Modeling Quarterly Review Meeting

January 20-21, 2016
CBPO Conference Room - The Fishshack
410 Severn Avenue Annapolis, MD 21403
Event webpage: http://www.chesapeakebay.net/calendar/event/23394/

MINUTES: January 20

Announcements and Amendments to the Agenda – Dave Montali, WVDEP and Lee Currey, MDE

- Lee reiterated the goals and responsibilities of the Modeling WG, which look to refine the modeling tools in order to better assess watershed goals. The Modeling WG is trying to make sure that these modeling tools are available and can help the WQGIT answer management questions.
- This meeting also served as the release for the Phase 6 Beta 1 calibration of the Watershed Model (WSM).
- The workgroup is also trying to reach consensus on decisions, and Lee noted that issues need to be worked through with an updated list of Modeling WG membership.

Phase 6 Watershed Model Schedule Update – Gary Shenk, EPA-CBP
Attachment A

- Gary reviewed the progress and release of the Phase 6 Beta 1 Calibration model, the link for which can be found on the Modeling WG webpage.
- Gary also discussed the organization of the Phase 6 draft documentation, due to be released by February 1. The final documentation will be released with the final model in 2017.
- The Modeling Team is now also open to comments regarding the model outputs and documentation. It should be noted that comments regarding specific sections may need to be directed to different workgroups that made the relevant decisions.
- Lee asked how the Modeling Team should handle comments regarding the Phase 6 Beta 1 WSM.
    - Documentation may be put out for a 30 day comment period, and will be continually updated. Perhaps toward the end of Beta 2 or 3, the final documentation will be released for final comments and review. Changes in the model will also be reflected in the documentation. It was emphasized that time should be provided for partners to provide comments and fully review the Beta versions of the model.
    - **ACTION**: The Modeling Team will set up a timeline and process for receiving comments, and will return this to the WQGIT as well.
    - Karl asked for a release of the schedule of the plans for the P6 comments. This plan will be released on Monday, January 25, at the WQGIT meeting.

Phase 6, Beta 1 Calibration – Gopal Bhatt, PSU
Attachment B

- In addition to providing a complete overview of the Phase 6 WSM, Gopal reviewed the performance of the Beta 1 model calibration. Explanations of further specific points regarding calibration in the Lower Susquehanna reservoir system, nitrogen, and phosphorus were also discussed.
- The target calculation includes changes in the application rates, but does not include the variability that you would expect because of changes geographically.
- Nobody has as of yet looked into the two outliers in the Nash Sutcliffe Efficiency (NSE) graphs of Phase 6 hydrology shown on slide 7. These NSE graphs will be used to perform specific analyses between the Phase 5 and Phase 6 WSM, and this will be made a priority to effectively determine biases. Although NSE was not one of the objective functions used in the calibration process, it can be used to judge the robustness of the calibration as a sort of validation to reduce the bias between simulated and observed loads.
- There are approximately 6000 pages of graph comparisons between Phase 5 and Phase 6 Beta 1 on the Modeling WG website for specific stations, which can be searched if partners are interested to review specific stations. In these graph comparisons, a smaller k statistic indicates a better fit.
- In Phase 5 the hydrology calibration method is spelled out, that will be carried forward into Phase 6. Those tables simply need to be added to the documentation so that each station can be reviewed.
- Karl Berger asked whether the updates that occur between now and the final version of Phase 6 have some impact, albeit limited in its larger scope.
    - Gopal agreed that this is a fair characterization, and that there is room for improvement at multiple levels where the calibration can be improved. However, there are some indications that some of the RIM stations may be left with missing information that can't be captured in the model.
- Currently, P6 is attenuating much more phosphorus in the rivers in comparison with WRTDS loads.
- The increase in phosphorus delivered captured in the Rappahannock by WRTDS may be tied to a mass wasting event following a 2500 year storm in 1995, although there are not currently peer reviewed findings regarding this event and its legacy impacts. A question was posed by Gopal asking whether a particular regional factor in this instance may be the correct approach in order to capture the subsequent nutrient runoff effects. It was determined that this is an example of a decision that should be left up to the WQGIT.
- Karl asked how the changes between Beta 1 and Beta 2 willaffect the review of the calibration.
    - Lee asked, for partners that intend to review Beta 1, what significant changes shouldn't be scrutinized too heavily since they are planned to change anyway.
    - Gary recommended that reviewers first read the overview chapter and make comments, and also further review points where partners fit into the Bay Program and have expertise.

