Lag Times in the Watershed and Their Influence on Chesapeake Bay Restoration
Scientific and Technical Advisory Committee
October 16-17, 2012
Location: Sheraton Hotel
Annapolis, MD
Meeting Website: http://www.chesapeake.org/stac/workshop.php?activity_id=214

October 16

8:00 am **Breakfast (Provided)**

8:30 am **Overview of Workshop Objectives and Agenda - Bob Hirsch (USGS)**
The goal of the workshop is to bring together a diverse set of experts who can suggest ways in which the concept of lag-times can be represented in simulation models of the Chesapeake Bay watershed. The workshop outcome should be a set of recommendations to the Chesapeake Bay Program regarding data collection, research, model development, policy development and public communications that furthers a better incorporation of realistic representations of lag times in Chesapeake Bay restoration efforts.

8:45 am **Presentation on how the Chesapeake Bay Program and the various models and strategies in use, currently incorporates lag times into their process - Gary Shenk (EPA)**

9:00 am **Lag times associated with the storage of sediment - Jim Pizzuto (University of Delaware)**
Storage of particles (particularly on floodplains) can create long (decades, centuries, even millennia) lag times between upland BMPs and response in the Chesapeake Bay. Jim will discuss what we know about lag time issues and about the scientific approaches to understanding these, leading to improved predictions of the response of a watershed to changes in management practices.

9:45 am **The use of rare earth elements to quantify fine sediment travel times and distances in small streams - W. Cully Hession (Virginia Tech)**
Cully will describe field experiments being conducted at the Virginia Tech StREAM Lab in Blacksburg, VA to help us better understand the transport, deposition, and re-suspension of fine sediments (<63 μm) during high-flow events. They are injecting sediments labeled with different rare earth elements (REE) during consecutive storms, which allows them to evaluate deposition and re-suspension from flow event to flow event. The REE-labeled sediment has been detected at distances of more than 850 m downstream of the injection site. The knowledge gained from these experiments will improve sediment transport modeling, and help us pick apart the "lag-time" mystery associated with the installation of management practices intended to reduce sediments and associated pollutants to downstream waters.

10:30 am **Break**

10:45 am **The use of regional groundwater flow modeling to model transport of nitrate to the Chesapeake Bay and use of the model to explore the timing of potential impacts of changing inputs - Ward Sanford (USGS)**
Ward will describe his use of the USGS MODFLOW model coupled with groundwater and surface water nitrate data to describe the storage and movement of nitrate through the groundwater system of the Delmarva Peninsula. He will also show simulations results displaying the age of water entering the Bay and the flow paths of nitrate to the Bay, and projections of how changes in nitrate input at the land surface would affect nitrate inputs to the Bay and its sub-estuaries over time.

11:30 am **The use of a dynamic spatially referenced regression approach for total nitrogen with consideration of seasonal and long-term watershed storage of nitrogen - Dick Smith (USGS)**
Dick will describe a new dynamic approach to SPARROW (Spatially Referenced Regressions on Watershed Attributes) modeling and its application to the Potomac River basin. The model considers the inputs, storage, processes and outputs of nitrogen in the basin and uses statistical parameter estimation. Applications can consider the potential impacts of changes in nitrogen applications and/or changes in climate forcing on nitrogen outputs by sub-watershed over time.

12:15 pm **Lunch (Provided)**

1:00 pm Riparian, stream and floodplain restoration in urban watersheds: the experience from the Baltimore Ecosystem study - Peter Groffman (Cary Institute of Ecosystem Studies)

Peter will describe the results of research on nitrogen processing in streams, riparian zones and floodplain wetlands in urban, suburban and exurban watersheds in the Baltimore metropolitan area. This processing is controlled by the nature and extent of hydrologic and geomorphic alteration associated with urbanization and is quite responsive to restoration efforts that influence hydrologic connectivity, residence time and soil/sediment conditions. A few examples will be shown and issues related to lag times between completion of the restoration project and the realization of stream-quality improvements will be discussed.

