

2021 SIX-YEAR PLAN NARRATIVE (Part II) Updated 7.11.22

INSTITUTION: Virginia Institute of Marine Science

OVERVIEW

The totality of the six-year plan should describe the institution's goals as they relate to state goals found in the *Pathways to Opportunity: The Virginia Plan for Higher Education*; the Higher Education Opportunity Act of 2011 (TJ21); and the Restructured Higher Education Financial and Administrative Operations Act of 2005.

The instructions under institutional mission and alignment to state goals, below, ask for specific strategies, in particular related to equity, affordability and transformative outcomes. Other sections will offer institutions the opportunity to describe additional strategies to advance institutional goals and state needs. ***Please be as concise as possible with responses and save this narrative document with your institution's name added to the file name.***

SECTIONS

Section A. Pandemic Impact: Briefly discuss, in one to two paragraphs, how the pandemic has impacted your institution. What things did your institution already have in place that proved helpful? What lessons were learned? What short-term changes have been made? What long-term changes will be made? What are the concerns moving forward?

RESPONSE:

The Virginia Institute of Marine Science has a non-residential campus with no dorms, dining halls, sports facilities or visitor centers. Impacts from the pandemic were therefore not tied to undergraduate education, but rather to graduate education (~90 students) and most notably to the field and laboratory research that underpins all three parts of the VIMS mission. The primary challenges were (1) moving quickly with little warning to teleworking, ensuring insofar as possible that students were able to continue to meet milestones, (2) developing protocols for conducting research in both laboratory and field settings while maintaining social distancing requirements, (3) meeting deliverables on federal and state grants because of research restrictions and uncertainty regarding opportunities for grant renewals and new grant submissions and, most recently, (4) implementing a plan for returning primarily to an in-person institution given that some employees have been working remotely for nearly 16 months. There are no anticipated long-term institutional changes as a result of the pandemic, and the most important lesson was the need for and great benefit from consistent, timely, and accurate COVID-related messaging to the VIMS community.

Section B. Institutional Mission, Vision, Goals, Strategies, and Alignment to State Goals: Provide a statement of institutional mission and indicate if there are plans to change the mission over the six-year period.

Provide a brief description of your institutional vision and goals over the next six years, including numeric targets where appropriate. Include specific strategies (from Part 3 – Academic-Financial Plan and Part 4 – General Fund Request) related to the following state themes and goals:

- **Equitable:** Close access and completion gaps. Remove barriers to access and attainment especially for Black, Hispanic, Native American and rural students; students learning English as a second language; students from economically disadvantaged backgrounds; and students with disabilities.
- **Affordable:** Lower costs to students. Invest in and support the development of initiatives that provide cost savings to students while maintaining the effectiveness of instruction.
- **Transformative:** Expand prosperity. Increase the social, cultural and economic well-being of individuals and communities within the Commonwealth and its regions. This goal includes efforts to diversify staff and faculty pools.

Strategies also can cross several state goals, notably those related to improved two-year and four-year transfer, and should be included here. If applicable, include a short summary of strategies related to research. The description of any strategy should be one-half page or less in length. Be sure to use the same short title as used in the Part 3 and Part 4 worksheets. If federal stimulus funds will fund activities and are included in Part 3 as reallocations, please note how they will be used.

RESPONSE:

The Mission of the Virginia Institute of Marine Science is to seek and broadly communicate knowledge in marine and coastal science to the Commonwealth of Virginia, the nation, and the world through research, education, and advisory service.

As a nationally and internationally recognized premier marine science institute, our overarching goals in the VIMS Vision are to (1) make seminal advances in understanding marine and coastal systems through research and discovery, (2) translate research findings into practical solutions to complex issues of societal importance, and (3) provide new generations of researchers, educators, problem solvers, and managers with a marine-science education of unsurpassed quality.

~~**Support ^{LR11} the Commonwealth Fisheries Collection.** The Nunnally Ichthyology Collection at VIMS is a library of preserved fishes from Virginia, the Chesapeake Bay, the North Atlantic, and the world beyond. The collection supports VIMS' institutional mission of research, education, and advisory service by engaging a broad community of scientists worldwide, providing the foundation for graduate education and research, and inspiring the public by sharing the biodiversity of fishes and the research that is being done to gain a better understanding of the natural world. The collection also serves as the only active, cataloged repository in the Commonwealth for voucher specimens of fishes collected by biologists at VIMS, numerous state (VDGIF, VMRC and DEQ) and federal agencies (NOAA and USFWS), Virginia Parks and Recreation (various counties), and the Virginia Aquarium.~~

~~The Nunnally Ichthyology Collection at VIMS also houses approximately 54,000 individual fish from institutions of higher education in Virginia that have divested their collections, including: Virginia Commonwealth University, University of Richmond, College of William & Mary, and George Mason University, and another approximately 52,000 fish formerly from the Chesapeake Biological Laboratory collection in Maryland. It is the only state collection for marine and freshwater fishes, and serves as the state repository for fishes collected in the Commonwealth. VIMS bears the responsibility of ensuring that this valuable resource is maintained on behalf of the Commonwealth. To date we have managed this through some allocation of our existing funds, federal grants and philanthropic gifts. As the size and value of this collection has grown, we lack the resources to ensure that the collection is adequately maintained and that it is available for use by state agencies and academic institutions.~~

Increase Base Operating Support

~~The normal formulas used by the state to assess and provide base operating support to higher education institutions puts VIMS at a significant disadvantage. In addition, whereas the state funding we receive for specific initiatives remains flat through time, our cost of producing the science and providing associated deliverables increases annually, particularly during inflationary periods such as the one we are in at present. This request includes vital institutional support for core operational functions that ensure that we can continue to meet the scientific and advisory service needs of the Commonwealth efficiently and effectively.~~

