Advancing Monitoring Approaches to Enhance Assessment Water Quality Standards for
Chesapeake Bay Dissolved Oxygen, Water Clarity/SAV and Chlorophyll *a* Criteria
A Programmatic CBP STAC Workshop Proposal
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Submitted By

- Criteria Assessment Protocol Workgroup
- Scientific, Technical Assessment and Reporting Team and its Modeling WG, ==Climate Resiliency and Status and Trends Workgroups==, others?

Workshop Steering Committee Members

1. Peter Tango, Chair, USGS, Chair of the Criteria Assessment Protocol Workgroup.

2. Suspect #1

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Workshop Objectives and Targeted Management Outcomes

Ambient Water Quality Criteria for Chesapeake Bay Dissolved Oxygen, Water Clarity and Chlorophyll (USEPA) was published in 2003. The document was the foundation reference for criteria and protocol assessment in support of water quality standards related to the Chesapeake Bay TMDL by the Bay States and USEPA. The Chesapeake Bay Monitoring Program was deemed "marginal" to address measurement and reporting for all applicable criteria. In 2021, the traditional long-term water quality monitoring program has decreased in data collection. 18 years later, the assessment of bay criteria remains incomplete such that the States are unable to provide a full accounting for the health status of the bay and its tidal tributaries. A multi-metric indicator is used to estimate the conditions outlined in the criteria that remain unmeasured and unassessed under the existing protocols and assessment methods.

Over the last 18 years, methods have been published (e.g. USEPA 2017) attempting to extend the utility of available, traditional water quality monitoring program data to fill gaps in the temporal and spatial scales of data needed for a full accounting of bay health associated with the criteria related to the TMDL targets for recovery based on data collected at the appropriate scales. Further, new data collection programs involving Citizen Science derived data and satellite sensed water quality offer opportunities to improve accounting where space-time gaps have existed. New technologies have been piloted (e.g. vertical water quality profiler, CBT GIT-funded Hypoxia Monitoring Project 2019-2020, Tango, Vogt, and Lazaar) to address continuous data collections in the deepest, open water habitats of the bay with robust sensors at 10-minute time scales that address multiple designated uses…

USEPA CBPO has invested in continuing coordination and collaboration with Citizen groups through an annual grant award growing the network of opportunity for enhanced data collection throughout tidal waters of the Bay. The CBP partnership inasmuch signed a Memorandum of Understanding supporting the use of these and other non-traditional data sets of appropriate quality and integrity to enhance assessments and provide decision-support. STAC further supported a workshop on advancing the use of satellite imagery for SAV assessments. NASA and NOAA have further explored satellite sensor results for measuring and depicting water clarity related conditions and harmful algal bloom distributions in

Chesapeake Bay which have potential to inform needed analyses at improved spatially and temporally relevant scales of management interest.

The workshop objective is to develop adoptable recommendations on adaptive monitoring for updating the structure for the next generation Chesapeake Bay Program tidal monitoring program with methods that 1) improve temporal resolution to address short duration dissolved oxygen criteria and spatial resolution for depicting spatial variability, 2) improve temporal and spatial coverage in water clarity assessments, 3) improve SAV assessment with repeated intra-annual measures of cover, 4) evaluate the status of chlorophyll a assessments with satellite imagery and 5) consider cost efficiencies in updating and expanding data streams acknowledged and adopted into use for updated assessment accountability in evaluating Bay health.

Management Relevance

USEPA, in collaboration with hundreds of scientists, managers and policy-makers across the Chesapeake Bay Program partnership published its ambient water quality criteria for dissolved oxygen, water clarity and chlorophyll to support targets of water quality standards that, when achieved, represent conditions supporting survival, growth and reproduction of aquatic life, characterizing restoration conditions for Chesapeake Bay habitat (USEPA 2003). These target conditions define a restoration goal under the Chesapeake Bay Total Maximum Daily Load (TMDL) (USEPA 2010). The traditional Chesapeake Bay Program long-term water quality monitoring and assessment program was deemed "marginal" for measuring and reporting on all published criteria to produce a complete accounting of Bay health (USEPA 2003). For 18 years the traditional monitoring program has been sustained, had some adjustments, explored and published analysis options, however, never achieving the temporal and spatial scales necessary for full annual and seasonal accounting to report on the condition of ANY of 92 segments in the bay. The program has essentially been insufficient to effectively monitoring and assess all required water quality criteria in all designated uses associated with water quality standards the Bay jurisdictions need to meet associated with the TMDL. A Multimetric Indicator was developed (Hernandez et al. 2020) to use the limited information available from the monitoring program to estimate conditions where data gaps existed in the accounting as a place-holder until more complete accounting could be supported by more appropriate monitoring data and assessment protocol.

