JOINT FACTORS & ITAT RETREAT

Location: USGS MD-DC-DE Office (5522 Research Park Drive Catonsville, MD 21228)
Date: October 25th Time: 10 am – 3:30 pm

ACTION ITEMS

- **Topics to investigate further:**
  - **Compare the density gradients of the stations in the channel at the mouth of the Bay with other stations of equivalent salinity to determine if mixing in the channel is distorting results.**
  - **Effective science communication practices to compare how trend results from different methodologies should be evaluated. This should involve collaboration with local partners who can contribute basin-specific expertise. This effort is critical to securing long-term funding support for monitoring programs. This should involve an explainer narrative that allows people to understand why these results vary and why multiple methodologies are informative. This will require more work, but it is important to ensure there is not potentially harmful mixed messaging.**
  - **Explore new symbology to represent status (concentration) and trends of the tidal trends results. This could involve scaling the size of symbols by the average concentration over the last two years or by utilizing new symbols. See slides 24 and 25 of this presentation for details.**
  - **Including the watershed trends next to the tidal trends in one document or tool.**
  - **Why phosphorus transport is likely changing.**
  - **Explore statistical methods to employ probabilistic data.**
- **The ITAT and Factors Teams will have a broader conversation with PA DEP (contact- Kristen Wolf) about how to utilize and communicate their science.**
- **Future Directions (identified by the slide at the end of the day)**
  - **Comparison of nontidal and tidal methods**
  - **Discuss strategies to evaluate trends in the "in-between" areas of the watershed**
  - **How best to show nontidal and tidal trends together – maybe through the story maps ITAT is already creating**
  - **Understand existing tools and blending ours with theirs (jurisdictions)**
  - **Continue to discuss with end users/stakeholders to build trust and share information**
  - **Studies on why phosphorus is changing**
  - **Utilization of continuous monitoring data (to inform responses to EPA and NOAA about their investment)**

Meeting Minutes

10 – 12 pm - **Headwaters to the Bay** - Selection of presentations and breakouts on trends in water quality in the non-tidal and tidal areas of the Chesapeake Bay and its watershed.

- Introductions – Snowball Effect Icebreaker
    - The meeting began with an "icebreaker" activity designed to help attendees get to know one another better.
- Chesapeake Bay Program Integrated Trends Analysis Team (ITAT) and Factors' Mission – *Breck Sullivan (USGS), Kaylyn Gootman (EPA), and John Clune (USGS)*
    - Breck, Kaylyn, and John introduced the purpose of the day's meeting, which was to utilize the knowledge of the combined ITAT and Factors team to answer questions such as:
        - What are the patterns and drivers of the observable nutrient and sediment trends, and do they match CAST predictions?
        - Which BMPs are having a meaning effect on water quality and how do we target at local scale?
        - Can we quantify the presence and effects of legacy nutrients and sediment?
- Critical questions to consider with our work - *Gary Shenk (USGS)*
    - Gary began with quoting the aphorism attributed to George Box that all models are wrong, but some are useful. In the context of the day's discussion, Gary walked through a few conceptual models (slides 7-12) which, flawed as they are, are still useful for framing the following presentations. Gary highlighted the disconnect between our monitoring, robust as it is, and the remaining gaps in understanding.
- Analysis Methods – *Bob Hirsch (USGS)*
    - Bob identified the benefits brought by approaches like SPARROW (SPAtially Referenced Regression On Watershed attributes) and WRTDS (Weighted Regressions on Time Discharge and Season). For example, WRTDS allowed for more dynamic smoothing of water quality trends to capture seasonal variation in flow. SPARROW improved the spatial understanding of water quality in watersheds, facilitating enhanced targeting of resources. The focus of the last decade has been to take the respective temporal and spatial strengths and connect these models together to improve the overall results, which has resulted in models like SWAN. GAMs (Generalized Additive Models) is similar to WRTDS in that it flexibly handles temporal data. FACET has more of a geomorphic focus.
- Tidal Trend Results – *Rebecca Murphy (UMCES)*
    - Rebecca began with an overview of what the tidal trends results cover and where they can be accessed. Rebecca reviewed the GAMs method used to

produce the tidal trends (slides 4-9). Rebecca presented both long-term and short-term flow-adjusted results, as well as a few spotlight station examples, for total nitrogen (TN), total phosphorus (TP), secchi depth, chlorophyll a, and dissolved oxygen (DO) on slides 10-23. Rebecca also presented some ideas for enhancing the communication of the trends maps on slides 24-25. Rebecca concluded with an overall summary of key points from the results and acknowledgements.

