Center for TMDL and Watershed Studies

CENTER FOR TMDL AND WATERSHED STUDIES

At the Center

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Center affiliates make presentations at ASABE conference in Minneapolis

Two Center research papers and a poster were presented at the American Society of Agricultural and Biological Engineers (ASABE) Annual International Meeting (AIM) held June 17-20 in Minneapolis, MN. This meeting featured numerous technical sessions in all areas of agricultural and biological engineering including session under the Societies Soil and Water division.

View of Upper St. Anthony Falls, Minneapolis, MN (photo courtesy of US Army Corp of Engineers)

A paper presented at the meeting, "Uncertainty of Predicted In-stream Fecal Coliform Concentration for TMDL Development using HSPF: a Two-Phase Monte Carlo Approach," highlights research on estimating uncertainty in the total maximum daily load (TMDL) process. A two-phase Monte Carlo technique was used to estimate uncertainty in in-stream fecal coliform (FC) bacteria concentration and evaluate the effects of both knowledge uncertainty and stochastic variability. In-stream FC bacteria concentrations were simulated using the Hydrologic Simulation Program – FORTRAN (HSPF) model developed for the Mossy Creek watershed in Virginia for two different pollutant allocation scenarios that were suggested for the bacteria TMDL. By quantifying the uncertainty, decision makers and stakeholders can then choose their level of confidence in achieving a particular water quality standard and the associated level of needed pollutant reduction to achieve that confidence level.

A biological or aquatic life impairment is assessed based on bioassessment protocols used to assess the benthic macroinvertebrate community. The second paper, "Linking Sediment with Biological Impairment in Virginia," summarizes various types of evidence that have been used to identify sediment as the primary stressor in biological TMDLs, With such evidence, the link between sediment and ecosystem integrity can be identified.

The poster presented at the meeting, "Simulating BMPs for TMDLs in Virginia," describes the use of HSPF and Generalized Watershed Loading Function (GWLF) models to simulate the effects of various conservation practices. Some best management practices (BMPs) impact the area where the BMP is applied and can be simulated as land use changes; others impact runoff from upstream areas and require models that either perform overland routing or that use post-processing procedures to account for the impact of BMPs on these areas.

Presentations at the WEF TMDL 2007 Conference

Every two years, the Water Environment Federation (WEF) brings together hundreds of environmental experts to exchange ideas on the TMDL process at a TMDL specialty conference. At this year's meeting, held June 24-27 in Bellevue, Washington, Center Director, Dr. Brian Benham, made two presentations: "Development and Evaluation of TMDL Planning and Assessment Tools and Processes: Perspectives and Products from a USDA Funded Multi-state Research Project" and "TMDL Implementation: Lessons Learned".

The first of these talks was presented in a session designed to share information between two professional societies that are active in the TMDL area, namely the American Society of Agricultural and Biological Engineers (ASABE) and WEF. Like WEF, ASABE holds a biennial TMDL specialty conference. Since 2005 WEF and ASABE have scheduled a special session where members from the other society make presentations that inform attendees about ongoing TMDL-related activities, a cross pollination of sorts. In his presentation, Dr. Benham discussed the history and accomplishments of a USDA-Cooperative State Research, Education, and Extension Service (USDA-CSREES) sponsored multi-state research project entitled "Development and Evaluation of TMDL Planning and Assessment Tools and Processes (S-1004)." Beginning in the 1960s several multi-state and multi-discipline 'regional' research projects have addressed water quality and water quality modeling. S-1004 is the latest of these projects and the largest most diverse project to date. It includes 105 scientists from 33 universities, agencies, and corporations and a range of disciplines from economics, to engineering, to forestry and soil science. S-1004 and similar multi-state projects bring teams of scientists and engineers together to work together on common interests under an overarching project proposal. The objectives of the S-1004 project are to:

1. develop, improve, and evaluate watershed models and other approaches for TMDL development and implementation
2. assess potential/likely economic benefits and costs and equity issues associated with TMDL implementation, and
3. assess the potential ecological benefits/ implications of TMDL implementation.

In 2006, members of S-1004 collaborated to publish a series of journal articles related to TMDL development in the *Transactions of the ASABE* (volume 49, number 4). In his presentation Dr. Benham presented details about this series of publications and gave examples of Center research efforts that serve to meet the S-1004 project objectives. Other S-1004 members from around the country are working on TMDL-related projects that achieve S-1004 project objectives.

TMDLs and TMDL implementation plans are actively being developed across the country using a variety of approaches, with varying levels of detail, stakeholder participation, and success. A second presentation made by Dr. Benham entitled, "TMDL Implementation: Lessons Learned", reviewed the findings of a Center project that assessed implementation efforts from across the country using a series of seventeen case studies. This study detailed those factors that positively and negatively affected implementation in watersheds where water quality is improving as a result of implementation. The full project report can be accessed via the Center's website http://www.tmdl.bse.vt.edu/uploads/File/pub_db_files/TMDL%20Implementation-Characteristics%20of%20Successful%20Projects_Report.pdf.

