Chesapeake Bay Program
Science. Restoration. Partnership.

Submerged Aquatic Vegetation Outcome
Management Strategy
2015–2025, v.4

Water stargrass (Heteranthera dubia) in the clear waters of the upper Potomac River, Maryland on July 28th, 2019. (Photo by Brooke Landry/Maryland Department of Natural Resources)

I. Introduction

Submerged aquatic vegetation (SAV), or underwater grasses, provide significant benefits to aquatic life and serve critical functions in the Chesapeake Bay ecosystem. Underwater grasses provide food, habitat and nursery grounds for a number of commercially and ecologically important finfish and shellfish, such as striped bass and blue crabs, and migratory waterfowl. They reduce erosion by slowing currents and softening waves, anchor bottom sediments and help keep the water clear by absorbing nutrients and trapping sediments. Through photosynthesis, underwater grasses act as a carbon sink by taking in carbon dioxide. This contributes to the reduction of greenhouse gas emissions and reduces the potential for climate change impacts. Likewise, underwater grasses also produce oxygen, which helps sustain other aquatic life. Increasing the abundance of underwater grasses in the Bay and its rivers will dramatically improve the entire Bay ecosystem.

II. Goal, Outcome and Baseline

This management strategy identifies approaches for achieving the following goal and outcome:

Vital Habitats Goal

Restore, enhance and protect a network of land and water habitats to support fish and wildlife, and to afford other public benefits, including water quality, recreational uses and scenic value across the watershed.

Submerged Aquatic Vegetation (SAV) Outcome

Sustain and increase the habitat benefits of SAV (underwater grasses) in the Chesapeake Bay. Achieve and sustain the ultimate outcome of 185,000 acres of SAV Bay-wide necessary for a restored Bay. Progress toward this ultimate outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025

This outcome was derived by the Chesapeake Bay Program's SAV Workgroup and is based on observed historical SAV abundance and distribution throughout the Bay and its rivers.

Baseline and Current Condition

The Bay Program's SAV Workgroup has reviewed the historic record, as well as photographic evidence from the 1930s to present and determined that the Bay has historically supported at least 185,000 acres of SAV. The most critical action for restoring SAV is to achieve the Water Quality Goal (reduce pollutants to achieve the water quality necessary to support the aquatic living resources of the Bay and its tributaries and to protect human health). In most cases, as water clarity improves, SAV will reestablish itself without the need for direct restoration (planting or seeding). However, as the Water Quality outcomes are met, there will be places where water clarity is sufficient but there is no longer a seed source for natural recolonization of SAV. Therefore, the workgroup supports efforts to plant or seed SAV each year in areas of the Bay deemed likely for success. This restoration effort is intended to stimulate natural SAV bed growth to aid in reaching the Bay-wide abundance goal of 185,000 acres. Actively restoring SAV each year will provide future seed sources and improve physical conditions for further SAV recruitment. Additionally, continuous seed bank restoration and planting will encourage the expansion of SAV propagule production facilities, increase expertise among restoration practitioners and provide opportunities for community and student engagement.

SAV constitutes one of the most important biological communities in estuaries. SAV has historically contributed to the high primary and secondary productivity of the Bay, but increased nutrient and sediment inputs from the watershed caused Bay-wide declines in the mid-1900s. Hurricane Agnes in 1972 and Tropical Storm Lee and Hurricane Irene in 2011 further stressed the resource. SAV recovered rapidly between 2012 and 2018 with the implementation of the Chesapeake Bay Total Maximum Daily Load (Bay TMDL) but declined substantially between 2019 and 2020 when above average precipitation and high flows degraded water quality/clarity conditions necessary for SAV growth and survival.

Since 1976, the workgroup has served the larger Bay community by providing technical expertise and applied research findings to resource managers in an effort to inform the restoration and protection agenda. Please refer to the Chesapeake Bay Program's site (https://www.chesapeakeprogress.com/abundant-life/sav) for the current status of SAV abundance.

