

Review of the Lower Susquehanna Watershed Assessment



STAC Review Report

August 2014

Annapolis, Maryland



STAC Publication 14-006

Review Team:

Carl Friedrichs (Lead), VIMS
Theo Dillaha, Virginia Tech
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George Van Houtven, RTI
Peter Wilcock, Johns Hopkins

STAC Report = 40 p., condensed
from ~ 100 pages of individual
reviews submitted by the team.

Available to all of STAC, to be
publically released following USACE
approval.

Motivation:



Figure 2-22. Conowingo Dam Aerial

3.3.4 Conowingo Hydroelectric Station

On August 30, 2012, Exelon filed with FERC an application for a new license for its 573-MW Conowingo Hydroelectric Project, FERC Project No. 405 (Exelon, 2012). The existing license for the project was issued by FERC to Susquehanna Power Company and Philadelphia Electric Power Company on August 14, 1980, for a term ending August 31, 2014.

Exelon intends to continue to operate the project as it has operated historically. FERC must decide whether to issue a new hydropower license to Exelon for the Conowingo project and what conditions should be placed on any license issued. Like the Muddy Run relicensing action, FERC will consider and balance the project's energy, recreation, fish and wildlife, and other environmental resources. Coordination among Exelon, resource agencies, and stakeholders regarding potential license conditions is ongoing. At the writing of this report, Exelon still needs to acquire a 401 WQC from MDE, and FERC is expected to complete an EIS before a license can be issued. A FERC license is expected to be issued in early 2015.

Source: USACE LSRWA Study Report

Motivation: Hirsch (2012)



Flux of Nitrogen, Phosphorus, and Suspended Sediment from the Susquehanna River Basin to the Chesapeake Bay during Tropical Storm Lee, September 2011, as an Indicator of the Effects of Reservoir Sedimentation on Water Quality



Scientific Investigations Report 2012–5185

U.S. Department of the Interior
U.S. Geological Survey

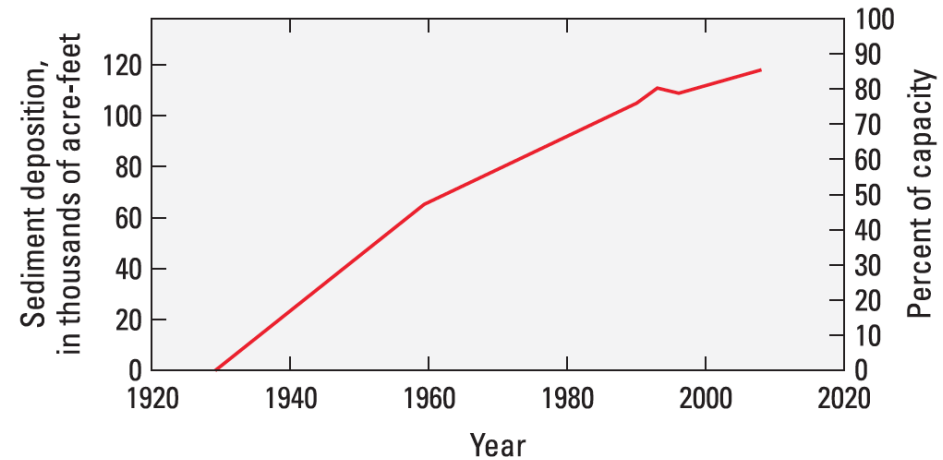


Figure 3. Sediment deposition in the lower 11.5 miles of Conowingo Reservoir from the time of dam construction (1929) to the most recent survey (2008), in acre-feet and as a percentage of the estimated capacity of 138,000 acre-feet (data from Langland, 2009, table 3).

