Chickahominy Indian Tribe Native Plant Nursery Business Plan

Figure 1. VIMS, "Living Shoreline Vegetation," https://www.vims.edu/ccrm/outreach/living_shorelines/vegetation/

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August 12, 2025

A Collaboration With:

William & Mary | Virginia Coastal Resilience Collaborative

Chickahominy Tribe

VIMS | William & Mary
Virginia Institute of Marine Science

Raymond A. Mason School of Business
William & Mary

Acknowledgements

This project would not have been possible without the support of William & Mary's Office of the Provost. This report is the product of a collaboration between William & Mary's Virginia Coastal Resilience Collaborative, William & Mary's Raymond A. Mason School of Business, the Virginia Institute of Marine Science, and the Chickahominy Indian Tribe.

Thank you to the leaders and representatives of the Chickahominy Indian Tribe– Dana Adkins, Joe Hunt, Troy Adkins, Wayne Adkins, and Wesley Adkins– for sharing their vision for the nursery and offering valuable insights throughout the development of this plan. Their commitment to environmental stewardship and cultural resilience grounded the purpose of this project. It was a great experience collaborating and engaging in shared learning with them throughout the process. We hope that this plan can help bring the nursery to life, and we are excited to see how it will impact the Chickahominy Tribe's community and local restoration efforts.

Thank you also to project advisor Dr. Tonya Boone, VCRC Director Thomas Ruppert, and VCRC Assistant Director Cameron Bruce for their thoughtful guidance and support.

There are many people who have contributed to this project from inception to completion. Their insights and support were invaluable:

- Natalie Klesch, VIMS M.A in Marine Policy
- Dr. Doug DeBerry, Research Assistant Professor of Environment & Sustainability at William & Mary
- Dr. Kirk Havens, Center for Coastal Resources Management at VIMS
- Dr. Stephen Via, Associate Professor of Biology at Norfolk State University
- Dr. Taylor Sloey, Assistant Professor of Biological Sciences at Old Dominion University
- Vince Bowhers, Restoration Manager at Lynnhaven River Now
- Brent Hunsinger, Advocacy & Coastal Programs Director at the Friends of the Rappahannock
- Phoebe Murrell, Restoration & River Star Homes Program Manager, and Luísa Black Ellis, Director of Resilience & Community Engagement at Elizabeth River Project
- Gabi Kinney, Assistant Director Living Infrastructure, and Stacie McGraw, Director of Operations & Living Infrastructure at Wetlands Watch
- Jamie Brunkow, Director of Ecology, and Ryan Walsh, Senior Coastal Restoration Manager at James River Association
- Edward Zimmer, Deputy State Forester, Virginia Department of Forestry
- William Judd, Instruction & Research Librarian for Business at William & Mary

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Executive Summary

The Chickahominy Indian Tribe partnered with William & Mary's Virginia Coastal Resilience Collaborative to create a business plan for a native plant nursery. The Tribe intends for the nursery to supply plants for shoreline restoration, aiding in environmental stewardship and encouraging cultural resilience and economic opportunity. To mitigate the risks of a new business venture, the business plan gives recommendations for a small-scale pilot nursery.

Market Opportunity
In coastal Virginia, native plants are needed for living shorelines, which are a nature-based solution to help mitigate the impacts of sea level rise through erosion control. Living shoreline permit applications have been on the rise for the past 10 years, reflecting demand for native plants. In a pilot phase, targeting local nonprofit practitioners as nursery clients is likely the best option for the nursery. Data gathered from five nonprofits shows that a small nursery can provide full orders for small nonprofit-installed projects. Nonprofits frequently source *Spartina Alterniflora* and *Spartina Patens* out of state, but some would value the opportunity to source these plants locally. If the nursery can meet product expectations, compete with other nurseries, and form relationships with nonprofits, it could capture some out-of-state customer demand.

Sourcing Strategies
The plant type cultivated determines its performance at the outplanting site. There are three material options: local seeds, nursery stock, and wild-harvested plants. Local seeds are the best option for fostering genetic diversity and growing a local ecotype, which creates a resilient plant. Seeds are difficult to germinate, but the Tribe has the opportunity to work with a nonprofit to learn the basics. Propagating plants from existing nursery stock is another option, but it does not promote genetic diversity and may not yield local ecotypes. Using wild-harvested plants ensures the plants are locally adapted, but this option has the most challenges.

Production and Costs
The nursery can utilize a new or existing minimally or semi-controlled propagation environment to grow containerized plants. Based on estimates, the set up with the cheapest costs in the first year, although not by a significant amount, is a minimally controlled environment that grows plants from wild-harvested plants. Costs of labor and a water source have the greatest impact on the total cost but can be manageable provided the Tribe receives funding. There are multiple avenues for the nursery to market itself, acquire clients, and engage with the local community. When scaling up production from the pilot phase, the nursery can expand stock and clients.

Ultimately, there is a need for in-state suppliers, and a small-scale nursery established by the Tribe can feasibly supply for small nonprofit projects. There are challenges with sourcing material and production, but with effective planning, the nursery can generate long-term success for the Tribe and coastal restoration.

1. Background

Formation of the Proposal

Upon investigating growing native and culturally important grasses, the Chickahominy Indian Tribe realized a need for native plants in shoreline restoration projects. The Tribe partnered with William & Mary's Virginia Coastal Resilience Collaborative to formulate a native plant nursery business plan. This business plan poses an opportunity for the Tribe to promote its values of sustainability, cultural preservation, and economic opportunity. Graduate VIMS student Natalie Klesh, working under the supervision of Donna Bilkiovic, completed a study on the supply and demand of native coastal and wetland plant species in Virginia. Klesh's report is the intended foundation for this business plan.

The *Chickahominy Indian Tribe Native Plant Nursery Feasibility Study* project proposal, finalized in February 2025, details the plan for the project including objectives, methodology, and outcomes. According to the project proposal, the outcomes are:

- A comprehensive business plan outlining the establishment and operation of a Native Plant Nursery on Chickahominy Indian Tribal land.
- Clear strategies for marketing, sales, and outreach to promote the nursery's products and services to potential customers and stakeholders.
- Financial projections indicating the viability and potential profitability of the nursery over the first five years of operation.
- Recommendations for incorporating principles of environmental sustainability and cultural preservation into all aspects of the nursery's operations.
- A roadmap for implementation, including key milestones, timelines, and responsibilities for executing the business plan and launching the native plant nursery.[1]

Some terms of these outcomes changed as the scope of the project shifted, but generally the outcomes remain the same. On June 9, 2025, Tribal Leaders gathered on video conference with VCRC representatives involved in the project to discuss a vision and goals for the nursery. Based on the discussion and desires of the tribe, the following information was established:

- The Tribe does not have any revenue generating businesses or prior business management experience.
- The nursery will primarily focus on cultivating grasses utilized in shoreline restoration.
- The nursery will first target the Chesapeake Bay region and can expand customer location upon further development.

- The Tribe would like the nursery to be a self-sustaining operation and hopes that it can eventually be a profitable endeavor.
- The early stages of the nursery will run in a pilot phase. The first few seasons of production will practice growing operations and customer relations before scaling up production.
- To minimize upfront investment, utilizing an existing production site may be ideal.
- Tribal community members have minimal involvement in the project thus far, but leadership hopes to involve citizens in later stages.
- The extent of Tribal members' agriculture and gardening experience is unknown, but likely limited.
- The nursery will be an educational and community building space for collaboration.

Defining a Pilot Nursery

The plant nursery business can be a challenging, volatile, and unpredictable endeavor. It requires both business management knowledge and plant expertise. Because the Chickahominy Tribe does not have experience running a nursery or members with adequate knowledge of plant growth, we recommend that the nursery launches in a pilot phase. A pilot phase, otherwise known as a testing phase, is a best educated guess on the optimal nursery production operation. In the pilot phase, a nursery runs on a small scale to gather information that can be used to scale up operations after a few seasons, such as:

- What infrastructure is really necessary
- Ideal plant material source
- Optimal propagation techniques
- Estimated costs per season
- How to build client relations
- How clients respond to the plants
- How to develop growing timelines

This initial phase can help minimize upfront investment and the risk that comes with taking on a business venture.[2]

Tribal Nurseries in the United States

"'*As stewards of the land, we are committed to promoting sustainable practices and drawing from the wisdom of our ancestors*.'" [3]
– Chickahominy Indian Tribe

Across the United States, other indigenous tribes have similar goals to the Chickahominy. Native plant nurseries owned and operated by tribes are an increasingly common practice to give back to the land. According to the Forest Service National Center for Reforestation, Nurseries, & Genetic Resources, indigenous tribes gathered in 2001 from across the United States to share issues related to plant production and restoration. Common deficiencies in areas such as nursery training and preservation of ecological knowledge were identified. The Intertribal Nursery Council (INC) was founded by tribal members to create a tribal nursery network. In 2003, a Tribal Nursery Needs Assessment was completed by USDA to create a framework for addressing common problems in INC nurseries. Subsequently, the Tribal Nursery Manual was written. The manual details nursery processes from forming a vision, all the way to propagation and nursery management. The INC meets once a year to share knowledge and promote collaboration.[4]

Before the founding of the INC, it is estimated that 10 tribal plant nurseries existed. As of 2021, there were about 100 nurseries, likely thanks to the INC and the needs assessment that connected tribes with similar restoration and community-building missions.[5] In those 20 years of development, tribal nurseries became more visible to the public. With more resources available, nurseries across the country are now thriving. An example is The Confederated Tribes of Grand Ronde in Oregon, which runs the Tribal Native Plant Materials Program, founded in 2014. With generous grants and funding, it now grows containerized plants, houses 41 different species, and utilizes a hoop house for seedlings. Besides the restoration benefits of the plants, the nursery is a gathering place for community members and youth to learn about conservation and traditional ecological knowledge.[6] Today, countless other tribal native plant nurseries are champions of restoration projects, while diversifying income streams and strengthening cultural resilience. The Chickahominy can look to these tribes for inspiration for their goals.

