Maryland
Department of the Environment

Wes Moore, Governor
Aruna Miller, Lt. Governor

Serena McIlwain, Secretary
Suzanne E. Dorsey, Deputy Secretary

September 19, 2023

To: David Wood, Chesapeake Stormwater Network
Norm Goulet, Chair, Urban Stormwater Workgroup

From: Maryland Department of the Environment, Water and Science Administration (MDE)

Re: Comments on the August 2023 Revisions to Stream Restoration Crediting under Protocol 3

Thank you for the opportunity to review the revised methodology proposed for calculating nutrient and sediment load reductions for stream restorations under Protocol 3. MDE agrees that the calculation for percent treatable flow in the approved 2020 Protocol 3 update does not account for the total treatable flow across the length of the project. MDE appreciates that many of the comments on the June 2022 proposed revision that were submitted by MDE on September 2, 2022 were addressed, in particular, reinstating the one foot cap on the floodplain trapping volume. However, some major comments are outstanding and the August 2023 proposed revision introduces changes that raise additional technical questions and concerns. Specifically, the sediment accretion rate was significantly increased based on a study limited in scope and default sediment nutrient concentration values were introduced that do not reflect statewide variation. MDE would like to collaborate on a solution that addresses the scale concern while avoiding unrealistically inflating reductions and ensuring that the credit calculations represent a robust and diverse dataset that is defensible. MDE submits the following comments.

Sediment Accretion Rate

1. In MDE's comments in September 2022, the Department questioned how the data collected by Noe et al. (2020 and 2022) were used to determine the sediment accretion rate of 0.102 inches/year. While those questions remain unanswered, the Department notes that the Noe study included a robust analysis and an extensive cross section of data across the Chesapeake Bay region and MDE did not object to using those numbers. However, the revisions proposed in the August 2023 memo significantly increase the accretion rate to 0.33 inches/year based on the 2017 study by McMillan and Noe. MDE's questions and concerns on the use of a universal rate and other implications inherent in the calculation are described below. MDE suggests that using the 0.102 rate would offer a realistic solution to allow moving forward with an update to the approved 2020 Protocol 3 report. Practitioners could have the option to monitor case by case to justify a greater rate. MDE's concerns include:

    - Recent documentation suggests that sediment accumulation on the floodplain is variable and dependent on land use, scale, and land use history. These variables have been documented in Noe et. al (2020), which suggests that headwater streams have minimal

active floodplains and are expected to be a net source of sediment. Noe documents that larger streams (such as third, fourth, or fifth order streams) can perform the sediment trapping functions inherent in the Protocol 3 revisions. Therefore, application of a uniform rate will overestimate stream restoration accretion rates in smaller headwater and second order channels. It appears the assumptions behind the calculation are predominantly applicable to very large streams and rivers.

- The proposed sediment accretion rate of 0.33 inches/year was derived from data collected in the McMillan and Noe study at four restoration sites in North Carolina. Sediment accretion rates were evaluated by placing a clean tile in certain locations along various study plots over approximately an 18 month period. The tiles were removed each month and a clean tile placed to determine a monthly accretion rate, which was extrapolated to develop an assumed annual rate. While this methodology helped to support the scope of that study, it does not support the application of one unified accretion rate for all stream restoration projects on an annual basis. By removing and cleaning the tile each month, it is not certain that sediment would accumulate at a consistent rate throughout the calendar year and over a period of years. Moreover, the method does not consider that gradual accretion across the floodplain will cause a shift in the location of where sediment deposits and where sediment is subject to remobilization during the year and over a period of years. Therefore, this small dataset that was derived based on monthly accretion rates is not sufficient to support a single rate of 0.33 inches/year over a period of years for all projects within the Chesapeake Bay region.

- Application of the Big Spring Run sediment accretion rate to validate the 0.33 inches/year assumption is not well supported. This project is located in a farm field and as Noe (2020) documents, one variable of sediment deposition on floodplains is land use. Therefore, using results from limited data to apply to all stream restoration in the Bay region is not justifiable. MDE strongly suggests using the rates derived from Noe of 0.102 inches per year with the option to develop long term monitoring and calculate based on site specific accretion rates.

- An inherent assumption of the Protocol 3 calculation in the proposed revision is that sediment will be trapped on the floodplain and essentially taken out of the system. This assumption does not consider other processes such as nutrient leaching back into the soil, remobilization, or floodplain scour during larger events.

- MDE previously requested evaluation of other studies in the September 2, 2022 correspondence on Protocol 3. Consideration of other studies may have provided an accretion rate that reflects a broader range of conditions, and MDE requests clarification on why the McMillan and Noe study was the only study used. Additional references are attached that include a more comprehensive view of stream restoration performance and effectiveness.

