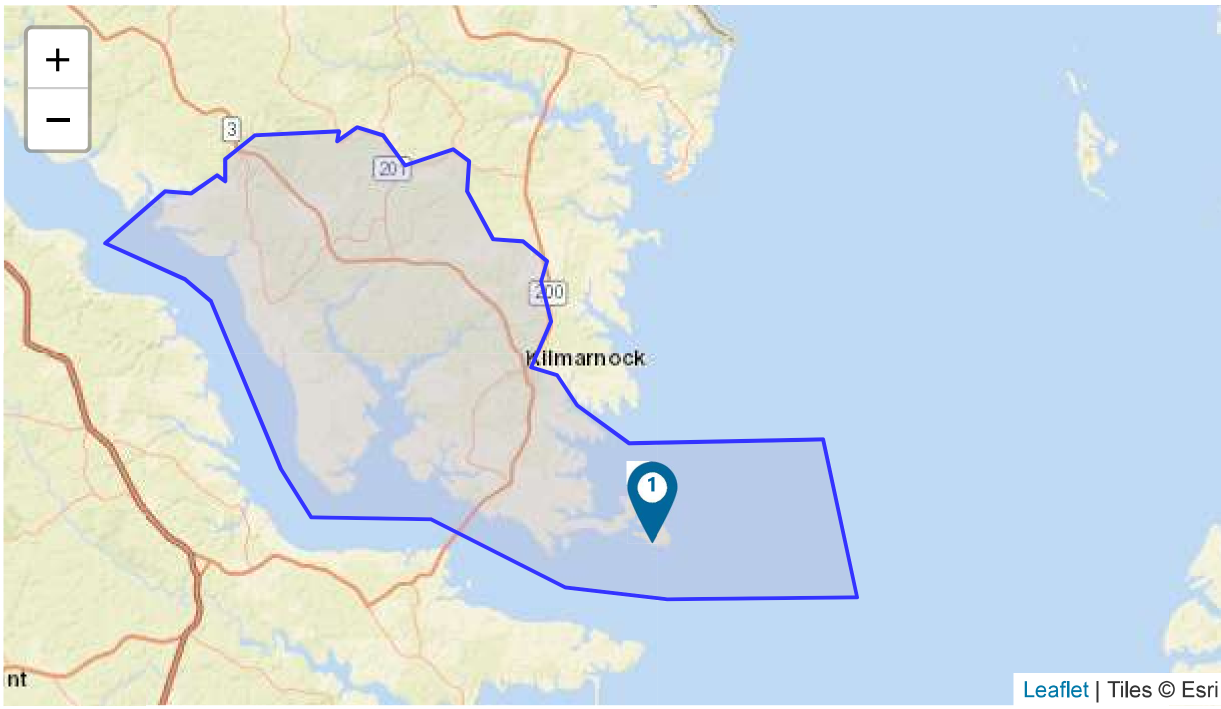
FEMA

Benefit-Cost Calculator

V.6.0 (Build 20221028.1600 | Release Notes)

Benefit-Cost Analysis

Project Name: Lancaster County - Westland Beach - Windmill Point Shoreline



				Using 7% Discount Rate			Using 3% Discount Rate (For FY22 BRIC and FMA only)		
Map Marker ▲	Mitigation Title	Property Type	Hazard	Benefits (B)	Costs (C)	BCR (B/C)	Benefits (B)	Costs (C)	BCR (B/C)
1	Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578		DFA - Coastal V Flood	$ 7,458,373	$2,319,119.00 ~~$ 2,195,299~~	3.22 ~~3.40~~	~~$ 9,347,049~~	~~$ 2,199,680~~	~~4.25~~
TOTAL (SELECTED)				$ 7,458,373	~~$ 2,195,299~~	~~3.40~~	~~$ 9,347,049~~	~~$ 2,199,680~~	~~4.25~~
TOTAL				$ 7,458,373	~~$ 2,195,299~~	~~3.40~~	~~$ 9,347,049~~	~~$ 2,199,680~~	~~4.25~~

Property Configuration

Property Title:	Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578
Property Location:	22578, Lancaster, Virginia
Property Coordinates:	37.61586099752033, -76.291977007078
Hazard Type:	Coastal V Flood
Mitigation Action Type:	Floodplain and Stream Restoration
Property Type:	Roads & Bridges
Analysis Method Type:	Professional Expected Damages

Cost Estimation

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Project Useful Life (years):	12
Project Cost:	$2,178,000
Number of Maintenance Years:	12 Use Default:Yes
Annual Maintenance Cost:	$2,178

Comments

-

Project Useful Life:

Project-specific, the PUL and event RI should be the same to show the complete loss of the asset being protected by the project.

-

Mitigation Project Cost:

Construction costs for the shoreline stabilization project. Design and construction costs for pier. Floodplain and Stream Restoration (FSR) projects are used primarily to reduce flood risk and erosion by providing stable reaches but can also be used to help mitigate drought. These projects restore and enhance the floodplain, stream channel and riparian ecosystem’s natural function. They provide baseflow recharge, water supply augmentation, floodwater storage, water quality renovation, terrestrial and aquatic wildlife habitat, and recreation opportunities, by restoring the site’s soil, hydrology and vegetation conditions that mimic the pre-development, or pre-alteration natural channel/floodplain connectivity.

-

Annual Maintenance Cost:

Based on 1% of the project costs.

Damage Analysis Parameters - Damage Frequency Assessment

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Year of Analysis was Conducted:	2022
Year Property was Built:	1961
Analysis Duration:	62 Use Default:Yes

Roads and Bridges Properties

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Estimated Number of One-Way Traffic Detour Trips per Day:	1,000
Additional Time per One-Way Detour Trip (minutes):	60
Number of Additional Miles:	1
Federal Rate ($):	0.625 Use Default:Yes
Economic Loss Per Day of Loss of Function ($):	36,225

Comments

-

Number of Trips:

A minimum of 1,000 cars were assumed as this location is a tourist-attraction.

-

Time per Trip:

Dead End Road: 60-minute input was used.

-

Number of Miles:

Assumed additional 1 mile of detour since this is a dead end road.

Professional Expected Damages Before Mitigation

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

	ROADS AND BRIDGES	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Impact (days)	Facility and Revenue Loss	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
12.75	365	500,000	0	0	0	0	13,722,125

Comments

-

Damages Before Mitigation:

This 56-year event was used as the baseline for damages before mitigation for this site. This baseline was developed assuming a constant erosion rate based on the 2019-2022 erosion rate estimate, which could reach the roadway shoulder/bridge in 12.75 years (102-ft divided by 8 ft/year = 12.75 years), or about a 7.8-percent annual chance event (1 event or 100% divided by 12.75 years = 7.8%). While this assumption was used for the BCA, field conditions demonstrate that the erosion risk and impacts can change quickly due to one flood. These changes to the river alignment due to a single high flow event highlight the erosion susceptibility of this coast, in proximity to the subject roads and facilities. Optional Damages for potential revenue loss, road damages and total loss to the World Marina structure, and contents.

Annualized Damages Before Mitigation

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
12.75	13,722,125	1,076,244
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	13,722,125	1,076,244

Professional Expected Damages After Mitigation

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

	ROADS AND BRIDGES	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Impact (days)	Facility and Revenue Loss	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
100	365	500,000	0	0	0	0	13,722,125

Comments

-

Damages After Mitigation:

Design of the improvements is intended to provide stream stability and flood damage reduction up to the 100-year recurrence interval event (1-percent annual chance) without significant damage to the improvements.

Annualized Damages After Mitigation

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
100	13,722,125	137,220
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	13,722,125	137,220

Standard Benefits - Ecosystem Services

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Total Project Area (acres):	0
Percentage of Urban Green Open Space:	0.00%
Percentage of Rural Green Open Space:	0.00%
Percentage of Riparian:	0.00%
Percentage of Coastal Wetlands:	0.00%
Percentage of Inland Wetlands:	0.00%
Percentage of Forests:	0.00%
Percentage of Coral Reefs:	0.00%
Percentage of Shellfish Reefs:	0.00%
Percentage of Beaches and Dunes:	0.00%
Expected Annual Ecosystem Services Benefits:	$0

Benefits-Costs Summary

Floodplain and Stream Restoration @ 40 Windjammer Ln, White Stone, Virginia, 22578

Total Standard Mitigation Benefits:	$7,458,373
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$7,458,373
Total Mitigation Project Cost:	~~$2,195,299~~ $2,319,119.00
Benefit Cost Ratio - Standard:	~~3.40~~ 3.22
Benefit Cost Ratio - Standard + Social:	~~3.40~~ 3.22

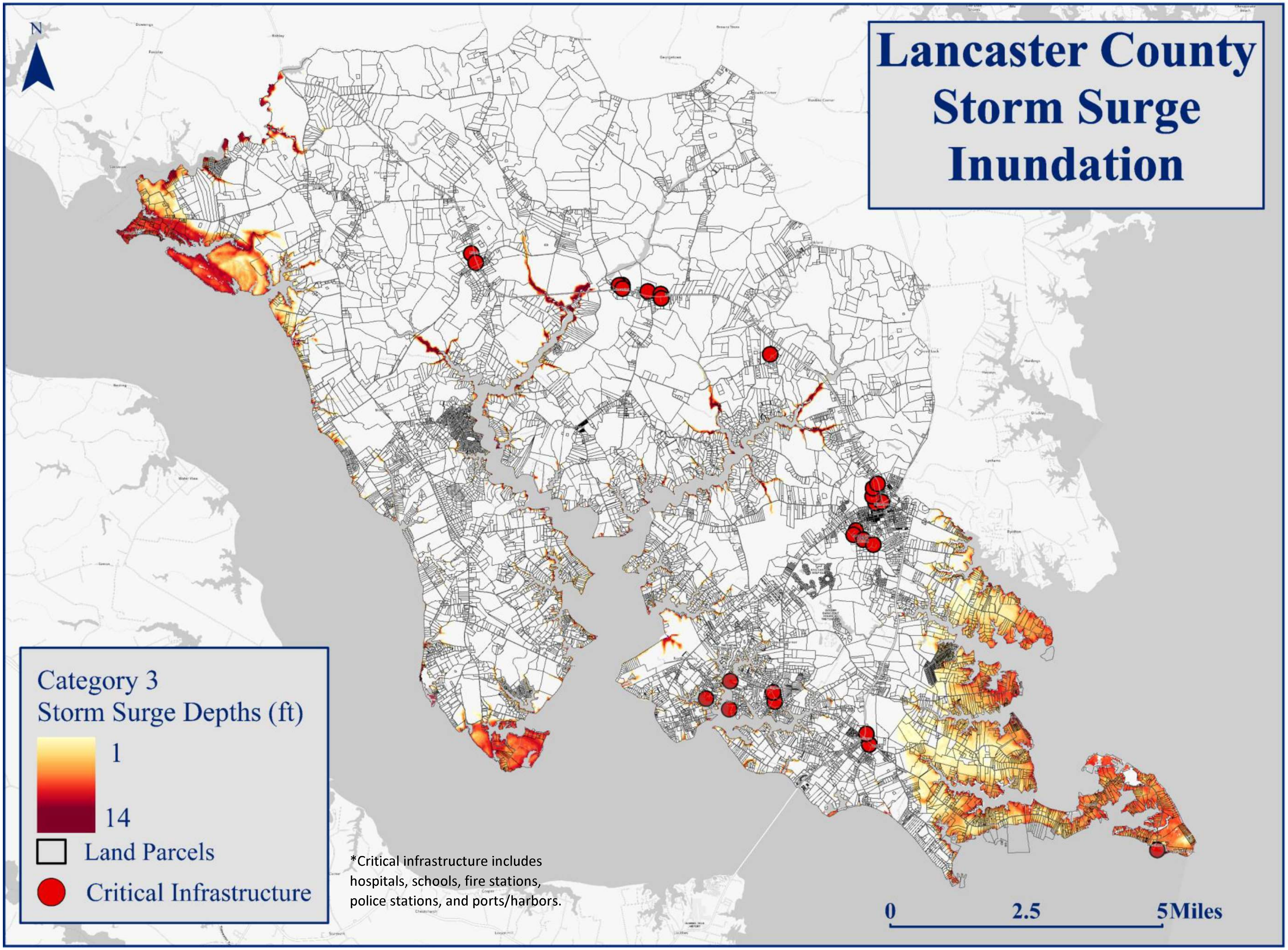
Appendix A - Storm Surge

OLD DOMINION UNIVERSITY
Resilience Collaborative

WILLIAM & MARY
LAW SCHOOL
VIRGINIA COASTAL
POLICY CENTER

UNIVERSITY of VIRGINIA
INSTITUTE for ENGAGEMENT & NEGOTIATION
Shaping Our World Together

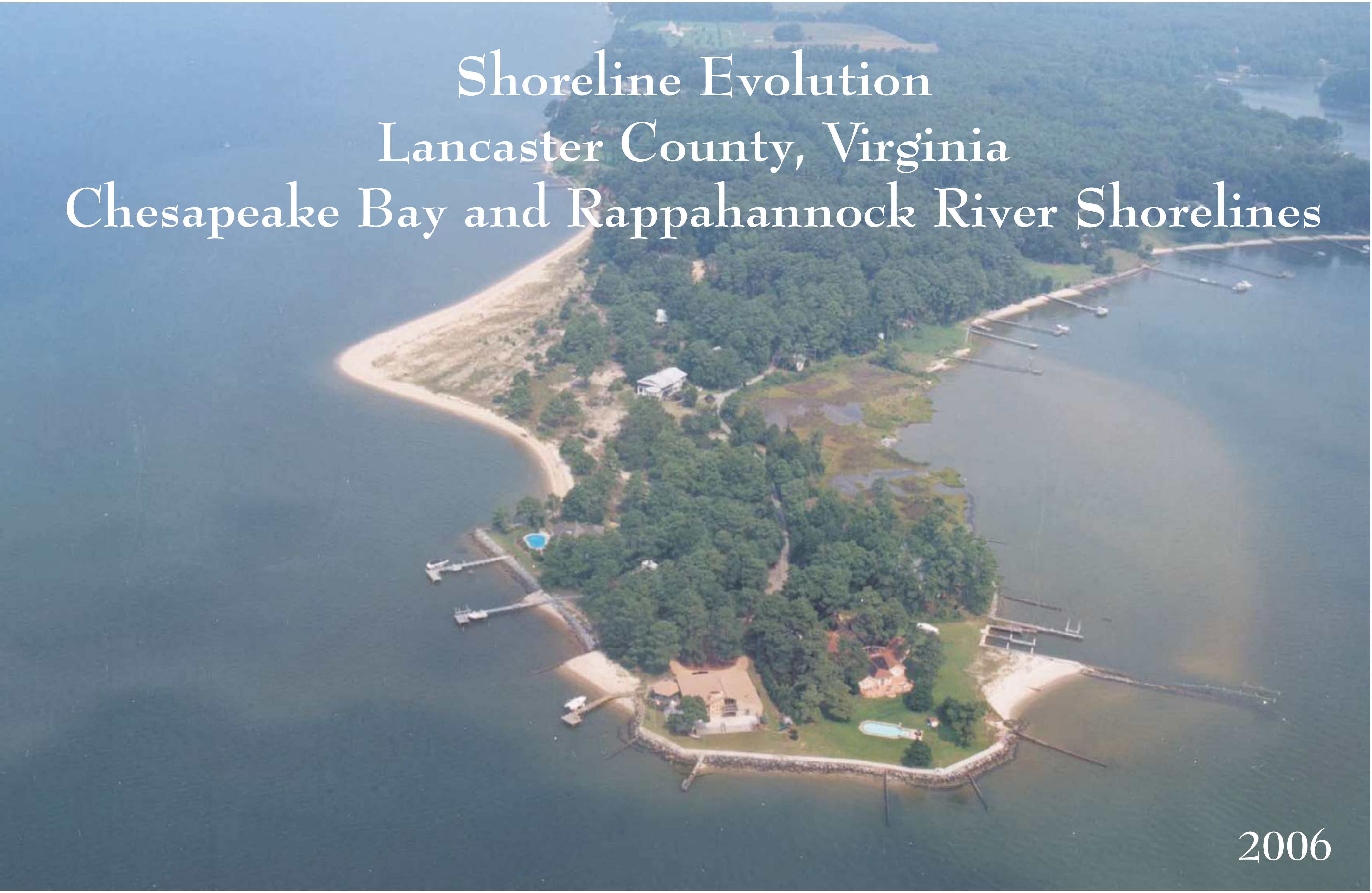
Lancaster County Storm Surge Inundation



For more information visit: https://raft.ien.virginia.edu/

Appendix B - Shoreline Evolution

Shoreline Evolution
Lancaster County, Virginia
Chesapeake Bay and Rappahannock River Shorelines



2006

Shoreline Evolution
Lancaster County, Virginia
Chesapeake Bay and Rappahannock River Shorelines

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Virginia Institute of Marine Science
College of William & Mary
Gloucester Point, Virginia

2006

This project was funded by the Virginia Department of Environmental Quality's Coastal Resources Management Program through Grants NA17OZ2355, NA17OZ1142,and NA04NOS4190060 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended.

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Cover Photo: Photograph of Mosquito Point in Lancaster County. Photo taken by Shoreline Studies Program on 15 August 2003.

I. INTRODUCTION

A. General Information

Shoreline evolution is the change in shore position through time. In fact, it is the material resistance of the coastal geologic underpinnings against the impinging hydrodynamic (and aerodynamic) forces. Along the shores of Chesapeake Bay and Rappahannock River, it is a process-response system. The processes at work include winds, waves, tides and currents, which shape and modify coastlines by eroding, transporting and depositing sediments. The shore line is commonly plotted and measured to provide a rate of change but it is as important to understand the geomorphic patterns of change. Shore analysis provides the basis to know how a particular coast has changed through time and how it might proceed in the future.

The purpose of this report is to document how the dunes along the Bay and river shores of Lancaster (Figure 1) have evolved since 1937. Aerial imagery was taken for most of the Bay region beginning that year, and it is this imagery that allows one to assess the geomorphic nature of shore change. Aerial imagery shows how the coast has changed, how beaches, dunes, bars, and spits have grown or decayed, how barriers have breached, how inlets have changed course, and how one shore type has displaced another or has not changed at all. Shore change is a natural process but, quite often, the impacts of man through shore hardening or inlet stabilization come to dominate a given shore reach. Most of the change in shore positions will be quantified in this report. Others, particularly very irregular coasts, around inlets, and other complicated areas will be subject to interpretation.

B. Chesapeake Bay Dunes

The primary reason for developing this Shoreline Evolution report is to be able to determine how dunes and beaches along the Bay and river coast of Lancaster have and will evolve through time. The premise is that, in order to determine future trends of these important shore features, one must understand how they got to their present state. Beaches and dunes are protected by the Coastal Primary Sand Dune Protection Act of 1980 (Act)[1]. Research by Hardaway *et al.* (2001) located, classified and enumerated jurisdictional dunes and dune fields within the eight localities listed in the Act. These include the counties of Accomack, Lancaster, Mathews, Northampton and Northumberland and the cities of Hampton, Norfolk and Virginia Beach (Figure 2). Only Chesapeake Bay and river sites were considered in that study.

In 2004, Hardaway *et al*. created the Lancaster County Dune Inventory. That report detailed the location and nature of the jurisdictional primary dunes along the Bay shore of Lancaster County and those results appear in Appendix B. For this study, the positions of the dune sites are presented using the latest imagery in order to see how the sites sit in the context of past shoreline positions. The dune location information has not been field verified since the original visits in 2000. This information is not intended to be used for jurisdictional determinations regarding dunes.

[1]The General Assembly of Virginia enacted the Coastal Primary Sand Dune Protection Act (the Dune Act) in 1980. The Dune Act was originally codified in § 62.1-13.21 to -13.28. The Dune Act is now recodified as Coastal Primary Sand Dunes and Beaches in § 28.2-1400 to -1420.

II. SHORE SETTING

A. Physical Setting

The Bay shoreline of the Lancaster includes about 12 miles of shoreline from Windmill Point to Indian Creek which is the border with Northumberland County. The Rappahannock River shoreline extends from Windmill Point to Morattico Creek which is the border with Richmond County. This includes about 40 miles of tidal shoreline on the Rappahannock River and Corrotoman River. The shorelines along Chesapeake Bay are mostly low sandy banks and marsh. Historic shore change rates vary from 0 ft/yr (inside Little Bay) to -8 ft/yr (Windmill Point) for shore recession along the Bay coast (Byrne and Anderson, 1978). The open Bay coasts have the highest erosion rates. Up the Rappahannock River, shore erosion and accretion rates are highly variable. The point at Morrattico Creek had an erosion rate of -3.1 ft/yr. The shore along the Corrotoman River has erosion and accretion rates between -5 ft/yr and +2 ft/yr. Between the Corrotoman River and Mosquito Point, erosion and accretion occurred between +2.4 ft/yr (Mosquito Point) and -1.6 ft/yr (farther upriver). Some areas showed no change (Byrne and Anderson, 1978). The shore along the Rappahannock River includes high and low sandy banks and occasional marshes.

The coastal geomorphology of the County is a function of the underlying geology and the hydrodynamic forces operating across the land/water interface, the shoreline. The Chesapeake Bay coast of Lancaster County varies between Holocene marsh and Holocene beach sands (Figure 3). Both sediment types overlie the Lynnhaven Member of the Tabb Formation (Late Pleistocene). Along the Rappahannock River, the Sedgefield Member, Shirley Formation and Lynnhaven Member outcrop along the shoreline. In addition, Quaternary alluvium was deposited at Towles Point. The Atlantic Ocean has come and gone numerous times over the Virginia coastal plain over the past million years or so. The effect has been to rework older deposits into beach and lagoonal deposits at the time of the transgressions. The last low stand found the ocean coast about 60 miles to the east when sea level about 300 feet lower than today and the coastal plain was broad and low. The current estuarine system was a meandering series of rivers working their way to the coast. About 15,000 years ago, sea level began to rise and the coastal plain watersheds began to flood. Shorelines began to recede. The slow rise in sea level is one of two primary long-term processes which cause the shoreline to recede; the other is wave action, particularly during storms. As shorelines recede or erode the bank material provides the sands for the offshore bars, beaches and dunes.

Sea level is continuing to rise in the Chesapeake Bay Region. Tide data collected at Gloucester Point on the York River showed that sea level has risen 3.95 mm/yr or 1.3 ft/century (http://www.co-ops.nos.noaa.gov/). Lewisetta on the Potomac River rose 4.85 mm/yr or 1.59 ft/century. Windmill Point and the Rappahannock River are between these two guages. The amount of sea level rise directly effects the reach of storms and their impact on shorelines. Anecdotal evidence of storm surge during Hurricane Isabel, which impacted North Carolina and Virginia on September 18, 2003, put it on par with the storm surge from the "storm of the century" which impacted the lower Chesapeake Bay in August 1933. Boon (2003) showed that even though the tides during the storms were very similar, the difference being only 4 cm or about an inch and a half, the amount of surge was different. The 1933 storm produced a storm surge that was greater than Isabel's by slightly more than a foot. However, analysis of the mean water levels for the months of both August 1933 and September 2003 showed that sea level has risen by 41 cm (1.35 ft) at Hampton Roads in the seventy years between these two storms (Boon, 2003). This is the approximate time span between our earliest aerial imagery (1937) and our most recent (2002), which means the impact of sea level rise to shore change is significant. The beaches, dunes, and nearshore sand bars try to keep pace with the rising sea levels. Five shore reaches are described along the coast of Lancaster County (Figure 4). Reaches I, III, and IV are on the north shore of the Rappahannock River. Reach II is on the Corrotoman River, and Reach V is on the open Chesapeake Bay.

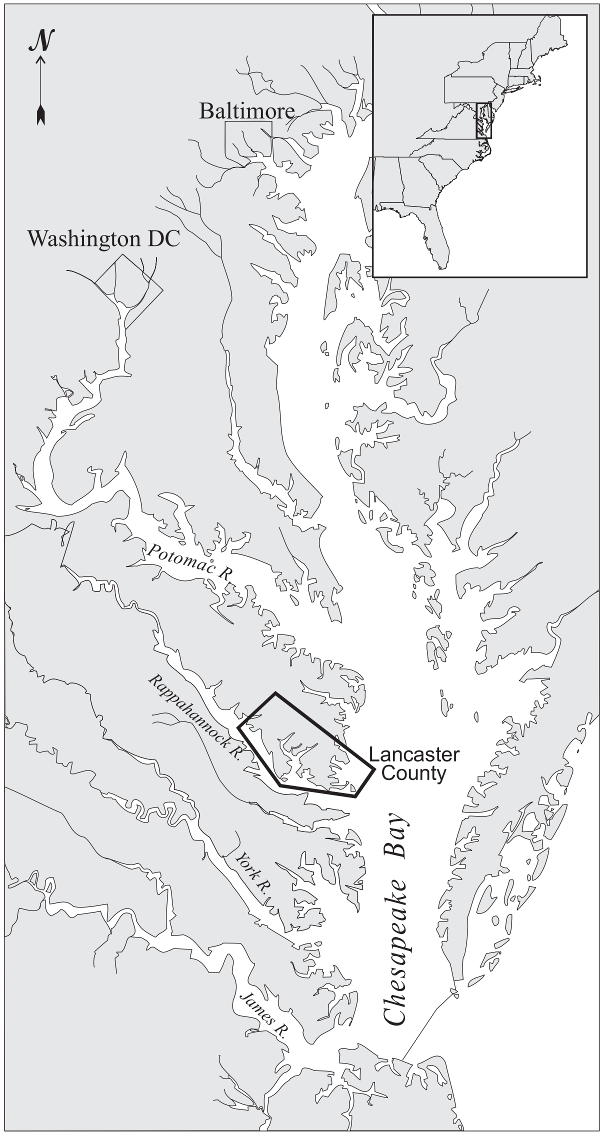


Figure 1. Location of Lancester County within the Chesapeake Bay estuarine system.

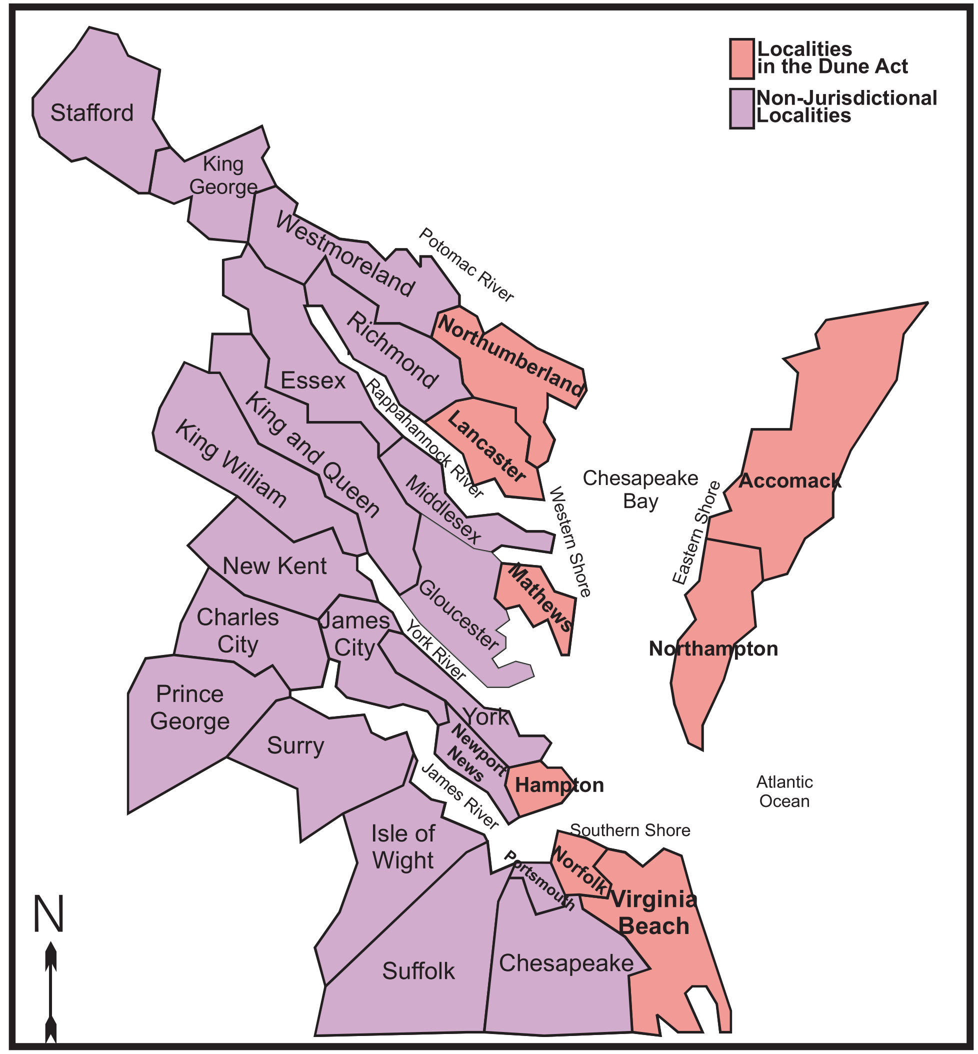
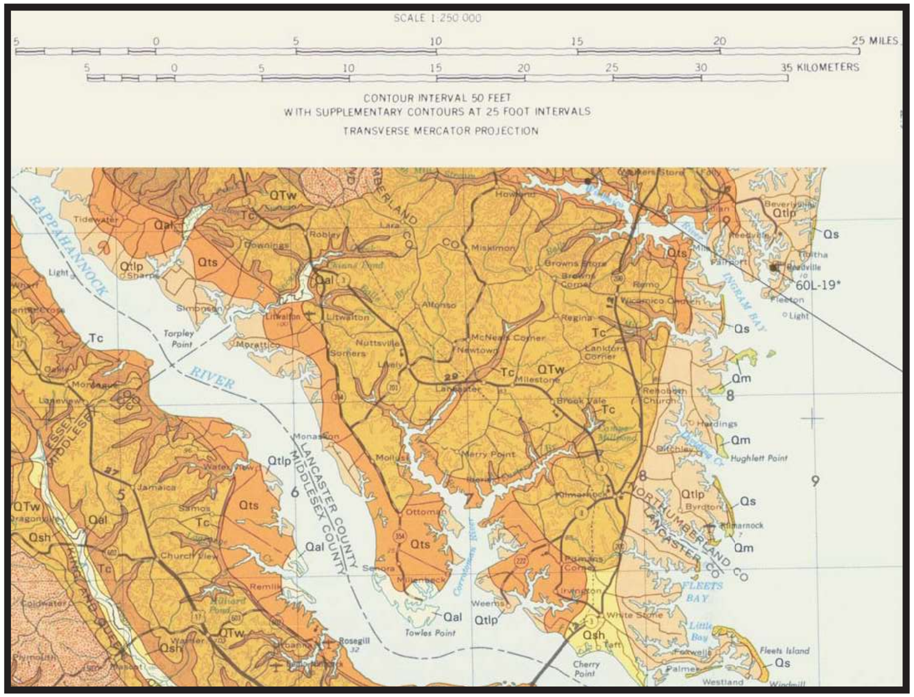


Figure 2. Location of localities in the Dune Act with jurisdictional and non-jurisdictional localities noted.



Qm — **Holocene Soft Mud** - Medium to dark-gray, and peat, grayish brown. Comprises sediment of marshes in coastal areas and Chesapeake Bay. Thickness is 0-10 ft.

Qs — **Holocene Sand** - Pale gray to light-yellowish gray, fine to coarse, poorly sorted to well sorted, shelly in part; contains angular to rounded fragments and whole valves of mollusks. Comprises deposits of coastal barrier islands and narrow beach-dune ridges bordering brackish-water marshes of Chesapeake Bay. As much as 40 ft in thickness.

Qtlp — **Lynnhaven and Poquoson Members, undifferentiated.**

Qts — **Sedgefield Member** - Pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt; locally, channel fill at base of unit includes as much as 50 ft of fine to coarse, crossbedded sand and clayey silt and peat containing in situ tree stumps. Sandy bay facies commonly contains Crassostrea biostromes, Mercenaria, Anadara, Polynices, Ensis, and other mollusks. Specimes of the coral Astrangia have yielded estimated uranium-series ages averaging 71,000 +/- 7,000 yrs B.P. (Mixon and others, 1982). Unit constitutes surficial deposit of river- and coast-parallel plains (alt. 20-30 ft) bounded on landward side by Suffolk and Harpersville scarps. Thickness is 0-50 ft.

Qal — **Alluvium** - Fine to coarse gravelly sand and sandy gravel, silt, and clay, light- to medium- gray and yellowish-gray. Deposited mainly in channel, point-bar, and flood-plain environments; includes sandy deposits of narrow estuarine beaches, and mud, muddy sand, and peat in swamps and in fresh- and brackish-water marshes bordering tide-water rivers. Grades into colluvium along steeper valley walls at margins of unit. Mostly Holocene but, locally, includes low-lying Pleistocene(?) Terrace deposits. As much as 80 ft thick along major streams.

QTw — **Windsor Formation (lower Pleistocene or upper Pliocene)** - Gray and yellow to reddish-brown sand, gravel, silt, and clay. Constitutes surficial deposits if extensive plain (alt. 85-95 ft) seaward of Surry scarp and coeval, fluvial-estuarine terrace west of scarp. Fining-upward sequence beneath plain consists of basal pebbly sand grading upward into crossbedded, quartzose Sand and massive, clayey silt and silty clay; lower and upper parts of sequence were deposited, repectively, in shallow-marine or open-bay and restricted-bay or lagoonal environments. In terraces west of Surry scarp, fluvial-estuarine deposit comprise muddy, coarse, trough-crossbedded sand and gravel grading upward to sandy silt and clay. Unit is 0-40 ft thick.

Qsh — **Shirley Formation (middle Pleistocene)** - Light-to dark-gray and brown sand, gravel, silt, clay, and peat. Constitutes surficial deposits of riverine terraces and relict baymouth barriers and bay-floor plains (alt. 35-45 ft) inset below depositional surfaces of the Chuckatuck Formation (Johnson and Peebles, 1984). Upper part of unit is truncated on the east by the Suffolk and Harpersville scarps; locally, lower part extends east of scarps. Fluvial-estuarine facies comprises (1) a lower pebble to boulder sand overlain by (2) fine to coarse sand interbedded with peat and clayey silt rich in organic material, including in situ tree stumps and leaves and seeds of cypress, oak, and hickory, which grades upward to (3) medium- to thick-bedded, clayey and sandy silt and silty clay. Marginal-marine facies in lower James River and lowermost Rappahannock River areas is silty fine sand and sandy silt containing *Crassostrea virginica*, *Mulinia*, *Noetia*, *Mercenaria*, and other mollusks. *Astrangia* from lower Rappahannock River area has yielded a uranium-series age of 184,000 +/- 20,000 years B.P. (Mixon and other, 1982). Thickness is 0-80 ft.

Tc — **Chesapeake Group (upper Pliocene to lower Miocene)** - Fine to coarse, quartzose sand, silt, and clay; variably shelly and diatomaceous, deposited mainly in shallow, inner- and middle-shelf waters. Ages of units based in studies of foraminiferal, nannofossil, diatom, and molluscan assemblages in Virginia and adjacent states (Andrews, 1988; Gibson, 1983; Gibson and others, 1980; Poag, 1989; Ward and Blackwelder, 1980; Ward and Krafft, 1984), Includes the following formations (see also sheet 2, figure 1), from youngest to oldest; Chowan River Formation (upper Pliocene), Yorktown Formation (lower upper and lower Pliocene), Eastover Formation (upper Miocene), St. Mary's Formation (upper and middle Miocene), Choptank Formation (middle Miocene), and Calvert Formation (middle and lower Miocene).

Figure 3. Geologic map of Lancaster County (from Mixon *et al*., 1989).

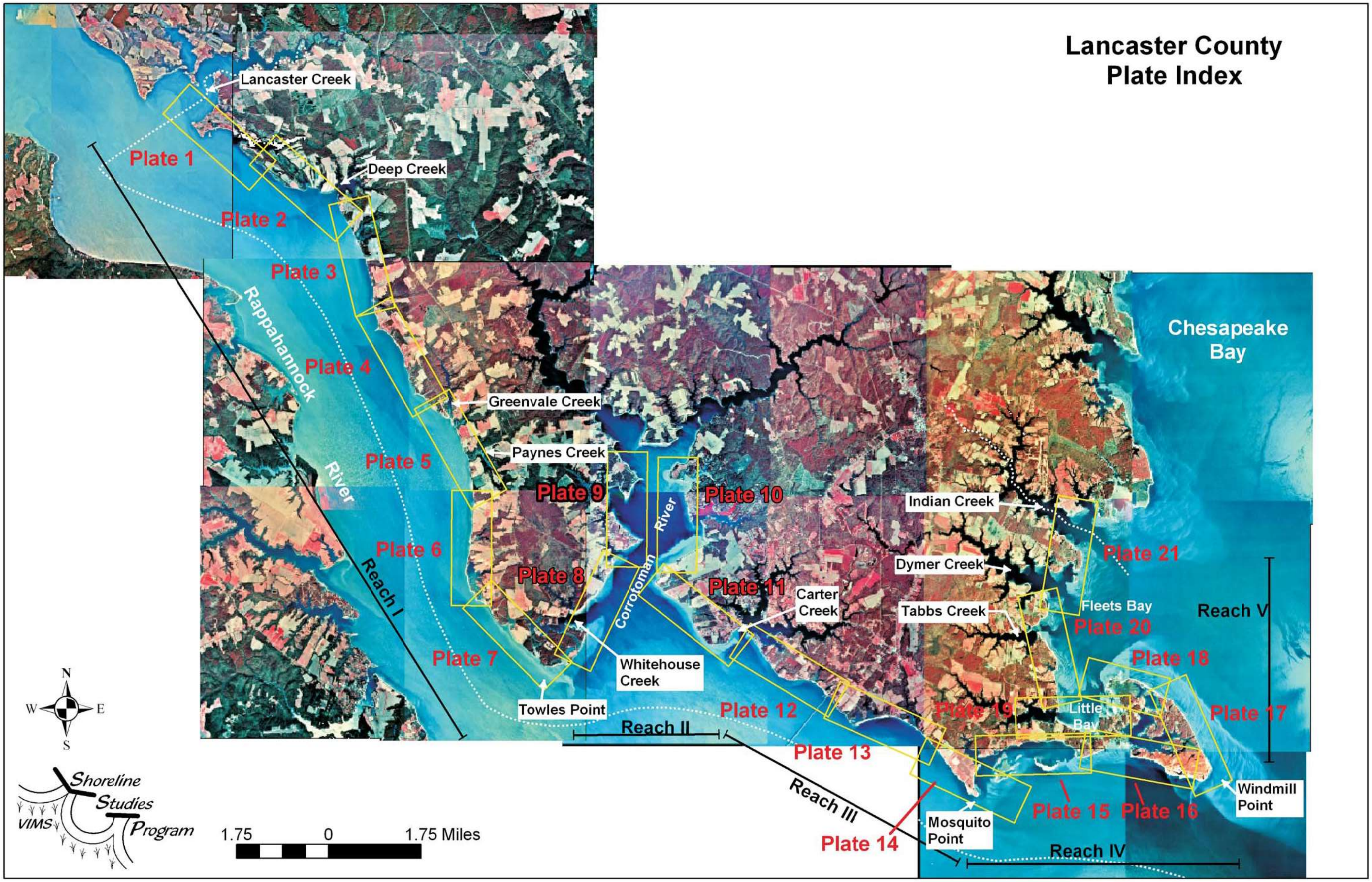


Figure 4. Index of shoreline plates.

B. Hydrodynamic Setting

Mean tide range at Windmill Point in Lancaster County is 1.2 ft (1983-2001). Up the Rappahannock River, mean tide range is 1.3 ft on the Corrotoman River, and 1.6 ft at Bayport which is across the river from Morattico Creek. The wind/wave climate impacting the Bay coast is defined by large fetch exposures to the northeast, east and southeast across Chesapeake Bay. Wind data from Norfolk International Airport reflect the frequency and speeds of wind occurrences from 1960 to 1990 (Table 1). Northeasters can be particularly significant in terms of the impacts of storm surge and waves on beach and dune erosion. The Rappahannock River is more fetch-limited. With the exception of the shore between Mosquito Point and Windmill Point, the coast is impacted by waves from the southwest, south, and southeast across limited open water.

Hurricanes, depending on their proximity and path can also have an impact to the Lancaster County Bay coast. On September 18, 2003, Hurricane Isabel passed through the Virginia coastal plain. The main damaging winds began from the north and shifted to the east then south. Beach and dune erosion were significant. Storm surge and wave action combined to create wrack lines measuring up to 8 ft above MLW around much of the Bay and up the rivers.

Table 1. Summary wind conditions at Norfolk International Airport from 1960-1990.

		WIND DIRECTION								
Wind Speed (mph)	**Mid Range (mph)**	**South**	**South west**	**West**	**North west**	**North**	**North east**	**East**	**South east**	**Total**
< 5	3	5497* 2.12+	3316 1.28	2156 0.83	1221 0.47	35748 13.78	2050 0.79	3611 1.39	2995 1.15	56594 21.81
5-11	8	21083 8.13	15229 5.87	9260 3.57	6432 2.48	11019 4.25	13139 5.06	9957 3.84	9195 3.54	95314 36.74
11-21	16	14790 5.70	17834 6.87	10966 4.23	8404 3.24	21816 8.41	16736 6.45	5720 2.20	4306 1.66	100572 38.77
21-31	26	594 0.23	994 0.38	896 0.35	751 0.29	1941 0.75	1103 0.43	148 0.06	60 0.02	6487 2.5
31-41	36	25 0.01	73 0.03	46 0.02	25 0.01	162 0.06	101 0.04	10 0.00	8 0.00	450 0.17
41-51	46	0 0.00	0 0.00	0 0.00	1 0.00	4 0.00	4 0.00	1 0.00	0 0.00	10 0.00
Total		41989 16.19	37446 14.43	23324 8.99	16834 6.49	70690 27.25	33133 12.77	19447 7.50	16564 6.38	259427 100.00

*Number of occurrences +Percent

III. METHODS

A. Photo Rectification and Shoreline Digitizing

Recent and historic aerial photography was used to estimate, observe, and analyze past shoreline positions and trends involving shore evolution for Lancaster County. Some of the photographs were available in fully geographically referenced (georeferenced) digital form, but most were scanned and orthorectified for this project.

Aerial photos from VIMS Shoreline Studies and Submerged Aquatic Vegetation (SAV) Programs, as well as from United States Geological Survey (USGS) archives were acquired. The years used for the shoreline change analysis included 1937, 1959, 1982, 1994, and 2002. Color aerials were obtained for 1982 and 1994. The 1994 imagery was processed and mosaicked by USGS, while the imagery from 2002 was mosaicked by the Submerged Aquatic Vegetation Program. The aerial photography for the remaining years were mosaicked by the VIMS Shoreline Study Program.

The images were scanned as tiffs at 600 dpi and converted to ERDAS IMAGINE (.img) format. They were orthorectified to a reference mosaic, the 1994 Digital Orthophoto Quarterquadrangles (DOQQ) from USGS. The original DOQQs were in MrSid format but were converted into .img format as well. ERDAS Orthobase image processing software was used to orthographically correct the individual flightlines using a bundle block solution. Camera lens calibration data was matched to the image location of fiducial points to define the interior camera model. Control points from 1994 USGS DOQQ images provide the exterior control, which is enhanced by a large number of image-matching tie points produced automatically by the software. A minimum of four ground control points were used per image, allowing two points per overlap area. The exterior and interior models were combined with a 30-meter resolution digital elevation model (DEM) from the USGS National Elevation Dataset (NED) to produce an orthophoto for each aerial photograph. The orthophotographs that cover each USGS 7.5 minute quadrangle area were adjusted to approximately uniform brightness and contrast and were mosaicked together using the ERDAS Imagine mosaic tool to produce a one-meter resolution mosaic also in an .img format.

To maintain an accurate match with the reference images, it was necessary to distribute the control points evenly. This can be challenging in areas with little development. Good examples of control points are permanent features such as manmade features and stable natural landmarks. The maximum root mean square (RMS) error allowed is 3 for each block.

Once the aerial photos were orthorectified and mosaicked, the shorelines were digitized in ArcMap with the mosaics in the background to help delineate and locate the shoreline. For Lancaster' coast, an approximation to mean low water (MLW) was digitized. This often was defined as the "wetted perimeter" on the beach sand as the last high water location. In areas where the shoreline was not clearly delineated on the aerial photography, the location was estimated based on the experience of the digitizer. Digitizing the shoreline brings in, perhaps, the greatest amount of potential error because of the problems of image clarity and definition of shore features. A series of Lancaster dune site profiles are displayed in Figure 5 which shows beach/dune variability. Figure 6 shows the relationship of MHW, MLW and beach/dune system components.

B. Rate of Change Analysis

A custom Arcview extension called "shoreline" was used to analyze shoreline rate of change. A straight, approximately shore parallel baseline is drawn landward of the shoreline. The extension creates equally-spaced transects along the baseline and calculates distance from the baseline at that location to each year's shoreline. The output from the extension are perpendicular transects of a length and interval specified by the user. The extension provides the transect number, the distance from beginning baseline to each transect, and the distance from the baseline to each digitized shoreline in an attribute table. The attribute table is exported to a spreadsheet, and the distances of the digitized shoreline from the baseline are used to determine the rates of change. The rates of change are summarized as mean or average rates and standard deviations for each Plate.