2. Market Overview

To assess the need for a Chickahominy nursery, looking at the market for native plants is necessary. This section overviews the larger national market for native plants in restoration projects, narrows in on the Virginia living shoreline market that the Chickahominy will target, and eventually points to a specific market sector that the nursery can best provide for while in the pilot phase.

National Shortage of Native Plant Material

As weather becomes more extreme, droughts are more frequent, and natural disasters are commonplace, the United States has increasingly abundant natural landscapes that need restoring. Native plants are the best option to revive these degraded and vulnerable ecosystems,

as “diverse communities of locally adapted plants are often better than non-native species at resisting stresses…”[7]. There is an urgent need for native plants in places like the Pacific Northwest, where wildfires frequently wipe out vast stands of trees, but past studies and surveys on the native plant market indicate a “chronic commercial shortage of [native plant material]”[8]. Even further, of 760 native plant material users in an Eastern United States survey, “75% expect their organization’s demand for native plants to increase over the next 10 years”[9].

Each region of the United States faces unique restoration and land management challenges. Local communities must unite to attack plant material shortages from a regional level. In coastal Virginia, one major issue is sea level rise. Living shorelines are a common restoration project, and they require significant amounts of native plants.

What are Living Shorelines?

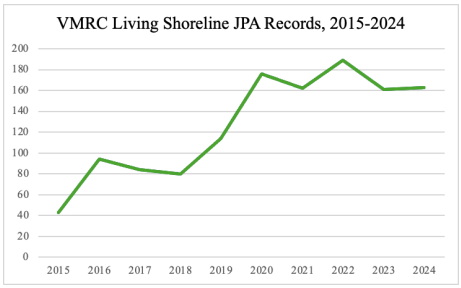
Coastal Virginia is facing threatening rates of sea level rise, causing floods, the inundation of wetlands, and property loss.[10] To fight the effects of shoreline erosion and wetland loss on ecosystems and coastal communities, living shorelines are utilized as a nature-based shoreline adaptation solution. They use vegetation and organic material, bank grading, and engineered structures to reduce wave energy, mitigating erosion and property damage, especially during storms.[11] Other benefits of living shorelines include the filtration of pollution, improvement of water quality, and habitat creation. Native plants are the key vegetation component in living shoreline projects. They are adapted to the local climate and growing conditions. These plants in tidal marshes and riparian buffer zones create an extensive root network that holds soil stable.[12] The Chickahominy nursery will be a provider of key native plants used in living shorelines.

Growing Demand for Living Shorelines

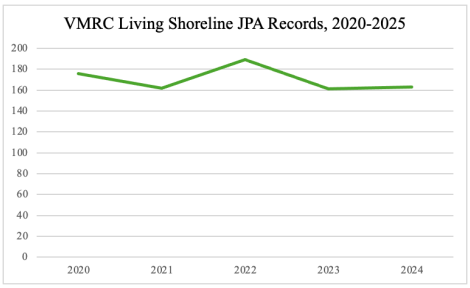
In recent years, the amount of living shoreline projects has rapidly increased. In 2020, the Virginia General Assembly amended the Virginia Wetlands Act, making living shorelines the default method for shoreline stabilization unless the “best available science” suggests a better solution. The living shoreline permit process requires that a Joint Permit Application (JPA) be submitted to the Virginia Marine Resources Commission (VMRC).[13] The data on JPAs can act as a representation of the anticipated living shoreline project activity, or a proxy for demand. It is important to note that not all JPAs are implemented due to a variety of factors that prevent follow through for living shoreline projects. However, the anticipated demand depicted by the JPAs is an important indicator of intent and the public’s general sentiment around living shorelines.

Looking at the VMRC database, an increase in the demand for living shorelines in the last 10 years is apparent. In 2015, the number of living shoreline JPAs was 46. In the year 2020, when

the Virginia Wetlands Act was amended, the number of living shoreline JPAs dramatically increased from 114 to 176 (Graph A). The living shoreline JPA growth trend has stabilized more in the last 5 years since the new code, as depicted in Graph B.[14]



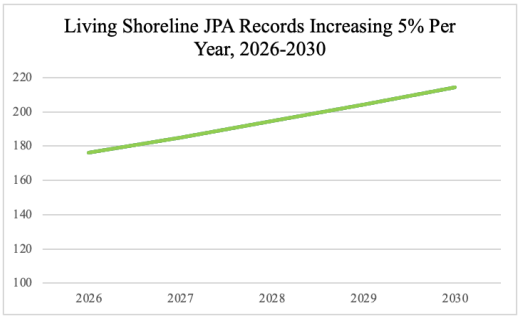
Graph A



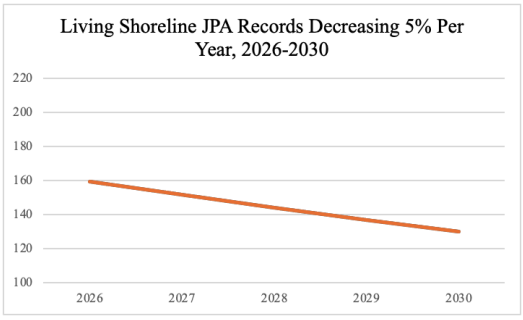
Graph B

The Chickahominy nursery will be entering the native plant market at a time when demand for living shorelines, and subsequently native plants, is high. It is necessary to gain a sense of what the living shoreline market will look like in the next 5 years, but first growth constraints must be addressed. Because of constraints like the limited amount of contractors and organizations fit for engineering a shoreline, funding and grant availability, implementation capacity, and landowner interest, JPAs are unlikely to have another jump like the one in 2020.[15] Even further, these limitations could potentially cause the JPAs to decrease in coming years, especially if federal and state funding for these projects becomes scarce.

To evaluate future projections of JPAs, data for January to July of 2025 was annualized to 168 JPAs to account for the expected amount for the entire year. Prior year data, including 2025, was used to estimate optimistic, pessimistic, and base scenarios. In the last 3 years, there have been minimal changes in JPAs. There were 161 JPAs in 2023, 163 in 2024, and 168 in 2025.[16] To reflect the recent low volatility, 5% increments per year based on the 2025 number were used to project optimistic (Graph C) and pessimistic (Graph D) forecasts.

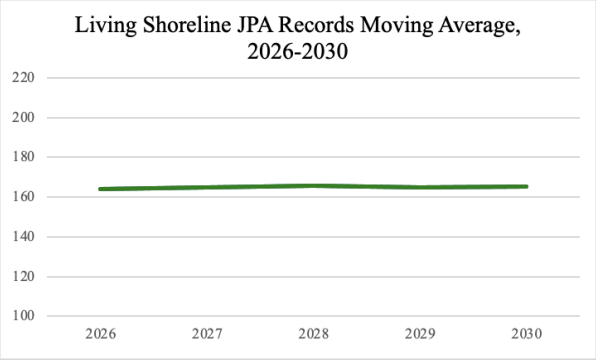


Graph C



Graph D

The optimistic forecast shows that in 2030, there will be 214 JPAs. In contrast, the pessimistic forecast predicts 130. The difference in these forecasts is significant, yet both scenarios still reflect meaningful demand for living shorelines in the wake of the Virginia Wetlands Act. Even in a pessimistic case, there is still significantly more intent for living shorelines than before 2020. Graph E shows what a steady state of JPAs may look like over the next 5 years using a 3-year moving average, which is the average of the prior 3 years for each year. It is difficult to predict exactly what the living shoreline landscape will look like in the next 5 years, but these forecasts serve as a reminder that there would have to be significant disturbance for the anticipated demand of living shorelines to fall back to pre-2020 levels.



Graph D

As previously mentioned, not all JPAs are made a reality. In these cases, JPA records do not accurately reflect the actual living shoreline projects that require native plants. However, the influx of JPAs shows interest and pressure building in shoreline restoration that should give cause for appropriate preparation. The JPAs offer a wide picture of the current trends in living shoreline camaraderie. This business plan dives into a specific market sector in hopes of offering a valuable supply solution.

The Nonprofit Market Sector

Living shorelines are implemented by practitioners, often either private contractors or nonprofit organizations. Sometimes, nonprofits work with private contractors to install a living shoreline. In both cases, nonprofits assist with obtaining funding, increasing homeowner awareness, creating resources for the permitting and installation process, along with installation and plant procurement.[17] The nonprofits working on living shoreline projects in the Chesapeake Bay watershed are passionate and determined in their work. As mission-based organizations, nonprofits are more likely to care about building tribal partnerships, engage in informal and relationship-based contracts with plant nurseries, and take on smaller projects that do not require additional resources. Because the Chickahominy Tribe nursery will need time to build relationships with clients and develop a reliable growing and distribution timeline, we

recommend that the nursery focuses on nonprofit clients during the pilot stage. Working with nonprofits is a great way for the nursery to establish itself before branching out to other clients.