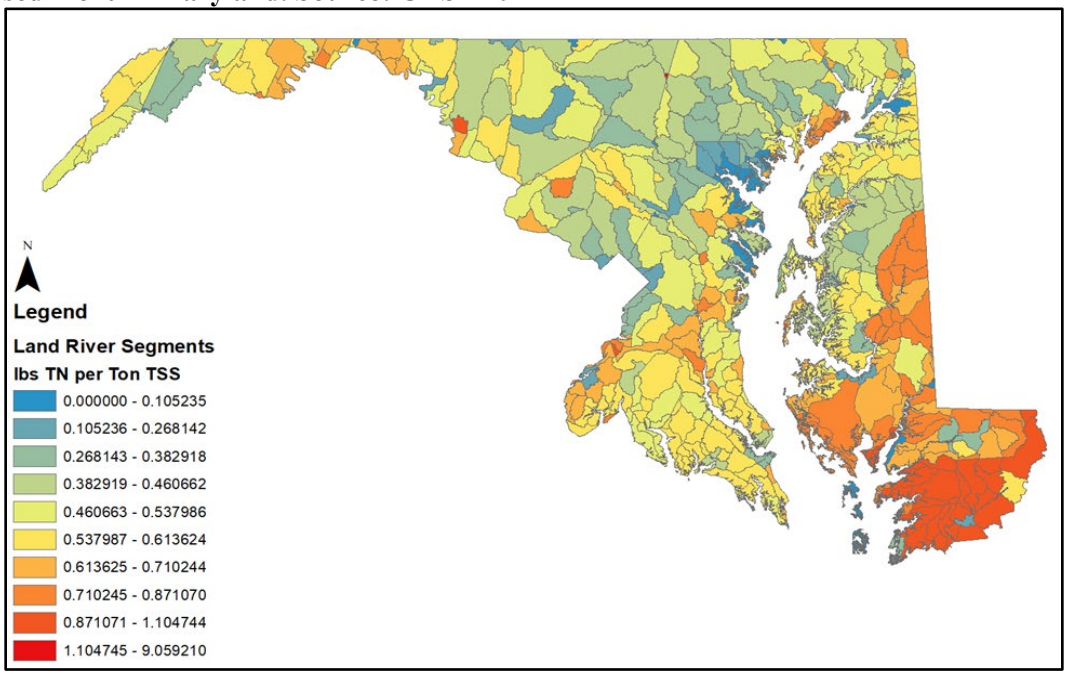
Sediment Nutrient Concentrations

2. In the June 2022 version of the protocol revision, the calculations for total suspended sediment (TSS), total nitrogen (TN), and total phosphorus (TP) were based on the sediment storage effectiveness. In the August 2023 revision, TN and TP were assigned soil nutrient concentrations that rely on the Chesapeake Delaware Floodplain Network (CDFN) dataset and unpublished data from the Big Spring Run stream restoration project. The concern with using one concentration for nitrogen and phosphorus across the entire State of Maryland is demonstrated below. MDE recommends assigning a sediment nutrient concentration value that better reflects the variation across the state, either by analyzing additional published data or requiring individual site level data collection consistent with Protocol 1. MDE offers these suggestions based on the following:

    - The proposed method for calculating Protocol 3 nutrient reductions utilizes a sediment nutrient concentration multiplied by the volume of sediment that accumulates on the newly reconnected floodplain. This sediment nutrient concentration is used to determine the pounds (lbs) of nitrogen and phosphorus treated by the project and the nutrient reduction credit the project receives.

      Using Stream Bed and Bank loads provided in the Chesapeake Assessment Scenario Tool (CAST), the nitrogen to ton sediment ratio by Land-River Segment in **Figure 1** illustrates the range of Stream Bed and Bank nitrogen per ton sediment ratios throughout the state. This demonstrates that neighboring watersheds may contain substantial differences in nitrogen concentrations and these ranges are significantly variable across the entire state.

Figure 1. Land-River Segment specific Stream Bed and Bank lbs of nitrogen load per ton sediment in Maryland. Source: CAST-19



The calculations in **Figure 1** were derived from CAST, which provides Stream Bed and Bank loads for every Land-River Segment in the Chesapeake Bay watershed in lbs/stream mile. The sediment Stream Bed and Bank load is utilized in the protocol calculation to convert to a volume of sediment in steps 5 and 6. The Stream Bed and Bank sediment load in CAST also has a corresponding nitrogen and phosphorus load in lbs/mile. These Stream Bed and Bank nutrient loads can be converted into lbs per ton sediment by dividing the nutrient load in lbs/mile by the associated sediment load in tons/mile. The Maryland-only statewide averages for nitrogen, phosphorus, and sediment load per mile of stream derived from CAST Stream Bed and Bank loads are presented in **Table 1**.

