

Partnership and Jurisdictional Review of the Suite of Chesapeake Bay Program Partnership Models: A Proposal

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Below please find a proposal for dividing up and assigning responsibilities for reviewing the calibrations and model responsiveness to early versions of a suite of ranging scenarios across the full suite of Chesapeake Bay Program Partnership models. This proposed approach is based on a series of conversations with a number of involved jurisdictional partners and their requests and recommendations as well as an initial round of review by the Modeling Workgroup and members of the Water Quality Goal Implementation Team's (WQGIT) Model Review Strategy Team.

Prior to and Going into Fatal Flaw Review

Scheduling Webinars Explaining Each of the Models/Critical Components

- Ask the respective source sector, technical support and modeling workgroup to take the lead on scheduling and conducting a webinar/series of webinars which provide partners and stakeholders with an insider look at each model/critical components of each model—how they were developed, what's different in the Phase 6 version, and how they will be applied in support of management decision making
 - Here's an example of a webinar scheduled by the Partnership's Land Use and Urban Stormwater Workgroups:

“The CBP Land Use and Urban Stormwater Workgroups are jointly sponsoring a special session to review and discuss the new sediment loading methodology for the new Phase 6 watershed model – with a particular emphasis on urban areas. The meeting is being timed to coincide with the beginning of the fatal flaw review period. This will be an opportunity to see how all the new pieces of the sediment modeling methodology fit together.

There is significant interest in how this new method might affect sediment crediting under the stream restoration BMP along with interest in reviewing the data used to quantify aspects of the new simulation, such as the estimate of watershed sediment loads using RUSLE 2 and the data to calibrate whatever method is eventually chosen to simulate stream delivery.”

Access to Full Model Documentation

- Charge the Modeling Workgroup continue to oversee development of and on-line publication of enhanced/expanded documentation during final Watershed Model and Water Quality/Sediment Transport Model (WQSTM) calibration prior to the start of the respective fatal flaw reviews.

Development of New/Enhancement of Existing Model Review Tools

- Charge the appropriate Chesapeake Bay Program Partnership Office teams with responsibility for enhancing existing model input review tools (e.g., Tableau) and development of new model output review tools (e.g., scenario visualization, WQSTM output) to have facilitate the below described reviews by the Partnership’s workgroups and jurisdictional partners.
- These existing enhanced and new model review tools will be developed, field tested by small groups of partners, and made publically accessible on-line prior to the start of the two-month model fatal flaw review period.
- Training on the use of these model review tools will be conducted for the appropriate source sector and technical support workgroups as well as jurisdictional representatives in advance of the two-month model fatal flaw review period.

Responses to Key Recommendations from STAC Model Uncertainty Workshop

- Charge the Modeling Workgroup to make progress on the “do something now” recommendations from the February 2016 STAC Model Uncertainty Workshop prior to the start of the two-month model fatal flaw review period
 - *List uncertainties*: better capture these in the model documentation
 - *Identify most sensitive parameters*: documented in Chapter 4 in the Phase 6 Watershed Model documentation is devoted to sensitivities and includes nitrogen and phosphorus specific tables
 - *Automate calibration*: accomplished for the Watershed Model, but still not possible given the very long run times for the Water Quality/Sediment Transport Model
 - *Make data and skill assessment results available*: these data and results are available for the Watershed Model and still need to be compiled and published on-line for the Water Quality/Sediment Transport Model

Phase 6 Watershed Model

Dividing Up and Assigning Responsibilities

- Ask each of the technical support and source sector workgroups to take on the responsibility for: 1) ensuring the collective partnership-based decisions have been fully carried out (omissions review), and 2) evaluating model calibration inputs and outputs specific to their respective land uses (evaluate illogical outcomes or unintended consequences) or larger source categories
 - Modeling Workgroup¹

¹ Recognizing most source sector and technical support workgroups do not have the modeling expertise or needed experience to conduct or review sensitivity and other model suitability/scale analyses, the Modeling Workgroup is charged with conducting much of these initial reviews and analyses. The Modeling Workgroup will also be responsible for preparing and sharing detailed and summary information regarding such reviews and analyses with each of the source sector and other technical support workgroups to facilitate their separate reviews described here.

