COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION

Stephen C. Brich, P.E.
Commissioner

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November 28, 2022

The Honorable Sheppard Miller III
Secretary of Transportation
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The Honorable Travis A. Voyles
Secretary of Natural and Historic Resources
(Acting)
P.O. Box 1475
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The Honorable Janet D. Howell
Chair, Senate Finance and Appropriations
Committee
Virginia General Assembly
P.O. Box 2608
Reston, Virginia 20195

The Honorable Barry D. Knight
Chair, House Appropriations Committee
Virginia General Assembly
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Virginia Beach, Virginia 23457

The Honorable David W. Marsden
Chair, Senate Transportation Committee
Virginia General Assembly
P.O. Box 10889
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The Honorable Terry L. Austin
Chair, House Transportation Committee
Virginia General Assembly
P.O. Box 400
Buchanan, Virginia 24066

The Honorable Lynwood W. Lewis, Jr.
Chair, Joint Subcommittee on Recurrent
Flooding
Virginia General Assembly
P.O. Box 760
Accomac, Virginia 23301

Secretaries and Members of the Virginia General Assembly:

On behalf of the Virginia Department of Transportation (VDOT), I am submitting this update required by Item 451 (D) of Chapter 2 of the 2022 Special Session I Acts of Assembly (the "Appropriation Act"). In 2019, VDOT's Virginia Transportation Research Council (VTRC) entered into an agreement with the Virginia Institute of Marine Science (VIMS) for a five-year study to develop a strategy for understanding and addressing sea level rise, land subsidence, and recurrent flooding impacts on road infrastructure (the "VIMS Study"). The Appropriation Act directed VDOT, with the assistance of the Virginia Institute for Marine Science, to provide an annual update on the status of the "Coastal Virginia Transportation Infrastructure Inundation

Study" including: (i) progress on identification of at-risk rural, suburban and urban infrastructure; (ii) planning and options to mitigate or eliminate the identified risks; and (iii) a report on remaining work and an estimated time frame for completion.

In accordance with the agreement and pursuant to the Appropriation Act, the attached report has been developed to summarize progress on the VIMS Study and any significant findings for December 2021 – December 2022 ("Study Year Three"). In addition, the report includes discussion on VDOT's Resilience Plan, which has been under development throughout the 2022 calendar year and was recently finalized by the Department in November. The Resilience Plan is a roadmap to incorporate a framework of resiliency principles agency-wide in transportation planning, project development, delivery, operations, maintenance, and asset management. Given this recent effort, the attached interim report also addresses how VDOT intends to leverage the methodologies and findings of the VIMS Study to help inform its broader resilience planning efforts statewide and implement its Resilience Plan.

Please find attached the interim report containing the update requested by Chapter 2, Item 451 (D). If you have any questions regarding this update, please do not hesitate to reach out to Mr. Christopher Swanson, Environmental Division Director, by emailing him at chris.swanson@VDOT.Virginia.gov or by calling 804-786-6839.

Sincerely,

Stephen C. Brich, P.E.
Commissioner of Highways

ANNUAL UPDATE
Coastal Virginia Transportation Infrastructure Inundation Study

December 2021 - December 2022

VDOT
Virginia Department of Transportation

ANNUAL UPDATE
Coastal Virginia Transportation Infrastructure Inundation Study
December 2021 - December 2022
Virginia Department of Transportation

EXECUTIVE SUMMARY

This report has been developed in response to Item 451 (D) of Chapter 2 of the 2022 Special Session I Acts of Assembly (the "Appropriation Act"). The Appropriation Act directed the Virginia Department of Transportation (VDOT or the "Department"), with the assistance of the Virginia Institute for Marine Science (VIMS), to provide an annual update on the status of the "Coastal Virginia Transportation Infrastructure Inundation Study" including: an up-to-date identification of at-risk rural, suburban and urban infrastructure, and planning and options to mitigate or eliminate the identified risks; and a report on what work remains to be completed and estimated time frame for the completion of its work.

In 2019, VDOT's Virginia Transportation Research Council (VTRC) entered into an agreement with VIMS requesting that VIMS conduct a five-year study to develop a strategy for understanding and addressing sea level rise, land subsidence, and recurrent flooding impacts on existing and planned road infrastructure, as well as how that infrastructure will impact natural ecosystems in Virginia's coastal zone as the climate changes (the "VIMS Study"). This report summarizes the overall cumulative progress of the VIMS Study, provides an update on significant findings made since the submission of last year's report in December 2021 ("Study Year Three"), and identifies how data from the VIMS Study is being incorporated into VDOT's statewide resilience planning efforts to manage identified risks to transportation infrastructure.

Alongside the VIMS Study, VDOT has independently developed a statewide Resilience Plan—a roadmap to incorporate a framework of resiliency principles in the Department's transportation planning, project development, delivery, operations, maintenance, and asset management efforts.