It is very important to note that this extension is only useful on relatively straight shorelines. In areas that have unique shoreline morphology, such as creek mouths and spits, the data collected by this extension may not provide an accurate representation of true shoreline change. The shore change data was manually checked for accuracy. However, where the shoreline and baseline are not parallel, the rates may not give a true indication of the rate of shoreline change.

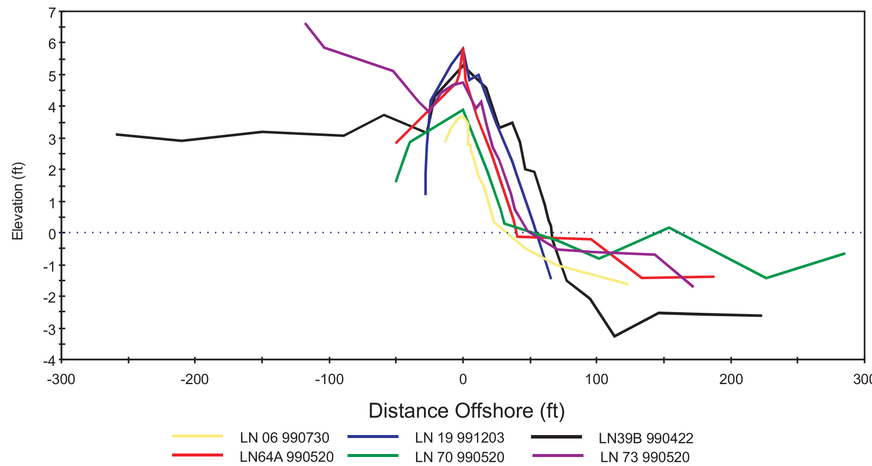


Figure 5. Variability of dune and beach profiles in Lancaster County.

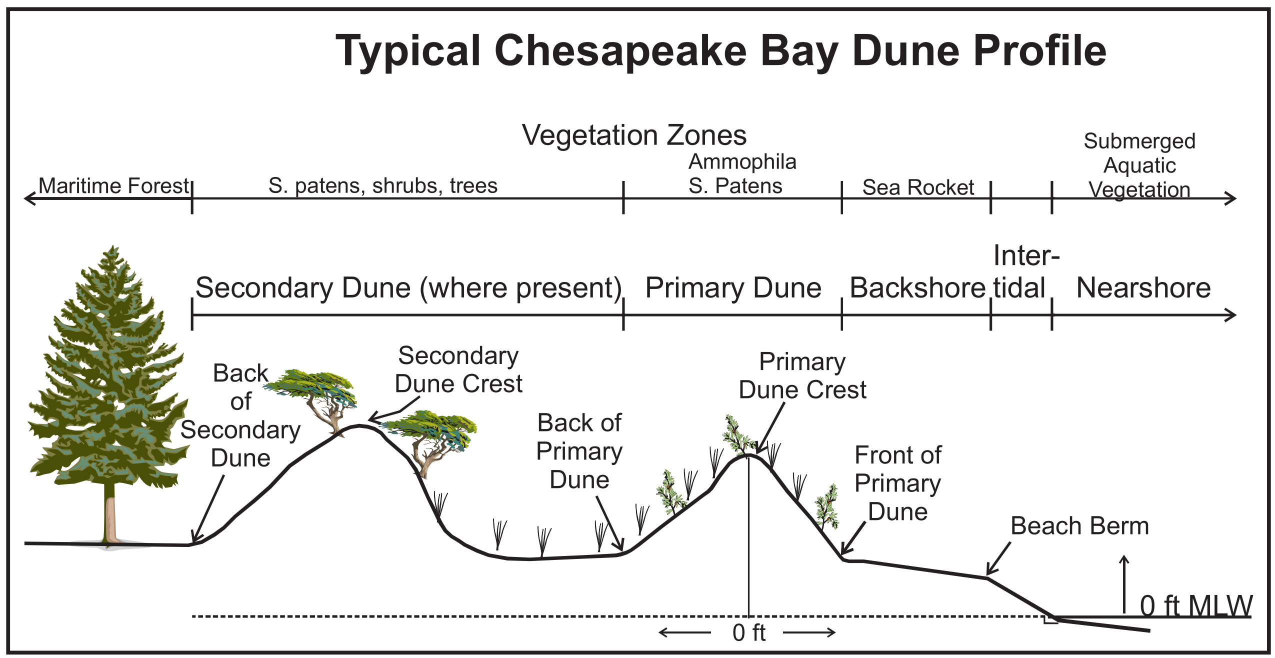


Figure 6. Typical profile of a Chesapeake Bay dune system (from Hardaway *et al.*, 2001).

IV. RESULTS

The Plates referenced in the following sections are in Appendix A. Dune locations are shown on all photo dates for reference only. Dune sites and lengths are positioned accurately on the 2002 photo. Because of changes in coastal morphology, the actual dune site might not have existed earlier. Site information tables are in Appendix B. More detailed information about Chesapeake Bay dunes and individual dune sites in Lancaster County can be found in Hardaway *et al.* (2001) and Hardaway *et al.* (2004). Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits. Some Plates did not have dunes identified on them, but the shore change information can still be valuable from a shoreline management perspective.

A. Reach I

Reach I occurs along the Rappahanock River and extends from the upriver county line at Lancaster Creek down to Towles Point and includes Plates 1 thru 7. The dune sites along Reach I are riverine dunes and generally face southwest. Plates 1 and 2 have no identified dune sites. The long-term trend for shore change (1937-2002) is negative on all three baselines on Plate 1. Baseline 1C has the highest due to its open exposure along the Rappahannock River. Shore trend is erosional along the single baseline on Plate 2.

Plate 3 contains dune sites LN3, LN4 and LN5. Site LN3 came into its present day form by 1994 and is maintained by a series of low groins. Sites LN4 and LN5 have evolved around respective small creek inlets since 1937 and are likely to continue change as the inlet spits and shoals do but stay in the same geomorphic setting. The overall shore change for Plate 3 is slightly erosional.

Plate 4 contains dune sites LN6, LN7, LN8, LN10 and LN11. Sites LN6, LN7 and LN8 reside along a relatively stable curvilinear coast protected on the upriver end by an unnamed point at Monaskon where the remains of an old pier help hold the headland. The sites are separated by breaks in the semi-continuos beach/dune system. Site LN10 and LN11 sit on either side of a man-made point (fill) that has eroded back over the years. Site LN11 has a secondary dune. The advance of these points can be seen in the shore change rates from 1937 to 1959. The long-term shore change trend along Plate 4 is slightly erosional.

Dune sites LN12, LN13, LN15 and LN16 are shown on Plate 5. Site LN12 is very small and developed as an overwash into a small tidal pond. Site LN 13 has been some type of beach feature since 1937 as it resides just upriver of Greenvale Creek. Dredging of Greenvale Creek was first performed in 1965 and sporadically since. Much of the material was placed just downstream of the entrance where it formed a large sandy headland. This headland has eroded away, but it has provided material for a small spit dune site, LN15, at its distal end. Dune site LN16 is a small dune on a spit across the mouth of Payne's Creek. The shoreline along Plate 5 has been relatively stable over time except for an advance and subsequent recession spike at the mouth of Greenvale Creek associated with dredge material disposal.

Plate 6 is the home of nine isolated dune sites labeled LN17 thru LN25. Sites LN17 and LN18 sit on either side of Bulls Creek as creek mouth dunes. Dune sites LN19 to LN24 are erosional remnants of a once more continuous beach/dune shoreline that fronts a marsh spit separating Beach Creek from the Rappahannock River. Most likely this is why this creek got its name. Dune site LN25 was formed as the distal end of the spit as it continued to lengthen. Channel dredging can be seen at the distal end of the spit since 1937 just downriver of LN24. The material was placed downriver which sealed up the natural channel. Site LN25 is attached to land on its downriver end. Grass became established, and a riverine dune developed. The shoreline rates of change are quite variable but show a long-term erosional trend for the baseline shown. The high variability of shore change along the Beach Creek spit is not quantified but can be seen pictorially.

Dune sites LN24 and LN25 also are shown on Plate 7, but no other sites occur. Shoreline change is minimal but slightly erosional. The shore attachment of the Beach Creek spit and its subsequent accretion is reflected between stations 0 and 1000.

B. Reach II

Reach II includes Plates 8, 9 and 10; no identified dune sites exist along this reach. These plates cover the main trunk of the Corrotoman River. Plate 8 has two baselines both showing erosional trends. Baseline 9A on Plate 9 shows a stable coast while baseline 9B is slightly erosional. The short single baseline on Plate 10 is also erosional.

C. Reach III

Reach III extends from the downstream side of the entrance to the Corrotoman River to Mosquito Point. This coast is a series of headland and embayments where the subreaches alternate riverine fetch exposures from the southwest then south. Reach III includes Plates 11 thru 14.

Plate 11 had dune site LN28 and LN29 (discussed in next plate). Site LN28 is a small isolated dune that resides in a small coastal embayment. This embayment can be seen in the imagery as early as 1937. The overall long-term shore trend from Corrotoman Point to Orchard Point has been stable.

Plate 12 has dune sites LN29 and LN32. Site LN29 has resided against the jetty at Crab Point since at least 1959. Site LN32 has developed on the upstream side of the Norris Bridge approach abutment since it was installed in the 1950s. It has developed a series of secondary dune ridges. Long-term shoreline trends along the Plate 12 coast are erosional becoming stable to accretional toward the Norris Bridge, then erosional on the downriver side.

Two dune sites occur along the Plate 13 shoreline, LN34 and LN36. They are the dune segments of a long curvilinear sandy embayment on the downstream side of Cherry Point. Portions of the beach are known locally as White Stone Beach. This is a relatively stable coast as reflected in the near zero net shore change rate for that shore segment. The Plate 13 shoreline is the upsteam, spiral bay section of a larger embayment that extends from Cherry Point downriver to Mosquito Point. Site LN34 is the longer site on Plate 13 and has had a tidal creek near its center breach intermittently over the years. This would cause an ebb shoal to form at its exit. The inlet's position can be seen in 1937 and 1959 imagery, but then the shoal moves downriver forcing the channel alongshore where it exits again and shoals as seen in 1982, 1994 and 2002.

The Plate 14 shoreline is the dowriver extension of the Plate 13 shoreline; it is the tangential section of the embayed shoreline from Cherry Point to Mosquito Point. It has one continuous dune site but with two wind/wave fetch exposures. Site LN39A faces west-southwest up the Rappahannock River while LN39B faces the open Bay. The dune crests vary accordingly with the higher one on LN39B (Bay Influenced) and the lower

one along LN39A (Riverine). Mosquito Point dunes are also a VIMS monitoring site (http://www.vims.edu/physical/research/shoreline). They have evolved over time as Mosquito Point has moved upriver. Most of the Plate 14 shoreline on the Rappahannock River has been slightly erosional over time.

D. Reach IV

Reach IV includes Plate 15 and 16 and extends from Mosquito Point to Windmill Point. The coast includes several island complexes and faces generally southerly. Plate 15 includes the small isolated dune site LN40A along the sheltered mainland coast. LN40A resides against a protruding bulkhead and has been there since 1937. A long spit ending at Deep Hole Point with dune signature existed until 1982. This spit was actually an island in 1937 which became shore connected in 1959 and 1982. The spit was significantly breached by 1994 leaving the distal end an island that has advanced upriver into Deep Hole. Shoreline change rates are for the sheltered embayed coast showing it to be very stable.

The Deep Hole Island spit extended to Windmill Point Creek in 1937 and was an island (Plate 16). The island attached by 1959 creating two spits with one going to Deep Hole Point and the other ending at Windmill Point Creek. This spit receded landward and connected to the mainland by 1982 creating the foundation for site LN43 and has persisted since. Other dune sites along the Plate 16 coast include LN47, LN50, LN51 and LN52. These are all isolated erosional remnants that were once part of a continuous beach/dune system along the south side of Fleet's Island from Windmill Point Creek to Windmill Point (Plate 17). Numerous groins, large and small have been installed over the years, and each of the dune sites resides within a groin field.

E. Reach V

From Windmill Point north to the county line is designated Reach V and includes Plates 17, 18, 19, 20 and 21. This is mostly open bay shoreline that is broken by four smaller tidal creeks including Little Bay, Tabbs Creek, Dymer Creek and Indian Creek. Plate 17 includes Fleets Island with no identified dune sites. Historical erosion is significant at an average of 7 ft/yr. In order to abate erosion, a series of breakwaters were placed along the shoreline between 1994 and 2002. Plate 18 has no dune sites identified either and is also very erosive at about 5 ft/yr. The erosion of Fleets Island has provided sediments to upriver shorelines, particularly the Rappahannock River coast, where spits, islands, beach and dune have evolved and decayed over time. Plate 19 has no dune sites identified and was too irregular to apply the straight line shore change model.

Plate 20 contains dune sites LN64A, LN65, LN66 LN67 and LN68 which all occur along the distal end of Poplar Neck between Dymer Creek and Poplar Creek. These sites evolved and were created as the Bay-exposed end of Poplar Neck eroded. Dune sites LN64A and LN65 were not in existence in 1937. Site LN64 evolved by 1982 between two groins. A pond existed in 1937 and 1959, but it had completely breached by 1982. By 1959, LN65 had found a niche at a small washover into the pond and stabilized. Dune sites LN66 and LN67 evolved as isolated dunes on the mainland side of the old pond shoreline after the pond was breached as seen in 1982 imagery. Site LN68 resides as a small pocket beach bounded by a marsh headland and stone revetment.

Plate 21 shows the end of Fleets Neck which lies between Rones Bay and Indian Creek. Five dune sites occur on Fleets Neck including LN69, LN70, LN71, LN72 and LN73. They were all part of more extensive dune/beach coast in 1937. Over time, shore recession and development fragmented the coast. Each site settled into its own isolated geomorphic setting. Erosion has been most severe on the distal end on the Neck, and Grogg Island has been reduced to almost non-existence.

V. DISCUSSION: NEAR FUTURE TRENDS OF DUNE SITES

The following discussion is a delineation of shoreline trends based on past performance. Ongoing shore development, shore stabilization and/or beach fill, and storms will have local impacts on the near term. "Near Future" is quite subjective and only implies a reasonable expectation for a given shore reach to continue on its historic course for the next 10 to 20 years. In addition, the basis for the predictions are the shorelines digitized on geo-rectified aerial photography which have an error associated with them (see Methods, Section III). Each site's long-term and recent stability as well as a near future prediction are shown in a table in Appendix B. **This data is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.**

A. Reach I

Dune site LN3 has been stable for the last 30 years or so and should remain so for the near term (Figure 7). Site LN4 that occurs across a creek mouth has advanced and receded over time and will most likely continue that trend so it might be deemed erosional in that regard. Site LN5 appears stable as long as the bounding marsh headlands remain intact.

Site LN6 has lost much of its beach and the *Spartina patens* is eroding. The upriver headland also is eroding so this site will continue to recede. Site LN7 resides in a relatively stable coastal setting (Figure 7), and LN8 is reasonably secure within its groinfield. Site LN10 is in an erosional trend, and LN11 appears stable as it resides on the "sheltered" side of the adjacent upriver headland.

Dune site LN12 appears to be in a stable setting with the potential to advance and recede as the creek mouth opens and closes (Figure 7). Site LN13 is fairly stable within the existing groinfield. Although relatively stable now, LN15 may face potential long-term impacts as the bounding marsh headland recede. Site LN16 will most likely continue to recede.

Dune sites LN17 and LN18 are generally receding while LN19 resides in a relatively stable groinfield. Dune sites LN20, LN21, LN22 and LN23 are isolated dune features along a decaying shoreline while LN24 might be stable against the old jetty for the near term. Dune site LN25 will probably maintain its existence as the spit recedes to the mainland.

B. Reach II

No dune sites exist along this reach.

C. Reach III

Site LN28 and LN29 appear stable for the near term in their isolated geomorphic settings.
The Norris bridge has provided a stable coastal setting for LN32 (Figure 8). Dune sites LN34 and LN36 also occur along a stable beach planform though their vegetative extent may transition alongshore (Figure 8). The Mosquito Point dunes, LN39A and LN39B will continue to exist as mobile features an the point migrates upriver (Figure 8).

D. Reach IV

Site LN40A is in a stable setting. Dune site LN43 is transgressing landward while LN47 is stable within its groinfield (Figure 9). Site LN50 is stable to accretionary, and LN51 and LN52 appear stable on either side of the old wharf/groin (Figure 9).

E. Reach V

Along the end of Poplar Neck, LN64A and LN65 appear to be in an erosional/transgressive state while LN66 is stable if not advancing. Site LN67 is presently in a stable configuration but will recede as the adjacent headland erodes, and LN68 appears stable to accretionary for the near term (Figure 9).

Site LN69 is stable between groins, and LN70 is still mobile between a revetment and breakwater but might become stable over time as it evolves between these man-made headlands. A groinfield helps maintain the stability of LN71 and LN72 in a stable embayment. Site LN73 also appears stable between a jetty and groin (Figure 9).

Figure 7. Selected dune site ground photos in Reach I.

Figure 8. Selected dune site ground photos in Reach III.

Figure 9. Selected dune site ground photos in Reach IV and V.

VI. SUMMARY

Shoreline change rates are based on aerial imagery taken at a particular point in time. We have attempted to portray the same shoreline feature for each date along the coast of Lancaster County. Every 500 feet along each baseline on each plate, the rate of change was calculated. The mean or average rate for each plate is shown in Table 2 for five time periods with the long-term rate determined between 1937 and 2002. The total average and standard deviation (Std Dev) for the entire data set of individual rates is also given. The standard deviation shows the relative spread of values about the mean or average. Larger standard deviation values relative to the mean indicates a wider scatter of erosion rates about the mean while lower standard deviation values indicates erosion rates are concentrated near the mean (*i.e.* all the rates calculated for the entire plate were similar).

The largest variability in mean shore change rates and standard deviations were recorded for the shoreline described by baseline 16A. For instance, between 1982 and 1994, the standard deviation was larger than the average rate of change indicating that the overall rate is probably not indicative of the change which occurred on this section of shore. However, not all of the dates for this section of shore had mean shore change rates with large standard deviations. In fact, many standard deviations were equal to or significantly less than the average rate of change, indicating that the shore change rates were relatively consistent for those time periods. In general, the plates influenced by the Chesapeake Bay wave climate (Plates 16-21) had the largest rates of change.

When short time frames are used to determine rates of shoreline change, shore alterations may seem amplified. The rates based on short-time frames can modify the overall net rates of change. Hopefully, the shore change patterns shown in this report along with the aerial imagery will indicate how the coast will evolve based on past trends and can be used to provide the basis for appropriate shoreline management plans and strategies. Dunes and beaches are a valuable resource that should be either maintained, enhanced or created in order to abate shoreline erosion and provide sandy habitat.

Table 2. Summary average shoreline rates of change and their standard deviation for Lancaster County.

	Plate 1A		Plate 1B		Plate 1C		Plate 2		Plate 3		Plate 4		Plate 5		Plate 6	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	-0.3	0.7	0.3	0.7	-0.5	1.4	-0.4	0.9	-0.2	2.8	0.2	4.4	-0.8	1.9	-0.5	1.6
1959-1982	-1.0	0.7	-0.4	0.6	-2.6	1.3	-2.3	1.3	-1.0	1.4	0.1	2.3	1.2	5.9	0.0	1.4
1982-1994	-0.1	0.7	-0.6	0.8	-5.0	3.7	-2.8	1.2	-1.5	2.6	-0.7	2.7	-1.6	2.1	-0.4	2.2
1994-2002	-3.8	1.3	-0.4	0.8	-4.3	4.8	-3.3	2.8	-0.6	3.7	-1.9	4.8	-1.8	4.9	-3.3	1.9
1937-2002	**-0.9**	**0.4**	**-0.2**	**0.3**	**-2.6**	**0.8**	**-1.9**	**0.8**	**-0.8**	**1.0**	**-0.7**	**2.0**	**-0.3**	**1.3**	**-0.9**	**1.4**

	Plate 7		Plate 8A		Plate 8B		Plate 9A		Plate 9B		Plate 10		Plate 11		Plate 12	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	0.3	1.7	-3.4	3.4	-3.0	2.2	0.9	0.6	4.5	1.1	-0.7	1.5	-1.2	1.7	0.0	2.4
1959-1982	-1.8	1.6	-0.7	0.9	-0.7	1.1	-1.9	0.7	-5.9	2.3	-1.3	0.4	-0.4	0.9	-1.2	2.1
1982-1994	1.2	9.7	-1.3	1.5	0.0	1.6	0.1	0.3	3.3	2.6	-0.4	0.7	-0.8	1.4	-0.6	3.5
1994-2002	-3.7	5.6	-1.7	0.9	-1.6	1.7	-0.5	0.6	-4.8	3.1	-1.6	2.6	-0.6	2.4	0.1	1.7
1937-2002	**-0.7**	**1.7**	**-1.9**	**1.3**	**-1.4**	**1.0**	**-0.4**	**0.3**	**-0.6**	**0.5**	**-1.0**	**0.5**	**-0.8**	**0.6**	**-0.5**	**1.0**

	Plate 13		Plate 14		Plate 15		Plate 16A		Plate 16B		Plate 17		Plate 18		Plate 20	
Imagery Dates	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**	**Rate of Change (ft/yr)**	**Std. Dev.**
1937-1959	-0.7	1.0	-0.2	5.5	0.5	0.9	-5.7	8.6	-2.1	5.0	-9.6	1.3	-3.3	4.3	-2.9	2.8
1959-1982	-1.2	1.6	-0.4	3.5	-0.6	0.9	-14.4	7.4	-0.7	3.4	-6.8	3.6	-4.3	3.6	-3.0	2.4
1982-1994	-1.8	2.4	-2.0	4.8	-0.9	1.7	-20.1	27.7	-1.0	2.1	-4.3	7.1	-9.3	11.7	-1.4	3.9
1994-2002	0.9	2.6	2.7	4.1	1.1	3.4	-3.0	1.8	-0.4	2.3	-1.8	5.2	-1.6	9.9	-1.8	2.5
1937-2002	**-0.9**	**1.0**	**-0.3**	**1.7**	**-0.1**	**0.6**	**-11.1**	**4.5**	**-1.2**	**1.5**	**-6.7**	**2.0**	**-4.6**	**2.4**	**-2.5**	**1.8**

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APPENDIX A

For each Plate shown on Figure 4 (Page 4), Appendix A contains orthorectified aerial photography flown in 1937, 1959, 1982, 1994, and 2002. Also shown are the digitized shorelines, identified dune sites, and an arbitrarily created baseline. A plot shows only the relative locations of the shorelines while another one depicts the rate of shore change between dates. A summary of the average Plate rate of change in ft/yr as well as the standard deviation for each rate is also shown.

This data is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

APPENDIX B

The data shown in the following tables were primarily collected as part of the Chesapeake Bay Dune: Evolution and Status report and presented in Hardaway *et al.* (2001) and Hardaway *et al.* (2004). Individual site characteristics may now be different due to natural or man-induced shoreline change.

An additional table presents the results of this analysis and describes each dune site's relative long-term, recent, and near-future predicted stability. This data results from the position of the digitized shorelines which have an error associated with them (see Methods, Section III).

Since much of the dune data were collected several years ago and the beach and dune systems may have changed, this report is intended as a resource for coastal zone managers and homeowners; it is not intended for use in determining legal jurisdictional limits.

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al*., 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

Identified dune sites in Lancaster County as of 2000.

Dune Site No.	Location^ Easting (Feet)	Location^ Northing (Feet)	Date Visited	Dune Shore Length (feet)	Primary Dune Site?	Secondary Dune Site?	*Public Ownership?
3	2,555,400	525,350	30-Jul-1999	250	Yes	No	No
4	2,555,750	524,600	30-Jul-1999	210	Yes	No	No
5	2,557,700	518,400	30-Jul-1999	130	Yes	No	No
6	2,558,750	515,750	30-Jul-1999	670	Yes	No	No
7	2,559,900	514,900	30-Jul-1999	1,025	Yes	No	No
8	2,560,450	514,150	30-Jul-1999	580	Yes	No	No
10	2,562,200	509,650	30-Jul-1999	110	Yes	No	No
11	2,562,800	509,450	30-Jul-1999	990	Yes	Yes	No
12	2,564,500	507,800	30-Jul-1999	190	Yes	No	No
13	2,565,400	507,250	30-Jul-1999	300	Yes	No	No
15	2,566,000	507,200	30-Jul-1999	150	Yes	No	No
16	2,567,750	503,350	30-Jul-1999	125	Yes	No	No
17'	2,568,300	495,050	30-Jul-1999	120	Yes	No	No
18	2,568,350	494,750	30-Jul-1999	310	Yes	No	No
19	2,568,050	492,350	30-Jul-1999	200	Yes	No	No
20'	2,568,150	491,450	03-Dec-1999	140	Yes	No	No
21'	2,568,200	491,200	03-Dec-1999	160	Yes	No	No
22'	2,568,550	490,250	03-Dec-1999	100	Yes	No	No
23'	2,568,950	489,800	03-Dec-1999	170	Yes	No	No
24'	2,569,200	489,150	03-Dec-1999	240	Yes	No	No
25	2,570,000	488,750	03-Dec-1999	420	Yes	No	No
28'	2,593,600	485,650	03-Dec-1999	120	Yes	No	No
29'	2,596,400	486,600	03-Dec-1999	150	Yes	No	No
32	2,604,050	481,450	22-Apr-1999	900	Yes	Yes	No
34	2,608,900	478,650	22-Apr-1999	1,200	Yes	No	No
36	2,610,700	479,100	22-Apr-1999	140	Yes	No	No
39A	2,619,050	471,800	22-Apr-1999	850	Yes	Yes	No
39B	2,619,050	471,800	22-Apr-1999	600	Yes	No	No
40A	2,623,930	476,750	22-Apr-1999	320	Yes	No	No
43	2,631,650	476,200	22-Apr-1999	820	Yes	No	No
47	2,636,250	475,750	22-Apr-1999	360	Yes	No	No
50	2,638,500	474,850	22-Apr-1999	580	Yes	No	No
51	2,638,750	747,350	22-Apr-1999	250	Yes	No	No
52	2,639,000	474,150	22-Apr-1999	100	Yes	No	No
64A	2,626,220	489,950	20-May-1999	200	Yes	No	No
65	2,626,300	490,350	20-May-1999	150	Yes	No	No
66	2,626,100	490,600	20-May-1999	170	Yes	No	No
67	2,625,750	491,250	20-May-1999	140	Yes	No	No
68	2,625,350	491,900	20-May-1999	250	Yes	Yes	No
69	2,628,800	494,300	20-May-1999	100	Yes	No	No
70	2,628,550	496,450	20-May-1999	100	Yes	No	No
71	2,628,250	496,850	20-May-1999	300	Yes	No	No
72	2,627,400	497,650	20-May-1999	570	Yes	Yes	No
73	2,626,700	498,050	20-May-1999	300	Yes	Yes	No

*Public ownership includes governmental entities including local, state, and federal; otherwise ownership is by the private individual.
^Location is in Virginia State Plane South, NAD 1927
'Sites were noted as dunes but were not photographed or surveyed

Dune site measurements in Lancaster County as of 2000.

Dune Site Measurements									
		Primary Dune			Secondary Dunes				
			Distance from Crest				Distance From		
Site No.	Dune Shore Length (feet)	Crest Elev (ftMLW)	landward to back base (feet)	To MLW (feet)	2nd Dune Site	Crest Elev (ftMLW)	Primary Crest to 2nd Crest (feet)	2ndCrest landward (feet)	2nd Crest seaward to 1st back base (feet)
3	250	5	18	35					
4	210	3.94	21	44					
5	130	3.44	32	45					
6	670	3.67	14	33					
7	1025	5	6	53					
8	580	4.81	39	40					
10	110	4.06	12	32					
11	990	3.53	3	28	Yes	3.27	29	3	26
12	190	3.87	9	47					
13	300	4.58	23	28					
15	150	3.75	19	35					
16	125	2.77	13	23					
17'	120								
18	310	5.09	18	27					
19	200	5.83	24	54					
20'	140								
21'	160								
22'	100								
23'	170								
24'	240								
25	420	4.59	15	50					
26	240								
27'	360								
28'	120								
29	150								
32	900	4.52	18	45	Yes	4.41	61	29	43
34	1200	5.54	28	60					
36	140								
39A	850	3.7	32	61	Yes	3.44	143	86	25
39B	600	5.28	27	65					
40A	320	5.5	20	45					
43	820	5	20	30					
47	360	5	50	41					
50	580	4.34	15	60					
51	250	5	40	28					
52	100	7.15	32	63					
64A	200	5.84	50	40					
65	150	4.86	44	48					
66	170	3.74	7	42					
67	140	5.13	63	50					
68	250	3.63	18	79	Yes	3.42	60	13	42
69	100	5.41	25	65					
70	100	3.91	50	52					
71	300	5.25	4	44					
72	570	3.39	18	29	Yes	3.03	40	18	4
73	300	4.74	25	50	Yes	5.11	104	52	27

These data were collected as part of the Chesapeake Bay Dune: Evolution and Status Report (Hardaway *et al.*, 2001). Site characteristics may now be different due to natural or man-influenced shoreline change.

Dune site parameters in Lancaster County as of 2000.

Site No.	Type	Fetch Exposure A	Shoreline Direction of Face B	Nearshore Gradient C		Morphologic Setting D	Relative Stability E	Underlying Substrate F	Structure or Fill G
3	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Pocket	Stable	Upland	Groin
4	Natural	Riverine	Southwest	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	
5	Natural	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	
6	Natural	Riverine	South	Steep	No Bars	Isolated, Shallow Bay	Erosional	Upland	
7	Natural	Riverine	Southwest	Steep	No Bars	Dune Field, Linear	Stable	Upland	
8	Man Inf	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
10	Natural	Riverine	West	Steep	No Bars	Isolated, Linear	Erosional	Upland	
11	Natural	Riverine	Southwest	Medium	No Bars	Dune Field, Shallow Bay	Stable	Upland	
12	Man Inf	Riverine	Southwest	Medium	No Bars	Ck Mouth Barrier/Spit	Accretionary	Marsh	Revet/Bulkhead
13	Man Inf	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
15	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Linear	Erosional	Marsh	Beach Fill
16	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
17	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
18	Man Inf	Riverine	West	Medium	No Bars	Ck Mouth Barrier/Spit	Erosional	Marsh	Revet/Bulkhead
19	Man Inf	Riverine	West	Medium	No Bars	Isolated, Linear	Stable	Upland	Groin
20	Man Inf	Riverine	West	Medium	No Bars	Isolated, Linear	Erosional	Marsh	Groin
21	Natural	Riverine	West	Medium	No Bars	Isolated, Linear	Erosional	Marsh	
22	Natural	Riverine	Southwest	Steep	No Bars	Isolated, Pocket	Erosional	Marsh	
23	Natural	Riverine	Southwest	Steep	No Bars	Isolated, Linear	Erosional	Marsh	
24	Man Inf	Riverine	West	Steep	No Bars	Ck Mouth Barrier/Spit	Accretionary	Marsh	Jetty
25	Man Inf	Riverine	Southwest	Medium	No Bars	Isolated, Linear	Stable	Marsh	Beach Fill
26	Natural	Riverine	Southwest	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	
27	Man Inf	Riverine	Southeast	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
28	Natural	Riverine	South	Steep	No Bars	Isolated, Pocket	Stable	Marsh	
29	Man Inf	Riverine	Southwest	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Upland	Jetty
32	Man Inf	Riverine	Southwest	Steep	No Bars	Dune Field, Linear	Stable	Upland	Jetty
34	Man Inf	Riverine	South	Steep	No Bars	Ck Mouth Barrier/Spit	Stable	Marsh	Groin
36	Man Inf	Riverine	South	Steep	No Bars	Isolated, Shallow Bay	Stable	Upland	Groin
39A	Natural	Riverine	West	Steep	No Bars	Dune Field, Salient	Accretionary	Upland	
39B	Natural	River, Bay Inf	South	Steep	No Bars	Dune Field, Salient	Erosional	Upland	
40A	Man Inf	River, Bay Inf	Southeast	Shallow	No Bars	Isolated, Shallow Bay	Stable	Upland	Revet/Bulkhead
43	Natural	River, Bay Inf	Southeast	Medium	Bars	Dune Field, Linear	Erosional	Upland	
47	Man Inf	River, Bay Inf	South	Medium	Bars	Isolated, Linear	Stable	Upland	Groin
50	Man Inf	River, Bay Inf	Southwest	Medium	No Bars	Dune Field, Shallow Bay	Stable	Upland	Groin
51	Man Inf	River, Bay Inf	Southwest	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
52	Man Inf	River, Bay Inf	South	Steep	No Bars	Isolated, Linear	Stable	Upland	Groin
64A	Man Inf	Open Bay	East	Medium	Bars	Isolated, Linear	Erosional	Upland	Beach Fill
65	Man Inf	Open Bay	East	Medium	Bars	Isolated, Pocket	Erosional	Upland	Revet/Bulkhead
66	Natural	Riverine	Northeast	Shallow	No Bars	Isolated, Salient	Accretionary	Upland	
67	Natural	River, Bay Inf	East	Medium	Bars	Isolated, Pocket	Erosional	Marsh	
68	Natural	River, Bay Inf	North	Steep	No Bars	Isolated, Salient	Accretionary	Upland	
69	Man Inf	River, Bay Inf	South	Steep	Bars	Isolated, Pocket	Erosional	Upland	Groin
70	Man Inf	River, Bay Inf	Northeast	Steep	Bars	Isolated, Linear	Erosional	Marsh	Breakwaters
71	Man Inf	River, Bay Inf	Northeast	Steep	Bars	Isolated, Linear	Stable	Upland	Groin
72	Natural	River, Bay Inf	North	Steep	No Bars	Dune Field, Shallow Bay	Stable	Upland	
73	Man Inf	River, Bay Inf	Northeast	Steep	No Bars	Isolated, Salient	Stable	Upland	Jetty

Long-term, recent stability and future predictions of shore erosion and accretion rates for dune sites in Lancaster County.

	Site No.	Long-Term Stability 1937-2002	Recent Stability 1994-2002	Near Future Prediction
LN	3	Erosional	Stable	Stable
LN	4	Stable	Erosional	Erosional
LN	5	Erosional	Erosional	Stable
LN	6	Erosional	Erosional	Erosional
LN	7	Accretionary	Erosional	Stable
LN	8	Accretionary	Stable	Stable
LN	10	Accretionary	Erosional	Erosional
LN	11	Accretionary	Stable	Stable
LN	12	Erosional	Accretionary	Stable
LN	13	Stable	Stable	Stable
LN	15	Erosional	Stable	Erosional
LN	16	Erosional	Erosional	Erosional
LN	17	Erosional	Erosional	Erosional
LN	18	Accretionary	Erosional	Erosional
LN	19	Accretionary	Stable	Stable
LN	20	Erosional	Erosional	Erosional
LN	21	Erosional	Erosional	Erosional
LN	22	Erosional	Erosional	Erosional
LN	23	Erosional	Erosional	Erosional
LN	24	Accretionary	Erosional	Stable
LN	25	Accretionary	Erosional	Erosional
LN	28	Erosional	Stable	Stable
LN	29	Stable	Stable	Stable
LN	32	Accretionary	Stable	Stable
LN	34	Erosional	Stable	Stable
LN	36	Erosional	stable	Stable
LN	39A	Accretionary	Accretionary	Accretionary
LN	39B	Accretionary	Erosional	Erosional
LN	40A	Accretionary	Accretionary	Stable
LN	43	Accretionary	Erosional	Erosional
LN	47	Erosional	Stable	Stable
LN	50	stable	Stable	Stable
LN	51	Erosional	stable	Stable
LN	52	Erosional	Stable	Stable
LN	64A	Erosional	Erosional	Erosional
LN	65	Erosional	Erosional	Erosional
LN	66	Erosional	stable	Accretionary
LN	67	Erosional	Accretionary	Stable
LN	68	Accretionary	Stable	Stable
LN	69	Stable	Stable	Stable
LN	70	Erosional	Erosional	Erosional
LN	71	Erosional	Stable	Stable
LN	72	Accretionary	Stable	Stable
LN	73	Accretionary	Stable	Stable

COUNTY OF LANCASTER

FOUNDED 1651 IN VIRGINIA

LANCASTER COURTHOUSE
8311 MARY BALL ROAD
LANCASTER, VIRGINIA 22503

804-462-5129
804-462-0031 (FAX)
www.lancova.com

Don G. Gill
County Administrator

November 9, 2023

Virginia Department of Conservation & Recreation
2023 Virginia Community Flood Preparedness Fund – Project Grants
600 East Main Street, 4th Floor
Richmond, VA 23219
Attn: CFPF/RVRF Grant Submittal

RE: Pledge of Agreement for Westland Beach – Windmill Point Shoreline Stabilization Project

To whom it may concern:

The County of Lancaster, which is the applicant organization, is submitting this *Pledge of Agreement* to support its *2023 Virginia Community Flood Preparedness Fund – Project Grants* proposal, Westland Beach – Windmill Point Shoreline Stabilization Project.

The County of Lancaster is committing project funding in cash, in the amount of $659,735.70, from the Lancaster County FY23 Adopted Capital Improvement Budget Project. The $659,735.70 is 30% of the total project amount ($2,319,119.00). The County is requesting $1,623,383.30 in grant funding. Lancaster County will pay the match contribution during the agreement period.

Thank you for considering our *2023 Virginia Community Flood Preparedness Fund – Project Grants* proposal.

Sincerely,

Don G. Gill
County Administrator

Lancaster County, Virginia

MEMORANDUM

MAINTENANCE AGREEMENT

The County of Lancaster, accepts responsibility, at its own expense, if necessary, for the routine maintenance of any property, structures, equipment or facilities acquired or constructed as a result of such grant funded aid. Routine maintenance shall include, but not be limited to, such responsibilities as keeping vacant land clear of debris, maintaining beach nourishment and vegetative plantings, and maintenance of breakwaters as necessary.

By signing this agreement, the Applicant acknowledges and accepts maintenance responsibility to preserve the long-term mitigation effectiveness of the project. It does not replace supersede, or add to any other maintenance responsibilities imposed by Federal or State laws or regulations which are in fore on the date of the project award.

Thank you for considering our *2023 Virginia Community Flood Preparedness Fund – Project Grants* proposal.

Name of Designated Agent: Don G. Gill

Signature of Designated Agent: Don G. Gill

County Administrator

Date: 11/9/23

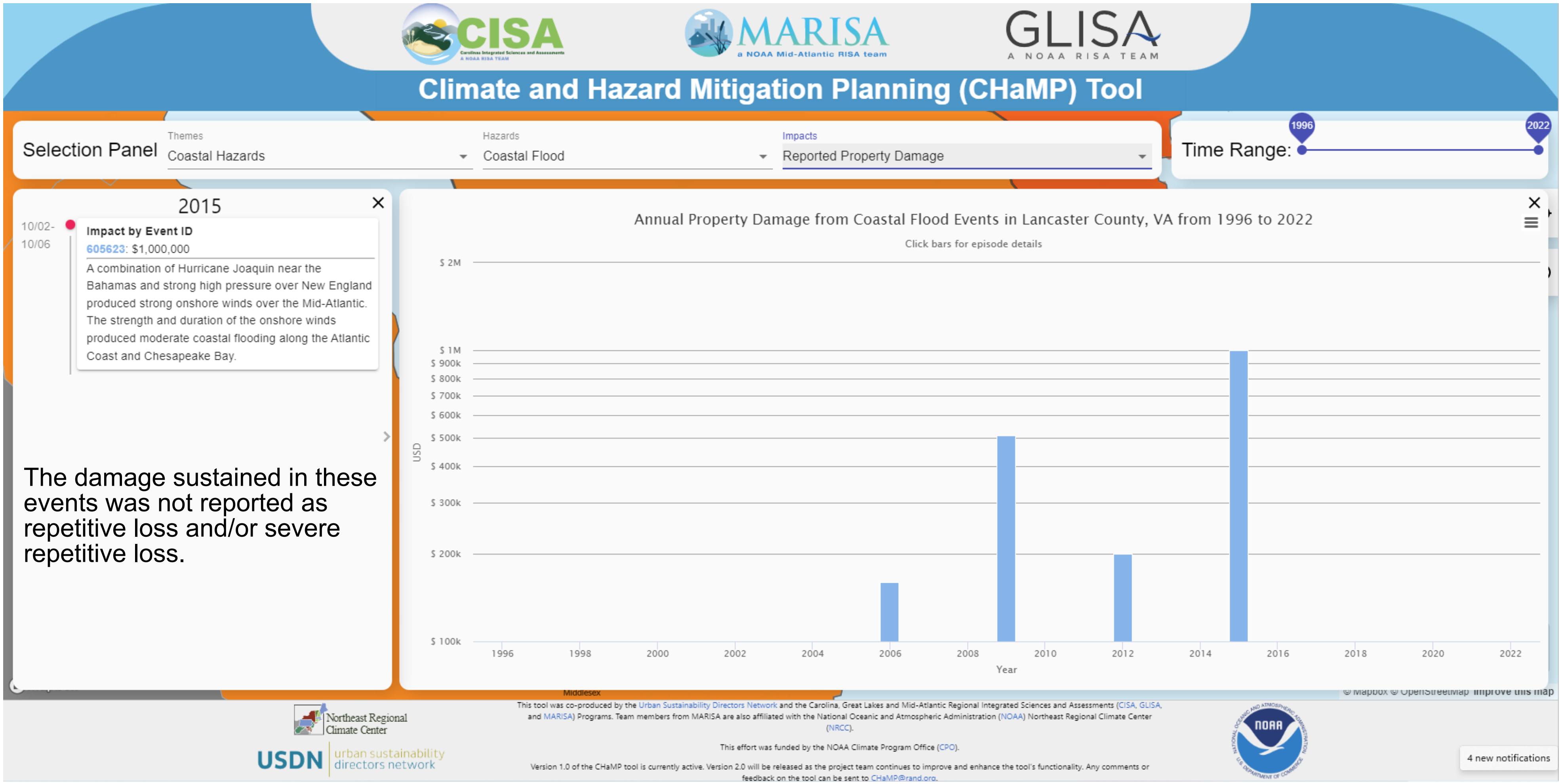
Lancaster County, Virginia

MEMORANDUM

MAINTENANCE PLAN

The County of Lancaster, accepts responsibility, at its own expense, if necessary, for the routine maintenance of any property, structures, equipment or facilities acquired or constructed as a result of such grant funded aid. Routine maintenance shall include, but not be limited to, such responsibilities as keeping vacant land clear of debris, maintaining beach nourishment and vegetative plantings, and maintenance of breakwaters as necessary.

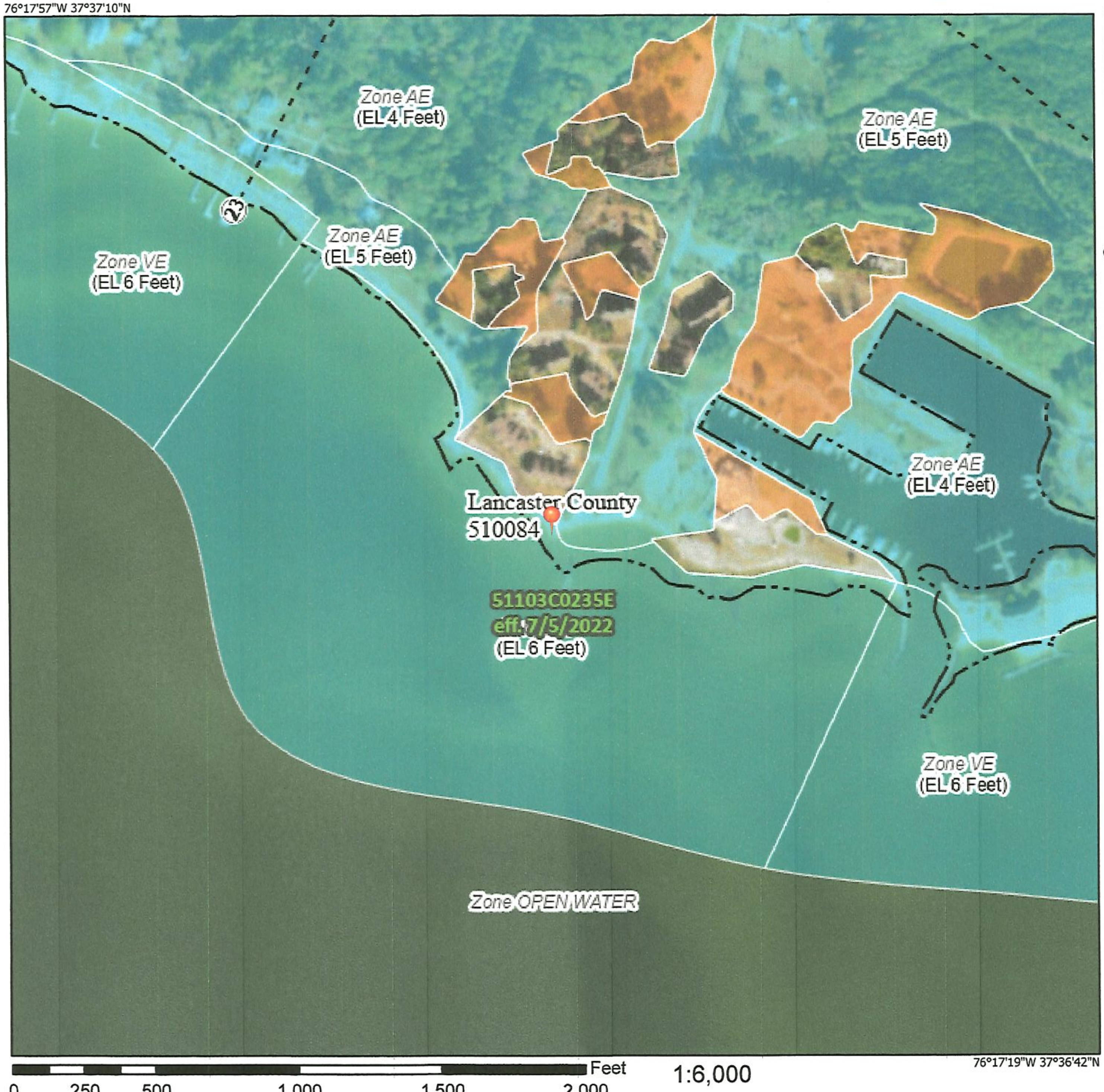
Maintenance of the project will continue to be funded annually through the County's General Fund as part the Department of Parks budget. A new position has been created to oversee the maintenance of Parks. This job has been advertised and is in the hiring process. Sea level rise remains a serious concern. Based on sea level rise, it may be necessary, in the future, to increase the height of the breakwaters to prolong their functionality. These breakwaters will continue to be monitored and stone added as needed to maintain functionality.



