

# 2021 Chesapeake Bay Oyster Restoration Update

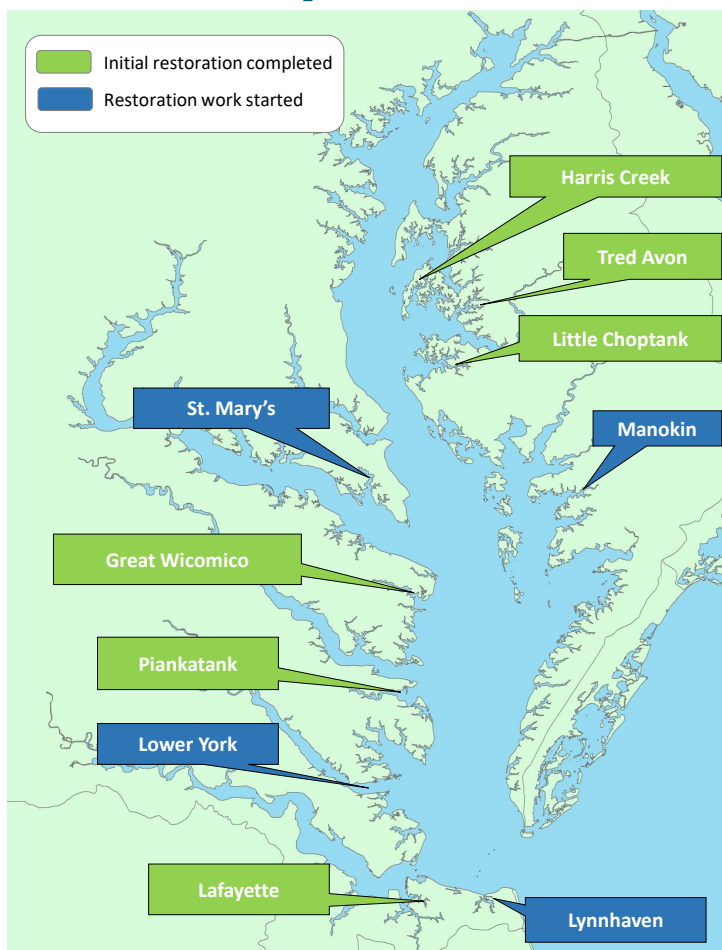
## Summary of Progress toward the Chesapeake Bay Watershed Agreement's 'Ten Tributaries by 2025' Oyster Outcome

*Numbers in this document are rounded.*

The [2014 Chesapeake Bay Watershed Agreement](#), which guides the work of the Chesapeake Bay Program, calls for state and federal partners to “restore native oyster habitat and populations in 10 Bay tributaries by 2025, and ensure their protection” (hereafter, “Ten Tributaries” initiative). Five tributaries are being restored in Maryland and five in Virginia. To achieve this outcome, the Chesapeake Bay Program’s [Sustainable Fisheries Goal Implementation Team](#) (GIT) convened [working groups](#) in each state. With guidance from consulting scientists and the public, these groups set tributary-specific restoration goals and developed plans (hereafter, “[Restoration Blueprints](#)”) describing how the tributaries will be restored, consistent with success criteria described in the [Chesapeake Bay Oyster Metrics Report](#) (hereafter, “Oyster Metrics”). Detailed summaries of progress in Maryland and Virginia follow.

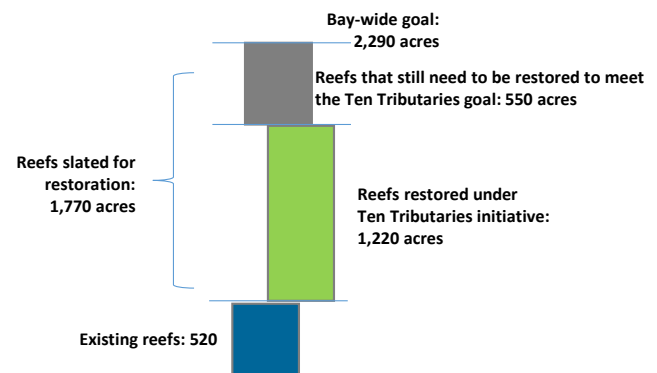
### Bay-wide Progress

#### Tributaries Complete: Six of Ten Planned



*See following sections for state- and tributary-specific information.*

#### Acres of Reef Restored: 1,220 of 1,770 Planned



#### Bay-wide Cost to Date: \$77 million (*\$12.05 million in 2021*)

This cost is Bay-wide, through the end of 2021, for reefs restored under the ‘Ten Tributaries’ initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef height and configuration, hydrologic factors, agency and stakeholder preferences, whether a reef requires seeding with juvenile oysters (as is typical in Maryland, due to lower natural oyster reproduction than Virginia rivers), and other factors.

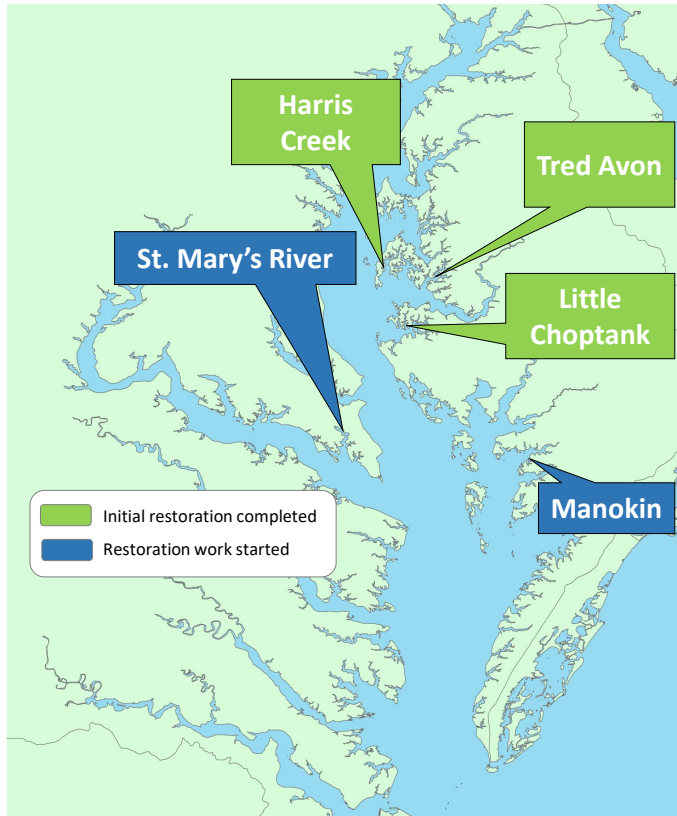
*Please cite this document as: Maryland and Virginia Oyster Restoration Interagency Workgroups of the Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team. 2021 Chesapeake Bay Oyster Restoration Update: Progress toward the Chesapeake Bay Watershed Agreement's 'Ten Tributaries by 2025' oyster outcome. 2022.*

# Maryland Summary

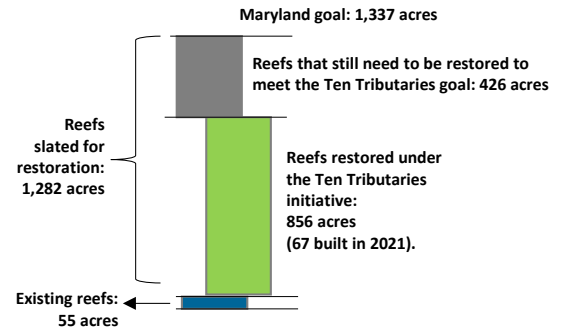
All five Maryland tributaries targeted for restoration under the Ten Tributaries initiative have been selected, and each now has a completed [Restoration Blueprint](#). Restoration work in three Maryland tributaries has now been completed (Harris Creek, Little Choptank River, and the Tred Avon River). In-water restoration work in the St Mary's and Manokin rivers started in 2021. To date, partners have restored 856 acres of oyster reefs at a cost of approximately \$65.05 million. These reefs were constructed using one of two methods: by building a substrate base followed by planting with hatchery-produced oyster seed, or by placing only seed onto remnant reefs.