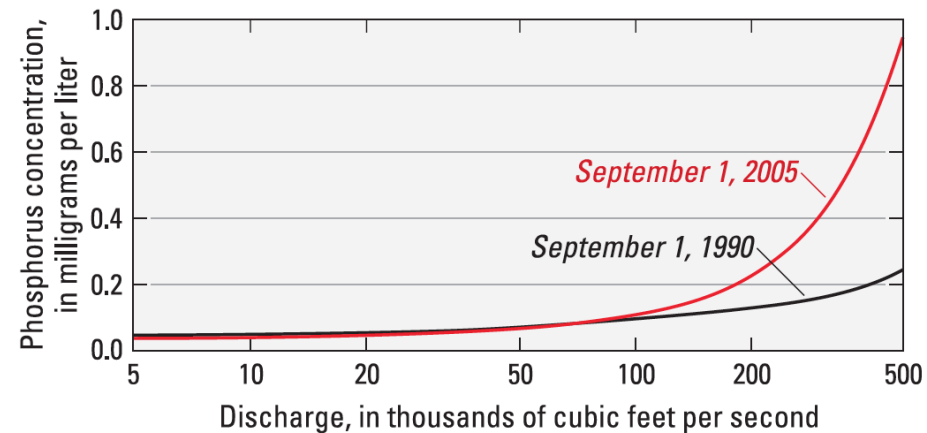


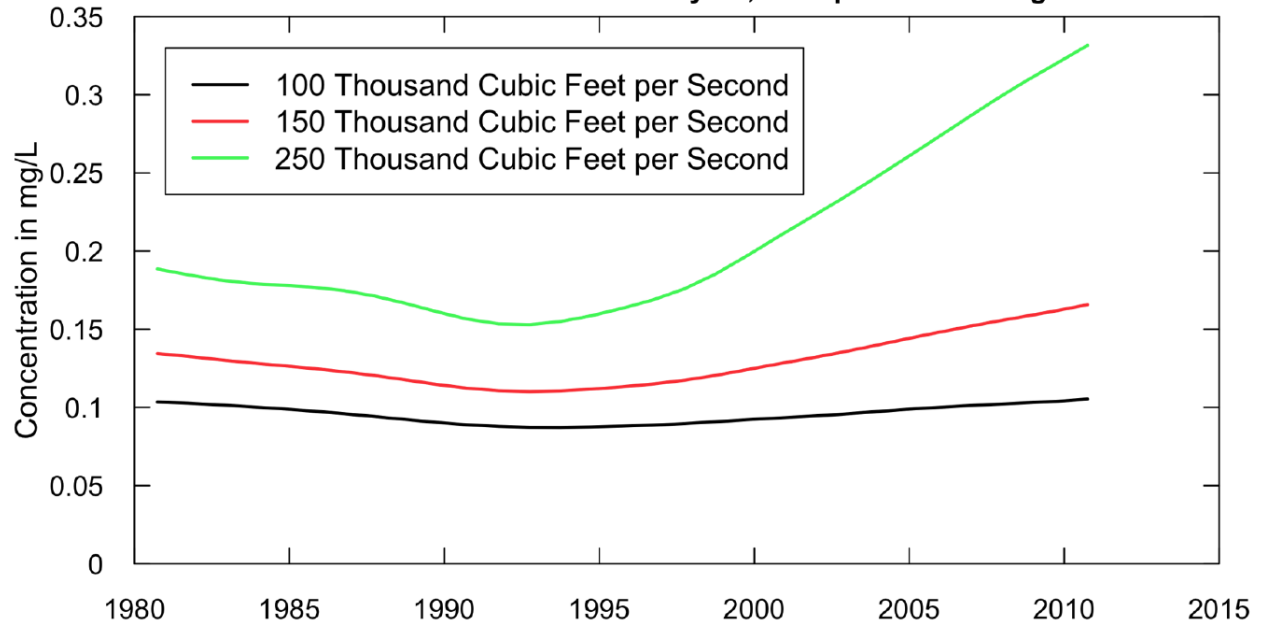
Figure 12. Estimated concentration of total phosphorus as a function of discharge for the Susquehanna River at Conowingo, Maryland, based on smoothing centered on September 1, 1990, or on September 1, 2005.

Motivation (cont.):

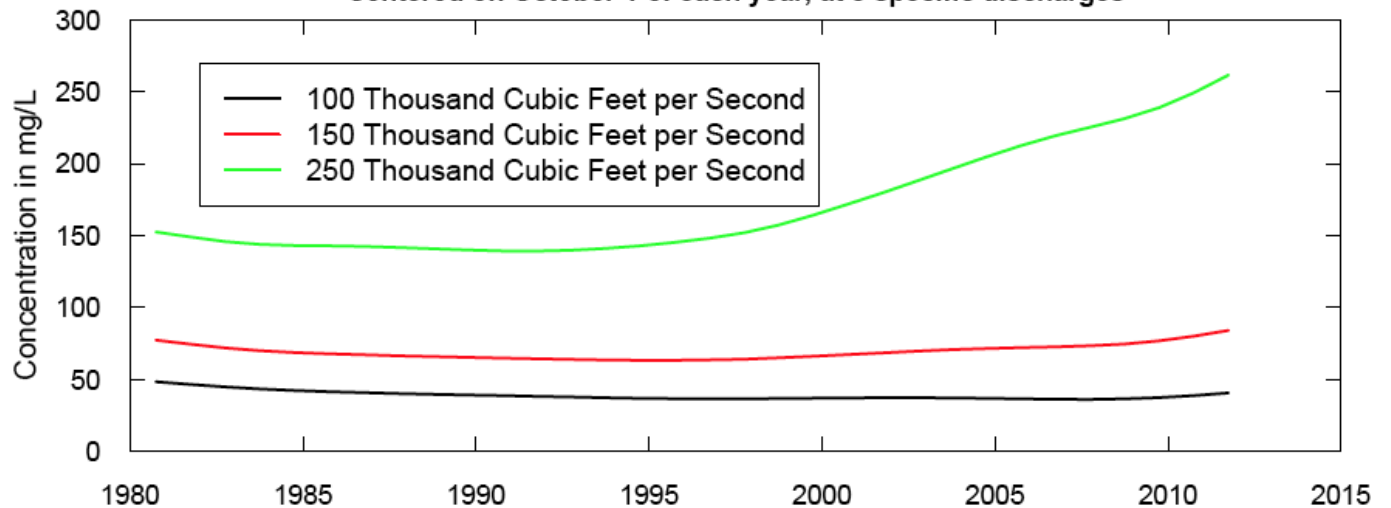
Hirsch (2014)

[Jan'14 CBP Modeling Quarterly Review Meeting.]

