Modeling Workgroup Support for Expert Group on Conowingo Dredging as a CBP Management Practice

Modeling Workgroup July Quarterly Review

July 13, 2022

Lew Linker and CBPO Modeling Team

linker.lewis@*epa.gov*

Chesapeake Bay Program

Science, Restoration, Partnership

Rivers are the gutters down which flow the ruins of continents.

Luna B. Leopold

What is being proposed to Modeling Workgroup

Maryland is interested in pursuing a model-supported expert panel approach to evaluating Conowingo dredging as a nutrient and sediment reduction best management practice (BMP) for the CBP. The MDE, Modeling Workgroup, WQGIT, Watershed Technical Workgroup, the State of Maryland, and a proposed future expert panel all have a role in the work.

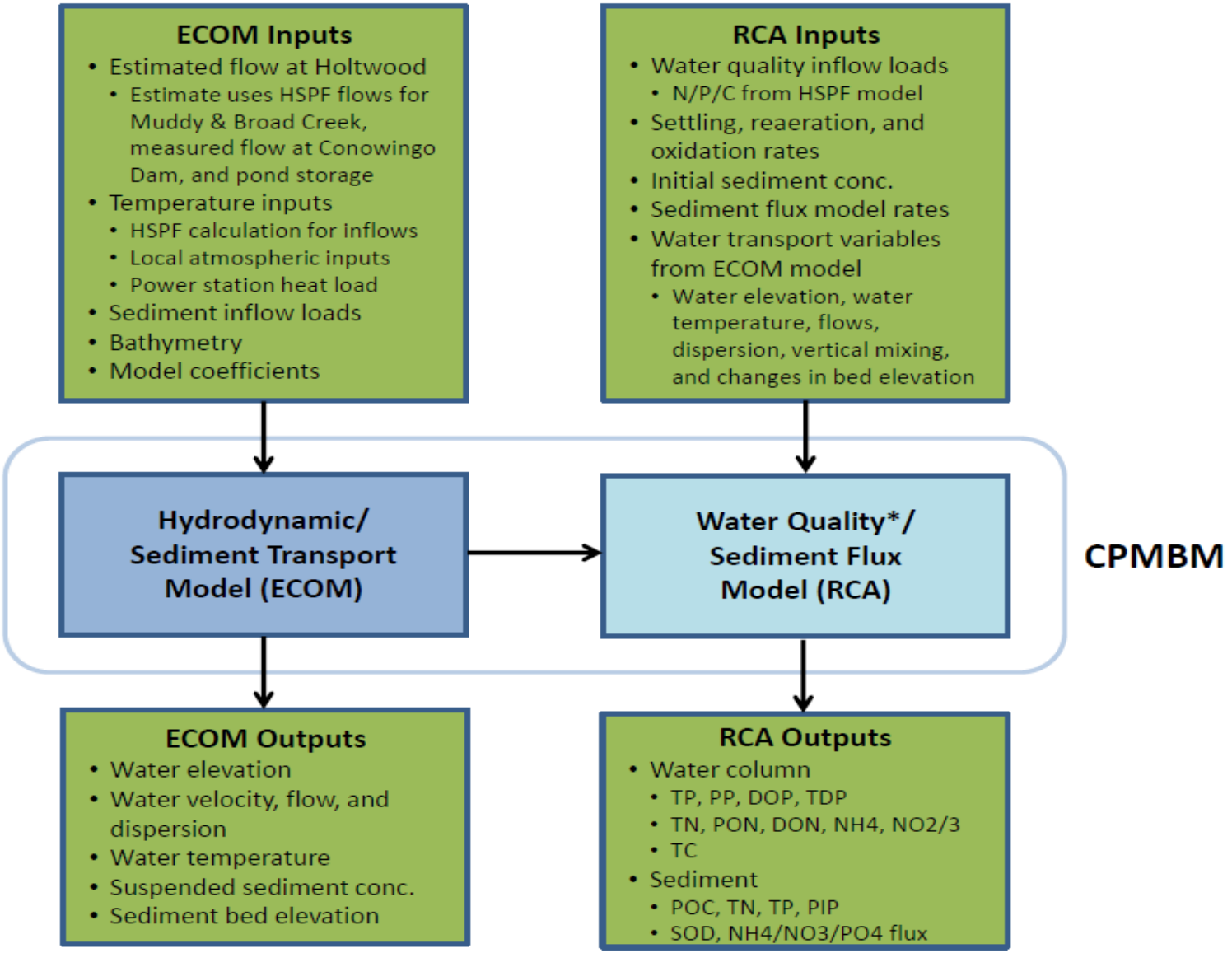
The role of the Modeling Workgroup would be to provide Watershed Model, Airshed Model, and Land Use Model inputs to the Conowingo Pool simulation and to use the Conowingo Pool Model outputs in the 2017 Bay Model to assess water quality. In addition, the Modeling Workgroup would provide technical guidance to the Conowingo model practioners and review of the Conowingo Pool simulation.