New monitoring and analysis approaches are needed to address the nearly 2-decade long short-comings of the Chesapeake Bay Program's traditional monitoring and assessment program to address all time and spatial scales for applicable water quality criteria in a cost-effective manner. The information needs include 1) short duration (instantaneous, 1-day mean and 7-day mean) dissolved oxygen measurements in all tidal bay habitats, 2) greater spatial representation and resolution of habitat conditions, 3) cost-effective measurement methods that improve the benefit of the number of data points in space and time per dollar invested, and 4) baywide water quality estimation in 4-dimensions that uses   traditional and new data streams to inform estimates of habitat status.

Formalizing the use of new data streams into the analysis of bay conditions is essential to improving the capacity of our networks. Investing time and resources in protocols for interpreting and analyzing new data streams is critical to growing our program. Modernizing our monitoring program capacity and related assessment tools will generate updated outputs providing information needs outlined by CBP teams addressing the Water Quality Goal, Climate Resiliency Goal, Sustainable Fisheries Goal and Healthy Habitat Goal of the 2014 Watershed Agreement. Subsequent statements of science needs outlined under the Chesapeake Bay Programs SRS process by these groups have been captured in the Strategic Science and Research Framework.

Why a STAC Workshop and the Urgency

The traditional long-term water quality monitoring and assessment program supported through the Chesapeake Bay Program partnership remains world class, however, 1) we are approaching 20 years of not measuring and reporting water quality criteria that EPA published and bay jurisdictions adopted into their water quality standards where only traditional, EPA grant funded data streams have always been and remain inadequate for that task, 2) traditional program capacity is eroding and data collection has been steadily declining for more than a decade and 3) with no new funding available to dramatically expand the monitoring program through the sole source of EPA-based grant funding, outstanding yet flat funding translates to cost of living erosion of cost effectiveness on even sustaining the program we have in place today.

Coincidentally, there are other high integrity data collections either underway (e.g., Citizen Science-based data collections available through the Chesapeake Bay Monitoring Cooperative) or tested under pilot studies (e.g., satellite-image based SAV assessment, e.g., Chesapeake Bay Trust supported test of vertical profiling water quality monitoring infrastructure) providing needed water quality information at spatial and temporal resolutions well beyond historical data collections. A lot of work has been done since 2018 to have policy in place to support the use of new data streams (e.g. 2018 CBP partnership MOU on Citizen Science data use) and evaluate the use of these new data sources for making measurements and supporting assessments relevant to the assessment gaps that have been identified (e.g., 2019-2020 STAC-sponsored workshop Exploring satellite image assessment of SAV). These additional sources of data represent some of the best new opportunities for the Chesapeake Bay Program partnership to formally adopt and leverage by including the data into the annual needs for water quality assessment and reporting.   fold as acknowledged and accepted data streams that fill gaps of now decades long data needs for criteria assessment and water quality standards reporting. There is parallel, complementary work underway to update the water quality interpolation framework amenable to simultaneously working with diverse data sources to generate 4D water quality characterization of bay habitat. The tandem effort benefits from aligning recognition for and anticipation of using traditional and new data sources to improve water quality criteria attainment assessments, evaluating water quality standards and fish habitat health at management relevant time and space scales.

A STAC workshop provides the ideal forum for synthesizing what is known, developing science-based support for modernizing our assessments, and, ultimately, for building the scientific and technical foundations for making changes in Partnership priorities, policies, and management decision systems and tools. The credibility of the findings and recommendations from a STAC workshop is definitely needed for the Partnership to recognize the capacities available by which to overcome long-standing gaps in assessments with cost effective options coupled with work to update our assessment tools that are efficient, flexible and nimble for incorporating diverse data streams. The result of the community formally adopting recommendations and adapting our programs in a timely manner will produce outputs supporting CBP partnership decision-making for evaluating status and assessing progress for achieving the fisheries, habitat, water quality and healthy watersheds goals.

Workshop Preparation and Planning
We propose addressing the desired workshop outcomes in three sequential phases, leading to production of a final workshop report with recommendations in STAC's requested 'SPURR' format.

Phase 1 This workshop preparation phase will   Provide the subcommittee with the time to create a 4-day agenda and create a background presentation on the gaps and cost challenges limiting habitat assessments as outlined by the water quality standards under the TMDL for dissolved oxygen, water clarity/SAV and chlorophyll a.   A tentative agenda to the workshop will be:

Day 1. Afternoon session for all participants. Overview the existing long term water quality monitoring program in place, overview of the gaps identified in the CBP Science and Research Framework spreadsheet directly from the SRS biennial review process, identify financial pinch points and other stressors impacting erosion now and imminently in the future on data collection, outline key opportunities for modernizing our monitoring program to adapt to increasingly available resources that leverage our investments in existing programs and enhance our assessment of dissolved oxygen, water clarity/SAV and chlorophyll a criteria. A closing element of the day 1 presentations will include a vision for the new data interpolator for 4-D water quality estimation to allow participants an understanding for how traditional and new data sources will improve our understanding of habitat conditions to meet the needs of multiple Watershed Agreement Goal efforts, and specifically addressing the Water Quality Goal on Water Quality Standards Monitoring and Assessment.

