Chesapeake Bay Program
Science. Restoration. Partnership.

Scientific, Technical Assessment and Reporting (STAR) Team

Theme: Integrating Monitoring and Modeling

Visit the meeting webpage for meeting materials and additional information.

This meeting was recorded for internal use only to assure the accuracy of meeting notes.

Minutes

I. Welcome, Introductions & Announcements (10:00 – 10:05)

*Lead: **Ken Hyer** (U.S. Geological Survey, USGS) STAR Chair, **Breck Sullivan** (USGS) STAR Coordinator, and **Peter Tango** (USGS) CBP Monitoring Coordinator.*

- After the ***June 2026*** STAR Meeting, this group will transition into the new science support team.
- Please help us develop recommendations for strengthening the CBP networks by completing this Network Development Assessment survey. Due ***Friday, May 29th.***

Upcoming Conferences, Meetings, Workshops and Webinars

- Chesapeake Community Research Symposium – June 1-3, 2026. Annapolis, Maryland.
- Restore America's Estuaries' 2026 Coastal & Estuarine Summit – September 22-25, 2026. San Francisco, California.

II. Water Quality Standards Attainment Indicator: 2022–2024 Assessment Results (10:05 – 10:30)

Lead: **Qian Zhang** (UMCES)
Materials: Meeting Webpage here.

In this presentation, Qian provided an update on the Water Quality Standards Attainment Indicator results. First, he introduced the Total Maximum Daily Load (TMDL) and how it states that we are working towards meeting water quality standards. He also highlights the Water Quality Standards Attainment and Monitoring (WQSAM) Outcome and its indicators, including the water quality standards attainment indicator. Qian gave a brief introduction into the indicator, including the Bay segments and the designated uses. The indicator pulls from several water quality monitoring parameters.

In the most recent assessment period, the indicator resulted in 29% attainment, which is a slight decrease from 29.4% in the last assessment period. When separating results by designated use, Qian found that deep-water and deep-channel habitats showed recent improvements and open-water and shallow-water habitats showed recent declines. Qian also separated results by segment and whether the segment has switched between attainment and non-attainment in each designated use. Qian also showed the results per segment by area. The number of segments attaining all applicable designated use criterion increased from 22 to 24. The rate of increase has slowed.

Qian states that the lower scores over the last few years can be attributed to the high flows in 2018 and 2019, as this indicator can be highly influenced by weather. Qian also compared indicator results to nitrogen input and found they have a statistically significant negative relationship. He also compared the deep zones and shallow zones to the overall indicator score, where he found that the overall indicator score reflects the deep zones, while shallow zones are showing higher rates of improvement.

Lastly, Qian explained why additional metrics are needed along with the indicator score. For example, the pass/fail nature of the attainment indicator doesn't show improvements in segments that haven't passed yet. However, these improvements are being observed across the Bay. Qian also mentioned that DO attainment is improving in the long- and short-term. There are positive signs despite the decline in the indicator.

Discussion Notes:

Comment: *Ken Hyer:* It is phenomenal when you unpack the shallow zone attainment. There is such a rich story that goes along with the indicator that we need to continue telling. I know that can be hard because it's more complex, but it is an excellent story to show what we are achieving in the partnership.

- ***Response:*** *Qian Zhang:* Thank you, Ken. That is why we have these four indicators under the WQSAM Outcome – to provide information on change in water quality. They are all very important for the story.

III. Hydrologic and Critical Period Analysis Update (10:30 – 11:00)

Lead: **Robin Glas** (USGS)
Materials: Meeting webpage here.

In this presentation, Robin covered her hydrological and critical period analysis which will be shared for a decision at the September Clean Water Goal Team (CWGT) meeting. These are preliminary tests and results. Robin began by sharing her study area, which are 9 River Input Monitoring (RIM) stations. These stations are weighted at 95%, which can be adjusted to be consistent with their dominance in the Bay. They are also using weights from the Chesapeake Bay Program (CBP) Phase 6 model to align with the nitrogen inputs and hypoxia.