## Progress in Maryland

**Tributaries Complete: Three of Five Planned**



**Acres of Reef Restored: 856 of 1,282 Planned**



**Maryland Cost to Date: \$65.05 million**  
(*\$6.55 million in 2021*)

This cost is through the end of 2021, for reefs restored under the 'Ten Tributaries' initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.

**Seed Planted in Maryland under the Ten Tributaries Initiative: 5.43 billion**  
(*697 million planted in 2021*)

All seed was spat-on-shell, produced primarily at the University of Maryland's Horn Point oyster hatchery. Some additional spat-on-shell was produced and planted by the Chesapeake Bay Foundation.

*The Maryland portion of this report was compiled for the Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team by the Maryland Oyster Restoration Interagency Workgroup (Stephanie Westby, chair, [stephanie.westby@noaa.gov](mailto:stephanie.westby@noaa.gov)).*



**OYSTER RECOVERY PARTNERSHIP | ORP**

*Additional partners include the National Fish and Wildlife Foundation, The Nature Conservancy, University of Maryland, and the Chesapeake Bay Foundation.*

Initial restoration work in Harris Creek was completed in 2015, followed by several years of planned second-year-class oyster plantings where needed. The second-year-class plantings are now complete as well. The [Harris Creek Oyster Restoration Blueprint](#) called for monitoring three years, and again six years, after restoration. All three- and six-year postrestoration monitoring is complete. Monitoring results show that the restored reefs are largely successful. For example, of the 14 six-year-old reefs monitored in Harris Creek in winter 2020-21, 100% met the [Oyster Metrics](#) minimum threshold success criteria for oyster density and biomass, and 86% met the Oyster Metrics higher target criteria for oyster density and biomass. See the full [2021 Maryland Oyster Monitoring Report](#) for details. Results from past years were similar.

**Acres Restored: 348** (*restoration complete*)

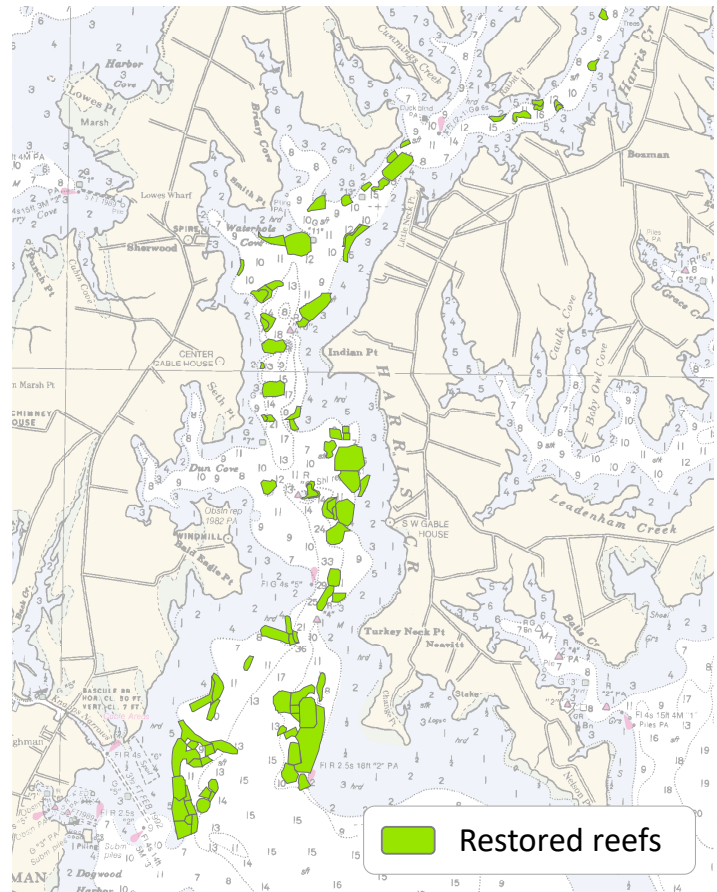


**Cost to Date: \$29.06 million** (*\$0 in 2021*)

This cost is through the end of 2021, for reefs restored under the ‘Ten Tributaries’ initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.

**Seed Planted: 2.49 billion** (2011-2020)

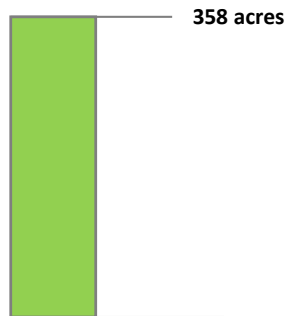
All seed was spat-on-shell, produced primarily at the University of Maryland’s Horn Point oyster hatchery. Some additional seed was produced and planted by the Chesapeake Bay Foundation.



# Little Choptank River

Initial restoration work was completed in the Little Choptank River in 2020 (see [video](#)). Since 2014, partners have restored 358 acres of reefs in the river. Future work will focus on monitoring and, where needed, completing the scheduled second-year-class oyster seedings called for in the [Little Choptank River Restoration Blueprint](#). If reef densities and biomass are higher than projected, the scheduled second seeding will not be required. If reef densities and biomass are as projected, or lower, the scheduled second-year-class seeding will be implemented four years after restoration. Reefs will also be evaluated to determine if they meet other Oyster Metrics success criteria, including presence of multiple year classes and reef structural integrity. Monitoring to date shows that virtually all reefs are meeting the established success criteria. See the full [2021 Maryland Oyster Monitoring Report](#) for details. Results from past years were similar.

**Acres Restored: 358** (*restoration complete*)

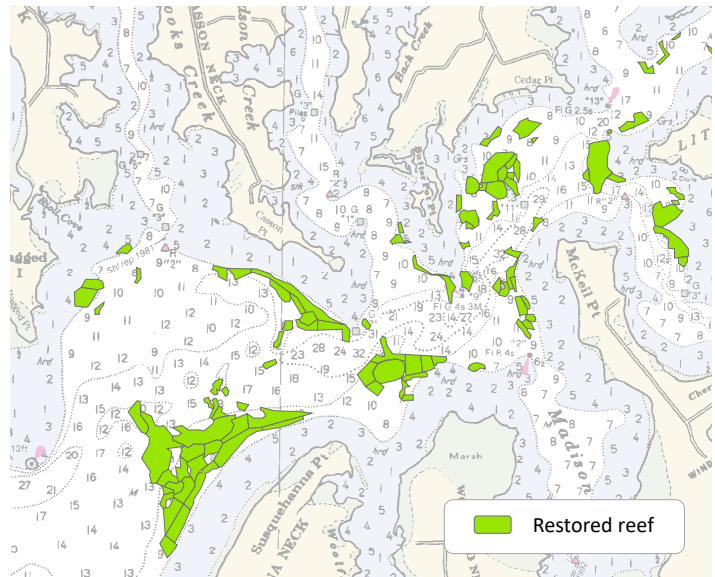


**Cost to Date: \$23.66 million** (*\$270,700 in 2021*)

This cost is through the end of 2021, for reefs restored under the ‘Ten Tributaries’ initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.