CISA
MARISA
a NOAA Mid-Atlantic RISA team
GLISA
A NOAA RISA TEAM
Climate and Hazard Mitigation Planning (CHaMP) Tool
Selection Panel
Themes
Coastal Hazards
Hazards
Coastal Flood
Impacts
Reported Property Damage
Time Range:
1996
2022
2015
10/02-
10/06
Impact by Event ID
605623: $1,000,000
A combination of Hurricane Joaquin near the Bahamas and strong high pressure over New England produced strong onshore winds over the Mid-Atlantic. The strength and duration of the onshore winds produced moderate coastal flooding along the Atlantic Coast and Chesapeake Bay.
The damage sustained in these events was not reported as repetitive loss and/or severe repetitive loss.
Annual Property Damage from Coastal Flood Events in Lancaster County, VA from 1996 to 2022
Click bars for episode details
USD
$ 2M
$ 1M
$ 900k
$ 800k
$ 700k
$ 600k
$ 500k
$ 400k
$ 300k
$ 200k
$ 100k
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Year
Middlesex
Northeast Regional Climate Center
USDN urban sustainability directors network
This tool was co-produced by the Urban Sustainability Directors Network and the Carolina, Great Lakes and Mid-Atlantic Regional Integrated Sciences and Assessments (CISA, GLISA, and MARISA) Programs. Team members from MARISA are also affiliated with the National Oceanic and Atmospheric Administration (NOAA) Northeast Regional Climate Center (NRCC).
This effort was funded by the NOAA Climate Program Office (CPO).
Version 1.0 of the CHaMP tool is currently active. Version 2.0 will be released as the project team continues to improve and enhance the tool's functionality. Any comments or feedback on the tool can be sent to CHaMP@rand.org.
NOAA
4 new notifications

National Flood Hazard Layer FIRMette

76°17'57"W 37°37'10"N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) *Zone A, V, A99*
		With BFE or Depth *Zone AE, AO, AH, VE, AR*
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainag areas of less than one square mile *Zone X*
		Future Conditions 1% Annual Chance Flood Hazard *Zone X*
		Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
		Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
		Effective LOMRs
		Area of Undetermined Flood Hazard *Zone*
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

N

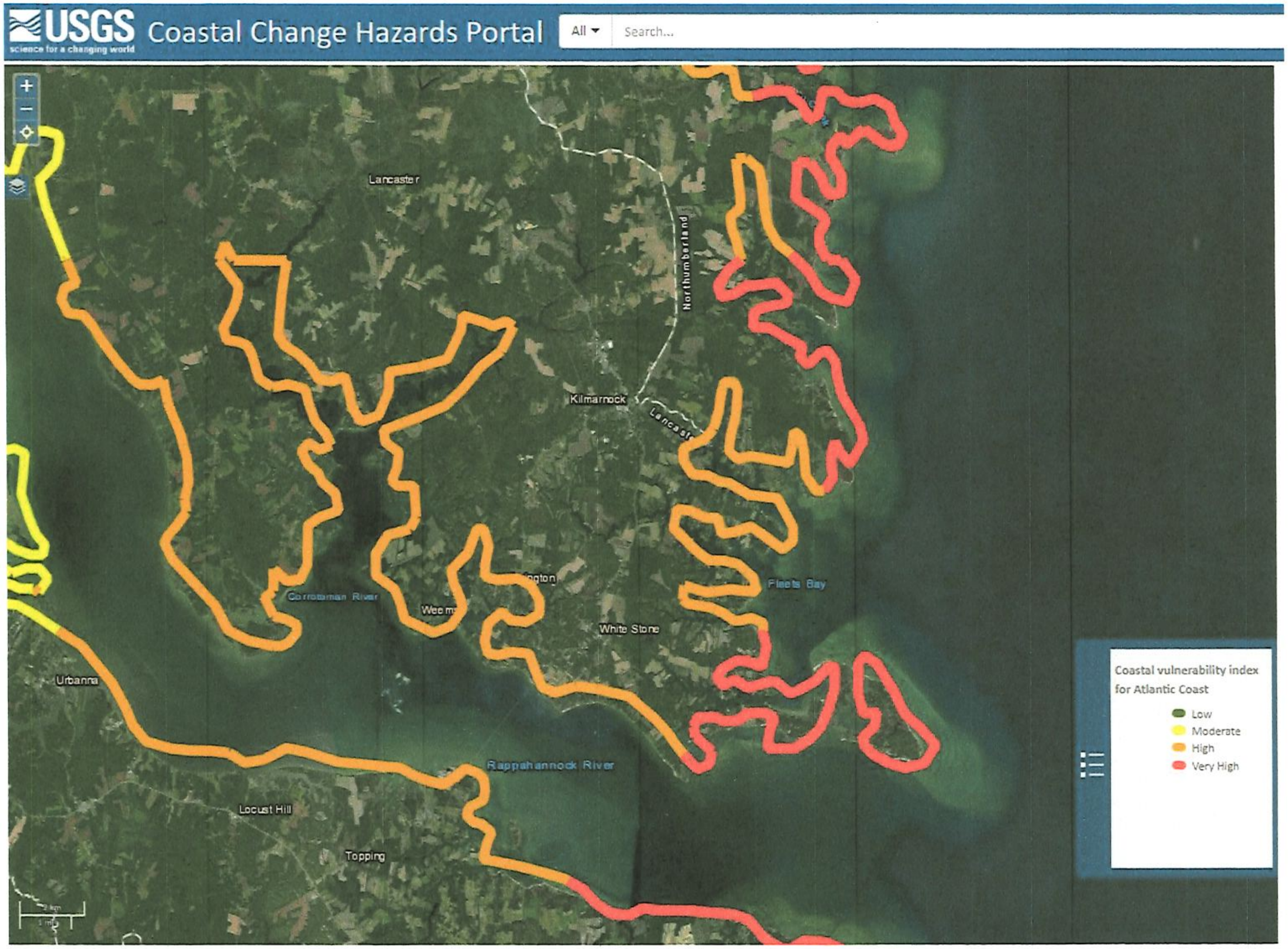
The pin displayed on the map is an approximate point selected by the user and does not represe an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/10/2022 at 2:41 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.


USGS
science for a changing world
Coastal Change Hazards Portal
All
Search...
White Marsh
Windmill Point Creek
Windmill Point Creek
Westland
Windmill
Point
Coastal vulnerability index
for Atlantic Coast
Low
Moderate
High
Very High
100 m
500 ft


USGS
science for a changing world
Coastal Change Hazards Portal
All
Search...
Lancaster
Northumberland
Kilmarnock
Lancaster
Corrotoman River
Weems
White Stone
Fleets Bay
Urbanna
Rappahannock River
Locust Hill
Topping
Coastal vulnerability index
for Atlantic Coast
Low
Moderate
High
Very High

Climate and Hazard Mitigation Planning (CHaMP) Tool

CISA · MARISA a NOAA Mid-Atlantic RISA team · GLISA A NOAA RISA TEAM

Selection Panel

Themes: Coastal Hazards

Hazards: Coastal Flood

Impacts: Reported Property Damage

Time Range: 1996 – 2022

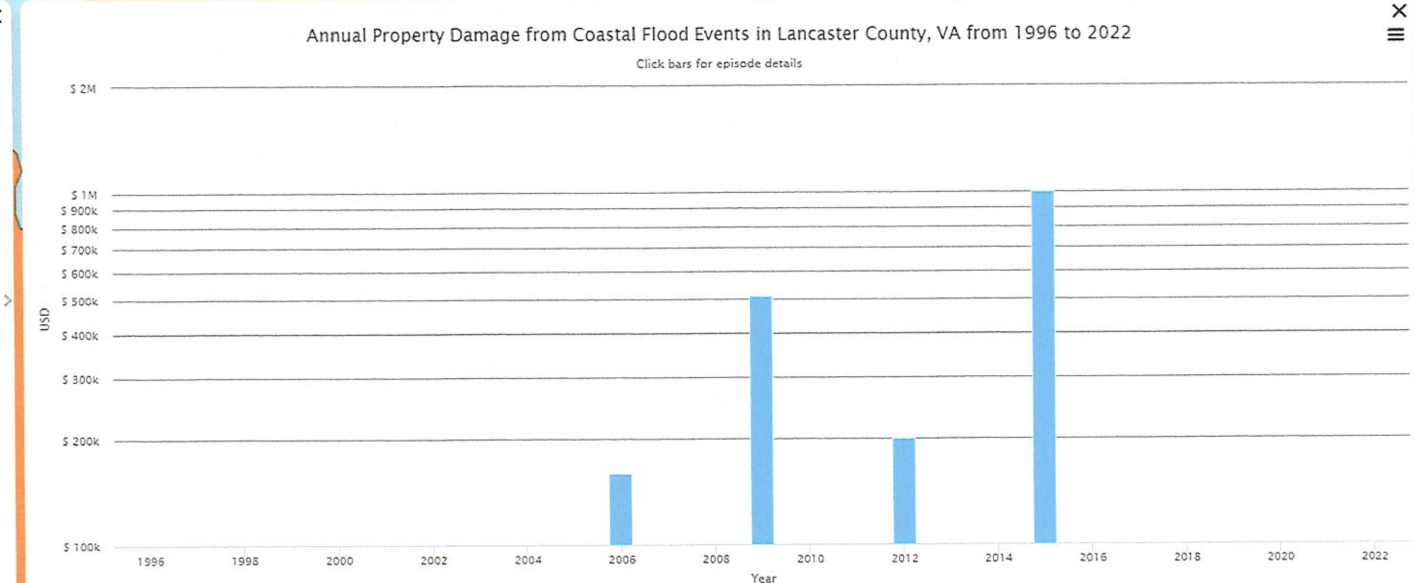
2015

10/02-10/06

Impact by Event ID

605623: $1,000,000

A combination of Hurricane Joaquin near the Bahamas and strong high pressure over New England produced strong onshore winds over the Mid-Atlantic. The strength and duration of the onshore winds produced moderate coastal flooding along the Atlantic Coast and Chesapeake Bay.



Northeast Regional Climate Center

USDN urban sustainability directors network

This tool was co-produced by the Urban Sustainability Directors Network and the Carolinas, Great Lakes and Mid-Atlantic Regional Integrated Sciences and Assessments (CISA, GLISA, and MARISA) Programs. Team members from MARISA are also affiliated with the National Oceanic and Atmospheric Administration (NOAA) Northeast Regional Climate Center (NRCC).

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© Mapbox © OpenStreetMap Improve this map

4 new notifications

Climate and Hazard Mitigation Planning (CHaMP) Tool

Selection Panel

Themes: Coastal Hazards

Hazards: Coastal Flood

Impacts: Total Reported Episodes

Time Range: 1996 – 2022

2021

10/10-10/11

Impacted Counties

Lancaster

Northampton

The combination of King Tides and high pressure over the Canadian Maritimes and low pressure just off the North Carolina coast, produced east northeast winds which caused minor to moderate (tidal) coastal flooding across portions of the Chesapeake Bay.

10/28-10/30

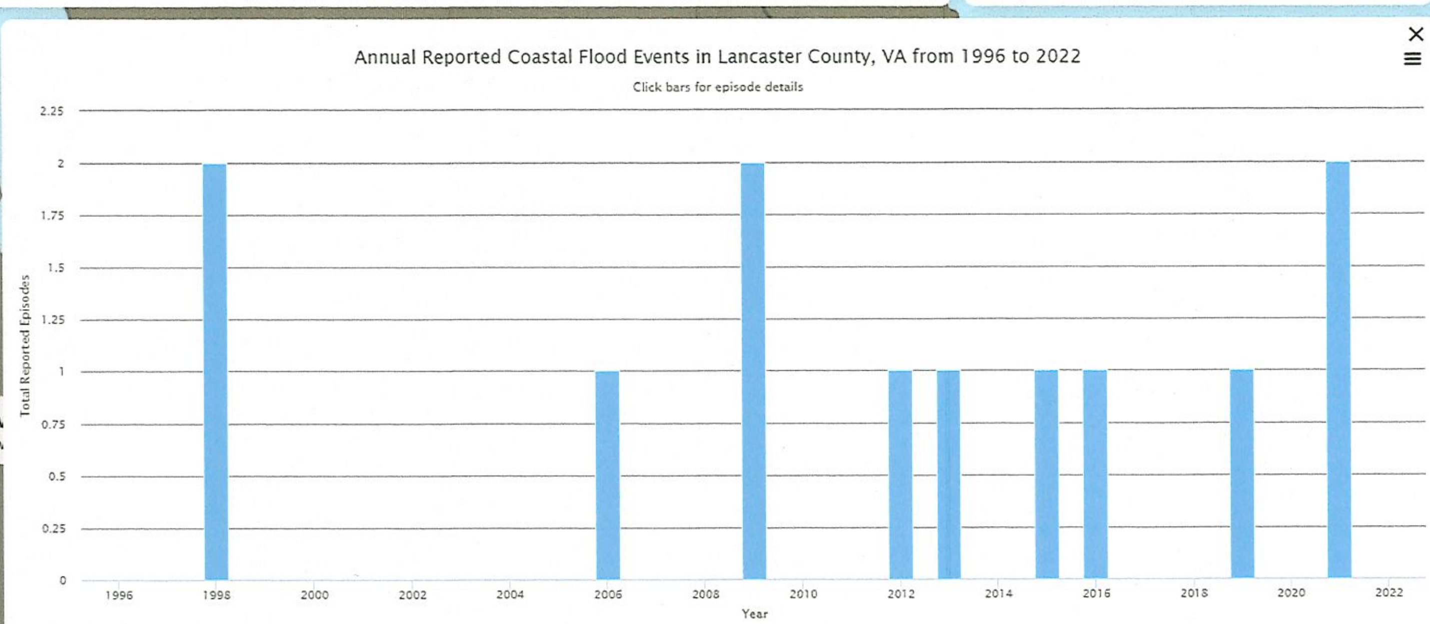
Impacted Counties

Accomack

Lancaster

Northampton

Strong low pressure tracked from the Middle Mississippi Valley east northeast toward the Northeast United States from Thursday, October 28th into Saturday, October 30th. This system produced very strong east southeast winds, then strong south to southwest winds through the period. This caused moderate to major (tidal) coastal flooding across portions of the Chesapeake Bay.



This tool was co-produced by the Urban Sustainability Directors Network and the Carolina, Great Lakes and Mid-Atlantic Regional Integrated Sciences and Assessments (CISA, GLISA, and MARISA) Programs. Team members from MARISA are also affiliated with the National Oceanic and Atmospheric Administration (NOAA) Northeast Regional Climate Center (NRCC).

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Version 1.0 of the CHaMP tool is currently active. Version 2.0 will be released as the project team continues to improve and enhance the tool's functionality. Any comments or

Northeast Regional Climate Center

USDN urban sustainability directors network

COMMONWEALTH of VIRGINIA

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

Marine Resources Commission
2600 Washington Avenue
Third Floor
Newport News, Virginia 23607

William A. Pruitt
Commissioner

November 21, 2003

[redacted]
The Landing Association
[redacted]

RE: VMRC #03-1960

Dear [redacted]

Enclosed is the Marine Resources Commission permit for your proposal to install a 24-foot long by 16-foot wide quarry stone spur adjacent to an existing stone and timber groin, which will be repaired in place, adjacent to Association property along the Rappahannock River at Windmill Point in Lancaster County.

A yellow placard is also enclosed. This placard reflects the authorized activities for inspection purposes and <u>must</u> be conspicuously displayed at the work site throughout the construction phase. Failure to properly post the placard in a prominent location will be considered a violation of your permit conditions.

YOU ARE REMINDED THAT ANY DEVIATION FROM THE PERMIT OR ATTACHED DRAWINGS REQUIRES PRIOR AUTHORIZATION FROM THE MARINE RESOURCES COMMISSION. FAILURE TO OBTAIN THE NECESSARY MODIFICATION WILL BE CONSIDERED A VIOLATION AND COULD SUBJECT YOU TO CIVIL CHARGES IN AMOUNTS NOT TO EXCEED $10,000 PER VIOLATION.

November 21, 2003

The work authorized by this permit is to be completed by November 30, 2006. Please note that in conformance with Special Condition 17 of your permit you are to notify the Commission prior to commencement of your permitted project. The enclosed self-addressed, stamped post card is to be used for this purpose. All other conditions of the permit will remain in effect.

Please be advised that you may also require issuance of a U. S. Army Corps of Engineers permit before you begin work on this project. You may wish to contact them directly to verify any permitting requirements.

Sincerely,

Robert W. Grabb
Chief, Habitat Management

RWG/bac
HM
Enclosure
cc: U. S. Army Corps of Engineers
Lancaster County Wetlands Board
Applicant

MRC 30-317

VMRC #03-1960
Applicant: The Landing Association

COMMONWEALTH OF VIRGINIA
MARINE RESOURCES COMMISSION
PERMIT

The Commonwealth of Virginia, Marine Resources Commission, hereinafter referred to as the Commission, on this **14th** day of **November 2003**, hereby grants unto: **The Landing Association**

[redacted]

White Stone, Virginia 22578

hereinafter referred to as the Permittee, permission to:

x Encroach in, on, or over State-owned subaqueous bottoms pursuant to Chapter 12, Subtitle III, of Title 28.2 of the Code of Virginia.

____ Use or develop tidal wetlands pursuant to Chapter 13, Subtitle III, of Title 28.2 of the Code of Virginia.

Permittee is hereby authorized to install a 24-foot long by 16-foot wide quarry stone spur adjacent to an existing stone and timber groin, which will be repaired in place, adjacent to Association property along the Rappahannock River at Windmill Point in Lancaster County. All activities authorized herein shall be accomplished in conformance with plans and drawings dated received September 5, 2003, and revisions dated received October 29, 2003, which are attached hereto and made a part of this permit.

This permit is granted subject to the following conditions:

(1) The work authorized by this permit shall be completed by November 30, 2006. The Permittee shall notify the Commission when the project is completed. The completion date may be extended by the Commission in its discretion. Any such application for extension of time shall be in writing prior to the above completion date and shall specify the reason for such extension and the expected date of completion of construction. All other conditions remain in effect until revoked by the Commission or the General Assembly.

(2) This permit grants no authority to the Permittee to encroach upon the property rights, including riparian rights, of others.

(3) The duly authorized agents of the Commission shall have the right to enter upon the premises at reasonable times, for the purpose of inspecting the work being done pursuant to this permit.

(4) The Permittee shall comply with the water quality standards as established by the Department of Environmental Quality, Water Division, and all other applicable laws, ordinances, rules and regulations affecting the conduct of the project. The granting of this permit shall not relieve the Permittee of the responsibility of obtaining any and all other permits or authority for the projects.

(5) This permit shall not be transferred without written consent of the Commissioner.

(6) This permit shall not affect or interfere with the right vouchsafed to the people of Virginia concerning fishing, fowling and the catching of and taking of oysters and other shellfish in and from the bottom of acres and waters not included within the terms of this permit.

(7) The Permittee shall, to the greatest extent practicable, minimize the adverse effects of the project upon adjacent properties and wetlands and upon the natural resources of the Commonwealth.

(8) This permit may be revoked at any time by the Commission upon the failure of the Permittee to comply with any of the terms and conditions hereof or at the will of the General Assembly of Virginia.

(9) There is expressly excluded from the permit any portion of the waters within the boundaries of the Baylor Survey.

(10) This permit is subject to any lease of oyster planting ground in effect on the date of this permit. Nothing in this permit shall be construed as allowing the Permittee to encroach on any lease without the consent of the leaseholder. The Permittee shall be liable for any damages to such lease.

(11) The issuance of this permit does not confer upon the Permittee any interest or title to the beds of the waters.

(12) All structures authorized by this permit which are not maintained in good repair shall be completely removed from State-owned bottom within three (3) months after notification by the Commission.

(13) The Permittee agrees to comply with all of the terms and conditions as set forth in this permit and that the project will be accomplished within the boundaries as outlined in the plans attached hereto. Any encroachment beyond the limits of this permit shall constitute a Class 1 misdemeanor.

(14) This permit authorizes no claim to archaeological artifacts which may be encountered during the course of construction. If, however, archaeological remains are encountered, the Permittee agrees to notify the Commission, who will, in turn notify the Department of Historic Resources. The Permittee further agrees to cooperate with agencies of the Commonwealth in the recovery of archaeological remains if deemed necessary.

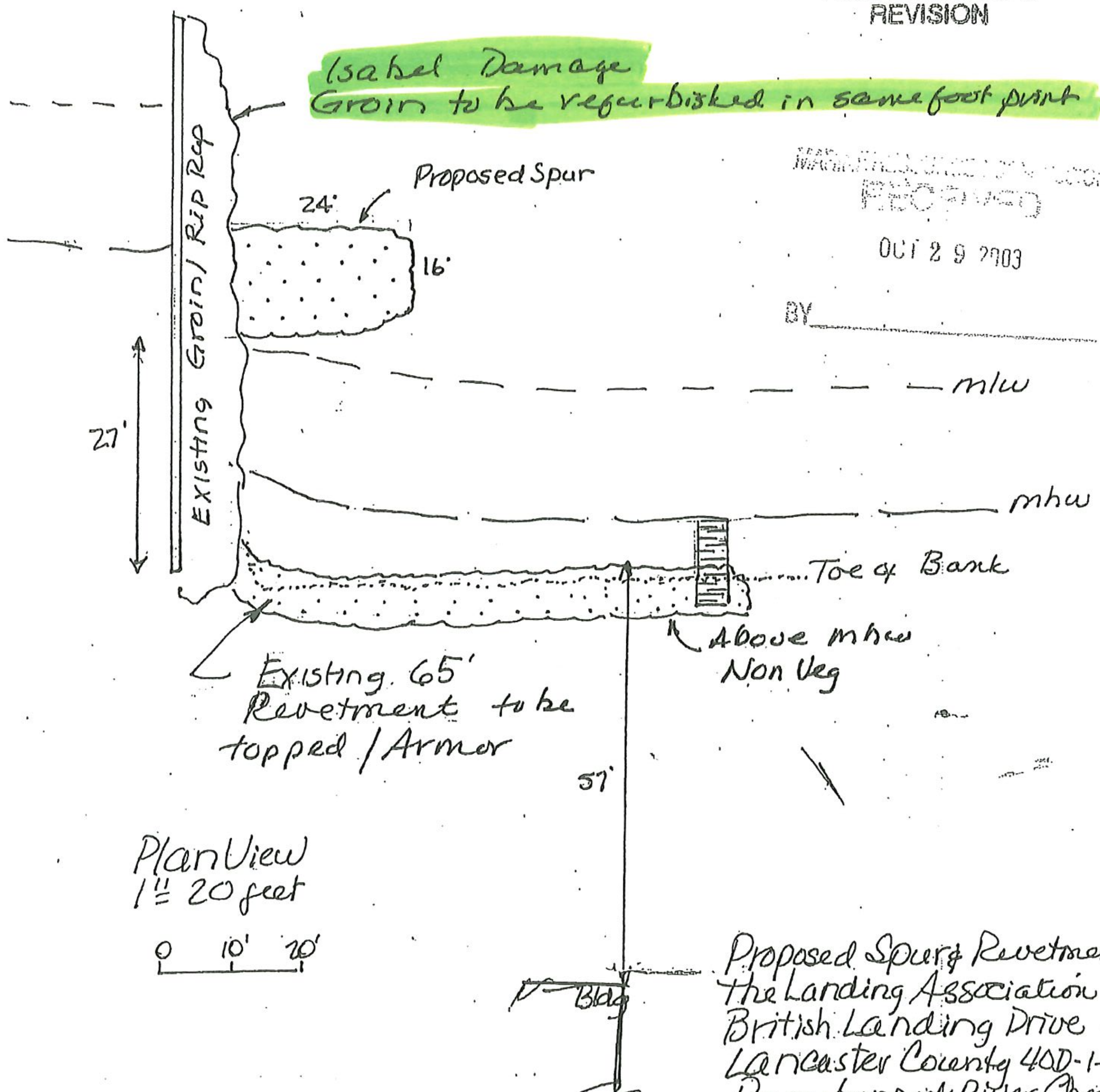
(15) The Permittee agrees to indemnify and save harmless the Commonwealth of Virginia from any liability arising from the establishment, operation or maintenance of said project.

The following special conditions are imposed on this permit:

(16) The yellow placard accompanying this permit document must be conspicuously displayed at the work site throughout the construction phase of the authorized activity.

(17) Permittee agrees to notify the Commission a minimum of 15 days prior to the start of the construction activities authorized by this permit.

ADDITIONAL INFO
REVISION



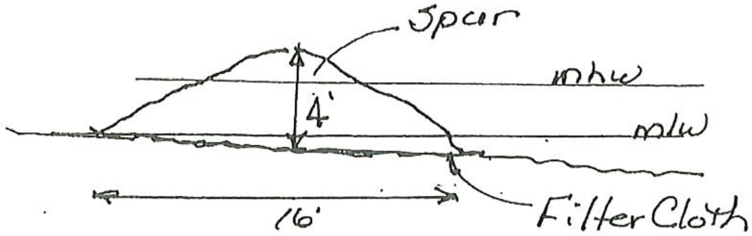
OCT 2 9 2003

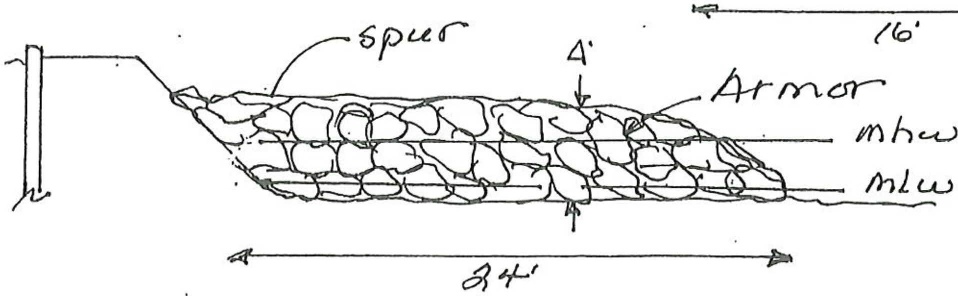
BY

Proposed Spur & Revetment
The Landing Association
British Landing Drive
Lancaster County 400-1-2
Rappahannock River Ches Bay
August 2003
Sheet 1 of 1

VMRC 03- 1960
corrected 10/26/03

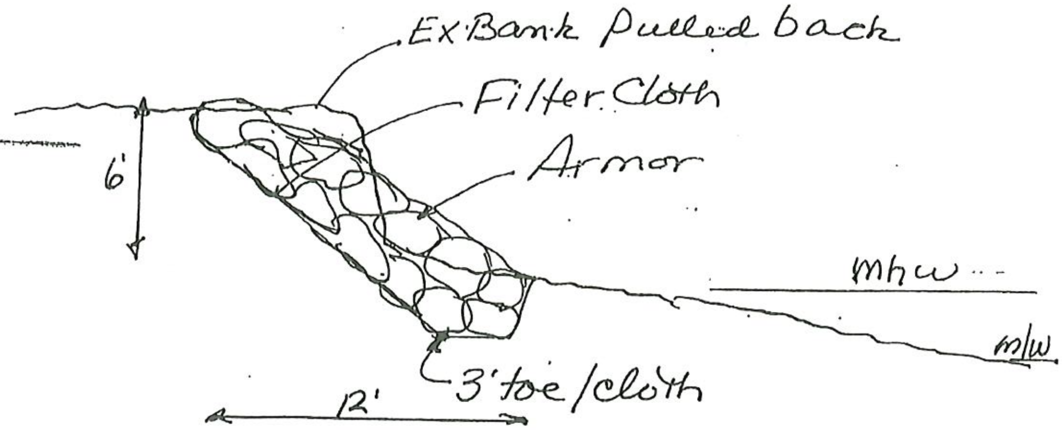
Side View 1" = 8 feet
0 4' 8'



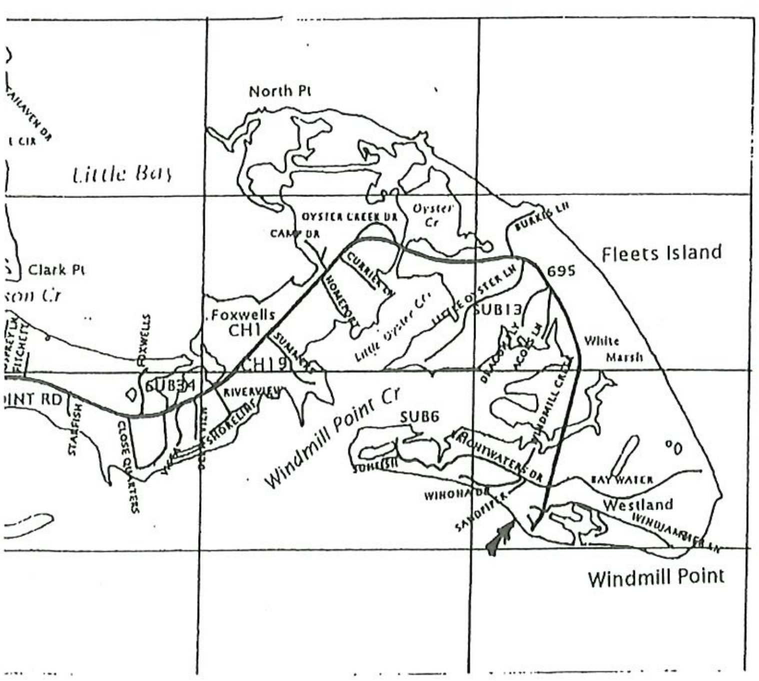


384SF below mlw

MARINE RESOURCES COMMISSION
RECEIVED
SEP 5 2003
BY________________



195SF above mhw
Spoil on Bank



Proposed Spur & Revetment
The Landing Association
British Landing Drive
Lancaster County 400-1-2
Rappahannock River - Ches Bay
August 2003
Sheet 2 of 2

COUNTY OF LANCASTER

FOUNDED 1651 IN VIRGINIA
LANCASTER COURTHOUSE
8311 MARY BALL ROAD
LANCASTER, VIRGINIA 22503

William H. Pennell, Jr.
County Administrator

804-462-5129
804-462-0031 (FAX)
www.lancova.com

BOARD OF SUPERVISORS
F. W. Jenkins, Jr., 1st District
Donald O. Conaway, 2nd District
Patrick G. Frere, 3rd District
Cundiff H. Simmons, 4th District
B. Wally Beauchamp, 5th District

WETLANDS BOARD
COUNTY OF LANCASTER, VIRGINIA
WETLANDS PERMIT

Pursuant to chapter 2.1 of the Code of Virginia (1950) as amended, the Commonwealth of Virginia, Lancaster County Wetlands Board, Hereinafter referred to as the Board, hereby authorizes the construction project described in Paragraph 1. below.

PERMITTEE, PROJECT, SPECIAL CONDITIONS, AND BOARD-REQUIRED REVISIONS BEARING THE DATE OF October 23, 2003:

The Landing Association, c/o The Salt & The Earth, Inc., 863 Fishing Bay Road, Deltaville, VA 23043 requests permission to construct 24' spur on an existing groin & 65' of rip rap revetment on the shoreline on the Rappahannock River located on British Landing Drive off VSH 695(Windmill Point Road) (Tax Map# 40D-1-2) VMRC# 03-1960. Approved to include the recommendations of the VIMS report and the re-working of the existing stone revetment and the additional armor to the existing stone.

2. The Official and complete description of this project is contained in the permittee's application for wetlands permit as approved by this Board on this date and is made a part hereof.

3. THE GRANTING OF THIS PERMIT SHALL NOT RELIEVE THE PERMITTEE OF THE RESPONSIBILITY OF OBTAINING ANY AND ALL OTHER PERMITS OR AUTHORITY REQUIRED FOR THE PROJECT.

4. DATES: The project shall not be started before NOVEMBER 3, 2003 ,and must be completed prior to NOVEMBER 3, 2004. **NOTE: NO EXTENSIONS SHALL BE GRANTED BEYOND THESE DATES WITHOUT APPLICATION FOR EXTENSION, IN WRITING, TO THE WETLANDS BOARD PRIOR TO THE PERMIT EXPIRATION DATE.**

5. GENERAL CONDITIONS: THIS PERMIT IS GRANTED SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS:

a. Except as hereinafter provided, all phases of the project shall conform in all particulars to the permittee's application for wetlands permit. The duly authorized agents of the Board shall have the right to enter the premises at any reasonable time for the purpose of inspecting the work being done pursuant to this permit.

b. The permittee shall, to the greatest extent practicable, minimize the adverse effects of the project upon adjacent properties and wetlands and upon the natural resources of the Commonwealth. (Such other terms and conditions peculiarly applicable to the particular project being permitted in order to promote to the greatest extent possible the public policy expressed in the Act and to minimize the impact of the project upon the rights and property of others and upon the ability of the local government to provide governmental services.)

c. This permit shall not be transferred without the prior written approval of the Board.

d. Permittee shall comply with all applicable laws, ordinances, rules and regulations affecting the conduct of this project.

e. Permittee shall adhere to proper E & S controls during wetlands construction and acquire the necessary county E & S permits for work landward of mean high water.

f. This permit shall be revoked at any time by the Board upon failure of the permittee to comply with any of the terms and conditions hereof.

IN WITNESS WHEREOF, the County of Lancaster, Virginia, Wetlands Board has caused these presents to he executed in its behalf by the Chairman, whose signature is affixed hereto as evidence of his acceptance of the terms and conditions hereof.

Commonwealth of Virginia
County of Lancaster
Wetlands Board:

By Clay Holcomb

Clay Holcomb, Chairman
Affirmed before me this 13th day of NOV , 2003
By the Chairman, Lancaster Co. Wetlands Board

Notary Public
My commission expires 5/31/06

Permittee:

City/County of Middlesex
Commonwealth of Virginia
The foregoing instrument was acknowledged before me this 17th day of Nov , 2003

By
(Name of person seeking acknowledgment)

Carla Ackley
Notary Public (authentication & seal)
My commission expires 6/30/05

COMMONWEALTH of VIRGINIA

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

Marine Resources Commission
2600 Washington Avenue
Third Floor
Newport News, Virginia 23607

William A. Pruitt
Commissioner

October 30, 2003

MEMORANDUM

TO: Lancaster County Wetlands Board

FROM: Habitat Management Division

SUBJECT: The Landing Association
#03-1960
Additional Information/Revision

The attached is for your information.

/blh
HM
Attachment

NOTE

The Virginia Institute of Marine Science (VIMS) recognizes that the regulatory process considers all aspects of a particular project, including socioeconomic factors. This report, however, only addresses marine environmental concerns.

Findings & Recommendations:

A 24-foot rock spur is proposed adjacent to an existing groin to reduce downdrift erosion occurring on the west side of the groin. The adverse environmental impacts resulting from construction of the spur will be minor, given the current extent of rock already present at this groin.

A 65-foot rock revetment is also proposed, but only if the spur does not give the expected protection to the erosion area. However, there is already a rock revetment in place that is not depicted in the drawing. The proposed revetment will exceed the dimensions of the existing structure, but the alignment was not clearly flagged to verify the additional impact area to the beach and dune.

Even if the proposed revetment is not constructed, re-working the existing stone is advised for both the revetment and the groin to consolidate scattered material that is undersized for this high energy location.

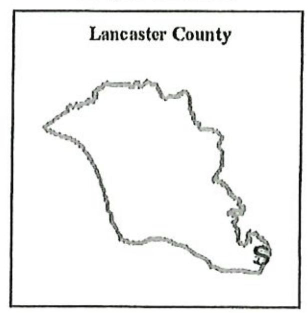
Karen A. Duhring
Karen A. Duhring
Marine Scientist

VIMS Shoreline Permit Application Report #03-1960

APPLICANT:	THE LANDING ASSOCIATION
Locality:	LANCASTER COUNTY
Immediate Waterway:	Rappahannock River
Watershed:	RAPPAHANNOCK RIVER
Purpose:	Shoreline Stabilization
Application Type:	Beach/Dune, Subaqueous
Site Inspection:	10/7/03
Report Date:	10/14/03

Type of Activity	Proposed Extent
Riprap (ft)	65
Impact Beach/Dune (ft2)	780
Groin Extension (ft)	24
Groin Extension	1 Unit(s)
Groin Extension	1 Spur(s)
Impact Subaqueous Bottom (ft2)	384
Fill Subaqueous Bottom (ft2)	192
Total Impacts (ft2)	1164
Total Impacts (Wetlands)	0
Total Impacts (Subaqueous)	384
Total Impacts (Beach/Dune)	780
Total Fill (ft2)	192

Project Location



Wetlands Program

Center for Coastal Resources Management
P.O. Box 1346
Gloucester Point, VA 23062-1346

Thomas A. Barnard, Director

(804)684-7380, fax: (804)684-7179, e-mail: http://ccrm.vims.edu/

WILLIAM & MARY
VIMS
VIRGINIA INSTITUTE OF MARINE SCIENCE
SCHOOL OF MARINE SCIENCE

JOINT PERMIT APPLICATION

40D-1-2

PART I - GENERAL INFORMATION

PLEASE PRINT OR TYPE ALL ANSWERS: *If a question does not apply to your project,* ***please print N/A (not applicable) in the block or space provided.*** *If additional space is needed, attach extra 8-1/2" x 11" sheets of paper.*

If using JPA as Pre-Construction Notification, please indicate so here: ___ PCN

1. Applicant's name and complete mailing address:

The Landing Association
[redacted]
White Stone, VA 22578

Contact Information:
Home [redacted]
Work (____)________________
Fax (____)________________
Mobile/Pager (____) __________
E-mail ____________________

2. Property Owner's name and complete mailing address:

Contact Information:
Home (____)________________
Work (____)________________
Fax (____)________________
Mobile/Pager (____) __________
E-mail ____________________

3. Authorized agent's name and complete mailing address (if applicable):

[redacted]

Contact Information:
Home [redacted]
Work [redacted]
Fax (____) none
Mobile/Pager (____) none
E-mail alor@oonl.com

FOR AGENCY USE ONLY

MARINE RESOURCES COMMISSION
RECEIVED
SEP 5 2003
BY________________

NOTES:

JPA #: 03-1960

4. Have you obtained a contractor for the project? x Yes __No. If your answer is "yes" complete the remainder of this question and submit the Applicant's and Contractor's Acknowledgement Form on page __ with your application.

Contractor's name and complete mailing address:

[redacted]

Lan[redacted]

Contact Information:
Home (____)______________
Work ([redacted]_______
Fax (____)______________
Mobile/Pager(____)__________
E-mail ___________________

---

5. List the name, address, and telephone number of the newspaper having general circulation in the area of the project. Failure to complete this question may delay Local and State processing.

Name and complete mailing address:

Rappahannock Record
POB 400
Kilmarnock, VA 22482

Telephone number:
(804) 435 1701

6a. Give the following project location information:
Street Address British Landing ~~Road~~ DRIVE
Lot/Block/Parcel # 40D (1) 2
Subdivision ___________________
City/County Lancaster County

b. If project is located in a rural area, please give driving directions
695 Windmill Point Road to end, right on British Landing, DRIVE site is near the last building on the left.

c. List the waterbody(ies) within the project boundaries: Rappahannock River
Tributary(ies) of Chesapeake Bay

NOTE: IF THE PROJECT IS IN AN UNDEVELOPED SUBDIVISION OR PROPERTY, CLEARLY STAKE AND IDENTIFY PROPERTY LINES AND LOCATION OF PROPOSED PROJECT. A SUPPLEMENTAL MAP SHOWING HOW THE PROPERTY IS TO BE SUBDIVIDED SHOULD ALSO BE PROVIDED.

7. Provide a detailed description of the project and primary and secondary purposes. For example, a description may be "construction of a timber bulk head, 125 linear feet, 6 feet high, etc." and the purpose may be "to protect a property from erosion due to boat wakes".

Existing groin with scour on west side. Proposed spur 24 feet long to be constructed. Also proposed is 65 feet of rip rap armor revetment at toe of existing bank that will be constructed only if the spur does give the expected protection to the eroding sand bank.

8. Proposed use (check one):
__ single user (private, non-commercial, residential)
x_ multi-user (community, commercial, industrial, government)

9. Attach a description of the measures taken during project design and development both to avoid and minimize impacts to surface waters, including wetlands, to the maximum extent practicable.

10. Have you previously had a site visit, applied to, or obtained a permit from any agency (Federal, State, or Local) for any portion of the project described in this application or any other project at the site?
__ Yes X No If your answer is "Yes", provide the following information:

Agency/Representative	Activity	Application No.	Action* & Date

* Issued, Denied, Withdrawn, or Site Visit

11a. Has any work commenced or has any portion of the project for which you are seeking a permit been completed? __ Yes x_ No

b. Are you submitting this application at the direction of any state, local or federal agency? __ Yes x_ No

If your answer to either question above is "YES", give details below stating when the work was completed, who performed the work, and which agency (if any) directed you to submit the application. Please clearly differentiate between completed work and proposed work on your application drawings.

12. Approximate cost of the entire project (materials, labor, etc): $ 4000.00
Approximate cost of only that portion of the project which affects State Waters (below mean low water in tidal areas or ordinary high water in nontidal areas): $____________

13a. Will the project be located at the site of any historic property? (Note: historic properties include but are not limited to archeological sites, Civil War earthworks, graveyards, buildings, bridges, canals, etc.)__ Yes x_ No. If "Yes", please provide a map showing the location.

b. Is your project located within a historic district? __ Yes x_ No __ Uncertain. If "Yes", please indicate which district: ____________

c. Have you previously contacted the Virginia Department of Historic Resources concerning this project? __ Yes x__ No. If "Yes", please provide copies of all correspondence concerning your project.

d. Has a survey to locate archeological sites and/or historic structures been carried out on the property? __ Yes x__ No. If "Yes", please provide the following information:
Date of survey: ______________________________
Name of firm: ____
Is there a report on file with the Virginia Department of Historic Resources? ____________
Was any historic property located? ____________

14. List the name and complete mailing address, including zip code, of each adjacent property owner (APO) to the project (other than yourself).

Cora Abrams Estate, Ralph Abrams, 71 Brightwaters Drive, White Stone, VA 22578

Virginia Marine Resources Commission
Permit Application 20037122
Printed: Monday October 10, 2022 11:36 AM

Applicant: Windmill Point Resort & Yacht Harbour, Inc.
[redacted]

Application Number:	20037122	**Engineer:**	Jay Woodward
Application Date:	November 10, 2003	**Locality:**	Lancaster
Permit Type:	No VMRC Permit Nec.	**Waterway:**	Rappahannock River
Permit Status:	No Permit Nec	**Expiration Date:**	
Wetlands Board Action:	No Permit Required	**Public Hearing Date:**	

Project Description: Replace Pier/Bulkhead after Hurricane Isabel

Project Dimensions:

Bulkhead: 60 Linear Feet
Pier: 60 Linear Feet

FEB 01 REC'D

COMMONWEALTH *of* VIRGINIA

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

Marine Resources Commission
2600 Washington Avenue
Third Floor
Newport News, Virginia 23607

William A. Pruitt
Commissioner

January 31, 2005

41-4

[redacted]
White Stone, VA 22578

RE : Windmill Point Resort and Yacht Harbor
Groin Repairs

Dear [redacted]

This is in further reference to your desire to repair the existing four (4) stone groins in front of the resort's motels, as well as the groin that is located beneath the old ferry dock at the end of Rt. 695 on the Rappahannock River in Lancaster County. We are in receipt of a copy of a letter from Bay Design Group describing the proposed repairs, as previously discussed on site. I have attached an aerial photograph of your property which shows the area in question prior to Hurricane Isabel.