Robin showed a graph of mean annual flow since 1908 and noted major droughts and storms. They are trying to determine a reference hydrologic period for the CBP Phase 7 model. They have determined their ten-year reference period will span between 1985-2022. For these results, they have zeroed in on methodology and want to know what modelers would like moving forward.

Robin explains the mean absolute percent difference (MAPD), the long-term average, and how these compare to the potential ten-year window. Next, she explains the load effectiveness weights from Phase 6. She shares which ten-year windows had the lowest MAPD scores, which are, beginning with lowest score, 2015-2024, 2014-2023, and 2002-2011. However, she is no longer considering windows past 2022 because of the lack of land use data.

Next, she divided these results by the different metrics she is analyzing through the MAPD score. This included the 5^{th} percentile (low flows) and 95^{th} percentile (high flows). There is no ten-year window that performs optimally under each metric, so there are tradeoffs with each.

She also visualized the results across the Susquehanna River at Conowingo with a flow duration curve comparing some of the ten-year windows to the long-term average. It was mostly uniform with some issues at 90% exceedance probability. She also ran a Kolmogorov-Smirnov (K-S) Test with the Phase 6 Load Effectiveness Weighting and found that the K-S minimum occurs between

2005-2014. Then she plots the MAPD and K-S Score for each window. The top window using both of these tests would be 2001-2010. The final selection for this decision will include other considerations, like land use changes.

Moving forward, Robin will be completing the process again with the slightly smaller time period of 1985-2022. She could also run tests where she adjusts how the MAPD metrics are weighted, RIM station weighting, and updated load effectiveness ratios. Before the 1970s, there was a drier period which has now turned into a wetter period. Robin also has to consider whether to include drier periods, where data is less available or only include the wetter period. Is this a regime change that could switch back to drier? Will wetter patterns persist?

Robin attempted using a reference period of post 1970 with a candidate window of 1985-2022. When ran using combined MAPD and K-S scores she has the top three periods of 1988-1997, 1987-1996, and 1991-2000. They will need to decide what they want to use are their reference period and candidate window based on lots of considerations.

Discussion Notes:

Comment: *Ken Hyer:* I just wanted to share that this project came out of a conversation over a year ago in a Water Quality Goal Implementation Team (WQGIT) meeting where the modeling team wanted to consider whether the hydrologic reference window needed to be changed. We decided we wanted a quantitative statistical hydrologist to take us through this analysis, which is where Robin came in to help. This has been a phenomenal opportunity to rework the analysis and share the results with the Modeling Workgroup. As a partnership, we will need to make these decisions about whether and how we want to update the reference period. Thank you for jumping into this project.

Q: *Bruce Vogt:* I'm thinking about the new Agreement and the target that calls for the development of the non-tidal habitat assessment. Does anyone have thoughts on how this type of work would feed into that? Of course, we've worked on some tidal/non-tidal joint assessments. We have a well-fleshed out plan for the tidal piece but not for the non-tidal piece. I think non-tidal will be impacted by hydrology and water quality. How might this fit into that or not?

- ***A:*** *Ken Hyer:* I don't know if I have a good answer. Clearly having the more detailed hydrologic assessment would allow us to bring hydrology into the thought about non-tidal habitat assessment.
- ***Response:*** *Bruce Vogt:* We have a lot of data. We're learning more. Part of me thinks we should start smaller for the non-tidal assessment and then add to it, but we have a lot of information that might help guide that. This is a thought I had. Between this and other things, how can we pull it together to say something about habitat conditions that can help guide land-based management activities?
- ***Response:*** *Ken Hyer:* I think that is a good thought. We would have to workshop a little more but you're right. I see how we're in the process of figuring out the non-tidal habitat piece.
- ***Response:*** *Robin Glas:* These data are isolated to non-tidal. Our gauges are located upstream of the tidal zone. Folks are bringing in some tidal modeled hydrographs for us to look at and compare patterns.
- ***Comment:*** *Chris Guy:* Historically, we've had Stream Health at the Bay Program look at the smaller streams. We have a missing habitat piece in the larger waterbodies. In the Bay proper, we have a lot of indicators. In the smaller waters, we have Stream Health, and in the headwaters, we have Brook Trout and the Chessie BIBI (Chesapeake Bay Index of Biotic Integrity). We are missing the connection, but we are building it. It will be tied to mussels. There is a lot of work to be done. It won't be as easy as with the tidal segments.