**Seed Planted: 1.85 billion**  
(*74.09 million in 2021*)

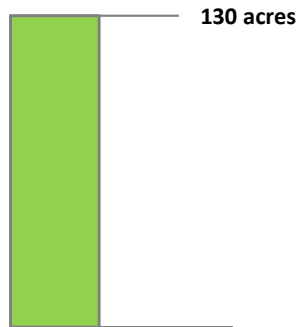
All seed was spat-on-shell, produced primarily at the University of Maryland’s Horn Point oyster hatchery. Some additional seed was produced and planted by the Chesapeake Bay Foundation.





Initial restoration work in the Tred Avon River was completed in 2021. The [Tred Avon River Restoration Blueprint](#) initially called for 147 acres of reefs, but approximately 17 acres were not constructed, primarily due to user group conflicts that came to light after the plan was developed. The U.S. Army Corps of Engineers' Baltimore District constructed just over 30 acres of reefs in 2021, using 2"-6" stone sourced from Vulcan Materials in Havre de Grace, Maryland. These reefs were seeded in summer 2021, along with an additional seven acres of seed-only reefs. These together resulted in 37 new acres of reefs this year. Between 2017 and 2021, USACE-Baltimore District constructed nearly 65 acres of reefs from stone and shell substrate, at a cost of \$6.9 million, making that organization the primary funder for restoration in this tributary. These reefs were seeded with spat-on-shell oyster seed, with funding from NOAA and MD DNR.

**Acres Restored: 130** (*restoration complete*)



**Cost to Date: \$10.87 million**

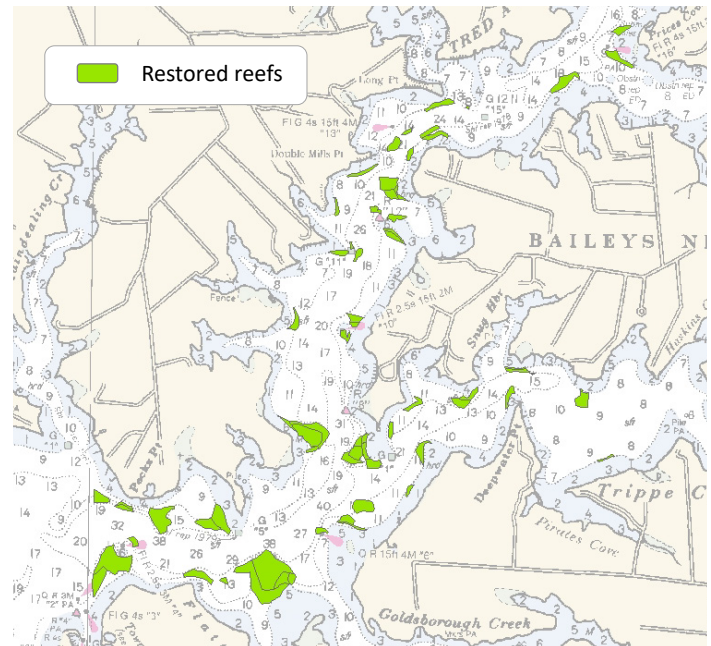
*(\$4.83 million in 2021)*

This cost is through the end of 2021, for reefs restored under the 'Ten Tributaries' initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.

**Seed Planted: 926 million**

*(465.54 million planted in 2021)*

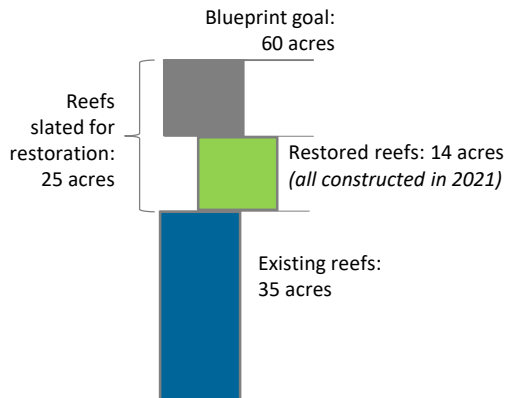
All seed was spat-on-shell, produced primarily at the University of Maryland's Horn Point oyster hatchery. Some additional seed was produced and planted by the Chesapeake Bay Foundation.



# Upper St. Mary's River

In-water restoration work started in the [upper St. Mary's River](#) in 2021. Fourteen acres of seed-only reefs were planted with spat-on-shell this year. Additionally, MD DNR constructed nearly nine acres of reefs from stone substrate (2"-4" in diameter, sourced from Vulcan Materials in Havre de Grace, Maryland). These stone reefs are slated to be seeded with spat-on-shell in 2022. Once these reefs are seeded, the river will be considered initially restored.

## Acres Restored: 14 of 25 Planned



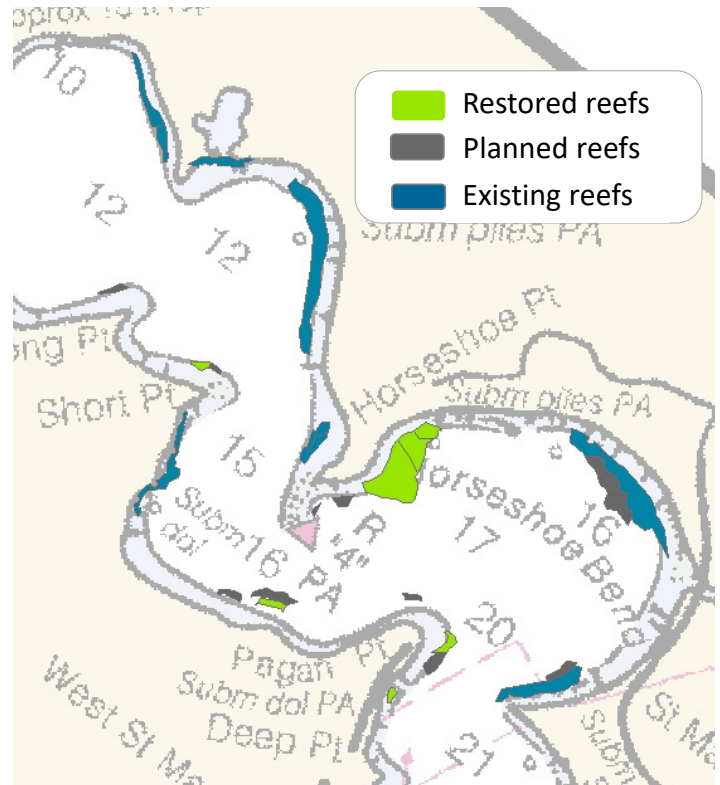
## Cost to Date: \$1.24 million (all in 2021)

This cost is through the end of 2021, for reefs restored under the 'Ten Tributaries' initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.

## Seed Planted: 83.6 million

*(all planted in 2021)*

All seed was spat-on-shell, produced primarily at the University of Maryland's Horn Point oyster hatchery. Some additional seed was produced and planted by the Chesapeake Bay Foundation.

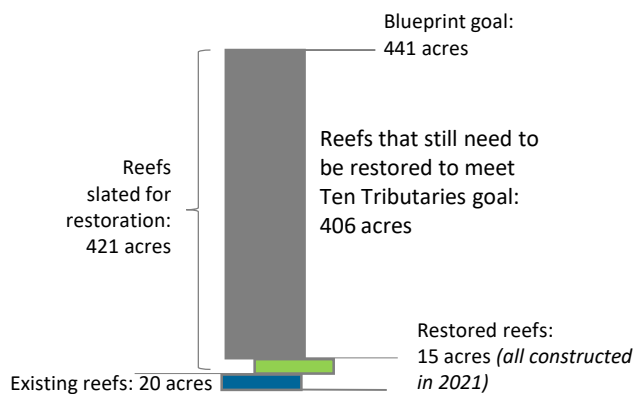


# Manokin River

In-water restoration work started in the Manokin River in 2021. Fifteen acres of seed-only reefs were planted with spat-on-shell this year. Per the [Manokin River Restoration Blueprint](#), this river requires the largest number of acres to be restored of any of the ten tributaries Bay-wide slated for restoration. Restoration work here will likely take until 2025. MD DNR has let a contract with Murtech Inc. to construct the remaining reefs in the river that require substrate (approx. 137 acres).

