Bay Sediments

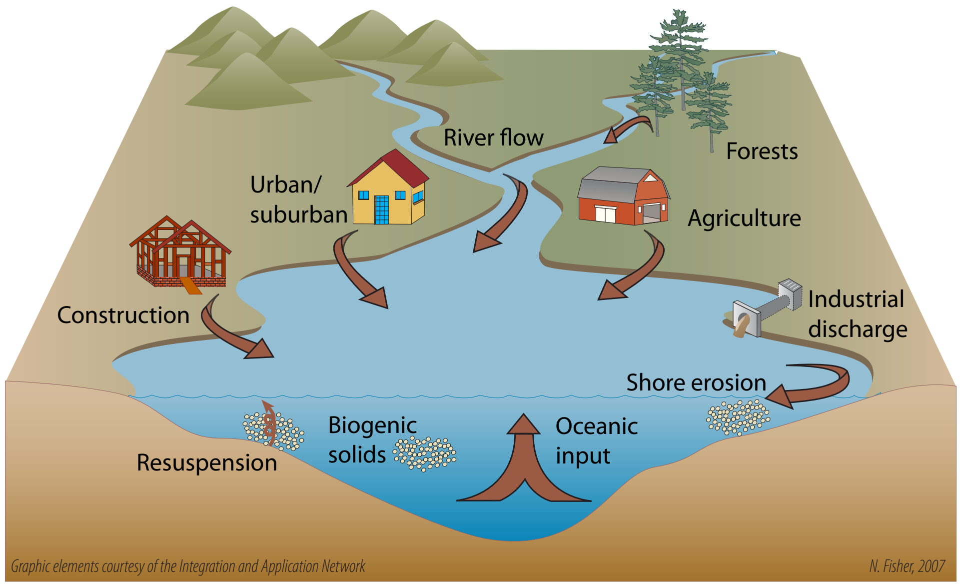
Sediment and its Relationship to Water Clarity in the Chesapeake Bay

An Unsettling Problem: Sediment in the Bay

Erosion. It's one of the bad boys of poor water quality. With erosion comes sediment – particles of sand, silt and clay that cloud the Bay and its tributary waters, lessen the penetration of sunlight into the water, slow the growth of submerged aquatic plants, and smother the oyster beds.

When the Chesapeake Bay Program's Sediment Workgroup and Scientific and Technical Advisory Committee convened a workshop in early 2007 to discuss sediment and erosion problems in the Chesapeake Bay, the general assumption going in was that both are bad. So, it came as a bit of a surprise when the

Natural and Anthropogenic Sources of Sediment to the Chesapeake Bay



Although sediment erosion and sediment deposition occur naturally, human activities can greatly hasten the rates of both processes. While some sediment enters through oceanic input and shore erosion, the bulk of the sediment washing into the Bay comes from stream channel erosion as well as erosion of upland surfaces: croplands, mining areas, pasture, and forests along with urban and suburban lands.

Photo courtesy of the Integration and Application Network

What is a sedimentshed?

Analogous to the widely used "watershed" concept, a sedimentshed is the area of water and land supplying the sediment that directly influences water clarity in nearshore areas where submerged aquatic vegetation (SAV) can grow.

New & Improved: The 2008 Water Quality Model

Three key water quality standards — dissolved oxygen, chlorophyll, and clarity — are key in protecting the plants and animals of the Chesapeake Bay. The 2003 Water Quality Model used acceptable levels of nutrients and sediment (called allocations) to identify both dissolved oxygen and chlorophyll standards. This version of the model could not specify a water clarity standard (needed to restore underwater grasses or SAV), however, due to insufficient information on shore erosion and shallow-water resuspension.

The 2008 Water Quality Model rectifies this situation by providing the first detailed estimates of shore erosion in the Bay. In the 2003 model, the best estimate of shore erosion was a single value representing the entire Bay. The 2008 model, on the other hand, uses hundreds of estimated shoreline erosion rates, offering a much-improved estimate of sediment loads entering the Bay through scouring of the shore.

Equally important, the upgraded model tracks wind speed and direction, combining this information with fetch — the distance the wind blows over the water. Together, wind and fetch generate the waves that resuspend sediment in shallow waters. The model simulates wave energy resuspension every hour over a two-decade period. Recent monitoring and research, combined with the model assessment, will supply the estimates of suspended sediment in shallow waters that were unavailable in the 2003 model.