When targeting the nonprofit sector, the JPA data is not directly relevant, as there is no way to discern which projects will be nonprofit implemented. While it is difficult to determine the exact share of the projects that nonprofits account for, qualitative information, existing research, and data collected for this project show the relevant opportunity to provide native plants for nonprofit-implemented living shorelines.

Especially since 2020, environmental nonprofits operating in Virginia's area of the Chesapeake Bay have worked to spread awareness about living shorelines. In 2019, the Living Shoreline Collaborative (LSC) was founded by two nonprofits, the James River Association and Wetlands Watch. The LSC is an organization that brings together diverse stakeholders to create a connected stream of collaboration.[18] In 2022, the Chesapeake Bay Landscape Professionals piloted the Living Shoreline Training Certificate for Coastal Landscape Professionals to aid in increasing the amount of people who have the knowledge and skills to install a living shoreline.[19] Additionally, in 2024, Wetlands Watch launched a comprehensive document, "Designing Living Shorelines for Sea Level Rise in Virginia: A Resource for Practitioners", in hopes of educating practitioners on case studies and best practices.[20] A handful of local nonprofits have been hard at work the last five years, and their efforts show activity in the nonprofit sector.

3. Native Plant Demand for Nonprofit Living Shoreline Projects

Research done by Natalie Klesch, a Virginia Institute for Marine Science graduate student, builds on the JPA data, showing that the demand for native plants aligns with the increase in Virginia's JPAs. Klesch interviewed six practitioners, including four nonprofit organizations and two private contracting firms, and six native plant nurseries. All of the practitioners expressed that their "use of native coastal and wetland plants had increased over the last five years"[21]. Five of the practitioners claimed that their use of native plants will continue to rise over the next two years.

The last five years saw a sharp increase in living shoreline projects that remains substantial, and the need for native plants has to be met if these projects are to be successful. Unfortunately, the native plant market in Virginia was not well equipped to handle the surge in coastal and wetland plant demand. All six practitioners reported the preference for sourcing their plants in-state for multiple reasons, including lower shipping costs and obtaining regionally adapted plants, also called local ecotypes. Despite this, all of the nurseries noted that they rely heavily on out of state sourcing because of the lack of reliable in-state supply. Klesh's interviews also show asymmetry between native plant species supply and demand. The most fundamental species for living

shoreline and wetland restoration projects are not supplied and available at the rate necessary. *Spartina Alterniflora* and S*partina Patens* are wetland grasses that all six practitioners reported using, but only one nursery reported growing each of these species.[22]

Results from Discussions With Local Nonprofits

For this project, five key local nonprofit practitioners were consulted to assess the scale of their projects, their demand for native plants, and their current sourcing practices. The Chickahominy Tribe nursery can use this information to gain an understanding of potential customers and assess the feasibility of providing for nonprofits.. The questions asked during these discussions evolved as the project progressed and new needed information was identified, so not all organizations were asked the same questions, nor are there answers available from all organizations for all of the questions. The organizations consulted were Lynnhaven River Now (LRN)[23], Friends of the Rappahannock[24], Elizabeth River Project (ERP)[25], James River Association (JRA)[26], and Chesapeake Bay Foundation (CBF)[27]. All numerical data provided in this section is an estimate obtained from the knowledge of the practitioners.

Recommended Native Plants

When speaking with a variety of experts for this project, including nonprofit practitioners, one issue expressed multiple times was the unavailability of *Spartina Alterniflora* in Virginia. Three practitioners reported sourcing all *Spartina Alterniflora* and *Spartina Patens* from Delmarva Native Plants in Maryland, one of the closest providers that can reliably fill large orders. Another practitioner mentioned an instance where they were not able to fill a project entirely in state and had to source from Environmental Concern nursery, also in Maryland. LRN noted that if any plant is ever hard to come by, it is *Spartina Alterniflora*, and it will likely become increasingly difficult to find it locally. *Spartina Alterniflora* and *Spartina Patens* are critical wetland species that protect shorelines from erosion,[28] so it makes sense that they are in high demand.

We recommend that the Chickahominy Tribe nursery grows *Spartina Alterniflora* and *Spartina Patens* in the pilot phase. Additionally, *Juncus Roemerianus*, another dominant species,[29] is frequently planted above high tide. One practitioner recommended this plant, and it was also discussed with the Chickahominy Tribe during a meeting. With these three plants, the hope is that the nursery can be a one-stop-shop for foundational native plants used in living shoreline projects.

Nonprofit Practitioner Market Size

Four of the five organizations consulted most commonly work on small to medium residential living shoreline projects. Although size differs depending on the site, the size for a small project is usually between 60 to 400 linear feet of shoreline, as one practitioner reported, or an average of 150 linear feet as another noted. Usually, a living shoreline is planted back 8 to 10 feet from the shoreline and 1 plant is installed in every 1 square foot of shoreline. For a 100 linear foot shoreline planted 10 feet back, 1,000 plants would be used. For comparison, a larger and more rare project that JRA worked on was a 14,000 linear foot shoreline.

Each nonprofit estimated a low and high number of native plant plugs used in smaller projects, often *Spartina Alterniflora* and *Spartina Patens*. They also estimated a low and high number for how many of these projects they complete a year. Using this information, the demand for plugs of *Spartina Alterniflora* and *Spartina Patens* in these nonprofits' small living shoreline projects is anywhere from 11,500 to 39,500 in a single year (see Appendix A). The small number estimates the number of plugs in a year when each nonprofit completes a low amount of projects using a minimal amount of plugs. The high number estimates the number of plugs in a year when each nonprofit completes a high number of projects using the maximum amount of plugs needed for a smaller project. The lowest plug count recorded was 400, and the highest plug count recorded was 3,000. In total, the number of projects ranges between 19 and 26.

Plugs used in larger projects were not accounted for in this estimate, as the Chickahominy Tribe nursery will only have the capacity to fill smaller orders in the pilot phase. CBF mostly completes large projects, estimating the use of 9,000 plugs per project, so their plug usage was not included in the estimate. However, CBF did offer valuable information on their general sourcing practices, which was included in the proceeding sections. This estimate also does not include plugs used for replanting projects, which most organizations do during check-ins on their past projects. For example, ERP stated that they use 1,000 to 3,000 plugs every year on all replanting projects. The 11,500 to 39,500 plugs per year estimate is only based on four nonprofits' small projects and therefore is not representative of Virginia's entire nonprofit native plant demand, but it can be used for the purposes of this project to evaluate opportunity for the nursery.

When asked if they saw living shoreline projects increasing in the next five years, practitioners gave mixed responses. No responses mentioned a projected decline due to an overall decline in living shoreline projects, however. One practitioner noted that their 2 to 3 projects a year used to be only 1, and they hope to continue the upward trend. Another has ample funds available for living shoreline projects, but ultimately whether projects increase depends on interest from homeowners. Two others noted internal changes that could affect their projects. The plug estimates given by Friends of the Rappahannock are likely to decrease in the coming seasons as they decrease direct work on living shorelines to increase work as a liaison between homeowners and contractors.

Despite any future changes in the nonprofit living shorelines installed–growth, decline, or a steady state– one thing is apparent: there is a need for reliable in-state sources of native plants. Two practitioners explicitly expressed that it is preferable to source plants locally, and two expressed that ideally they would like to source locally, but certain expectations must be met. As the Chickahominy nursery establishes itself, it has the opportunity to be a valued in-state supplier of key wetland species. Even in a small pilot set up, it may be capable of filling multiple small project orders, according to the minimum plug count of 400. As the nursery grows over the seasons, it can work on redirecting out of state purchases locally and continually increase how much of the local market it captures.

Product Expectations

Even though there is a gap in the local market, to redirect out-of-state purchases locally, the Chickahominy nursery must deliver a quality product and customer experience. It is not just lack of availability that prevents in-state purchases, one practitioner noted. There are a variety of other factors that go into a sourcing decision. Cost, availability of species, quality of plants, and clear supplier communication are all factors that constitute where a practitioner chooses to source their plants.

Competition and Lead Time

The Chickahominy Tribe nursery's competition will be a mix of in and out-of-state suppliers. Larger nurseries already mentioned, like Delmarva Native Plants and Environmental Concern, house facilities that are capable of producing plants for high quantity orders. These nurseries may be difficult to compete against because of their production capabilities. Two of the three practitioners who order from Delmarva do so on a need basis, meaning that Delmarva can consistently deliver high quantities of plants without being priorly informed. In comparison, a smaller nursery likely requires substantial lead time to fill orders, which is the amount of advance notice a practitioner gives a grower.[30] To compete with larger nurseries, the Chickahominy nursery must have clear and consistent communication with nonprofit practitioners, or an informal agreement, prior to the growing season to plan nursery stock.

Other nurseries mentioned by nonprofits were Charleston Aquatics, Lady Fern's Native Plants, Southern Branch Nursery, and Aquatic Plants of Florida. One practitioner sources *Juncus Roemerianus* from Charleston Aquatics. Lady Fern is a small, mostly native nursery located in Norfolk.[31] Southern Branch is located in Hampton Roads and offers all three recommended plants for sale.[32] There are a handful of other local nurseries that offer *Spartina Alterniflora*, *Spartina Patens*, and *Juncus Roemerianus*. CBF often has trouble finding flowering species in the state and orders them from Aquatic Plants of Florida.