**Acres Restored: 15 of 421 Planned**

**Cost to Date: \$212,300 (all in 2021)**

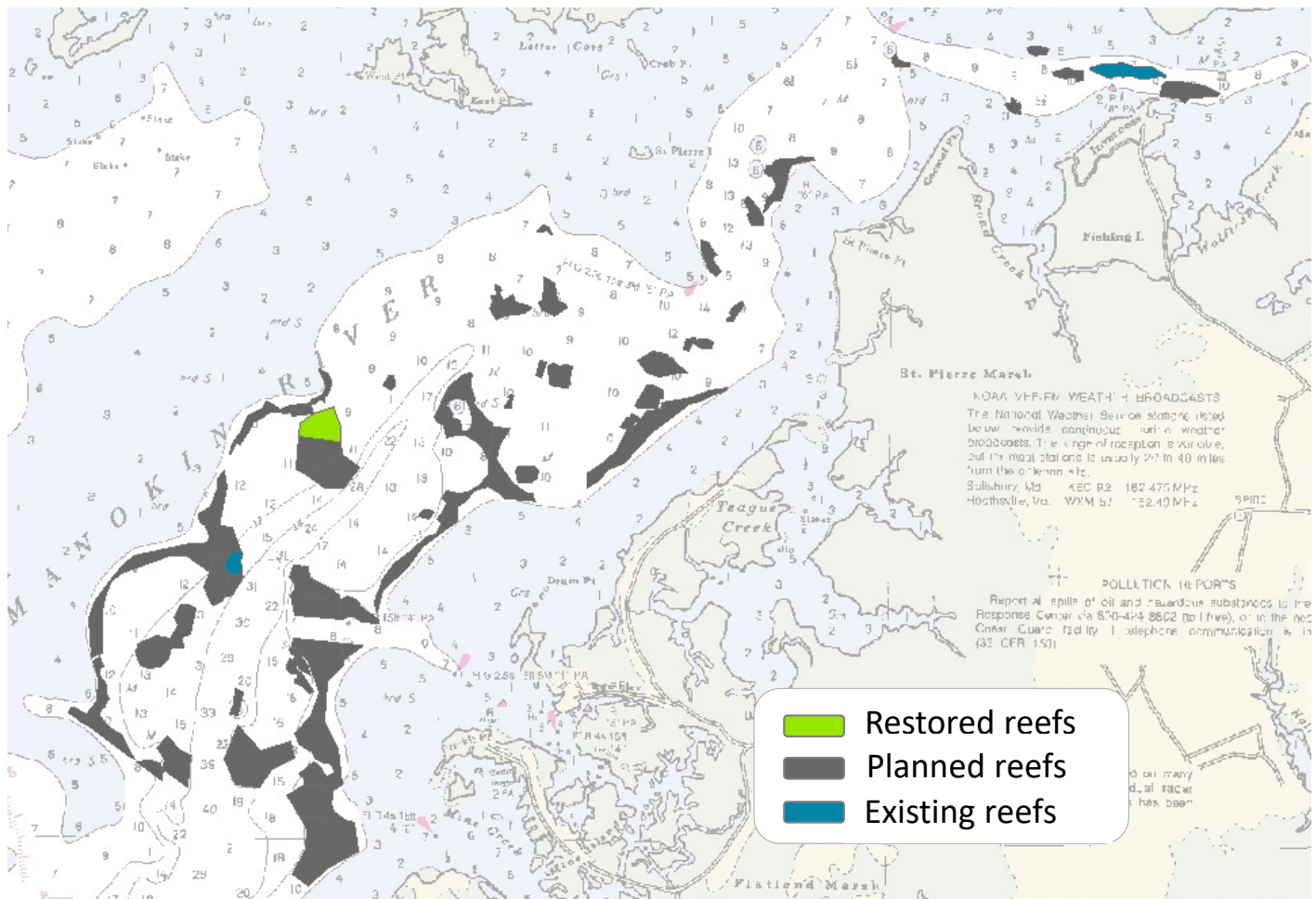


This cost is through the end of 2021, for reefs restored under the ‘Ten Tributaries’ initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.

**Seed Planted: 73.4 million**

*(all planted in 2021)*

All seed was spat-on-shell, produced primarily at the University of Maryland’s Horn Point oyster hatchery. Some additional seed was produced and planted by the Chesapeake Bay Foundation.



## Maryland 2021 Highlights and Challenges

### Highlights

- Partners completed initial restoration work in the Tred Avon River.
- In 2021, Maryland saw a good natural oyster spat set, including in the Tred Avon River, which has historically been a lower natural recruitment area than any of the other ten tributaries slated for restoration Bay wide.
- Reef substrate placement is now complete in the St Mary's River; partners plan to seed these reefs in summer 2022, which should mark the completion of initial restoration work in the river.
- In 2021, University of Maryland's Horn Point Hatchery produced nearly 700 million spat-on-shell for the five Maryland restoration sanctuaries. This was a significant increase over 2019 and 2020 production. (In 2019, unprecedented rainfall reduced hatchery capacity, and in 2020, COVID-related restrictions reduced seed production.)
- [Monitoring shows success](#) across the vast majority of three-year-old and six-year-old reefs.
- NOAA Fisheries hosted its first "[Oyster Week](#)," highlighting content about oyster restoration and the benefits of restored oyster reefs as well as aquaculture on its nationwide website and several social media platforms, including nearly 25 Twitter posts during the November 1-5 event.
- In October, the Chesapeake Bay Foundation hosted the 2021 Maryland Rod and Reef Slam Fishing Tournament, designed to demonstrate the habitat value of restored oyster reefs. This year, 27 different species were caught during the tournament.

### Challenges

- Some individuals in user groups (e.g., boating public, adjacent private lease holders, waterfront property owners, watermen) have expressed opposition to some proposed projects in Maryland.
- Manokin is the largest tributary yet in terms of the number of acres of reefs that need to be constructed.

## Factors Influencing Success in Maryland

Many factors may influence the success of the Ten Tributaries outcome. These include water quality, oyster disease, fluctuations in natural oyster recruitment, fluctuations in hatchery production, and availability of suitable reef-building substrate. Despite these challenges, oyster restoration efforts in the Maryland waters of the Chesapeake Bay are already showing success with the completion of the Harris Creek, Little Choptank River, and, in 2021, the Tred Avon River restoration projects. Maryland is on track to meet its goal to restore five of the ten targeted tributaries Bay wide. These tributaries serve as evidence that oyster populations can prosper in Chesapeake Bay sanctuaries, either naturally or due to restoration efforts. Recent declining trends in disease mortality rates may increase on-reef survival and sustainability of restoration efforts.