    - Roger Stewart said he was looking at some of our open water stations in the Lower Bay and overlaid the known navigational charts with them. Roger learned that these stations are in a very busy channel and are dredged to 50 feet deep. Right outside of that channel the water is very shallow. Roger asked if this is leading to mixing, which may be distorting results at that station. Rebecca said it would be interesting to check the density gradients on that station versus other ones that are not in the channel in areas with equivalent salinity.
    - Roger noted that stations upstream of the Bay Bridge Tunnel experiences drastically different wave energy, especially if there are active swells compared to stations south of the tunnel.

- Non-tidal Results – *Chris Mason (USGS)*
    - Chris gave an overview of the network, the 2020 trends results for TN, TP, and suspended sediment (SS), and how the results are being communicated with partners.
- Integration of non-tidal and tidal efforts – *Jimmy Webber (USGS)*
    - Jimmy highlighted results from the collaborative Science to Inform Management Priorities, from Loads to Endpoints (SIMPLE) team. Jimmy then compared the nontidal and tidal monitoring networks and selected a few trends to review for the group to consider.

Group Discussion

- Questions to Consider:
    - What research questions arise from the trends?
    - What are some next studies to implement?
    - What resources could be used to support a science need?
    - How can we better integrate tidal/non-tidal trends?
        - Are we to be able to use the downstream River Input Monitoring (RIM) trends or physical fluxes as direct inputs to the GAMs for the most upstream tidal stations?
            - Rebecca Murphy said she, Elgin Perry, and Renee Karrh did that with flow, but ending up just linking the loads with the concentrations in

the estuary. Ultimately this only explained some of the tidal stations, since below fall line point source loads can have a considerable influence. Lack of temporal alignment between water year and calendar year need to be considered.

- Kaylyn Gootman asked how to surmount the communication problem of multiple trends methodologies with multiple, sometimes disagreeing, results.
  - John Clune said it is understandable to have different trend results with different methodologies, so the question of communication alone should not discourage comparing methodologies.
  - Rebecca said Jeremy Testa worked on putting together a white paper that combines multiple methodologies and data sources, so we could build from that work.
  - Roger said for Virginia's integrated report, they are instructed to write their trend analysis at a sixth-grade level, which ends up meaning much of the science is left out. Comparing and contrasting methodologies allows for more insights.
  - Gary and Kaylyn agreed we need to have an explainer narrative that allows people to understand why these results vary and why multiple methodologies are informative. This will require more work, but it is important to ensure there is not potentially harmful mixed messaging.
- Renee Karrh said MD DNR is unique in how we try to frame our research questions for both management and scientific grant work. This means she has tried to compare tidal and non-tidal trend results. Renee concluded localized experts and communication is required to better understand the results. Strong communication is critical for ensuring monitoring funds continue.
- Joel Bloomquist said the most recent report on projecting hypoxic volume incorporated wastewater as well as riverine fluxes, which improved prediction results dramatically. Results showed that equal amounts of flow now causing less hypoxia than they did previously. From a big system response perspective, Joel thinks we have a tool to link the watershed with estuarine response in a very real way with monitoring data alone. There is a purpose behind each of the 122 nontidal monitoring sites: 9 RIM stations show what is going into the Bay, the rest help understand what we are learning from these changes.
  - Kaylyn replied that we have the ingredients we need to improve tidal-non-tidal connections, we just need to develop an overall recipe to bring it together in a more cohesive narrative.

- Any hypotheses are you considering?
  - Dale Robertson asked how the team flow normalizes in a tidal area?