Sustain VIMS' World-Class, Advanced Breeding Program for Shellfish

~~Virginia is a national leader in aquaculture production of clams and oysters. These developments have been rooted in scientific advances and transfer of contemporary technologies to the industry by VIMS. In fact, VIMS has become a world leader in shellfish aquaculture technologies. Advances made by VIMS in this area include the development and maintenance of disease-resistant, fast-growing oyster strains and tetraploid oysters used by industry to produce sterile triploid oysters that can be marketed year-round. Current grant funded research is allowing VIMS to develop advanced genomic selection technologies that will further revolutionize our ability to produce even better strains of oysters. Virginia's oyster aquaculture industry is based almost entirely on the use of these selected oyster strains and~~

VIMS' ability to continually develop improved strains. Current operations in this area funded through a mix of E&G funds, royalty fees paid by industry, and research grant funds. The latter of these sources suffices to make scientific advances in breeding technologies, but they are not sufficient to operationalize those advances in support of industry. Additional E&G base funding is needed to ensure that VIMS and Virginia can maintain its national and international leadership in this valuable industry.

Support the Virginia Department of Health (VDH) and Virginia Marine Resources Commission (VMRC) needs in shellfish aquaculture management. Shellfish aquaculture is one of the fastest growing economic drivers in coastal Virginia, especially in rural areas. With this growth has come the need for new monitoring and assessment programs to support the work that VDH does in protecting human health and that VMRC does in managing the availability and use of the state's aquatic resources. VIMS has the technical skills necessary to conduct these new programs, but lacks the state-supported personnel to conduct the monitoring as well as some of the needed field sensors. Federal grant funding that we employ with great success in supporting our research programs is typically not available to support such monitoring programs. We seek support to conduct three separate monitoring programs to meet VDH and VMRC needs that have been expressed to us directly by the agencies.

1. Improved risk management of Vibriosis—A key threat to the growth and sustainability of shellfish aquaculture is the association of human pathogenic *Vibrio* bacteria with product marketed for raw consumption, in particular oysters. Infections by the two *Vibrio* species of concern, *Vibrio vulnificus* and *Vibrio parahaemolyticus* (or vibriosis) are responsible for an estimated 80,000 illnesses and 100 deaths U.S. annually, with most of these infections associated with consumption of raw or undercooked shellfish. These bacteria can also have significant repercussions for the shellfish industry through product recall, closure of harvest beds and reduced opportunity for sales associated with negative publicity. With the rise in shellfish production and in consumption of shellfish, particularly oysters, as a raw product, as well as the likelihood for *Vibrio* species abundance to increase with warming seawater, favorable conditions are in place for an increase in vibriosis cases. Because these bacteria occur naturally in shellfish and their surrounding environment, preventing illnesses relies on a robust monitoring program. Within this context, we propose to increase the monitoring of our local waters and shellfish to enhance our understanding of the factors driving the distribution and abundance of these bacteria in the environment and in shellfish, and work in collaboration with Virginia Department of Health to foster science-based risk management strategies. Specific tasks will include: Expand our collaboration with VDH by enhancing data sharing between the two agencies; Optimize and/or develop monitoring tools allowing the detection of *Vibrio* strains of concern, i.e., the strains known to cause vibriosis in humans; Monitor the presence and abundance of human pathogenic *Vibrio* bacteria (and strains) in shellfish produced in Virginia waters; Identify environmental factors associated with higher risk of vibriosis to develop predictive models; and Provide training of undergraduate and graduate student in the field of microbiology, molecular biology and ecology.

2.1. Characterizing food quality and carrying capacity for shellfish production—Sustaining Virginia's shellfish aquaculture industry and enabling future expansion are dependent on an adequate and high quality food supply for the shellfish; this supply comes from primary production by phytoplankton which sets the amount of shellfish that can be grown in an area (carrying capacity). Increasingly, VMRC is seeking VIMS' guidance on the carrying capacity of shellfish growing areas throughout Virginia's coastal waters. In addition to high phytoplankton production rates, the quality of phytoplankton can impact a shellfish growing region. To accomplish this we need accurate, up-to-date measurements of local rates of phytoplankton production rates and phytoplankton community composition, quantities that change as nutrient inputs and temperature vary. We propose to conduct monthly surveys in shellfish growing waters throughout Tidewater Virginia to build and maintain a spatially-explicit database that can be used to identify phytoplankton species that constitute an 'ideal' diet for oysters and develop carrying capacity estimates for oyster and clam production in these waters. In conjunction with this we will develop user friendly decision support modeling tools that can be directly used by VMRC and the shellfish aquaculture

~~industry to assess carrying capacity and make informed decisions about the production capacity of a given water body.~~

- ~~3.2. Assessment of coastal acidification and its impact on shellfish aquaculture — Coastal acidification, caused by increased atmospheric CO₂, presents a serious and credible threat to the marine resources of the Commonwealth, including the shellfish aquaculture industry, fisheries stocks, and health of Chesapeake Bay and the Eastern Shore ecosystems. In September 2018, the Northam administration joined the International Alliance to Combat Ocean Acidification, demonstrating its commitment to ensuring that Virginia is a leader in addressing coastal acidification issues. To meet this commitment, we need to assess the severity of coastal acidification, develop an early warning system for stakeholders, and predict acidification impacts on living resources. In recent years, VIMS has developed observational capacity, advanced modeling tools, and sophisticated experimental facilities that are capable of supporting the Commonwealth's commitment. With additional state support, we will: 1) expand our network of sensors to detect acidification in the lower Chesapeake Bay and the seaside of the Eastern Shore, with a particular emphasis on shellfish growing areas; 2) identify threshold levels of acidification for critical species and life stages, such as larval and juvenile oysters; 3) predict the results of acidification on living resources in Chesapeake Bay and Virginia's coastal bays; and 4) develop an early warning system that predicts when and where acidification approaches critical thresholds for shellfish and other economically and ecologically important species.~~