One of the main objectives included in VDOT's Resilience Plan is the identification of available resilience measures to mitigate and/or eliminate identified risks to transportation infrastructure throughout planning, design, operations, and maintenance programs. The available measures will include (i) adaptive design criteria based upon the best available, forward looking data; (ii) physical enhancement measures; (iii) nature-based resilience measures; (iv) operations, maintenance, and emergency management enhancement measures; and (v) other administrative/policy measures. Once VIMS has completed its work on the flood hazard zone assessment, network flooding analyses, and the infrastructure interactive viewer tool, the appropriate options to mitigate or eliminate identified risks may be selected and implemented by decision-makers in conjunction with VDOT's Resilience Plan.

The anticipated completion date of the VIMS Study is September 2024. The remaining work includes expanding network flooding analyses for the remainder of Virginia's coastal area beyond the south Hampton Roads region and Planning District 8.

ANNUAL UPDATE
Coastal Virginia Transportation Infrastructure Inundation Study
December 2021 - December 2022
Virginia Department of Transportation

INTRODUCTION

This report has been developed in response to Item 451 (D) of Chapter 2 of the 2022 Special Session I Acts of Assembly (the "Appropriation Act"). The Appropriation Act directed the Virginia Department of Transportation (VDOT or the "Department"), with the assistance of the Virginia Institute for Marine Science (VIMS), to provide an annual update on the status of the "Coastal Virginia Transportation Infrastructure Inundation Study" including: an up-to-date identification of at-risk rural, suburban and urban infrastructure, and planning and options to mitigate or eliminate the identified risks; and a report on what work remains to be completed and estimated time frame for the completion of its work.[1]

In 2019, VDOT's Virginia Transportation Research Council (VTRC) entered into an agreement with VIMS requesting that VIMS conduct a five-year study to develop a strategy for understanding and addressing sea level rise, land subsidence, and recurrent flooding impacts on existing and planned road infrastructure, as well as how that infrastructure will impact natural ecosystems in Virginia's coastal zone as the climate changes (the "VIMS Study"). This report summarizes the overall cumulative progress of the VIMS Study, provides an update on significant findings made since the submission of last year's report in December 2021 ("Study Year Three"), and identifies how data from the VIMS Study is being incorporated into VDOT's statewide resilience planning efforts to manage identified risks to transportation infrastructure.

I. Identification of At-Risk Rural, Suburban and Urban Infrastructure

VIMS Study

A primary component of the VIMS Study is the ultimate development of a tool to identify management strategies for road segments subject to current and future flooding by tidal waters through 2080 in Virginia's coastal zone. Virginia's coastal zone is referred to as "Tidewater Virginia" by Va. Code § 62.1-44.15:68 and includes 44 localities: the counties of Accomack, Arlington, Caroline, Charles City, Chesterfield, Essex, Fairfax, Gloucester, Hanover, Henrico, Isle of Wight, James City, King and Queen, King George, King William, Lancaster, Mathews, Middlesex, New Kent, Northampton, Northumberland, Prince George, Prince William, Richmond, Spotsylvania, Stafford, Surry, Westmoreland, and York, and the cities of Alexandria, Chesapeake, Colonial Heights, Fairfax, Falls Church, Fredericksburg, Hampton, Hopewell, Newport News, Norfolk, Petersburg, Poquoson, Portsmouth, Richmond, Suffolk, Virginia Beach, and Williamsburg. In December 2020 – December 2021 ("Study Year Two"), the geographic scope

[1] This annual update was informed, in part, by the *Virginia Transportation Planning for Sea Level Rise Interim Report 2022* prepared by VIMS' Center for Coastal Resources Management for VTRC.

of the VIMS Study expanded to include the remaining localities of Virginia Planning District 8—Loudoun County and the Cities of Manassas and Manassas Park.[2] The scope of infrastructure evaluated by the VIMS Study in these areas has been inclusive of identifying all public at risk transportation infrastructure, whether occurring in a rural, suburban, or urban area.

VIMS had previously completed an assessment to identify public roads throughout the study area located within flood hazard zones designated by the Federal Emergency Management Agency (FEMA) during Study Year Two. The flood hazard zones designated by FEMA quantify the risk that a location will be flooded over a given year. For example, the most commonly known 100-year and 500-year flood plains represent flood hazard zones experiencing an annual risk of flooding at greater than or equal to a 1% annual chance and 0.2% annual chance, respectively. The analysis from the flood hazard zone assessment provides valuable information for identification of at-risk transportation infrastructure in coastal Virginia and Planning District 8 and helps to further classify road segments and identification of possible management strategies alongside the applicable flooding risk. The Department is currently evaluating the methodology of the flood hazard zone assessment for the feasibility of extending the model to all Commonwealth localities. This will allow for the continued identification of at-risk infrastructure statewide as well as inform the current and future planning of flood-resistant development and infrastructure.