Pricing

It is difficult to analyze current market pricing for these plants. Some nursery websites do not place pricing directly on the website and require a call, and for others, pricing varies based on quantity ordered and container size. The three practitioners who frequently order from Delmarva shared that they purchase their plugs for about $0.85. A practitioner who was not asked how much they pay for plugs nevertheless expressed frustration at the price of Ransone's Nursery plugs, which according to the practitioner, is $2.50 per a plug. Ransone's is located in Weems and is primarily a landscape and shoreline stabilization contractor.[33]

Because the Chickahominy nursery will be a local supplier, practitioners can save money on pick up or delivery costs and could be willing to pay a premium for their plants. The quality and type of plants that the nursery produces is also an important factor when deciding pricing. In the Survey of Native Plant Materials Use and Commercial Availability in the Eastern United States, 83% of respondents that prefer local ecotypes would pay a premium for them. Additionally, despite 78% of all respondents reporting that cost of plants is a limiting factor, over 60% would be willing to pay up to a 50% premium to obtain their preferred local ecotypes.[34] If the Chickahominy nursery supplies truly local ecotypes, it may gain an advantage in the pricing.

A smaller operation may not be able to sell plugs at the same price as a larger one. Large nurseries benefit from economies of scale, which states that the more plants that are produced, the cheaper a plant becomes when fixed costs cover more units produced. The ideal range for a plug is somewhere between $0.85 and $2.50. Depending on costs of production (see Cost Analysis), different price points may be considered.

4. Sourcing Plant Material

Propagules

Plants are grown from other plant parts, called propagules. When choosing how to source growing materials for native plants, the two main propagules to choose are seeds or vegetative material.[35] In the wild, *Spartina Alterniflora,*[36] *Spartina Patens*,[37] and *Juncus Roemerianus*[38] reproduce vegetatively, via networks of thick root systems called rhizomes, and sexually, via seeds that are released from stems. Vegetative reproduction is the propagation of cuttings or stem divisions, when one takes a part of an existing plant to grow a new one. Growing plants from seeds is sexual reproduction.[39] Each type of propagule for each plant has its own advantages and disadvantages. There is minimal modern information available on the production of foundational native wetland plants for restoration projects, but as the demand for them rises along the eastern coastline, research on the best practices for growing them continues to emerge. There are few

options for obtaining a reliable propagule source to start the Chickahominy nursery, but with input from people spearheading the effort to make Virginia's native plant production more accessible, especially that of *Spartina Alterniflora*, this section lays out considerations for growing and outplanting, possible sourcing avenues for each propagule, and associated costs.

Genetic Diversity and Local Ecotypes

To understand how best to serve the nonprofit native plant market, it is important to determine how to produce a high performing product. Practitioners' goals are to create a resilient and persistent living shoreline, so the native plants selected must be fit for the job. Klesch's research notes that Virginia practitioners prefer local ecotypes,[40] which are plants grown from regionally adapted seed sources,[41] instead of cultivars. Cultivars are plants that are bred by humans and selected for specific traits. When propagating from vegetative material, the product is a clone of the parent plant, meaning that the offspring has identical genes. Cultivars are propagated via stem divisions or other non-seed plant material to keep the same characteristics as the parent plant.[42] Several practitioners in Klesch's study voiced concern that reliance on cultivars, instead of local ecotypes, could eventually reduce genetic diversity,[43] especially when repeatedly using cloned plants in living shoreline projects.

The issue of genetic diversity in projects with *Spartina Alterniflora* is an ongoing and debated topic. The traditional assumption about *Spartina Alterniflora* is that it reproduces clonally far more frequently than sexually by seeds, leading some to believe that genetic diversity among wild clonal populations is low.[44] However, some researchers have shown that *Spartina Alterniflora* exhibits high clonal diversity, suggesting that sexual reproduction, and therefore genetic diversity, may be crucial to this species. One study notes that this high diversity has implications for restoring coastal ecosystems. Whether or not genetic diversity is promoted in outplantings can dictate the wetland's ability to weather environmental stressors and disease, and ultimately persist in the long-term.[45]

"Many of the native plant nurseries in Virginia purchase their seeds and plugs from out-of-state to grow in their greenhouses and then sell in-state as "Virginia" plants." [46] – Respondent in "A Survey of Native Plant Materials Use and Commercial Availability in Eastern United States"

In addition to genetic diversity, it is important that plants are adapted to the specific conditions of an outplanting site. Plants sourced out of state, which is the case with many practitioners, are not adapted to the conditions of outplanting sites in coastal Virginia. If nursery plants are not well adapted, a planting site could fail, either in the short term or long term. The issue of locally adapted plants is complex and uncertain– restoration projects are necessary and plants are

needed, but with minimal knowledge on how non-adapted plants will perform in the long run, they could have adverse impacts on coastal ecosystems.[47]

The Director of Resilience and Community Engagement at Elizabeth River Project, Luísa Black Ellis, commented in a local news publication on the fact that native plants for living shoreline projects are often sourced out of state: "When we're planting these native plants from these faraway places, we don't necessarily know that they are actually as climate resilient as we're hoping"[48]. When consulting Dr. Stephen Via, a native plant production researcher at Norfolk State University, he also urged the importance of sourcing propagules locally if they are to be used for nursery operations.[49]

With this information as a consideration, there are three options for sourcing propagules for the nursery. Each avenue may be pursued alone, or if the Tribe sees fit they can choose multiple sources of native plant propagules. *Spartina Alterniflora* is often considered the most dominant foundational wetland plant, and therefore most sourcing options and research done for this section is in support of *Spartina Alterniflora*. Sourcing and propagation of *Spartina Patens* and *Juncus Roemerianus* face similar challenges.

Seeds

Seeds are often deemed the most challenging propagule for the production of the selected native plants for the Chickahominy nursery. The usage of seeds requires a lengthy timeline and is the riskier option due to low germination rates.[50] Seeds are still labeled as unfavorable frequently because modern research on seed germination in a nursery environment for these plants is still developing. There are limited commercial sources of these seeds available on the market, so a common source of seeds is from the wild or local seed banks.

Seed collection in the wild can be highly successful, but it is a careful practice. Collecting seeds requires manpower to harvest vast amounts, perfect timing during the season, knowledge of plant identification, lawful access to habitat, and precarious best practices in the field to collect from a variety of individuals and respect the surrounding environment.[51] Once collected, one of the most difficult aspects of growing these seeds is determining which are viable. *Spartina Alterniflora* seeds are known to have low viability rates, meaning that while production of seeds is high, not all contain an embryo.[52] To assist in increasing germination rates, seeds can be sorted to determine which are viable and which are not. Once sorted, existing research on germination methods notes that *Spartina Alterniflora* seeds require cleaning and a cold stratification period for a few months.[53] Seed germination afterwards requires specific conditions before being potted in containers.

Source

The Chickahominy have the option to collect seeds in the wild if they wish, but during a discussion with ERP's Black Ellis, she expressed enthusiasm about a collaboration with the Tribe. Black Ellis recently pioneered a Native Seed Library at ERP in the Spring of 2025. The Seed Library, named the Seed Keepers Program, is working to promote environmental and cultural resilience. Beyond collecting seeds to fill the library, the program offers educational sessions on seed harvesting and processing. Once users take seeds from the library, the only rule is that they must eventually return seeds harvested from their mature plants to the library for others to use.[54]

Masters student Eric Liu at Old Dominion University's Wetland Plant & Restoration Lab led by Dr. Taylor Sloey is conducting research with Black Ellis at ERP on how plants grown from locally adapted seeds perform at a restoration site in comparison to non-locally sourced plants. Additionally, they are reviewing existing literature on growing these plants from seed and conducting new studies. ERP is doing the grunt work in hopes of "foster[ing] a market for native wetland seeds to be grown and sold by nurseries in the region"[55]. When consulting Black Ellis for this project, she emulated that wish. Black Ellis expressed excitement at supplying seeds for the Chickahominy and getting them involved in this mission. She estimates that she is able to supply the Tribe around 10,000 *Spartina Alterniflora* seeds, although she added that if the Tribe has a different specific target amount, Seed Keepers can prioritize harvesting that given number. She noted that of 10,000 seeds they collected last year, only 7-10% were viable, yielding about 700 to 1,000 plants.[56]As for *Spartina Patens* and *Juncus Roemerianus*, she mentioned that they are willing to harvest what the Tribe thinks will be valuable for them. Seed Keepers plans to harvest *Spartina Patens* this season, and they have harvested *Juncus Roemerianus* in the past. Ultimately, the Tribe must communicate their needs with Seed Keepers to decide on an ideal number and variety. Black Ellis also shared that her team of researchers would be willing to hold a seed-sorting workshop with the Tribe to help them learn the basics.

Vegetative Material

The easier and generally more reliable source for native plants is vegetative material. *Spartina Alterniflora* has thick, dense networks of rhizomes that can be divided by the stems and replanted for successful propagation.[57] This method uses vegetative material, so the plants produced are genetic clones of the divided plants. One plant yields multiple propagules and plants. The exact amount depends on the size and number of stems of the original plant. While this method may not yield the same genetic diversity as seeds, it is less risky for the grower.