**Susquehanna River at Conowingo, MD Total Phosphorus
Estimated Concentration Versus Year
Centered on October 1 of each year, at 3 specific discharges**



**Susquehanna River at Conowingo, MD Suspended Sediment
Estimated Concentration Versus Year
Centered on October 1 of each year, at 3 specific discharges**



Controversy:

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION



In the Matter of)
)
Exelon Generating Company, LLC)

Project No. 405-106

**COMMENTS OF STEWARDS OF THE LOWER SUSQUEHANNA, THE
LOWER SUSEQUEHANNA RIVERKEEPER, AND WATERKEEPERS
CHESAPEAKE**

Pursuant to 18 C.F.R. § 4.34(b)(3), Stewards of the Lower Susquehanna, Inc., (“SOLS”), the Lower Susquehanna Riverkeeper (“Riverkeeper”), and Waterkeepers Chesapeake (collectively, “SOLS et al.”) file comments in this proceeding, which addresses the relicensing of Exelon Generation Company, LLC’s Conowingo Hydroelectric Project.

50 pages of comments
submitted to FERC on
1/31/2014

...

CONCLUSION

For the foregoing reasons, if FERC issues the proposed renewed license for Project No. 405-106, it should include the conditions to ensure the following:

...

(3) Removal of sediment from Conowingo Pond sufficient to prevent scouring during the duration of the license period, and

Maryland Department of Natural Resources (DNR), Secretary Joseph P. Gill

I want to thank Senator Cardin for organizing the Public Hearing on the Conowingo Dam, addressing the potential negative impacts of the Dam reaching “dynamic equilibrium” on the Chesapeake Bay water quality, habitat and living resources, fishing industry and recreation, and the Dam Relicensing effort.

...

But Conowingo Dam is not the Bay’s only or even its main problem. Scour of sediments from behind the dam in a storm event adds only about 8% to 12% to the load from the watershed. Storm events and sediment and nutrient laden runoff come from every part of the watershed. Just like in the reservoir behind this dam, sediment and nutrients are trapped in every farm pond, stormwater pond and reservoir throughout the Bay and its tributary watersheds, and storm events carry trapped pollutants into local streams and rivers, just as they do in the Bay.

...

Maryland is working with all our State, federal, and Chesapeake Bay partners to develop and implement a suite of practices to mitigate the impacts of the Conowingo Dam reaching “dynamic equilibrium” on the Chesapeake Bay. This is one of Maryland’s highest priorities. Make no mistake: The key to restoring the Chesapeake Bay and her tributaries lies in reducing the input of pollution sources throughout the watershed. Over time, as the watershed is cleaned up and historic deposits of pollution like those found behind the Dam are diminished, storms will have less and less impact on a healthier and more resilient Bay.



Controversy (cont.):

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CLEAN CHESAPEAKE COALITION FILES SUPPLEMENTAL TESTIMONY TO U.S. SENATE SUBCOMMITTEE ON CONOWINGO DAM

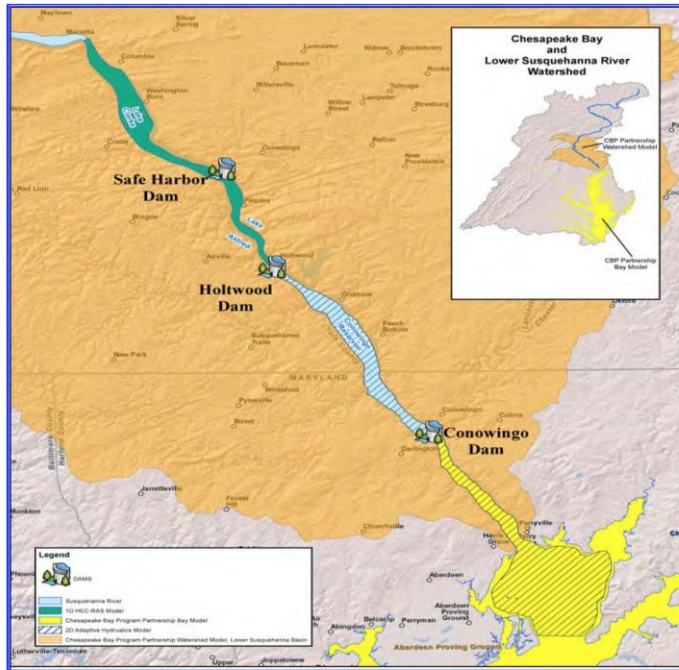
CHESTERTOWN, MD (May 16, 2014):

...