As you are aware, the stone groins in front of the Beach Cove Villas condos were "repaired" using different materials (concrete block) and were modified with T-heads which represented a violation of the Orders. For your information, the Commission has required that the T-head section of those groins be removed and that the channelward end of each groin be marked with a pile to act as a navigation aid. Accordingly, I would like to take this opportunity to clarify the Governor's Executive Orders 58 and 66 related to Hurricane Isabel repairs.

To be in compliance with the Executive Orders, please ensure that the groins are reconstructed in the same location and in identical or smaller dimensions as the remnant groins, with no further channelward extension, using only quarry stone to rebuild structures. As discussed with Mr. Caskie, no authorization will be required from the VMRC for the repairs provided these criteria are met. Furthermore, authorization will not be required from this agency for the removal of the old ferry pier, provided all of the material is removed completely from the water and beach area (piles may be cut at the mud line). Please be advised that the Orders pertain **ONLY** to repair or replacement of **pre-existing structures**. New structures must be applied for using the standard Joint Permit Application and will be subjected to full review. By copy of this letter, we are notifying your local wetlands board and the U. S. Army Corps of Engineers, Norfolk District, 803 Front Street, Norfolk, Virginia 23510, for their review and action as appropriate.

January 31, 2005

You are reminded the reconstruction activities authorized under the Executive Orders must be completed prior to June 30, 2005.

Should you have any questions regarding this matter please do not hesitate to call me at (757) 247-8032.

Sincerely,

Jay M. Woodward
Environmental Engineer

JMW/bac
HM
cc.: Lancaster County Wetlands Board
U. S. Army Corps of Engineers
Don Caskie, Bay Design Group

COUNTY OF LANCASTER

FOUNDED 1651 IN VIRGINIA

LANCASTER COURTHOUSE
8311 MARY BALL ROAD
LANCASTER, VIRGINIA 22503

804-462-5129
804-462-0031 (FAX)
www.lancova.com

Don G. Gill
County Administrator

BOARD OF SUPERVISORS
Craig H. Giese, 1st District
Ernest W. Palin, Jr., 2nd District
Jason D. Bellows, 3rd District
William R. Lee, 4th District
William C. Smith, 5th District

WETLANDS BOARD
COUNTY OF LANCASTER, VIRGINIA
WETLANDS PERMIT

Pursuant to chapter 2.1 of the Code of Virginia (1950) as amended, the Commonwealth of Virginia, Lancaster County Wetlands Board, hereinafter referred to as the Board, hereby authorizes the construction project described below.

1. **Permittee, Project, Special Conditions, And Board-Required Revisions Bearing the Date of September 20, 2022: Lancaster County Board of Supervisors et Al. c/o Craig Palubinski, 9 Steamboat Landing, Kinsale, VA 22488; requests permission to install five armor stone breakwaters (180', 240', 220', 90', & 110'), two armor stone spurs (60' & 50'), and 18,000 cubic yards of beach nourishment with 42,000 square feet of beach and dune vegetation plantings along the shoreline of the Rappahanock River. Located off VSH 695 (Windmill Point Road) at the end of Windmill Point Road. Tax Map #41-4-0, 40D-1-2 & 40-39. VMRC #22-2229.**
   Approved as submitted.
2. **The official and complete description of this project is contained in the permittee's application for wetlands permit as approved by this Board on this date and is made a part hereof.**
3. **The granting of this permit shall not relieve the permittee of the responsibility of obtaining any and all other permits or authority required for the project.**
4. **DATES:** The project shall not be started before **October 24, 2022,** and must be completed prior to **October 24, 2025.** **NOTE: No extensions shall be granted beyond these dates without application for extension, in writing, to the wetlands board prior to the permit expiration date.**
5. **GENERAL CONDITIONS: This Permit Is Granted Subject To The Following Terms And Conditions:**
   a. Except as hereinafter provided, all phases of the project shall conform in all particulars to the permittee's application for wetlands permit. The duly authorized agents of the Board shall have the right to enter the premises at any reasonable time for the purpose of inspecting the work being done pursuant to this permit.
   b. The permittee shall, to the greatest extent practicable, minimize the adverse effects of the project upon adjacent properties and wetlands and upon the natural resources of the Commonwealth. (Such other terms and conditions peculiarly applicable to the particular project being permitted in order to promote to the greatest extent possible the public policy expressed in the Act and to minimize the impact of the project upon the rights and property of others and upon the ability of the local government to provide governmental services.)
   c. This permit shall not be transferred without the prior written approval of the Board.
   d. Permittee shall comply with all applicable laws, ordinances, rules and regulations affecting the conduct of this project.
   e. Permittee shall adhere to proper E & S controls during wetlands construction and acquire the necessary county E & S permits for work landward of mean high water.
   f. This permit shall be revoked at any time by the Board upon failure of the permittee to comply with any of the terms and conditions hereof.

IN WITNESS, WHEREOF, the County of Lancaster, Virginia, Wetlands Board has caused these presents to be executed in its behalf by the Chairman, whose signature is affixed hereto as evidence of his acceptance of the terms and conditions hereof.

Commonwealth of Virginia
County of Lancaster
Wetlands Board:

By Elna Reuere
Board Chairman
Affirmed before me this 26th day of October, 2022
By the Chairman, Lancaster Co. Wetlands Board

Crystal Lynn Whay
Notary Public
My commission expires 11/30/23
Notary #: 7362746

CRYSTAL LYNN WHAY
Notary Public
Commonwealth of Virginia
Registration Number 7362746
COMM. EXPIRES: NOVEMBER 30, 2023

Permittee: Don G. Gill

City/County of Lancaster
Commonwealth of Virginia
The foregoing instrument was acknowledged before me this 26th day of October, 2022

By Don G. Gill
Crystal Lynn Whay
Notary Public (authentication & seal)
My commission expires 11/30/23
Notary #: 7362746

CRYSTAL LYNN WHAY
Notary Public
Commonwealth of Virginia
Registration Number 7362746
COMM. EXPIRES: NOVEMBER 30, 2023

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
FORT NORFOLK
803 FRONT STREET
NORFOLK VA 23510-1011

March 31, 2023

Northern Virginia Regulatory Section
NAO-2019-01193 / VMRC# 22-V2229 (Rappahannock River)

Don G. Gill, County Administrator - Lancaster County Board of Supervisors;
Peter D. Anzo, Manager - RL PROP. 2011 Investments, LLC; and
David J. Simons, Member - The Landing Owners Association
c/o Craig Palubinski – Bayshore Design, LLC
9 Steamboat Landing
Kinsale, VA 22488

Dear Sirs:

Enclosed is an electronic copy of a Department of the Army permit authorizing you to perform certain work in waters of the United States. The permit must be signed by the applicants in the spaces provided for the permittees signatures and returned to the address below or emailed to nancy.p.davis@usace.army.mil, if returned electronically. Upon receipt, the district engineer or his authorized representative will sign the permit and return it to you. **The permit is not valid until signed by both parties.**

This letter contains an initial proffered permit for your proposed project. If you object to this decision, you may request an administrative appeal under Corps regulations at 33 CFR part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and Request for Appeal (RFA) form. If you request to appeal this decision you must submit a completed RFA form to the Norfolk District Office at the following address: United States Army Corps of Engineers, CENAO-WR-R, Andrew Beaudet, Acting Chief, Regulatory Branch, 803 Front Street, Norfolk, VA 23510-1011.

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR part 331.5, and that it has been received by the District Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be received at the above address within **60 days** from the date of this letter. It is not necessary to submit an RFA form to the District office if you do not object to the decision in this letter.

Please take note of project specific special conditions and general conditions incorporated in this permit. Enclosed is a "compliance certification" form, which must be signed and returned within 30 days of completion of the project, including any required mitigation. Your signature on this form certifies that you have completed the work in accordance with the permit terms and conditions.

If any material change in the plan of the work is found necessary, revised plans must be submitted and approved before any work is begun.

If you have any questions, you may call Nancy Davis at (757) 677-6298 or nancy.p.davis@usace.army.mil.

Sincerely,

M Tucker Smith

Tucker Smith
Chief, Northern Virginia
Regulatory Section

Enclosure(s)

U.S. Army Corps
Of Engineers
Norfolk District

Fort Norfolk, 803 Front Street
Norfolk, Virginia 23510-1096

DEPARTMENT OF THE ARMY PERMIT

Permittees:

1) Don G. Gill, County Administrator - Lancaster County Board of Supervisors;
2) Peter D. Anzo, Manager - RL PROP. 2011 Investments, LLC; and
3) David J. Simons, Member - The Landing Owners Association

Permit No.: **NAO-2019-01193 / VMRC# 22-V2229**

Issuing Office: **U.S. Army Corps of Engineers Norfolk District Regulatory Branch (CENAO-WR-R)**

Note: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below pursuant to:

☒ Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).
☒ Section 404 of the Clean Water Act (33 U.S.C. 1344).
☐ Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

Project Description:

The permittees are hereby authorized to restore approximately 1,324 linear feet of eroding shoreline and construct five (5) armor stone breakwaters, two (2) armor stone spurs, and 2.80 acres of beach nourishment with 0.96 acre of new dune plantings. All work will be performed on the Rappahannock River at Westland Beach, Windmill Point Marina, and the Landing Owners Association at the end of Windmill Point Road, in Lancaster County, Virginia as described above and depicted on the attached drawings titled, "**Proposed Shoreline Stabilization Project, Windmill Point Marina and Westland Beach, Windmill Point-Fleets Island, Lancaster County, Virginia**" prepared by Bayshore Design, LLC and stamped as received by this office on September 20, 2022, October 11, 2022, and January 9, 2023.

Received by VMRC July 25, 2023 /blh

Project Location: The project is located on the Rappahannock River at Westland Beach, Windmill Point Marina, and the Landing Owners Association at the end of Windmill Point Road, in Lancaster County, Virginia.
Latitude 37.6157°, Longitude -76.2935°

Project Specific Special Conditions:

1. Prior to the commencement of any work authorized by this permit, you shall advise the project manager, Nancy Davis, at nancy.p.davis@usace.army.mil, at least two weeks in advance of starting work authorized by this permit. Alert the project manager of the anticipated start date of the authorized activity and the name and telephone number of all contractors or other persons performing the work. A copy of this permit and drawings must be provided to the contractor and kept on site at all times, available to any regulatory representative during an inspection of the project site.

2. The time limit for completing the work authorized ends on **March 31, 2028**. Should you be unable to complete the authorized activity in the time limit provided, you must submit your request for a time extension to this office for consideration at least one month before the permit expiration date.

3. Enclosed is a "compliance certification" form, which must be signed and returned within 30 days of completion of the project, including any required mitigation. Your signature on this form certifies that you have completed the work in accordance with the permit terms and conditions.

4. In compliance with the Endangered Species Act, work may not take place on the beach from May 15 to October 1 of any given year to protect the Northeastern beach tiger beetle (*Habroscelimorpha dorsalis dorsalis*).

5. The material used for beach nourishment and wetlands planting shall be of similar type and composition as the existing sand present along the shoreline with an average grain size of 0.5mm to 0.7mm.

6. Existing concrete debris and rubble will be removed and disposed of in an approved upland location. Only clean broken concrete, free of any rebar and wire mesh, may be used as part of the core base for the breakwaters. The existing failed stone groins will be removed and the stone will also be reused as part of the core base for the breakwaters.

7. MONITORING REQUIREMENTS: The applicant will provide a written monitoring report at the end of the first full growing season following planting, and after the second year of establishment. The monitoring should be undertaken between June and September of each year and should include at a minimum: the project location, the Corps project number, representative photos of the site, and a brief statement on the success of the project.

8. The permittee shall use appropriate erosion and sediment controls, including the use of turbidity curtains during construction.

9. Destruction or alteration of waters of the U.S. (including wetlands) other than those impacts authorized under this permit are prohibited.

10. If a project specific condition of this permit cannot be met, then you must apply for a permit modification. Any proposed permit modification will be coordinated with the Virginia Department of Environmental Quality, NOAA, USFWS, Lancaster County, and the Environmental Protection Agency Region III.

General Conditions:

1. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition **3** below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

2. If you discover any previously unknown historic or archaeological remains while accomplishing the activity authorized by this permit, you must immediately stop work and notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

3. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

4. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit.

5. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

6. No discharge of dredged or fill material may consist of unsuitable material (e.g.: trash, debris, car bodies, asphalt etc.) and material discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. Any temporary fills must be removed in their entirety and the affected areas returned to their preexisting elevation.

8. Appropriate erosion and siltation controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date.

9. The construction or work authorized by this permit will be conducted in a manner so as to minimize any degradation of water quality and/or damage to aquatic life. Also, you will employ measures to prevent or control spills of fuels or lubricants from entering the waterway.

10. Any heavy equipment working in wetlands other than those permitted for permanent impact must be placed on mats or other measures must be taken to minimize soil disturbance.

11. Failure to comply with the terms and conditions of this permit can result in enforcement actions against the permittee and/or contractor.

12. In granting an authorization pursuant to this permit, the Norfolk District has relied on the information and data provided by the permittee. If, subsequent to notification by the Corps that a project qualifies for this permit, such information and data prove to be materially false or materially incomplete, the authorization may be suspended or revoked, in whole or in part, and/or the Government may institute appropriate legal proceedings.

13. All dredging and/or filling will be done so as to minimize disturbance of the bottom or turbidity increases in the water which tend to degrade water quality and damage aquatic life.

14. Your use of the permitted activity must not interfere with the public's right to reasonable navigation on all navigable waters of the United States.

15. The permittee understands and agrees that if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army of his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required upon due notice from the Corps of Engineers to remove, relocate, or alter the structural work or obstructions caused thereby without expense to the United States. No claim shall be made against the United States on account of any such removal or alternation.

Further Information:

1. Limits of this authorization:
   a. This permit does not obviate the need to obtain other Federal, state or local authorizations required by law.
   b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.
d. This permit does not authorize interference with any existing or proposed Federal projects.

2. Limits of Federal Liability: In issuing this permit, the Federal Government does not assume any liability for the following:
   a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.
   b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.
   c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.
   d. Design or construction deficiencies associated with the permitted work.
   e. Damage claims associated with any future modification, suspension, or revocation of this permit.

3. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

4. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:
   a. You fail to comply with the terms and conditions of this permit.
   b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 3 above).
   c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

   Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

5. Extensions: Project Specific Condition #2 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit. Dredging authorization shall not exceed 10 years (33 CFR 325.6(e) and further authorization would require a new application.

Your signatures below, as the permittees, indicate that you accept and agree to comply with the terms and conditions of this permit.

Don G. Gill (Permittee)
County Administrator - Lancaster County Board of Supervisors

7/24/23
(Date)

Peter D. Anzo (Permittee)
Manager - RL PROP. 2011 Investments, LLC

7/24/23
(Date)

David J. Simons (Permittee)
Member - The Landing Owners Association

7/24/23
(Date)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

For Brian P. Hallberg, PMP
Colonel, U.S. Army
Commanding

July 25, 2023
(Date)

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

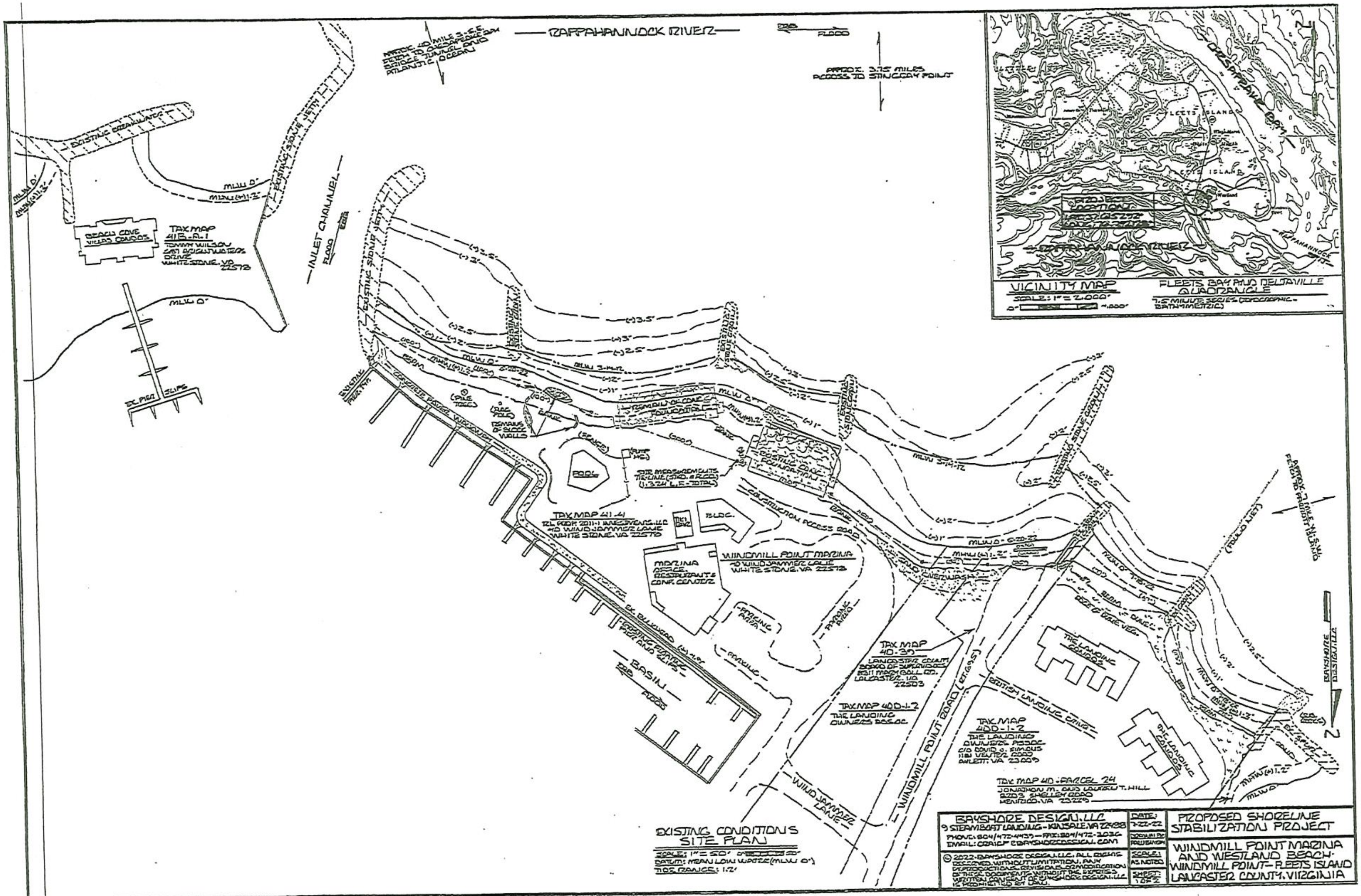
____

(Transferee)

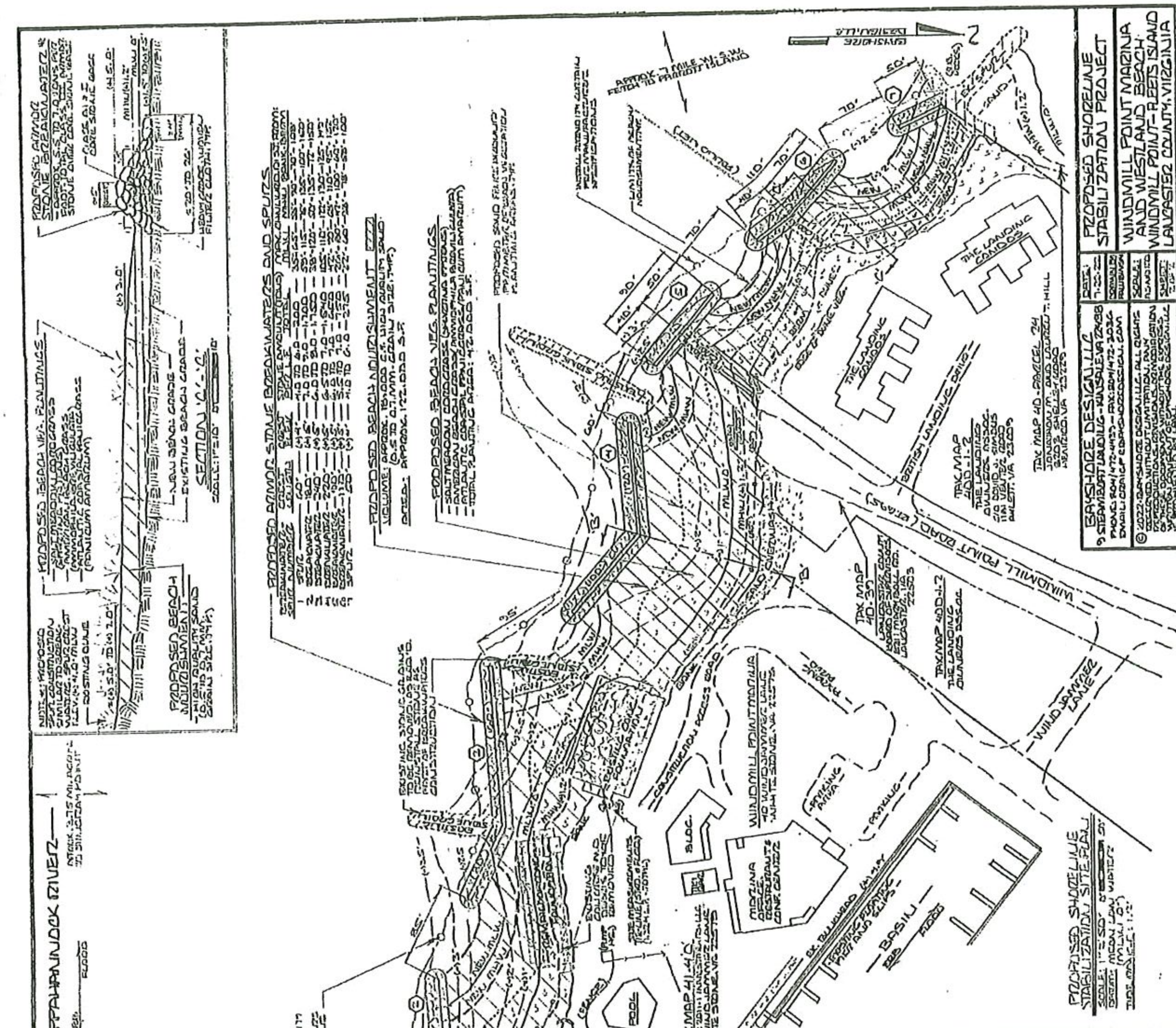
____

(Date)

Received by VMRC July 25, 2023 /blh

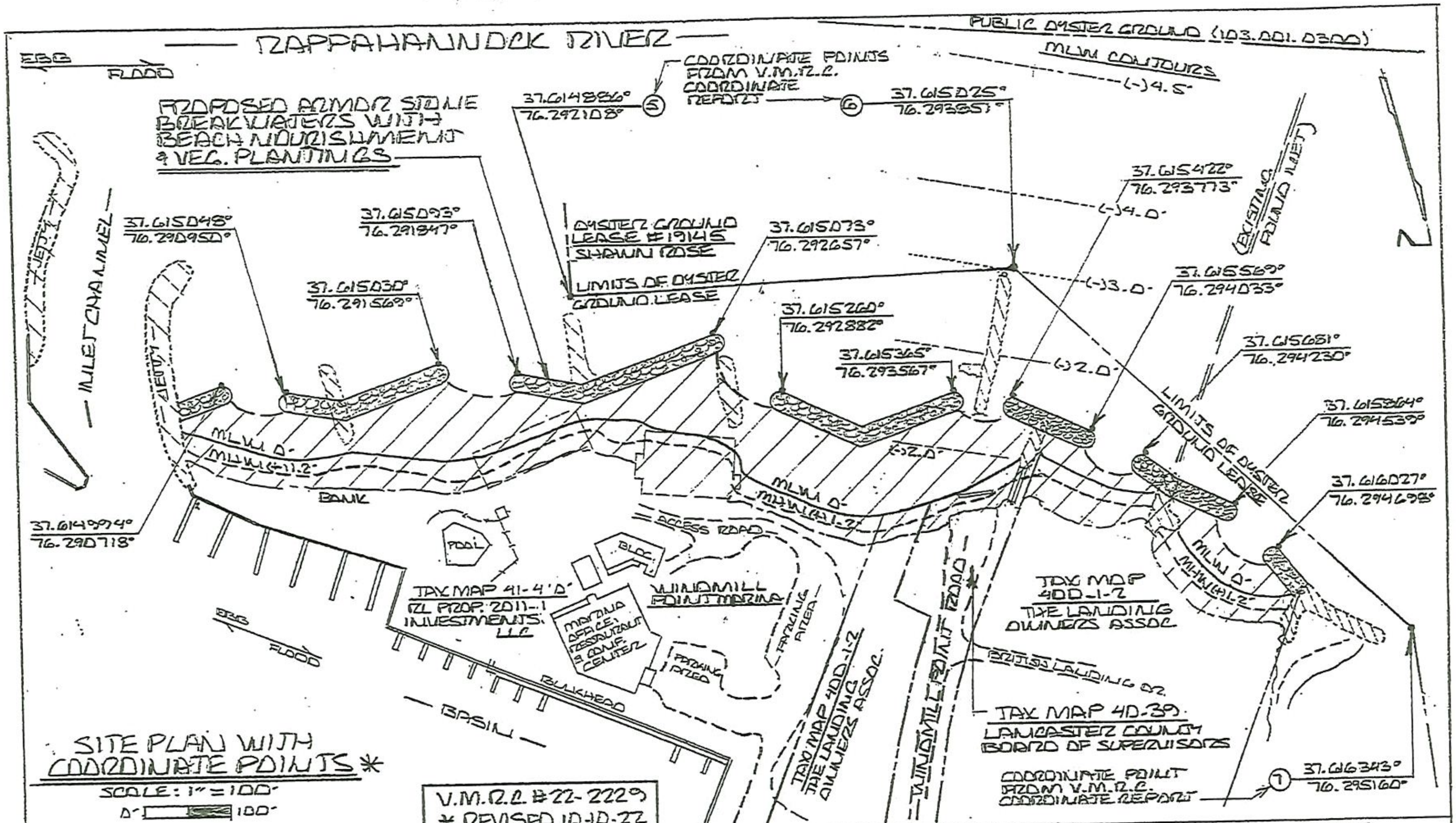


Received by VMRC July 25, 2023 /blh



Received by VMRC July 25, 2023 /blh

USACE received October 11, 2022

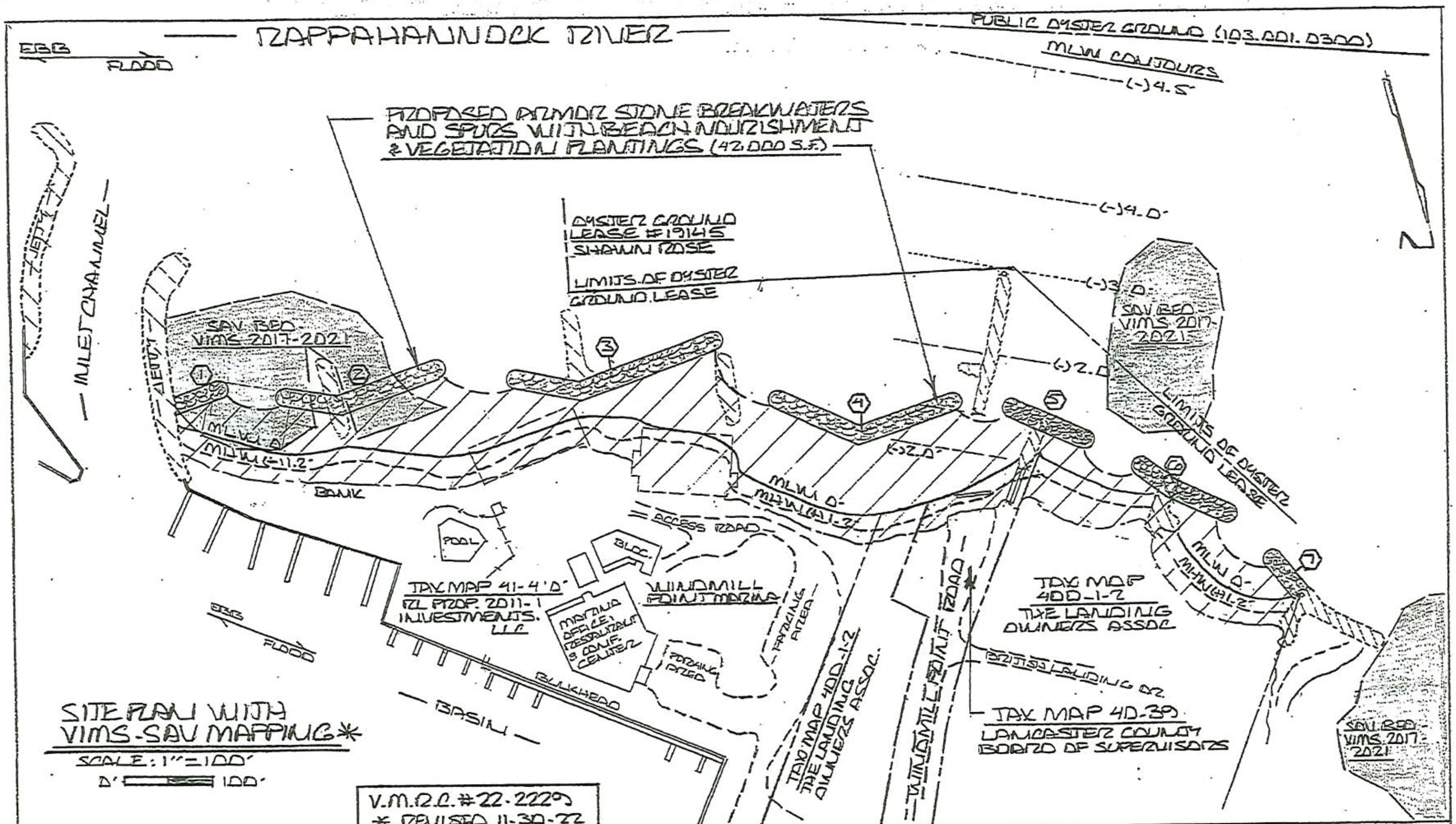


PROPOSED SHORELINE STABILIZATION PROJECT LANCASTER CO. BOARD OF SUPERVISORS, ETAL 8311 MARY BALL ROAD LANCASTER, VIRGINIA 22503	©-2022-BAYSHORE DESIGN, LLC, ALL RIGHTS RESERVED. WITHOUT LIMITATION, ANY REPRODUCTIONS, REVISIONS OR MODIFICATION OF THESE DOCUMENTS WITHOUT THE EXPRESS WRITTEN CONSENT OF BAYSHORE DESIGN, LLC IS PROHIBITED BY LAW.	LOCATION: WINDMILL POINT MARINA, WESTLAND BEACH & THE LANDING CONDOS, LANCASTER COUNTY, VIRGINIA SHT.: 1 OF 1 DATE: 10-10-22 BAYSHORE DESIGN, LLC

Additional Information/Revision Received by VMRC October 11, 2022 / lra

Received by VMRC July 25, 2023 /blh

USACE received January 9, 2023



PROPOSED SHORELINE STABILIZATION PROJECT
LANCASTER CO. BOARD OF SUPERVISORS, ETAL
831 MARY BALL ROAD
LANCASTER, VIRGINIA 22503

LOCATION: WINDMILL POINT MARINA, WESTLAND BEACH & THE LANDING CONDOS, LANCASTER COUNTY, VIRGINIA
SHT: 1 OF 1 DATE: 11-30-22 BAYSHORE DESIGN, LLC

Additional Information/Revision Received by VMRC January 9, 2023 / lra

Received by VMRC July 25, 2023 /blh

U.S. Army Corps
Of Engineers
Norfolk District

CERTIFICATE OF COMPLIANCE
WITH
ARMY CORPS OF ENGINEERS PERMIT

Permit Number: NAO-2019-01193 / VMRC# 22-V2229

Corps Contact: Nancy P. Davis

Name of Permittees: Don G. Gill, County Administrator - Lancaster County Board of Supervisors; Peter D. Anzo, Manager - RL PROP. 2011 Investments, LLC; and David J. Simons, Member - The Landing Owners Association

Date of Issuance: March 31, 2023

Permit Type: Individual Permit

Within 30 days of completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

US Army Corps of Engineers - Norfolk District
CENAO-WR-R
Attn: Nancy P. Davis
803 Front Street
Norfolk, VA 23510-1096

Or scan and send via email to nancy.p.davis@usace.army.mil

Please note that your permitted activity is subject to a compliance inspection by a U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation has been completed in accordance with the permit conditions.

___________________________ ___________________________

Signature of Permittee Date

Received by VMRC July 25, 2023 /blh

MRC 30-317

VMRC# 2022-2229
Applicant: Lancaster County Board of Sup

COMMONWEALTH OF VIRGINIA
MARINE RESOURCES COMMISSION
PERMIT

The Commonwealth of Virginia, Marine Resources Commission, hereinafter referred to as the Commission, on this 24th day of January 2023 hereby grants unto:

Lancaster County Board of SupervBotes; D. aAnzo
8311 Mary Ball Road
Lancaster, VA 22503

40 Windjammer Lane
White Stone, VA 22578

David J. Simmons
1181 Venter Road
Aylett, VA 23009

hereinafter referred to as the Permittee, permission to:

X Encroach in, on, or over State-owned subaqueous bottoms pursuant to Chapter 12, Subtitle III, of Title 28.2 of the Code of Virginia.

__ Use or develop tidal wetlands pursuant to Chapter 13, Subtitle III, of Title 28.2 of the Code of Virginia.

Permittees are hereby authorized to construct five (5) stone breakwaters and two (2) stone spurs, with associated clean sand beach nourishment and wetland plantings to create a public beach and living shoreline at end of State Route 695, Windmill Point Road in Lancaster County. All activities authorized herein shall be accomplished in conformance with the plans and drawings dated received September 20, 2022, and revised drawings dated received October 1, 2022, which are attached and made a part of this permit.

This permit is granted subject to the following conditions:

(1) The work authorized by this permit is to be completed by **January 24th, 2028.** The Permittee shall notify the Commission when the project is completed. The completion date may be extended by the Commission in its discretion. Any such application for extension of time shall be in writing prior to the above completion date and shall specify the reason for such extension and the expected date of completion of construction. All other conditions remain in effect until revoked by the Commission or the General Assembly.

(2) This permit grants no authority to the Permittee to encroach upon the property rights, including riparian rights, of others.

(3) The duly authorized agents of the Commission shall have the right to enter upon the premises at reasonable times, for the purpose of inspecting the work being done pursuant to this permit.

(4) The Permittee shall comply with the water quality standards as established by the Department of Environmental Quality, Water Division, and all other applicable laws, ordinances, rules and regulations affecting the conduct of the project. The granting of this permit shall not relieve the Permittee of the responsibility of obtaining any and all other permits or authority for the projects.

(5) This permit shall not be transferred without written consent of the Commissioner.

(6) This permit shall not affect or interfere with the right vouchsafed to the people of Virginia concerning fishing, fowling and the catching of and taking of oysters and other shellfish in and from the bottom of acres and waters not included within the terms of this permit.

(7) The Permittee shall, to the greatest extent practicable, minimize the adverse effects of the project upon adjacent properties and wetlands and upon the natural resources of the Commonwealth.

(8) This permit may be revoked at any time by the Commission upon the failure of the Permittee to comply with any of the terms and conditions hereof or at the will of the General Assembly of Virginia.

(9) There is expressly excluded from the permit any portion of the waters within the boundaries of the Baylor Survey.

(10) This permit is subject to any lease of oyster planting ground in effect on the date of this permit. Nothing in this permit shall be construed as allowing the Permittee to encroach on any lease without the consent of the leaseholder. The Permittee shall be liable for any damages to such lease.

(11) The issuance of this permit does not confer upon the Permittee any interest or title to the beds of the waters.

(12) All structures authorized by this permit, which are not maintained in good repair, shall be completely removed from State-owned bottom within three (3) months after notification by the Commission.

(13) The Permittee agrees to comply with all of the terms and conditions as set forth in this permit and that the project will be accomplished within the boundaries as outlined in the plans attached hereto. Any encroachment beyond the limits of this permit shall constitute a Class 1 misdemeanor.

(14) This permit authorizes no claim to archaeological artifacts that may be encountered during the course of construction. If, however, archaeological remains are encountered, the Permittee agrees to notify the Commission, who will, in turn notify the Department of Historic Resources. The Permittee further agrees to cooperate with agencies of the Commonwealth in the recovery of archaeological remains if deemed necessary.

(15) The Permittee agrees to indemnify and save harmless the Commonwealth of Virginia from any liability arising from the establishment, operation or maintenance of said project.

The following special conditions are imposed on this permit:

(16) The placard accompanying this permit document must be conspicuously displayed at the work site.

(17) Permittee agrees to notify the Commission upon the start of the activities authorized by this permit.

(18) The material used for beach nourishment and wetlands planting fill shall be comprised of at least 90% sand.

(19) The nourished area landward of the breakwater/sill shall be planted with appropriate wetland vegetation in conformance with the attached planting plan and schedule.

Description of Fees	Amount	Unit of Measure	Rate	Total	Frequency	After-The-Fact
Permit Fee				$600.00	One-Time	
Total Permit Fees				**$600.00**		

This permit consists of 7 Pages

PERMITTEE(S)

[X] BY CHECKING THIS BOX, I certify that I am the Permittee OR the certified agent acting on behalf of all Permittees, that I have read and understood the permit as drafted and accept all of the terms and conditions herein. I agree and understand that checking the box has the same legal authority as a written signature. The provisions of the permit authorization shall be binding on any assignee or successor in interest of the original Permittee(s). In cases where the Permittee is a corporation, agency or political jurisdiction, I certify I have proper authorization to bind the organization to the financial and performance obligations which result from activity authorized by this permit.

PERMITTEE OR CERTIFIED AGENT

Craig Palubinski - Agent
Print Your Name Here

DATE TERMS ACCEPTED

January 26, 2023

PERMITEE
Lancaster County Board of Supervisors, et al
8311 Mary Ball Road
Lancaster, VA 22503

PERMITEE 2
Peter D. Anzo
40 Windjammer Lane
White Stone, VA 22578

PERMITEE 3
David J. Simmons
1181 Venter Road
Aylett, VA 23009

AGENT
Bayshore Design
Craig Palubinski
Post Office Box 339
Kinsale, VA 22488

COMMISSION

This permit is executed on behalf of the Commonwealth of Virginia, Marine Resources Commission by the undersigned:

Justin Worrell
Deputy Chief, Habitat Management Division

DATE SIGNED
9th day of February 2023

From:	Woodward, Jay (MRC)
To:	MRC - jpa Permits
Subject:	FW: Notification of No Permit Required: JPA 22-2229 Windmill Point Marina Breakwaters and Beach Nourishment
Date:	Monday, December 19, 2022 8:26:03 AM
Attachments:	20221216_22-001763_VWP NPR Letter.pdf

DEQ comments,
thx

Jay Woodward
Environmental Engineer, Sr.
Habitat Management Division
Virginia Marine Resources Commission
380 Fenwick Road
Fort Monroe, VA 23651
Office (757) 247-8032
Mobile (757) 504-7009
Jay.woodward@mrc.virginia.gov
Website www.mrc.virginia.gov

WATER IS LIFE

From: Jones, Bryan <bryan.jones@deq.virginia.gov>
Sent: Friday, December 16, 2022 4:24 PM
To: Don Gill <dgill@lancova.com>
Cc: craigp@bayshoredesign.com; Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil>; Woodward, Jay (MRC) <Jay.Woodward@mrc.virginia.gov>
Subject: Notification of No Permit Required: JPA 22-2229 Windmill Point Marina Breakwaters and Beach Nourishment

Dear Mr. Gill,

Please find the attached notification regarding the Windmill Point Marina Breakwaters and Beach Nourishment project in Lancaster County, VA.

Feel free to contact me if you have any questions or concerns.

Respectfully,

Bryan Jones
Virginia Water Protection Program Manager
Department of Environmental Quality | Piedmont Region
4949-A Cox Road | Glen Allen, VA 23060
P: (804) 712-4001 | F: (804) 698-4178* | E: Bryan.Jones@deq.virginia.gov
www.deq.virginia.gov

*Please note that all faxes must contain the following information:

Received by VMRC December 19, 2022 / lra

DEQ recipient's first and last name

- Sender's name
- Sender's contact phone number

Received by VMRC December 19, 2022 / Ira

Commonwealth of Virginia

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

PIEDMONT REGIONAL OFFICE
4949-A Cox Road, Glen Allen, Virginia 23060
(804) 527-5020 FAX (804) 698-4178
www.deq.virginia.gov

Travis A. Voyles
Acting Secretary of Natural and Historic Resources

Michael S. Rolband, PE, PWD, PWS Emeritus
Director
(804) 698-4020

Jerome A. Brooks
Regional Director

December 16, 2022

SENT VIA E-MAIL: dgill@lancova.com

Re: Notification that a Virginia Water Protection (VWP) Individual Permit or General Permit Coverage is Not Required
NP No. 22-001763 / JPA No. 22-2229
Windmill Point Marina Breakwaters and Beach Nourishment

The Virginia Department of Environmental Quality (DEQ) has received your JPA, PCN, and/or project notification. Based on the information provided, the project meets one of the following criteria, and therefore, will not require a VWP individual permit or general permit coverage:

☐ The project is not proposing impacts to surface waters.

☐ The project qualifies for an exclusion from the permitting requirements per 9VAC25-210-60 and/or the provisions noted:

- ☐ Discharges of dredged or fill material into state waters, except wetlands, which are addressed under a U.S. Army Corps of Engineers (USACE) Regional, General or Nationwide Permit, and for which no § 401 Water Quality Certificate is required.

- ☐ Any stormwater discharge from municipal separate storm sewer systems or land disturbing activities authorized by 9VAC25-870, or discharges authorized by a Virginia Pollutant Discharge Elimination System (VPDES) permit in accordance with 9VAC25-31 or a Virginia Pollution Abatement (VPA) permit in accordance with 9VAC25-32.

- ☐ Any activity in a wetland governed under Chapter 13 (§ 28.2-1300 et seq.) of Title 28.2 of the Code of Virginia, unless state certification is required by § 401 of the Clean Water Act. Even where such certification is required due to a pending USACE permit action, such certification is waived if the activity meets the provisions of subdivision 10.a of 9VAC25-210-60 - see below. (§ 62.1-44.15:21.G; 9VAC25-210-220.C)

Received by VMRC December 19, 2022 / lra

(9VAC25-210-60.10.a) Construction or maintenance of farm ponds or impoundments, stock ponds or impoundments, or irrigation ditches that are operated for normal agricultural or silvicultural purposes, and are less than 25 feet in height or create a maximum impoundment capacity smaller than 100 acre-feet.

☐ Normal residential gardening and lawn and landscape maintenance in a wetland. (§ 62.1-44.15:21.G)

☐ Maintenance of currently serviceable structures.

☐ Impacts to open waters that do not have a detrimental effect on public health, animal life, or aquatic life or to the designated uses of such waters.

☐ Flooding or back-flooding impacts to surface waters resulting from the construction of temporary sedimentation basins on a construction site.

☐ Normal agriculture and silviculture activities in a wetland. (§ 62.1-44.15:21.G)

☐ Construction or maintenance of farm ponds or impoundments, stock ponds or impoundments, or irrigation ditches, or the maintenance (but not construction) of drainage ditches, provided the following:

- no surface water withdrawal is proposed;
- the final dimensions of the maintained ditch do not exceed the average dimensions of the original ditch; and,
- the farm or stock pond or impoundment does not fall under the authority of the Virginia Soil and Water Conservation Board pursuant to Article 2 (§ 10.1-604 et seq.) of Chapter 6 pursuant to normal agricultural or silvicultural activities. (§ 62.1-44.15:21.H)

☐ Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining equipment.

☐ Wetland and open water impacts to a stormwater management facility that was created on dry land for the purpose of conveying, treating, or storing stormwater. (§ 62.1-44.15:21.I)

☐ The activities cause impacts to an isolated wetland of minimal ecological value as defined in 9VAC25-210-10 (§ 62.1-44.15:21.D; 9VAC25-210-220.A).

☒ The activity does not impact instream flows; qualifies for a permit issued by the USACE; and receives a permit from the Virginia Marine Resources Commission or wetlands boards, pursuant to Chapter 12 (§ 28.2-1200 et seq.) or Chapter 13 (§ 28.2-1300 et seq.) of Title 28.2 of the Code of Virginia (9VAC25-210-220.B).

☐ Provided that the project is authorized by the USACE under a Regional permit and meets any applicable § 401 Certification Conditions, a VWP individual permit or general permit coverage will not be required for this project.

Received by VMRC December 19, 2022 / lra

☐ Provided that the project is authorized by the USACE under a Nationwide permit and the applicant has certified that the project complies or will comply with all of VDEQ's General § 401 Water Quality Certification Conditions (A.1-A.12 listed in Appendix A - Norfolk District's Final Regional Conditions for the 2021 Nationwide permits, issued February 25, 2022) and any NWP-specific, General § 401 Water Quality Certification Conditions, if applicable, a VWP individual permit or general permit coverage will not be required for this project.