IV. Forecasting the effects of climate change and Nutrient management on fisheries species in the Chesapeake Bay **(11:00 – 11:30)**

Lead: **Colin Hawes** (Virginia Institute of Marine Science, VIMS)
Materials: Meeting webpage here.

In this presentation, Colin discussed fisheries habitat under present and future conditions. Colin began by reviewing the scope of their project. They are using bioenergetic based models to project spatial extent and annual duration of suitable Bay habitat for Bay Anchovy, Striped Bass, Atlantic Menhaden, and Atlantic Croaker. This model calculates the growth rate of the fish based on weight, temperature, salinity and oxygen. The growth rate is used to determine habitat suitability. He uses the estuarine model along with the growth rate results.

For the results, Colin mapped the Habitat Suitability Index (HSI) with 0.5-1 representing growth. He found that the juvenile croaker habitat was unsuitable for growth in the winter months and highly suitable for growth in the summer months besides the locations with hypoxia. Next, he shows preliminary results for the juvenile menhaden with peak suitability in the warmer months. The overall habitat suitability is higher than for croaker. They would also experience loss of mass in hypoxic areas. Next, bay anchovy has an even higher year-long average habitat suitability while continuing to experience the peak in warmer months and decline in hypoxic regions. Lastly, the juvenile striped bass has more sensitivity to salinity and less sensitivity to temperature.

In the next part of his project, Colin focused in on Atlantic croaker and ran climate simulations for the 2070s. First, he ran a 1990s scenario as his control and a scenario that included CBP TMDL projections. For these two simulations, it was clear that TMDL reductions would positively impact habitat suitability at bottom areas. When adding the 2070s climate simulation with the TMDL, the habitat suitability at bottom areas is less than the 1990s TMDL but greater than the 1990s control. Warming decreases summer suitable habitat area via its impact on bottom dissolved oxygen concentrations. He shows a video of how these different scenarios change over the year. The most extreme climate scenario plus the TMDL has the longest suitable habitat period because of warming but also has substantial hypoxia, while the control has the worst hypoxia. The 1990s TMDL has the least hypoxia.

Discussion Notes:

Comment: *Breck Sullivan:* I appreciate the video showing the differences in shallow and deep waters. At the Chesapeake Bay Program, we are looking at shallow water areas more than before.

Q: *Bruce Vogt:* One thing we want to do with the habitat suitability runs is assess where the Bay Program could have a bigger impact in the shallow water and what things are manageable. Salinity isn't very manageable, but dissolved oxygen is. It looked like in some cases dissolved oxygen was driving habitat suitability in the mainstem. I'm trying to wrap my head around where we go with this when thinking about management strategies in the shallow waters. I was surprised to see that there weren't hotspots for the striped bass in the tributaries. Usually, we think of the shallow waters as the nursery habitat but it looked like the mouth of the Bay was more important. I've got a lot of questions I'd love to chat with you about.

- ***A:*** *Colin Hawes:* I think a lot of that comes down to the fact that these models are specifically functions of growth. There are a lot of considerations to certain life strategies that might not be reflected by these models. The estuarine model I am using might not get into the tributaries as well as other models because of its resolution. Maybe oxygen dynamics occurring in the tributary aren't being reflected by this. We can mainly see the impacts that would occur in the main Bay which are important. We are still seeing catch of a lot of these fish in those areas in the trawl data.

- ***Comment:*** *Bruce Vogt:* I know Mary's lab has looked at percent change over a time period, which you did some of. Those statistics are really helpful for the public. It's good to be able to talk about whether we are expanding or decreasing and where the biggest changes are.
- ***Response:*** *Colin Hawes:* I'll be sure to pass that along to the others. My responsibilities start and end with croaker.