III. Participating Partners

Team Lead: Vital Habitats Goal Implementation Team (GIT)

Workgroup Lead: Submerged Aquatic Vegetation Workgroup

- SAV Workgroup chair and vice-chair
  - Prepares biennial workplan and management strategy, coordinates and leads workgroup efforts.
- SAV Workgroup
  - Advises on SAV science, supports and contributes to efforts to implement the SAV management strategy and the biennial workplan.

Opportunities for Cross-Goal Team and Workgroup Collaboration:

- Sustainable Fisheries GIT
- Water Quality GIT
- Climate Resiliency Workgroup
- Wetland Workgroup (Habitat GIT)
- Black Duck Action Team (Habitat GIT)
- Maintain Healthy Watersheds GIT
- Communication Workgroup
- Plastic Pollution Action Team

Participating agencies **(Signatories in bold)**

High Level of Participation:

- **Maryland Department of Natural Resources**
  - Chairs SAV Workgroup and coordinates SAV Workgroup efforts.
  - Conducts SAV monitoring, restoration and research.
  - Financially supports Bay-wide SAV Survey.
  - Utilizes SAV data for project reviews requiring permits and/or mitigation when those projects impact SAV habitat.
- **Maryland Department of the Environment**
  - Financially supports Bay-wide SAV Survey.
  - Utilizes SAV data for project reviews, permits and mitigation if a project impacts existing SAV beds.
  - Tracks shallow water use criteria achievements.

- **Virginia Coastal Zone Management Program**
  - Financially supports Bay-wide SAV Survey and SAV restoration efforts.
- **Virginia Department of Environmental Quality**
  - Uses SAV data for project planning and to evaluate the value and function of shallow-water habitats.
  - Tracks shallow water use criteria achievements.
- **Virginia Marine Resource Commission**
  - Utilizes SAV data for permits required for mitigation if a project impacts existing SAV beds or historic SAV presence.
  - Uses SAV data for project planning.
  - Tracks shallow water use criteria achievements.
- **D.C.'s Department of Energy and Environment**
  - Conducts SAV research, monitoring and restoration.
- **U.S Environmental Protection Agency**
  - Financially supports Bay-wide SAV Survey and SAV research projects.
- **Virginia Institute of Marine Science**
  - Conducts and financially supports Bay-wide SAV Survey.
  - Utilizes SAV data for project reviews, permits and mitigation if a project impacts existing SAV beds.
  - Tracks shallow water use criteria achievements.
  - Conducts SAV research, restoration, outreach and education.
- **University of Maryland**
  - Conducts SAV research.
- **St. Mary's College of Maryland**
  - Conducts SAV research.
- **Old Dominion University**
  - Conducts SAV research.
- **Smithsonian Environmental Research Center**
  - Conducts SAV monitoring and research.
- **Tetra Tech, Inc.**
  - Conducts SAV research and restoration.
- **Chesapeake Bay Foundation**
  - Conducts SAV outreach and education.
- **The Nature Conservancy**
  - Conducts SAV research, restoration, outreach and education.

Medium Level of Participation:

- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- National Oceanic and Atmospheric Administration
- U.S Army Corps of Engineers

Likely Participating Jurisdictions:

- Maryland
- Virginia
- Washington, D.C.
- Pennsylvania
- Delaware

Likely Participating Federal Partners:

- U.S. Fish and Wildlife Service
- National Oceanic and Atmospheric Administration
- U.S. Geological Survey
- U.S. Army Corps of Engineers

Local Engagement and Diverse Representation

Non-profit groups such as the Chesapeake Bay Foundation and The Nature Conservancy have been historically involved in education and outreach regarding SAV, as well as active SAV restoration projects, in partnership with schools and state and local agencies. Other non-profits, such as Riverkeepers and local watershed organizations, are also playing an increasing role in the SAV Workgroup and contributing to SAV monitoring and restoration efforts, as well as education and outreach. To ensure representation reflects all stakeholders in the watershed, the SAV Workgroup will seek diverse membership representation and include Diversity, Equity, Inclusion and Justice (DEIJ) considerations into all aspects of the factors, efforts and strategies discussed below and into all workgroup decisions.