~~**Support the Implementation of the Virginia Coastal Resiliency Master Plan.** Under the leadership of the Virginia's Chief Resilience Officer and the Special Assistant to the Governor for Coastal Adaptation and Protection, the Commonwealth is in the process of producing the Virginia Coastal Resilience Master Plan (hereafter, the Plan) set for release in fall 2021. Through discussions with the leadership of this effort, we have preliminary indications of the some of the tasks that VIMS will likely be requested to support in implementing the Plan's recommendations. The following presents our best estimates of the additional resources required for VIMS to meet these needs. We anticipate that all or a subset of these tasks would be submitted as a budget initiative depending upon the final outcome of the Plan.~~

- ~~1. Deploy and integrate data from more tidal gauge and water level sensors throughout Tidewater Virginia. Working with federal and state agencies and local governments, VIMS will leverage state dollars to secure additional resources to place water level gauges in critical areas identified in the Plan and prioritized for underserved at risk communities. These gauges will be linked into our existing Tidewatch network and predictive model system, and the results served openly on the web in a user friendly, map-based platform.~~
- ~~2. Identify overlapping vulnerabilities and mitigative measures related to sea level rise/flooding/storm surge, including impacts on ecosystem and community resilience (e.g., septic system failures and saltwater intrusion into shallow drinking wells) throughout rural coastal Virginia. Link these vulnerabilities with others related to transportation, utilities and other infrastructure to develop high resolution adaptation guidance that considers socio-ecological co-benefits and impacts to underserved communities.~~
- ~~3. Develop shoreline management plans for areas identified in the Plan as being particularly susceptible to high erosion rates. Work with state agencies and local governments to identify vulnerable areas consistent with the Plan's priorities and develop site-specific shoreline management plans that incorporate shore protection, coastal resiliency, and monitoring. With these plans in place, the project cost can be estimated and habitats impacted/created can be determined so that agencies, local governments and property owners can obtain permits and financing thereby removing the perceived barriers to living shoreline construction.~~
- ~~4.1. Expand and maintain AdaptVA. Maintain currency of data and software and expand to the rest of the Commonwealth. Develop and serve new content to include precipitation and temperature based analyses, guidance for prioritizing underserved communities, cross reference adaptation strategies, and other priorities identified in the Plan. Explore accessibility under Americans with Disabilities Act and multi-lingual additions.~~

~~**Establish**^[LR2] **an Underrepresented Minority Postdoctoral Research Associate Program.** Despite the pioneering of African American marine scientists like Roger Arliner Young and Ernest Everett Just, the marine science field has a woeful history of producing PhDs and attracting postdoctoral researchers that come from minority groups. The average number of PhDs awarded nationally to underrepresented minorities in the ocean and marine sciences is six every year. Postdoctoral researchers work alongside faculty to assist with expanding our knowledge of fish in the Chesapeake Bay, managing aquatic diseases that impact shellfish, exploring the benefits of submerged aquatic vegetation, and understanding the effects of harmful algal blooms on people and marine life. This newly created postdoctoral program is essential to VIMS meeting its objective of advancing social mobility in a field that has a global impact on the prosperity of coastal communities. VIMS recognizes that the key to improving diversity in the marine sciences lies with focused investments in underrepresented minority faculty, more specifically with postdoctoral researchers. As we continue to provide cutting-edge research and high-quality advisory services to the Commonwealth in these and other key areas, we plan to do so by developing underrepresented minority postdoctoral researchers who have the potential to become faculty within three to four years.~~

- ~~● Prosperous coastal communities in Virginia depend on VIMS to provide cutting-edge research, high-quality advisory service and graduate education. Faculty diversity increases innovation on campus, promotes dynamic problem-solving and fosters an atmosphere that enhances VIMS' mission and overall excellence.~~
- ~~● VIMS is very well positioned to narrow the diversity gap in the marine science field globally. A key component to increasing faculty diversity in marine science involves creation of a more robust pipeline of underrepresented minority students earning doctorate degrees who then make the career choice to stay in academia.~~
- ~~● A strategic focus will be placed on recruitment for those recent underrepresented doctoral graduates with training and research interests in fields closely related to marine science who may be enthusiastic about the opportunity to change the course of their career.~~
- ~~● Each postdoctoral research associate will be mentored by one or more faculty members who have demonstrated a commitment to enhancing core competencies and professional skills to further solidify the choice to move into the faculty realm.~~
- ~~● Funding for a postdoctoral research associate program will not only add diversity to VIMS but will increase institutional capacity to sustain and protect the environment, bolster the marine-based economy, and help protect human health.~~

~~**Monitor Zooplankton and Larval Fish.** Zooplankton (small marine organisms) serve both as trophic links between primary producers and higher trophic levels such as commercially important fish and invertebrates. Furthermore, most commercially important fish and all shellfish in Chesapeake Bay have a pelagic, larval stage in the plankton the survival of which exerts key control on the fisheries stock. However, for the past two decades there has been no systematic sampling of spatial and temporal variability in zooplankton or fish larval abundance in Virginia waters. The Commonwealth's current water quality monitoring programs and fisheries stock assessments completely exclude this key link in the estuarine and coastal food web. Indeed, predictive models of Bay water quality and fisheries stocks if they include mid-trophic levels at all are based on obsolete zooplankton data. Rising temperatures and changing salinity distributions in the Chesapeake Bay are certain to alter this important link in the food web.~~