In the most recent Study Year Three, VIMS continued development of a network flooding analysis that measures the inaccessibility of road networks based on flooding intervals of 6" increments, up to 10 feet of inundation. The analysis classifies the degree of road network accessibility to selected priority destinations ("Source Points") at a minimum flood level of 6" water depth on the roadway. In its initial phase, VIMS conducted the network flooding analysis for approximately 11,000 miles of roadway in the south Hampton Roads region, with 19 VDOT facilities selected as Source Points. Primarily comprised of VDOT's maintenance facilities, this set of Source Points was chosen to determine the accessibility of those locations to surrounding impacted roadways needing repair during flood events at various flood level depths. In future iterations, the network flooding analysis methodology can be expanded to other geographic regions in the Commonwealth, as well as applied to priority destinations such as hospitals, fire stations, and other critical community services and facilities as Source Points.

As part of the VIMS Study, VIMS is also in the process of developing an infrastructure interactive viewer to display asset information on selected road segments which will serve as part of a planning portal for VDOT. In Study Year Three, VIMS created the framework for the viewer, as shown in Figure 1, and initiated the process to integrate results from the flood hazard zone assessment and the network flooding analyses with pertinent VDOT infrastructure information. Once further developed, the viewer will be a nimble visualization tool displaying asset

[2] It is noted that this geographical expansion of the VIMS Study was prompted by Chapter 978 of the 2020 Acts of Assembly (HB 1217) which directed VDOT, in collaboration with the Commonwealth Center for Recurrent Flooding Resiliency, to identify public transportation infrastructure under the jurisdiction of VDOT in Planning District 8 at risk of deterioration due to recurrent flooding and to (i) identify the issues related to recurrent flooding and the scope of such issues and (ii) make policy and budget recommendations to alleviate such issues. *See* https://rga.lis.virginia.gov/Published/2022/RD125/PDF

information, by road segment, including road category, pavement type, road ownership (e.g., city highway agency), pavement condition assessment, annual average daily traffic, future projects from the Six-Year Improvement Plan (SYIP), and use as an evacuation route.