IV. Factors Influencing Success

Many factors, both natural and anthropogenic and with wide-ranging levels of impact and management potential, influence the attainment of SAV goals. A thorough understanding of these factors is essential to promote the natural recovery of SAV and SAV restoration success:

1. **Habitat Conditions and Availability**

   High-quality habitat conditions are vital to the success of SAV recovery and restoration efforts. Good quality habitat conditions for SAV are defined by shallow water (two meters or less) with sufficient water quality/clarity, appropriate wave and current conditions, and healthy sediment in which SAV can grow and thrive. Salinity dictates SAV species distribution. Most significantly, water clarity is vital for a productive SAV habitat. Water clarity varies in time as a function of precipitation (as it affects run-off and consequently sediment and nutrient pollution entering the Bay).

   Habitat conditions and availability are impacted by additional factors, including stressors associated with climate change. The Bay is considered at high risk for sea level rise, increased water temperatures and extreme weather events from climate change, which will influence SAV habitat conditions and availability. Climate change and sea level rise have little management potential at the local scale. The SAV Workgroup, however, advocates for management approaches and implementation of best management practices that alleviate the impact from climate stressors (e.g.,

minimize shoreline hardening/modification to allow inland migration of SAV as water levels increase).

Shallow-water use conflicts also influence SAV habitat availability. Aquaculture and other commercial fishing activities and SAV removal for navigational purposes are examples of these potential conflicts.

2. **Protection of Existing and Recovering SAV**
   Anthropogenic activities, including dredging, propeller scarring, fishing and aquaculture practices, as well as the introduction of invasive species and marine debris, can cause direct physical disturbance to SAV. Indirect impacts from localized water quality degradation associated with activities such as shoreline alteration, sedimentation from changes in land use or in-water activities like clam dredging, also influence the health of SAV beds.

   Effective and enforceable regulations are necessary to adequately protect SAV. The adequate protection of existing and recovering SAV is necessary to reach the 185,000-acre Bay-wide SAV restoration goal. As new threats and conflicts (e.g., shellfish aquaculture, climate change impacts, SAV harvesting) emerge simultaneously with recovering SAV populations, the efficacy of existing regulations may diminish.

3. **SAV Restoration Potential and Activity**
   Direct SAV restoration is an important component to Chesapeake Bay SAV recovery. There are a number of reasons to actively restore SAV: to provide seeds to an area where a natural seed bank is not present, to increase genotypic and phenotypic diversity, to increase species diversity and to provide outreach and educational opportunities to the parties involved in the restoration effort. Direct restoration of SAV by planting whole plants or seeds is a multi-step, labor-intensive and expensive venture, and success is based on a number of factors, ranging from appropriate site selection (controllable) to future unpredictable weather events and water quality (uncontrollable).

4. **SAV Research and Monitoring**
   Annual Bay-wide SAV monitoring at multiple levels of detail is essential to guide appropriate SAV research and management actions. Annual monitoring data allow for adaptive management of SAV throughout the Bay and it is the only way to show with certainty that efforts to protect and restore SAV are effective. As such, SAV research and monitoring is a priority management strategy for increasing and sustaining the habitat benefits of SAV in the Chesapeake Bay.

5. **Public Perception, Knowledge and Engagement**
   Public perception of SAV affects its health: during periods of SAV recovery and high abundance, some members of the public perceive it as a nuisance and consequently take measures to deter its growth or directly remove it. SAV stewardship can be managed through education, outreach and regulation, and is an important component of SAV conservation and restoration.

V. Current Efforts and Gaps

While there are numerous factors influencing the success of SAV recovery and restoration throughout the Bay, extensive efforts are being made to address those factors, and to identify what additional efforts and actions are necessary to reach the 185,000-acre SAV restoration goal.