~~With the Commonwealth's significant investment in the new R/V *Virginia*, recent upgrades and digitization of the Nunnally Ichthyology larval fish collection, and the wide expertise of faculty members including plankton and benthic ecology, ichthyology, and ecosystem modeling, VIMS is now uniquely poised to address this critical gap in our understanding of Bay and coastal food web dynamics. Recent advances in remote observation technology using an Underwater Vision Profiler and machine learning~~

~~have also increased efficiency of zooplankton sampling, identification, and enumeration. This initiative will complete our fisheries monitoring program.~~

Establish Virginia Harmful Algal Bloom (HAB) Monitoring Consortium. Harmful algal blooms pose a significant threat to human and animal health, as well as to aquaculture, commercial fisheries, aquatic food webs and safe recreational water use. Recent increases in the frequency, severity and distribution of algal blooms have occurred worldwide and the threats posed by emerging HAB species are predicted to increase. Specifically, in Virginia's waters there are emerging HABs, as well as increases in the severity and distribution of several harmful species. Additional coordinated and intensive monitoring efforts are needed to gain a better understanding of the conditions that lead to blooms of HAB organisms and to more accurately predict the potential human health effects and impacts on aquatic life.

Virginia citizens would be best served by a HAB monitoring consortium where VIMS personnel would work cooperatively with other Virginia state agencies, particularly the Virginia Department of Environmental Quality (DEQ), Virginia Marine Resources Commission (VMRC) and the Virginia Department of Health (VDH). This consortium would coordinate a larger-scale HAB monitoring program in Virginia waters, engage in public education, and develop appropriate response and notification protocols for future HAB events. Currently the stations in VA estuarine and marine waters are typically monitored only monthly and more frequent monitoring is necessary, particularly during the peak bloom season of summer and early fall. More frequent monitoring is particularly important for shellfish growing areas where there is a risk to human and shellfish health. The role of VIMS scientists in this consortium would be species and toxin identification and quantification.

Enhance the sustainability and productivity of Virginia's shellfish aquaculture industry

Shellfish aquaculture is one of the fastest growing economic drivers in coastal Virginia, especially in rural areas. With this growth has come the need for new monitoring and assessment programs to protect human health and maximize the industry's productivity. We propose to establish three monitoring programs that will enhance the productivity and sustainability of this valuable industry in Virginia: 1) Monitor for the presence of the human pathogenic bacteria Vibrio species and establish links to environmental factors that lead to risk reduction; 2) Determine the carrying capacity (optimal amount of shellfish can be grown in a particular water body) for shellfish growing areas throughout Virginia's tidal waters; and 3) Expand our network of monitoring sites for coastal acidification and develop warnings systems and protocols to assist commercial shellfish hatcheries to mitigate the impacts of low pH in coastal waters. Federal grant funding, which we employ with great success in supporting our research programs, is typically not available to support such monitoring programs. State support in monitoring programs will allow us to meet the needs that have been expressed by industry

Monitor Zooplankton and Larval Fish. Zooplankton (small marine organisms) serve both as trophic links between primary producers and higher trophic levels—such as commercially important fish and invertebrates. Furthermore, most commercially important fish and all shellfish in Chesapeake Bay have a pelagic, larval stage in the plankton—the survival of which exerts key control on the fisheries stock. However, for the past two decades there has been no systematic sampling of spatial and temporal variability in zooplankton or fish larval abundance in Virginia waters. The Commonwealth's current water quality monitoring programs and fisheries stock assessments completely exclude this key link in the estuarine and coastal food web. Indeed, predictive models of Bay water quality and fisheries stocks—if they include mid-trophic levels at all—are based on obsolete zooplankton data. Rising temperatures and changing salinity distributions in the Chesapeake Bay are certain to alter this important link in the food web.

With the Commonwealth's significant investment in the new R/V Virginia, recent upgrades and digitization of the Nunnally Ichthyology larval fish collection, and the wide expertise of faculty members including plankton and benthic ecology, ichthyology, and ecosystem modeling, VIMS is now uniquely poised to address this critical gap in our understanding of Bay and coastal food web dynamics. Recent advances in remote observation technology using an Underwater Vision Profiler and machine learning

have also increased efficiency of zooplankton sampling, identification, and enumeration. This initiative will complete our fisheries monitoring program.

Expand Tetraploid Technology for Improved Yields of Oyster Aquaculture in Chesapeake Bay.

Virginia leads the east coast in aquaculture production of clams and oysters. These developments have been rooted in scientific advances and transfer of contemporary technologies to the industry by VIMS. In fact, VIMS has become a world leader in shellfish aquaculture technologies. One of those technologies has been a force in driving oyster aquaculture to the forefront: tetraploid technology.

Tetraploid oysters (which have 4 sets of chromosomes as opposed to normal diploid oysters with 2 sets) are used by commercial hatcheries to mate which then produce sterile (spawnless) triploid oysters (3 sets of chromosomes), which comprises >90% of farmed oysters in Virginia, and increasingly, east coast states. This technology is part of the Intellectual Property portfolio of the Aquaculture Genetics and Breeding Technology Center at VIMS. To date we have used tetraploids largely for the purpose of mating them with diploids producing sterile oysters, while normal diploids have been the focus of our breeding efforts to produce faster growing, disease resistant oysters.