Dr. Benham also made a presentation as part of a workshop preceding the WEF TMDL conference. The workshop introduced the "Third-party TMDL Development Toolkit." The toolkit was developed by a taskforce organized by WEF under a cooperative agreement with the U.S. Environmental Protection Agency and WEF. A third-party TMDL is one in which an organization or group other than the lead water quality agency takes responsibility for performing the TMDL study and developing the TMDL document. A third party can be a watershed group or organization, a municipal wastewater, stormwater or, industrial discharger, other unit of government (such as a county, city, municipality, or land management agency), or an organization representing non-point sources of pollution (e.g., farm bureau or irrigation and drainage district). The toolkit provides potential third parties an overview of the TMDL process, basic steps for completing a third party TMDL, and four case studies that describe their respective processes, challenges, outcomes, and lessons learned. The tool kit can be downloaded from the WEF website at: http://www.wef.org/ScienceTechnologyResources/TechnicalInformation/TopicalResourceDocs/ThirdPartyTMDLDev.html.

Statistical measures help improve HSPF water quality calibration when developing bacteria TMDLs

In modeling, calibration can be considered as much an art as science, especially when there is limited observed data. Calibration is required to ensure that a model is adequately simulating actual hydrologic and water quality processes. A new statistical tool developed by Center staff can be used to improve calibration efforts, helping a modeler to select which parameters to adjust and by how much, and develop outputs that more accurately reflect conditions in the waterbody.

"Temporal-window" statistics, tested for use with the Hydrological Simulation Program-FORTRAN (HSPF), were effectively used to adjust and refine calibrations related to in-stream bacteria concentrations. This statistical approach, described in "Water Quality Calibration Criteria for Bacteria TMDL Development" and published in Applied Engineering in Agriculture, is a time-saving and logical procedure. Each temporal window is centered on the day the observed data was collected. Thus, this measure of model calibration determines how frequently the observed data falls within the range of simulated data during a time period that extends several days before and after the observation. Additional calibration statistics include: geometric mean, daily violation rate of bacteria water quality criterion, and the minimum-maximum range associated with a temporal window.

Because in-stream bacteria concentrations are usually sampled infrequently and represent only an instant in time, it is not reasonable to expect any model to simulate a daily average concentration equal to an observed value on a particular day. However, it is reasonable to expect that the min-max range of the temporal window for a calibrated model to include the observed data.

Center researchers also developed associated calibration guidance, in the form of end-point criteria, to ensure a consistent approach when simulating in-stream bacteria concentrations. These criteria, along with temporal-window statistics, can help to determine when sufficient agreement is achieved between the observed and simulated data. Development of these statistics grew out of the researchers' experience modeling in-stream bacteria for TMDLs addressing bacterial impairments. They suggest this methodology could also be adapted for other water quality parameters with limited data.

Recent Meetings and Presentations

Water Environment Federation TMDL 2007 Conference:

Benham, B.L. 2007. Development and Evaluation of TMDL Planning and Assessment Tools and Processes: Perspectives and Products from a USDA Funded Multi-state Research Project. Water Environment Federation TMDL 2007 Conference. June 2007. WEF: Alexandria, Virginia.

Benham, B. L., R.W. Zeckoski, and G. Yagow. 2007. TMDL Implementation: Lessons Learned. Water Environment Federation's TMDL 2007 Conference. June 2007. WEF: Alexandria, Virginia.

ASABE Annual International Meeting:

Mishra, A. and B.L. Benham. 2007. Uncertainty of Predicted In-stream Fecal Coliform Concentration for TMDL Development using HSPF: a Two-Phase Monte Carlo Approach. ASABE Paper no. 072271. ASABE Annual International Meeting (AIM), June 17-20 in Minneapolis, Minnesota. ASABE: St. Joseph, Michigan.

Yagow, G. 2007. Linking Sediment with Biological Impairment in Virginia. ASABE Annual International Meeting (AIM), June 17-20 in Minneapolis, Minnesota. ASABE: St. Joseph, Michigan.

Yagow, G., B. Zeckoski, B. Benham, and K. Brannan 2007. Simulating BMPs for TMDLs in Virginia. ASABE Annual International Meeting (AIM), June 17-20 in Minneapolis, Minnesota, poster presentation. ASABE: St. Joseph, Michigan.

TMDL Meetings:

Brannan, K.M., S.M Kim and M. Ball. 2007. Second Technical Advisory Meeting for the Hardware River TMDLs June 6, 2007. Charlottesville, Virginia.

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VIRGINIA STATE UNIVERSITY

Center hires new staff, gains additional expertise

A new addition to the Center's staff brings a little 'west coast offense' to a team of talented watershed researchers and TMDL developers.

Maria H. Ball, who joined the Center this past spring, earned an M.S. in Environmental Systems,Geology from Humboldt State University, and a B.S. in Geology from the University of Washington. She has more than ten years of experience in modeling hydrologic systems and spatial watershed analyses, and studied hydrologic response mechanisms in numerous watersheds and river systems, including the impacts of urbanization and deforestation on these systems.