1. **Habitat Conditions and Availability**

   Successful recovery and restoration of SAV in the Bay are dependent upon improved water clarity and habitat conditions. Water clarity improvements are being made by meeting pollutant allocations set by the Bay TMDL and through the work of the Water Quality and Maintain Healthy Watersheds GITs.

   Recent increases in SAV were attributed to the Bay TMDL and concurrent long-term improvements in water quality and clarity. SAV coverage increased from 48,195 acres in 2012 to 104,893 acres in 2017, the most SAV ever recorded since monitoring began in 1984. However, due to record rainfall and freshwater inputs into the Bay in subsequent years, mapped SAV coverage decreased to 62,169 acres by 2020. SAV in Chesapeake Bay is currently only achieving 34% of the 185,000-acre goal.

   Furthermore, climate change will have both direct and indirect effects on Chesapeake Bay SAV. Bay scientists are currently assessing the direct effects of climate change (i.e., sea level rise, rising water temperatures) on SAV through research, literature reviews and Scientific and Technical Advisory Committee (STAC) sponsored workshops. Additional analyses are required, however, to understand the indirect effects of climate change more fully (e.g., increase in pathogens and invasive species) on SAV and to fully evaluate the potential for SAV to continue providing essential ecosystem services and to meet its restoration goal in the face of these multiple stressors.

   Additionally, shallow-water use conflicts (e.g., an expanding aquaculture industry) may impact habitat availability for SAV. In order to reach our Bay-wide SAV restoration goals, adequate shallow water habitat (adequate space and adequate water clarity) must remain available for SAV to expand into.

2. **Protection of Existing and Recovering SAV**

   Maryland, Virginia and the District of Columbia all have regulations in place that protect existing SAV from harmful practices, including dredging and filling, nearshore construction and commercial fishing. But it is unclear if those regulations will adequately protect new and expanding SAV beds as they recover throughout the Bay. A review of all the statutes, regulations and policies that affect SAV in the Chesapeake Bay was completed in 2019. The review included multiple recommendations that should be considered for more thorough protection of SAV in the Bay.

3. **SAV Restoration Potential and Activity**

   Direct SAV restoration is an important component to Chesapeake Bay SAV recovery. Academic institutions, organizations and agencies in Maryland, Virginia and Washington, D.C. currently work

to actively restore SAV in appropriate areas throughout Chesapeake Bay using seeds and, in some limited cases, adult plants. Based on recent successes in SAV restoration attempts associated with improved water quality and clarity conditions, the SAV Workgroup developed an SAV Restoration Guide that details current protocols for seed harvesting, processing and storage, as well as site selection and dispersal. Because restoration success is heavily dependent on water quality and clarity conditions, care should be given to determining when SAV restoration projects are appropriate.

Unfortunately, even in ideal habitat conditions with reduced human impacts, the limited availability of source seeds, plants and propagules (from laboratories, nurseries and wild collection), as well as the minimal availability of funding for restoration projects and restoration science research, has constrained the SAV Workgroup and its partners' ability to implement expansive SAV restoration efforts.

4. **SAV Research and Monitoring**

Annual Bay-wide SAV monitoring at multiple levels of detail is essential to guiding appropriate SAV research and management actions. Annual monitoring data allow for adaptive management of SAV throughout the Bay and it is the only way to show with certainty that efforts to protect and restore SAV are effective. The protection of existing SAV is, likewise, only possible with monitoring and distribution data, and is a priority management strategy for increasing and sustaining the habitat benefits of SAV in the Chesapeake Bay.