- Review watershed model documentation chapters 2, 4, 7, 9 and 10
- Review summary findings and implications of the Chesapeake Bay Program Office Modeling Team’s report out on their detailed review of calibration results for each calibration station, looking for any bigger picture anomalies or patterns
- Evaluate any significant changes in overall model calibration results over changes in the spatial scale
- Conduct sensitivity analyses of the Phase 5.3.2 vs. Phase 6 watershed model responses to varying levels of model inputs and BMP implementation
- Review sensitivity analyses based on running model responses to individual forestry management BMPs and multiple stacked BMPs and share/present the results and findings to the Forestry Workgroup for their further review and comment
- Review sensitivity analyses based on running model responses to individual stormwater management BMPs and multiple stacked BMPs and share/present the results and findings to Urban Stormwater Workgroup for their further review and comment
- Review sensitivity analyses based on running model responses to individual agricultural BMPs and multiple stacked BMPs and share/present the results and findings to Agriculture Modeling Subcommittee for their further review and comment
- Review sensitivity analyses based on running model responses to varied levels of on-site treatment systems and share/present the results and findings to Wastewater Treatment Workgroup for their further review and comment
- Schedule and conduct webinars focused on the overall Phase 6 watershed model as well as critical components
- Watershed Technical Workgroup
 - Review all technical chapters of the Phase 6 watershed model documentation
 - Review loading rates from specific land use dominated land river segments to ensure consistency with partnership approved target loading rates within and across source sectors—work with specific source sector workgroups as warranted based on the results of the review
- Land Use Workgroup
 - Review watershed model documentation chapter 5
 - Schedule and conduct webinars focused on the Phase 6 land use and land cover data sets as well as the hind-cast and forecast land use projections
- Agriculture Modeling Subcommittee
 - Review watershed model documentation chapters 3 and 6

- Compare the Scenario Builder (SB) edge of small stream (EOSS) simulated loads versus downstream delivered load calibration results for agriculture dominated watersheds
- Review the interconnecting steps (without BMPs) in the simulation of transport of nitrogen (then uniquely phosphorous, and then sediment)—from SB crop inputs, SB logic, load targets, atmospheric N, soil P—to EOSS calibration
- Review EOSS simulated impacts and calibration sensitivity analyses based on running model responses to individual agricultural BMPs and multiple stacked BMPs on the initial sensitivity analyses conducted by the Modeling Workgroup
- Brief the Agriculture Workgroup on findings from all the above analyses and evaluation as well as the ranging scenarios (e.g., All Forest, 1985, Phase II WIPs, E3, others) run through the calibrated Phase 6 models
- Urban Stormwater Workgroup
 - Review watershed model documentation chapter 2
 - Review calibration results for suburb/urban development dominated watersheds—both inputs and outputs
 - Review sensitivity analyses based on running model responses to individual stormwater management BMPs and multiple stacked BMPs based on the presentation by the Modeling Workgroup
- Forestry Workgroup
 - Review watershed model documentation chapter 2
 - Review calibration results for forest dominated watersheds
 - Review sensitivity analyses based on running model responses to individual forestry management BMPs and multiple stacked BMPs based on the presentation by the Modeling Workgroup
- Wastewater Treatment Workgroup
 - Review watershed model documentation chapter 8
 - Review the change in discharged loads over time to ensure it aligns with data provided by jurisdictions and the model simulated loads reasonably reflects what has occurred over time
 - Review sensitivity analyses based on running model responses to varied levels of on-site treatment systems based on the presentation by the Modeling Workgroup
- Ask the jurisdictions to take on the responsibility for: 1) evaluating how well the model simulates watershed loads at key stations and watersheds, and, 2) reviewing results from the early versions of a suite of management ranging scenarios comparing a change in

outputs from Phase 5.3.2 scenarios and the change in outputs for Phase 6 scenarios, specific to their jurisdiction²

- Focus on calibration results from: 1) relevant river input monitoring stations; and 2) the subset of monitoring stations which best capture loads leaving each individual jurisdiction
- Comparison of Phase 5.3.2 and Phase 6 scenario outputs for a suite of ranging scenarios like 1985, Phase II WIPs, E3, No Action, All Forested, and recent progress runs specific to their jurisdiction
- Review Regional Factors adjustment decisions

