Chesapeake Bay Program
Science. Restoration. Partnership.

Integrated Trends Analysis Team (ITAT)

Wednesday, March 26th, 2025

10:00 AM – 11:30 AM

Meeting Materials: Link

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

MINUTES

Action items:

✓ *Consider the addition of percent change and loads scatter plots to the tributary summaries report.*

10:00 – 10:05 AM *Welcome – Breck Sullivan (U.S. Geological Survey, USGS) and Kaylyn Gootman (Environmental Protection Agency, EPA)*

Announcements:

- 35th Annual Environment Virginia Symposium, April 8th – 10th, 2025. Lexington, Virginia (VA).
- Choose Clean Water Conference, May 19th-21st, 2025. Harrisonburg, VA. *Registration is now open!*
- Coastal & Estuarine Research Federation (CERF) 28th Biennial Conference, November 9-13th, 2025. Richmond, VA. *Call for Abstracts – **due April 28th***.
  - Send out ITAT session and Qian's session
- CBP MB and PSC this week.

10:05 – 10:45 AM *Loads and Trends Measured from the Chesapeake Bay Nontidal Monitoring Network (NTN)*

Presenter(s): *James Webber (US Geological Survey)*

Description: *RIM and full NTN network load and trend results through water year 2023 will be reviewed.*

James Webber presented updated nutrient and sediment load and trend results for the nontidal monitoring network in the Chesapeake Bay watershed, based on data through water year 2023. The results, part of a science-based data release led by Chris Mason and supported by USGS and state partners, reflect a high level of data quality and reproducibility. The network comprises 123 stations across the watershed, and this latest analysis used monitored data—streamflow, monthly, and storm-targeted water quality samples—to compute trends and loads for total nitrogen (TN), total phosphorus (TP), and suspended sediment (SS) using the Weighted Regressions on Time, Discharge and Season (WRTDS) model.

The data show that nutrient and sediment loads remain highest in agricultural and urban areas, such as the lower Susquehanna River basin, the Eastern Shore, and urban watersheds around Washington, D.C. Spatial analysis indicates that many watersheds exceed planning targets for nitrogen, phosphorus, and sediment, with variations tied to land use and natural processes like denitrification. A general trend emerges where more agricultural land correlates with higher nitrogen and phosphorus loads, although urban areas also show elevated levels.

When it comes to trends over time, long-term records (spanning back to the mid-1980s) show improving nitrogen and phosphorus conditions at many stations. However, recent short-term trends (2014–2023) are more mixed. Notably, combined nutrient and sediment loads from stations nearest the Bay have decreased — driven largely by improvements in the Susquehanna and Potomac Rivers — suggesting positive developments for tidal water quality. Despite these improvements, fewer than half of all stations in the broader watershed showed improving short-term trends for nitrogen, phosphorus, or sediment.

Jimmy also compared nontidal and tidal trends over the same timeframe. In several cases, there was consistency between nontidal reductions and downstream improvements in tidal waters, especially in the Potomac and Susquehanna basins. However, in other regions like the Rappahannock and Eastern Shore, increases in nontidal nutrient loads mirrored worsening tidal conditions. This comparison underscores the importance of understanding how upstream conditions affect tidal water quality and calls for continued collaborative analysis.

Phosphorus trends were especially concerning. On the Eastern Shore and in Virginia watersheds, many stations exhibited increasing phosphorus loads. Nearly half of the stations showed degrading short-term phosphorus trends, while only a quarter improved. Similarly, suspended sediment trends were mixed, with roughly equal numbers of stations improving, degrading, or showing no change. Headwater stations in the Susquehanna showed notable increases in sediment loads, while urban areas like Rock Creek and the Anacostia showed improvements.

There remains encouraging further exploration of the results, which are now publicly available via the USGS data release and the project's updated website and geo-narrative tool (Chesapeake Bay Water-Quality Loads and Trends Link and Loads and Trends in the Chesapeake Bay Nontidal Monitoring Network Link). These findings can offer critical insight into the effectiveness of management practices and highlight areas where additional attention is needed to reduce nutrient and sediment pollution in the Chesapeake Bay watershed.

Discussion:

Q from chat: *Olivia Devereux:* What do the long-term trends look like from 1990 forward, not just last 10 years?

- ***A:*** *Chris Mason:* Our long-term trends are those sites with data prior to 1990; not mentioned in this presentation. Big long-term picture across all five constituents: 77 improving, 38 degrading, 18 no trend. The water quality webpage has maps dedicated to long-term. Chesapeake Bay Water-Quality Loads and Trends Link. Loads and Trends in the Chesapeake Bay Nontidal Monitoring Network Link.

Q from chat: *Olivia Devereux:* When you compared to planning target lb/ac^2, which planning target version did you use? Did it include Conowingo and Climate Change too?