Q: *Breck Sullivan:* When you're looking at the different TMDL scenarios, was that taking into account the climate change impacts that the Phase 6 model has considered? If so, how did that relate to the different climate change scenarios you looked at?

- ***A:*** *Colin Hawes:* Gopal ran the Phase 6 model for us for each of these scenarios. Each of the six future climate scenarios also included the TMDL changes and the climate forcings I applied to the atmospheric conditions for our model. They had one-to-one reflections of some combination over a system model and emission scenario.

V. Changes in suspended sediment concentration along tidal rivers of the Chesapeake Bay: the tidal freshwater "sediment shadow" **(11:30 – 12:00)**

Lead: **Gregory Noe** (USGS)
Materials: Meeting webpage here.

In this presentation, Greg focused on his project identifying spatial and temporal patterns in suspended sediment across tidal rivers. This project was published. The manuscript can be found here. Greg begins by showing the varying suspended sediment concentrations in different tidal and salinity zones. He also reviews the impacts of suspended sediment, the CBP TMDL sediment reduction goal, and the tidal freshwater rivers of the Chesapeake Bay. Based on previous research findings, there are low levels of sedimentation in tidal freshwater wetlands.

The team used the CBP long-term surface tidal and nontidal monitoring data. For the tidal monitoring data, he compared the mean salinity and mean suspended sediment concentration. The turbidity maximum is around 5 psu while the tidal freshwater zone (0-0.5 psu) experienced some lower sedimentation, but also a lot of variability. They wanted to know if this was driven by nontidal inputs. After plotting the mean sediment concentration for the different salinity zones for each tidal river, they found that the nontidal sediment concentration is independent of the tidal freshwater means.

Next, Greg shows plots of the monitoring stations of each river based on suspended sediment from upstream to downstream. In seven of these rivers, they found that the sediment shadow was present where there was a local minima of sediment availability in the tidal freshwater zone. Then, there was a peak of sediment concentration at the oligohaline and then decreasing concentration as flow moves towards the Bay. This is a widespread phenomenon and is observed in the biggest rivers, like the Potomac and James. Other rivers in the Bay observed other patterns, like a flat concentration as you move from nontidal to tidal fresh, then there is a peak flow by decreasing concentration as you move through the salinity zones. Other rivers didn't have enough long-term monitoring to draw conclusions.

Next, Greg showed the same graph but focused on the Patuxent River. This shows an apparent decrease in suspended sediment as it moves from nontidal to tidal fresh. This concentration slowly increases as it approaches the estuarine turbidity maximum (ETM) and then slowly decreases as it approaches the mainstem of the Bay.

Greg and his team worked with Rebecca Murphy at the CBP Office to utilize her generalized additive model (GAM) to analyze the effect of freshwater flow on suspended sediment. He plotted the percent change in total suspended sediments (TSS) and salinity and found that freshwater stations had high variability. After 10 psu for salinity there was a mean of 25% reduction in TSS. They also plotted the GAM results by monitoring station and tidal river showing the time it took freshwater flow to impact suspended sediment, the direction of correlation, and how strong the correlation is. Greg gave an example of this for the James River.

Based on these findings, they found the sediment shadow patterns on 7 rivers in the Bay, a moderate response in 3 rivers, and little to no patterns in 3 rivers, which is partly due to lack of long-term data. Greg covered some caveats and limitations, like only using surface sampling. He also walked through some other literature and projects on sediment. There used to be higher sediment delivery in the past, going back to the colonial eras. However, in the recent decades, there has been no long-term trend of sediment delivery. Sediment is being deposited in the nontidal and beginning of the tidal freshwater zones causing the observed sediment shadow. The minimal availability of sediment in the tidal freshwater zone could impact response to sea level rise and influence restoration efforts.

Discussion Notes:

Q from chat: *Peter Tango:* Is there a difference in tidal fresh wetland effects that are evident in segregating patterns of the shadow?