Shallow-water assessment using the model, monitoring, and research is important because the water clarity standard only applies to the waters where SAV can grow — generally a narrow ribbon less than two meters deep along the shoreline. Using this triad of tools, the Bay Program can, for the first time, devise management plans to achieve all the water quality standards for protecting the Bay's plants and animals.

participants concluded that some erosion and some sediments are actually good.

Like most scientific problems, the situation is a bit more complicated than apparent at first blush. The coarser particles – primarily sands – are quite important for submerged plant growth. Aquatic plants, in turn, are critical for proper functioning of the Bay ecosystem. Processes that replenish nearshore areas with sand, largely through erosion elsewhere, can help maintain or re-establish aquatic plants. Finer sediments – silts and clays – that are deposited in marshes assist these dynamic areas in keeping pace with sea level rise.

In recent years and at the workshop, scientists, modelers, and managers have focused on the relative importance of the four sources of sediment entering the Chesapeake and its tributaries: the watershed (particles coming from the land and stream corridors that drain into the Bay); the ocean; shore erosion; and specific aquatic processes such as particles created by the remains of tiny organisms. Precisely identifying and managing sediment sources will prove critical for improving water clarity and bringing about conditions conducive to the growth of underwater grasses.

Of even greater importance, however, is understanding the relative impact of the different sediment sources on nearshore water clarity and underwater grass survival. The relationship between types of sediment loads and nearshore water clarity, however, can quickly become muddy.

Many sediment particles settle out of the water quickly or are transported only near the bottom and, therefore, have limited impact on surface water clarity. The smallest particles (clays, algae, and microscopic remains) that stay suspended in Bay and tributary waters for days or weeks at a time are most responsible for elevated turbidity and cause serious problems for the plants and animals trying to make a living in these waters.

Previous studies point to a somewhat unexpected alliance between nutrient loading and the quantity of small particles remaining in suspension during the growing season. Consequently, scientists suspect that additional reduction of nutrients entering Bay waters could significantly reduce levels of suspended fine particles. This shift would increase water clarity – a primary goal of Bay restoration efforts – and greatly enhance the effectiveness of sediment controls.

To make sense of the various factors that ultimately determine water clarity along the margins of the Bay where submerged plants grow, scientists will use a refined and more rigorous water quality model to evaluate where and on what to focus restoration efforts most successfully. This new model adds a much more realistic capability for predicting suspended sediments and their transport in the Bay; it will also offer the opportunity to tackle new questions and concerns.

The revised model will be ready for application as a management tool in 2008. This refined version has generated enthusiasm for its capability to address management issues and to define the historical conditions that once sustained a healthy Bay more precisely. New tools for identifying sources of suspended sediments by their geochemical "fingerprint" should also help with this effort.

Ultimately, translation of the science into concrete management actions will prove key – so that investigation into the role of sediment on Bay health moves beyond an academic exercise. To ensure useful management policies, scientists and managers who attended the workshop developed a set of recommendations that define the path for tackling some of the most troublesome issues plaguing the Bay.

Sediment Workgroup Recommendations

One of the primary objectives of the 2007 sediment workshop was to develop a set of recommendations that target critical water quality problems related to sediment. The workgroup's recommendations are:

- **Evaluate sediment management techniques**. The workgroup should decide if control of fine and coarse sediments mandates different management approaches. Targeting of SAV plantings should account for bottom sediment characteristics along with shoreline management methods that improve SAV habitat.
- **Coodinate actions with other entities.** The workgroup should work with the Modeling Subcommitee to refine suspended sediment scenario development and transport model predictions. It should also collaborate with ongoing SAV recovery and restoration activities and coordinate analyses of historic sediment loads.
- **Use the 2008 Water Quality Model**. The 2008 Water Quality model offers improved representation of sediment transport in the Bay and can answer questions on nearshore water clarity and sedimentshed delineation. Tinkering with such variables as settling speed, distributions of sediment size, erodibility, and wave activity can help pinpoint the critical factors dictating water clarity.
- **Analyze existing data**. In addition to collecting new data, using existing data sets (historical, monitoring, and other Bay studies) in innovative, untapped ways can yield new insights on the ways that sediment moves within the Bay system.
- **Conduct further research**. The workgroup suggests additional research that will enhance understanding of sediment dynamics in the Bay and tributaries. For instance, gaining a fuller appreciation of the specific sources of suspended sediment affecting SAV habitat will allow managers to focus on distinct locations most responsible for these problems.