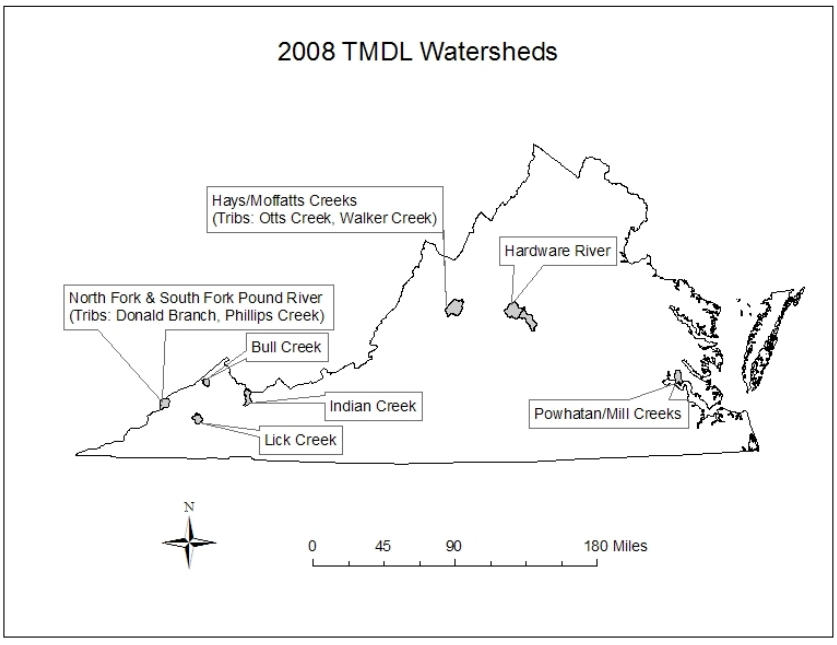
"Maria brings a new perspective to the Center," said Rebecca Zeckoski, a Research Associate at the Center. "Her expertise in landscape modeling, soils, and river mechanics, will be a great asset, helping us to refine modeling efforts and make our TMDLs that much more practical and realistic."

Her professional experiences include working as a hydrologist for organizations such as the U.S. Geological Survey, the Redwood Sciences Laboratory at the U.S. Forest Service Pacific Southwest Research Station, and Waterborne Environmental, Inc. where her responsibilities included evaluating the impacts of pesticides and fertilizers on water quality.

Ball said she is looking forward to some new challenges with Center projects. "I want to help bring awareness to the public of local environmental issues—educate people why it is important and help them understand what they can do to help maintain or improve the status quo of our streams and rivers and their environs," Ball explained.

Born and raised near Seattle, Ball spent summers at their cabin near Mt Rainier—fishing, playing in the creek, building dams, climbing trees, and getting lost. She has lived and worked in Virginia for almost 10 years.

Updates on current Virginia TMDLs



Lick Creek bacteria and aquatic life (VA general standard) TMDLs (active and historical coal mining): The final report has been submitted for review and public comment. The final public meeting is scheduled for July 16th, 2007 at 7pm at the Dante Lives On facility in Dante, Virginia.

Indian Creek bacteria TMDL: The hydrology calibration and animal source determination are underway.

Hardware River bacteria TMDL. The final report has been submitted to the Virginia DEQ.

North Fork and South Fork Pound aquatic life (VA general standard) impairment (active and historical coal mining): Data is being gathered on the North Fork and South Fork Pound River segments for the stressor analysis, the reference watershed comparisons, and for modeling purposes.

Hays/Moffatt Creeks bacteria TMDL: Watershed and pollutant source characterization is underway.

Recent Center Publications

Benham, B.L., A. Braccia, S. Mostaghimi, J.B. Lowery, and P.W. McClellan. 2007. Comparison of best management practice adoption between Virginia's Chesapeake Bay basin and Southern Rivers watersheds. J. Extension [On-line]. 45(21).

Center for TMDL and Watershed Studies. 2007. Bacteria Source Load Calculator v2.0 Users Manual. BSE Document no. 2007-0002. Available online: http://www.tmdl.bse.vt.edu/uploads/File/pub_db_files/BSLCUsersManual.pdf.

Kim, S.M., B.L. Benham, K.M. Brannan, R.W. Zeckoski, and J. Doherty. 2007. Comparison of Hydrologic Calibration of HSPF Using Automatic and Manual Methods. Water Resour. Res. 43. W01402, doi:10.1029/2006WR004883.

Kim, S.M., S.W. Park, J.J. Lee, B.L. Benham and H.K. Kim. 2007. Modeling and assessing the impact of reclaimed wastewater irrigation on the nutrient loads from an agricultural watershed containing rice paddy fields. J Environ. Sci. Heal. A. 42(3):305-315.

Kim, S.M., B.L. Benham, K.M. Brannan, R.W. Zeckoski, and G.R. Yagow. 2007. Water Quality calibration criteria for bacteria TMDL development. Applied Eng. Agric. 23(2): 171-176.

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Biological Systems Engineering

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The Center's mission is to conduct interdisciplinary research, teaching, and outreach to improve the integrity of the Nation's waters and watersheds by advancing the science, tools, and expertise available for developing, evaluating, and implementing watershed planning and management processes.