The SAV Workgroup has adopted a three-tiered, hierarchical monitoring approach for SAV. The Bay-wide SAV survey—Tier 1—maps SAV acreage and density throughout the Bay and its tributaries by interpreting data collected from aerial photographs. This broad-scale monitoring program is complemented by ground surveys conducted by CBP partners and community scientists engaged in the Chesapeake Bay SAV Watchers Program—Tier 2. SAV Watchers is a volunteer monitoring program that partners with Riverkeepers and other watershed groups to monitor a limited number of SAV habitat characteristics at a large number of locations throughout the Bay and its tributaries, which is useful for broad-scale condition assessments and for identifying and quantifying driver/response relationships. Tier 3, the Chesapeake Bay SAV Sentinel Site Monitoring Program, will monitor multiple parameters in greater detail at fewer locations (the sentinel sites). Sentinel site monitoring focuses on identifying causal relationships by intensively monitoring drivers of change, ecosystem responses and ecological processes. Together, these interconnected Chesapeake Bay SAV monitoring efforts will maximize our efficiency and forecasting capabilities, while informing conservation, restoration, research and management strategies for the Bay as a whole.

Additional support, including funding, for the three tiers of Chesapeake Bay SAV monitoring activity is needed to ensure their Bay-wide implementation and long-term sustainability. Likewise, CBP partner scientists and others in the region are currently conducting research in SAV biology, ecology, genetics, restoration and the impacts of climate change on SAV but because limited funding is

available for SAV research, extensive gaps in our knowledge base remain. To fully restore SAV in the Chesapeake Bay, SAV research and monitoring must be more effectively funded and supported.

5. **Public Perception, Knowledge and Engagement**

   In an effort to educate the public about the benefits of SAV and improve their perception of SAV, the SAV Workgroup works with the Chesapeake Bay Program communications team on annual press releases of SAV acreage and goal-attainment, community-based social marketing campaigns and produces SAV-related web and social media content throughout the year. Although these materials reach residents throughout the Chesapeake Bay watershed, some negative public opinions regarding SAV remain. A more elaborate and effective outreach strategy is needed to reach a broader audience to communicate the benefits and ecosystem services provided by Chesapeake Bay SAV.

VI. Management Approaches

The partnership will work together to carry out the following management approaches and specific actions identified in the biennial workplan to achieve the SAV outcome. These approaches seek to address the factors affecting our ability to meet the goal and the gaps identified above.

The following five approaches have been identified as critical to the success of SAV restoration goals.

1. **Support Efforts to Conserve and Restore Current and Future SAV Habitat and Habitat Conditions**
   In order to meet current and future SAV restoration goals, it is essential to meet water clarity standards in areas and at depths that are designated by Maryland, Virginia and the District of Columbia for the application of those criteria (i.e., SAV shallow water use). The water clarity standards reflect the light requirements that are necessary for the growth and maintenance of SAV populations throughout the shallow waters of the Chesapeake Bay and its tidal tributaries. This strategy is being implemented by meeting pollutant allocations set by the Bay TMDL and through the work of multiple Chesapeake Bay Program groups, including the Water Quality GIT and the Healthy Watersheds GIT.

   Additionally, the Bay is considered at high-risk for impacts related to climate change, several of which have the capacity to affect SAV. The SAV Workgroup supports measures that aim to minimize and mitigate those impacts (e.g., lessen shoreline hardening/modification to allow inland migration of SAV as water levels increase), as well as impacts associated with shallow-water use conflicts that may reduce the habitat availability for current and future SAV.

2. **Protect Existing and Recovering SAV**
   The SAV Workgroup will protect existing SAV by supporting efforts to characterize threats and develop protection measures, establish protection area criteria, minimize the effects of invasive species and human impacts, evaluate SAV protection laws and regulations and update when necessary, and increase understanding of the potential effects of sea-level rise and other climate-

change impacts on SAV populations. Protecting existing SAV beds will also help ensure continued seed and propagule sources for natural recovery.

3. **Restore SAV**
   The SAV Workgroup will lead and support efforts to actively restore SAV where possible, targeting sites with suitable habitat quality and high potential to benefit living resources, as well as vulnerable coastal communities and infrastructure.

4. **Enhance SAV Research and Monitoring**
   The SAV Workgroup will enhance SAV research and monitoring by implementing a hierarchical and integrated SAV monitoring program and by supporting and tracking research that advances our understanding of SAV restoration, recovery and resilience.