Conowingo Infill Influence on Chesapeake Water Quality Workshop – Lew Linker, EPA

- Lew outlined and reviewed the progress made at the STAC Conowingo infill workshop. The workshop goals included synthesizing the best science to prepare for the year of decisions in 2017, especially with regards to better understanding Conowingo infill.
- Michael Forlini of the Clean Chesapeake Coalition asked about reviewing the report from the STAC workshop. As a reminder, all reports are on STAC's website, and the report produced will be much shorter than the Lower Susquehanna River Watershed Assessment (LSRWA).
- One thing that the Modeling WG strives for is the development of sound science that can better simulate the changes in Conowingo infill. This group will not be the policy maker that discusses the implications of the modeling efforts. Ultimately the approval of the final model will depend on comments received within the Modeling WG, and those put forth by both the WQGIT and the Principals Staff Committee.

Phase 6 Reservoir Simulation Progress – Gopal Bhatt, PSU
Attachment C

- Gopal reiterated that there was substantial research presented at the STAC workshop, and further explained the simulation and of the Lower Susquehanna and Conowingo reservoirs within the Phase 6 WSM with an emphasis on the capture of the state of dynamic equilibrium.
- Gopal also further outlined the methodology of sediment transport outlined in HSPF, and the responses seen in the calibration for large flow events in the Conowingo.
- Gopal is looking for feedback on some of the suggestions made for reasonable pursuits to improve the capture of high flow scour events at Conowingo.
- Tom Sullivan pointed out that in modeling storm events there is a matter of matching not just the peaks, but also the precipitation patterns in the basin. It may be unavoidable to go about creating exceptions for particular storm events since the hydrology will be different.
    - Gary noted that the Modeling WG has twice decided to take this kind of action, like calibrating rainfall, in Phase 5 and it shouldn't be a problem moving forward.
- The modeling team agreed that it would be best to first look into the F-tables and stick by principles of hydrology before adjusting rainfall to better meet the observed peaks.
    - Mark noted that the missing percentage (roughness values for which we don't have much information) could just be a rounding error.
    - Tom Sullivan also brought up the fact that a generic basin wide adjustment may not adequately help to predict the impacts of storm events.

A HEC-RAS Representation of Lakes Clark and Allred – Marty Teal (WEST Consultants)
Attachment D/E

- Tom Sullivan reviewed the efforts made to capture and measure high flow events, and to improve the parameterization of models in the Lower Susquehanna reservoir system. Efforts within the model also aim to better characterize mass balance and the impacts of scour events in the reservoir monitoring program.
- Only two storms were able to be captured in 2015 to assist in the model calibration of large flow events.
- Tom also outlined the differences between the current model and previous models of the reservoir system, in addition to the calibration and validation processes. There are good cross section geometry representations for both ponds.
- It should be noted that Holtwood and Safe Harbor are only calibrated to bathymetry, and no loads are included. We will look to see if we're matched when that output is given to modeling team and to see if the output from our Conowingo output matches that produced by the HEC-RAS team.
- Covering the years of 2008-2015 with the HEC-RAS model would help to capture the 2011 large storm event. Going back to 1996 would allow us to better realize the objectives of capturing loads produced by larger storms.
- Essentially, the HEC-RAS model run from 2008-2015 would be used to reparametrize HSPF, and then the HSPF output would be inputted into the HDR HydroQual Model.
- Lew summarized what was on the table, specifically an option to take the curves of flow and sediment dynamics from those locations between Marietta and Conowingo and implement them in the Phase 6 model. There were no objections raised from the Modeling WG, and the approach was approved.
- Tom reiterated that two different reservoir states would be used to produce those curves that would then inform the Phase 6 model.

Lower Susquehanna River Impoundment Modeling Studies – Jim Fitzpatrick/Mark Velleux (HDR)
Attachment D/E

- Jim Fitzpatrick outlined the plans to use an integrated hydrodynamic and sediment transport model of the Conowingo Pond, and discussed details of the spatial resolution as well. The goal is to represent spatially and temporally the sediment transport into and out of Conowingo Pond, and will be fed by inputs from the WSM.
- Lew emphasized the need for coordination in providing necessary loads to help continue development of the updated Conowingo work.
- The Modeling Workgroup approved a go ahead for Jim Fitzpatrick and others to apply both sediment transport and diagenesis models and proceed with HydroQual's work to incorporate into the Chesapeake Bay Program's modeling system.