- ***A:*** *Jimmy Webber:* We worked with the planning targets from the metric tool, but we were only looking at the planning targets for the monitored watershed area. We used that as a reference to highlight whether these areas were generating relatively large or small amounts of material. I'm not sure about the specifics of Conowingo and climate change in that context.
- ***A:*** *Qian Zhang:* I need to check which version I used because the metric tool includes several different lines related to Conowingo. Specifically, for the result you showed, I believe it's a sum of all the nine RIM stations. I'll confirm which version I used and share that, but essentially, that target reflects the load we expect to see when WIP-level implementation is complete.
- ***Response:*** *Olivia Devereux:* Thank you for clarifying that you used the WIP numbers. That's actually not the planning target. It might be clearer to just say that these are the WIP targets that the states proposed—most of which were developed around 2018. Each state did it in a different year, and some overachieved while others underachieved their planning targets. But WIPs are not equivalent to any version of the planning targets, just to clarify.

Q: *Breck Sullivan:* Do you think you'll now be able to stick to the every-two-year schedule for producing these reports? I know this round took a little longer because of the new process. Do you expect to stay on track moving forward?

- ***A:*** *Jimmy Webber:* Yes, historically, we've reproduced these results every other year. Our goal is to have the next trend assessment run through water year 2025. Including a trend through 2025 would be valuable for the partnership. That's the next planned product. Along with the new method we developed for compiling all the input data—really led by James Colgin—we're also working on a publication to document the method. It will include a data release highlighting all the raw results from the database. We think this will provide real value to the community by being transparent about the samples and the exact methods we used.

Q: *Rebecca Murphy:* Your graphs that are trends vs loads (slide 19), I wonder if something like this would be useful for the tidal teams (i.e., trends in relation to loads/concentrations)? Has there been any feedback on whether that approach might help us better present tidal trends?

- ***A:*** *Jimmy Webber:* The feedback has been that the figures are complex, and we're still looking for ways to simplify the message. Even scatter plots like these may be too complicated, so our teams could work together on communicating the data more clearly.
- ***Comment:*** Qian Zhang: These graphs are valuable. Maybe we can consider adding them to tributary reports. The scatter plots are especially helpful when people question degrading trends at stations that already have good conditions. A degrading trend doesn't always mean a worse situation compared to other stations. These graphs help show both trend and status. For busy figures, maybe we could include a couple of big dots showing system-level averages, like medians, to give context—e.g., which sites are in the Potomac, etc.

Q: *Elgin Perry:* Do you have a list of next steps for explaining these trends? For instance, fertilizer sales in the watershed to understand what's driving them, etc.?

- ***A:*** *Jimmy Webber:* Yes, the list is long. We're definitely interested in continuing collaboration with watershed modelers. Metric has shown us where trends align or diverge from the model. That opens the door for exploring whether we're missing certain watershed characteristics or influencing factors. So yes—more empirical data analysis, streamflow trends, and ways to refine the model. And yes, you're all welcome to be part of those discussions. Presenting this here helps build that list.
- ***Comment:*** *Elgin Perry:* On slide 17, looking at the Rappahannock, it seems there's no trend in the upper watershed for nitrogen, but a degrading trend at the fall line. The upper area has most of the agriculture, but around Fredericksburg there's more development. Maybe the spatial trend is pointing us to a potential source.

Comment from chat: *Olivia Devereux:* Helen and I are continuing to look at the change in BMPs and the change in monitoring and modeling loads to understand where BMPs are having expected effects. These data are super helpful!

10:45 - 11:30 AM ***Dissolved oxygen criteria attainment in Chesapeake Bay: Where has it improved since 1985?***

Presenter(s): *Qian Zhang (University of Maryland Center for Environmental Science, UMCES)*

Description: Long-term and short-term trends in the dissolved oxygen criteria attainment were calculated using data through 2022. These results, documented in a recent publication, will be presented with a focus on the comparison of trends among 13 tidal systems.

Qian Zhang: Today I will present findings from two recent publications on Dissolved Oxygen (DO) criteria attainment in the Chesapeake Bay. The primary aim was to assess long-term

(1985–2022) and short-term trends in DO attainment across tidal segments, using a metric called "attainment deficit" (AD). This metric goes beyond binary attainment to quantify the degree of compliance or noncompliance. We will emphasize spatial variation among tidal systems and designated uses (DU) (open water, deep water, and deep channel) and introduce a visual "report card" to make trends more accessible.

The analysis relied on data from the Water Quality Database, including DO concentrations, salinity, and temperature. The core metric, AD, measures the gap between observed water quality and reference standards. Unlike traditional binary metrics, AD provides a gradient of attainment, making it more effective for detecting trends in persistently noncompliant areas. Segment-level AD values were aggregated using surface area weighting and assessed using Mann-Kendall trend analysis and change point detection. Both long-term and short-term trends were evaluated.

Bay-wide trends showed an overall improvement in DO attainment, with significant long-term gains and modest short-term improvement. Open water segments demonstrated steady, significant long-term improvement, while deep water showed modest gains and deep channel displayed a delayed but significant short-term recovery. Change point analysis suggested a progression in recovery across the water column: open water segments began improving earlier, followed by deep water and then deep channel segments.