There are Two Possible Options to Examine Conowingo dredging as a Potential CBP BMP

Option 1: Using the existing proprietary Constellation Energy Conowingo Pool Mass Balance Model based on the ECOMSED-RCA Model (HydroQual) that was applied to CBP's 2017 Conowingo Assessment.

Option 2: U.S. Corps of Engineers Baltimore District and Engineering Research Development Center (CoE ERDC) development of a Conowingo Pool simulation using a fine-scale grid CH3D-ICM model. The model would be open source/public domain.

Option 1: Constellation Energy Conowingo Pool Mass Balance Model – ECOMSED-RCA (HydroQual)



* Simplified water quality model does not include full eutrophication kinetics

Option 1: Constellation Energy Conowingo Pool Mass Balance Model – ECOMSED-RCA (HydroQual)

Advantages:

- The model has already been developed and applied in the 2017 Midpoint Assessment.
- Might be least cost solution.

Disadvantages:

- Not open source/public domain.
- Could only be used in the one application of assessing efficacy of Conowingo dredging BMP.
- Would require ongoing public-private cooperation over a multiyear effort.

Option 2: CoE – ERDC Conowingo Simulation with Fine Scale CH3D-ICM Model

Advantages:

- The model could be designed for permanent application in the CBP suite of models for 2027 and beyond.
- An open source/public domain model.
- Could be used for Conowingo dredging as a BMP analysis as well as for the examination of future conditions of the Conowingo under climate change and extreme flows.
- Would be continuously improved (as needed) as a CBP model.
- CBP is very familiar with the CH3D-ICM modeling approach.

Disadvantages:

- Could be highest cost solution.
- Requires support by the State of Maryland and CoE.

Upper, Middle, and Lower Regions of the Conowingo Pool

Link to *LOWER SUSQUEHANNA RIVER WATERSHED ASSESSMENT REPORT, 2015:* https://dnr.maryland.gov/waters/bay/Documents/LSRWA/Reports/LSRWAFinalMain20160307.pdf