        - Elgin said they add flow as a variable in the GAMs and try to optimize the lag time between the flow at the fall line and when it propagates downstream. Essentially it is a numerical fit. If there is a relationship between the observed concentration in the estuary and the delivery over the fall line, we used that relationship to adjust the trend line. This is nearly always the case for TN.
        - Dale said from the perspective of someone who studies lakes, flow normalization can be a tricky concept to present and work with, because ultimately the observed loads delivered are what managers are concerned about.
        - Elgin said this is a good point, but we do the trend analysis both ways with flow as an explanatory variable and then do the observed trend which address the questions you've raised.
        - George Onyullo said the interplay/relationship between flow and concentration/load is something that we may need to be on the lookout for, especially in the light of climate change. The scale at which this will be aggregated could also be important.
        - Chris Mason said he thinks the NTN load reports get lost in the WRTDS theme of flow-normalization. They still publish and report annual/monthly loads, as well as 10-year yields to contrast the 10-year trends in flow normalized loads. Our loads and yields are not flow-normalized.
            - Rebecca Murphy said those non-normalized loads are what we have used to link to estuary response so far. Those are very useful!
    - Bob Hirsch asked Rebecca to explain the concept salinity flow normalization, since it seems like those are two different products.
        - Rebecca replied it varies spatially, but in the middle of the mainstem flow adjustment really means using salinity to determine flow. However, in the tidal fresh stations, we use the method Elgin described. Renee Karrh tests these methods at different stations to determine which fits best.
        - Roger noted the tidal cycle leads to more variability which needs to be accounted for.

12 – 1:30 pm- - **Lunch**

1:30 – 3:30 pm - **Science to Inform Management -** Selection of presentations, panel discussions and breakouts on how our science can best inform end users of our science to make management decisions.

- Lightning Examples

- Tidal – Tributary Summaries, Bay Trends Mapper
    - Breck gave a brief overview of the tributary summaries and the story maps being developed to enhance their communication to broader audiences. Rebecca then walked through the interactive baytrendsmap app, which allows for the customization of presenting the tidal trend results she explained earlier in the meeting.
    - Dale suggested including the watershed trends next to the tidal trends.
        - Rebecca said that is a good question for this group to consider.
        - Qian said he thinks the tributary summaries and the story maps can help with this.
        - Rebecca said this is true, but those are only by basins and do not include the entire watershed.
    - Roger asked can you upload your own data to Baytrendsmap app.
        - Rebecca said yes, as long as it is formatted as a CSV file.
- Non-Tidal – TMDL Indicator, SIMPLE working with stakeholders
    - Gary Shenk gave a brief presentation on the new TMDL indicator and why it was created.
    - Olivia asked what is leading to the difference between CAST and observed data for Phosphorus?
        - Gary said Apple is a mass balance model used to look at how soil phosphorus is changing over time and is an input into CAST. If the mass balance is correct, we would not expect soil phosphorus to change that much because of the storage in the soil. So, perhaps it is an increase in transport. Gary does not know why transport is changing, but that would be a great thing for this group to think about.
    - John Clune provided some examples of how the SIMPLE team works with stakeholders and the purpose of SIMPLE.
        - Denice Wardrop asked where is the additional academic and research community in the SIMPLE network diagram?
        - John said an example of the research community envisioned in this diagram would be the group online and in-person today, plus the people in the workgroups and conferences on his visual diagram.

- Olivia added that investing in keeping up to date with the literature is another example of this category.
- Jimmy highlighted the focus on priority questions driving stakeholder interest for the management community. SIMPLE was asked to focus on nutrients, sediment, and agriculture. The feedback was organized into nine major themes.
- Denice suggested including Chesapeake Research Consortium and STAC, for example - my point is that it looks quite internal as per the science provisioning ecosystem.

Guided Discussion - *all*

- Questions
    - What works and doesn't work?
    - Are there barriers to using tools and communication products developed?
    - Is there a gap in what is needed?