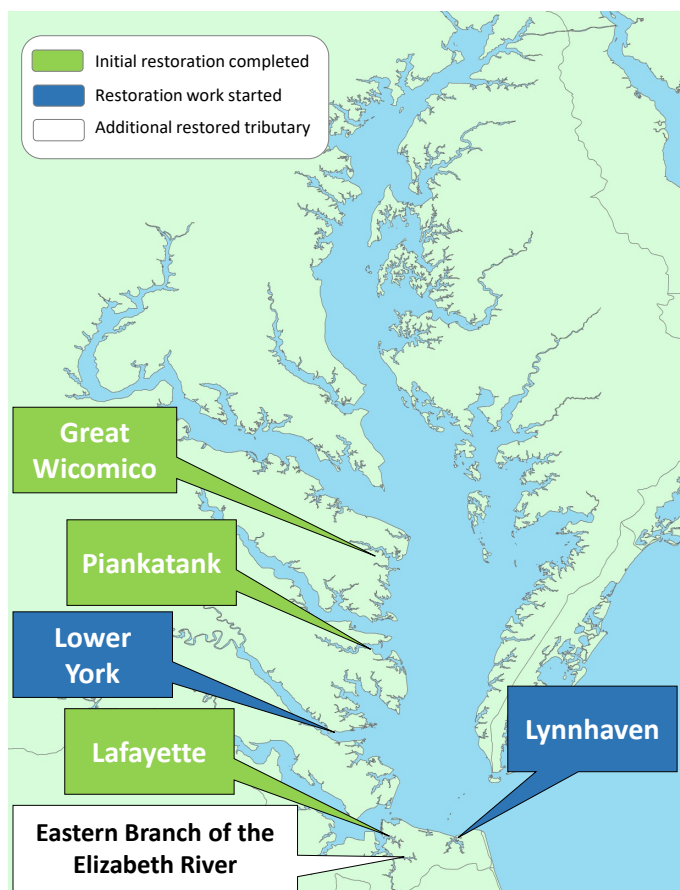


All five Virginia tributaries targeted for restoration under the Ten Tributaries initiative have been selected, and each now has a completed [Restoration Blueprint](#). Restoration work in three Virginia tributaries has been completed (Lafayette, Piankatank, and Great Wicomico rivers). In-water restoration work is well under way in the remaining two tributaries: the Lower York and Lynnhaven rivers. To date, partners have restored 355 acres of oyster reefs at a cost of approximately \$11.94 million. A description of restoration work done prior to the Ten Tributaries initiative is in each river's Restoration Blueprint. Above and beyond the ten tributaries planned for restoration Bay-wide, Virginia partners have also restored the Eastern Branch of the Elizabeth River to the same standards, making this an additional, 'bonus' tributary.

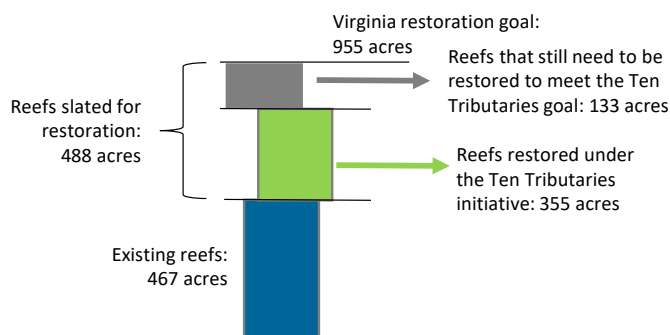
## Progress in Virginia

### Tributaries Complete: Three of Five Planned

*(plus the Eastern Branch of the Elizabeth River)*



### Acres of Reef Restored: 355 of 488 Planned



### Virginia Cost to Date: \$11.94 million *(\$5.5 million in 2021)*

This cost is through the end of 2021, for reefs restored under the 'Ten Tributaries' initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. This cost excludes the cost of restoring the Eastern Branch of the Elizabeth River, as that is considered above and beyond the Ten Tributaries initiative.

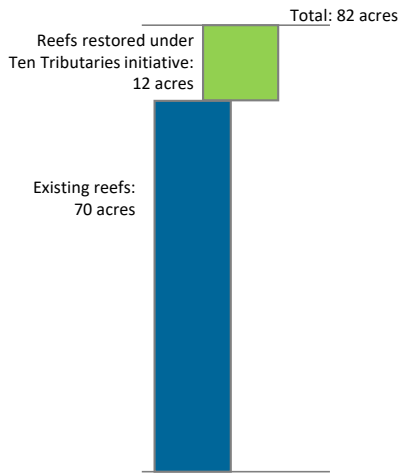
*The Virginia portion of this report was compiled for the Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team by the Hampton Roads and Western Shore Oyster Restoration Interagency Workgroups (Stephanie Westby, chair, [stephanie.westby@noaa.gov](mailto:stephanie.westby@noaa.gov)).*

*Members include: Chesapeake Bay Foundation; Christopher Newport University; City of Norfolk; City of Virginia Beach; Elizabeth River Project; Lynnhaven River NOW; National Fish and Wildlife Foundation; National Oceanic and Atmospheric Administration; The Nature Conservancy; The Pew Charitable Trusts; Pleasure House Oysters/Ludford Brothers Oyster Company; U.S. Army Corps of Engineers; Virginia Commonwealth University; Virginia Institute of Marine Science; Virginia Marine Resources Commission.*

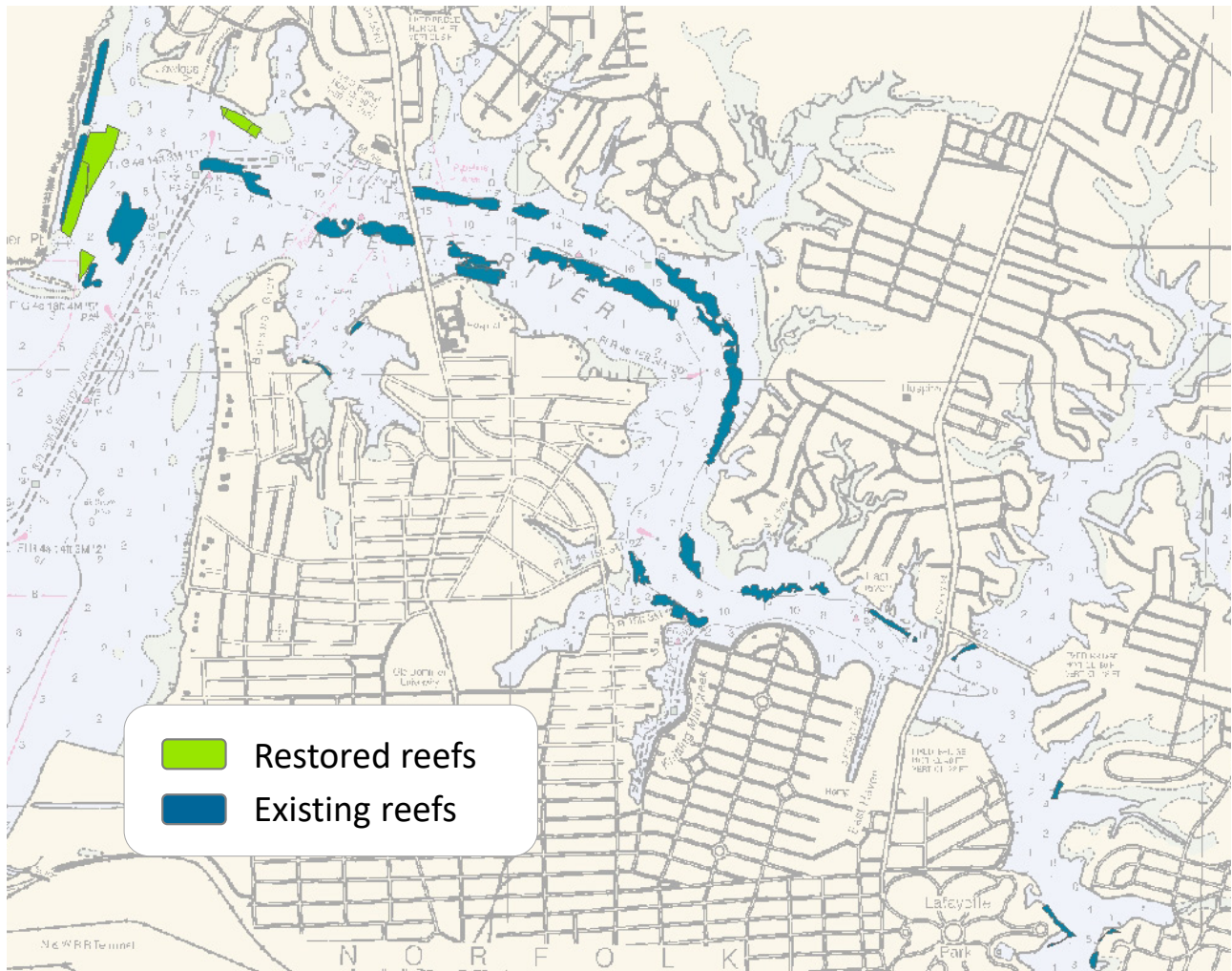
Planned oyster restoration work in the [Lafayette River](#) was completed in 2018, making it the first river in Virginia to be considered complete under the Ten Tributaries initiative. The focus now is on monitoring the restored and existing reefs in the river. Earlier restoration projects show high densities of oysters representing numerous year classes, boding well for the newer Lafayette reefs. In 2021, with funding from VIMS, partners started monitoring the restored reefs relative to the Oyster Metrics success criteria. Since 2018, the Elizabeth River Project has continued to coordinate the construction of shoreline oyster restoration projects through its partnership with the U.S. Navy's Lafayette Annex and waterfront residential property owners.