In its supplemental testimony, the Coalition challenges certain statements and conclusions offered by field hearing panelists and registers concerns regarding (i) increased vulnerabilities to the Bay due to climate change predictions (increased frequency and intensity of storms means more scouring of accumulated pollutants from Conowingo Pond); (ii) cherry-picking preliminary LSRWA “findings” to fit a “just do your WIPs” narrative; (iii) disregard for the voices of Maryland local government officials; and (iv) a misplaced sensitivity to the estimated costs of dredging and maintaining Conowingo Pond to regain trapping capacity while Maryland taxpayers have been committed to spending more than \$14 billion under the State’s WIP on programs, policies and practices that will reduce pollution loadings by fractions compared to Susquehanna River/Conowingo Pond loadings to the Bay.

LOWER SUSQUEHANNA RIVER WATERSHED ASSESSMENT, MARYLAND AND PENNSYLVANIA

PHASE I



June 2014 Draft



LSRWA Study Partners and Scope:

-- Lead: (i) U.S. Army Corps of Engineers (USACE) Baltimore District and (ii) Maryland Dept. of the Environment.

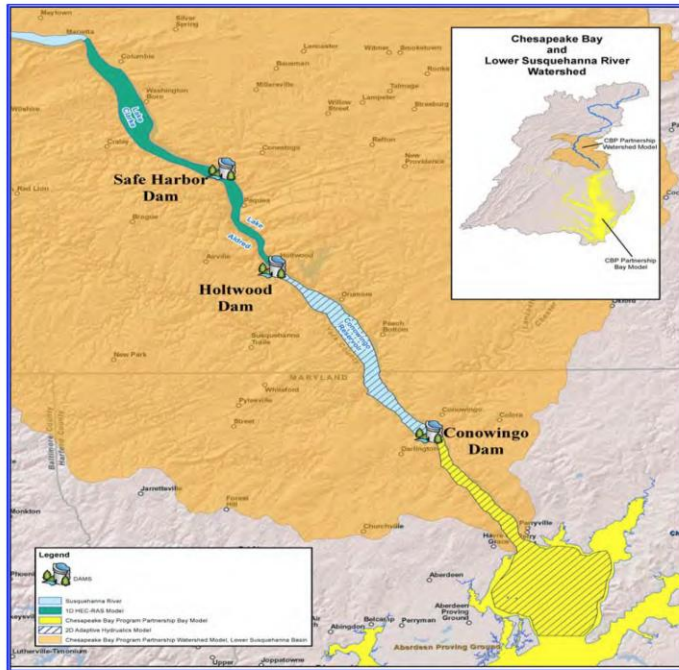
-- Additional members of LSRWA Interagency Team: (iii) U.S. Geological Survey, (iv) USACE's Engineer Research and Development Center, (v) Susquehanna River Basin Commission, (vi) The Nature Conservancy, (vii) EPA Chesapeake Bay Program Office, and (viii) Maryland Department of Natural Resources (including the Maryland Geological Survey).

-- 3 years (2011 – 2014), \$1.4 Million, 75% Federal/25% non-Federal cost-share.

-- Main report = 239 pages; Appendices = 1025 pages.

LOWER SUSQUEHANNA RIVER WATERSHED ASSESSMENT, MARYLAND AND PENNSYLVANIA

PHASE I



June 2014 Draft



LSRWA Study purpose:

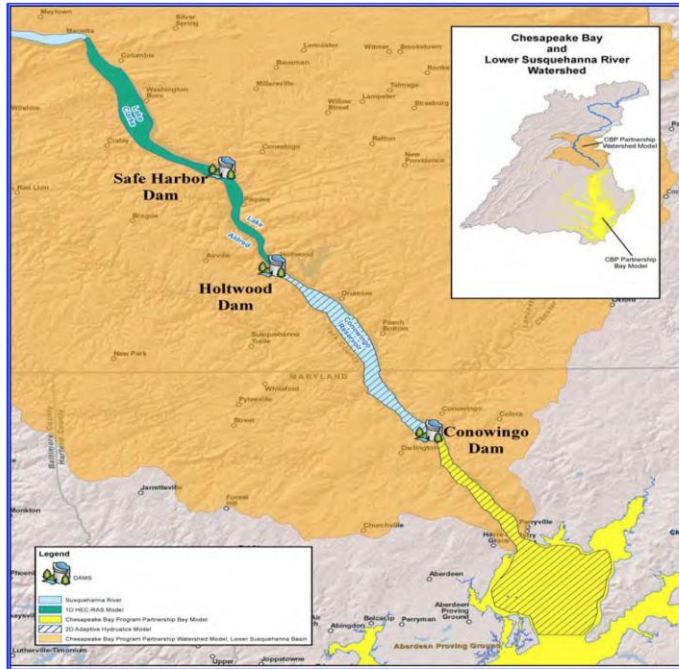
-- Analyze the movement of sediment and associated nutrient loads within the lower Susquehanna watershed through the series of hydroelectric dams (Safe Harbor, Holtwood, and Conowingo) located on the lower Susquehanna River to the upper Chesapeake Bay.