DEQ waives the issuance of a Virginia Water Protection (VWP) individual permit or general permit coverage for one or more of the reasons listed above. This letter also serves as a waiver of individual § 401 water quality certification for purposes of the USACE Nationwide Permits, when applicable.

Should the size or scope of the project change, a VWP individual permit or general permit coverage may be required.

If unauthorized impacts occur, you **must** contact DEQ at pro.vwpcompliance@deq.virginia.gov or 804-527-5020 (PRO) or fax 804-698-4178 within 24 hours of discovery. Any fish kills or spills of fuels or oils shall be reported to DEQ immediately upon discovery at 804-527-5020 (PRO). If DEQ cannot be reached, the spill or fish kill shall be reported to the Virginia Department of Emergency Management (VDEM) at 1-800-468-8892 or the National Response Center (NRC) at 1-800-424-8802. Any spill of oil as defined in § 62.1-44.34:14 of the Code of Virginia that is less than 25 gallons and that reaches, or that is expected to reach, land only is not reportable, if recorded per § 62.1-44.34:19.2 of the Code of Virginia and if properly cleaned up.

Please contact DEQ at pro.vwpcompliance@deq.virginia.gov or 804-527-5020 (PRO) if you have any questions.

Respectfully,

Bryan Jones
Regional VWPP Program Manager

cc: Authorized Agent(s)
U.S. Army Corps of Engineers
Virginia Marine Resources Commission

Received by VMRC December 19, 2022 / lra

From: Woodward, Jay (MRC)
To: Davis, Nancy P CIV USARMY CENAO (USA); Craig Palubinski
Cc: ohall@lancova.com; MRC - jpa Permits; Emily A. Hein
Subject: Re: Lancaster County/Windmill Point Marina/Landing HOA, breakwaters; NAO-2019-01193 / #22-V2229
Date: Thursday, December 1, 2022 8:54:58 AM

Nancy, VIMS notes SAV near the eastern end, recommends compensation. We will likely not require it as this is a living shoreline and good design. Similar to Carneal and Crutchfield a few years ago. Comments are in our database. Hope to have this on the January Commission agenda, protested by Oyster leaseholder and over $500k.
Just fyi…

Get Outlook for iOS

From: Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil>
Sent: Thursday, December 1, 2022 6:25:08 AM
To: Craig Palubinski <craigp@bayshoredesign.com>
Cc: Woodward, Jay (MRC) <Jay.Woodward@mrc.virginia.gov>; ohall@lancova.com <ohall@lancova.com>; MRC - jpa Permits <jpa.permits@mrc.virginia.gov>; Emily A. Hein <eahein@vims.edu>
Subject: Lancaster County/Windmill Point Marina/Landing HOA, breakwaters; NAO-2019-01193 / #22-V2229

Good morning, Craig:

Please see NOAA Fisheries Service comments below. Dave is not recommending any design changes so no action required at this point. I am still waiting for comments from other reviewing agencies and will keep you posted as I receive them.

Regards,

Nancy P. Davis
Environmental Scientist
U.S. Army Corps of Engineers
803 Front Street, Norfolk, VA 23518
Office: (757)201-7044
Email: Nancy.P.Davis@usace.army.mil
Website: http://www.nao.usace.army.mil/Missions/Regulatory.aspx

---

From: David OBrien - NOAA Federal <david.l.obrien@noaa.gov>
Sent: Wednesday, November 30, 2022 2:45 PM

To: Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil>
Subject: [URL Verdict: Neutral][Non-DoD Source] Lancaster County/Windmill Point Marina/Landing HOA, breakwaters; NAO-2019-01193 / #22-V2229

Hello Nancy,

I have reviewed the coordination materials you sent regarding the proposed breakwater project located along the Rappahannock River in Lancaster Count, Virginia. As you know, the Rappahannock River is designated as essential fish habitat (EFH) for 7 federally managed species and is also designated an anadromous fish use area by the Virginia Department of Wildlife Resources (DWR). Submerged aquatic vegetation (SAV) has also been documented in the immediate vicinity of the project by the VIMS SAV monitoring and restoration program. A small area of very sparse density (0-10% cover) SAV was mapped in the 2018 survey in the vicinity of proposed breakwater 6; the only year in the last five (5) years of available data (VIMS, 2017-2021 data).

The project includes removing several existing stone spurs to be incorporated as stone base material for the construction of new Class III stone offshore breakwaters and beach nourishment resulting in the loss of 0.57 acre of subaqueous bottom and 0.02 acre of tidal non-vegetated wetlands that cover the existing stone groins. The purpose of the project is to stabilize approximately 1.324 linear ft. of eroding shoreline, beach and dune habitats. The upper portions of the sand nourishment will be planted 18-inches on-center with various native high marsh species. The high energy shoreline has a fetch of >40 miles to the south-southeast across Chesapeake Bay and has experienced approximately 110 ft. of landward shoreline erosion over the past 10-yr. period (as stated per JPA and PN).

NOAA Fisheries Service concurs with your determination that the proposed breakwater and beach nourishment project will not substantially adversely affect essential fish habitat (EFH) or SAV and is of the opinion given the scope of the construction, a time of year restriction to help protect the migration and spawning of anadromous fish is not warranted.

Please note this EFH determination does not address threatened and endangered species under the purview of NOAA Fisheries Service. Therefore, please complete the GARFO ESA Section 7: 2017 NLAA Program Verification Form or contact Mr. Brian Hopper, NOAA Protected Resources Division (brian.d.hopper@noaa.gov) to discuss your project regarding federally listed shortnose and Atlantic sturgeon.

Thank you for the opportunity to comment on this project. Please feel free to contact me if you have any questions. If this project is authorized, I would appreciate a copy of your permit for my files.

Regards,
Dave

David L. O'Brien
Fisheries Biologist
NOAA Fisheries Service
P.O. Box 1346
1370 Greate Rd.

Received by VMRC December 1, 2022 / lra

Gloucester Point, VA 23062
804-684-7828
david.l.obrien@noaa.gov

On Mon, Nov 28, 2022 at 2:18 PM Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil> wrote:

> Hey, Dave,
>
> I wanted to make sure you saw these comments from VIMS. The public notice for this project can be accessed here: https://www.nao.usace.army.mil/Media/Public-Notices/Article/3212722/nao-2019-01193/
>
> I have also attached the species conclusion table (also available on the public notice) and SAV snapshots I pulled earlier.
>
> Thanks!
> Nancy
>
> Nancy P. Davis
> Environmental Scientist
> U.S. Army Corps of Engineers
> 803 Front Street, Norfolk, VA 23518
> Office: (757)201-7044
> **Email: Nancy.P.Davis@usace.army.mil**
> Website: http://www.nao.usace.army.mil/Missions/Regulatory.aspx
>
> The Norfolk District is committed to providing the highest level of support to the public. In order for us to better serve you, please complete our Customer Satisfaction Survey at: https://regulatory.ops.usace.army.mil/customer-service-survey/
>
> ---
>
> **From:** Emily A. Hein <eahein@vims.edu>
> **Sent:** Monday, November 28, 2022 1:59 PM
> **To:** Jay Woodward <jay.woodward@mrc.virginia.gov>
> **Cc:** Advisory <advisory@vims.edu>; Beth.Howell@mrc.virginia.gov; Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil>
> **Subject:** [URL Verdict: Neutral][Non-DoD Source] Lancaster Board of Supervisors 22-2229
>
> Good afternoon, Jay,
>
> Attached are our comments for the Lancaster Board of Supervisors et al. project in Lancaster

Received by VMRC December 1, 2022 / lra

County (VMRC #22-2229). Please let me know if you have any additional questions.

Best,

Emily

Upcoming out of office dates:
19 December – 9 January

Emily Hein
Pronouns: she/her
Assistant Director for Advisory Services
VIMS Research and Advisory Services
eahein@vims.edu, 804-684-7482
VIMS | William & Mary
Virginia Institute of Marine Science

Received by VMRC December 1, 2022 / Ira

From:	Davis, Nancy P CIV USARMY CENAO (USA)
To:	Craig Palubinski
Cc:	Woodward, Jay (MRC); ohall@lancova.com; MRC - jpa Permits; Emily A. Hein
Subject:	Lancaster County/Windmill Point Marina/Landing HOA, breakwaters; NAO-2019-01193 / #22-V2229
Date:	Thursday, December 1, 2022 6:25:41 AM

Good morning, Craig:

Please see NOAA Fisheries Service comments below. Dave is not recommending any design changes so no action required at this point. I am still waiting for comments from other reviewing agencies and will keep you posted as I receive them.

Regards,

Nancy P. Davis
Environmental Scientist
U.S. Army Corps of Engineers
803 Front Street, Norfolk, VA 23518
Office: (757)201-7044
Email: Nancy.P.Davis@usace.army.mil
Website: http://www.nao.usace.army.mil/Missions/Regulatory.aspx

From: David OBrien - NOAA Federal <david.l.obrien@noaa.gov>
Sent: Wednesday, November 30, 2022 2:45 PM
To: Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil>
Subject: [URL Verdict: Neutral][Non-DoD Source] Lancaster County/Windmill Point Marina/Landing HOA, breakwaters; NAO-2019-01193 / #22-V2229

Hello Nancy,

I have reviewed the coordination materials you sent regarding the proposed breakwater project located along the Rappahannock River in Lancaster Count, Virginia. As you know, the Rappahannock River is designated as essential fish habitat (EFH) for 7 federally managed species and is also designated an anadromous fish use area by the Virginia Department of Wildlife Resources (DWR). Submerged aquatic vegetation (SAV) has also been documented in the immediate vicinity of the project by the VIMS SAV monitoring and restoration program. A small area of very sparse density (0-10% cover) SAV was mapped in the 2018 survey in the vicinity of proposed breakwater 6; the only year in the last five (5) years of available data (VIMS, 2017-2021 data).

The project includes removing several existing stone spurs to be incorporated as stone snapshots I pulled earlier.

Thanks!
Nancy

Nancy P. Davis
Environmental Scientist
U.S. Army Corps of Engineers
803 Front Street, Norfolk, VA 23518
Office: (757)201-7044
Email: Nancy.P.Davis@usace.army.mil
Website: http://www.nao.usace.army.mil/Missions/Regulatory.aspx

The Norfolk District is committed to providing the highest level of support to the public. In order for us to better serve you, please complete our Customer Satisfaction Survey at: https://regulatory.ops.usace.army.mil/customer-service-survey/

From: Emily A. Hein <eahein@vims.edu>
Sent: Monday, November 28, 2022 1:59 PM
To: Jay Woodward <jay.woodward@mrc.virginia.gov>
Cc: Advisory <advisory@vims.edu>; Beth.Howell@mrc.virginia.gov; Davis, Nancy P CIV USARMY CENAO (USA) <Nancy.P.Davis@usace.army.mil>
Subject: [URL Verdict: Neutral][Non-DoD Source] Lancaster Board of Supervisors 22-2229

Good afternoon, Jay,

Attached are our comments for the Lancaster Board of Supervisors et al. project in Lancaster County (VMRC #22-2229). Please let me know if you have any additional questions.

Best,

Emily

Upcoming out of office dates:
19 December – 9 January

Emily Hein
Pronouns: she/her
Assistant Director for Advisory Services
VIMS Research and Advisory Services
eahein@vims.edu, 804-684-7482

Received by VMRC December 1, 2022 / Ira

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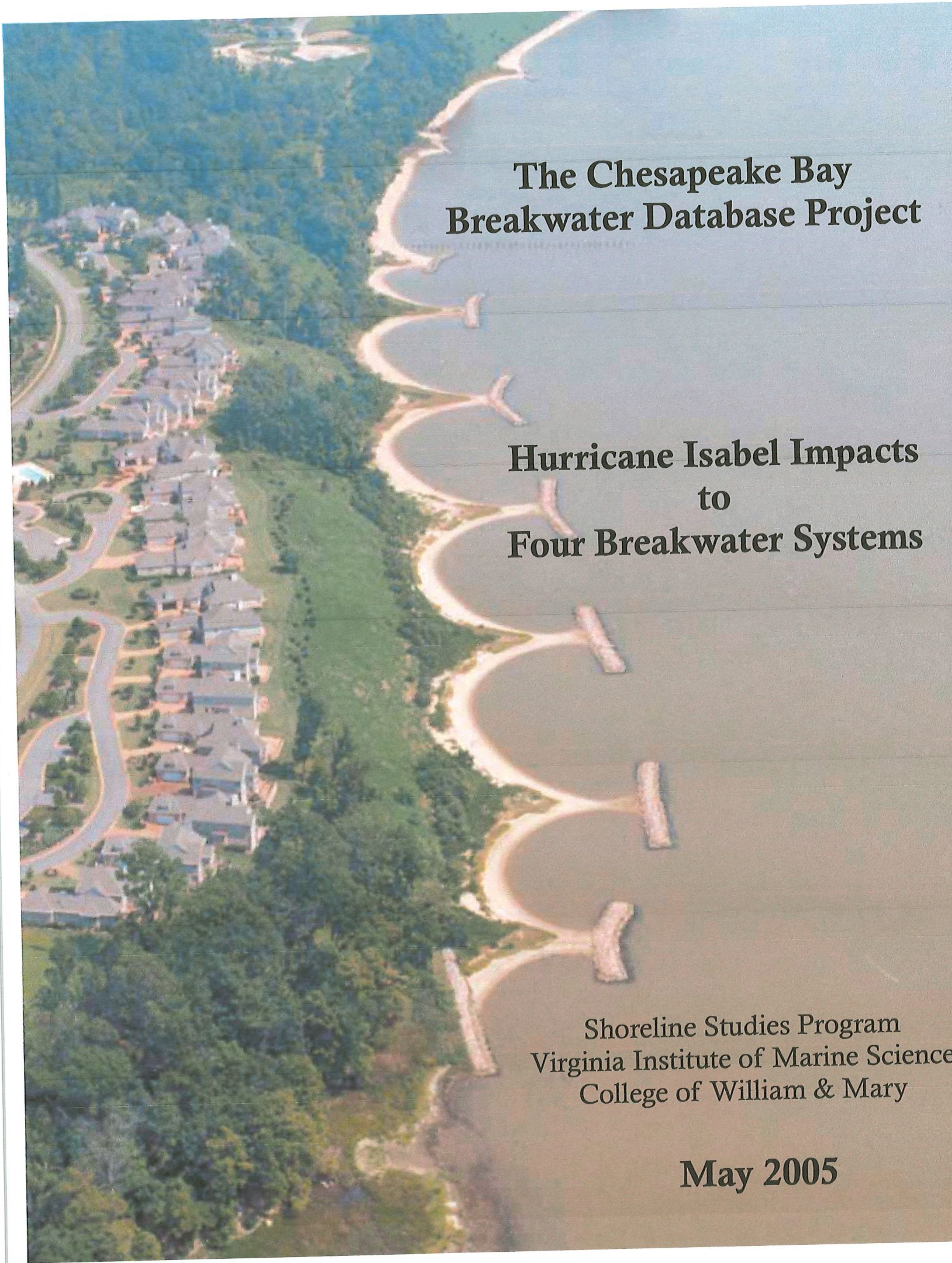
Virginia Institute of Marine Science

Received by VMRC December 1, 2022 / lra



The Chesapeake Bay Breakwater Database Project

Hurricane Isabel Impacts to Four Breakwater Systems

Shoreline Studies Program
Virginia Institute of Marine Science
College of William & Mary

May 2005

The Chesapeake Bay Breakwater Database Project

Hurricane Isabel Impacts
to
Four Breakwater Systems

C.S. Hardaway, Jr.
D.A. Milligan
C.A. Wilcox
L.M. Meneghini
G.R. Thomas
T.R. Comer

Shoreline Studies Program
Virginia Institute of Marine Science
College of William & Mary

May 2005

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Cover Photo: Kingsmill 26 August 2004 by Shoreline Studies Program

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1 Introduction

Hurricane Isabel impacted Chesapeake Bay on September 18, 2003 with record high storm surge and winds. Virtually all Chesapeake Bay shorelines were impacted. Those shorelines with open fetch exposures to the north, northeast, east, southeast, and south were especially effected due to the rotation of Isabel's winds from north to south during her passage. Hundreds, if not thousands, of shore protection systems were damaged or destroyed. Many shorelines around the Bay which had no shore protection were moved 10 to 30 feet landward due to storm surge and waves. Shore reaches with properly designed and constructed headland breakwater systems incurred varying degrees of damage from none to several feet of cut at the adjacent base of the upland banks. This report documents the impact of Hurricane Isabel on four such systems in Chesapeake Bay. These sites are part of the Chesapeake Bay Breakwater Database.

The Chesapeake Bay Breakwater Database is being developed by personnel in the Virginia Institute of Marine Science's (VIMS) Shoreline Studies Program for the U.S. Army Corps of Engineers (COE) in order to:

1) document breakwater system performance around Chesapeake Bay relative to predictions
2) develop guidelines for breakwaters in sand limited and fetch limited systems such as estuaries, reservoirs, lakes and bays.

The Chesapeake Bay Breakwater Database Project has 42 sites (Figure 1). Although more Bay breakwater systems exist, the sites in the database were chosen because they were designed with regard to their site setting, impinging wave climate, and desired level of protection, *i.e.* the 25 yr or 50 yr. storm event. Many projects are older than 10 years, and all were impacted by Hurricane Isabel. Aquia Landing, Kingsmill, Van Dyke, and Yorktown were selected for detailed analysis of Isabel's impacts since the four sites were surveyed immediately prior to the storm. This provided an opportunity to physically determine shore changes that may result due to a major storm event that equaled the 1933 Hurricane in storm surge level. Hurricane of 1933 is the unofficial 100 yr event that the Federal Emergency Management Agency (FEMA) has, until this point, used for a reference datum in Chesapeake Bay.

These four sites were mapped using a real-time kinematic global positioning system before and after the storm. The data were analyzed for changes in sand levels in the beach and nearshore as well as for any upland or backshore impacts from the storm. To better understand these changes, low-level vertical aerial photography, taken before and after the storm, were georectified and the shorelines digitized. At all sites, the breakwaters performed well allowing little overall change to beach systems. Since these sites were designed for 25 and 50 year storms, all were "overtopped" with the combination of surge and wave runup. The beach/upland interface at the two high bank sites (Kingsmill and Van Dyke) incurred varying degrees of bank scarping, but no bank failure while the two low backshore sites (Aquia Landing and Yorktown) saw sand washed over into adjacent roadways. Beach planforms adjusted bayward under storm conditions but returned to pre-storm position.

2 Shore Management

When developing a framework for shoreline management, establishing clear objectives is necessary. In developing management plans, the following objectives should be given consideration:

- Prevention of loss of land and protection of upland improvements;
- Protection, maintenance, enhancement and/or creation of wetlands habitat both vegetated and non-vegetated;
- Management of upland runoff and groundwater flow through the maintenance of vegetated wetland fringes;
- Address potential secondary impacts for a selected strategy within the reach which may include impacts to downdrift shores through a reduction in the sand supply or the encroachment of structures onto subaqueous land and wetlands; and
- Providing access and/or creation of recreational opportunities such as beach areas.

These objectives must be assessed in the context of a shoreline reach. While all objectives should be considered, each one will not carry equal weight. In fact, satisfaction of all objectives for any given reach is not likely as some may be mutually exclusive. For instance, the type of shore (*i.e.* marsh, beach, bank) and ownership of downdrift property may alter management strategies as potential impacts are discussed in the design process.

Sites with a natural or environmental edge provide protection from coastal hazards such as storms. Wider beaches allow the waves to reduce in size before impacting the backshore. Vegetation serves to maintain the substrate during storm events. Low marshes may be completely overwashed by surge and mitigate the impact of waves while maintaining their structure since marsh is naturally more resistant to erosion than unconsolidated (*i.e.* sand) substrate. Dunes provide a natural "backstop" to waves before they impact the upland. In fact, Milligan *et al.* (2005) found that natural dunes at nine sites within the Chesapeake Bay estuarine system are naturally resilient and recover quickly. They protected upland structures from direct wave attack and mitigated any impact to upland banks. In developing management strategies, incorporating these features into shore protection in a cost effective manner enhances the overall system.

2.1 Modeling Coastal Structures in Chesapeake Bay

Shore management utilizes wind/wave modeling in order to assess wave climate on a reach basis. The computer models SMB and RCPWAVE are used. SMB generates a predicted wave height and period based on the effective fetch and offshore bathymetry of a site. RCPWAVE is a linear wave propagation model designed for engineering applications. This model, originally developed by the U.S. Army Corps of Engineers (Ebersole *et al.*, 1986), computes changes in wave characteristics that result naturally from refraction, shoaling, and diffraction over complex shoreface topography. To this fundamentally linear-theory-based model, routines have been added which employ wave bottom boundary layer theory to estimate wave energy dissipation due to bottom friction (Wright *et al.*, 1987). Over the years, a three step process has been developed (Hardaway *et al.*, 1995; Hardaway and Gunn, 1999a; Hardaway and Gunn, 1999b) to 1) assess the wind/wave climate using model SMB), 2) calculate the nearshore/nearfield wave refraction using RCPWAVE, (Ebersole, *et al.*, 1986), and 3) plot pocket beach shore planforms using Model SEB (Hsu *et al.*, 1989).

Utilizing the output from the RCPWAVE model as input to the Static Equilibrium Bay (SEB) model, the equilibrium planforms between structures can be determined. Beach planform calculations use the annual significant wind-generated wave approach direction and selected design storm conditions. This procedure was first developed by Silvester (1970) and later refined by Hsu *et al.* (1989) and Silvester and Hsu (1993). Their methods were developed along open-ocean, coastal embayments usually influenced by a unidirectional, significant annual wave field (Figure 2). In Chesapeake Bay, there often is a bimodal annual wind field that generates a bimodal wave climate that must be accounted for in beach planform design. This sometimes results in embayments with two tangential beach sections at any one time as beach planforms from one wind-generated wave field replaces or resides with another. Figure 3 shows the relationship of the three procedures in beach planform design that can be used for predicting bay shape.

The relationship between four specific headland breakwater system parameters were investigated by Hardaway *et al.* (1991) and Hardaway and Gunn (1991) for 35 breakwater embayments around Chesapeake Bay. Referring to Figure 3, these parameters include breakwater crest length, (LB), gap between breakwaters (GB), backshore beach width (Bm) and embayment indentation (Mb). The mid-bay backshore beach width and backshore elevation are important design parameters because they determine the size of the minimum protective beach zone in the headland breakwater system. This beach dimension often drives the bayward encroachment that is required for a particular shore protection design. Linear regression analyses were best for the relationship of Mb vs. GB with a correlation coefficient of 0.892. The ratio of these two parameters is about 1:1.65 and can be used as a general guide in siting the breakwater system for preliminary analysis. Then, the detailed bay shape using the SEB can be obtained. Stable relationships for Mb and GB are not valid for transitional bay/breakwater segments that interface the main headland breakwater system with adjacent shores. Numerous variations can occur depending on design goals and impinging wave climate.

Hardaway and Gunn (2000) found that for 14 breakwater sites around the Bay, the Mb vs. Gb ratio varies in range and average for bimodal and unidirectional wind/wave settings. For unidirectional sties, the range of Mb:Gb can be 1:1.4 to 1:2.5 with an average of 1:1.8. Aquia Landing and Yorktown have average Mb:Gb of 1:1.25 and 1:1.8, respectively. For bimodal sites Mb:Gb ratios vary from 1:1.0 to 1:1.7 with an average of 1:1.6. Kingsmill and Van Dyke have Mb:Gb ratios of 1:1.2 and 1:1.7, respectively.

2.2 Coastal Structures for Shore Management

Revetments are shoreline armoring systems that protect the base of eroding upland banks and usually are built across a graded slope (Figure 4). The dimensions of the revetment are dependent on bank conditions and design parameters such as storm surge and wave height. These parameters also determine the size of the rock required for long-term structural integrity. Generally, two layers of armor stone are laid over a bedding stone layer with filter cloth between the earth subgrade and bedding layer.

Breakwaters and sills are "free standing" structures designed to reduce wave action by attenuation, refraction, and diffraction before it reaches the upland region. A sill (Figure 5) has a lower crest, is closer to shore, and usually, is more continuous than larger breakwater units. Sills can be used in combination with larger breakwater units. Sills are installed with beach fill to create a substrate for establishing a marsh fringe.

Attached or headland breakwaters require beach fill in order to acquire long-term shoreline erosion control (Figure 6) since they are constructed in areas that are subject to more energetic conditions. Headland breakwaters can be used to accentuate existing shore features. The dimensions of a breakwater system are dependent on the desired degree of protection and potential impacts on littoral processes. Spurs are similar to breakwaters and sills in that they are "free standing" structures. The distinction is that spurs are attached to the shoreline or another structure; the unattached end of the spur acts as a breakwater by diffracting incoming waves

3 Site Information

3.1 Aquia Landing

Aquia Landing is a county-owned public beach on the Potomac River in Stafford County, Virginia (Figure 7). Prior to the project installation, the county beach was severely deteriorated with failing groins and washovers across a very low upland shore zone (Figure 8A). Long fetch exposures to the southeast of over 7 nautical miles (nm) and northeast of over 4 nm made the site vulnerable to storm damage. With partial funding from the Virginia Board on Conservation and Development of Public Beaches, a breakwater and beach fill project was installed in 1987. The project covered 1,200 ft of shoreline and consisted of 700 ft of stone revetment, four 110 ft headland breakwaters with 20,000 cy of beach fill bounded on each end by spurs (Figure 8B). Downdrift impacts were considered negligible due to low marsh composition and property ownership being the same as the breakwater system. The design utilized the shore morphology of the existing groin field to determine tangential beach orientation. The Static Equilibrium Bay (SEB) model was then applied to assess the predicted beach planforms for the headland breakwater systems (Hardaway *et al.*, 1993; Hardaway *et al.*, 1995; Hardaway and Gunn, 1999a; Hardaway and Gunn, 1999b; and Hardaway and Gunn, 2000). The pocket beach configurations have been stable since installation. The overall purpose of the project was to provide shore protection, create a recreational beach, and reduce beach hazards from deteriorating groins.

The design and performance of the site was analyzed by Linden *et al.* (1991). They found that during the three years after the installation of the project, the overall volume of beach material within the monitoring area had not changed. The wide, flat, shallow nearshore has allowed submerged aquatic vegetation (SAV) to expand at the site in the last 10 years (VIMS SAV website). This has likely helped maintain a stable nearshore during storm events.

3.2 Kingsmill

Kingsmill is located on the north shore of the James River in James City County, Virginia (Figure 7). It is a privately owned site that had chronic bank erosion and which has a long fetch exposure to the south of over 12 miles. The developer of the upscale residential community wanted shore erosion control with environmental edge (Figure 9A). A 2,800 ft breakwater system was installed in 1996. It consisted of six headland breakwaters ranging in size from 115 ft to 210 ft, a 110 ft low breakwater and a 170 ft revetment for boundary interfacing structures, beach fill, and wetlands plantings, all of which were designed for a 50-yr storm event (Figure 9B). The site's seventy foot high banks had little sand and posed potential upland drainage problems. The design routed upland drainage to an adjacent marsh, and low swales in the bank were used to allow storm water to diffuse through a vegetated beach fill. Beach fill was obtained from an upland borrow pit. The design utilized existing reach morphology and shore erosion patterns along with a hydrodynamic analysis which included SMB, RCPWAVE, and SEB models for a bimodal wave climate. The overall purpose of the project was to provide shore protection and habitat enhancement.

3.3 Van Dyke

Van Dyke is located on the south shore of the James River in Isle of Wight County, Virginia (Figure 7). It is a privately owned site that had severe erosion of its 50 ft banks due, in part, to it's exposure to a long fetch to the north of over 12 miles (Figure 10A). The site's bimodal wave climate and sand rich banks called for a breakwater system which utilized the bank sand for beach fill. Several factors were important considerations in the design; these were impacts to adjacent properties and the coordination of 15 property owners with varying degrees of support for and input to the project. However, the 2,300 ft project was installed in 1997. The system consisted of eight headland breakwaters ranging in size from 90 ft to 160 ft with open upriver boundary and a low short 50 ft interfacing breakwater and revetment downriver (Figure 10B). The project also included beach fill and wetlands plantings. Beach fill sand was selectively mined from adjacent 40 foot upland banks when they were graded. The overall purposes of the project were to provide shore protection and access to the James River.

3.4 Yorktown Public Beach

The Yorktown Public Beach is located on the south side of the York River in Yorktown, Virginia (Figure 7). It is approximately 1,200 feet in length. Historically, the beach was a product of erosion of nearby sandy upland banks and the littoral transport system. Over the years, the beaches along the waterfront began to narrow as the natural sediment supply was depleted by hardening of the updrift shorelines. Beaches were easily overwashed in storms, and they continued to erode (Figure 11A). The nearshore closest to the Colman Memorial Bridge is very deep as the river narrows. The channel under the bridge is naturally 90 ft deep. Downriver, the nearshore widens toward the National Park Service property.

In 1978, York County installed a riprap revetment along its picnic area shore to the east end of Yorktown. This area had been filled in Colonial days to expand the warehousing facilities at the Port of Yorktown. After a damaging storm in November 1985, a small breakwater with beach nourishment was installed in order to maintain a storm water outfall (Figure 11B). Subsequent renourishment occurred three years later.

In September 1994, York County installed Phase I of an offshore breakwater system which consisted of two shore-attached breakwaters (Figure 11C). These breakwaters, 140 and 120 feet in length, were coupled with 7,500 cubic yards of beach fill and plantings of *Spartina alterniflora* and *S. patens* in the lee of the structure. The pre-existing breakwater was modified to interface the system on the downstream end and the 120 foot breakwater has a falling crest elevation to encourage wave refraction, and a winged breakwater was designed to achieve a reasonable interface with the adjacent shore and reduce potential wave force impacts during northeasters. In May 1996, approximately 600 cubic yards of sand was dredged from under the Coleman Bridge as part of the bridge widening project. This sand was subsequently used as beach fill on Yorktown Beach.

In the fall/winter of 1998-1999, Phase II of the Shore Erosion Control Plan was implemented along the shoreline (Figure 11C). Two winged, headland breakwaters, 120 and 130 ft in length, were constructed downriver from the existing breakwaters. The small breakwater built in 1986 to stabilize the storm water outfall was removed in order to establish a better breakwater gap-to-bay indentation ratio for the new system. The storm water outfall pipe was relocated through one of the new breakwaters. In addition, approximately 10,000 cubic yards of sand was placed on the beach, and beach grasses were planted behind the structures.

Phase III of breakwater construction began in June 2000. The completed project included three new breakwaters, beach fill along the Yorktown waterfront, and a revetment. Since then, the wharf where the old post office sat was removed. Two smaller breakwaters, 80 and 85 ft in length were positioned at the far west of the reach. A larger winged, headland breakwater, 150 ft in crest length, was installed as well, and beach grasses were planted behind it. The existing revetment on the upriver end of the site was repaired and a new section was added toward the west. Along with the breakwater construction, a new walkway adjacent to the Water Street was added (Figure 11C).

Since then, an additional two breakwaters have been built on the upriver end of the site, and in 2005, three more were constructed upriver and one more downriver. History of the site, design guidelines, and performance of the Yorktown site over time has been documented in Milligan *et al.* (1996) and Milligan *et al.* (2005).

4 Hurricane Isabel

Hurricane Isabel made landfall along the southeast coast of North Carolina on September 18, 2003. At one time, the storm was a Category 5 on the Safir-Simpson scale. It had been downgraded to a Category 2 before it made landfall (Figure 12). By the time it impacted the Chesapeake Bay, it was a minimal Category 1. However, in addition to being in the "right-front" quadrant of the advancing hurricane, southeastern Virginia experienced east and east-southeast winds which are known to have the greatest potential to transport water into Chesapeake Bay and its Virginia tributaries. The hurricane impacted as far inland as Lake Erie.

The extent of coastal flooding during a storm depends largely on both the background astronomical tide and the surge generated by the storm's high winds and low atmospheric pressure. Together, surge and astronomical tide combine to form a "storm tide." Storm-tide flooding is maximized when the storm surge and a rising tide reach their peak at the same time. The SLOSH Model (Figure 13) depicts the maximum predicted surge levels around the Bay. However, it may have under-predicted certain areas, particularly up the rivers. Measured storm impacts would seem to indicate higher surges than then model predicted.

The hurricane of 1933, widely known as the "storm of the century" for Chesapeake Bay, generated a storm surge in Hampton Roads of 5.84 feet, more than a foot higher than the 4.76 ft storm surge recorded for Hurricane Isabel. Yet many long-time Tidewater residents say that the high-water marks left by Isabel equaled or exceeded those of the 1933 storm (Boon, 2003).

An analysis of sea-level records shows that Isabel's coastal flooding matched that of the August 1933 storm due to the long-term increase in sea level in Hampton Roads (Boon, 2003). Data from a tide monitoring station at Sewells Point show that sea level in Tidewater Virginia rose 1.35 feet between August 1933 and September 2003. Based on storm surge and astronomical tide, the 1933 hurricane storm surge exceeded Isabel's by more than a foot. Its surge also occurred at the beginning of spring tides while Isabel's surge occurred in the middle of a neap tide. However, the increase in sea level at Hampton Roads in the seventy years between the two storms was enough to boost Isabel's storm tide to within an inch and a half of the level experienced during the 1933 storm (Boon, 2003).

Additional storm data was obtained by an Acoustic Doppler Current Profiler (ADCP) which was deployed in 28 ft of water offshore of VIMS at Gloucester Point. The instrument provided a quantitative record of the hurricane's impact on lower Chesapeake Bay. Data from the ADCP showed that Isabel created a 7-foot storm tide topped by 6-foot waves. At the height of the storm, wave crests were passing over the instrument once every 5 seconds, and the storm was forcing the entire flow of the York River upstream at a rate of 2 knots. Because Isabel was so large, its winds, waves, and surge effected the Bay for an abnormally long time. The ADCP data showed that storm conditions persisted in the Bay for nearly 12 hours and that wave-driven currents were strong enough to mobilize bottom sediments even at the instrument's depth, increasing water turbidity by a factor of two to three compared to fair-weather conditions (VIMS, 2003).

Weather data provided by instruments atop VIMS' Byrd Hall showed that maximum sustained winds on the campus reached 65 mph, with 90-mph gusts. The barometer bottomed out at 29.2 inches, with a rainfall accumulation of about 2.2 inches (VIMS, 2003).

Around the Bay, similar impacts were recorded by tide gauges (Figure 14). The location and records of five tide gauges indicate the widespread flooding that occurred due to the storm. In the lower Bay, the Sewells Point and Chesapeake Bay Bridge Tunnel gauges survived the storm and indicated a total water level of 8 ft and 7.5 ft above mean lower low water (MLLW) at the peak of the storm. This is about 5 ft above normal. Also of note, the tide was running higher than normal for the day before the storm and the two days after at both locations. In fact, on the day after the storm at Sewells Point, the lowest tide was higher than the predicted high tide of 2.5 ft.

The other three tide gauges were destroyed during the storm before the peak water level was reached (Figure 14). At Gloucester Point on the York River, the tide gauge stopped recording at 8.5 ft MLLW during the storm. Maximum measured stillwater level across the river at Yorktown was 8.6 ft MLLW with the trash line indicating the water plus waves was at 12.5 ft MLLW. That is a surge above the mean range (2.4 ft) of 6 ft with additional 4 ft waves. Kingsmill, on the James River, stopped recording at 6.5 ft MLLW. At this location, measured trash lines indicated that the maximum surge and wave level was about 12 ft MLLW or about 8 ft above the mean tide range.

The National Oceanic and Atmospheric Administration (NOAA) analyzed tide gauge data from all over the Chesapeake Bay. The report states that storm surge was generally lower and more variable in the lower Chesapeake Bay than those in the upper Chesapeake Bay. Also, surges at the open bay sites were lower than those located in the more restricted rivers (Hovis *et al.*, 2004). Their data show that the Hurricane Isabel tide levels exceeded the historical maximum water levels at two sites in the lower bay whose gauges were still in operation after the storm. These gauges were located at Lewisetta on the Potomac River and at the Chesapeake Bay Bridge Tunnel. The previous storm of record at these two sites was the Twin Northeasters in January/February 1998. The upper bay also was severely impacted by the storm. Tide gauges in Maryland at Cambridge, Annapolis, Tolchester, Baltimore and Chesapeake City all exceeded the historical maximum water levels during Hurricane Isabel. These stations are generally located at the headwaters of large rivers or bays where the storm's persistent winds pushed water into enclosed areas and held it there through a complete tidal cycle (Hovis *et al.*, 2004). At many sites, particularly in the upper Bay and rivers, the peak of the storm surge lagged behind high tide. At Sewells Point on the James River, the peak storm surge occurred about 2 hrs after predicted high tide while at Lewisetta on the lower Potomac river, the peak occurred about 3.5 hs after predicted high tide. The lag was even greater up the rivers and bay some even as much as 8 hours after predicted high tide. In fact, the maximum observed water level and peak storm surge in the upper Chesapeake Bay did not occur until the storm center had already reached Lake Erie (Hovis *et al.*, 2004).

5 Methods

5.1 Site Surveying

A shoreline and nearshore survey was performed at each breakwater site during the summer of 2003 serving as the pre-hurricane survey. After the passage of the storm, a post-storm survey was performed at each site. A Trimble 4700 Real-Time Kinematic Global Positioning System (RTK-GPS) was used to set site control and acquire shore data. The 4700 receiver utilizes dual-frequency, real-time technology to obtain centimeter accuracy in surveying applications. In addition, a Trimble 5600 Robotic Total Station was used to acquire data in the nearshore.

Base station benchmarks were pre-set at each site with a 2-hour occupation. These data were processed through the National Geodetic Survey's On-line Positioning User Service (OPUS) (http://www.ngs.noaa.gov/OPUS/). All the survey data were based on these benchmarks. In addition, 3-minute occupations were taken at secondary benchmarks in order to determine survey error. After the hurricane, many benchmarks needed to be reset. The horizontal datum is UTM, Zone 18 North, NAD83, international feet. The vertical datum is feet MLLW, geoid99, as determined from nearby benchmarks publishing both NAVD88 and MLLW for the 1960-1978 tidal epoch (http://www.co-ops.nos.noaa.gov/bench_mark.shtml?region=va).

Generally, the surveys included the following elements:

1. Dimensions of the project structures;
2. Mean High Water (MHW) and Mean Low Water (MLW); survey extends to approximately the -3 ft MLW contour;
3. Base of bank, mid-bank and top of bank, where appropriate and possible.

Survey dates and site length are as follows:

Aquia Landing	12 Aug 2003	30 Sept 2003	1,100 ft
Kingsmill	21 Aug 2003	6 Oct 2003	2,300 ft
Van Dyke	20 Aug 2003	21 Oct 2003	2,200 ft
Yorktown	June 2003	25 Sep 2003	1,800 ft

5.2 Storm Photo Geo-Referencing and Mosaicking

Recent color aerial photography was acquired by Shoreline Studies Program to help estimate, observe, and analyze shoreline changes before and after Hurricane Isabel impacted the breakwater sites on September 18, 2003. The images were scanned as tiff files at 600 dpi. ESRI ArcMap GIS (www.esri.com) software was used to georeference the images for Van Dyke, Aquia Landing, Elms Beach, and Kingsmill. The reference mosaic, the 2002 Digital Orthophotos from the Virginia Base Mapping Program (VBMP), is divided into a series of orthophoto tiles and is stored in a Virginia south, state plane projection, in feet. The aerial photo tiles from VBMP for each site were mosaicked and re-projected to a UTM zone 18 North, NAD83 projection, in meters.

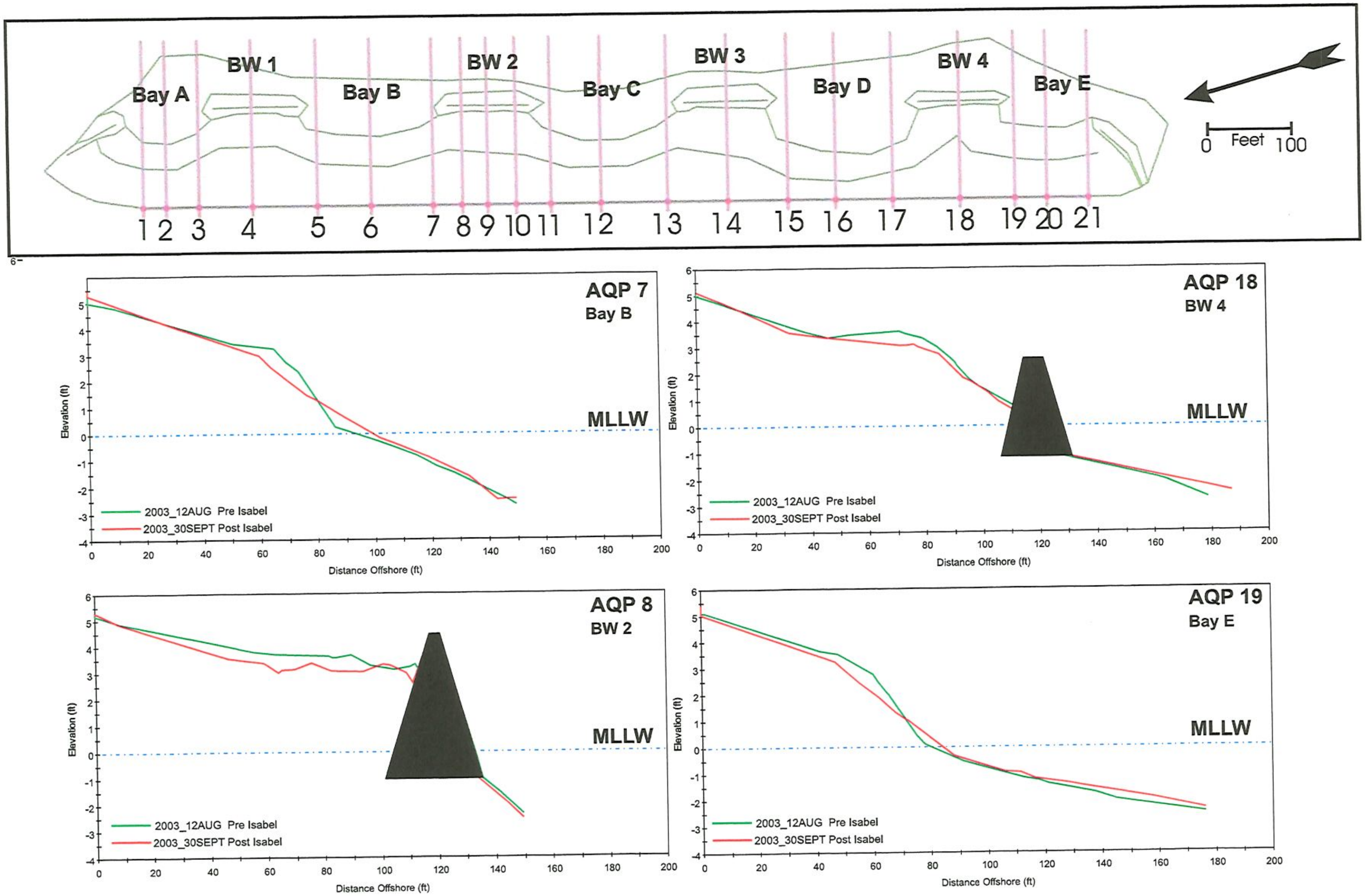

Figure 16. Aquia Landing baseline and selected pre and post storm cross-sections

Rectifying requires the use of ground control points to register the aerial photography to the reference images. Ground control points are points that mark features found in common on both the reference images and on the aerial photographs that are being georeferenced. Control points were distributed evenly to maintain an accurate registration without excessive amounts of warp and twist in the images. In addition, where possible, enough control points were placed within the area of interest, the shoreline and the breakwaters, to ensure accurate registration in these key areas. This can be challenging in areas with little development. Good examples of control points are permanent features such as manmade objects and stable natural landmarks. The standard in this project was to achieve a root mean square (RMS) error under six for each aerial photo.

Georeferencing was done by using the Georeferencing Tool in ArcMap. First the reference image and the scanned aerial photograph are roughly aligned so that common points can be identified. Then, with the aid of the Georeferencing tool, ground control points are added until the overall RMS error is less than six and the location of the aerial photograph closely matches the location of the reference image. When an acceptable correspondence is achieved, the aerial photograph is saved as a rectified image. All the rectified images were then mosaicked using the mosaic tool in ERDAS Imagine.

6 Results

6.1 Aquia

6.1.1 Isabel Hydrodynamic

Aquia Landing's east-facing shoreline has a nearly north-south orientation. Winds from the north, northeast, east, southeast, and southerly directions will impact this beach. Storm surge measurements at Colonial Beach stopped at about 6:00 p.m. on September 18, 2003 when the pier the gauge was attached to was destroyed (Figure 14). The tidal elevation had reached about +5.5 ft MLLW and was still climbing. Normal high tide at Colonial Beach is about 4 hours ahead of Aquia Creek. Mean tide range is 1.6 ft in Colonial Beach and 1.3 ft at Aquia Landing. The closest operating wind gauge during Isabel was at Lewisetta some 38 miles southeast down the Potomac River. On the day of the storm, northeasterly winds were increasing and sustained at 26 mph at about noon. By 4:00 p.m., they had reached 43 mph and were arriving from the east-northeast. At this time, a storm surge of about +2.2 ft MLLW may have been impacting Aquia's shoreline. As the wind increased, it's direction slowly shifted to the east then southeast resulting in a window of significant wind/wave impacts occurring between 6:00 p.m. and 10:00 p.m. as the surge rose. The peak sustained winds (53 mph from the east-southeast) occurred about 8:00 p.m. on September 18th. However, interpolated peak surge at Aquia was about 10:00 p.m. when sustained wind speeds had dropped to 43 mph from the southeast at Lewisetta. Maximum still-water level at Aquia Landing was surveyed at about +8.6 ft MLLW.