That means that the remarkable progress that we have made to date in breeding an improved oyster has been accomplished through genetic selection on only one third of the genetic material that makes up a triploid oyster. We have now produced thousands of tetraploid oysters and are prepared to make even greater advances by beginning to do selective breeding to improve the tetraploids.

This will increase the operational cost of the breeding program, but we expect it will lead to major advances in Virginia's oyster aquaculture industry. The initiative will allow us to expand the development of tetraploid strains by developing new genetic material for release to industry, all with the goal to ensure that Virginia maintains its world-leading role in research and development in support of oyster aquaculture.

Establish a Molecular Core Lab. Rapidly advancing technology has led to a revolution in the realm of molecular biology and genomics, giving scientists much greater power to address complex problems in marine and estuarine systems. This revolution offers the opportunity for VIMS to improve its capabilities in fulfilling its advisory mission to the Commonwealth in the areas of fisheries and aquaculture, environmental health, and coastal ecology. Extremely large amounts of data can be generated in a relatively short period of time using this technology, offering unparalleled opportunities to create more sustainable environments, bolster regional economies, and protect human health.

Currently, VIMS researchers within three different departments use molecular approaches to address important research questions related to resource management and public health issues in Virginia, including fisheries and aquaculture management, harmful algae blooms, and shellfish health and safety. Key pieces of heavily used shared equipment are scattered across campus and are rapidly becoming outdated. VIMS' ability to accommodate this research, which requires massively high-throughput sequencing, digital PCR, transcriptomics and single cell genomics, is limited by the absence of a centralized facility with support.

We are seeking to upgrade critical instruments and to add technical expertise in advanced bioinformatics analyses, and dedicated technical staff to operate and coordinate the use of specialized equipment, and to advise researchers on appropriate strategies and approaches to answer their research questions. Almost all top-tier marine research institutions, including Woods Hole Oceanographic Institute, Scripps Institution of Oceanography, Rosenstiel School at University of Miami, University of Rhode Island, University of Washington, and others, support these types of core facilities with state-of-the-art equipment and technical expertise. As VIMS is in the process of designing and building a new science laboratory building, it is an excellent opportunity to acquire the needed equipment and additional staff to develop the molecular capabilities to remain competitive in the 21st Century and to provide the Commonwealth with state-of-the-art, science-based advice. VIMS has leveraged its existing molecular genetics capabilities for over \$5M in extramural research funds.

Enhancing our capabilities further would expand our capacity to leverage even more extramural money in support of our research, education and advisory missions.

Expanding VIMS' public presence and impact

Over the next six years VIMS is committed to maximizing the influence of our science in the estuarine environments and coastal communities that need it the most. We are also committed to increasing our visibility, expanding our community engagement, broadening our public education, and developing more robust pipelines for future marine scientists from a variety of backgrounds. VIMS is exploring how best to meet these ambitious goals in communities along the Virginia coastline.

~~**Increase Base Operating Support.** The normal formulas the state uses to assess and supply base operating support to higher education institutions does not readily apply to VIMS and, thus, disadvantages the Institute. Specifically, this request includes vital support for 1) service contracts for high tech scientific equipment purchased through the Equipment Trust Fund, 2) inflationary increases in general operating expenses, and 3) support for personnel services in support units. Also, see **Section E** below for needed operating support associated with new capital projects that will come on line in FY 2023.~~

Continue to Operate as a Year-round Facility. As an independent state agency that is heavily involved in research and graduate education, VIMS also provides advisory service to the Commonwealth in the form of expert scientific advice on marine-related issues throughout Chesapeake Bay and the coastal ocean. All three of our missions, the graduate program, research and advisory programs, are heavily operational for the entire 12-month calendar year, and in fact, all of our faculty hold 12-month appointments. Field research is most active between April and October, but most other activities occur equally throughout the year. VIMS always has been, and will continue to be, a year-round operation.

Section C. In-state Undergraduate Tuition and Fee Increase Plans: Provide information about the assumptions used to develop tuition and fee information the institution provided in the Excel workbook Part 1. **The tuition and fee charges for in-state undergraduate students should reflect the institution's estimate of reasonable and necessary charges to students based on the institution's mission, market capacity and other factors.**

RESPONSE:
Not Applicable

Section D. Tuition and Other Nongeneral Fund (NGF) Revenue: Provide information about factors that went into the calculations of projected revenue, including how stimulus funds may mitigate tuition increases.

RESPONSE:
Not Applicable

Section E. Other Budget Items:

Operating costs for new facilities coming online in CY 2022.

1. **Acuff Center for Aquaculture.** Construction will be completed on this project early CY 2022. The Center will support numerous programs that benefit Virginia's shellfish aquaculture industry, including our Aquaculture Genetics and Breeding Program, research into improved oyster culture techniques, development of techniques for culturing other species, education and outreach. Operating costs for personnel and M&O in the amount of \$406,714 is required for FY 2023 and \$413,758 for FY 2024.
2. **Eastern Shore Lab Complex.** A total of six new and replacement buildings, including administration, education, research, visiting scientists lodging, and maintenance facilities, will be completed in CY 2022. These facilities will transform the Eastern Shore Laboratory, support its education, research and advisory missions, and contribute to the local economy. Operating costs for personnel and M&O for these facilities will require \$210,747 in FY 2023 and \$216,390 in FY 2024.

RESPONSE:

Not Applicable

Section F. Enrollment Projections: Include in this section information about how your institution developed its enrollment projections, whether your institution is concerned about future enrollment trends, and, if so, what planning is underway to address this concern. How have enrollment plans been impacted by the pandemic? For example, does your institution plan on enrolling more online students?