Enhancement of Watershed Model Review Tools³

- Expand the existing Tableau watershed model input data review tool to now include the same functionality for reviewing and evaluating Phase 6 watershed calibration and preliminary scenario results and outputs at the full array of available scales and cross comparisons
 - Provide functionality for evaluating output and making cross comparisons all the way down to the individual county scales
 - Break out the incremental loads, for the appropriate scales, on the ‘way to delivery to tidal waters’—edge of small streams, larger rivers, and delivered to tidal waters—so that the progression of attenuation can be viewed and understood
 - Charting capacity to easily cross compare from one county to another, from one watershed to another
 - Provide for the ability to compare relative loads across source sectors by major land uses
 - Expand years beyond just the calibration period—need to be able to view calibration data/early ranging scenario results for the entire record 1985-2016 so partners can see how well the model captures long term trends and responses to management action with a particular focus on the post 2013 years
 - Build off the county level framework that Sucharith Ravi has already set up
 - Set up ability to conduct comparisons of model simulated loads from the Partnership’s old (Phase 5.3.2) and new (Phase 6) approaches to simulating nutrient management approaches
- Build into the CAST user interface the ability to easily and rapidly run a series of sensitivity scenarios to fully understand the model’s responses to individual BMPs and multiple stacked BMPs as well as varying model inputs such as fertilizer and manure applications

² The relevant comparisons in the jurisdictions’ review are the changes between a base load and the scenario load, not a comparison of absolute numbers between Phase 5.3.2 and Phase 6.

³ Reflects the direct input and ideas from a number of partners called and consulted prior to drafting this proposed approach to model review by the Partnership and the jurisdictional partners.

- Expand the comparison of USGS’s WRTDS calculated loads with Phase 6 watershed model simulated scenario loads to include all monitoring stations with a sufficient temporal record of observations that supports the WRTDS calculations
- Generation of summaries of the extensive and detailed calibration data analyses (50+ pages of calibration documentation per station) at scales of interest to the jurisdictions
- Expand the capability to geographically map out/visualize watershed model calibration outputs and the output of early ranging scenarios at the full range of spatial scales supported by the model and enable side by side comparisons between different scenarios

Chesapeake Bay Water Quality/Sediment Transport Model

Dividing Up and Assigning Responsibilities

- Ask the Modeling Workgroup to take on responsibility for ensuring: 1) the collective partnership-based decisions have been fully carried out; 2) the estuarine hydrodynamic, water quality, and lower trophic level processes and rate functions are consistent with the current scientific understanding; and 3) the review of summary findings and implications of the Chesapeake Bay Program Office Modeling Team’s report out on their detailed review of calibration results for each calibration station, looking for any big picture anomalies or patterns
- Ask Maryland, Virginia, Delaware and the District to take on the responsibility for: 1) evaluating how well the model simulates tidal water quality conditions over time at key stations and segments within their jurisdiction’s tidal waters; and 2) reviewing results from a suite of ranging scenarios comparing outputs from the Phase 5.3.2 and Phase 6 versions of the Bay Water Quality/Sediment Transport Model relevant to their jurisdiction

Enhancement of Water Quality Sediment Transport Model Review Tools

- Take the Maryland Department of the Environment’s developed approach⁴ to statistically analyzing and graphing Water Quality/Sediment Transport Model calibration output and enhance it to generate results for all calibration stations and all 92 segments which includes:
 - Graphical time series plots, boxplots and target plots
 - Statistical analyses including standard regression, dimensionless (NSE) and error index (PBIAS)

⁴ MDE’s approach as presented to the Partnership’s Modeling Workgroup on February 15, 2017 can be accessed at http://www.chesapeakebay.net/channel_files/24718/wqstm_accuracy_assessment_2_13_17.pdf.

Chesapeake Bay Airshed Models

Dividing Up and Assigning Responsibilities

- Assign the Modeling Workgroup with responsibility for reviewing outputs of the enhanced versions of the Penn State Chesapeake Bay deposition model and the national CMAQ model
 - Ensure the collective partnership-based decisions have been fully carried out in upgrading both the Penn State deposition model and the national CMAQ model
 - Compare the wet and dry atmospheric deposition loading rates direct to the watershed and tidal waters and the fraction of those loads that reach tidal waters between the Phase 5 and Phase 6 versions of both models under a range of early scenarios

Process for Cataloging and Resolving Identified Issues

- Communicate all identified model calibration issues directly to the appropriate Chesapeake Bay Program Office Modeling Team lead for cataloging:
 - Gary Shenk: watershed model
 - Lew Linker: water quality sediment transport model
 - Lew Linker: airshed models
- Gary Shenk/Lew Linker will then assign each issue to the appropriate technical support/source sector workgroup or Chesapeake Bay Program Office team for resolution
- The chair and coordinator for each technical support/source sector workgroup assigned a model or calibration issue for resolution has the lead for confirming partnership support for the proposed resolution issue
- Chesapeake Bay Program Office staff will then document resolution of each identified model or calibration issue and the subsequent workgroup/WQGIT concurrence