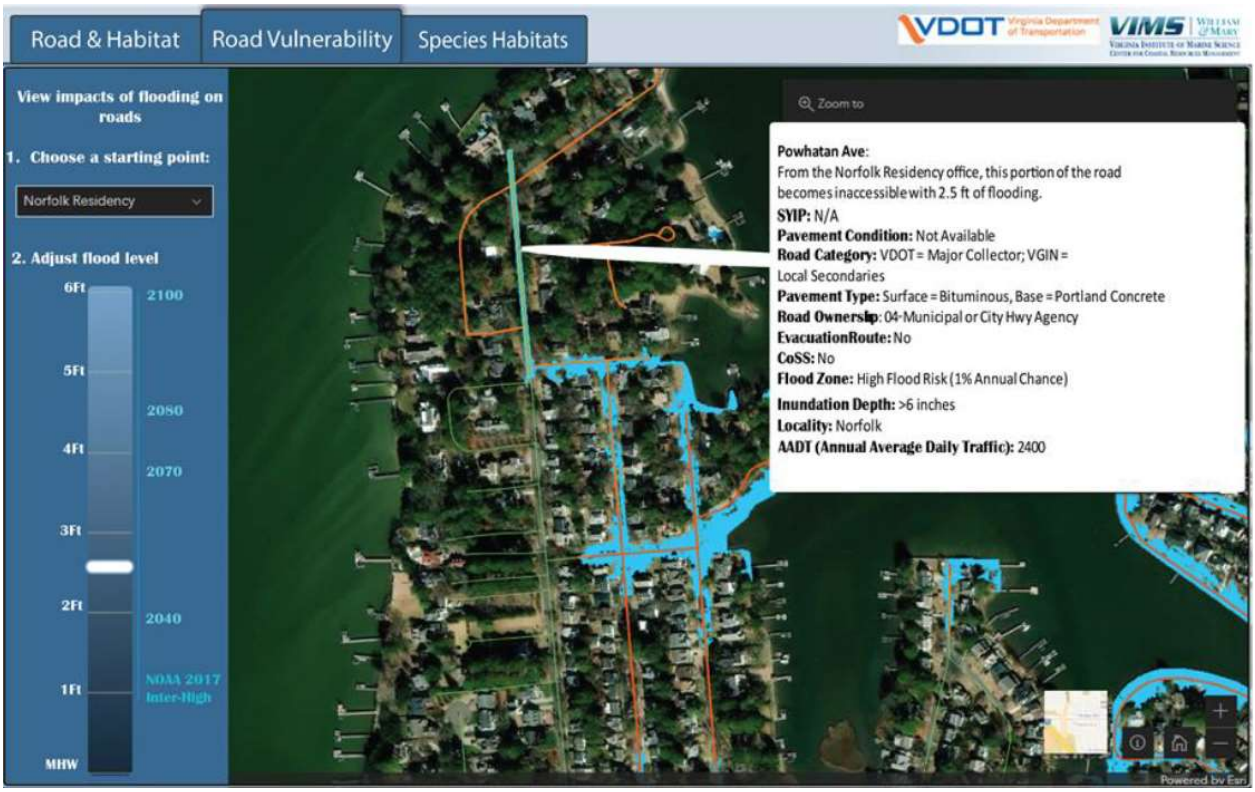

Figure 1. Infrastructure Interactive Viewer

In addition to the impacts of a changing climate on existing and planned road infrastructure, the VIMS Study is tasked with examining the impacts of road infrastructure on the natural ecosystems in Virginia's coastal zone.[3] The goals of the task are to evaluate the extent of the recurrent and future flood impacts on rare, threatened, and endangered (RTE) species and the essential habitats they occupy. VIMS has approached this task by undertaking several independent analyses focused on contributing critical data and improving capacity to inform appropriate management strategies that mitigate future land use conflicts. In Study Year Three, VIMS' progress for this task included: (i) completion of species distribution models of current populations for all targeted RTE and migratory bird species with outputs classified into predicted and observed categories; (ii) finalization of models of anadromous fish migration in relation to water temperature; (iii) creation of a real-time, interactive water temperature viewer to allow VDOT employees to understand the potential status of individual anadromous fish species runs which may facilitate assessments for time-of-year restrictions; (iv) completion of climate models for water temperatures in 2050; (v) mapping of future potential marsh habitat in 3-inch intervals up to

[3] While this task relates to mitigating risks from transportation infrastructure (rather than risks to transportation infrastructure), it is included here to provide insight on the VIMS Study and the Department's broader resilience planning efforts.

4.5 feet of sea level rise; (vi) completion of detailed species information reports for 14 species, including information on life history, demographics, current threats, and the results of previous and ongoing mitigation efforts in Virginia and elsewhere; and (vii) the development of an environmental-specific interactive viewer.

VDOT's Resilience Plan

Alongside the VIMS Study, VDOT has independently developed a statewide Resilience Plan—a roadmap to incorporate a framework of resiliency principles in the Department's transportation planning, project development, delivery, operations, maintenance, and asset management efforts. One of the objectives necessarily included in the Resilience Plan, and closely related to the VIMS Study, is the identification of at-risk infrastructure through the evaluation of vulnerability across current and planned transportation infrastructure. The risk-based methodology employed by the Resilience Plan evaluates vulnerability as the degree of risk to which infrastructure is susceptible to deterioration. Vulnerability is subjective to the type of infrastructure being assessed and may be evaluated as a function of the asset characteristics including exposure and sensitivity to hazards, criticality, and/or adaptive capacity. Through the Resilience Plan, and with input from the VIMS Study, VDOT expects to further develop this risk-based methodology to evaluate and inventory the vulnerability of transportation assets which, in turn, would then provide the basis for a systematic, documented approach for the application of resilience strategies to the assets. Ultimately, VDOT's risk-based methodology might then be incorporated into broader resilience planning efforts such as a visualization and planning tool for determining at-risk transportation infrastructure statewide.

II. Planning and Options to Mitigate or Eliminate the Identified Risks

One of the main objectives included in VDOT's Resilience Plan is the identification of available resilience measures to mitigate and/or eliminate identified risks to transportation infrastructure throughout planning, design, operations, and maintenance programs. The available measures will include (i) adaptive design criteria based upon the best available, forward looking data; (ii) physical enhancement measures; (iii) nature-based resilience measures; (iv) operations, maintenance, and emergency management enhancement measures; and (v) other administrative/policy measures. The work towards this objective can be used to inform the development of the required planning and options to address identified at-risk transportation infrastructure throughout the Commonwealth. Once VIMS has completed its work on the flood hazard zone assessment, network flooding analyses, and the infrastructure interactive viewer tool, the appropriate options to mitigate or eliminate identified risks may be selected and implemented by decision-makers in conjunction with VDOT's Resilience Plan.

III. Remaining Work and Estimated Time Frame for Completion

The anticipated completion date of the VIMS Study is September 2024. The remaining work includes expanding network flooding analyses for the remainder of Virginia's coastal area beyond the south Hampton Roads region and Planning District 8. Newly developed data from the

network flooding analyses and other identified VDOT planning requirements will be incorporated into the infrastructure interactive viewer during the following year, which is anticipated to be available in September 2024, commensurate with completion of the VIMS Study. The Department expects that the Resilience Plan, which is informed and spring boarded by the data gathered in the VIMS Study, will continue to be updated as an ongoing resource and toolkit for the foreseeable future.