-- Including: (i) analyze hydrodynamic and sedimentation processes and interactions within the lower Susquehanna River watershed, (ii) consider strategies for sediment management, and (iii) assess cumulative impacts of future conditions and sediment management strategies on the upper Chesapeake Bay.

-- The need for this assessment is to understand how to better protect water quality, habitat and aquatic life in the lower Susquehanna River and Chesapeake Bay.

LOWER SUSQUEHANNA RIVER WATERSHED ASSESSMENT, MARYLAND AND PENNSYLVANIA

PHASE I



June 2014 Draft



LSRWA Study purpose:

-- Analyze the movement of **sediment** and associated **nutrient** loads within the lower Susquehanna watershed through the series of hydroelectric dams (Safe Harbor, Holtwood, and Conowingo) located on the lower Susquehanna River to the upper Chesapeake Bay.

-- Including: (i) analyze hydrodynamic and **sedimentation** processes and interactions within the lower Susquehanna River watershed, (ii) consider strategies for **sediment** management, and (iii) assess cumulative impacts of future conditions and **sediment** management strategies on the upper Chesapeake Bay.

-- The need for this assessment is to understand how to better protect water quality, habitat and aquatic life in the lower Susquehanna River and Chesapeake Bay.

Lower Susquehanna River Watershed Assessment Request for STAC Technical Review



Photo: Jane Thomas (UMCES-IAN)



“Why Request a STAC Review?”

- Fresh eyes to help identify gaps, opportunities... all especially important given potential legal proceedings.
- Opportunity to share state of the science”

Review Organizer, Kevin Sellner, Chesapeake Research Consortium – **STAC Exec Sec**

Review Team:

Carl Friedrichs (Lead), Virginia Institute of Marine Science – **STAC**

Theo Dillaha, Virginia Tech

John Gray, U.S. Geological Survey

Robert Hirsch, U.S. Geological Survey – **STAC**

Andrew Miller, University of Maryland, Baltimore Campus – **STAC**

David Newburn, Economics, University of Maryland, College Park – **STAC**

James Pizzuto, University of Delaware

Larry Sanford, University of Maryland Center for Environmental Science

Jeremy Testa, University of Maryland Center for Environmental Science

George Van Houtven, RTI International

Peter Wilcock, Johns Hopkins University

Expertise: resource economics, and watershed, riverine, and estuarine processes

Charge to review team from STAC Executive Secretary:

“You should focus your comments on the following [questions], but you are encouraged to provide additional comment that would improve the analyses, report, or its recommendations.

Question 1: Does the main report clearly define the goals, strategies, and the results/conclusions of the study, and also present adequate background material at a level suitable for understanding by non-technical audiences?

Question 2: Are the alternative sediment management approaches clearly described and documented? Does this background material provide supporting evidence for the finding and conclusions of the study with regard to alternative sediment management approaches?

Question 3: Does the main report provide clear, supporting evidence for the results, findings, and conclusions of the study?

Question 4: Does the report adequately identify key uncertainties in the model applications which, with better information, could change the predicted outcomes of the alternative management scenarios evaluated in this study?

Question 5: Are the recommended follow-up evaluations and analyses (Section 9.1) complete and comprehensive as well as clearly stated to enable the next phase of work to continue under the Partnership’s Midpoint Assessment?

Question 6: Do the technical appendices provide the necessary documentation for the models and their applications in support of the study’s results, findings, and conclusions?”

General reaction of the review team to the LSRWA report

Overall positive:

-- The majority of the reviewers of the LSRWA report agree that its authors have done a commendable job in trying to address an extremely challenging set of issues.

-- Overall, the results of the study are reasonable, the major conclusions are important, and the report's recommendations are by-and-large appropriate and productive.

-- The project was an enormous effort with multiple participants, and the authors did an impressive job bringing together a wide range of information to support their report.

General reaction of the review team to the LSRWA report (cont.)

But...

-- The science that needs to be done here is at the cutting edge of what sediment transport and water quality science has ever accomplished in the past.

-- Thus, there are no standard models and protocols for such a study, and the existing capabilities are understandably limited.”

-- Hence, it is not surprising that the review team identified many sections of the report that would benefit from revisions, corrections and/or additional analysis.

Question 1: Does the main report clearly define the goals and strategies of the study?

-- Goals are 50%/50% Sediments vs. Nutrients:

(LSWRA Report p.10): “the specific goals and objectives for the LSRWA effort were: 1. Generate and evaluate strategies to manage sediment and associated nutrient loads delivered to Chesapeake Bay... 2. Generate and evaluate strategies to manage sediment and associated nutrients available for transport during high-flow storm events to reduce impacts on Chesapeake Bay. 3. Determine the effects to Chesapeake Bay due to the loss of sediment and associated nutrient storage within the reservoirs on the lower Susquehanna River.”