RESPONSE:

Not Applicable

Section G. Programs and Instructional Sites: Provide information on any new academic programs, including credentials and certificates, new instructional sites, new schools, or mergers supported by all types of funding, that the institutions will be undertaking during the six-year period. Note that as part of the revised SCHEV program approval process, institutions will be asked to indicate if a proposed new program was included in its six-year plan. Also, provide information on plans to discontinue any programs.

RESPONSE:

Not Applicable

Section H. Financial Aid: Discuss plans for providing financial aid, not including stimulus funds, to help mitigate the impact of tuition and fee increases on low-income and middle-income students and their families, including the projected mix of grants and loans. Virginia's definitions of low-income and middle-income are based on HHS Poverty Guidelines. A table that outlines the HHS guidelines and the definitions is attached.

RESPONSE:

Not Applicable

Section I. Capital Outlay: Discuss the impact, if any, that the pandemic has had on capital planning, such as decreasing the need for space or other aspects. Provide information on your institution's main Education and General Programs capital outlay projects, including new construction as well as renovations that might be proposed over the Six-Year Plan period that could have a significant impact on strategies, funding, student charges, or current square footage. Do not include projects for which construction (not planning) funding has been appropriated. *Special Note: The requested information is for discussion purposes only and inclusion of this information in the plans does not signify approval of the projects.*

RESPONSE:

Construct New Fisheries Science Building. This request supports the construction of a new 38,000 square-foot state-of-the-art research laboratory building to replace the 31-year-old Nunnally/Fisheries Science Laboratory. It will include a fish processing laboratory, climate-controlled storage and faculty research offices and laboratories supporting the Department of Fisheries Science. The new building will consolidate the Fisheries Science Department into one location, improving the colloquy between faculty, staff and students of the department. Additionally, space for the Nunnally Ichthyology Collection (Fish Collection Museum) will serve as the largest repository for freshwater, Chesapeake Bay and coastal fishes of Virginia. The building will be required to meet LEED Silver design standards, at a minimum. The total cost for this project is estimated at \$35M.

Construct Marine Operations Administration Complex. This request supports the construction of a new 10,000 square-foot marine operations facility to replace several existing structures. The facility will be constructed with a raised elevation that will take into consideration sea level rise and will consist of offices for the department's administrative staff, a training/instruction classroom, a workshop to support the dive equipment program, a maintenance repair shop to support the marine operations equipment repair program, and field and equipment storage. This project also includes the expansion and modifications to the boat basin to allow to berth the R/V *Virginia*. The new Marine Operations

Administration Complex will require a feasibility study to analyze the current program needs and will be designed to meet LEED Silver standards, at a minimum. The total cost for this project is estimated at \$11.9M.

Section J. Restructuring: Provide information about any plans your institution has to seek an increased level of authority, relief from administrative or operational requirements, or renegotiation of existing management agreements.

RESPONSE:

Not Applicable

Section K. Evaluation of Previous Six-Year Plan: Briefly summarize progress made in strategies identified in your institution's previous six-year plan. Note how additional general fund support and reallocations were used to further the strategies.

RESPONSE:

Restore Saltwater Fisheries Survey – Funds Appropriated in 2021 General Assembly Session.

Long-standing fisheries surveys by VIMS provide the scientific data on which saltwater fisheries in the Commonwealth of Virginia are managed. These surveys have been supported by a combination of state dollars and federal grants. Recent reductions in the state and federal funds resulted in five of our most important surveys being dramatically cut. Beginning in 2018, federal funding from the US Fish and Wildlife Service that flows through the Virginia Marine Resources Commission (VMRC) was reduced from \$1.8M to \$1.13M, largely as a result of a federal decision to alter the percentage split between freshwater and saltwater fish survey support provided to Virginia. At the same time, VMRC's source for providing their share of a 33% state match requirement (historically VMRC provided \$300K and VIMS provided \$300K of the required \$600K match for \$1.8M of federal funds) was reduced by the General Assembly so that most of those dollars could be used to support the Saltwater Fishing Tournament.

Secretary Strickler and the Commissioner Bowman managed to negotiate a slightly more favorable split in federal funds that resulted in a federal funding of \$1.4 M going to saltwater fisheries surveys, but the total loss between the state and federal sources was approximately \$700K. VIMS implemented austere cuts to these surveys, reduced personnel, and combined surveys to gain efficiency, but still fell \$250K short of having funding needed to sustain the surveys at a level to meet the needs of the Commonwealth. We are seeking to recover this lost support to maintain these surveys that are critical to wise management and economic viability of Virginia's saltwater fisheries.

Manage Aquatic Diseases – Funds Appropriated in 2021 General Assembly Session.

Recent outbreaks of disease have damaged economically important and ecologically sensitive marine resources in the Commonwealth and nation. Examples include mycobacterial infections in striped bass, dermo and MSX in oysters, *Hematodinium* in blue crabs, morbillivirus in dolphins, wasting disease in seastars, bacterial infections in scallops, and parasitic infections in eels, to name a few. The pathogens responsible for these outbreaks are not well known, their risks to marine life and potential to spread remain understudied, and their ecological impacts have been difficult to assess with existing resources. To meet the challenge of diseases in marine systems, this initiative will provide science-based guidance on the management of existing and emerging disease threats to critical fishery and aquaculture resources in the Commonwealth and Chesapeake Bay region. VIMS scientists have considerable expertise working with diseases of marine animals; however, we aim to leverage this expertise by establishing state and regional response protocols, identifying and liaising with key groups such as state and federal resource managers and public health officials, as well as the fishing and aquaculture industries, serving as a clearinghouse for information to policy makers, and developing modeling tools to mitigate the effects of disease outbreaks. The health of marine resources such as fish and shellfish is fundamental to the growth of industries and the revitalization of coastal communities dependent upon them. This initiative will provide expert guidance on the management and mitigation of existing and emerging disease threats to vital fishery and aquaculture resources in the Commonwealth and

Chesapeake Bay region. It will significantly enhance our responses to known pathogens and provide a clear framework, based on state-of-the-art science, for addressing the dangers of emerging diseases.