Source

The two options to source vegetative material for propagating *Spartina Alterniflora* that USDA notes are commercial nurseries or donor wetlands.[58] The Chickahominy may decide to order plants from another nursery, in or out of the state, and create their nursery stock using existing plugs. Sales of these plants happen in early spring to late summer. The Chickahominy would have to monitor stock throughout the summer or make an agreement with a nursery to purchase stock at the end of the summer. The plants must be stored in proper conditions during the fall until they are able to be divided in the winter time. The range of price for this option is anywhere between $0.85 and $2.50. The Tribe can order from a large nursery, like Delmarva, for a cheap, high quantity order. If the Tribe would prefer to source from local stock, it is recommended that they confirm the origin of the plants they order from a local nursery. Just because a nursery is local does not mean that the plants are local ecotypes. Purchasing local stock could cost the tribe upwards of $2.50 a plug, per the price of *Spartina Alterniflora* at Ransone's.

There is another option for vegetative material propagation that would support genetic diversity and cultivate local ecotypes. Obtaining plants via a donor wetland is not recommended by the USDA, but it has been done in the past, and current research is underway to see if it is a better possibility in the future. A study done in 1974 on the *Propagation of Spartina Alterniflora for Substrate Stabilization and Salt Marsh Development* identified "transplanting of established plants obtained by digging and dividing mature plants from natural stands"[59] as one of three means of propagation for *Spartina Alterniflora*. Dr. Via at NSU is doing similar research, looking into the feasibility of harvesting grasses from wild wetlands and cultivating them in a nursery environment. He hopes to develop modern, accessible propagation techniques that do not require seeds, while still producing local ecotypes. Dr. Via is testing the splitting of various numbers of stems, preferred watering conditions, and how fast the area of marsh removed can recover. Dr. Via's results so far indicate that wild plants that are divided and transplanted with two or more stems have the highest survival rates. Watering conditions mattered less than the size of the plants, as long as the plants had sufficient water. As for the donor wetland, the holes removed were small, and there were no major impacts on the surrounding ecosystem.[60] Dr. Taylor Sloey, leader of ODU's Wetland Plant & Restoration Lab, conducted similar trials to Dr. Via. She noted that the donor wetland in her trials was not as resilient as Dr. Via's, though.[61] There is ongoing research on this propagation technique, and it may be a viable option for the Chickahominy nursery.

The largest obstacle with this sourcing strategy is understanding laws and regulations around taking plants from wild populations. Dr. Via shared that from his research, he could not find any wording in codes that stated wetland disruption at a scale as small as his research was illegal. However, he did recommend that a WP1 permit (general permit) may be the best option for extra

personal protection. He also worked with the Middle Peninsula Public Access Authority. Dr. Sloey recommended working with the Army Corps of Engineers, as they manage regulation.

If the Tribe selects this sourcing option, it is recommended that they conduct ample research on laws and regulations before proceeding. Dr. Via offered his assistance to the Chickahominy for the act of wild plant harvesting, including necessary tools and equipment. Unless a permit is deemed necessary, associated costs for this option are low to none.

5. Production

Every plant nursery should be designed to fit the product's and grower's specific needs. Each aspect, including location, propagation environment, propagation structure, irrigation, and growing timeline will differ between nurseries. Locations that may be considered for the Chickahominy nursery include the Mamanahunt and James River properties, the New Kent Department of Forestry, and other property owned by the Tribe. Using an estimated range of plugs grown in a small nursery to fill a few nonprofit practitioner orders, options will be given for 1,200, 2,000, and 3,200 plug scenarios. This section combines the desires of the Chickahominy with the general best production practices for wetland restoration plants to offer options for an ideal set up. To gain expert advice, Dr. Via operates a greenhouse at NSU and was consulted about growing conditions.

Bare Root v.s Containerized

The first step of deciding what nursery production will look like is determining how the plants will be grown. There are two main categories of nursery grown plants: bare root or containerized. Bare root plants are grown in nursery beds and harvested without any soil around their roots. If grown outdoors in the ground, there may be a large upfront investment associated with land leveling and soil quality. Additionally, bare root nurseries often require more land, water, and time to grow. On the other hand, bare root nurseries tend to have lower operating costs. Container nurseries grow plants in propagation containers with an artificial growing medium. Constrained to a compact growing area, the roots of the plant bind with the growing medium, creating a plug when removed from the container. Containerized plants can be grown outdoors, depending on the climate and specific needs of the plant, or indoors, if growth-limiting factors like climate and pests would like to be controlled.[62]

The common form of plants for nonprofit living shoreline projects is a plug. Plugs are great at establishment in high impact outplantings where there might be wave energy.[63] To have more control over the growing environment, we recommend that the Chickahominy nursery grows its plants in containers. Planning for space needed and costs associated will be based on the 2x2

inch standard living shoreline plug container size, industry standard 10x20 inch flats, and 4x4 foot flood trays. The artificial medium used in the growth of native wetland plants varies, using sand, peat, and other soil mixtures.[64] For this scenario, a 1:1 mix of sand and peat will be used.

Propagation Environment and Structures

A propagation environment is defined as "any area that is modified to encourage the growth of nursery stock"[65]. There are three levels of propagation environments: minimally controlled, semi-controlled, and fully controlled. This business plan will focus on recommendations for minimally and semi-controlled environments, as these are very viable options and ideal for a pilot nursery.

Minimally Controlled

A minimally controlled environment is the least expensive and most basic nursery set up available. It is an outdoor area that is fully exposed to sunlight and the elements, often fenced to keep out animals. An outdoor container nursery would likely grow plants on benches surrounded by a fence. While this option has cheap start up costs, it is the riskiest for the plants. Rain, wind and pests are all considerations when choosing a site for a minimally controlled nursery. The plants do have a slight advantage being exposed to the elements though– they are often very well acclimated to outplanting conditions.[66] Virginia has a relatively mild climate, and it is possible to grow plants outdoors. Dr. Via grew 500 plugs outside during the winter time at NSU. The major challenge of growing outdoors is keeping water from freezing during irrigation, but Dr. Via shared that his plants were successful.

Semi-Controlled

A semi-controlled environment utilizes structures like cold frames, shade houses, and hoop houses to manipulate some growing conditions. This set up is a great alternative to a fully functioning greenhouse that utilizes electricity for a temperature control system. A simple propagation structure can help to keep out pests and extend the growing season earlier in the wintertime. For the Chickahominy nursery, a hoop house structure is the best option. Hoop houses are made from PVC pipes or metal framing in a tunnel shape with a thick plastic covering. The plastic covering aids in season extension by trapping heat from the sun inside the hoop house, caused by the greenhouse effect. In warmer months, it can become too hot inside a hoop house, so proper daily ventilation is necessary. Hoop houses with retractable plastic siding are very helpful in this case, where siding can be folded up for airflow during the day time.[67]

Location and Available Structures

Considerations for choosing a location for a minimally or semi-controlled nursery should be accessibility, proximity to a water source, and strength of the elements.[68] If an area of land floods often, it may not be the best option for an outdoor nursery. Potential locations are the Mamanahunt and James River properties and any other Tribal land, like land around the Chickahominy headquarters, that has ample space. The Tribe must ensure that zoning and land easement regulations are abided by when choosing a location.

On June 30, 2025, representatives from the Chickahominy Tribe and VCRC visited the New Kent Department of Forestry (DOF) center and met with Deputy State Forester Edward Zimmer to evaluate the possibility of using existing infrastructure.[69] There are three non-functional greenhouses that were last used 20 years ago for a tree seedling operation. Two of the greenhouses have the potential for refurbishment. From rough estimates made during the visit by Troy Adkins, the large greenhouse measures 100x50 feet and the smaller 90x30 feet. These greenhouses contain more than enough space to house a small nursery operation. The remaining infrastructure after 20 years of abandonment is just metal framing that used to hold a plastic covering and tables to hold the plants. The greenhouses were equipped with electricity and water access when they were functional.

To make one of these greenhouses ready for use, a new plastic cover would have to be installed, ideally one that has retractable siding. There are weeds and plants growing in the greenhouses that need to be removed. A semi-controlled growing environment does not need electricity, so electricity would not have to be re-installed. Water access at the old operation came from an underground line that stemmed from a pump in a river. Edward Zimmer believes that this pump is beyond repair, so a new pump or strategy for accessing water would be necessary. There is a storage shed next to the greenhouses in good condition.

Another option at the New Kent Department of Forestry is an open plot of land surrounding the greenhouses. This land could be used for either an outdoor nursery or a space to put a new hoop house in. The Tribe has the chance of receiving a donated hoop house, and it could be housed at the New Kent Department of Forestry. Any land usage at the Department of Forestry site would be the result of a land usage agreement between the Tribe and the Department of Forestry.

Irrigation

Although the proposed plants for the nursery are found in saltwater and brackish environments, they are typically grown in freshwater nursery conditions with tap water. *Spartina Alterniflora* is most often irrigated via sub irrigation.[70] Plug trays that contain small holes at the bottom of

containers are placed in flood trays. Water floods the trays one or multiple times a day and is soaked into the plant roots through the bottom opening of the container. This technique of irrigation does not require a great amount of water. Water can be recycled for use after flooding is complete.[71]

For a small nursery, Dr. Via confirmed it may be feasible to not have direct access to a water source. Keeping a reservoir of water filled from an outside source, like purchased gallons, could be an option. Additionally, utilizing rainwater as a means of recharging the reservoir is a sustainable option for water usage. If the DOF site is the chosen location and the Tribe chooses to source water from the nearby river, a new pump would have to be installed.