**Acres Restored: 12** (*restoration complete*)

**Cost to Date: \$716,000**  
(*restoration completed in 2018*)



This cost is through the end of 2021, for reefs restored under the 'Ten Tributaries' initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.

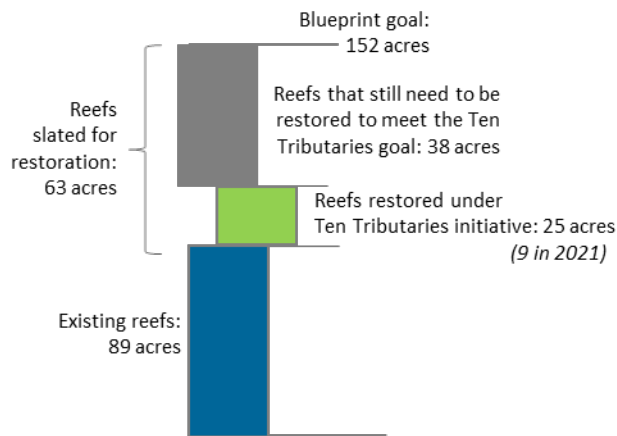




# Lynnhaven River

The [Lynnhaven River Restoration Blueprint](#) sets a goal of 152 acres of reefs in the river. In 2021, the U.S. Army Corps of Engineers' Norfolk District constructed eight acres of reefs in the river using reef balls. With funding from NOAA, the Chesapeake Bay Foundation and Lynnhaven River NOW partnered to construct a one-acre shell reef. Together, these nine acres constructed in 2021 bring the total to 25 acres of reefs constructed under the 'Ten Tributaries' initiative. Partners plan to continue reef construction in the coming years. In 2022, CBF and LRN, with funding from the National Fish and Wildlife Foundation, plan to construct 26 acres of reefs using crushed concrete as a base, to be topped with spat-on-shell. As early as mid-2023, USACE-Norfolk District, with the City of Virginia Beach as its non-federal cost-share partner, plans to construct up to 27 acres of reefs in Broad Bay.

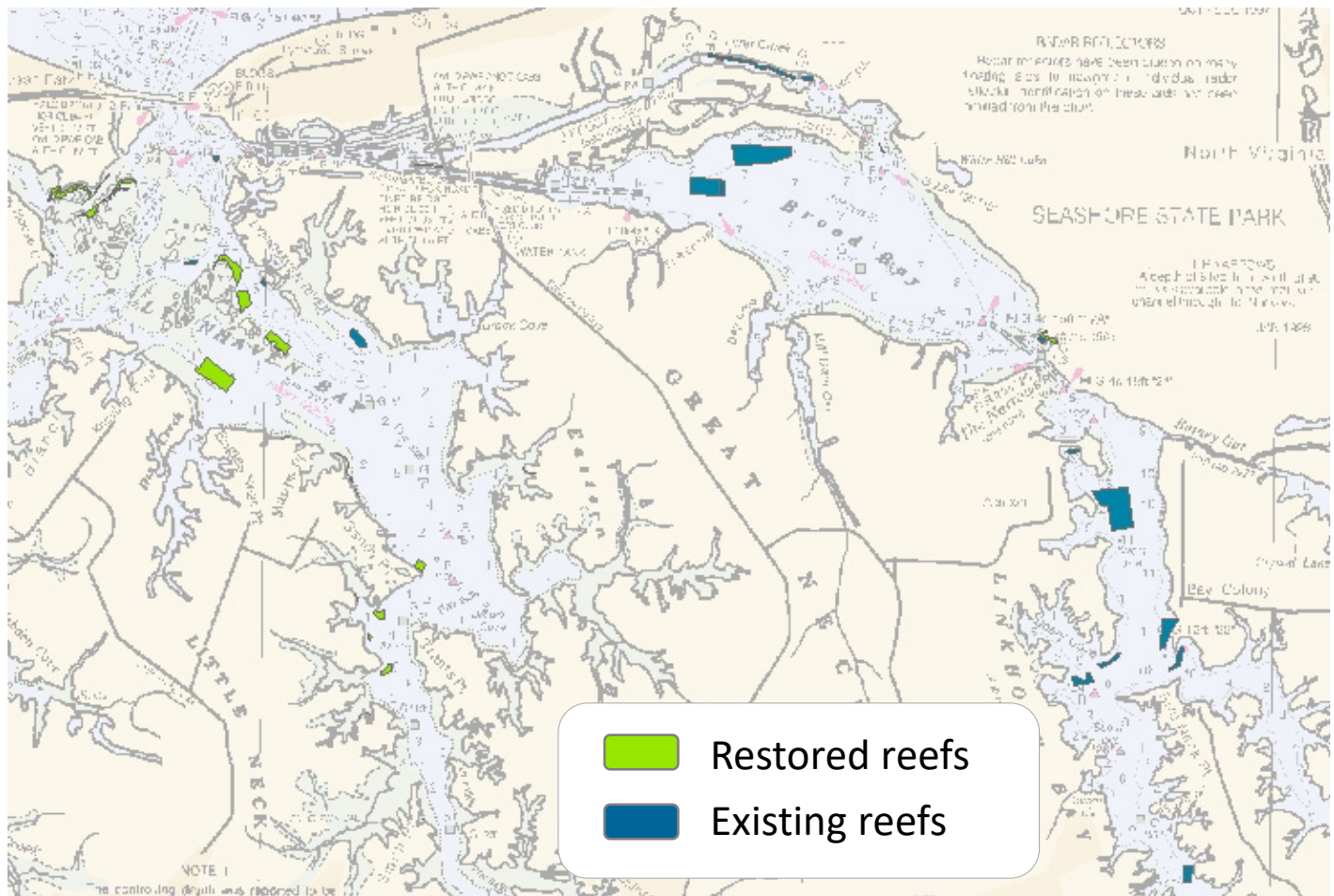
## Acres Restored: 25 of 63 Planned



## Cost to Date: \$2.62 million

*(\$1.85 million in 2021)*

This cost is through the end of 2021, for reefs restored under the 'Ten Tributaries' initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.