6.1.2 Physical Impacts

The survey baseline at Aquia Landing runs along the top of a Jersey wall that separates the public beach from the adjacent access road. The road is about 2 ft lower than the beach at the junction of the wall. Aerial imagery pre- and post-Isabel show that enough sand, about 1 ft, overwashed the wall to completely cover the access road (Figure 15). The shift in shoreline position was mostly landward after Isabel. Typical bay beach profiles (Figure 16) show a cut and fill scenario while the tombolo beach in the lee of each breakwater unit were sheared down about 0.5 feet. Little or no scour existed in front of the breakwaters while slight infilling occurred in each embayment. A slight increase in elevation was measured on the river side of the wall as the sand was moved up and over except where one scour hole occurred at the beach/wall junction. In addition, a reduction in vegetation in the lee of each breakwater occurred (Figure 17). The walkover to the beach was destroyed, and the bathhouse was flooded by the 8.6 ft MLLW surge that covered everything at the site.

The overall change in topography of the site is shown in Figure 18. The yellow and orange areas on the isopach map indicate decreases in elevation of -0.5 ft and -1.0 ft, respectively (Figure 18C). These areas occur in front and in the lee of each breakwater and along the beach berm zone of each embayment. Overall slight increases in sand elevation are shown in purple (+0.5 ft change) which occur intermittently along the backshore of each embayment and green (+1.0 ft change) which occur mostly along the very nearshore of each bay. No extreme changes (>1 ft) were measured in topography indicating the overall stability of the breakwater system.

6.2 Kingsmill

6.2.1 Isabel Hydrodynamics

The Kingsmill south-facing shoreline is oriented approximately east-west allowing wind/waves from the southeast, south, and southwest to impact the site. Water levels were measured at Kingsmill by a tide gauge until about 2:30 p.m. on September 18, 2003 (Figure 14). During the storm, the gauge was damaged, and the last reading was about 6.6 ft MLLW while tide was still rising. Wind and water level data also were measured at Sewells Point which is about 23 nautical miles downriver from the site. Wind speeds at Sewells Point exceeded 45 mph and remained so from 9:30 a.m. to about 5:00 p.m., and they reached sustained speeds of over 50 mph while water levels peaked at about 4 p.m. Kingsmill is located about halfway between Richmond and Norfolk, both of which have long-term wind monitoring stations. Wind data from Richmond shows more persistent winds from the north and northeast through the day on September 18 while Norfolk wind data showed winds more persistent from the east-northeast before they turned east then south. The combination of storm surge and southerly wind/wave climate, as indicated by the survey as the top of the bank scarping, resulted in water levels greater than +10.2 ft MLLW.

6.2.2 Physical Impacts

Pre- and post-Isabel aerial imagery of the site show slight changes in shore position (Figure 19). Each tombolo apex had a tendency to shift upriver. Measurable base of bank recession occurred along much of the project, but it was particularly prevalent adjacent to each embayment. These changes are illustrated in the typical bay and breakwater profiles in Figure 20. The combination of storm surge and wave runup limits were measured in the field and are shown for each typical profile at just over 10 ft MLLW. This was a significant event for the site, yet overall damage was minimized by the heavily vegetated backshore/base of bank (Figure 21). Post-Isabel recovery is shown in Figure 19; the beach planforms have returned to approximately their pre-storm poitions.

Topographic changes along the site between BW3 and BW7 are shown in Figure 22. The isopach map that indicates a general pattern of reduction in elevation occurred along the beach, backshore, base of bank and around each breakwater unit. Most increases in elevation were in the nearshore and in small pockets in the lee of each breakwater unit. The most severe scour occurred along the base of the bank (BOB) between BW5 and BW6. However, the damage did not endanger the integrity of the bank face. No slumping or failure was noted or has occurred since. Just upriver, extensive damage (more than $3 million) occurred at the adjacent marina which only had a timber pile breakwater for protection.

6.3 Van Dyke

6.3.1 Isabel Hydrodynamics

Once again, Sewells Point is the closet data station to this site; both wind and tide data are available through the entire storm event. Normal tidal lag for MHW between Sewells Point and the site is about 1 hr and 20 minutes. Although Sewells Point is the closest climatic station to the site, every indication is that conditions were more intense at Van Dyke than Kingsmill as evidenced by the severity of bank cut and limit of runup. Data from Richmond indicated that winds were more from the north and northeast throughout the day of September 18 while Norfolk data showed winds more persistent from the east-northeast before turning east then south. As a result of Van Dyke's north and northeast-facing shoreline, winds from the northwest, north, and northeast impacted this site. Wind speeds at Sewells Point got above 45 mph and remained so from 9:30 a.m. to about 5:00 p.m., and they reached sustained speeds of over 50 mph. The wind direction at 9:30 am was east-northeast and turned east by noon and southeast by 5:00 p.m. By interpolating between Richmond and Sewells Point, it would appear that Van Dyke had more of a northeast wind than indicated by the Sewells Point data.

Storm surge at Van Dyke at 9:30 a.m. was +4.8 ft MLLW, about +6.0 ft by noon, and over 8 ft MLLW by 5:00 p.m. The storm surge and northeast wind/wave climate combined to produce significant impacts to the site with wave runup measured to over 10 ft MLLW. The twin northeasters of 1998 produced storm surge of 7.5 ft over two tidal cycles but with less sustained winds, peaking around 35 mph. Wave modeling at the site (Hardaway and Gunn, 1999) predicts that for an 8 foot surge and 70 mph wind from the northeast, a 3.5 foot breaking wave would be produced.

6.3.2 Physical Impacts

Aerial imagery pre- and post-Isabel shows mostly landward shifts in the positions of both the shoreline and base of bank (Figure 23). Reduction in tombolo size are seen behind BW3, BW4, BW5, BW6 and also BW7 which had the narrowest attachment before the storm. The adjacent base of bank (BOB) along these structures also receded. Significant BOB recession also occurred in Bay A. General BOB stability is seen between BW2 and BW4 as well as between BW7 and BW8. These trends are shown in typical profiles for select bays and breakwaters (Figure 24). The combination of storm surge and wave height exceeded 11 ft MLLW, about 3 feet higher than project design. Post-storm recovery shows the shore planforms have returned to approximately their pre-storm configuration (Figure 23).

Ground photos taken before and after Hurricane Isabel show the extent of the upland bank scarping by the combination of storm surge and wave impacts (Figure 25). The retreat of the BOB was generally more severe in the embayments than behind the breakwaters and associated tombolos. Also, BOB impacts were minimal where the interface between the backshore and BOB had a less steep gradient. This occurred where the banks had been mined for sand, at Bay B and Bay G.

The overall change in topography at this site is seen in Figure 26. Negative topographic changes are evident at each tombolo and around and in front of BW5, BW6 and BW7. Severe land reduction occurs along the aforementioned BOB and along the top of the downriver revetment. Consequent increases or no change in topography are generally greater in the nearshore areas as indicated by the pink patterns (0 ft<change<1 ft).

6.4 Yorktown

6.4.1 Isabel Hydrodynamics

Yorktown is located across the York River from VIMS where NOAA maintains the Gloucester Point tide gauge (Figure 14). During Isabel the gauge stopped at about 2:30 p.m. with a reading of about +8.3 ft. MLLW as the tide was still rising. Wind speed measurements at VIMS provided by instruments atop VIMS' Byrd Hall showed that maximum sustained winds on the campus reached 65 mph, with 90-mph gusts. The barometer bottomed out at 29.2 inches, with a rainfall accumulation of about 2.2 inches. At the height of the storm, VIMS' Acoustic Doppler Current Profiler (ADCP) measured what might be considered a "deepwater" wave of 6 ft with a 5 second period. Still-water level at Yorktown was measured at 8.6 ft MLLW (mean tide range is 2.4 ft), and the combination of maximum storm surge and wave runup was measured at about 12.5 ft MLLW. One could infer that there could have been a 4 foot or greater wave breaking across the breakwater system and into the adjacent infrastructure.

6.4.2 Physical Impacts

Pre- and post-Isabel low level aerial imagery show a narrowing of each tombolo and a landward shift of sand behind each breakwater unit (Figure 27). The shoreline position in the two middle and largest embayments showed only slight changes after the storm. Typical profiles show cross-sectional changes as a basic cut and fill in the embayments (Figure 28). Shearing occurred across the top of the tombolos as well. Some sand was lost to the offshore after the storm but the County filled the beach to it's pre-storm profile shortly after the hurricane. Post-storm recovery about one year later shows shore planforms to have returned to their pre-storm position. A noticeable shore advance is seen in Bay C.

Sand was carried into the adjacent street but recent granite block "backstops" helped reduce this tendency. These blocks measuring about 1 ft square, 5 feet long, and weighing about 1 ton were easily shifted around by the storm waves. Several areas of scour occurred along the backshore/sidewalk/road juncture (Figure 29), but post storm clean up and added fill restored the public beach to use by late October 2003. The businesses along the waterfront were severely impacted, and it took several months for their rehabilitation due to water damage, but they are presently operating. Figure 30 shows a low backshore along Water Street in Yorktown as well as the storm wrack lines. At Colonial National Historical Park, just downriver from Yorktown, small rocks from the revetment along the shoreline were scattered on the road, and the adjacent upland bank was severely scarped.

7 Discussion

7.1 Aquia

Aquia Landing was the least impacted by Hurricane Isabel of the four sites discussed in this report. It had the least storm surge and it was not directly impacted by wave attack. Nevertheless, the storm impacts were enough to carry sand into the access road due to the low backshore and the absence of an upland bank. However, no significant infrastructure was damaged at the site. Overall, this site faired very well with little or no impact.

Just downriver at two other sites which had no shore protection system, significant change occurred (Figure 31). Dahlgren is on the south side of the Potomac River just downriver from the Route 301 Potomac River Bridge. Its bank was eroded 15-20 ft threatening upland infrastructure (Figure 32). On the north side of the Potomac River, Lenhart is slated for development. During the storm, its bank retreated 10-15 ft due to the storm (Figure 33).

7.2 Kingsmill

At Kingsmill, the very high banks and high end infrastructure posed a significant problem for long-term shore protection. The design had considered these factors so performance expectations were high. The headland breakwater system performed beyond expectations. The storm surge and wave action overtopped the system but impacted a heavily vegetated backshore/base of bank area causing minimal bank scarping which posed no threat to the integrity of the graded bank face.

Just up the James River along the National Park Service's Colonial Parkway, significant retreat occurred to the unprotected bank (Figure 34). The higher bank at the Confederate Fort had scarping leading to the loss of trees along the waterfront. Farther upriver in the open area adjacent to the Parkway, in areas where the bank was not sloped, scarping and retreat occurred. However, where the upland is graded to water interface, only minor scarping occurred.

7.3 Van Dyke

Hurricane Isabel exceeded the design conditions at the site, but it is difficult to accurately quantify its hydrodynamic forces. All of the piers along the shore sustained significant damage, and although the base of the bank was cut along most of the site, no banks failed or incurred significant damage. The banks will be regraded and a wider backshore will provide a larger buffer between the banks and storm waves once the vegetation is restored. No significant alteration in beach planform or loss of sand from the system occurred. The breakwater system is stable.

Both Kingsmill and Van Dyke have high graded banks adjacent to the breakwater/beach system which interface at about +7 ft MLLW for each site which is the elevation of a 50 year return interval storm. During Hurricane Isabel, the combination of storm surge and wave height impacted the banks to over +10 ft MLLW at both sites. Kingsmill had a much denser vegetated backshore and was able to withstand wave attack better than areas of Van Dyke. The Van Dyke site is more exposed due to its orientation causing bank cutting in the embayments in front of the steeper bank areas. Areas with a gentler grade at the beach/base of bank interface had little or no bank scarping. Isabel exceeded the design level for each site.

Near Van Dyke on the James River, other sites did not fair as well. Just downriver from Van Dyke, a revetment at the east end of the site was overtopped by the storm surge and waves (Figure 35). No erosion occurred of the graded bank just upriver from the revetment where the beach is wide behind a headland breakwater. The revetment crest elevation is +8 ft MLLW. Mogarts Beach, a few miles downriver on the James, suffered severe erosion of the beach and bank, a loss of over 20 ft in places, such that a road is now threatened (Figure 36). The narrow beach and low revetment offered little protection to the shoreline.

7.4 Yorktown

The waterfront at Yorktown was severely impacted by Hurricane Isabel. The low backshore and adjacent low bank allowed the storm surge to inundate the structures protected by the project. However, the wave action was significantly reduced by the public beach's breakwater system which may have spared the structural integrity of the buildings located along Water Street. This system experienced sand losses and local scour but maintained its overall integrity and performed above expectations. The system was designed for a 50 year event and sustained what many consider a 100 year event in this part of the Bay.

Approximately 1.5 miles downriver from the Coleman Memorial Bridge, also on the south side of the York River, the National Park Service maintains the Moorehouse. Their 1,600 ft of shore has a general west-northwest to east-southeast orientation and is exposed to the Chesapeake Bay from the northeast. Water depths are relatively shallow with the 12 ft contour approximately 800 ft offshore, and waters deeper than 36 ft is 2,000 ft offshore. The upland shore areas have 30 to 40-foot mostly vertical cliffs with interspersed ravines. The elevation of the revetment is about +6 ft MLLW. Significant scarping occurred above the revetment and along the section of shore that was unprotected with bank recession of about 5 to 10 ft (Figure 37).

8 Conclusions

The four breakwater sites assessed for this report performed very well under the direct impacts of high water and waves produced by Hurricane Isabel. All systems were 2 to 4 ft under water with an additional 2 to 3 foot waves breaking across what was the surf zone during the storm. Aquia and Yorktown were completely overtopped as waves attenuated across the breakwater system and impacted the low backshore and adjacent upland. Maintenance at each site only required returning the sand to the beach from the adjacent road. Yorktown required about 1,000 cy of sand to fill in the scour holes along the backshore/side walk intersection.

The Kingsmill and Van Dyke breakwaters systems had the task of reducing storm wave attack against high upland banks and preventing catastrophic scour and bank failure. Each system performed well, and the results indicate that a less steep gradient between backshore and the bank face greatly reduced the potential for bank scour. Also, a heavily vegetated backshore/base of bank interface may greatly reduce bank scour. The only post-storm maintenance to the banks that had to be performed was regrading several areas at Van Dyke. No additional sand fill was required at either site.

There is always a discussion of costs vs. benefits for any type of shore protection. The fact is that well built stone walls at +8 ft MLLW were overtopped and the adjacent upland scarped. The advantage or desirable element with headland breakwaters is that comparable or better shore protection is attained with a stable beach system that remains intact after the event. Higher breakwaters and more sand would give more protection, but at what cost?

The significance of the hurricane and the minor damages occurring at each site shows that headland breakwater systems offer effective shore protection with the benefits of beach and dune habitat. The post storm recovery is also important and shows the durability of the designed beach planforms.

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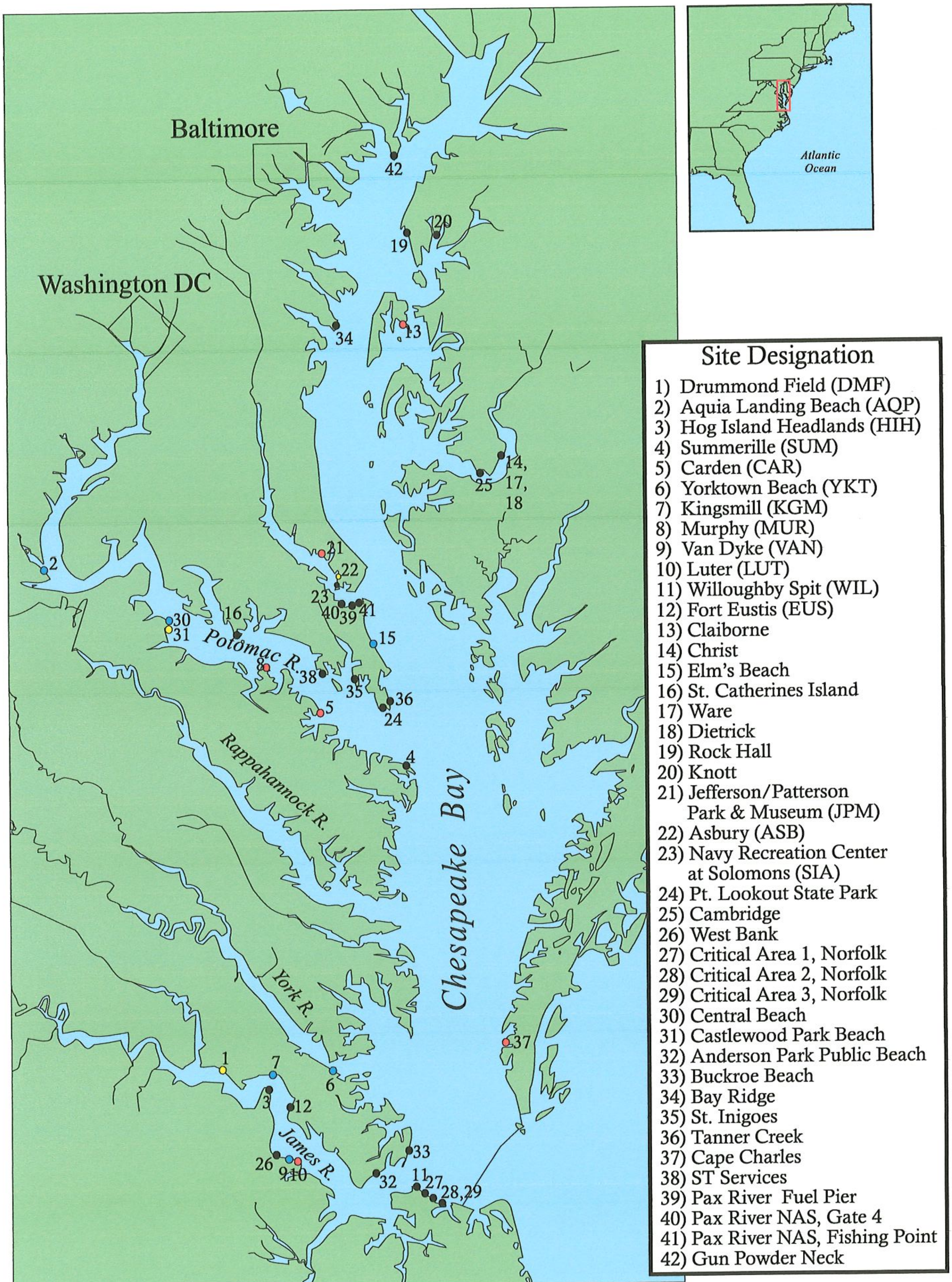


Figure 1. Location of breakwater sites throughout Chesapeake Bay. 2003 survey sites are shown in yellow; Post Isabel survey sites are shown in blue; and 2004 survey sites are shown in red.

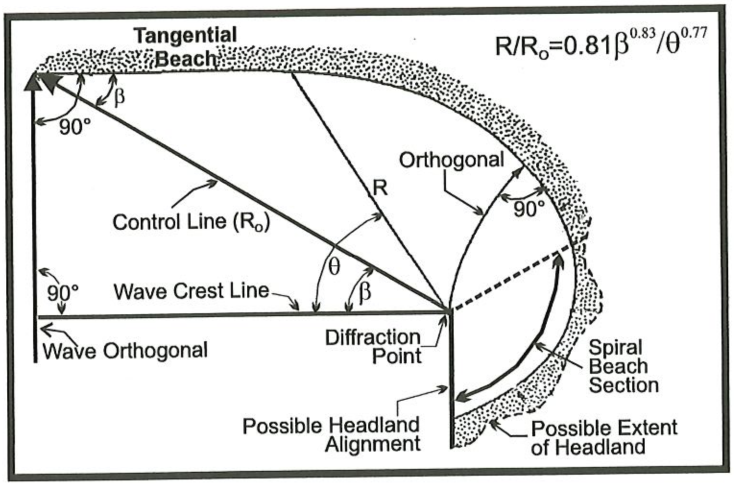


Figure 2. Parameters of the Static Equilibrium Bay (after Hsu *et al.*, 1989).

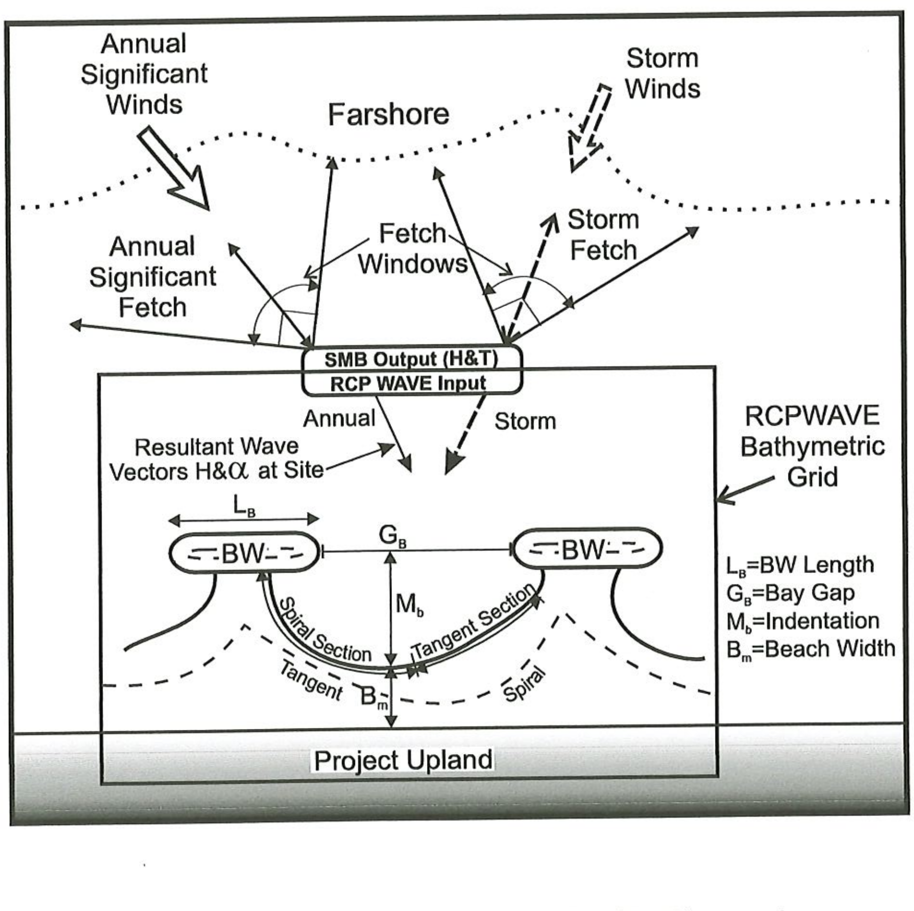


Figure 3. Parameters related to wind/wave generation (SMB), nearshore wave refraction (RCPWAVE), and beach planform prediction (SEB).

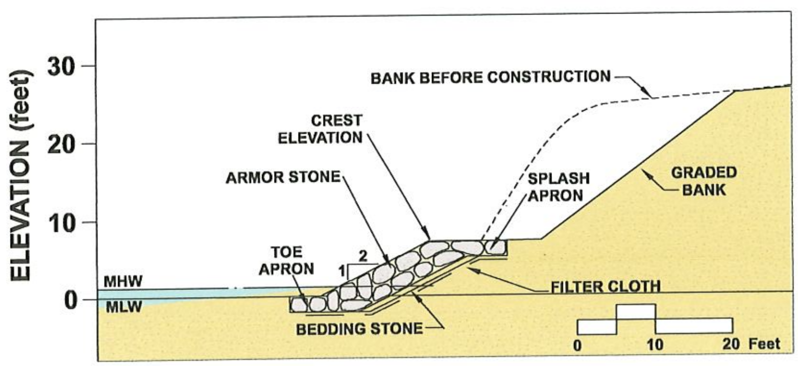


Figure 4. Stone revetment shortly after construction on the Potomac River, Virginia; and cross-section of elements necessary for proper stone revetment design. There are usually two layers of armor stone over a bedding stone layer with filter cloth between the earth subgrade and bedding layer. Armor size is dependent on the design wave height which is determined from an analysis of wave climate for each project site (Hardaway and Byrne, 1999).

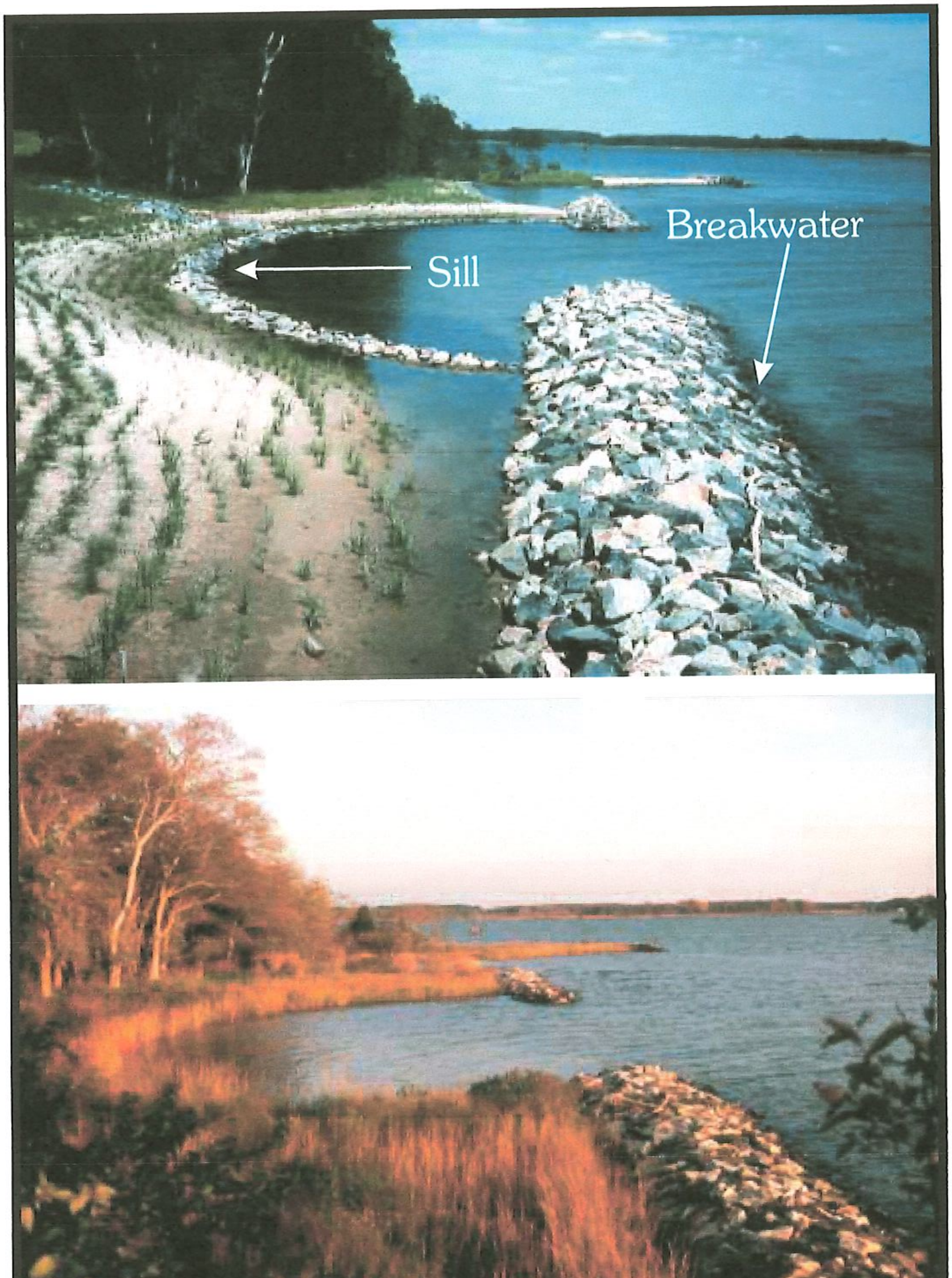


Figure 5. Stone sill connecting breakwaters with sand fill and marsh implantation on Choptank River, Talbot County, Maryland just after construction and 5 years post-construction (Hardaway and Byrne, 1999).

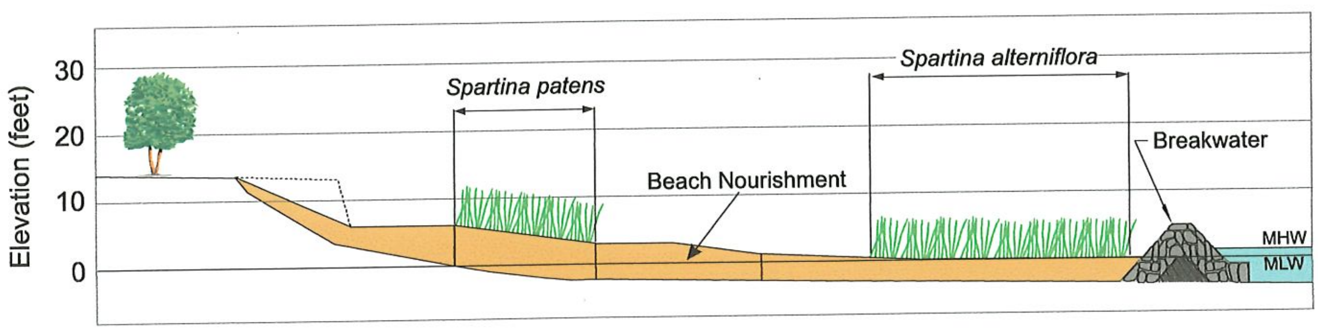


Figure 6. Breakwater system on Patuxent River in Calvert County, Maryland and a typical breakwater cross-section.

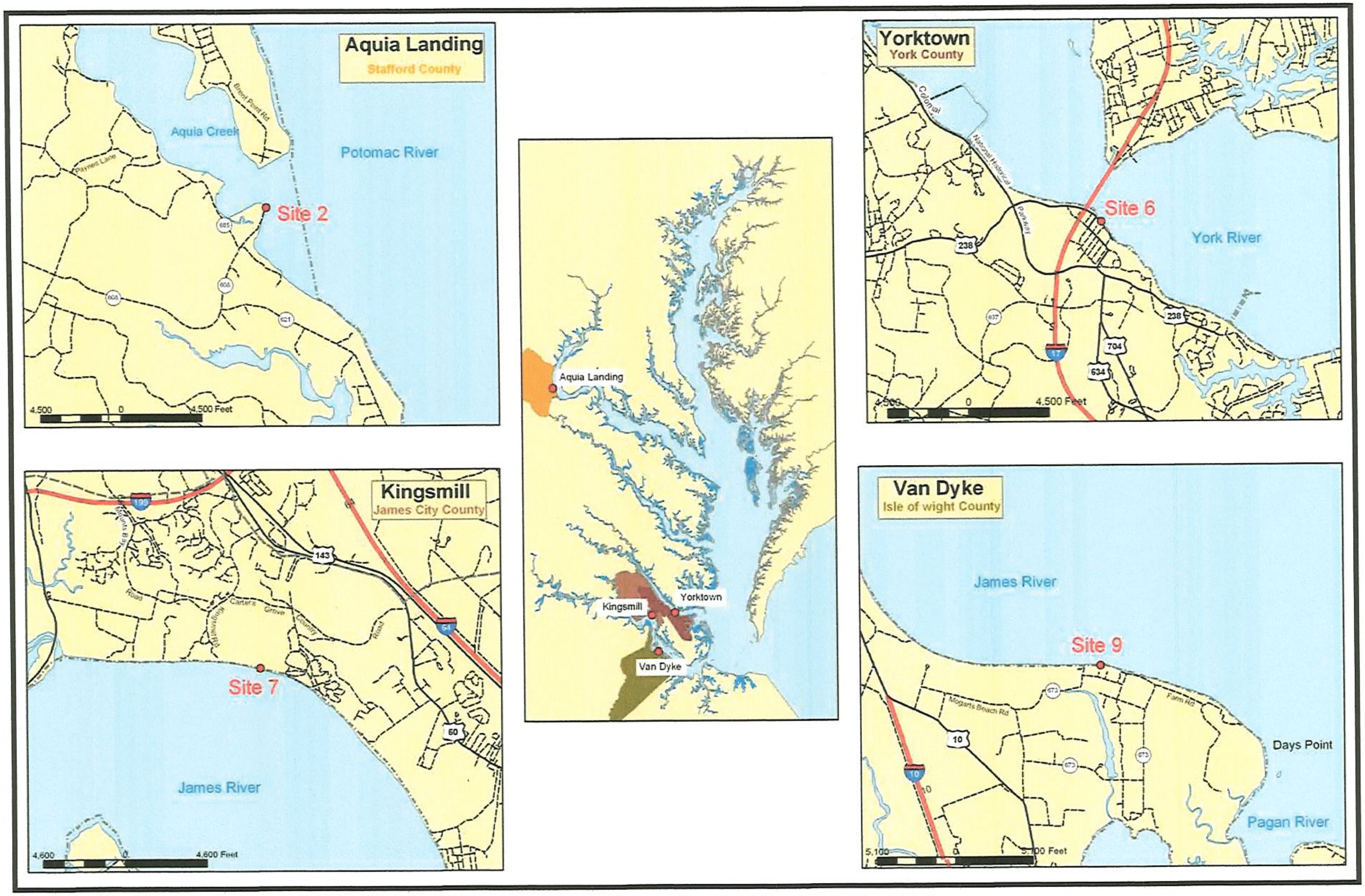
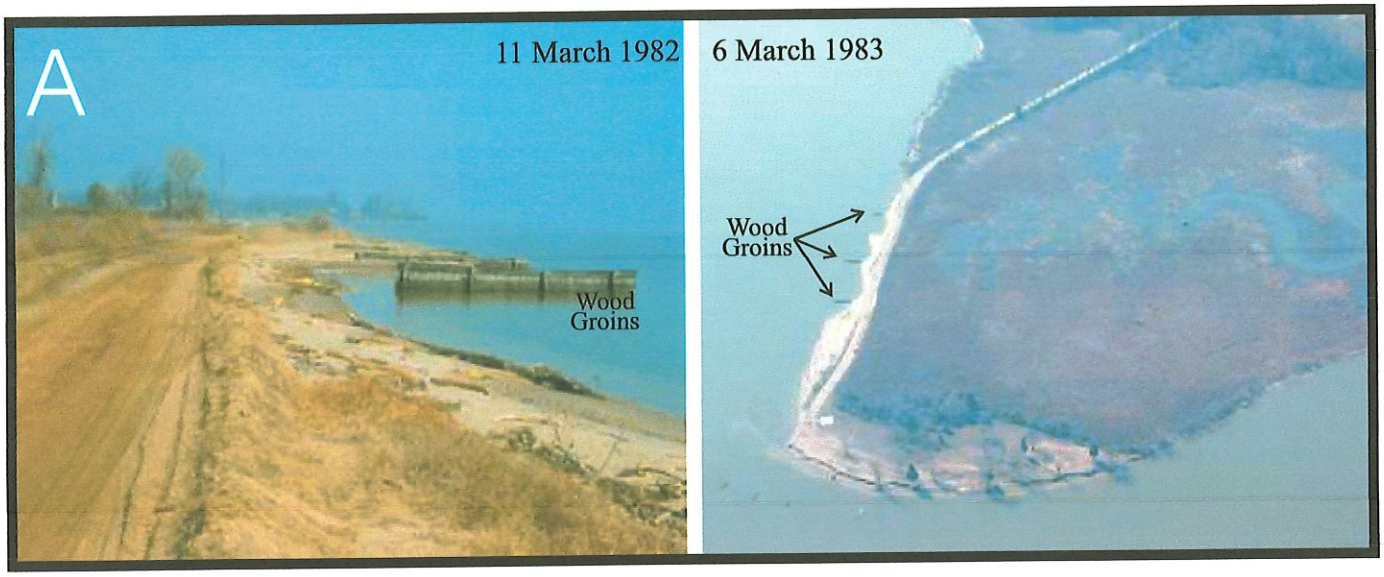


Figure 7. Location of the surveyed breakwater sites analyzed for this report.



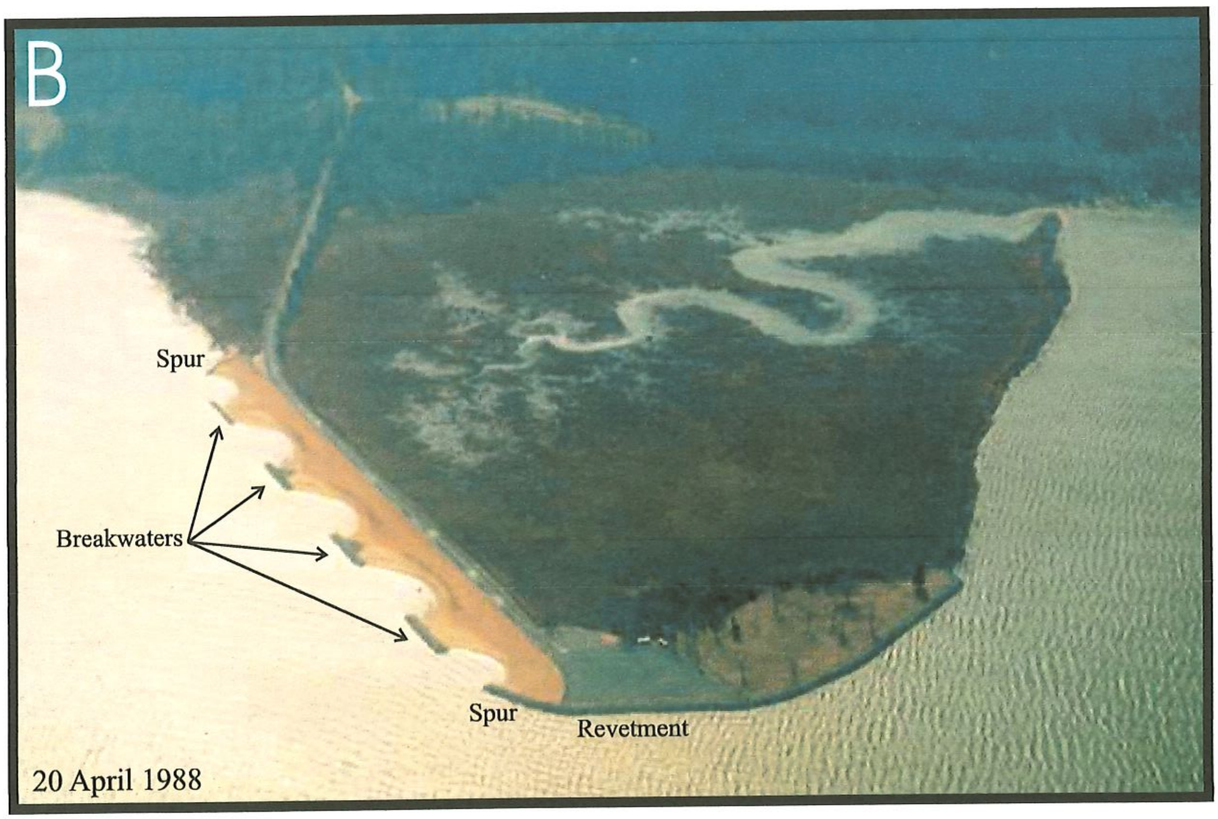


Figure 8. Photos of Aquia Landing A) before installation of breakwaters on the ground and aerially, and B) after installation of breakwaters.

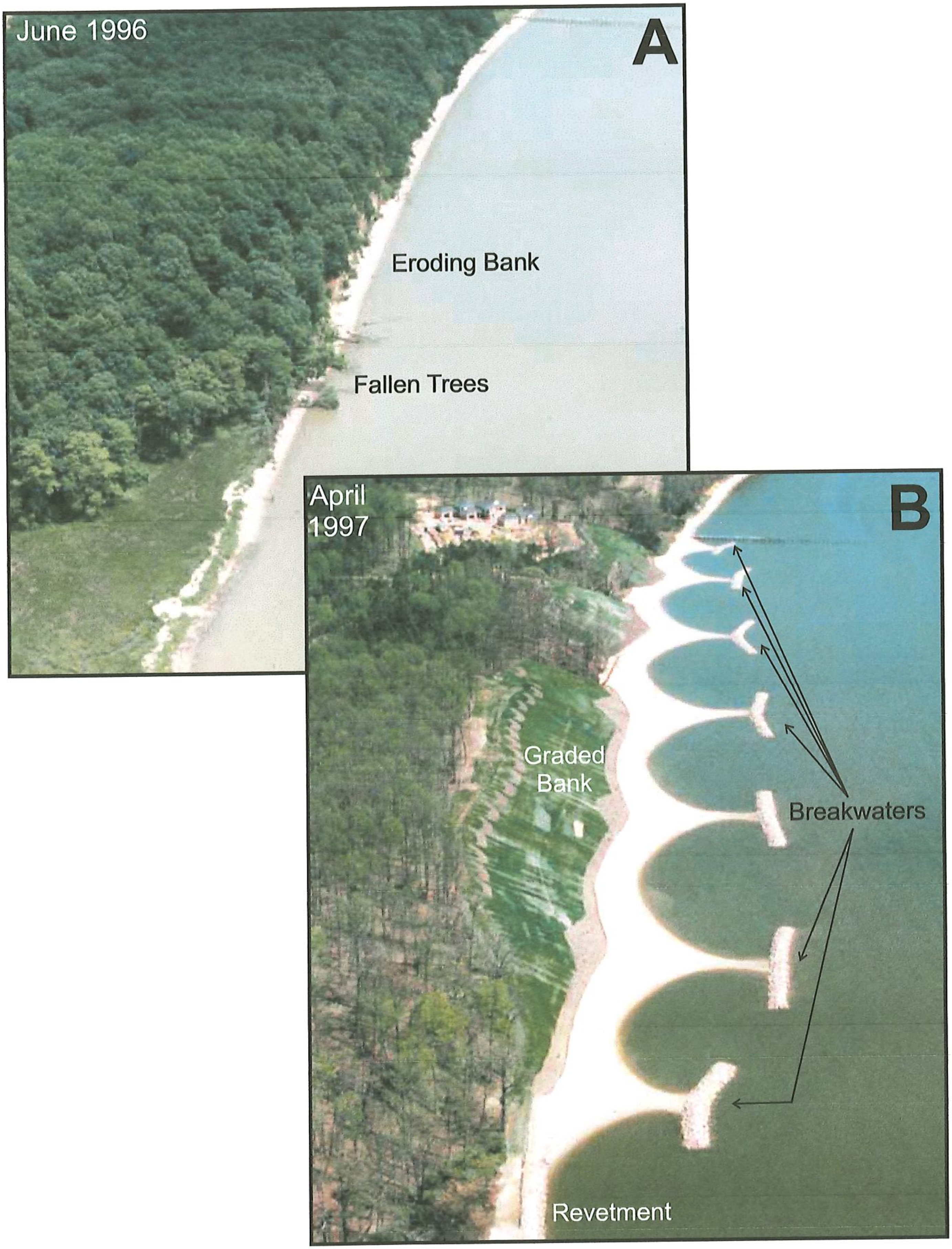


Figure 9. Photo of Kingsmill A) before installation and B) after installation.

Figure 10. Non-rectified aerial photography of Van Dyke A) before installation and B) after installation.

Figure 11. Aerial photos of Yorktown A) before installation of any shore management structures, B) after installation of a revetment and small breakwater, and C) after Phase III breakwater construction.