1:45 pm Temporal dynamics of changes in delivered nutrient loads resulting from various cropland nutrient reduction practices - Ken Staver (University of Maryland)

Ken will present results from long-term field studies on the movement of nutrients from Coastal Plain cropland through both surface and subsurface flow paths after implementation of most of the major nutrient reduction practices.

2:30 pm Break

2:45 pm Distributed watershed modeling for assessing the dynamic age of solutes in watersheds of the Chesapeake Bay - Chris Duffy (Penn State University)

New approaches to watershed modeling developed at the Susquehanna/Shale Hills Critical Zone Observatory (CZO) are applied to the problem of predicting the dynamic age of stable isotopes, nutrients and other geochemical species in an integrated ground-water surface-water solute transport model. The model is used to evaluate multi-year watershed responses to climatic variations and estimate the relative age of solutes in each hydrologic state.

3:30 pm Organization and objectives of breakout groups - Jack Meisinger (USDA-ARS)

Participants will be assigned to one of the three groups. The groups will discuss what is well understood about aspects of lag-time issues and what new knowledge and methods are needed.

Each breakout should address each of the following issues:

1. What new data collection, data analysis, and research is needed at the scale of individual management actions (a single BMP implementation)?
2. What new data collection, data analysis, and research is needed at the scale of river reaches, reservoirs, floodplains, wetlands, and aquifers?
3. What new approaches to modeling should be developed and/or enhanced to better understand and predict lag times?
4. Are there modifications (perhaps post processing) of existing watershed models that could adjust their results to better accommodate lag times? Would implementing these likely be worthwhile?
5. Are there some broad general statements that STAC can make to the Bay community about the typical lag times for sediment, nitrogen and phosphorus associated with broad categories of BMPs that would be applicable over the entire Bay watershed (or significant portions of the Bay watershed)? Is it even useful to try to do this?
6. Does the consideration of lag times matter to the implementation of policies such as load allocations or effluent trading? How should these policies deal with the issue of lag times?
7. What, if anything, can or should be done about improving the understanding by the public and public officials regarding lag times?

The three breakout groups would be organized by these 3 areas of interest:

- **A. Processes associated with the erosion, storage and re-entrainment of sediment and associated nutrients (N and/or P).**
  Moderators: Bob Hirsch and Gene Yagow
  Location: Severn Room

- **B. Processes associated with transport, reaction, and storage of N and/or P in their dissolved form in soils, vegetation, shallow groundwater, and across the groundwater/surface water interface.**
  Moderators: Claire Welty and Weixing Zhu
  Location: Glebe Room

- **C. Dealing with lag times in the context of regulation, enforcement, pollutant trading, and public perception.**
  Moderators: Marc Ribaudo and Jack Meisinger
  Location: Chester Room

4:00 pm **First meeting of breakout groups (more to follow in morning)**

5:00 pm **Adjourn for the day**

October 17

8:00 am **Breakfast (Provided)**

8:30 am **Consideration of how pollution trading systems can be designed so as to consider the differences in time lags among multiple pollution sources - Jim Shortle (Penn State University)**

Jim will discuss what lags mean for the allocation of pollution abatement across types, time and space. This includes which sources cannot be used to achieve near term goals and the implications for abatement costs. In addition, Jim will discuss what lags mean for the design of trading markets and the potential role for lagged sources.

9:15 am **Feedback from Day One - Jack Meisinger (USDA-ARS)**

Open discussion of the charge to the breakout groups. Opportunity to seek clarification of information about current Chesapeake Bay Watershed models and regulatory approaches. Organization and objectives of morning discussion groups.

9:45 am **Breakout groups continue**

10:30 am **Break**

10:45 am **Breakout groups continue**

12:00 pm **Lunch (Provided)**

12:45 pm **Breakout groups report back (15 minutes each)**

1:30 pm **Overview of breakout ideas and initial ideas for STAC workshop report and possible review article**

2:30 pm **Meeting adjourns. Organizing committee stays on to discuss next steps**

3:30 pm **Organizing committee adjourns**