# Piankatank River

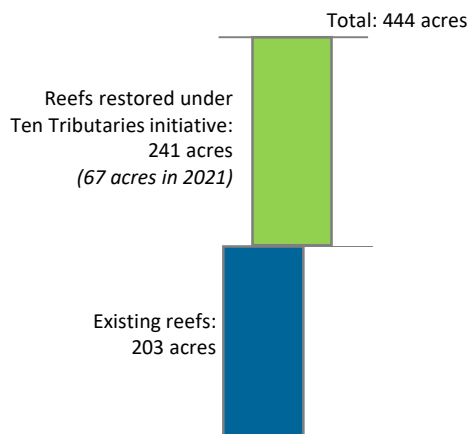
Oyster reef restoration work was completed in the Piankatank River in 2021. This year, the Virginia Marine Resources Commission, using NOAA and state funding, constructed 67 acres of reefs on the Piankatank River from crushed stone 2-4" in diameter. This brings the reef construction in the river to 241 acres. Combined with the 203 acres of existing healthy reef, this brings the total to 444 acres of reefs, exceeding the [Piankatank River Restoration Blueprint](#) goal of 438 acres of reefs. Also this year, staff from Virginia Commonwealth University, with funding from NOAA, placed interpretive signs outdoors at the Deltaville Maritime Museum, describing the importance of the restoration work happening in the Piankatank River.

Starting as soon as mid-2022, USACE-Norfolk District, with VMRC as its non-federal cost-share partner, plans to construct up to 50 additional acres of reefs in the river.

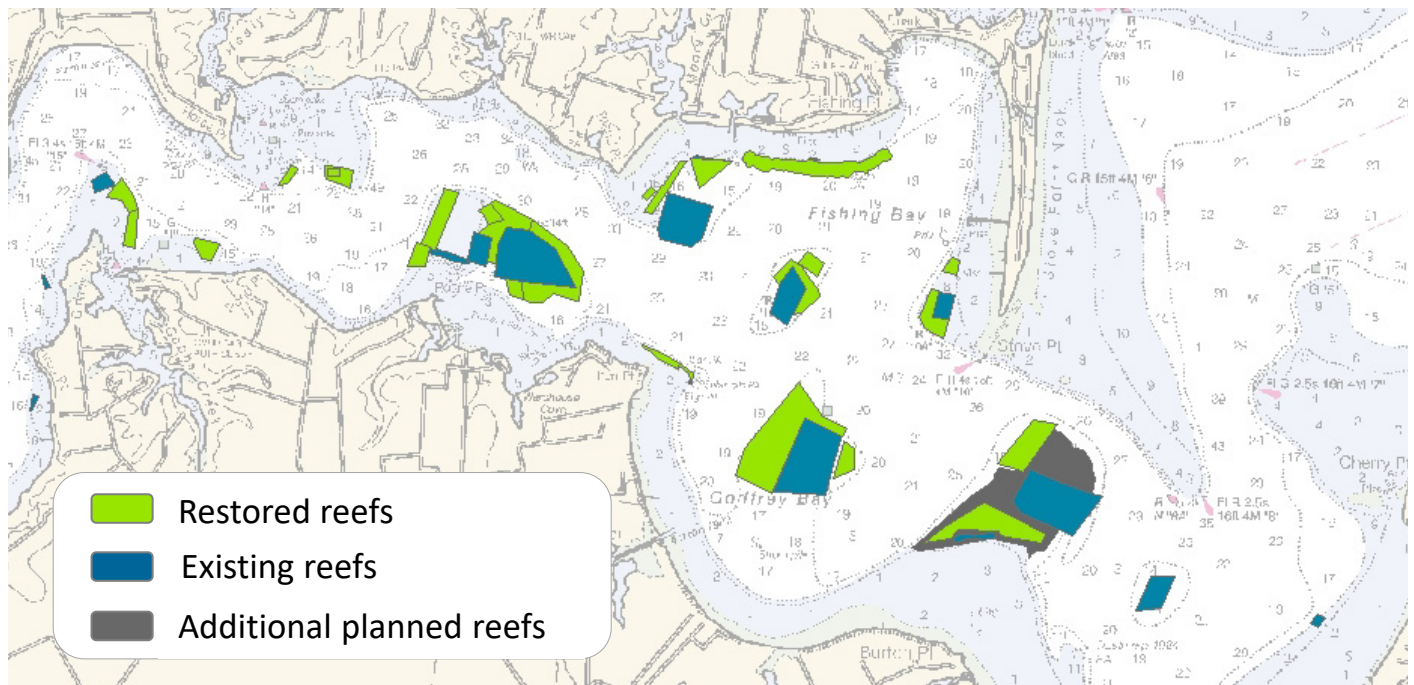
**Acres Restored: 241** (*restoration complete*)

**Cost to Date: \$6.4 million**

*(\$1.76 million in 2021)*



This cost is through the end of 2021, for reefs restored under the 'Ten Tributaries' initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.



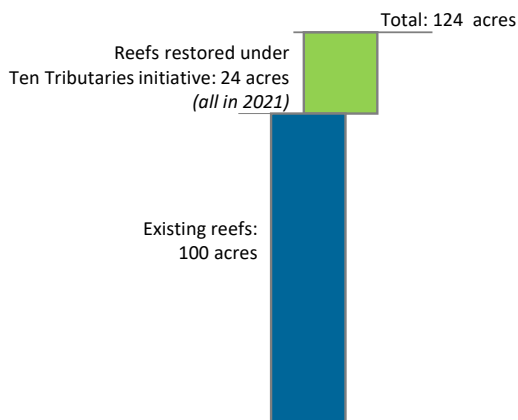


# Great Wicomico River

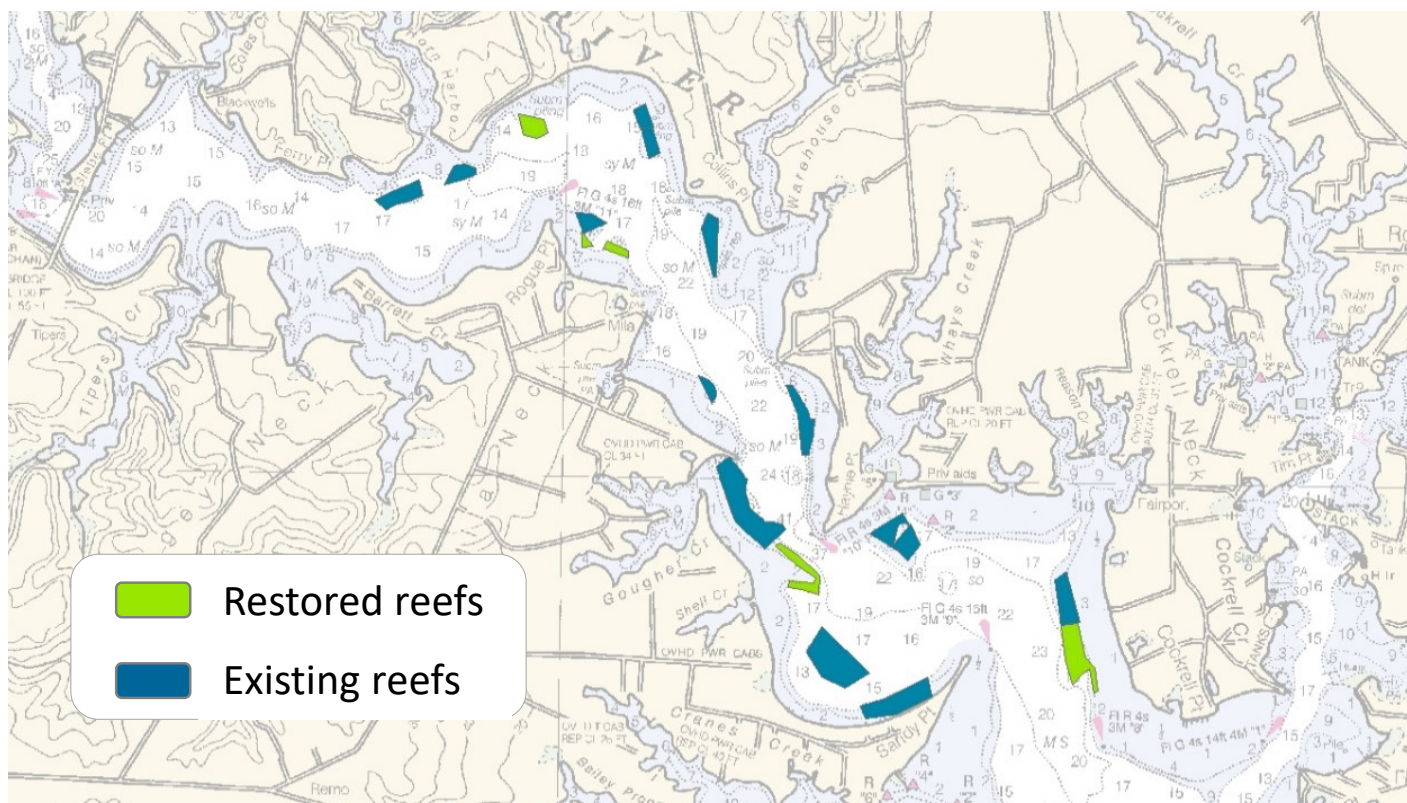
Oyster reef restoration work was completed in the Great Wicomico River in 2021. This year, VMRC constructed 24 acres of reefs in the river using crushed stone 2-4” in diameter, deployed with a crane and bucket. These reefs, together with the 100 acres of existing reefs restored prior to the Ten Tributaries Initiative by USACE-Norfolk District and VMRC, bring the total restored reefs to 124 acres. This slightly exceeds the 122 acre goal laid out in the [Great Wicomico River Restoration Blueprint](#).