Construct New Research Facility (Chesapeake Bay Hall) – Supplemental Funds Appropriated in 2021 General Assembly Session.

The Virginia Institute of Marine Science (VIMS) is requested supplemental funding in the amount of \$28.25M to support the construction of a new 68,250 sq. ft. state-of-the-art research facility that would replace Chesapeake Bay Hall (CBH). The project was authorized during the 2018 General Assembly Special Session. The increase in construction cost could have been attributed to the strong economy, impacts from the pandemic, and present building code requirements; however, the primary driver for the cost increase was that the proposed new building is more "dense" with lab equipment and specialized research space that is required for today's cutting-edge research. The cost is directly comparable to the Division of Engineering and Buildings (DEB) construction cost database for research labs. VIMS and DEB have reconciled and are thus in agreement with the project's scope and budget. DEB continued to recommend replacement over renovation of the existing building. During schematic design, VIMS value engineered over \$4M in projected savings as an effort to reduce and align scope and budget. As one of two primary research buildings on the VIMS campus, research conducted by faculty in CBH generates approximately \$5M in research grants and contracts annually which is now jeopardized by the condition of CBH. The research is instrumental in sustaining and protecting the environment, bolstering the marine-based economy, and helping protect human health.

Section L. Diversity, Equity and Inclusion (DEI) Strategic Plan: Provide an update on the completion status of your institution's plan that is being coordinated with the Governor's Director of Diversity, Equity and Inclusion. If a copy of the plan is available, please include it when your institution submits its initial plan. If a copy of the plan is not available for July 1 or if changes are made, please provide a copy with your institution's final plan submission on October 1.

RESPONSE:

Although William & Mary will be submitting the University's DEI Strategic Plan that includes VIMS, below are highlights of VIMS-specific initiatives:

- Engaged with Norfolk State University (NSU) to set up a collaboration around the ecological health and restoration of the Elizabeth River. This collaboration includes establishing student internships for NSU students, formalizing research partnerships in the Elizabeth River, and evaluating environmental justice issues associated with risks from contaminants in the river and its watershed.
- Helped the Pamunkey Indian Tribe to submit a grant proposal to the Bureau of Indian Affairs for a comprehensive review of the surface and groundwater resources on and in the vicinity of their reservation. If funded, VIMS will work with tribal members to conduct the study by developing a comprehensive tidal wetland management plan. VIMS has also worked with the Pamunkey Indian Tribe in the past to submit a proposal to the Environmental Protection Agency.
- Along with Old Dominion University, planned the 24th annual Blue Crab Bowl that was held virtually in February 2021 where 16 teams from Virginia high schools displayed their mastery of oceanic knowledge. The virtual platform provided expanded access to schools who may not have been able to participate in the past due to costs, particularly transportation and lodging.

Section M. Economic Development Annual Report: Provide a copy of any report your institution has produced about its economic development contributions.

RESPONSE:

In June 2018, Gloucester County produced a video promoting economic development that featured, in one segment, its relationship with VIMS under the heading "where inquiring minds come to learn." VIMS is one of the county's economic drivers and maintains a strong relationship with the Director of Economic Development, always with an eye towards mutually-beneficial partnerships.

VIMS is located in GO Virginia Region 6, and the VIMS Dean and Director is a voting member of the Region's Council. Virginia Sea Grant (VASG), which is headquartered at VIMS and composed of six Virginia R1 universities, was awarded a \$2.9M GO Virginia state grant (Region 6 in partnership with Region 5 – Hampton Roads) to launch a coastal resilience and adaptation economy. Requiring collaboration with the private sector and enhanced university public-private partnership R&D capacity, this effort aids in positioning Virginia to be a global leader in coastal adaptation products, technologies, designs and services. This 2021-23 project is estimated to spur \$95.7M in economic activity and return \$2.48 tax dollars to the Commonwealth per grant dollar by Year 5. In addition, working with multiple universities, VASG produced \$7.5M in economic benefits in 2020, including over \$1.3M from a VIMS-W&M-ODU-VT collaboration to support aquaculture companies' expansion of direct marketing and sales strategies after COVID-19 shut down their restaurant markets, as well as over \$880K for a VIMS and VT effort to expand catfish electrofishing technologies and processing capacity in Virginia.