-- But the Purpose and Approach are ~80%/20% Sediments vs. Nutrients:

(LSWRA Exec. Summary p.ES-1): “The purpose of this assessment was to analyze the movement of sediment and associated nutrient loads within the lower Susquehanna watershed through the series of hydroelectric dams... This included analyzing hydrodynamic and sedimentation processes and interactions within the lower Susquehanna River watershed, considering strategies for sediment management, and assessing cumulative impacts of future conditions and sediment management strategies on the upper Chesapeake Bay.”

-- The review recommends that the “original goals” of the study (i.e., sediment management to extend the life of Conowingo Dam more than nutrient management to protect Chesapeake Bay water quality) be presented in the introduction followed by a fuller explanation of how and why the focus of the study evolved in time toward the impact of nutrients.

Question 2: Are the alternative sediment management approaches clearly described and documented? Does this background material provide supporting evidence for the finding and conclusions of the study with regard to alternative sediment management approaches?

Table 6-6. Summary of Representative Alternatives

Representative Alternative	Description of Alternative	Estimated Unit Cost for Annual Removal (\$/cy)		
		1 mcy	3 mcy	5 mcy
1 – Innovative Reuse	Sediment hydraulically dredged and turned into LWA for use as construction material	\$39-50	\$29-39	\$26-39
2C – Open-Water Placement, 9 Months of Sediment Bypassing	Hydraulically dredge sediment; utilizing a pipeline from the dredge, to pump past Conowingo Dam downstream to a release point over 9 months (September-April)	\$6-12	\$5-11	\$5-11
3A – Upland Placement, Stancills Quarry	Hydraulically dredge material and pump downstream to a dewatering site at Stancills Quarry, prior to permanent placement at Stancills Quarry	\$23-35	\$22-34	\$22-33
4 – Watershed Management, Sediment Management Beyond the WIPs	Based on CBP E3 Scenario, this includes additional BMPs in the Susquehanna watershed above the planned WIPs. Scenario estimates a reduction of 117,000 cubic yards (95,000 tons) of sediment annually for a one-time total investment of \$1.5-3.5 billion	\$256-\$597		

Watershed management of sediment costs 50 times as much as sediment bypassing. However, LSWRA study focused on cost of reducing amount of sediment from behind Conowingo Dam, **NOT** the cost of removing nutrients.

Question 2: Are the alternative sediment management approaches clearly described and documented? Does this background material provide supporting evidence for the finding and conclusions of the study with regard to alternative sediment management approaches?

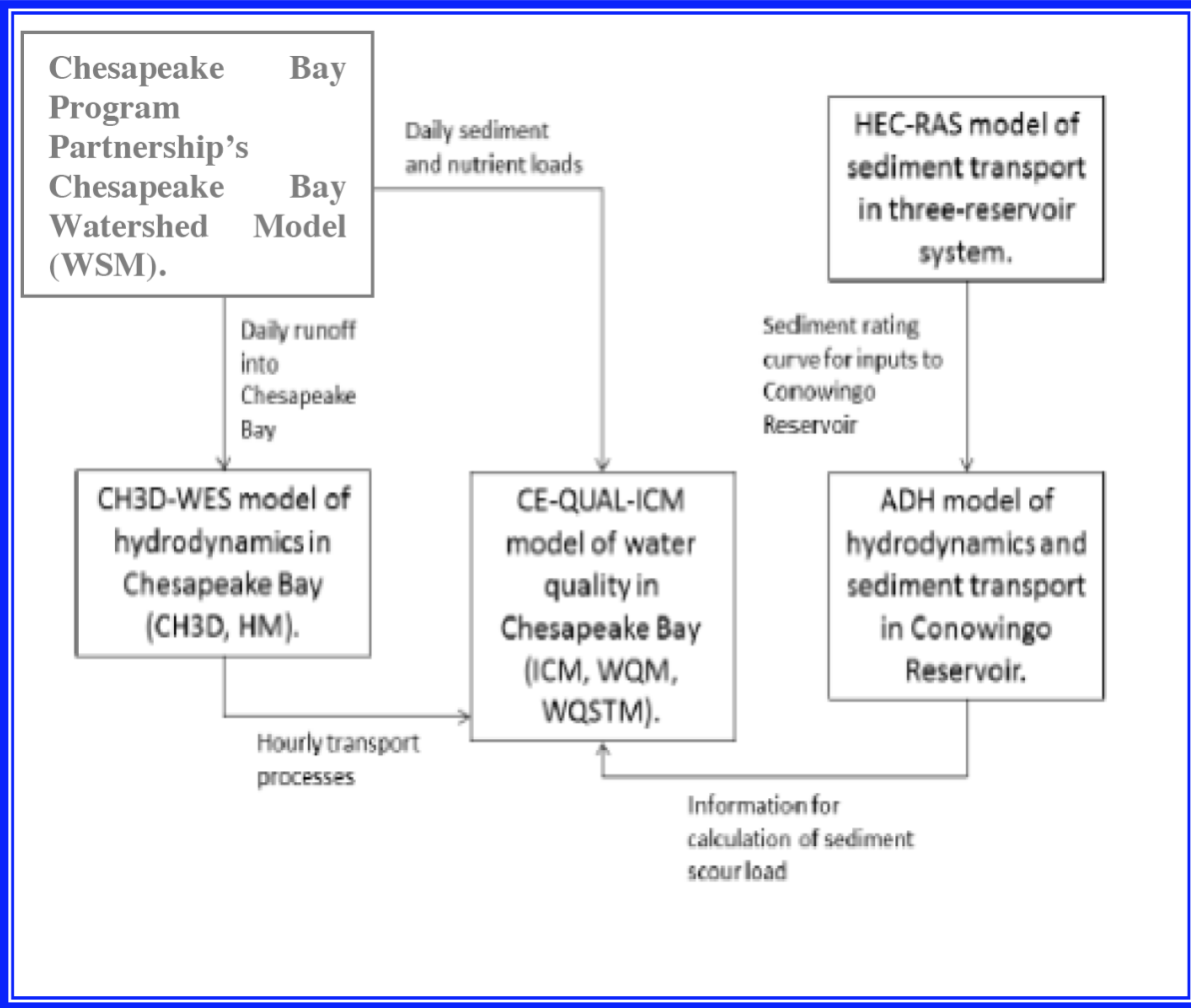
-- Where clearly defined as methods for reducing the cubic yards of total sediment present in the reservoir, the alternative sediment management approaches were found by the large majority of the reviewers to be well-documented, well-described, and comprehensive.