- Norm Goulet agreed, and stated that any new information that we receive is for the better on this matter.
- Jim also expressed a hope for collaborative analysis of future measurements of observed data from UMCES researchers, particularly Jeff Cornwell's sediment research.

Review of Modeling Workgroup Membership – Dave Montali, WVDEP - Lee Currey, MDE
Attachment F

- Lee began be reviewing the key principles and emphasis that the Modeling Workgroup places on open dialogue, attendance, decision making.
- The Modeling WG leadership is looking for workgroup members to provide further nominations of membership status within the workgroup, which will be filled for academic and at-large spots.
- Requests for nominations will be sent out shortly and will be brought back to the Modeling Workgroup at a later date.

MINUTES: January 21

Comparison of Chester River Shallow-Water Models – Marjorie Friedrichs and Aaron Bever, VIMS
Attachment G

- Marjy introduced the shallow water modeling project, which involves four modeling teams to assess the performance of multiple models in simulating shallow waters in the Chester River, for application to larger areas throughout the Chesapeake Bay.
- Raleigh Hood discussed his proposal for a workshop that will look at the next generation of models that could be incorporated into the future CBP modeling framework and will combine numerous components of modeling, from water quality to the airshed.

Chester River Shallow Water Multiple Models – Joseph Zhang and Harry Wang, VIMS
Attachment H.1, *Attachment H.2*

- Joseph reviewed some recent updates of the SCHISM model that included aspects of tidal dynamics, wave model results, and preliminary sediment model results.
- Recent work has been completed on the upper Chesapeake Bay, which is used to drive the boundary conditions for studies of the Chester River modeling efforts.
- **ACTION**: Lew to distribute Joseph's paper regarding some of the presented z-grid methodologies to the larger Modeling Workgroup.
- Overall, the salt intrusion performance was improved, and the wave and sediment model were able to be fully coupled with good results.

- Harry discussed the coupling of the eutrophication model HEM3D with SCHISM and the results of the model runs.
- Raleigh asked about the possibility of capturing spatial variation of growth with a light field despite missing sediment aspects and CDOM in the model.
- Lew asked about the possibility of running different loading rate scenarios to see the dynamic response of the simulation. Harry agreed that this would be beneficial and could be worked out in the schedule of runs.
- Jeremy asked about the increase of groundwater to Morgan Creek within the simulation and Harry emphasized that there were probably only local effects. Jeremy and Harry also discussed the possibility of flushing effects.

Sediment Composition and Diagenesis – Jeff Cornwell and Jeremy Testa, UMCES
Attachment I.1, *Attachment I.2*

The composition of Conowingo sediments in long and short cores, the estimated reactivity of their organic material, and their estimated biogeochemical fate in tidal water deposition will be described. Measured sediment nutrient flux rates of Conowingo Sediment will be discussed.

- Jeff provided an update regarding the analysis of diagenesis experiments and reiterated there is still ongoing planning to measure particle sizes for sufficiently high flow events in spring 2016.
- Raleigh asked about the sediment additions to the Bay cores that may have promoted enhanced denitrification and produced a bigger supply of ammonium through nitrification.
    - Jeff explained that the current theory is an inadvertent addition of ammonium produced when bringing in Conowingo sediments and collecting the material. There were thoughts about resuspending sediments do determine whether the study group is creating more ammonium in sampling. However, the ambient rates in the Bay (upper, low salinity sites) are pretty similar to what's occurring in the Conowingo.
- Jeremy described simulations and data sensitivities that have been performed to run a sediment biogeochemical model based off of Jeff's data to understand some of the controls and processes that lead to fluxes in line with Jeff's observations.
- The group has worked with turning off nitrification within the sediment diagenesis model which produces better results of nitrogen fluxes, but produces far more ammonium than what was observed.
- Sensitivity tests will be run based on measurements to understand the effects of dissolved oxygen on nutrient fluxes in the Conowingo Reservoir.
- The corroboration of this model's findings with those from HydroQual will serve as a useful assurance to benefit the Bay Program's assessment of ongoing processes within the reservoir.
- Raleigh asked about whether there had been further looks at the deposition function being used may be warranted, and if there were any other potential functions that could be used to get a sense of its relation to flow and further impacts on the model. A relationship between deposition and flow may warrant further next steps.

Sedimentation Rates and Patterns – Cindy Palinkas (UMCES)
Attachment J

The details of particle dynamics in the Conowingo Pool including sedimentation rates and patterns will be described and the remaining work to be done on the Conowingo long cores will be discussed.