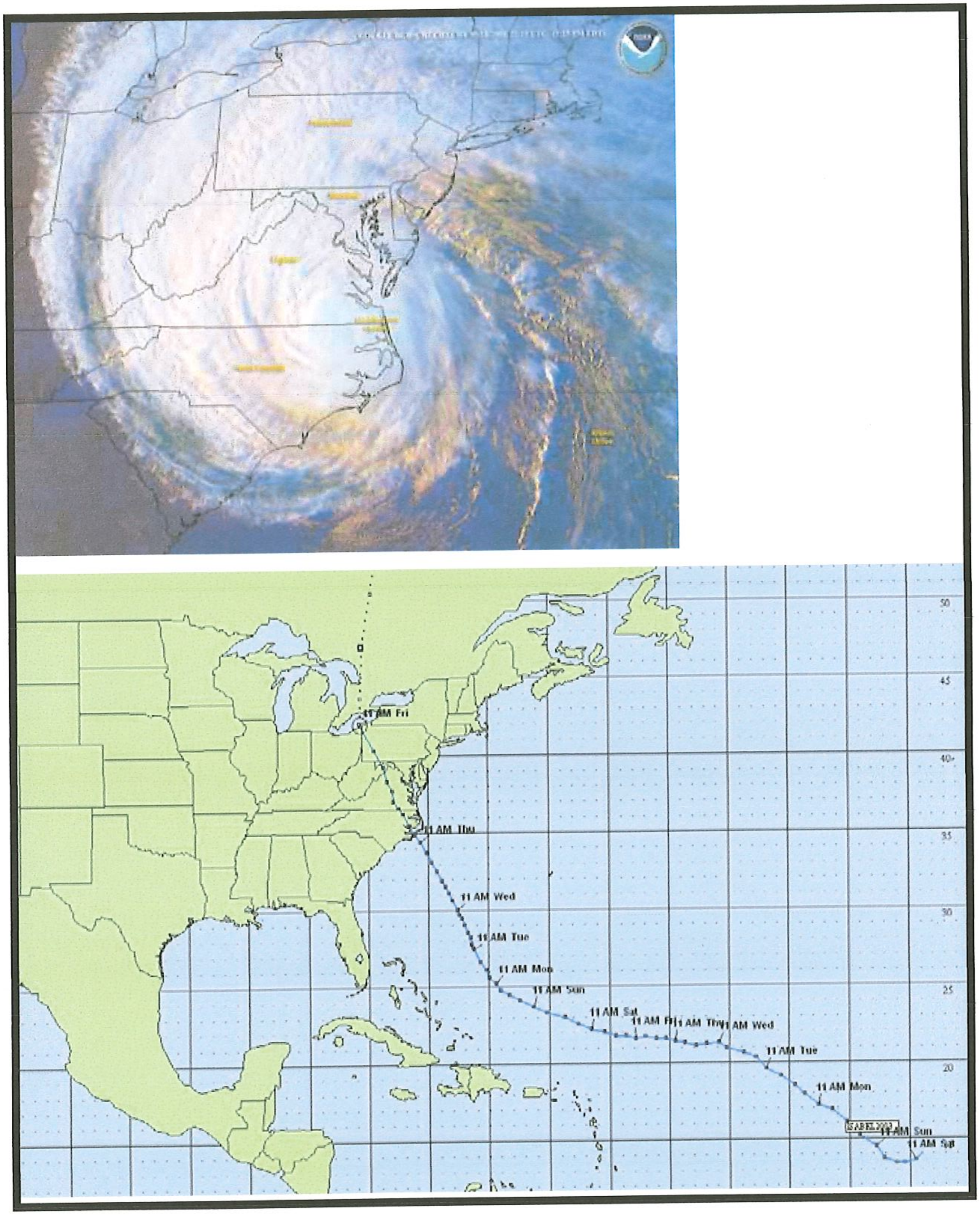


Figure 12. Hurricane Isabel photo at landfall and storm track from the National Hurricane Center.

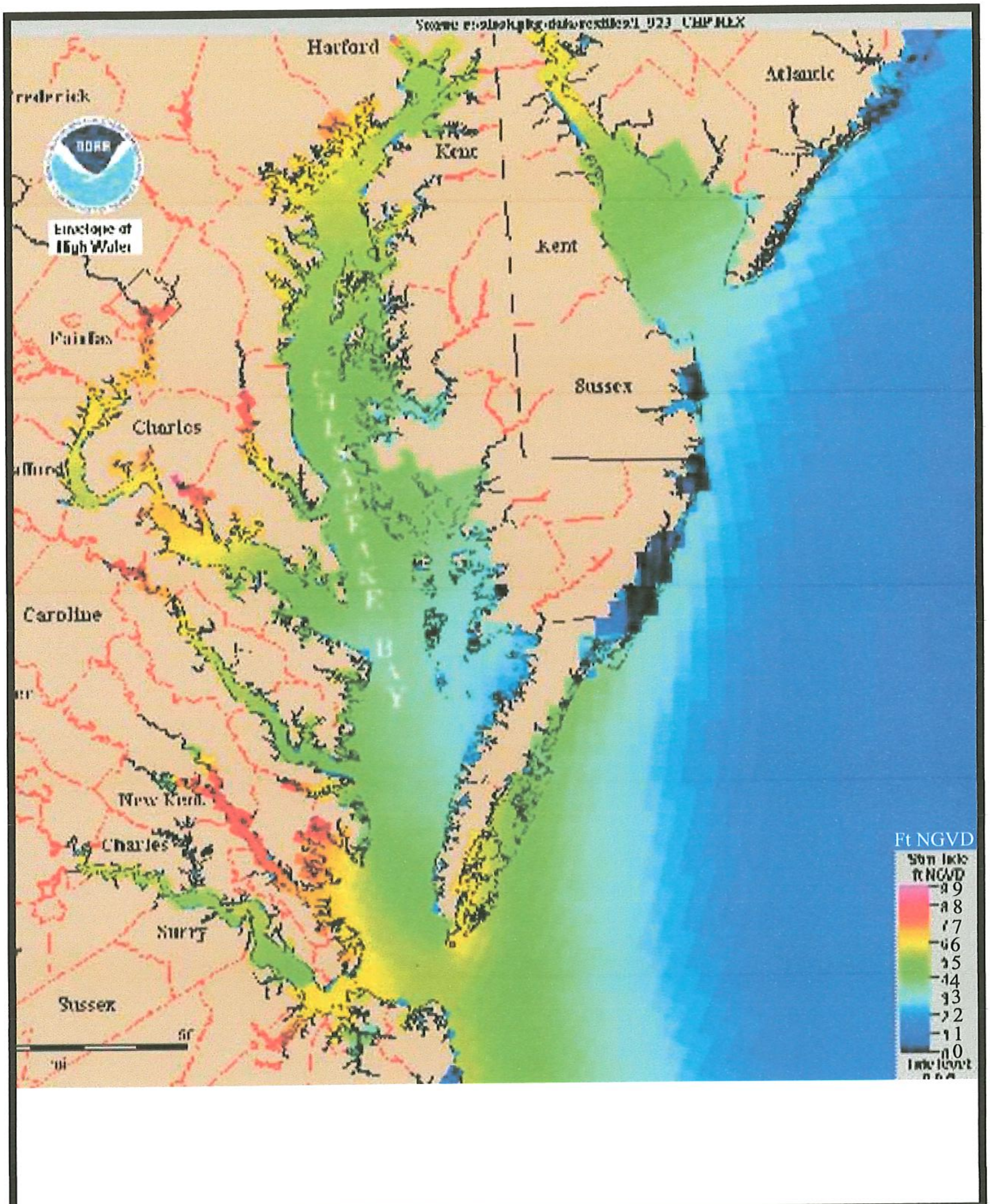


Figure 13. NOAA's slosh model storm surge prediction graphic.

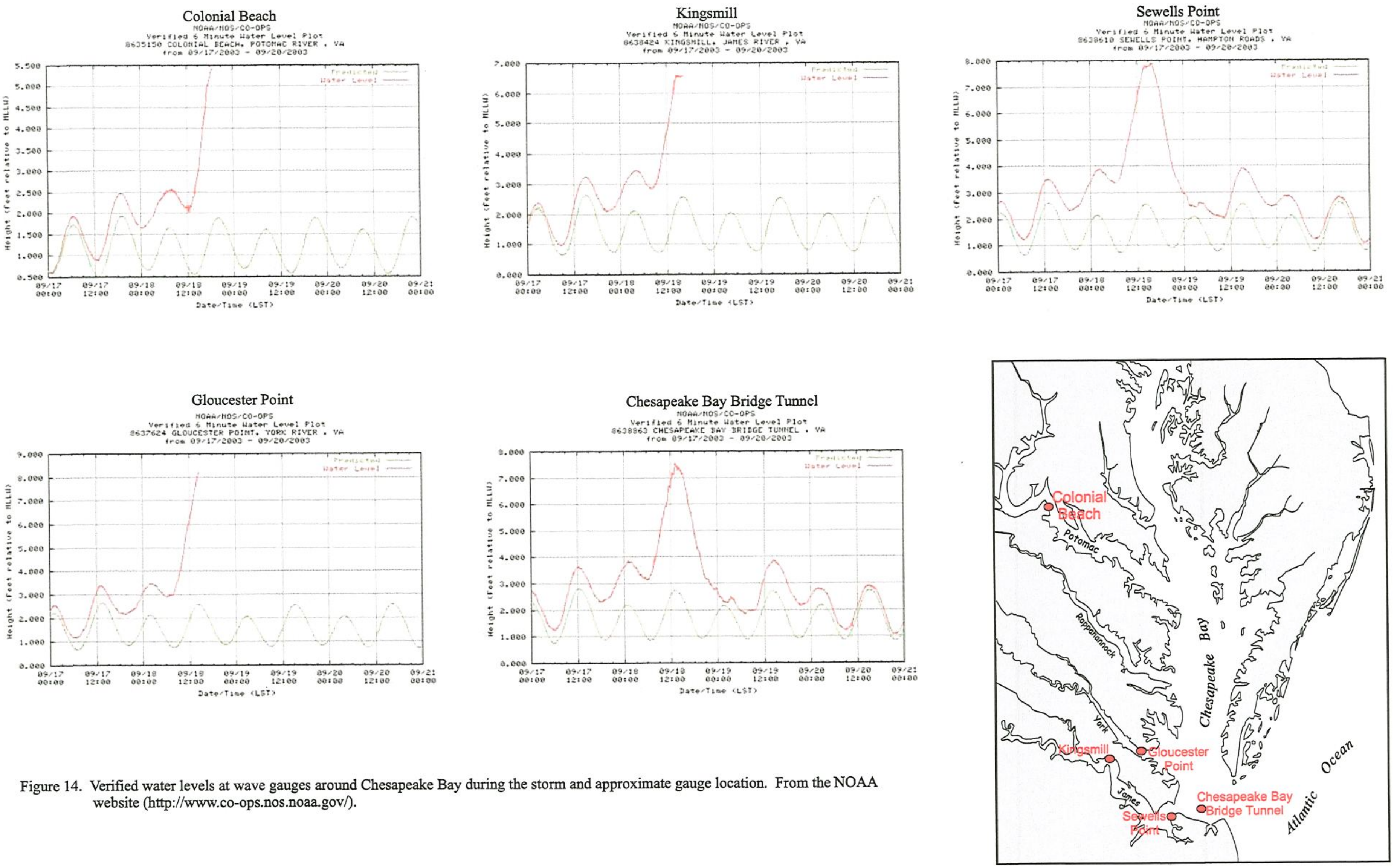


Figure 14. Verified water levels at wave gauges around Chesapeake Bay during the storm and approximate gauge location. From the NOAA website (http://www.co-ops.nos.noaa.gov/).

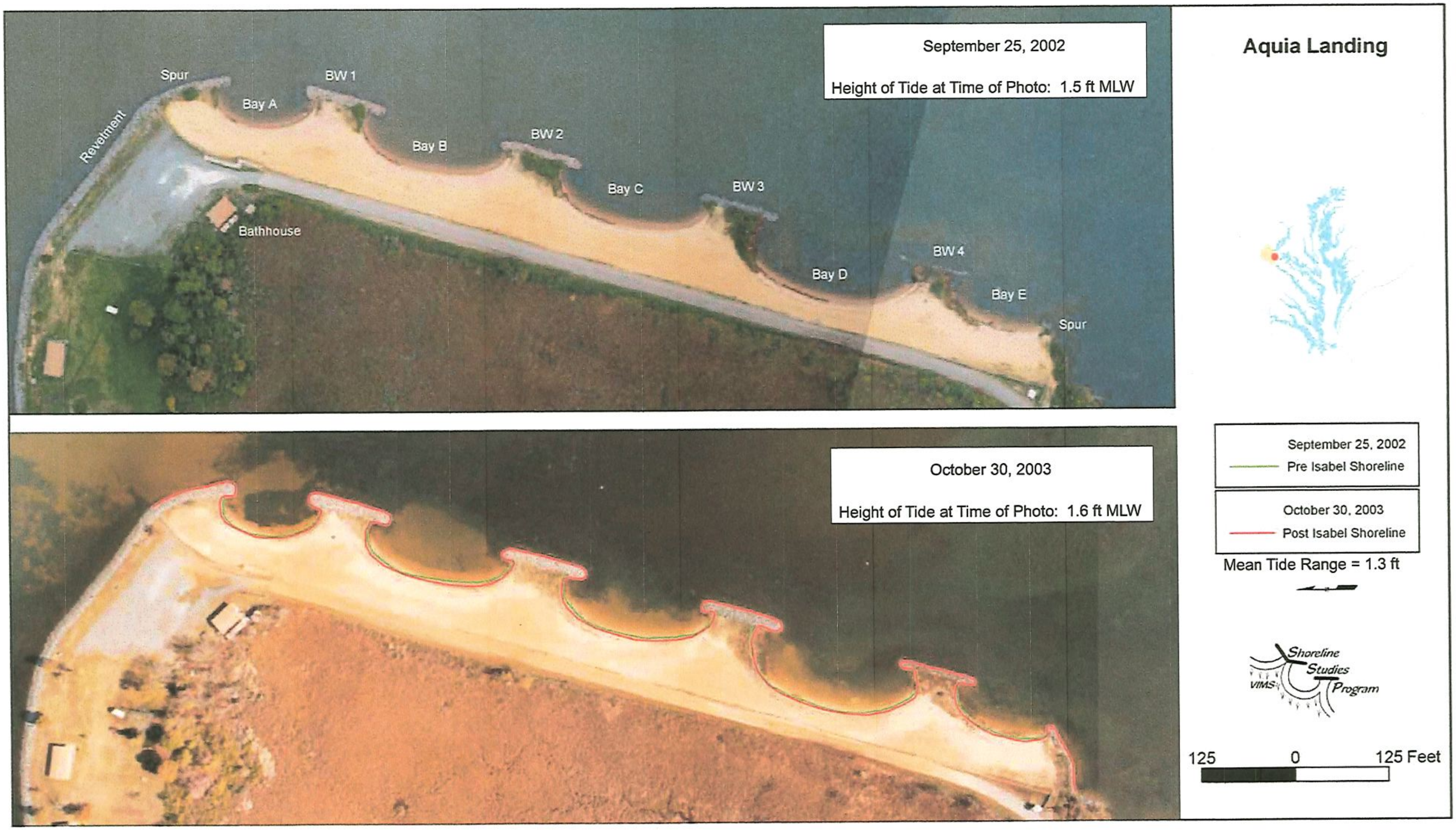
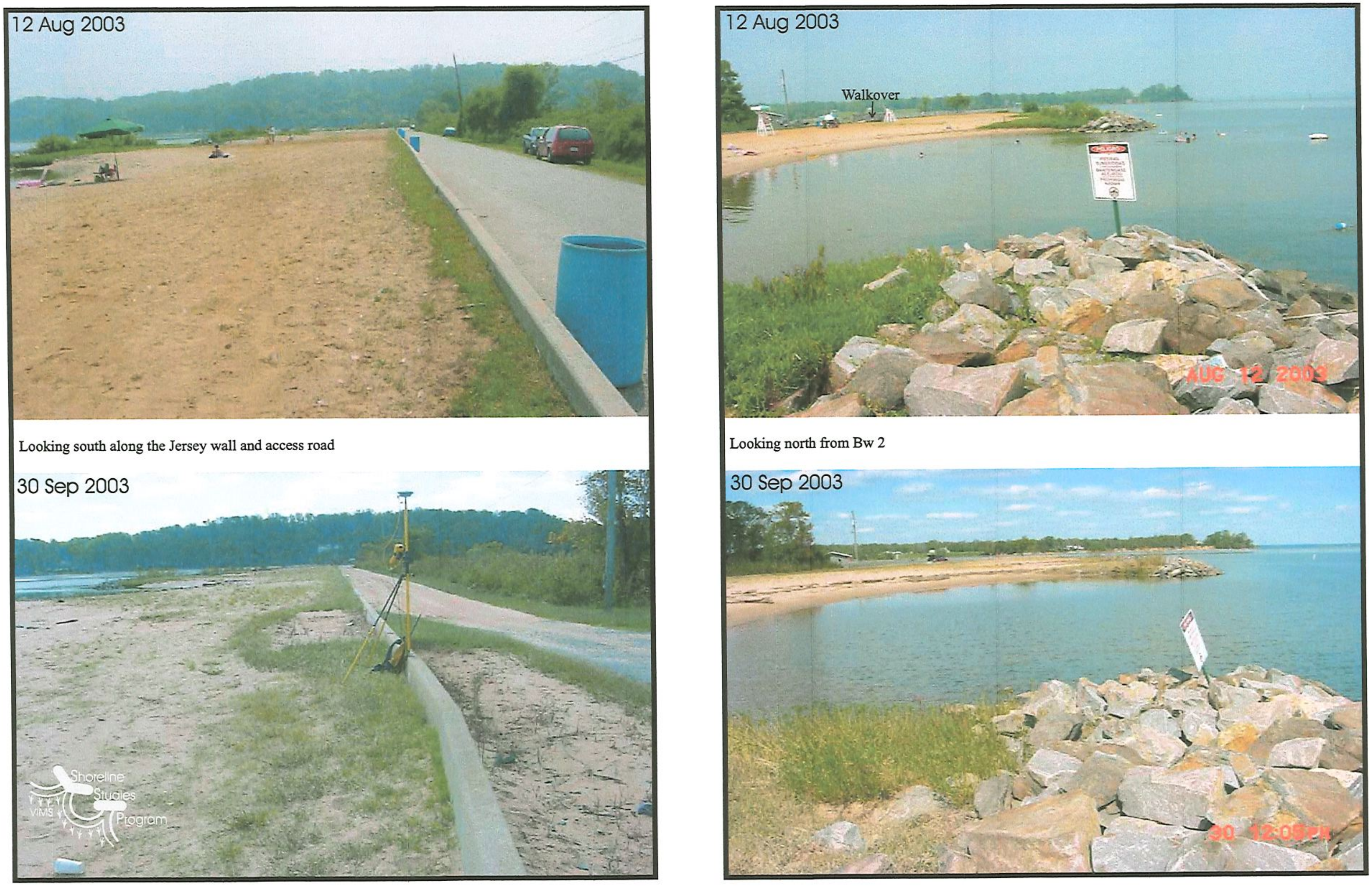


Figure 15. Aquia Landing low-level pre- and post-Hurricane Isabel ortho-rectified aerial photos.



Looking south along the Jersey wall and access road

Looking north from Bw 2

Figure 17. Aquia Landing ground photos before and after Hurricane Isabel.

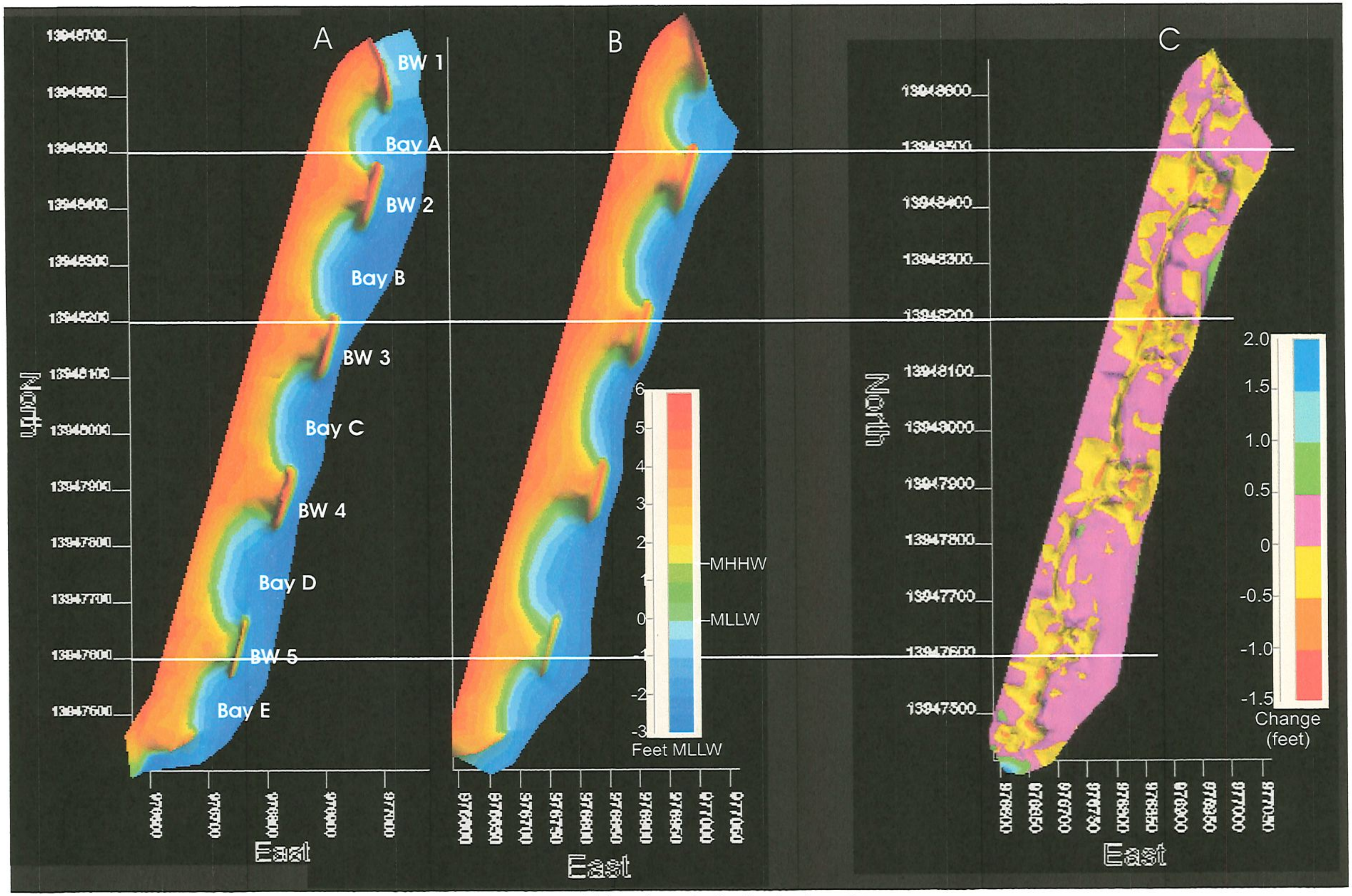


Figure 18. Aquia Landing color contour maps for the A) pre- and B) post-storm conditions, and C) isopach map showing elevation changes between surveys.

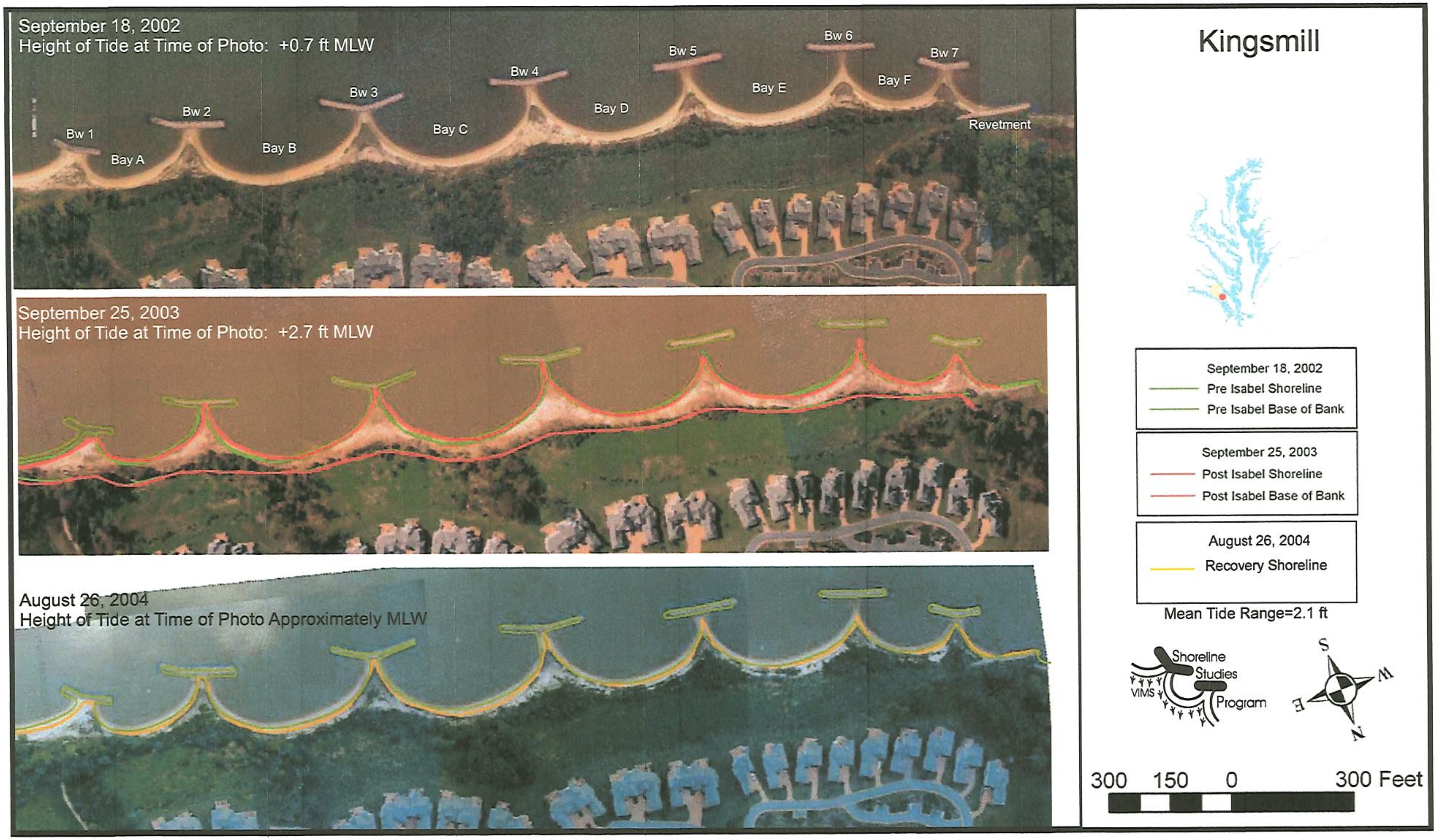


Figure 19. Kingsmill low-level pre- and post-Hurricane Isabel and recovery ortho-rectified aerial photos.

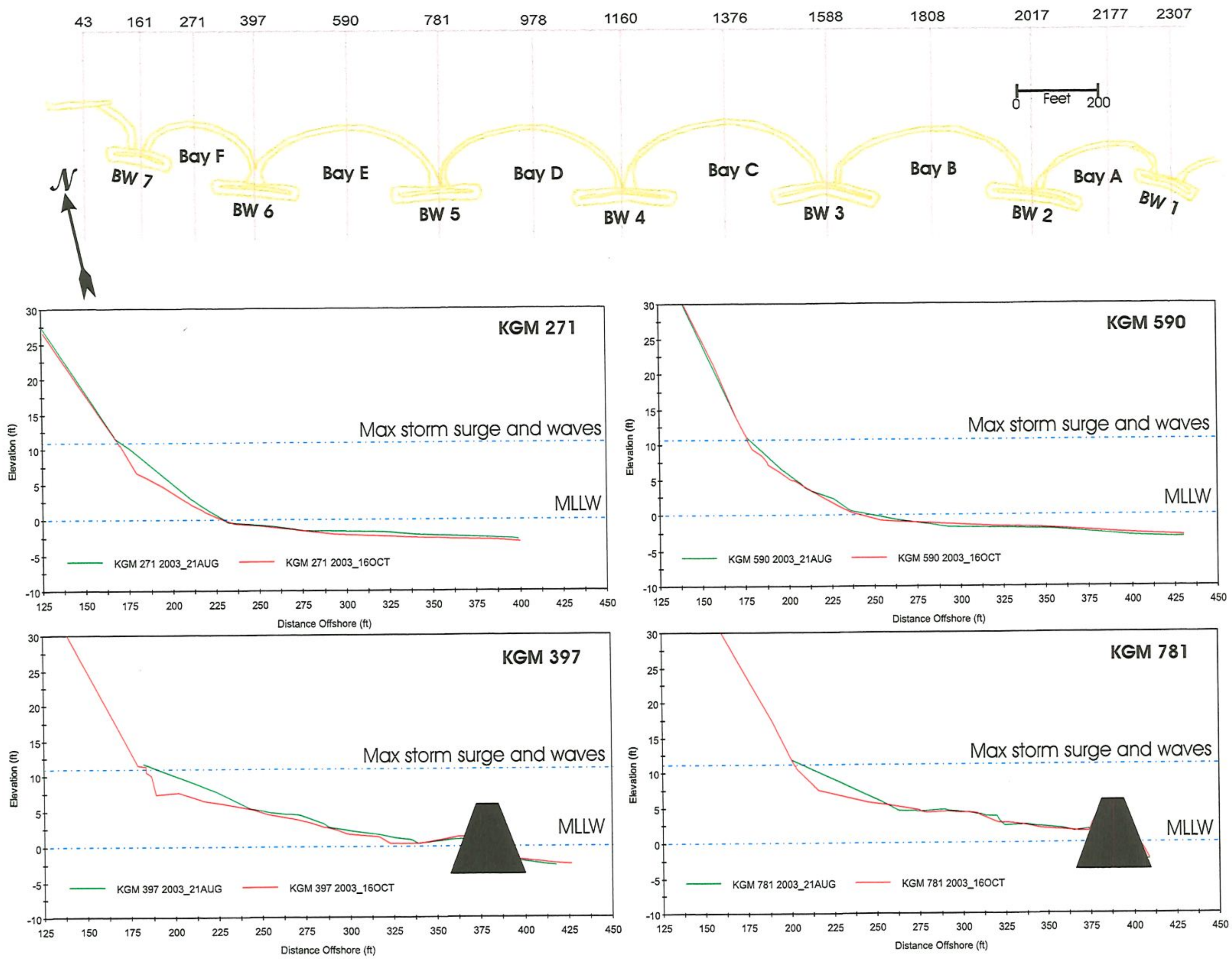


Figure 20. Kingsmill baseline and selected pre and post storm cross-sections.

Figure 21. Kingsmill ground photos before and after Hurricane Isabel.

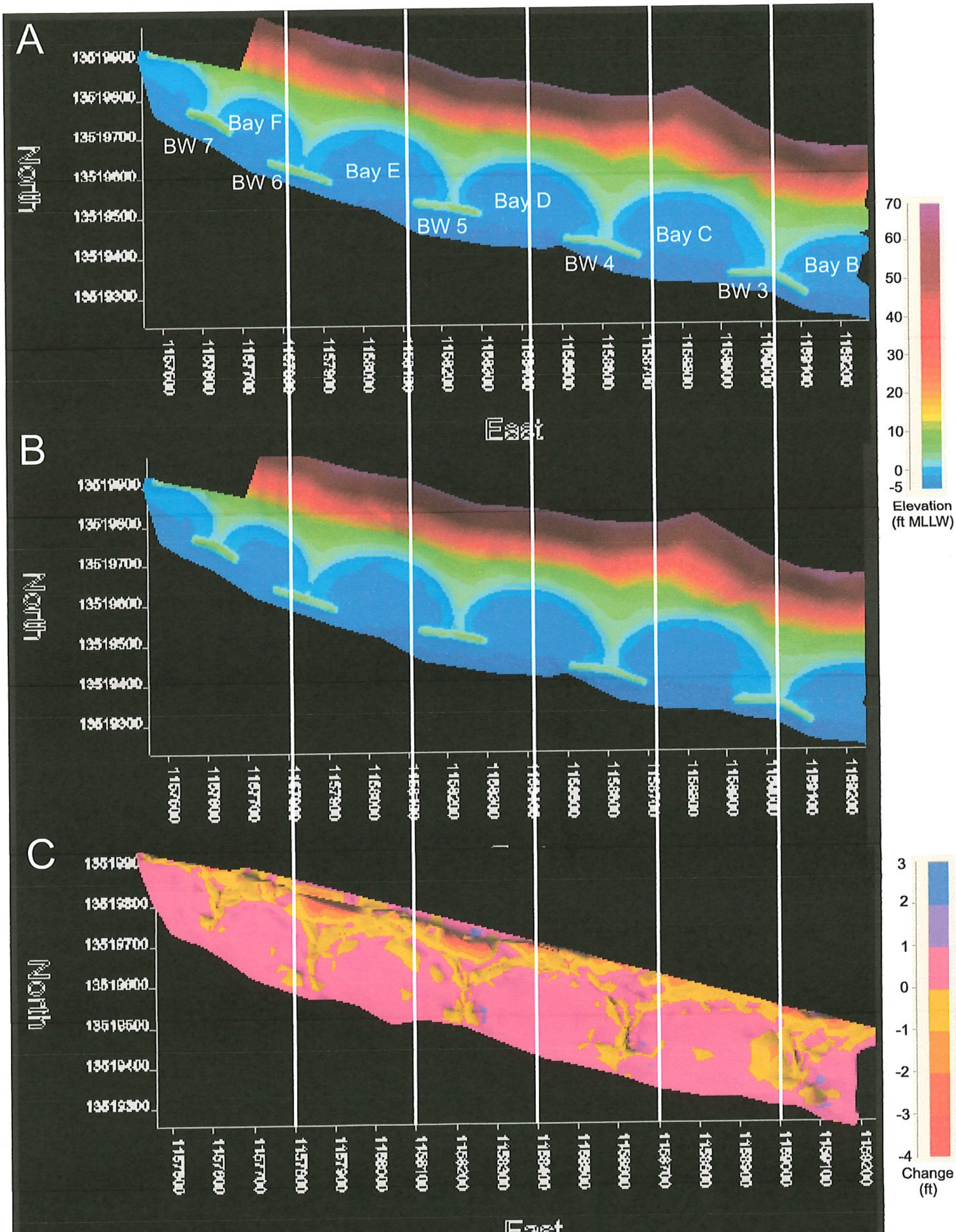


Figure 22. Kingsmill color contour maps for the A) pre- and B) post-storm conditions and C) isopach map showing elevation changes between surveys.

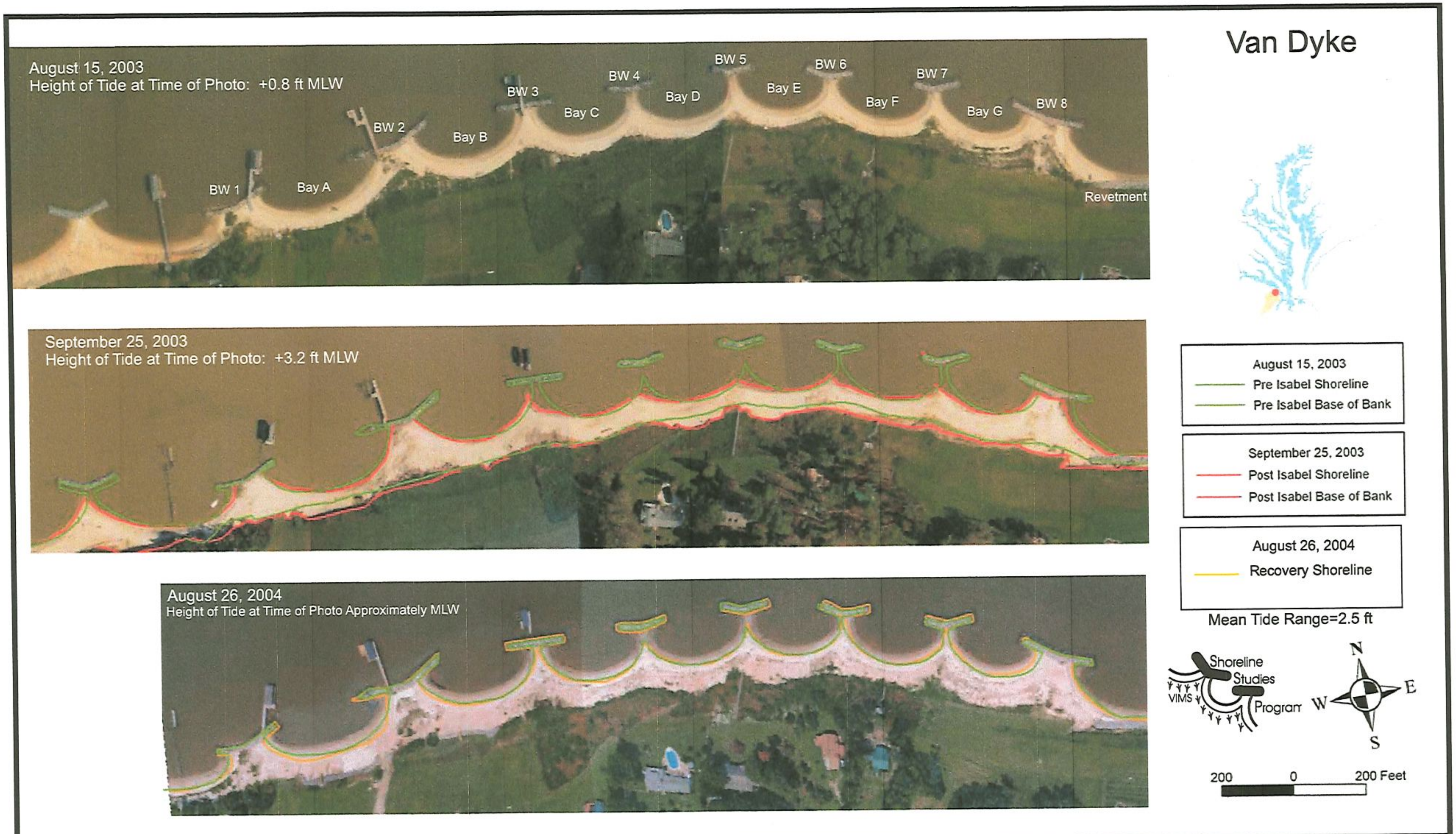


Figure 23. Van Dyke low-level pre- and post-Hurricane Isabel and recovery ortho-rectified aerial photos.

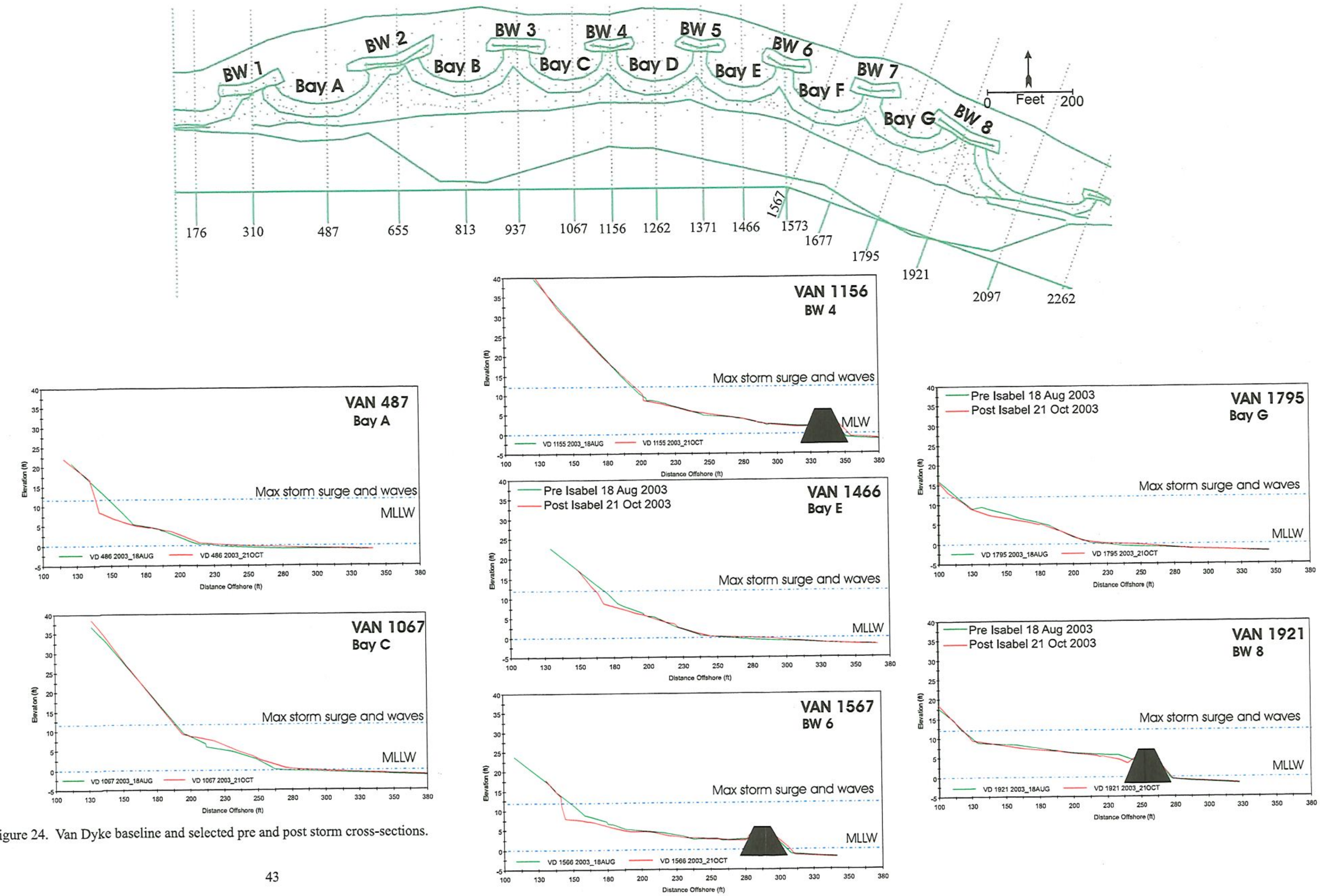


Figure 24. Van Dyke baseline and selected pre and post storm cross-sections.

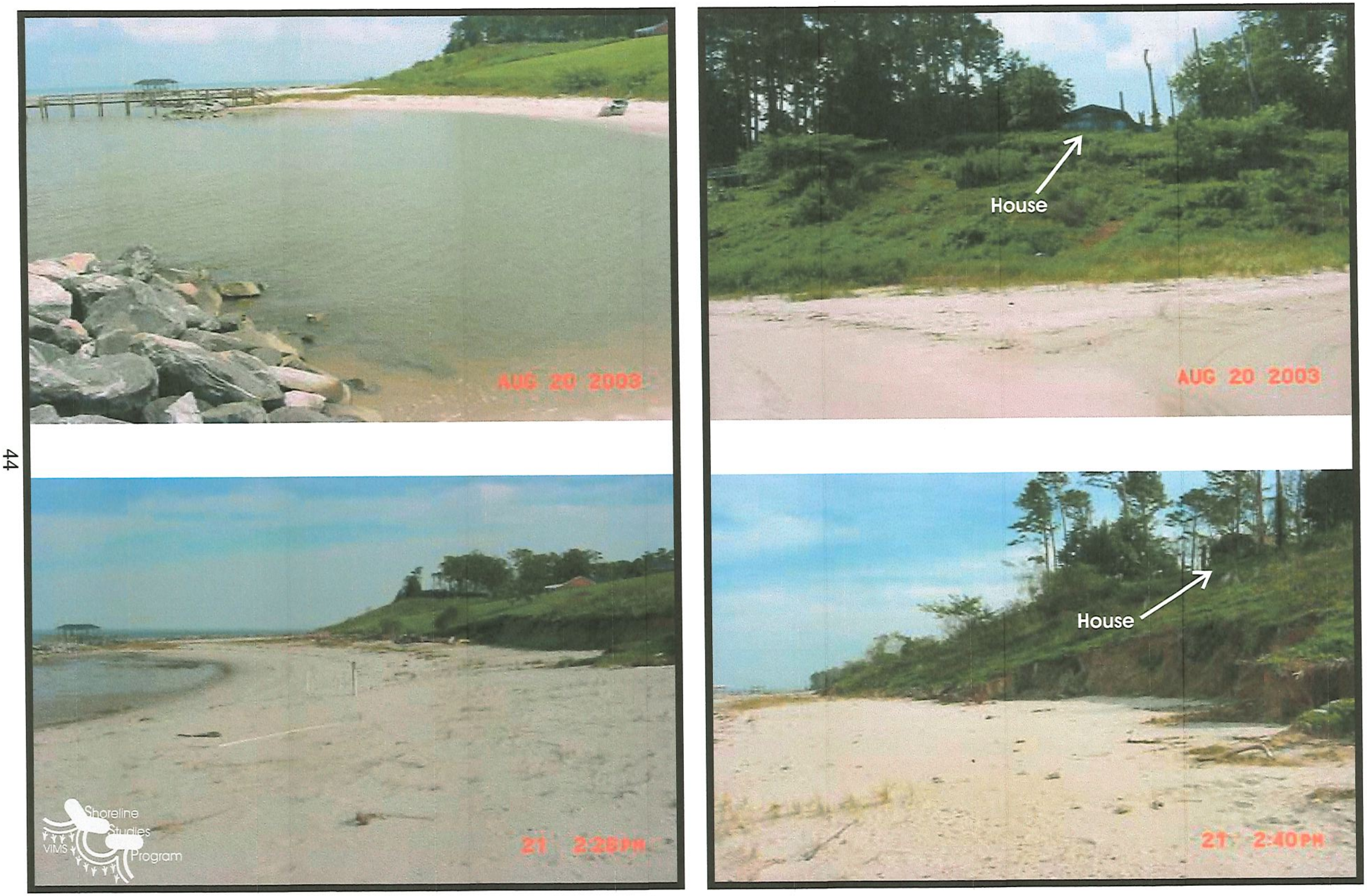


Figure 25. Van Dyke ground photos before and after Hurricane Isabel.