Day 2. Afternoon for dissolved oxygen monitoring program discussion. Goal is to target sampling needs to effectively support temporal and spatial data density needs that will support assessment of all criteria durations appropriate to all habitats under water quality standards associated with the TMDL (i.e., instantaneous minimum, 1 day mean, 7 day mean, 30-day mean). Recognize that an assessment tool update is being developed that will ingest diverse data sources enhancing our ability to address all criteria durations. Presentations and discussions will highlight advances in data source availability including 1) data profilers in use, 2) citizen science program-based data collections, 3) MDE monitoring program adjustments to include water quality profile collections, and likely needs of the new assessment tool in order to develop and recommend a sampling design for adoption and investment by the CBP community.

Day 3. Water clarity/SAV program discussion. Goal is to establish the status of satellite imagery to support SAV and water clarity assessments and target the steps necessary to adopt satellite image use into the monitoring program and plan AI/ML algorithm development that can provide comparable or improved coverage of assessments and address cost effective strategies to conducting the assessment. Presentations anticipated include 1) and update from the STAC-sponsored Exploring satellite assessment of SAV workshop, 2) NASA algorithm exploration on water clarity assessment, 3) NOAA product(s) evaluating turbidity. Evaluation of the presentations will be discussed to indicate what is ready for approved use, and what steps are needed on what timeline to adopt NASA or NOAA based advances in water clarity assessments.

Day 4. Chlorophyll *a* assessment updates. Goal is to 1) recognize updated CHLA criteria, 2) highlight case studies on assessing CHLA criteria being pursued and 3) establish the opportunity for satellite assessments to improve criteria assessment in tidal waters where criteria apply now and recognize the potential for expanded coverage should all jurisdictions have established CHLA criteria.

Phase 2. Conduct the workshop as proposed in the outline.

Phase 3 The third phase will start with Steering Committee working from a written synthesis from the workshop days to develop and further refine the findings and developing a set recommendations directed towards more effective use the available resources that are formally recognized, acknowledged

and have targeted, time bound adoption schedules for adapting the existing sub-optimal program for assessment into a fully operational program with expanded capacities. Work will be directed towards developing a set of 'SPURR' formatted recommendations. The development of workshop notes from each day will help ensure a draft workshop report that is completed within 90 days of the day 4 events.

Questions to Answer

- What new or previously unused data sources are available annually beyond the traditional monitoring to inform a modernized assessment of habitat conditions in Chesapeake Bay ?
- What is the status of algorithm development for interpreting satellite-based data to improve efficiencies in the habitat assessments?
- What new protocols for assessment require outlines and documentation to formalize their use in the habitat assessment framework
- What sampling efforts/designs are needed beyond the traditional long term water quality monitoring program?
- Can we prioritize the adoption of data uses? What is the first data we can ingest into the monitoring program for the next 3-year assessment of water quality? What is the timeline for other sources confirmed and to be formally adopted in annual updates on water quality/habitat assessments? WHat QA plans are needed for establishing annual integrity of the data sources?What are the data management needs associated with new data sources and integrating diverse resources with a new assessment tool?

Expected Outcomes

The end-product of this workshop will provide: (1) recommendations for specific actions tailored directly to the Partnership's, Water Quality Goal Implementation Team, and complementary and supportive of decision-support needs under the Sustainable Fisheries, Habitat Healthy Watersheds Goal Implementation Teams and their workgroups, the Scientific, Technical Assessment and Report Team and its workgroups, the Scientific and Technical Advisory Committee, and, ultimately, the Management Board, Principals' Staff Committee and the jurisdictions; (2) specific recommendations for expanded, cost effective monitoring and assessment capacities recognized by, and adopted formally into CBP outcomes assessment applications to improve accuracy in condition assessments, reducing uncertainty in the understanding of bay status and trend assessment in response to management actions.

Logistics

We anticipate that the Steering Committee will need six months in which to conduct the necessary pre-workshop planning to organize sessions and establish agendas, participant invites and key presentations. Workshop meetings will be conducted over the course of two months. Compilation and synthesis in the final months will enable the Steering Committee to summarize workshop results, work with all participants on the recommendations, and hold a review meeting with the Steering Committee during the winter of 2022 finalizing the text of the recommendations.

Budget

The total cost is projected to be $6,000. Estimates for different aspects of the workshop are: venue: Webinar-based (cost?); travel/lodging/contributions from selected participants: $3,000; and contractual assistance with pre-and post-workshop compilation and synthesis of findings, technical data and supporting information: $3,000.