-- **This review recommends that further caveats be included throughout the report to clarify that the dollar-based cost estimates regarding alternative sediment management approaches are specifically for reducing cubic yards of total sediment in the reservoir, not for achieving broader goals regarding nutrient reductions.**

-- **The LSRWA report should also emphasize that further analysis would be required to appropriately rank the alternative strategies based on a more environmentally relevant total cost in terms of dollars per pound of nitrogen and/or phosphorus reduction.**

Question 3 & 4: Does the main report provide clear, supporting evidence for the results, findings, and conclusions of the study? Does the report adequately identify key uncertainties in the model applications which, with better information, could change the predicted outcomes of the alternative management scenarios evaluated in this study?

Figure 1-5. Flow Chart of Modeling Components and Applications



Notes: Chesapeake Bay Program Partnership's Chesapeake Bay Watershed Model, CH3D-WES and CE-QUAL-ICM are all components of the CBEMP.

Question 3 & 4: Does the main report provide clear, supporting evidence for the results, findings, and conclusions of the study? Does the report adequately identify key uncertainties in the model applications which, with better information, could change the predicted outcomes of the alternative management scenarios evaluated in this study?

General Uncertainty – Although the report lists and discusses sources of uncertainty, it expresses the expected confidence intervals on its model predictions less often. Ideally, ranges of uncertainty should be provided for all model predictions (rather than a specific number).

-- The review recommends the LSRWA report should more explicitly explain why confidence intervals on predictions are generally not provided.

Reduced deposition associated with reservoir infilling has been neglected – Net trapping efficiency is the sum of increases in average annual scour and decreases in average annual deposition. However, the simulations and calculations in the study only considered the increase in scour. This issue underlies a significant weakness in the report, which is that it focuses its inquiry on the impact of large, but infrequent, scour events rather on the total impact of the change in trapping efficiency of the reservoir system.

-- The review recommends that a discussion should be added to the report that clearly states that decreases in the average annual deposition in the reservoir in the absence of scour have not been considered.

-- The revised report should clearly state that the added transport of sediment-associated nutrients past Conowingo Dam due to decreased deposition may be as large as that due to increased scour.

Question 3 & 4 (cont.): Supporting evidence for the results, findings, and conclusions of the study/identification of key uncertainties?

Grain size effects within and exiting the reservoir were not sufficiently considered – It is reasonable to expect that the texture of the sediment behind the dam will continue to coarsen through successive scour events and deposition interludes. Nutrients associated with fine sediments, not with the total load of sediments, are the main water quality concerns.

-- The review recommends that the concept of dynamic equilibrium be clearly qualified in the report to indicate it does not yet apply to sediment grain size, and thus it does not yet fully apply to the flux of fine sediment or associated nutrients.

Limitations of HEC-RAS and AdH models were not made sufficiently clear – The HEC-RAS modeling effort was unsuccessful. The AdH model was not fully validated and was forced by boundary conditions outside the range of observations. AdH model has not, as yet, added substantial new understanding of the sediment dynamics of the reservoir.

-- This review recommends that the failure of the HEC-RAS model be reported more clearly and fully in the Chapter 4 of the main report.

-- This review also recommends that the limitations of the AdH application as described above be made much clearer in both Appendix B and the main report.

-- The review recommends that more of the observational data in the Appendices be incorporated into the main report, particularly those that bear on the time-varying sediment budget. This will make the report's conclusions more convincing. Even if the fidelity of the models can be questioned, the observational data are compelling.

Question 5: Are the [main conclusions] and recommended follow-up evaluations and analyses (Section 9) complete and comprehensive as well as clearly stated to enable the next phase of work to continue under the Partnership's Midpoint Assessment?