- Cindy discussed her work on the sedimentation within the reservoir, with focus on short-term cores although there will be further study on longer-term deposition.
- The role of the project is to look at sediment characterization in both short and long term cores, and to look at sedimentation ages based on radioisotopes.
- **ACTION**: Lew noted that the modeling team could provide sediment loads data at the Marietta station for Cindy's analysis.

WQSTM Calibration to the Phase 6, Beta 1 Loads – Carl Cerco, U.S. CoE ERDC
Attachment K

- The goal outlined was to have a fully operational water quality model by the end of January 2016, meaning that the results would be as good as or better than the model version used in 2010. These improvements would involve the different breakouts of G1, G2, and G3 organic matter estimates, shoreline loads, wetland nutrient attenuation and loss, and the representation of shallow water data and processes, among others.
- The model has been run for two sequences: 2002-2011, when shallow water data is available, and 1991-2000, the classic validation of the water quality model.
- Any changes that have been made to the models and parameters since 2010 may influence changes in results, as well as the changes in loads from the improved Beta version of the WSM.
- Gary noted that the watershed model RIM sites in Phase 5 were calibrated to the Estimator loads, though Estimator may be a little bit lower in the mid-90s period because the time factor is quadratic and there was a phosphorus dip at around that time. The main reason that the model produces higher loads now is because of increased loads coming from the Eastern Shore based on multiple sources of evidence. In the modeling team's best estimation, it is likely that the loads produced at this point are close to those that will be generated at the end of the Beta version process.
- Bill Keeling asked whether the increased loads could be related to the representation of BMPs, which appear to be less effective in reducing loads.
    - Gary pointed out that this would not be the case at the RIM stations, although if there was a lower BMP representation on unmonitored sections, then higher loads would be the result.
- Gopal and Carl agreed that they would continue to discuss the processes and results that have helped to generate greater amounts of load below RIM stations, like those seen in the southern reaches of the Potomac.

Progress in the Simulation of Tidal Wetland and Shallow Water Processes – Carl Cerco, U.S. CoE ERDC
Attachment L

- Carl reviewed the status to date of wetlands simulation along with shallow water processes and the impacts that they have on the Bay in more regional contexts.
- There are a few regions where wetlands have a profound impact, like the Nanticoke, while other areas like the Potomac or the upper Chesapeake Bay have a much lesser impact resultant from tidal wetlands.
- Carl reviewed the breakouts of sediments, classified as G1 (labile), G2 (refractory), and G3 (slow refractory or inert) and their role as applied to different loading sources.
    - The numbers for splits derived from the laboratory experiments will be of great importance in guiding the work that Carl does in the model
    - ACTION: Lew will set up a call to discuss the process of incorporating laboratory experiments with Carl, Jeff Cornwell, and Jeremy Testa.
- A proposal has also been put forth for Jeff to study eroded wetlands, but this has stalled out because of legal issues at ERDC. At this point, Carl may have to just work with model calibration procedures as a stand-in.
- The process for simulation of oysters is no different than what was in place 10 years ago. Currently Carl needs the present oyster biomass and distribution and a way to represent the biggest change, being the change in aquaculture.
    - ACTION: Carl will call the author of the Chesapeake Quarterly article regarding oyster aquaculture about MD plots, and Bill Keeling will help to put Carl in touch with VADEQ folks for Virginia aquaculture data.
- Carl stressed that the aim in simulation of wetlands is not the development of a predictive biogeochemical model for wetlands. Rather, the objective is to create a relatively simple module that includes important processes like burial, respiration, denitrification, primary production, and maybe others.
- Maps of wetlands that will be used to simulate processes within the Bay model are based on the work provided by Peter Claggett.
- There was discussion regarding the timing of starting scenarios in the spring of 2016 based on the Bay Model's calibration to the Phase 6 Beta 1 loads. Dave suggested that at some point there would be a line drawn that states where progress stands and what can be run for April scenarios while emphasizing that more refinements are to come. Carl noted that what could be produced by March is not likely to substantially differ from what exists currently, although he can provide the code to the Modeling Team before leaving the country.
- In regards to simulating wetlands loss based on sea level rise modeling, Carl stated that progress has not been made. There was previous discussion with Lora Harris regarding Patty Glick's work that had been rendered in a more useful form, and had been volunteered to Carl. Carl will work to follow up on that dataset offer and will report back.

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