- ***Q:*** *Peter Tango:* I was thinking of places like the Patuxent, that have a lot of wetlands compared to other rivers that don't have as extensive of a wetland system. For the rivers that followed the shadow pattern, were they places with higher wetland areas?
- ***A:*** *Greg Noe:* We hypothesized that it would impact this, but the drowned river valley systems, like the Potomac, shouldn't have this pattern because there's no wetland to suck up that sediment. It could also be benthic shoaling subtidal deposits. We know they are there. They are too aqueous to generate wetland vegetation at this point.

Q from chat: *Julie Reichert-Nguyen:* What are your thoughts on the tidal freshwater wetlands holding onto the sediment and when the wetland area decreases from sea level rise, is there an expectation that more sediment will go downstream? If the sediment is not even reaching the tidal freshwater zone is there a way to direct the sediment to tidal freshwater wetlands?

- ***A:*** *Greg Noe:* I'm not sure. There is also the question of tradeoffs and whether we'd want that. If you could carefully control the delivery, that would be good. You could end up piping sediment to the lower estuary instead, which would be bad for habitat. I don't know if it's possible. These tidal wetlands are connected to the river during high tides. It's usually daily and we don't know how to augment that. We have debated working with beneficial dredge reuse to convince folks that we should be trying with the tidal freshwater zone. An issue with that is it can be far away and costly. That's the only way I could think of doing it effectively. Also, the long-term storage of the wetland is long. You can have lateral edge erosion of tidal wetlands but that tends to be greater where there is more fetch and greater wave energy, which isn't very present in the Bay rivers. During sea level rise, we are creating a lot of accommodation space. As the water comes up, there is more opportunity to trap sediment in the wetlands. As long as they can keep up with sea level rise, they can store that sediment for a long time, but if they convert to subtidal habitats, there could be a lot of erosion.

Q from chat: *Julie Reichert-Nguyen:* I wonder if subsidence is having any effect on creating the sediment shadow. Has it been examined?

- ***A:*** *Greg Noe:* Yes. It's the same process with accommodation space. Relative sea level rise is what matters, so if you are lowering the land and creating the extra accommodation space it can trap the sediment.

Q from chat: *Bruce Vogt:* Very interesting. We've been interested whether large scale oyster restoration has any effect on TSS. We know from reef level studies oysters do have a positive effect on water clarity. Given the large-scale effort to restore oysters (in some cases hundreds of acres of in a tributary) can we identify an oyster induced signal in TSS. We've done some preliminary work using satellite derived TSS and found some correlations. I wonder if there is a way to look at your data in this context? TSS pre and post restoration in select restoration tributaries/areas. This interest is less about sediment delivery but more about whether oysters can impact a system that can improve conditions for things like SAV.

- ***A from chat:*** *Rebecca Murphy:* With a specific list of locations and dates, I could probably pull the TSS and aggregate before and after.

VI. Adjourn **(12:00)**

Next Meeting: *June 25th, 2026, from 10 AM – 12 PM.*

Attendees:

- Alex Fries, UMCES
- Amanda Shaver, VA DEQ
- Amy Handen, EPA
- Angie Wei, UMCES
- Ashley Hullinger, PA DEP
- Bella Konchar
- Breck Sullivan, USGS
- Bruce Vogt, NOAA
- Chris Guy, US FWS
- Christina Garvey, CRC
- Colin Hawes, VIMS
- Emily Young, ICPRB
- Gabriel Duran, CRC
- Greg Noe, USGS
- Joe Morina, VA DEQ
- John Wolf, USGS
- Julie Reichert-Nyugen, NOAA
- Keith Bollt, EPA
- Ken Hyer, USGS
- Liz Chudoba, ACB
- Marisa Baldine, ACB
- Marjy Friedrichs, VIMS
- Mary Stack, ICPRB
- Matthew Stover, MDE
- Melissa Fagan, CRC
- Meg Cole, CRC
- Nick Staten, CRC
- Patrick Thompson, EnergyWorks
- Peter Tango, USGS
- Rachel Owrutsky, DNREC
- Rebecca Murphy, UMCES
- Robin Glas, USGS
- Tou Matthews, CRC
- Qian Zhang, UMCES