Spacing & Planning

To gain a sense of how much space is needed to grow a small, medium, and large number of plugs within the constraints of a small pilot nursery, an example scenario can be utilized. The chart below assumes the use of 4'x4' flood trays, 10''x20'' flats and plug trays that can each hold 50 2'' plugs. The Number of Plugs is determined so that there is no extra space in each flood tray. The Total Area and Total Perimeter are exact measurements based on the dimensions of the flood trays. It is unrealistic that a nursery is only as large as the area of the plants, so the Total Area was increased by 50% in the Total Realistic Area to include space for aisles between rows of plants and a buffer around the outside area of the plants.

Number of Plugs	Flood Trays Needed	Flats Needed	Total Area (sq ft)	Total Perimeter (ft)	Total Realistic Area (sq ft)
1,200	3	24	48	32	72
2,000	5	40	80	40	120
3,200	8	64	128	48	192

In the pilot phase, it is advantageous that the nursery not only grows what they place on their inventory lists, but also begins to experiment growing other high demand plants. When planning nursery production and allocating space for a certain number of plants, the Tribe may choose to incorporate a small section to learn propagation techniques for other species (see Scaling Up Production).

Additionally, when planning for spacing, the Chickahominy Tribe can incorporate culturally important plants and grasses that are hard to obtain. Plants like sweetgrass, sage, and tobacco can be grown to enhance the cultural purpose of this new business venture.

Growing Timeline

Since outplanting projects take place in spring and summer, mature plants should be ready as early as April. Seeds and vegetative materials have different growing timelines. Seed storage and germination should begin in early winter to ensure that they are ready for growth. In both cases, propagation must begin in the winter season, as plants take a few months to mature.[72] After growth in the propagation environment, plugs should be placed outside for a hardening period to acclimate to outplating conditions.[73]

6. Business Operations

Labor

Sufficient labor for the production of the plants and business management is needed. Because the tribe has minimal experience in agriculture and the recommended native plants have specific propagation techniques, it is advantageous to hire an expert to assist in the nursery. Hiring outside help comes in multiple capacities. If the Tribe would like to make it a community-based operation, a consultant can be hired to advise in a minimal capacity. The manual labor, including production and business management, may be done with volunteer labor if the Tribe feels it is a feasible option. Volunteers can include Chickahominy Tribe members, community members interested in native plants, and even student interns who could use the opportunity toward college credit. Bringing in an outside expert for larger involvement may look like hiring a part-time nursery manager. The nursery manager may still need volunteer labor, but this person would handle plant production and business management for about 25 to 30 hours a week, depending on the amount of plants grown.

General Management

Tasks for managing a nursery are diverse. There are essential tasks that must happen day to day, like watering, monitoring plants, and updating any plant records kept. Especially in the pilot phase, it is important to keep track of the phases of growth that the plants go through. Records can act as a blueprint for future seasons. Other semi-frequent tasks are equipment management, keeping production schedules and plant inventory up to date, and managing finances.[74] Since minimal lead time may be an issue for the Chickahominy nursery, a website should be updated frequently with stock lists. In addition to creating an accessible website, maintaining customer relations throughout the season is crucial for success. To understand what the nursery is doing well and what improvements need to be made for expanding after the pilot phase, it may be beneficial to distribute a customer survey to clients after transactions have been completed.

Transportation

While the Chickahominy nursery may be more local than out of state suppliers, distribution to customers is still a major consideration. Of the nonprofits interviewed, some strictly pick up their orders, and some strictly get them delivered. Despite this though, three organizations stated that if the nursery was close enough, they would pick up plants to avoid delivery costs. However, it is best to not rely on this practice. Depending on where the living shoreline project is and where the nursery is located, it may still be a far distance for a pick up. If the Tribe owns a large vehicle that can be used to transport plants, this may help save costs for deliveries. If not, renting a trailer or truck from U-Haul or another vehicle rental company for deliveries is the next best option. Delivery costs can be handed off to the client, but keeping costs low is still ideal.

7. Cost Analysis

There are a variety of situations presented that the Chickahominy nursery could implement. To best capture costs associated with different decisions, costs were estimated for eight scenarios for the first season of operation to account for a range of cost differences: low and high cost using seeds in a minimally controlled environment, low and high cost using seeds in a semi-controlled environment, low and high cost using vegetative material in a minimally controlled environment, and low and high cost using vegetative material in a semi-controlled environment. Given a range of scenarios, the Chickahominy can gain a sense of which nursery is best for them. All costs for this analysis were obtained using market research and listed prices on the internet. These costs are not meant to serve as an exact projection, but rather as an estimate of the cost differences between different decisions.

Defining Variable Costs and Fixed Costs

The variable costs estimated for starting a nursery include: propagules, plug trays, flats, flood trays, benches, soil, labor, miscellaneous tools/supplies, transportation, and propagation structure. Fixed costs include: a refrigerator, propagation structure, and irrigation system. For all scenarios, the high and low costs for plug trays, flats, flood trays, benches, miscellaneous supplies/tools, and transportation stay consistent. The high and low costs for propagules stay consistent for seed and vegetative material situations. Labor costs followed the outline offered in the labor section. The low cost represents the hiring of a consultant for a certain amount of time during the growing season and utilizing volunteer labor. The high cost reflects the hiring of a part-time nursery manager that completes most of the nursery's daily tasks. For the propagation structure, the minimally controlled situations require a cost for fencing, and the semi-controlled

situations range from getting a donated hoop house to repairing an existing greenhouse. As for irrigation, the low cost option is using a manually or rain-filled reservoir, and the high cost option is repairing or installing a water pump. A refrigerator is only needed in seed-using scenarios, where there must be a cold stratification period.

Some costs were estimated using bulk order pricing to find a per-unit cost. Costs for certain items may be larger if exact bulk quantities cannot be filled. Tables detailing explanations of cost estimates and sources used are located in the appendix.

Results and Analysis

Cost estimates for the eight different scenarios are below. The lowest cost is in a minimally controlled environment using vegetative material to grow 1,200 plugs. The highest cost is in a minimally controlled environment using seeds to grow 3,200 plugs. Surprisingly, the most expensive option is a minimally controlled environment. The benefits of a semi-controlled environment often outweigh those of a minimally controlled environment, and cost is a large barrier. Because the Tribe has access to existing infrastructure, costs for using a hoop house are not significant, and the benefits of a hoop house may outweigh the costs. Additionally, the slightly greater costs in the seed-using scenarios may be worth it if the nursery can market locally adapted plants well and sell them at a premium price.

Minimally Controlled, Seeds				Minimally Controlled, Vegetative Material	
	Low Cost	**High Cost**		**Low Cost**	**High Cost**
1,200	$ 3,919.78	$28,550.99		$2,734.78	$15,487.74
2000	$ 7,171.00	$31,188.99		$5,311.00	$18,406.08
3,200	$10,070.78	$33,611.30		$8,045.78	$21,442.07
Semi-Controlled, Seeds				Semi- Controlled, Vegetative Material	
	Low Cost	**High Cost**		**Low Cost**	**High Cost**
1,200	$ 3,809.78	$28,606.99		$3,134.78	$25,558.74
2,000	$ 7,061.00	$30,774.99		$5,711.00	$28,022.08
3,000	$10,470.78	$33,182.30		$8,445.78	$31,058.07

Looking at Appendices B-G, the most influential costs in all scenarios are labor and the installation of an on-site water pump for irrigation. Especially in a pilot phase, to avoid any large upfront costs associated with a water source, using a manually or rain-recharged reservoir may be the best option. Including labor in cost estimates makes it difficult to realize solely infrastructure costs. When not including labor, the least expensive options are seeds and vegetative material in a semi-controlled environment with 1,200 plugs, at just $884.78. The only variable that differs between the two is labor, so this stripped back cost is the same for both

scenarios. Looking at more costs without labor in a semi-controlled environment, it also shows that 2,000 and 3,200 plugs are more reasonable, at $1,211 and $1,695.78, respectively. Depending on how the Tribe decides to organize labor, the total cost with labor may differ from what estimated results show.

With the highest price per plug, $2.50, and the lowest start up cost, $2,734.78, the nursery's profit for its first season would be $265.22. This scenario is the only profitable scenario, and it is possible that there are unaccounted for and unexpected costs that may come up before and during production. The nursery would benefit greatly if it is able to secure grant funding for infrastructure or other materials. With such a low price per product, the profit margins for plant nurseries are quite low as it is, and the Chickahominy nursery may run at a loss the first few seasons without funding. Funding will help reduce startup costs and make it easier to continue in the long run.

8. Client Acquisition, Partnerships, and Community Engagement

Getting Involved

Of the nonprofits consulted, they either have an informal agreement with a nursery or order based on stock available. To acquire local clients, it is important that the Chickahominy nursery meets market and product expectations while creating and maintaining relationships with practitioners. Because of the rise in demand for native wetland plants, there are now multiple resources available for growers to connect with clients.