- John said given the impressive efforts from NRCS, PA DEP, and Chesapeake Conservancy, he invited them to contribute to the conversation. As trusted sources for local partners, they have valuable perspectives to share.
    - Denise Coleman, NRCS, said we utilize science to advance precision conservation – prioritizing the best practices for the best locations to achieve optimal benefits. We prioritize practices based on the soils and soil type using our own models. We are looking to put practices on the landscape that avoid, control, and trap nutrients. For example, in Karst soils, we look at nitrogen leaching and comprehensive nutrient management plans to make sure they are being followed. We use our CART tool, which is a conservation assessment tool, that allows us to ask if we are addressing the resource concern to its maximum potential. This is a site-specific approach and takes advantage of the data available: soils data, USGS, biological data.
        - John said USGS is trying to understand the existing tools and how we can feed into them. At the end of the day, resource managers will end up using the tools they already have available and are familiar with, so it is critical to connect these tools.
        - Denise said we spend a lot of financial resources on IT management for the CART tool, but if you can share the data in a compatible file format, we can likely include it. We need to do business with these tools given our history of investment.
        - Olivia asked what is the scale required for input data in the CART tool.
            - Denise said we can accept state data layers and in some cases at the county level.

        - Olivia replied the CAST team is still working on producing information requested by Denise and John on how to target BMPs.
    - Scott Ator said it would be neat to see how the PA DEP small agricultural rapid delisting watersheds line up with this effort. We could share that GIS layer.

- Kristen Wolf, PA DEP, said that part of her role is ensuring that all the scientists within PA are able to communicate clearly and collaborate in the partnership.
    - Kristen said the gaps come down to a failure to:
        - Coordinate
        - Collaborate
        - Develop partnerships
        - Apply data
        - Develop science to inform policy and decision making
        - Address egos
    - Kristen said what is working:
        - Collaboration continuum based on science
        - Developing trust at the county level to facilitate the usage of data
        - Inviting a diverse group of stakeholders to attend a listening session where we had honest discussions about challenges
            - Expanding the diversity of the partnership by focusing on hiring for communication skills, which allows for creating two-page factsheets that are targeted for specific partners. These factsheets also highlighted data on progress we have made on implementation
            - Bringing in a private sector facilitator to implement purpose driven meetings and consider what is in it for our audience
        - Fully voluntary approach for counties
        - Focus on small watersheds to implement holistic restoration and build diverse partnerships
    - John asked if this is an open invite for us to work with you to communicate our science.
        - Kristen said she thinks we should start with a broader conversation about how to utilize and communicate this science.

        - Breck thanked Kristen for the invitation to have more discussion with you on how we can integrate our work with the amazing work you and PA are doing!
        - Kristen said PA DEP welcomes collaboration and expanding the discussion on sharing our mutual needs for information and products.

- Adrienne Gemberling, Chesapeake Conservancy, stated their focus on delisting streams originates from our high resolution land use data. We realized our data did not need to be perfect to be useful. We heard early on that stakeholders wanted to achieve rapid delistings in small areas so we can show tangible, concrete progress. To identify these areas, we combined local stakeholder knowledge, high resolution land use data, and monitoring data. We also used these data to begin implementation. Previous challenges dealt with funding, but the major challenge now is capacity and how to properly allocate resources, given the large amounts of paperwork that come along with these challenges.
    - Carly Dean shared the 2017/2018 High Resolution Land Cover Data and Documentation, released in 2021 Areial Imagery version of High Resolution Land Cover is anticipated for release in June 2024. High resolution hydrography data anticipated for release in June 2024.
    - Olivia asked what work has been done in VA.
        - Adrienne said they have not scaled up rapid stream delistings to VA. They have been working in the James River watershed with parcel scale prioritization data.
        - Olivia said the BMP team in VA is working with DCR to look at where practices are broadly not being implemented. This allows us to collaborate with local partners to do cold calling and knocking on doors to understand where to target.
    - Jeff Chanat asked what types of data are you using in this work?
        - Adrienne said we use IBI scores and habitat assessments (short term indicators) from the state's integrated report on impairments and delistings.
        - John commented the delistings can draw attention because they somewhat feel like ribbon cuttings in the sense that they are exciting.
    - Kaylyn asked about approaching BMP data and filling in those gaps for prioritization.
        - Adrienne said Carly is focused on scaling these rapid delistings across the Chesapeake Bay watershed. We have been conducting extensive stakeholder engagement at the parcel level.
        - Carly expressed, the most effective way to get local stakeholders excited about using the high-resolution data is to run analyses in their

communities so they can start brainstorming how to use it. Depending on the community, they may or may not need extended analysis support.

- Gary asked what other factors besides parcel information lead to the targeting of these communities?
    - Adrienne said they identified areas without vegetated riparian areas and areas with high slopes. They also look at interest in topics like trout populations.

