

COMMONWEALTH of VIRGINIA

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January 30, 2024

The Honorable Sheppard Miller III Secretary of Transportation P.O. Box 1475 Richmond, Virginia 23218

The Honorable Travis A. Voyles Secretary of Natural and Historic Resources P.O. Box 1475 Richmond, Virginia 23218

The Honorable George L. Barker Co-Chair, Senate Finance and Appropriations Committee Virginia General Assembly P.O. Box 10527 Alexandria, Virginia 22310

The Honorable Janet D. Howell Co-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 1852 Mill Landing Road Virginia Beach, Virginia 23457

The Honorable David W. Marsden Chair, Senate Transportation Committee Virginia General Assembly P.O. Box 10889 Burke, Virginia 22009

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 1 of the 2023 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 VIMS, to provide an annual update on the status of the

VirginiaDOT.org WE KEEP VIRGINIA MOVING The Honorable W. Sheppard Miller III The Honorable Travis A. Voyles The Honorable George L. Barker The Honorable Janet D. Howell The Honorable Barry D. Knight The Honorable David W. Marsden The Honorable Terry L. Austin The Honorable Lynwood W. Lewis, Jr. January 30, 2024 Page 2

"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 2022 – December 2023 ("Study Year Four"). The anticipated completion date of the VIMS Study is September 2024.

Please find attached the interim report containing the update requested by Chapter 1, 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,

Brich, P.E.

Commissioner of Highways



ANNUAL UPDATE Coastal Virginia Transportation Infrastructure Inundation Study

December 2022 - December 2023



ANNUAL UPDATE Coastal Virginia Transportation Infrastructure Inundation Study December 2022 - December 2023 Virginia Department of Transportation

EXECUTIVE SUMMARY

This report has been developed in response to Item 451 (D) of Chapter 1 of the 2023 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 2022 ("Study Year Four"), 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.

In the most recent Study Year Four, VIMS continued development of a network flooding analysis that measures the inaccessibility of road networks based on flooding intervals of 6-inch increments, up to 10 feet of inundation. In its initial phase, VIMS conducted the network flooding analysis for approximately 11,000 miles of roadway in the south Hampton Roads (Peninsula and Southside) region, with 19 VDOT facilities selected as priority destinations or "Source Points." VIMS included an additional 13 VDOT facilities as Source Points and 7,163 miles of roadway in the Peninsula and Eastern Shore regions to the network flooding analysis in Study Year Four. VIMS also continued to build the interactive viewer by integrating the results from the flood hazard zone assessment, the completed network flooding analyses, and pertinent VDOT infrastructure information. In addition to the impacts of a changing climate on existing and planned road infrastructure, VIMS continued their work on examining the impacts of road infrastructure on the natural ecosystems in Virginia's coastal zone. 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 which was published in December 2022, and serves as a roadmap to incorporate a framework of resiliency principles in the Department's transportation planning, project development, delivery, operations, maintenance, and asset management efforts.

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 (Peninsula and Southside) region, Eastern Shore, and Planning District 8. VIMS will also add a network flooding analysis using hospitals and emergency medical facilities as destination points. VIMS will continue further to incorporate new data from the network flooding analyses and other identified planning requirements into the interactive viewer.

ANNUAL UPDATE Coastal Virginia Transportation Infrastructure Inundation Study December 2022 - December 2023 Virginia Department of Transportation

INTRODUCTION

This report has been developed in response to Item 451 (D) of Chapter 1 of the 2023 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 2022 ("Study Year Four"), 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

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 46 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 of the VIMS Study expanded to include the remaining localities of

¹ More detailed information will be available in the upcoming *Virginia Transportation Planning for Sea Level Rise Interim Report 2023* prepared by VIMS' Center for Coastal Resources Management for VTRC and expected in December 2023. Access to the report may be obtained by sending an email to <u>Resilience@vdot.virginia.gov</u>.

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 included identification of all public at-risk transportation infrastructure, whether occurring in a rural, suburban, or urban area.

Alongside the VIMS Study, VDOT has independently developed a statewide Resilience Plan, published in December 2022, which serves as 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.

Study Efforts Reported in Previous Annual Updates

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

² The 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. For the submitted report, see https://rga.lis.virginia.gov/Published/2022/RD125/PDF

infrastructure statewide as well as inform the current and future planning of flood-resistant development and infrastructure.

Study Efforts in Year Four

In this most recent Study Year Four, VIMS continued development of a network flooding analysis that measures the inaccessibility of road networks based on flooding intervals of 6-inch 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 6inch 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 (Peninsula and Southside) region, with 19 VDOT facilities selected as Source Points. In Year Four, VIMS added an additional 13 Source Points and 7,163 miles of roadway in the Peninsula and Eastern Shore regions. 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. VIMS also developed a layer that shows the anticipated duration of flooding across the land surface under different water levels. This information will help inform the understanding of the length of delay time associated with flooding.

As part of the VIMS Study, VIMS has also developed an infrastructure interactive viewer to display asset information on selected road segments that will serve as part of a planning portal for VDOT. In Study Year Four, VIMS built the viewer (Figure 1) with feedback from VDOT and integrated results from the flood hazard zone assessment and the completed network flooding analyses with pertinent VDOT infrastructure information. The viewer is a nimble visualization tool displaying asset 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 potential use as an evacuation route. The interactive viewer has the capability to summarize information in an interactive dashboard and print reports. Users can also add their own data into the viewer for use in planning considerations.



Figure 1. The infrastructure interactive viewer tool shows the roads that are inaccessible from VDOT's Norfolk Area Office at 7 feet of flooding and the NFIP flood zones (100-yr flood plain in blue and 500-yr flood plain in red). A total of 679 miles of roadway within the southside region will be inaccessible from the office under these flood conditions.

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 Four, VIMS' progress for this task included: (i) incorporation of species distribution model outputs (total = 32) into an interactive viewer; (ii) development, testing, and launch of a real-time, interactive migratory fish spawning run viewer to allow VDOT employees to understand the potential status of individual anadromous fish species spawning, which may facilitate assessments for time-of-year restrictions (Figure 2); (iii) refinement of future potential marsh habitat in 3-inch intervals up to 4.5 feet of sea level rise; (iv) completion of detailed species information reports for 32 species, including information on life history, demographics, current threats, and the results of previous and ongoing mitigation efforts in Virginia and elsewhere; and (v) the continued development of an environmental-specific interactive viewer.

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.



Figure 2. Screenshot of AlosApp, the interactive migratory fish spawning run status prediction tool in support of project planning. Accessible at <u>https://shiny.vims.edu/AlosApp</u>

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 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 Hampton Roads region (Peninsula and Southside), Eastern Shore, and Planning District 8. VIMS will also add a network analysis using hospitals and emergency medical facilities as Source Points. 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.