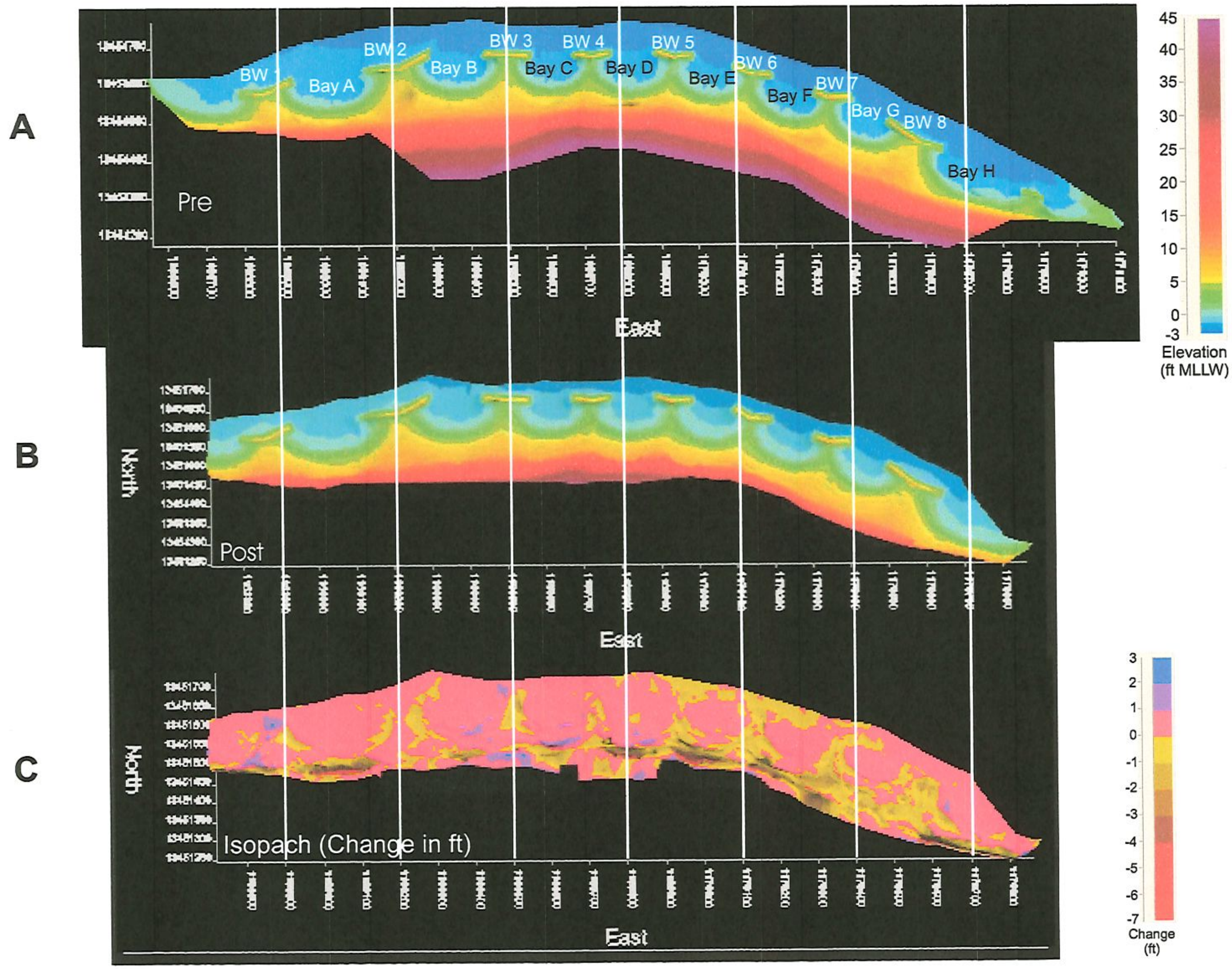


Figure 26. Van Dyke A) pre- and B) post-storm color contour maps, and C) isopach map showing elevation changes between surveys.

Figure 27. Yorktown low-level pre- and post-Hurricane Isabel and recovery ortho-rectified aerial photos.

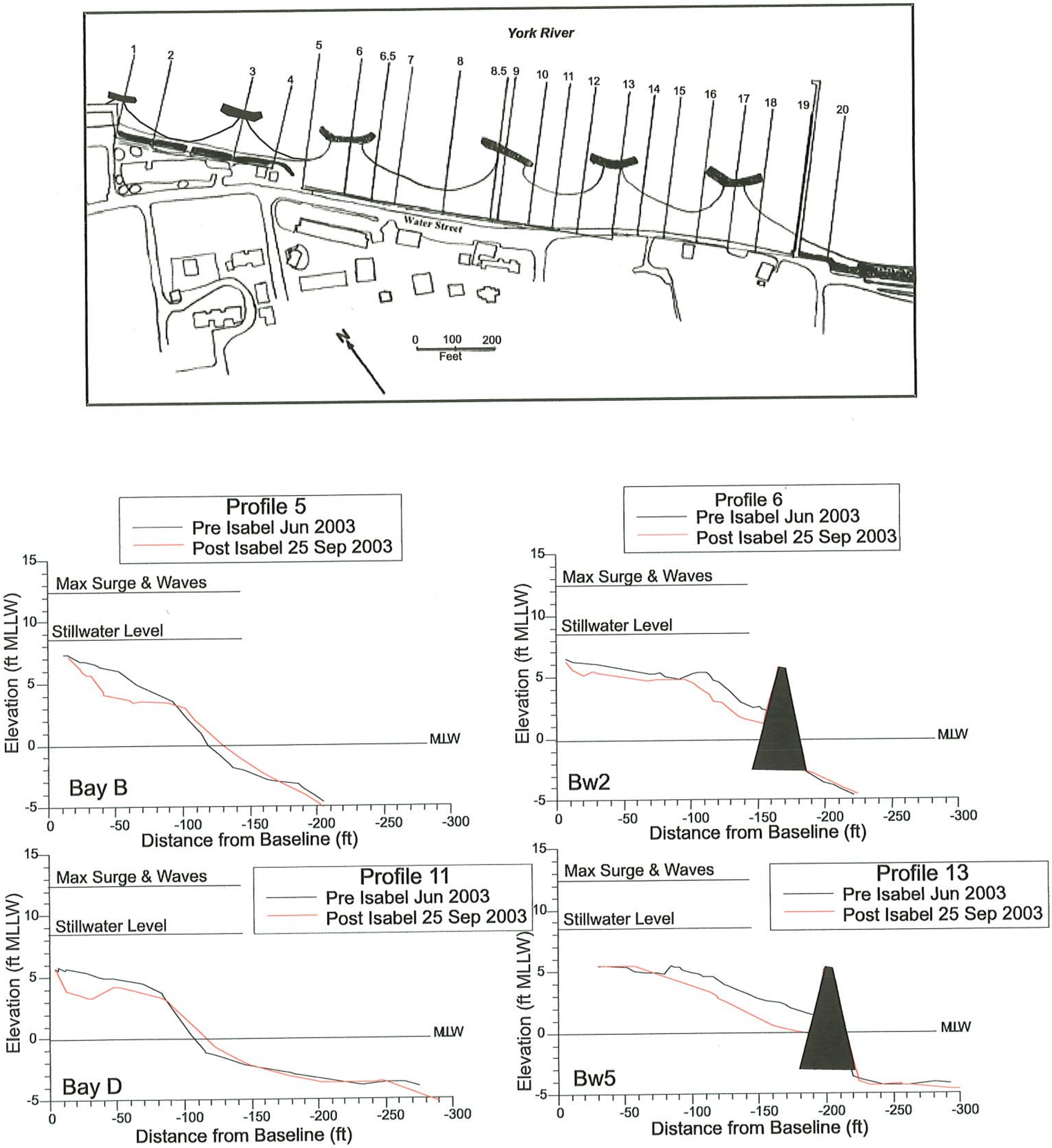


Figure 28. Yorktown baseline and selected pre and post storm cross-sections.

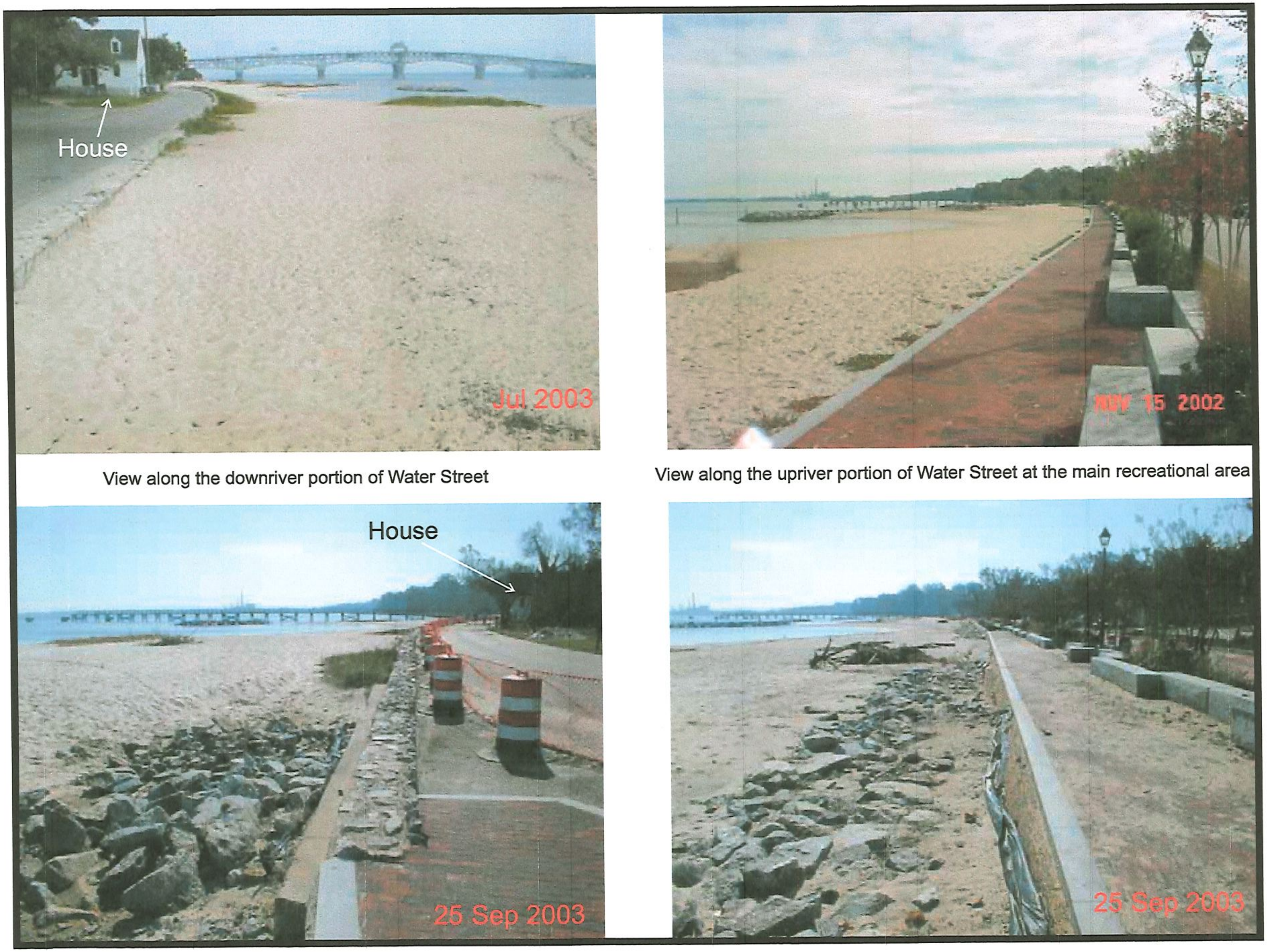


Figure 29. Yorktown ground photos before and after Hurricane Isabel.

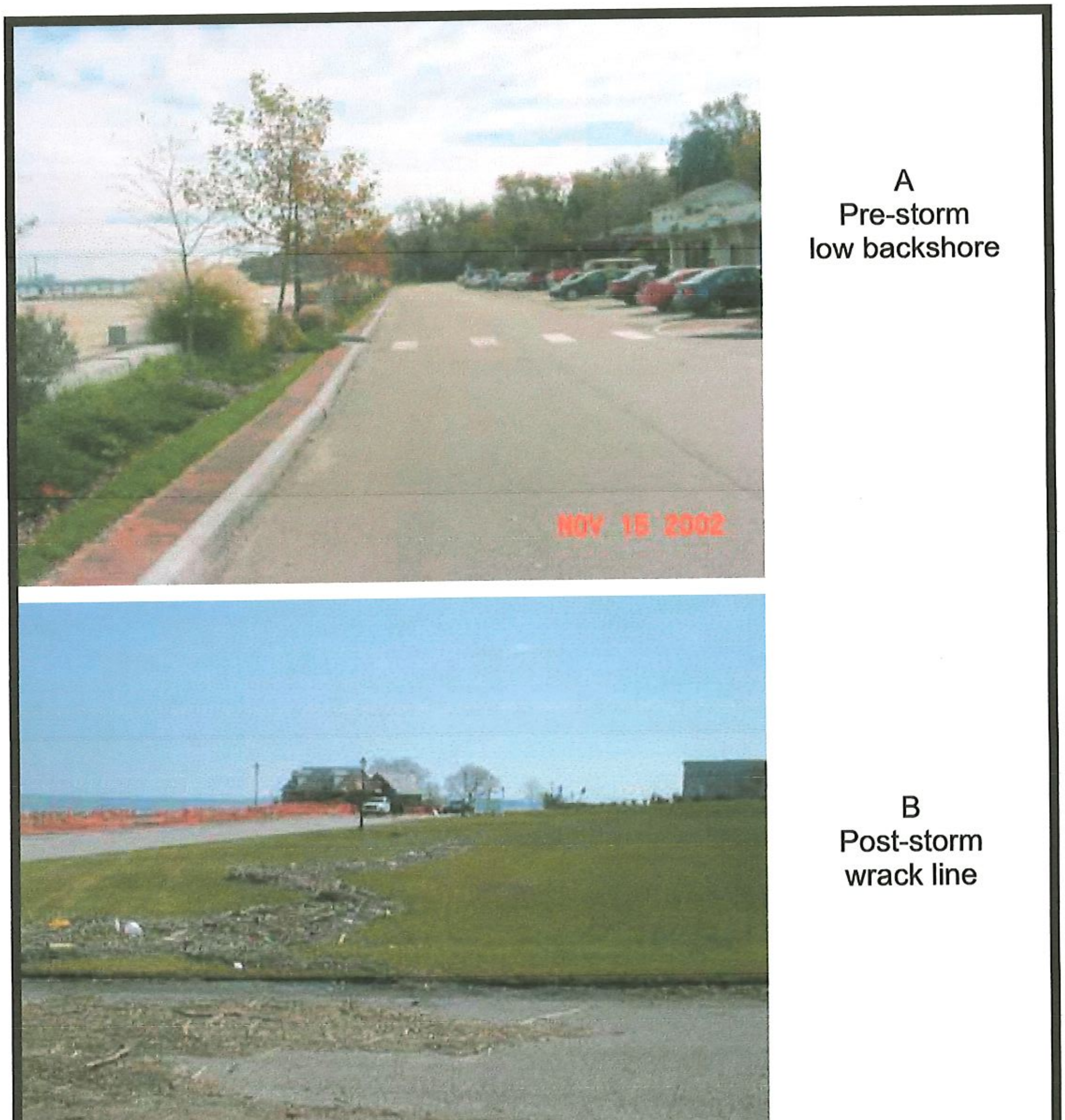


Figure 30. Yorktown A) backshore and B) post storm wrack line and C) adjacent shore impacts.

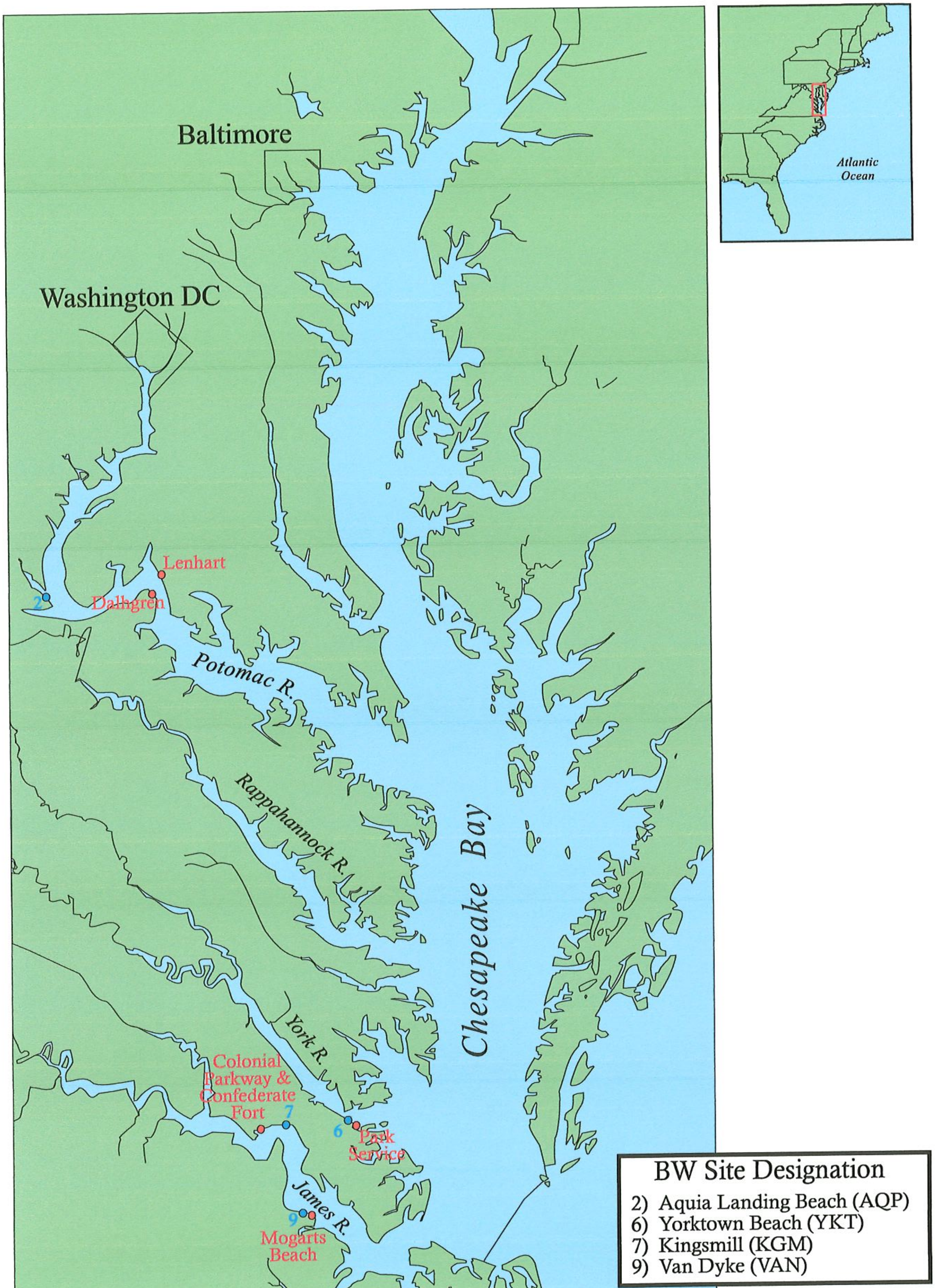


Figure 31. Location of breakwater sites used in this report (blue) and other impacted sites (red).

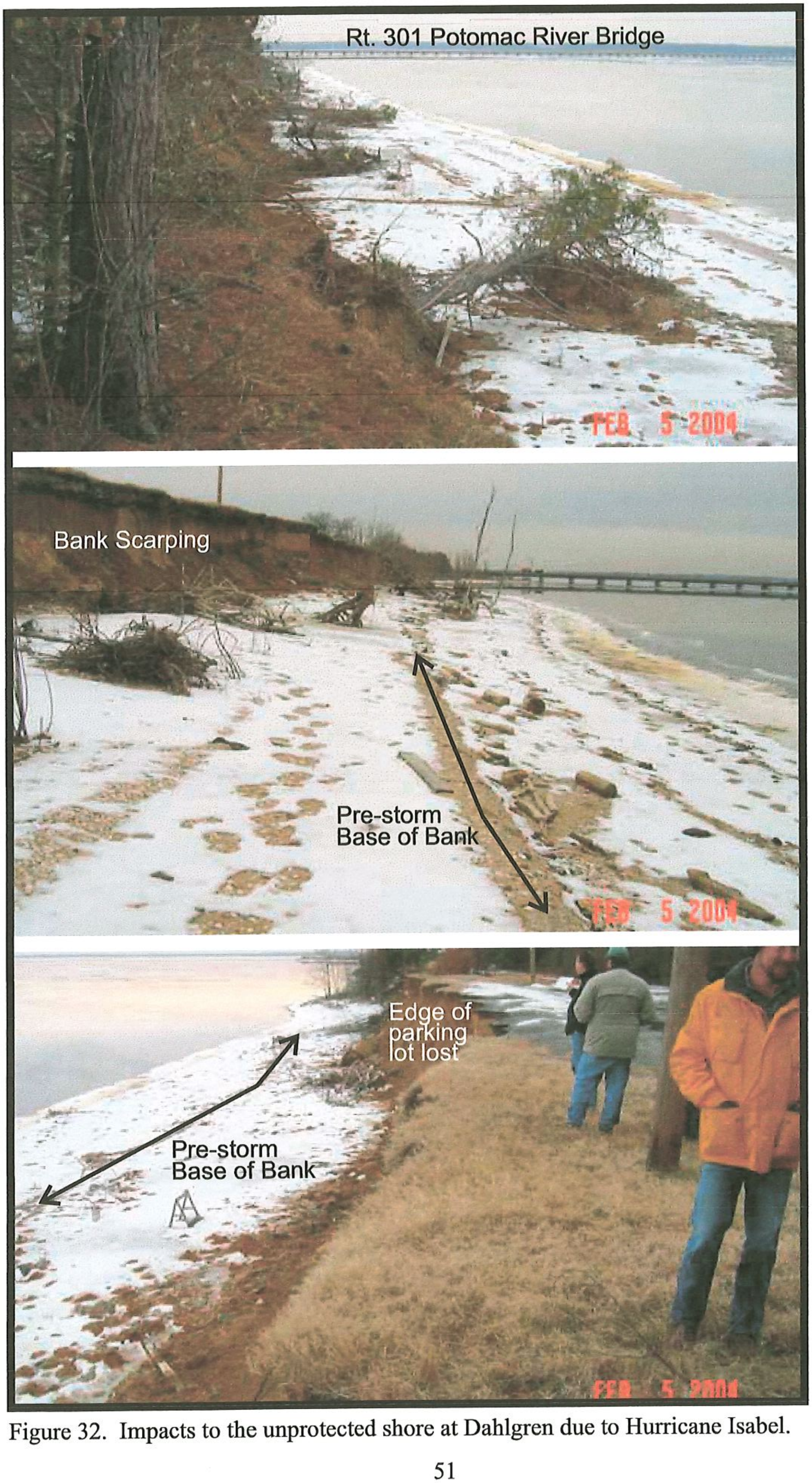


Figure 32. Impacts to the unprotected shore at Dahlgren due to Hurricane Isabel.

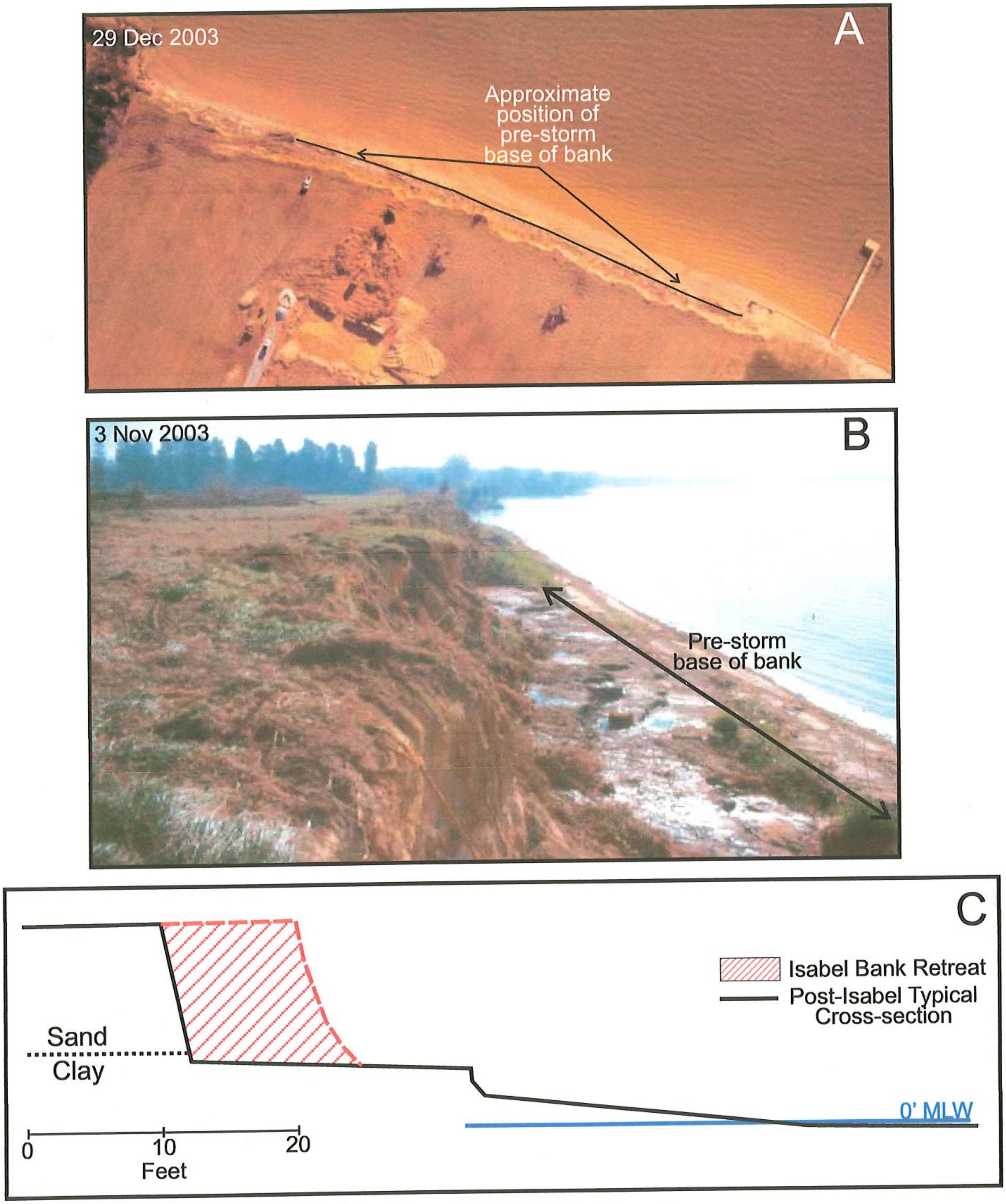


Figure 33. Impacts to the unprotected shore at Lenhart due to Hurricane Isabel shown A) on a non-rectified aerial photo, B) ground photo, and C) on a typical post-storm cross-section.

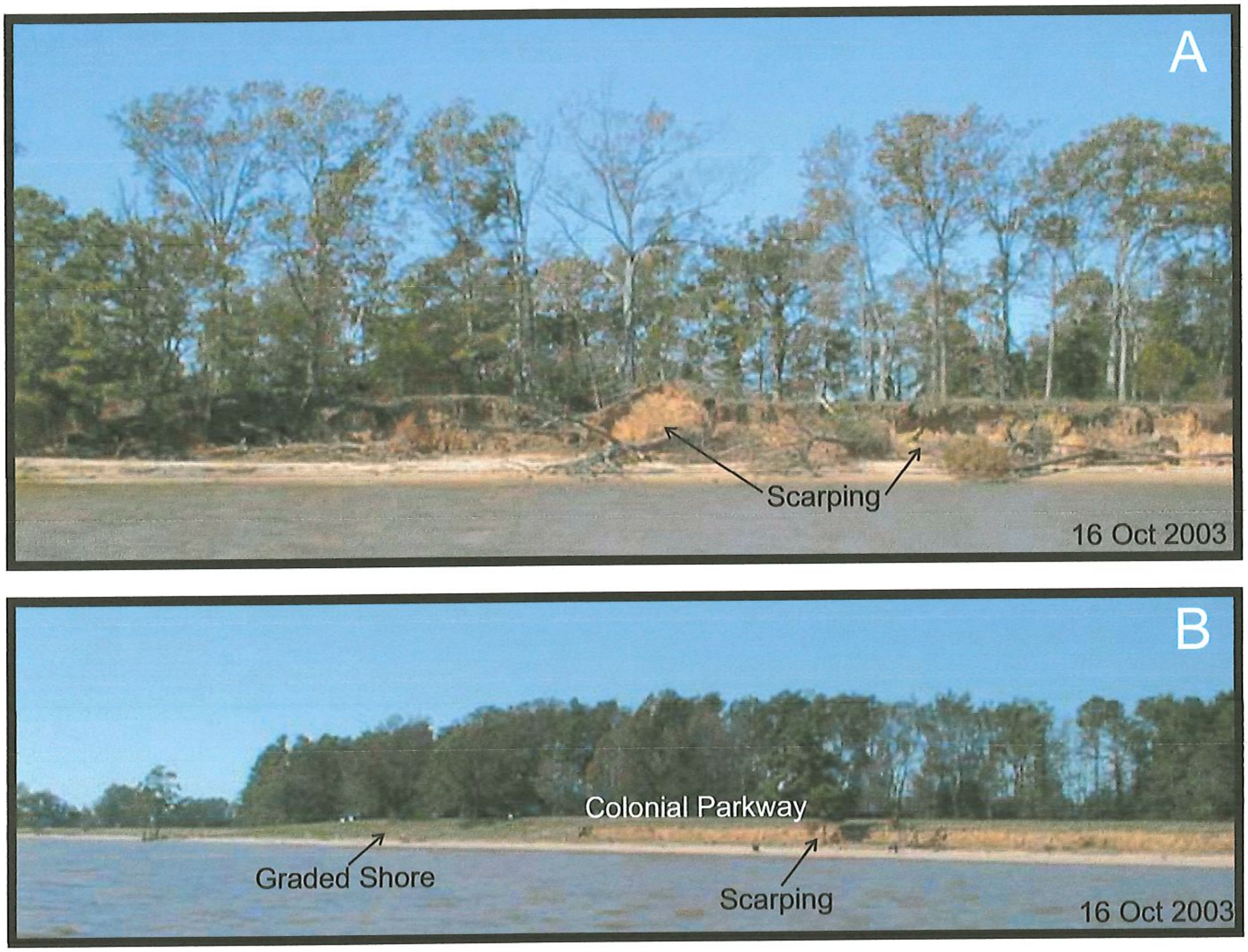


Figure 34. Impact to unprotected shores on the James River due to Hurricane Isabel A) at the Confederate Fort and B) along the Colonial Parkway.

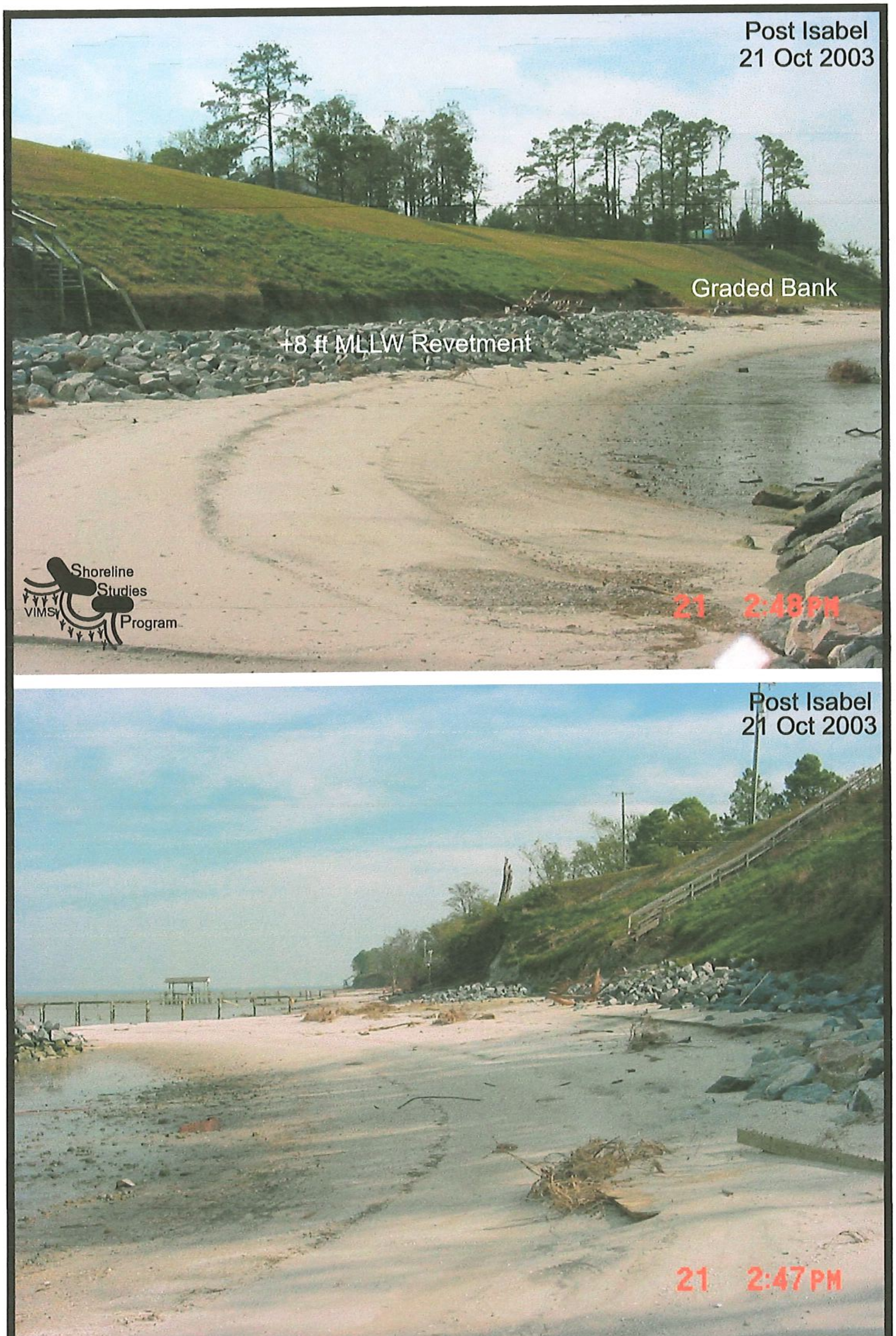


Figure 35. Impacts at the downriver end of Van Dyke where the shore is protected by a revetment.

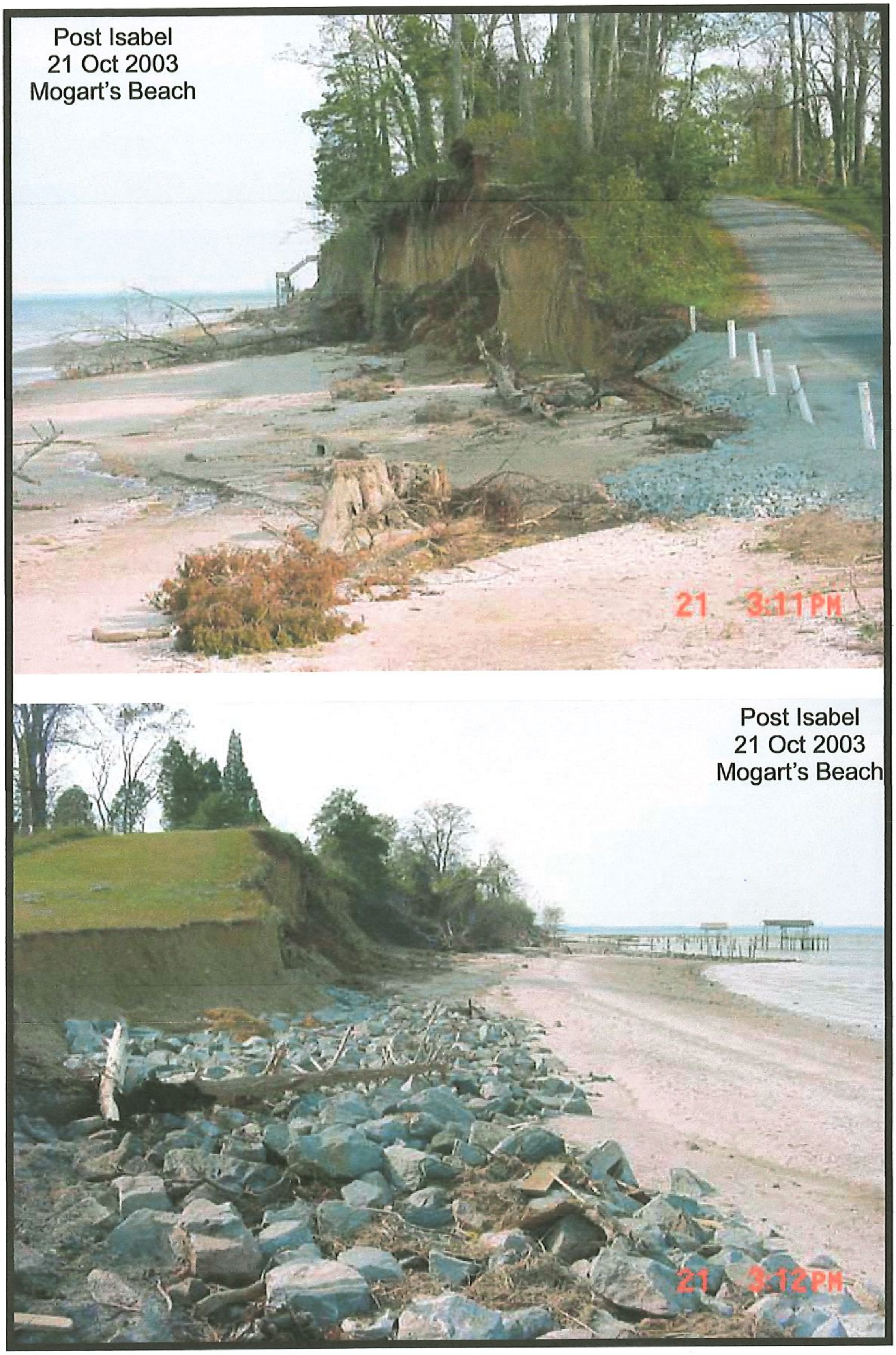


Figure 36. Impacts to the shore downriver from Van Dyke at Mogarts Beach.

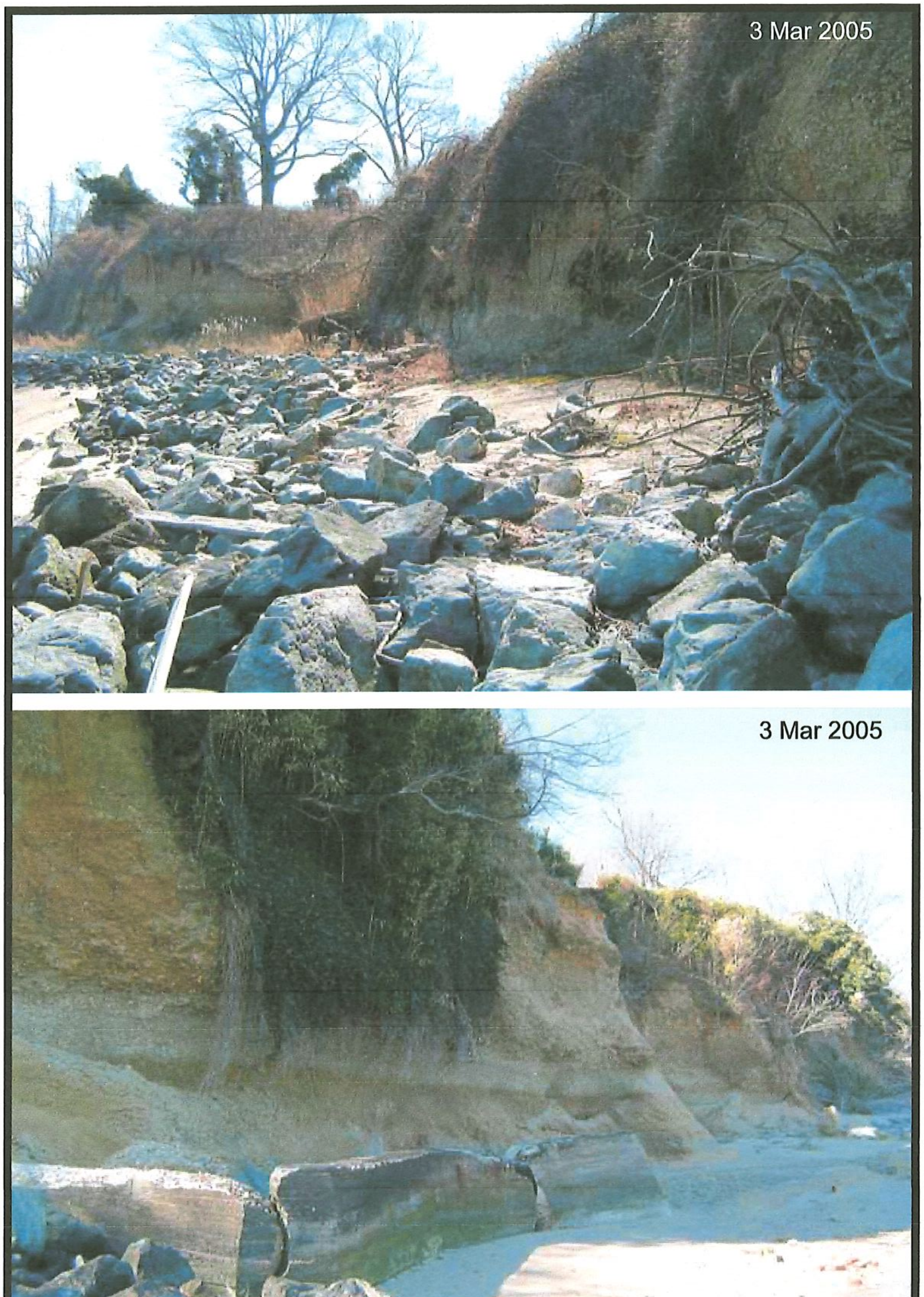


Figure 37. Impacts to the shoreline downriver from Yorktown Beach at the National Park Service's Moorehouse.

Westland Beach – Windmill Point Shoreline Stabilization Project Schedule, Deliverables, and Partners

Schedule

Schedule

The selected contractor will work cooperatively with the Lancaster County to complete the work in a timely fashion in accordance with the following generally expected schedule in order to meet infrastructure development commitments for the facilities:

- **October 20, 2023** Receipt and Public Opening of Bids
- **October 26, 2023** Owner review and award of contract
- **November, 2023** Contract preparation/execution and pre-construction meeting
- **December, 2023** Anticipated VMRC and Corps of Engineers approval of pending Joint Permit Application for Dredging and Fishing Pier
- **December 1, 2023** Notice to Proceed with Contractor mobilization to begin work (336 day construction period)
- **Dec 1, 2023--May 15, 2024** 167 day construction period prior to "Tiger Beetle pause of any beach work" per Corps permit
- **May 15-Oct 1, 2024** 138 day "Tiger Beetle pause of any beach work" limits dredge material placement, but pier construction may proceed
- **October 1-15, 2024** 15 day construction period to Substantial Completion
- **October 16-31, 2024** 16 day construction period to Full Completion

The Westland Beach – Windmill Point Shoreline Stabilization Project will produce the following deliverables:

- Stabilization of the shoreline using nature-based solutions;
- Restoration of 110' of beach;
- Expanded public beach and water access;
- Protection of the Windmill Point Marina, The Landing Townhomes and The County's public beach access properties from continued erosion and high tide flood events;
- Protection of critical infrastructure (the marina and adjacent boat ramp);
- Habitat creation both in the water and on land through the installation of breakwaters and plantings;

- Increased recreational opportunities for the community; and
- Increased tourism opportunities for the community.

Partners

Individualized past attempts to stabilize the shoreline with hardening measures have failed. Leveraging the cooperation and support of the marina, townhomes, and the local government will provide an innovative comprehensive response to the continued erosion of the coastline. The Westland Beach-Windmill Point Shoreline Stabilization Project will combine armor breakwaters and spurs with nature-based solutions such as beaches and dunes as effective storm buffers, helping to protect critical infrastructure from risk of erosion, damage, and loss. Structures will also enhance habitat functions and values, supporting local ecosystems through the creation and improvement of near shore and coastal habitat. The County has also partnered with local fishermen to address there concerns regarding the project. The County has altered the design, implementation and purchased an oyster lease in a good faith effort to satisfy the concerns of the fishermen and community members. Lancaster County hopes to partner with the Friends of the Rappahannock for the installation of the vegetative plantings associated with this project. We also plan to partner with either the Virginia Commonwealth University Oyster Shell Recycling program or the Friends of the Rappahannock on the establishment and maintenance of the planned legacy oyster bed. 24 public comments were made in favor of this project. The lone public comment in opposition has generated a response from the County which will benefit all stakeholders and as a result, the opposition has since been rescinded. The County's Workgroup for Access to Public Waters will continue to support this project in any way they can to ensure that this project meets the communities need for public access.