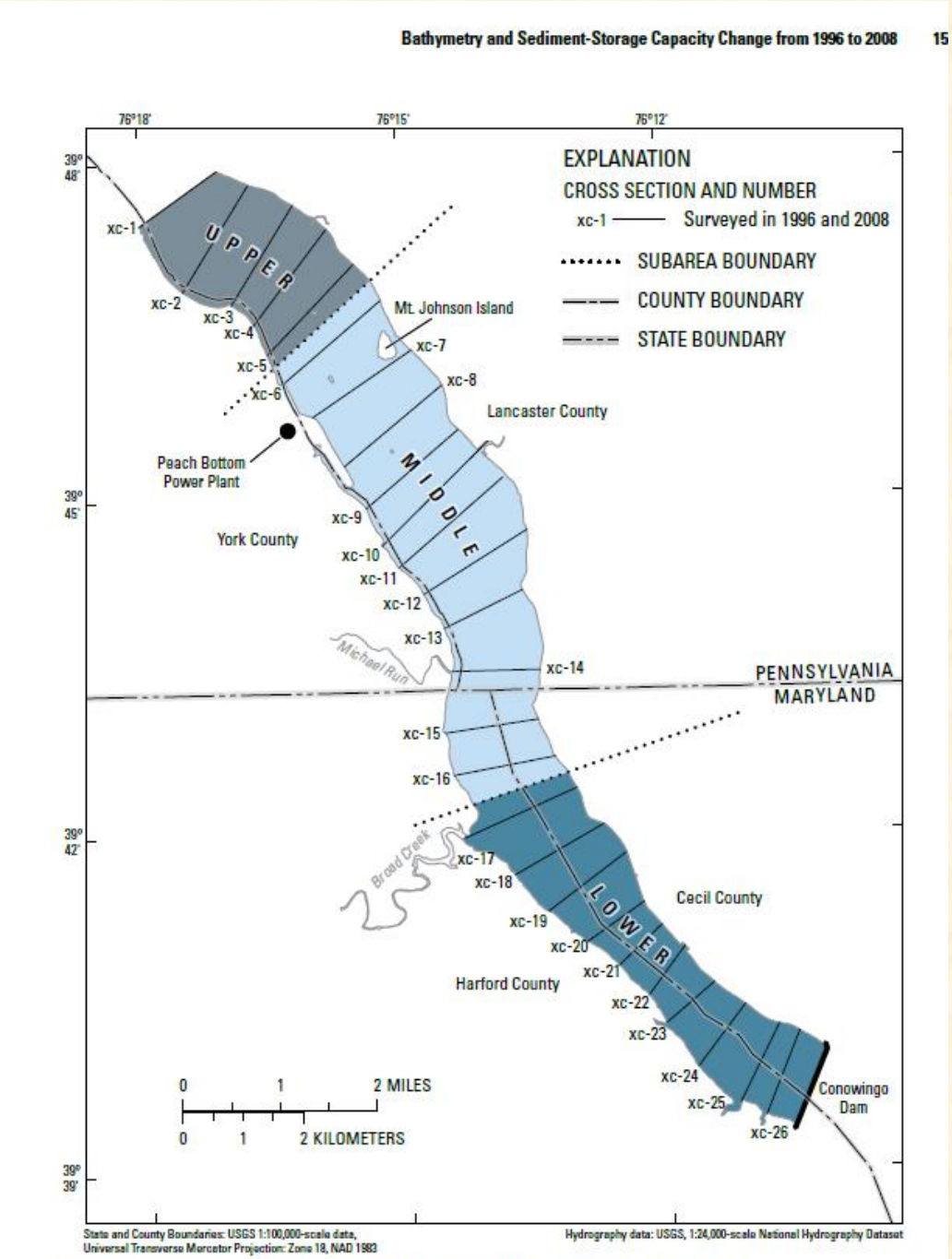


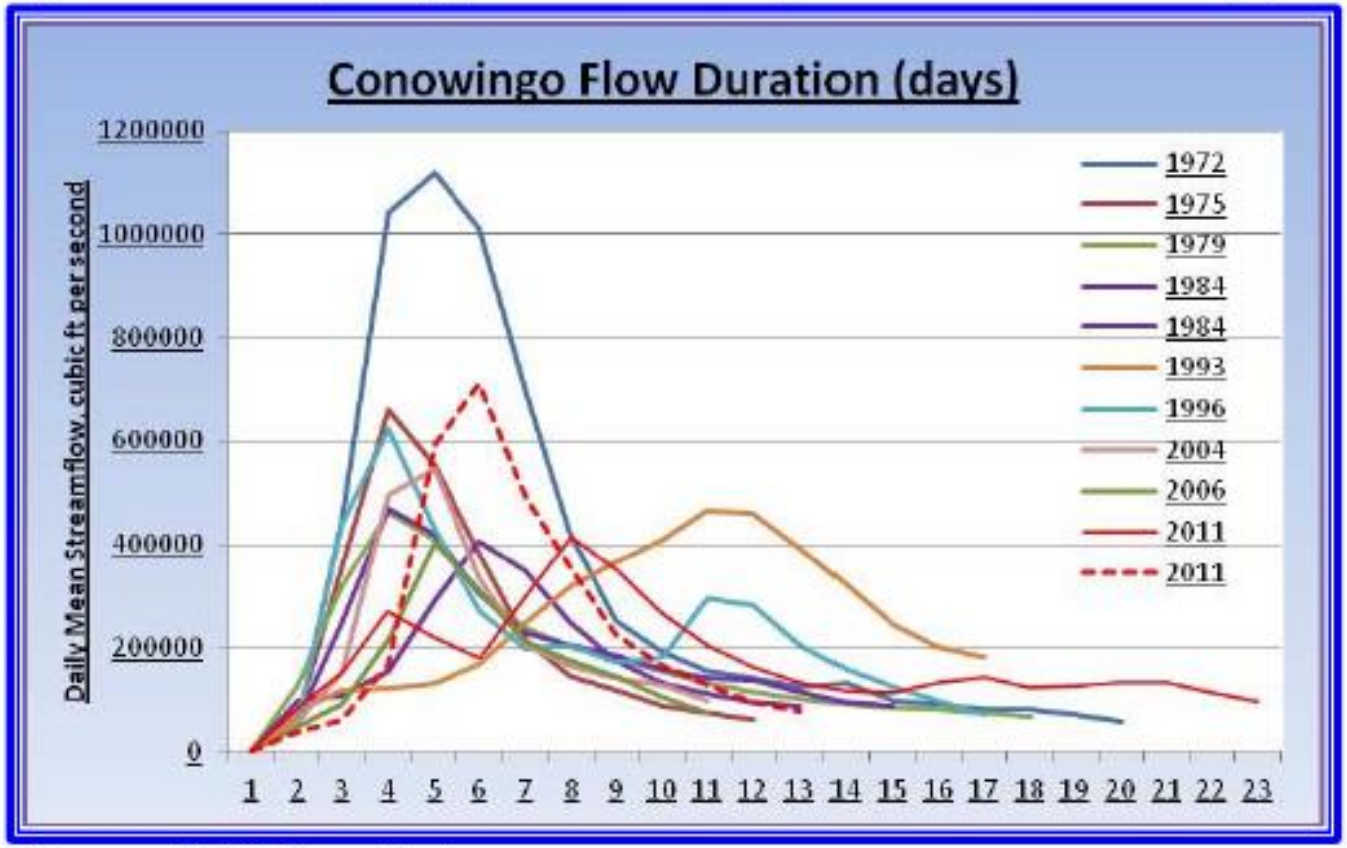
Figure 9. Bathymetric survey transects surveyed in Conowingo Reservoir, lower Susquehanna River.

Ten Scoping Scenarios on Dredging Location, Depth, Area, and Duration Using 2025 Flows and Loads With Some Tests at 2055 Flows and Loads

- Upper Conowingo Pool (CP) large area, shallow depth, continuous operation
- Upper Conowingo Pool (CP) large area, shallow depth, seasonal operation
- Upper CP small area, deep depth, seasonal operation
- Lower Conowingo Pool (CP) large area, shallow depth, continuous operation
- Lower CP large area, shallow depth, seasonal operation
- Lower CP small area, deep depth, seasonal operation
- Area of high deposition in CP large area, shallow depth, continuous operation
- Area of high deposition in CP large area, shallow depth, seasonal operation
- Area of high deposition in CP large area small area, deep depth, seasonal operation
- Dredging Embayments

Extreme Flow Events at the Conowingo Gage From Agnes (1972) to Topical Storm Lee (2011)

Figure 4-2. Flow Hydrographs for 11 Recent High-flow Events at Conowingo, MD



Source: USGS, Appendix A.