State industries to which the institution's research efforts have direct relevance

There are several industries in which VIMS' research efforts have had a direct impact. Examples include:

- *Oyster and Clam Aquaculture Industry.* In 2017, the farm gate value for Virginia's shellfish aquaculture industry was \$56.6 million, of which \$38.1M was attributed to Hard Clams and \$18.5M to Oysters. This is an all-time high for the shellfish aquaculture industry. The research conducted at VIMS by our faculty and staff over the last 50 years has led to this economic success. Specifically, VIMS researchers provide genetically superior oyster brood stock to industry without charge, and provide guidance to industry on the leading diseases that impact shellfish to provide guidance to industry.
- *East Coast Off Shore Scallop Industry.* In the early 1990s, the scallop fishery along the U.S. Atlantic seaboard was on a sharp downward slide. Commercial fishermen were having to spend more and more time at sea, up to 240 days per year, but were catching fewer and smaller scallops. Today, that fishery is the second most valuable commercial fishery on the East Coast, with more than \$400 million in scallops landed in 2014. Virginia alone unloaded \$33.6M in scallops in that year, generating an additional \$21M in economic activity in the Commonwealth for a total impact of over \$50M. A large part of the recovery and growth of the East Coast scallop fishery is due to a long-term collaboration between scallopers, fishery managers, and scientists at VIMS. Our scientists have spent thousands of days on commercial scallop boats and research vessels during the last decades, testing and refining dredge equipment to maximize sustainable scallop harvests while minimizing bycatch of yellowtail flounder and sea turtles.
- *Agriculture Industry.* The Eastern Shore of Virginia is home to tomato farms and, increasingly, chicken farms. VIMS' researchers work with the state and local municipalities to understand the potential impacts of these industries on water quality, and assist in developing mitigation strategies to reduce the impacts.
- *Environmental Industry.* VIMS researchers developed state-of-the-art biosensors that have early detection functionality for oil spills, rapid quantification in real-time of polycyclic aromatic hydrocarbons (PAHs) concentration (EPA considers PAHs highly toxic and lists 17 as suspected carcinogens), and other contaminants. Data from these biosensors have been used guide sediment remediation in the Elizabeth River in real-time, thus avoiding additional unintended environmental damage.

High-impact programs designed to meet the needs of local families, community partners, and businesses

- *Oyster Aquaculture Training Program.* The Oyster Aquaculture Training program is a popular five-month hands-on program that focuses on the principles of oyster aquaculture. Participants learn and work alongside researchers during our oyster hatchery season from April to August. They receive a stipend for the duration of their involvement. To ensure a one-on-one experience, we accept a maximum of only 3-5 participants. During the five-month program, participants rotate through various stages of oyster aquaculture, from our hatchery and field grow-out operations, to our laboratory. Working through these rotations provides a sound

- understanding of all phases of the oyster life-cycle. Participants also work in the field, learning the importance of seawater flow rates, sieve and bag sizes, and oyster seed sizes and densities. They learn various field grow-out methods, such as suspended culture and rack and bag techniques. By the end of the program, participants have a clear understanding of all areas of oyster aquaculture and are highly qualified and confident in their ability to perform tasks in both oyster hatchery and field operations. Although there are only a small number of participants in any given year, the impact of the program is high and community and industry relations are enhanced.
- **Community Outreach.** VIMS and its federal partners offer a wide variety of free public programs both on VIMS' campuses in Gloucester Point and Wachapreague, as well as throughout Hampton Roads and the lower Chesapeake Bay region. VIMS has offered more than 280 outreach programs that reached more than 21,000 citizens. Our programs include After Hours Lecture Series, Discovery Labs, Annual Open Houses at Gloucester Point and Wachapreague, Public Tours, Seafood Symposia, Speakers Bureau, Technical Training and Workshops, Summer Camps for K-8th graders, Field and Classroom Experiences, and booths at local Fairs and Festivals.

Business management/consulting assistance

As the state's mandated advisor on a wide range of natural resources management and use issues, VIMS plays a truly unique role as an institution of higher education. In fact, VIMS is a model for the nation in this regard because our advisory services mission is so significantly different from traditional university service to the community, and it shapes VIMS in a most fundamental way. VIMS is identified in 40 sections of the *Code of Virginia*, and as such we are on call and expected to provide advice based on the highest quality science when requested by the Governor, the General Assembly, state agencies, marine industries, and citizens. The charge put forth to us in the *Code of Virginia* is an asset, an advantage, and a vibrant part of our institutional culture. Advisory service is in many ways the public face of VIMS.

Currently, there are over a dozen major projects ranging from municipal surface water intakes, to the Chesapeake Bay Bridge Tunnel and Hampton Roads Bridge Tunnel expansions, to Dominion Energy's Offshore Commercial Wind Energy project on which VIMS is providing science-based advice to industry and permitting agencies. Expectations from stakeholders are high and we have a long history of furnishing advice of unsurpassed quality. Many of these projects require multiple permits and are complicated, time-consuming and often controversial. VIMS brings, at no charge, an objective voice that ultimately results in better policy and management decisions, and that help sustain the environment and protect public health.

The Commonwealth Center for Recurrent Flooding Resiliency (CCRFR), a partnership between Old Dominion University, W&M Law School's Virginia Coastal Policy Center (VCPC) and VIMS, was established in 2016 to bring university-based expertise to the growing challenge of recurrent flooding. The CCRFR conducts studies, provides training and offers a variety of services in the area of recurrent flooding resiliency, and is currently working with local governments and state and federal agencies throughout Tidewater Virginia to enhance the region's resiliency to flooding. Examples include: 1) working with the City of Virginia Beach to assess resiliency in the tourism industry and assemble policy recommendations; 2) collaborating with Newport News, Hampton and Norfolk to install low cost-water level-monitors to enhance prediction and visualization tools; 3) assisting the City of Portsmouth in incorporating resiliency to future storms in their comprehensive plan; 4) evaluating the effectiveness of various risk communication methods; 5) mapping local land subsidence rates; 6) contributing to the development of easy-to-use data portal, *Adapt Virginia*, that provides a wide range of technical and policy decision support for building resiliency; 7) providing leadership in addressing storm water concerns in rural Tidewater, and; 8) developing an improved version of *TideWatch*, which currently predicts water levels at selected tide gauge stations 36 hours in advance, and will soon provide flood inundation predictions up to 48 hours in advance.