Coastal Virginia Adaptation & Resilience Consortium (CoVa A&R) was developed at Old Dominion University to bring a range of stakeholders together. One project developed in 2021 is working to understand the economic area around plant production. A survey was sent to practitioners and growers that revealed misalignment in their beliefs– growers felt that they were supplying plants sufficiently, but practitioners did not agree. To solve this problem, CoVa A&R is working to figure out what resources growers need to increase production. The CoVa A&R website houses a Wetland Plant Hub that lists Virginia nurseries capable of large-scale production. There is also a page for growers to identify projects in need from practitioners.[75] Dr. Sloey runs this program and shared that they are planning for a meeting in the fall targeted to growers and helping increase their production capacity. The consortium is a great way for the Chickahominy nursery to engage in the local effort to increase the supply of locally grown and adapted plants while connecting with potential clients.

The Living Shoreline Collaborative is another avenue to help the Chickahominy nursery grow connections in the community. The Living Shoreline Collaborative hosts frequent meetings and

workshops open to all, including community members, contractors, nonprofits, and government officials. Jamie Brunkow, contact point for the LSC planning team, voiced that the LSC would like to increase Tribal engagement.

Gaining Presence on Online Nursery Lists

If possible, there are additional websites that might boost the Chickahominy nursery's visibility to the public and clients. The Virginia Department of Conservation and Recreation (DCR) website has a Virginia Native Plant Finder page that lists 1,582 native plants. Along with general information on the plants, for more common plants there is a link that lists a source to obtain live plants or seeds.[76] The VIMS website also has a "Find Native Plants" page that lists six Virginia nurseries, including Ransone's and Southern Branch.[77] Lastly, Virginia Native Plants society houses a "Native Plant Nurseries" page that lists 49 Virginia nurseries.[78] Any nursery in Virginia can submit an application, but plants must be grown from nursery stock or collected seeds– no nurseries that remove plants from the wild are allowed on the list. If the Chickahominy nursery is able to be listed on any of these sites, it would be a great opportunity to reach more clients, especially when reaching clients outside of the nonprofit space eventually.

Community Impact

Educational workshops for primary schools, community volunteering events, and workshops for those interested in living shorelines are all ways to get the local community involved, on a Tribal level and beyond. Community engagement does not just create cultural resilience, but it is also a great way for the nursery to gain exposure. The nursery can also partner with nonprofits for workshops and shed light on the operations behind a successful living shoreline.

9. Scaling Up Production

How to Know the Nursery is Ready

Starting in a pilot phase with the plan to eventually increase production capacity begs the question of how to know when the nursery is ready to expand. Returning to the list of information to gather in a pilot phase (see Defining a Pilot Nursery), a list of questions can be asked to evaluate whether the nursery is ready:

- Has the nursery successfully produced quality plants with a given propagule?
- Does the nursery have a reliable technique and timeline for production?
- What were production costs last season?

- Did the nursery successfully acquire clients and fill full orders?
- What feedback did the nursery receive from clients?

If the nursery feels confident that it can fill more orders and obtain a larger customer base while still covering production costs without a net loss, it is likely ready to increase production. Getting to this point may take multiple seasons. Figuring out propagation techniques and business operations will take trial and error, but this is why a pilot phase is strategic.

Expanding Production

If the nursery has great success with growing and selling just *Spartina Alterniflora*, *Spartina Patrens*, and *Juncus Roemerianus*, it may choose to expand the production of the current inventory. Producing more plants may mean obtaining larger infrastructure, or simply just utilizing more space in a hoop house. Based on feedback from clients, if the Tribe would like to grow different species when expanding production, nonprofits offered additional plants that they felt would be valuable to grow. Saltbush is often grown above high tide and used in projects with *Spartina Patens* and *Juncus Roemerianus.* Flowering species that are planted in riparian zones are difficult to come by within the state and neighboring ones, according to CBF. One practitioner said that they anticipate the demand for freshwater native plants increasing. In the future, collecting seeds from Tribal property that is on freshwater, like Mamanahunt, could be a strategy to grow freshwater plants.

Expanding Clientele

Once the nursery has become confident in customer relations, managing orders, and delivering plants, leaders and managers may decide to expand clientele beyond nonprofits. Acquiring private contractors as clients is a step beyond working with nonprofit organizations. Some contractors, like Bay Environmental, work with nonprofits on projects and provide a good transition to a new type of client.

Summary

A native plant nursery run by the Chickahominy Tribe offers a unique opportunity for the Tribe to engage in environmental restoration while strengthening its community and cultural values. There is a need for native coastal and wetland grasses in living shoreline projects, and the Chickahominy nursery can be a supplier for the high number of recent projects. Starting production in a pilot phase will allow the Tribe to evaluate and change any aspects about the nursery while minimizing startup costs. There are challenges with selecting a plant material source and getting a site ready for production, but there are many people and organizations that

would like to support the nursery with its establishment. With planning, persistence, and an entrepreneurial mindset, the nursery can grow from an idea to an impactful operation.

Contacts

People who expressed interest in helping the development of the nursery:

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Appendix

Appendix A: Nonprofit Practitioners Estimate Their Yearly Plugs and Projects

Organization	Low Plugs	High Plugs	Low Project	High Project
Lynnhaven River Now	1,000	3,000	2	3
Friends of the Rappahannock	400	1,500	2	3
Elizabeth River Project	500	1,500	11	12
James River Association	800	1000	4	8

Appendix B: Low and High Costs for Seed Scenarios

Costs for minimally controlled environment and semi-controlled environment are displayed together in this table for all seed scenarios:

Variable Costs	Low Cost	High Cost
Seeds	Obtained from the Seed Keepers program free of cost	Obtained from the Seed Keepers program free of cost
Plug Trays	A 3'' deep 10''x20'' 50 plug tray from for $3.20 per tray Plug Tray 1	A 5'' deep 10''x20'' 50 plug tray for $6.36 per tray Plug Tray 2
Flats	A 10''x20'' mesh tray for $1.40 per flat Flat 1	A 10''x20'' mesh tray for $4.40 per flat Flat 2
Flood Trays	A 4'x4' flood tray for $89.00 Flood Tray 1	A 4'x4' flood tray for $95.00 Flood Tray 2
Benches	Assuming the use of New Kent DOF tables for no cost	Assuming the use of New Kent DOF tables for no cost
Soil	Assuming a 1:1 sand and peat mix to fill a 3'' deep container using a .5 cubic foot bags of sand for $6.38 and 2.2 cubic foot peat bags for $15.48. Fills 3'' containers Peat Sand	Assuming a 1:1 sand and peat mix to fill a 3'' deep container using a .5 cubic foot bags of sand for $6.38 and 2.2 cubic foot peat bags for $15.48. Fills 5'' containers Peat Sand
Labor	Assuming a consultant works 1, 2, or 3 hours a week depending on the amount of plugs, at a	Assuming a part-time manager works works 25, 27.5, or 30 hours a week at a rate of $17.17 an hour, the BLS 50th percentile wage

	rate of $75.00 an hour, for 39 weeks, or 9 months	for wholesale nursery workers, for 39 weeks, or 9 months BLS Wage Data by Occupation
Miscellaneous Supplies/Tools	Estimate for scissors, paper towels, plastic bags, plant labels	Estimate for scissors, paper towels, plastic bags, plant labels
Transportation	Assuming all orders are picked up at the nursery by clients	Assuming 2, 3, or 4 delivery orders as plugs increase, with a 100 mile round trip at $3.00 a gallon. The use of a U-Haul trailer is about $15.00 a day. State Gas Prices U-Haul
Minimally Controlled Environment-Fencing	–	A 7.5’ tall garden fence with top and gate, the small size can be used for 1,200 plugs, and the larger size can fit 2,000 and 3,200 plugs. Garden Fence 2
Fixed Costs		
Fencing	A 4’x100’ deer fence, sold at this quantity but can be adjusted for size Garden Fence 1	–
Semi-Controlled Environment-Hoop House Costs	Assuming the Tribe receives a donated hoop house for no cost	Assuming the repair of an existing greenhouse. Sizing may differ, but a 100’x50’ greenhouse covering costs a maximum of $900.00 Plastic Cover
Refrigerator	Assuming the use of an already owned refrigerator for seed cold stratification	An average small refrigerator on the market
Water Source	Assuming the use of a water reservoir, like a rain barrel. Rainwater Reservoir	Assuming the repair or reinstallation of a water. Pump Cost Estimator

Appendix C

Low Cost: Minimally Controlled Environment, Seeds			
Variable Costs	**1,200**	**2,000**	**3,200**
Seeds	$ -	$ -	$ -
Plug Trays	$ 76.80	$ 128.00	$ 204.80
Flats	$ 33.60	$ 56.00	$ 89.60
Flood Trays	$ 267.00	$ 445.00	$ 712.00
Benches	$ -	$ -	$ -
Soil	$ 47.38	$ 82.00	$ 129.38
Labor, Consultant	$ 2,925.00	$ 5,850.00	$ 8,775.00
Miscellaneous Supplies/Tools	$ 60.00	$ 100.00	$ 160.00
Transportation	$ -	$ -	$ -
Fixed Costs			
Fencing	$ 110.00	$ 110.00	$ 110.00
Refrigerator	$ -	$ -	$ -
Rain Barrel Reservoir	$ 400.00	$ 400.00	$ 400.00
High Cost: Minimally Controlled Environment, Seeds			
Variable Costs	**1,200**	**2,000**	**3,200**
Seeds	$ -	$ -	$ -
Plug Trays	$ 152.64	$ 254.40	$ 407.04
Flats	$ 105.60	$ 176.00	$ 281.60
Flood Trays	$ 285.00	$ 475.00	$ 760.00
Benches	$ -	$ -	$ -
Soil	$ 82.00	$ 135.76	$ 217.76
Labor, Part-Time Manager	$ 16,740.75	$18,414.83	$20,088.90
Miscellaneous Supplies/Tools	$ 90.00	$ 150.00	$ 240.00
Transportation	$ 66.00	$ 99.00	$ 132.00
Fencing	$ 829.00	$ 1,284.00	$ 1,284.00
Fixed Costs			
Refrigerator	$ 200.00	$ 200.00	$ 200.00
Water Pump	$ 10,000.00	$10,000.00	$10,000.00