Estimated Extreme Flow Loads for Susquehanna Watershed and Conowingo Pool

Table 4-7. Scour and Load Predictions for Various Flows in Conowingo Reservoir

Streamflow (cfs)	Recurrence Interval (years)	Percent Chance of Flow Event per Year	Predicted Sediment Scour Range (million tons)[1]	Predicted Total Sediment Load Range (million tons)[2]	Percent Scour to Total Load Range
1,000,000	60	1.7	10.5 - 15.5	27.1 - 31.1	39 - 49
900,000	40	2.5	6.6 - 11	21.8 - 26.2	30 - 42
800,000	25	4	4.5 -7.5	17.2 - 20.2	26 - 37
700,000	17	5 .9	3.5 - 6	13.1 - 15.6	27 - 38
600,000	10	10	1.8 - 4	7.9 - 10.1	22 - 40
500,000	5.7	17.5	1 - 3	4.9 - 6.9	20 - 42
400,000	4.8	21	0.5- 1.5	2.4 - 3.4	21 - 44
300,000	1.9	52	0 – 0.5	0.5 – 1.5	0 - 33

Notes: [1] Predicted scour from USGS scour equation, bathymetry results, and literature estimates.

[2] Predicted total load based on regression equation, bathymetry results, and literature estimates.

Ten Scoping Scenarios To Examine Efficacy of Developing An Extreme Event Safety Factor

1996 Big Melt Event

- 1996 Big Melt Extreme Event with dynamic equilibrium conditions
- 1996 Big Melt Extreme Event with 1928 original bathymetry conditions
- 1996 Big Melt Extreme Event with 1970 bathymetry conditions

Tropical Storm Lee

- Tropical storm Lee with current dynamic equilibrium conditions
- Tropical storm Lee with 1928 original bathymetry conditions
- Tropical Storm Lee with 1970 bathymetry conditions

Extreme event of record:

- Hurricane Agnus with current dynamic equilibrium conditions
- Hurricane Agnus with 1928 original bathymetry conditions
- Hurricane Agnus with 1970 bathymetry conditions

Partnership Roles and Responsibilities in the Conowingo Modeling-Based Expert Panel Process

- **State of Maryland:** Maryland is the sponsor of the BMP expert panel process for Conowingo dredging. As the sponsor, Maryland will work with the Bay Program Partnership to find financial resources to support the technical assistance needed for developing model scenarios and performing the model runs that will generate required model outputs. The outputs would then be provided to the Modeling Work Group and the Expert Panel.

- **Modeling Workgroup (MWG):** The MWG will review existing and proposed modeling tools to determine whether the scientific rigor, model documentation and model transparency is sufficient for achieving the Expert Panel goals. Specifically, the Modeling workgroup will review the existing Conowingo Pond Mass Balance Model (CPMBM) and related documentation. Based upon that review, the MWG will make recommendations whether the CPMBM is approvable for use in determining scenario-based nutrient reductions associated with Conowingo dredging. The MWG will also provide modeling advice and technical support to the Expert Panel and assist with integrating Conowingo model outputs with the Chesapeake Bay modeling suite to assess water quality impacts in the Bay.

- **Expert Panel (EP):** the EP will consist of modelers, engineers, hydrologists, geochemists, biologists and water quality experts. Selection will be coordinated with the MWG, Water Quality Goal Implementation Team (WQGIT), and Watershed Technical Work Group. The EP will review and advise on the overall modeling framework, model inputs and outputs, model integration, hydrologic, geochemical, and ecological processes, evaluate dredging nutrient reduction results, and the fate and transport in Chesapeake Bay for both accuracy and precision. The EP will ultimately recommend dredging nutrient reduction efficiencies to the WQGIT for concurrence.

- **Water Quality Goal Implementation Team (WQGIT):** the WQGIT will serve in an advisory and coordination role throughout the model-based EP process. The WQGIT will approve of the process used for this effort and approve any recommendations from the EP to go to the Management Board for approval.

- **Watershed Technical Workgroup (WTG):** the WTG will serve in an advisory and coordination role throughout the model-based EP process and support the WQGIT on related items. The WTG will also provide technical review and recommendations to the MWG on watershed model processes and input data.