5. **Enhance Community Involvement, Education and Outreach**
   The SAV Workgroup will expand efforts to educate and engage the public about the critical importance of SAV and include community scientists and volunteers in SAV monitoring and restoration efforts.

VII. Monitoring Progress

Monitoring programs are critical to understanding year to year fluctuations in living resource distribution and abundance. SAV distribution in the Chesapeake Bay is assessed using annual aerial surveys, and abundance acreage is derived from the imagery taken during the aerial survey. Continued annual Bay-wide monitoring is the top funding priority for SAV resource management as it provides information vital to managing water quality and tracking restoration progress. The most recent SAV distribution data and survey-related information are available at the Virginia Institute of Marine Science and Chesapeake Progress websites.

VIII. Assessing Progress

Recent increases in SAV were attributed to the Bay TMDL and concurrent long-term improvements in water quality and clarity. SAV coverage increased from 48,195 acres in 2012 to 104,893 acres in 2017, the most SAV ever recorded since monitoring began in 1984. Due to record rainfall and freshwater inputs into the Bay in subsequent years, however, mapped SAV coverage decreased to 62,169 acres by 2020. Progress toward this outcome will be measured against a target of 130,000 acres by 2025. SAV in the Chesapeake Bay is currently only achieving 48% of the 2025 target and 34% of the ultimate 185,000-acre outcome.

Increased resources and capacity for SAV and water clarity restoration are required to hasten progress toward this goal. Please refer to the Chesapeake Progress SAV site (https://www.chesapeakeprogress.com/abundant-life/sav) for the current status of SAV abundance and to the Data Dashboard (https://gis.chesapeakebay.net/sav/) for segment specific SAV information.

IX. Adaptive Management

The partnership will use the following approaches to ensure adaptive management:
The SAV Workgroup will meet quarterly each year to track progress toward the 185,000-acre goal, as well as share progress and discuss any new challenges or opportunities. The workgroup will use this time to review performance assessment information and adjust management strategies if appropriate. As new issues are identified, the workgroup will collectively develop strategies to overcome barriers to restoration, as well as identify trends, priority areas and research needs.

X. Biennial Workplan

The SAV Workgroup develops a biennial workplan to support the SAV Management Strategy. The workplan is revised every two years and includes the following information:

- Each key action.
- Timeline for the action.
- Expected outcome.
- Partners responsible for each action.

Lessons Learned

1. Climate Change –
Climate change will impact our ability to reach the SAV outcome of 185,000-acres without significant improvements in water quality and clarity. Since 2019, approximately one-third of SAV was lost in the Bay as a result of increased precipitation, flows and rising water temperatures.

2. Monitoring –
While the annual Bay-wide aerial survey is one of the best SAV monitoring programs in the world, it has become apparent over the last several years that a need existed for more detailed species and habitat information. As such, in 2018-2019, the SAV Workgroup (in collaboration with UMCES/IAN) developed a volunteer-based ground survey program, the Chesapeake Bay SAV Watchers, that supplements the Bay-wide aerial survey by providing species and other habitat data. In 2020-2021, a third, higher level SAV Sentinel Site Program was developed. Together, the aerial survey, the SAV Watchers program and the SAV Sentinel Site Program will form a coordinated three-tiered hierarchical monitoring program for SAV, enabling the CBP partnership to conserve and restore SAV in the Bay more effectively and efficiently.

3. Policy –
As SAV recovers in areas throughout the Bay in response to improvements in water clarity facilitated by the Bay TMDL, instances of shallow water use conflicts continue to arise. In 2018-2019, the Chesapeake Legal Alliance worked with the SAV Workgroup to review all current statutes and regulations protecting SAV in the Bay. A new action in the 2020-2021 Workplan built on that effort to act on the recommendations made in the regulatory review where feasible. Unfortunately, time and resources did not allow for that action to take place, so it remains included in the 2022-2023 workplan.