Appendix D

Low Cost: Semi-Controlled Environment, Seeds			
Variable Costs	**1,200**	**2,000**	**3,200**
Seeds	$ -	$ -	$ -
Plug Trays	$ 76.80	$ 128.00	$ 204.80
Flats	$ 33.60	$ 56.00	$ 89.60
Flood Trays	$ 267.00	$ 445.00	$ 712.00
Benches	$ -	$ -	$ -
Soil	$ 47.38	$ 82.00	$ 129.38
Labor, Consultant	$ 2,925.00	$ 5,850.00	$ 8,775.00
Miscellaneous Supplies/Tools	$ 60.00	$ 100.00	$ 160.00
Transportation	$ -	$ -	$ -
Fixed Costs			
Refrigerator	$ -	$ -	$ -
Hoop House Costs	$ -	$ -	$ -
Rain Barrel Reservoir	$ 400.00	$ 400.00	$ 400.00
High Cost: Semi-Controlled Environment, Seeds			
Variable Costs	**1,200**	**2,000**	**3,200**
Seeds	$ -	$ -	$ -
Plug Trays	$ 152.64	$ 254.40	$ 407.04
Flats	$ 105.60	$ 176.00	$ 281.60
Flood Trays	$ 285.00	$ 475.00	$ 760.00
Benches	$ -	$ -	$ -
Soil	$ 82.00	$ 135.76	$ 217.76
Labor, Part-Time Manager	$ 16,740.75	$18,414.83	$20,088.90
Miscellaneous Supplies/Tools	$ 90.00	$ 150.00	$ 240.00
Transportation	$ 51.00	$ 69.00	$ 87.00
Fixed Costs			
Refrigerator	$ 200.00	$ 200.00	$ 200.00
Hoop House Cover	$ 900.00	$ 900.00	$ 900.00
Water Pump	$ 10,000.00	$10,000.00	$10,000.00

Appendix E: Low and High Costs for Vegetative Material Scenarios

Costs for minimally controlled environment and semi-controlled environment are displayed together in this table for all vegetative material scenarios:

Variable Costs	**Low Cost**	**High Cost**
Vegetative Material	Obtained from marsh removal	Obtained from a local nursery for $2.50 per plug
Plug Trays	A 3’’ deep 10’’x20’’ 50 plug tray from for $3.20 per tray Plug Tray 1	A 5’’ deep 10’’x20’’ 50 plug tray for $6.36 per tray Plug Tray 2
Flats	A 10’’x20’’ mesh tray for $1.40 per flat Flat 1	A 10’’x20’’ mesh tray for $4.40 per flat Flat 2
Flood Trays	A 4’x4’ flood tray for $89.00 Flood Tray 1	A 4’x4’ flood tray for $95.00 Flood Tray 2

Benches	Assuming the use of New Kent DOF tables for no cost	Assuming the use of New Kent DOF tables for no cost
Soil	Assuming a 1:1 sand and peat mix to fill a 3'' deep container using a .5 cubic foot bags of sand for $6.38 and 2.2 cubic foot peat bags for $15.48. Fills 3'' containers Peat Sand	Assuming a 1:1 sand and peat mix to fill a 3'' deep container using a .5 cubic foot bags of sand for $6.38 and 2.2 cubic foot peat bags for $15.48. Fills 5'' containers Peat Sand
Labor	Assuming a consultant works 1, 2, or 3 hours a week depending on the amount of plugs, at a rate of $75.00 an hour, for 39 weeks, or 9 months	Assuming a part-time manager works works 25, 27.5, or 30 hours a week at a rate of $17.17 an hour, the BLS 50th percentile wage for wholesale nursery workers, for 39 weeks, or 9 months BLS Wage Data by Occupation
Miscellaneous Supplies/Tools	Estimate for scissors, paper towels, plastic bags, plant labels	Estimate for scissors, paper towels, plastic bags, plant labels
Transportation	Assuming all orders are picked up at the nursery by clients	Assuming 2, 3, or 4 delivery orders as plugs increase, with a 100 mile round trip at $3.00 a gallon. The use of a U-Haul trailer is about $15.00 a day. State Gas Prices U-Haul
Minimally Controlled Environment-Fencing	–	A 7.5' tall garden fence with top and gate, the small size can be used for 1,200 plugs, and the larger size can fit 2,000 and 3,200 plugs Garden Fence 2
Fixed Costs		
Fencing	A 4'x100' deer fence, sold at this quantity but can be adjusted for size Garden Fence 1	–
Semi-Controlled Environment-Hoop House Costs	Assuming the Tribe receives a donated hoop house for no cost	Assuming the repair of an existing greenhouse. Sizing may differ, but a 100'x50' greenhouse covering costs a maximum of $900.00 Plastic Cover
Water Source	Assuming the use of a water reservoir, like a rain barrel. Rainwater Reservoir	Assuming the repair or reinstallation of a water. Pump Cost Estimator

Appendix F

Low Cost: Semi-Controlled Environment, Vegetative Material			
Variable Costs	**1,200**	**2,000**	**3,200**
Vegetative Material	$ -	$ -	$ -
Plug Trays	$ 76.80	$ 128.00	$ 204.80
Flats	$ 33.60	$ 56.00	$ 89.60
Flood Trays	$ 267.00	$ 445.00	$ 712.00
Benches	$ -	$ -	$ -
Soil	$ 47.38	$ 82.00	$ 129.38
Labor, Consultant	$ 2,250.00	$ 4,500.00	$ 6,750.00
Miscellaneous Supplies/Tools	$ 60.00	$ 100.00	$ 160.00
Transportation	$ -	$ -	$ -
Fixed Costs			
Hoop House Costs	$ -	$ -	$ -
Rain Barrel Reservoir	$ 400.00	$ 400.00	$ 400.00
High Cost: Semi-Controlled Environment, Vegetative Material			
Variable Costs	**1,200**	**2,000**	**3,200**
Plugs	$ 1,000.00	$ 1,666.67	$ 2,666.67
Plug Trays	$ 152.64	$ 254.40	$ 407.04
Flats	$ 105.60	$ 176.00	$ 281.60
Flood Trays	$ 285.00	$ 475.00	$ 760.00
Benches	$ -	$ -	$ -
Soil	$ 82.00	$ 135.76	$ 217.76
Labor, Part-Time Manager	$12,877.50	$14,165.25	$15,453.00
Miscellaneous Supplies/Tools	$ 90.00	$ 150.00	$ 240.00
Transportation	$ 66.00	$ 99.00	$ 132.00
Fixed Costs			
Hoop House Cover	$ 900.00	$ 900.00	$ 900.00
Water Pump	$10,000.00	$10,000.00	$10,000.00

Appendix G

Low Cost: Minimally Controlled Environment, Vegetative Material			
Variable Costs	**1,200**	**2,000**	**3,200**
Vegetative Material	$ -	$ -	$ -
Plug Trays	$ 76.80	$ 128.00	$ 204.80
Flats	$ 33.60	$ 56.00	$ 89.60
Flood Trays	$ 267.00	$ 445.00	$ 712.00
Benches	$ -	$ -	$ -
Soil	$ 47.38	$ 82.00	$ 129.38
Labor, Consultant	$ 2,250.00	$ 4,500.00	$ 6,750.00
Miscellaneous Supplies/Tools	$ 60.00	$ 100.00	$ 160.00
Transportation	$ -	$ -	$ -
Fixed Costs			
Fencing	$ 110.00	$ 110.00	$ 110.00
Rain Barrel Reservoir	$ 400.00	$ 400.00	$ 400.00
High Cost: Minimally Controlled Environment, Vegetative Material			
Variable Costs	**1,200**	**2,000**	**3,200**
Plugs	$ 1,000.00	$ 1,666.67	$ 2,666.67
Plug Trays	$ 152.64	$ 254.40	$ 407.04
Flats	$ 105.60	$ 176.00	$ 281.60
Flood Trays	$ 285.00	$ 475.00	$ 760.00
Benches	$ -	$ -	$ -
Soil	$ 82.00	$ 135.76	$ 217.76
Labor, Part-Time Manager	$12,877.50	$14,165.25	$15,453.00
Miscellaneous Supplies/Tools	$ 90.00	$ 150.00	$ 240.00
Transportation	$ 66.00	$ 99.00	$ 132.00
Fencing	$ 829.00	$ 1,284.00	$ 1,284.00
Fixed Costs			
Water Pump	$10,000.00	$10,000.00	$10,000.00