- Kaylyn said given that we've heard a lot from nontidal programs, do tidal jurisdictions have similar or differing lessons learned?
    - Olivia said tidal wetlands are a focus of protection given their role as indicators and nutrient sinks.
    - Roger said in Virginia, most of our local engagement is focused on the nontidal sectors, not as much in tidal areas.
- Breck asked our colleagues in the Great Lakes, how do these lessons compare?
    - Dale said we really do not have much local engagement since the Great Lakes Regional Initiative (GLRI) is more structured around state-federal engagement.
    - Denise Coleman said it can be site specific, but a lot of the focus is on specialty crops and soil types. Additional interest in rotational grazing.
    - Olivia asked Denise if the list of data layers NRCS uses for planning in PA something that she can provide? Olivia thinks it would be useful to people to know the number and type of layers in CART. Olivia thinks NRCS in PA has close to 100 layers!
        - There was not a response to this question.
- Kaylyn asked if there is anything we want to share that does not work.
    - John said we learned not to reinvent the wheel. We should utilize existing tools and infrastructure.
    - John said we also learned that in the review process, you should include your audience as well. This will help increase the utilization of your work.
    - John said to use similar language as your audience. Say prioritization instead of targeting.

- Future Direction and Collaboration - *all*
    - Discussion on what studies and collaboration we need to better connect tidal and non-tidal science.
        - Based on the discussion, the following topics have been added to future directions:

        - Comparison of nontidal and tidal methods
        - Discuss strategies to evaluate trends in the “in-between” areas of the watershed
        - How best to show nontidal and tidal trends together – maybe through the story maps ITAT is already creating
        - Understand existing tools and blending ours with theirs (jurisdictions)
        - Continue to discuss with end users/stakeholders to build trust and share information
        - Studies on why phosphorus is changing
        - Utilization of continuous monitoring data (to inform responses to EPA and NOAA about their investment)
- Dale suggested dropping out monitoring sites and increasing temporal frequency.
    - Gary replied that the stakeholders are not interested in dropping sites because they don’t trust the model, so more spatial coverage is in their interest.
    - Elgin replied we are much more accurate (when looking at residual error) when interpolating between time steps as opposed to over space. I think if anything we would drop frequency in favor of more sites.
    - Jon Harcum said Elgin's cluster analysis of GAM results can inform this discussion.
- Roger asked if we have considered using probabilistic data.
    - Kaylyn said maybe, but we need to talk about this more.
- Dale asked how to utilize the continuous monitoring data.
    - Kaylyn said a lot of this data is based on continuous data and there is a need to reconcile with discrete data.
    - Bob said he is in favor of utilizing continuous data because it is the future, but the reality is, to his knowledge, it is not being integrated into regional water quality assessments enough. This topic is fraught with many questions. In his opinion, the USGS leadership overall has failed to develop scientific management protocols soon enough. It is a lengthy process to develop how to address a new data type to inform management.
        - Alex Soroka said in next year’s NTN budget, they are looking at ways to address this topic. In the short term, he

thinks they have the data to continue exploring these questions.

Participants: Adrienne Gemberling, Alex Gunnerson, Alex Soroka, Andrew Keppel, Andrew Sekellick, August Goldfischer, Bob Hirsch, Breck Sullivan, Carly Dean, Carol Cain, Chris Mason, Chuck Cravotta, Cindy Johnson, Claire Buchanan, Dale Robertson, Denice Wardrop, Denise Coleman, Donald Bonville, Efeturi Oghenekaro, Elgin Perry, Gary Shenk, George Onyullo, Helen Golimowski, Hilary Gibson, Isabella Bertani, Jimmy Webber, Jeff Chanat, JK Bohlla, Joel Blomquist, John Clune, Jon Harcum, Joseph Morina, Kaylyn Gootman, Kristen Wolf, Kristina Gutchess, Matt Diebel, Michael Pennino, Mukhtar Ibrahim, Olivia Devereux, Qian Zhang, Rebecca Murphy, Renee Karrh, Robert Sabo, Roger Stewart, Sam Miller, Scott Ator, Scott Heidel, Tom Parham, Tony Timpano, Tyler Shenk, Wes Slaughter.