Table 1. Average of Stream Bed and Bank nutrient and sediment loads for Maryland Land-River Segments. Source: CAST-19

MD Statewide Average Stream Bed and Bank Loads			
Nitrogen	***Phosphorus***	***Sediment***	***Sediment***
323 lb TN/mi	94.8 lb TP/mi	468,048 lb TSS/mi	234 tons TSS/mi

After converting the average nutrient Stream Bed and Bank loads per mile into nutrient per ton sediment ratios for every Maryland Land-River Segment, the resulting statewide average ratio of nutrients per ton sediment are presented in **Table 2**.

Table 2. Average of Stream Bed and Bank nutrient and sediment loads per ton of sediment for Maryland Land-River Segments. Source: CAST-19

MD Statewide Average Stream Bed and Bank Loads per ton Sediment	
Nitrogen	***Phosphorus***
2.14 lb TN/ton TSS	0.53 lb TP/ton TSS

While the Stream Bed and Bank nutrient to ton sediment ratios presented in **Table 2** may not represent the Bay-wide average values that would be analogous to the proposed sediment nutrient concentration, they provide a valuable comparison (**Table 3**). The average ratios of nutrients to ton sediment that is used in the Phase 6 model for Maryland is nearly half of the proposed sediment nutrient concentration. Therefore, **Table 3** shows that the Protocol 3 revisions will result in higher than average rates for all stream restoration projects in the State of Maryland.

Table 3. Comparison of proposed sediment nutrient concentrations and CAST-derived Stream Bed and Bank loads per ton sediment.

	Sediment Nutrient Concentrations (Proposed Protocol 3 fix)	**MD Statewide Average Stream Bed and Bank Loads per ton Sediment**
Sediment Nitrogen Concentration	4.82 lb TN/ton TSS	2.14 lb TN/ton TSS
Sediment Phosphorus Concentration	1.13 lb TP/ton TSS	0.53 lb TP/ton TSS

MDE suggests that additional data should be analyzed to revise the proposed sediment nutrient concentrations to develop a ratio of nutrients to sediment that addresses the variation across the state. Data is available for Stream Bed and Bank loads through CAST as well as additional research, such as that cited in the References section, which indicate concentrations and loads entering and exiting restoration projects. The spatial range of nutrient per ton sediment Stream Bed and Bank loads from CAST (**Figure 1**) suggests that stratification may be necessary to address this issue. Alternatively, Protocol 3 could require site-level data collection for determining sediment nutrient concentrations consistent with the Protocol 1 expert panel report requirements.

Other Comments

3. The credit increases proportionally with the area of the floodplain treatment zone (FTZ). Doubling the FTZ will mean doubling the credit, which will serve to address the scale issue, however, it is not clear from the literature cited that doubling the credit proportional to floodplain treatment area is well supported.

4. Calculation example #2 shows that the delivered TN and TP loads in the overbank flow will be 100% removed. This is not a realistic expectation and raises cause to justify re-examination of the proposed method. In addition, this result contradicts the justification for using the wetland removal efficiencies in the 2020 report. This was explained in the response to comments on page 98 of that report which states: "... [b]ecause 100% of TN, TP and TSS in the overbank flow does not settle out onto the floodplain, a treatment efficiency must be applied. The group felt that using the rates developed by the NTW [Non-Tidal Wetland] expert panel provided consistency with the structure of the original expert panel and is based on an extensive literature review."

   The explanation noted above in the 2020 report clarifies that 100% of the delivered loads are not expected to be removed. MDE recognizes that Noe (2020) explains this could happen in very large river systems, such as fourth or fifth order rivers, however, this process is not expected in headwater or first or second order streams where much of the restoration in Maryland takes place.

5. MDE requests clarification as to whether or not this protocol would apply to projects characterized as "dynamic alluvial valleys," in which a riparian area with a defined bed and bank stream is replaced by a system with unchannelized flow, which may or may not result in new shifting stream channels over time. If the determination is that projects with these outcomes qualify for credit under this protocol, a sample calculation would be helpful.

6. MDE suggests that the protocol and its justification would benefit from review by persons with scientific expertise who have not been involved in developing the protocol to date, to provide additional support for the protocol.

7. MDE requests the addition of language similar to that used for the shoreline management expert panel report: if negative impacts outweigh the benefits as determined by the relevant state agency on a case-by-case basis, the practice will not be reported to the Bay Program for model credit.

8. MDE advises that these recommendations may be revisited in the future based on the report from the STAC workshop "Evaluating an Improved Systems Approach to Crediting: Consideration of Wetland Ecosystem Services" held March 21-23, 2022.

9. MDE notes that Step 6d of the three examples have calculation errors.

10. MDE requests that a new Protocol 3 document be developed complete with calculation examples to avoid the need to reference the outdated document and the proposed revisions.

MDE appreciates the opportunity to provide comments on the August 2023 Protocol 3 memo. For further discussion on these comments, please contact Christina Lyerly at christina.lyerly@maryland.gov to coordinate a call with MDE staff.

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