LSRWA Finding 1:

Present version: Conowingo Reservoir is essentially at full capacity; a state of dynamic equilibrium now exists. There has been a loss of long-term sediment and associated nutrient trapping capacity.

Recommended rephrasing: The Conowingo Reservoir is essentially at full capacity and is no longer a long-term sink helping to prevent sediment-associated nutrients (primarily particulate phosphorus) from entering the Chesapeake Bay.

LSRWA Finding 2:

Present version: The loss of long-term sediment trapping capacity is causing impacts to the health of the Chesapeake Bay ecosystem.

Recommended rephrasing: Increases in particulate phosphorus loads entering the Bay as a result of the full reservoir are likely causing significant impacts to the health of the Chesapeake Bay ecosystem.

Question 5 (cont.): Are the [main conclusions] and recommended follow-up evaluations and analyses (Section 9) complete?

LSRWA Finding 3:

Present version: Sources upstream of Conowingo Dam deliver more sediment and nutrients, and therefore, have more impact on the upper Chesapeake Bay ecosystem, than do the scoured sediment and associated nutrients from the reservoir behind Conowingo Dam.

Recommended rephrasing: Sources of nutrients upstream of the Conowingo reservoir have far more impact on the Chesapeake Bay ecosystem than do the increases in nutrients caused by scour plus reduced deposition in the reservoir.

LSRWA Finding 4:

Present version: Managing sediment via large-scale dredging, bypassing and dam operational changes, by itself does not provide sufficient benefits to offset the upper Chesapeake Bay water quality impacts from the loss of longterm sediment trapping capacity.

Recommended rephrasing: Managing sediment via large-scale dredging, bypassing and/or operational changes are clearly not cost-effective ways to offset Chesapeake Bay water quality impacts from the loss of long-term trapping of sediment-associated nutrients.

Question 5 (cont.): Are the [main conclusions] and recommended follow-up evaluations and analyses (Section 9) complete?

LSRWA Recommendation 1:

Present version: Before 2017, quantify the full impact on Chesapeake Bay aquatic resources and water quality from the changed conditions in the lower Susquehanna River and reservoirs.

Recommended rephrasing: As soon as possible, follow-up studies should more fully quantify the impact on Chesapeake Bay water quality from increases in sediment-associated nutrients brought about by reservoir infilling.

LSRWA Recommendation 2:

Present version: U.S. EPA and Bay watershed jurisdictional partners should integrate findings from the LSRWA into their ongoing analyses and development of the seven watershed jurisdictions' Phase III WIPs as part of Chesapeake Bay TMDL 2017 mid-point assessment.

Recommended rephrasing: There is no compelling reason to reduce sediment loads *per se* from the Susquehanna watershed to compensate for increased sediment passing out of the Conowingo reservoir. Nutrients are the main problem, not sediments.

Question 5 (cont.): Are the [main conclusions] and recommended follow-up evaluations and analyses (Section 9) complete?

LSRWA Recommendation 3:

Present version: Develop and implement management options that offset impacts to the upper Chesapeake Bay ecosystem from increased nutrient and sediment loads.

Recommended rephrasing: Additional particulate phosphorus load reductions from the Susquehanna watershed (beyond present WIPs) should be considered to compensate for changes to the Conowingo.

LSRWA Recommendation 4:

Present version: Commit to enhanced long-term monitoring and analysis of sediment and nutrient processes in the lower Susquehanna River system and upper Chesapeake Bay to promote adaptive management.

Recommended rephrasing: Commit to enhanced long-term monitoring and analysis of sediment and nutrient processes in the lower Susquehanna River system and upper Chesapeake Bay to promote adaptive management in response to improved scientific understanding.

Question 5 (cont.): Are the [main conclusions] and recommended follow-up evaluations and analyses (Section 9) complete?

Suggested Additional LSRWA Finding/Recommendation:

[The negative impacts of sediment input to the Chesapeake Bay \(relative to nutrients\) are overstated by present TMDLs and are overemphasized in management priorities](#)

-- TMDL requirements for sediment loads are most likely overly restrictive. The water quality simulations conducted as part of the LSRWA study further support the conclusion that sediment alone does not have as great an impact on Bay aquatic life and attainment of water quality standards as previously thought.

-- An underlying assumption at the start of the LSRWA study, and indeed of the CBP in general, is that all sediment is bad. However, some sediments are actually good, important components of the estuarine ecosystem (e.g., for sustaining wetlands and habitat).

-- Given the relatively minor impact of sediments in general (separate from their associated nutrients) to Bay water quality, it is especially clear that the additional sediments (separate from nutrients) associated with the filling of the Conowingo reservoir are particularly insignificant to overall Bay health.

-- The effectiveness of BMPs in reducing sediment loads to the Bay may be overstated by present TMDLs. This is ultimately a result of massive watershed storage of sediment.

-- Thus, the possibility that sediment BMPs may not lead to a major reduction in sediment coming from the upstream watershed needs to be considered as a real possibility in considering management actions.