Out of 13 tidal systems, 10 showed long-term improvement (4 significant), and 9 improved in the short term (2 significant). A report card-style visualization highlighted spatial and DU-specific trends (slide 16). Notably, the York River showed a significant short-term degradation in both open and deep water. In contrast, systems like the Mainstem Bay and Potomac exhibited strong, consistent improvements across DUs. The report card helped distill complex multi-layered data into a comparative and digestible format.

A second study focused on attributing the observed trends to potential drivers using random forest modeling. Segments were grouped into shallow and deep zones, with shallow zones showing more rapid improvement—though their effect on overall Bay trends was muted due to smaller area coverage. Nutrient reductions (especially nitrogen and phosphorus) emerged as the strongest drivers of improvement, while warming and stratification acted as degrading influences, particularly in the deep zone. Chlorophyll concentration was especially important for shallow zone improvements, likely due to its role in both DO and submerged aquatic vegetation (SAV) dynamics.

Two scenario simulations underscored the importance of nutrient management. Holding nutrient loads constant at 1985 levels resulted in significantly lower attainment, while a 20% annual reduction led to consistent gains. The analysis demonstrated that simultaneous reductions in both nitrogen and phosphorus are most effective. These results affirm the value of long-term nutrient reduction strategies but also emphasize the need to consider climate change impacts, which may offset some gains.

The studies show clear evidence of DO improvement in the Bay, particularly in open water and deep channel segments. While not all improvements were statistically significant, the general trend is positive. The work highlights the importance of nuanced, non-binary assessment metrics, the value of long-term monitoring data, and the effectiveness of nutrient reduction strategies. However, slower recovery in some systems and degrading trends in others call for more localized analysis, potentially leveraging machine learning or statistical models to inform future restoration and policy decisions.

Discussion:

Q: *Tish Robertson:* I know the amount of monitoring data for a given segment can vary. For example, during some three-year periods, we might have had a lot of stations in a segment due to shallow water monitoring. But in the next three-year period, we may have shifted focus, and those stations wouldn't appear, resulting in a sparser dataset. I'm curious—have you done the trend analysis and attainment deficit calculation using only the long-term core stations, rather than including all available data? If you focus on the long-term stations, you might minimize the variability introduced by short-term monitoring efforts like shallow water studies or other intermittent datasets.

- ***A:*** *Qian Zhang:* That's definitely something I haven't considered. I'll admit the results I showed today are entirely based on the full dataset used for our assessments—essentially what's displayed in our Shiny apps, just categorized and aggregated by system. But that's a very good comment, and something we should consider—maybe by constraining the data inputs to just long-term stations.

Q: *Breck Sullivan:* Why did you choose 2006-2022 trend for your short-term timeframe?

- A: Qian Zhang: We considered aligning it with trends used in the GAM analysis or USGS trends from Jimmy's presentation. But our primary reasons were, first, that we wanted at least 10 data points for the Mann-Kendall test, and second, that this timeframe represented roughly half the full time period.

Q: *Elgin Perry:* One thing I was wondering about: have you considered doing a trend analysis on the earlier period, from 1985 to 2006, so you could contrast the early period with the later one? Additionally, on Slide 19, I noticed the Chester River has a significant degrading trend in open water. But depending on whether you're looking at the long-term or short-term data, the deep water and deep channel trends either show degradation or improvement. Is there some estuarine process at play that might explain this divergence?

- ***A:*** *Qian Zhang:* For your first question, we have not done that but that is a great idea and we will do that. For your second question, that would be some good next steps and I know there are others at UMCES, like Jeremy Testa and Richard Tian, who work in this area that we can discuss with in addressing this.

11:30 AM Adjourn

Next Meeting: Wednesday April 23rd, 2025, from 10 AM – 12 PM

Attendees:

James Webber (USGS), Breck Sullivan (USGS), Qian Zhang (UMCES), Gabriel Duran (CRC), Kaylyn Gootman (EPA), Lewis Linker (EPA), Elgin Perry (CBPO), Andrew Keppel (MD DNR), Olivia Devereux (Devereux Consulting), Helen Golimowksi (Devereux Consulting), Blessing Edje (DOEE), Rebecca Murphy (UMCES), Roger Stewart (VADEQ), Mukhtar Ibrahim (MWCOG), Joseph Morina (VADEQ), Douglas Moyer (USGS), Joseph Delesantro (ORISE), Renee Karrh (MDDNR), Carly Maas (USGS), Christopher Mason (USGS), Tish Robertson (VADEQ), Cynthia Johnson (VADEQ), George Onyullo (DOEE), Anthony Timpano (VADEQ), Efeturi Oghenekaro (DOEE), Jeremy Hanson (CRC), Stephanie Nummer (ICPRB), Jon Harcum (Tetra Tech).