**Acres Restored: 24** (restoration complete)

**Cost to Date: \$907,000** (all in 2021)

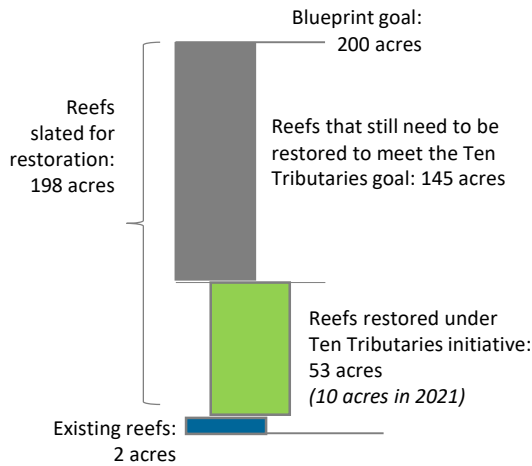


This cost is through the end of 2021, for reefs restored under the ‘Ten Tributaries’ initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.



The [Lower York River Restoration Blueprint](#) sets a goal of 200 acres of reefs in the river. In 2021, VMRC spent approximately \$971,000 maintaining, enhancing, and expanding reefs in the river. Ten acres of new shell reefs were constructed as part of this project. Several additional areas received an initial layer of fine shell, onto which a stone layer will be placed in 2022. This 2021 work brings the total restored reefs area in the river to 53 acres. VMRC intends to focus much of its oyster reef construction work in the lower York River in 2022.

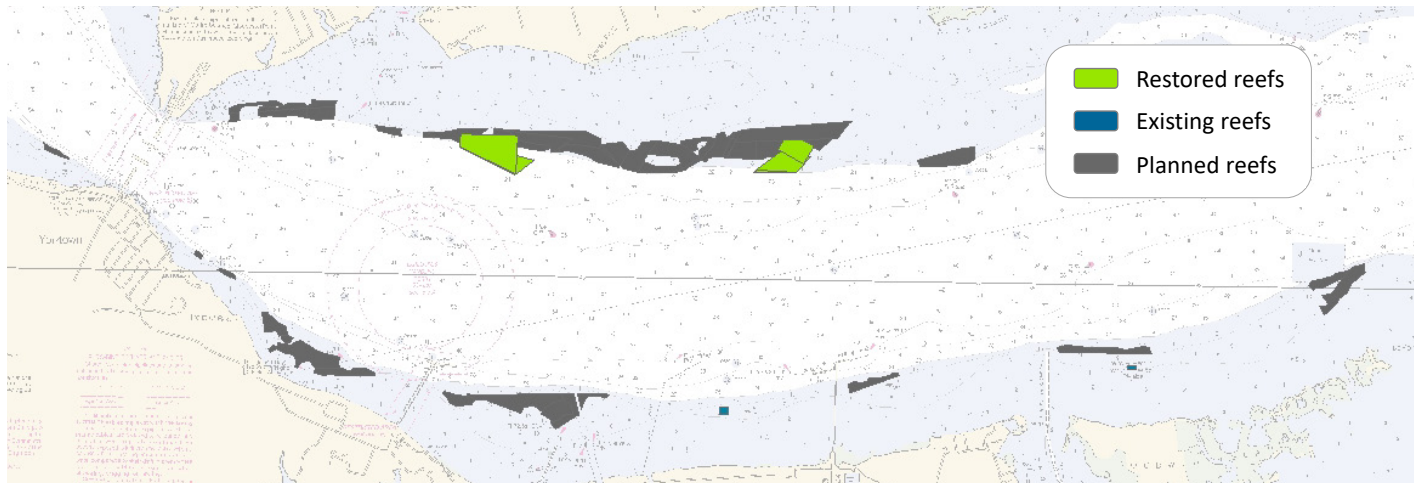
## Acres Restored: 53 of 198 Planned



## Cost to Date: \$1.29 million

*(\$971,000 in 2021)*

This cost is through the end of 2021, for reefs restored under the ‘Ten Tributaries’ initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors.



## Virginia 2021 Highlights and Challenges

### Highlights

- Partners completed oyster restoration work in two tributaries in 2021 (Piankatank and Great Wicomico); Governor Northam attended the celebration event with multiple partners who contributed directly to the restoration of the tributaries.
- Approximately 30% of the reef acreage constructed in Virginia under the Ten Tributaries initiative was constructed in 2021, making this a banner year.
- Construction progress was made in both the Lower York and Lynnhaven rivers. Funding is in place to finish both tributaries by 2025.
- NOAA Fisheries hosted its first “[Oyster Week](#),” highlighting content about oyster restoration and the benefits of restored oyster reefs as well as aquaculture on its nationwide website and several social media platforms, including nearly 25 Twitter posts during the November 1-5 event.

### Challenges

- Some individuals in user groups (e.g., boating public, adjacent private lease holders, waterfront property owners, watermen) have expressed opposition to some proposed projects in Virginia.
- As targets are almost reached, the last remaining acreage may become more difficult and/or expensive per acre of restoration on some tributaries.

## Factors Influencing Success in Virginia

Many factors may influence the success of the Ten Tributaries outcome. These include restoration funding, poaching, water quality, oyster disease, acquisition of real estate rights, fluctuations in natural oyster recruitment, and availability of suitable reef-building substrate. That oyster restoration can succeed in the Virginia waters of the Chesapeake Bay has been validated by past successful oyster restoration efforts in the Lafayette, Piankatank, Great Wicomico, and Lynnhaven rivers and by the discovery of a relict, self-sustaining oyster population in the Lafayette River. These serve as evidence that oyster populations can prosper in the Chesapeake Bay, either naturally or due to restoration in sanctuaries. Virginia experiences relatively high natural oyster recruitment rates, which minimizes the need for augmentation with hatchery-produced oysters. Recent declining trends in disease mortality rates may increase on-reef survival and sustainability of restoration efforts.