MARYLAND DEPARTMENT OF NATURAL RESOURCES

DNR Pub: 12-7232007-230

August, 2007

2006 Water Quality Newsletter
Bush River, Maryland

Real-time Continuous Monitoring instrumentation at Lauderick Creek.

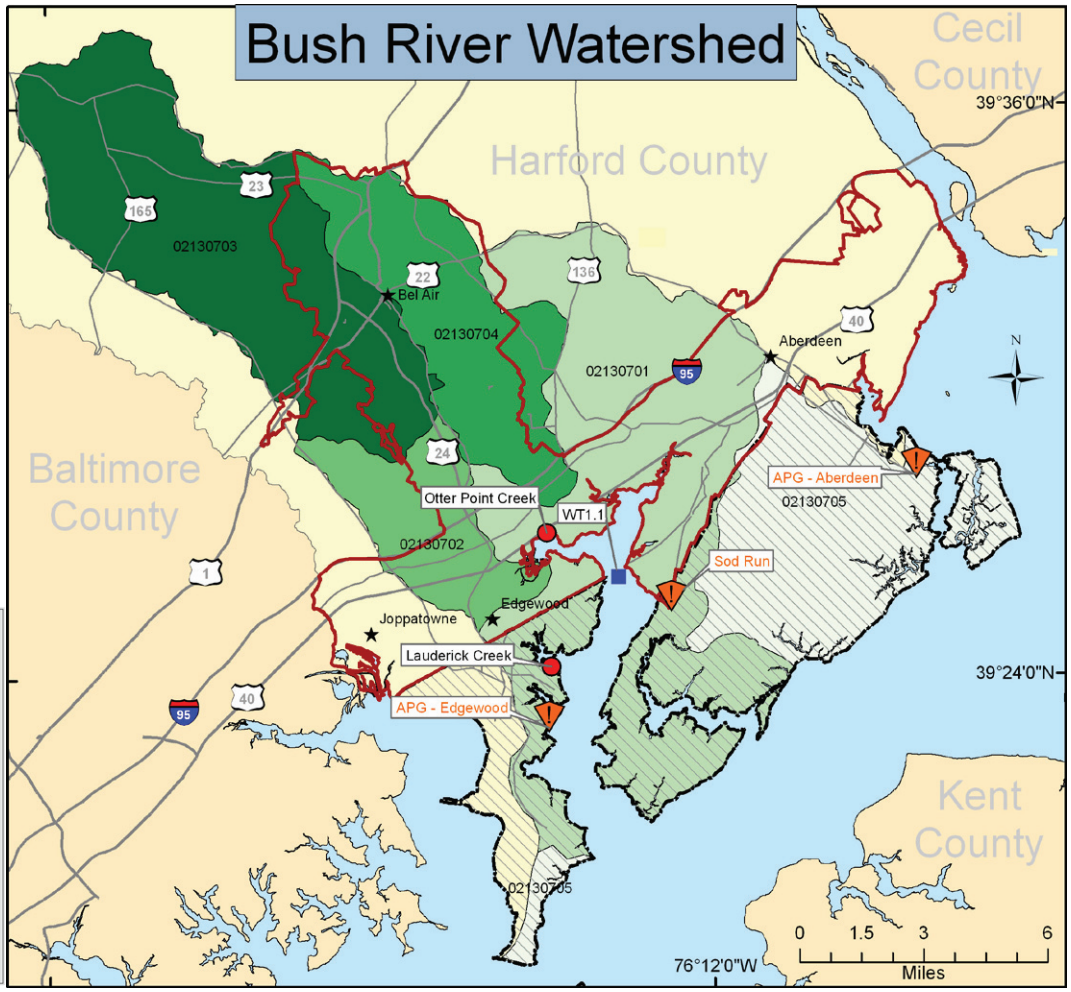
The Bush River is impacted by increasing urbanization, impervious surface area, sediment inputs, and nutrient pollution.

The Bush River Watershed

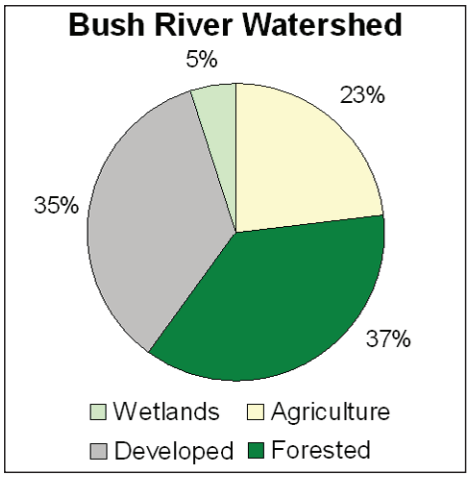
The Bush River watershed drains 117 square miles of land in Harford County, Maryland. The watershed consists of nearly equal parts forest, urban development, and agriculture. Approximately half of the watershed lies in the rolling hills of the Piedmont Plateau, and the other half is in the comparatively flat Coastal Plain. All five sub-watersheds (see map below) in the Bush River have been listed by the State of Maryland as impaired waters and the watershed as a whole is considered a priority for restoration.

A Long-Term Monitoring station has been sampled monthly since 1984. In 2003, the Maryland Department of Natural Resources (DNR) began a three year water quality criteria assessment of the Bush River as part of its Shallow Water Monitoring Program. This included two fixed Continuous Monitoring stations, which record automated measurements every fifteen minutes, and Water Quality Mapping cruises, which were conducted monthly April through October. Data from these monitoring efforts have shown the effects of nutrient pollution, such as algae blooms, and high turbidity from sediment loading.

Inside:



Increased Development Projected for Bush River Watershed



The Bush River watershed is becoming increasingly urbanized with the densest development located within Harford County's residential and industrial development envelope (see map on first page). The envelope was established by Harford County in 1977 to direct development towards areas served by public utilities (water and sewer). Approximately a quarter of the watershed, mostly north of the development envelope, is used for agriculture. Most of the forest cover is found in the lower watershed, while little forest remains in the Bynum Run and Atkisson Reservoir sub-watersheds. Currently, thirty-five percent of the Bush River watershed is developed land.

The Maryland Department of the Environment (MDE) cites all five subwatersheds in the Bush River Basin on its 303(d) impaired water body list (see map on first page). Causes of impairment include elevated levels of nutrients, suspended sediments, and toxic substances. Additionally, under Maryland's Clean Water Action Plan, the Bush River watershed has been listed as a Priority Category I Watershed, which indicates that it is most in need of restoration.

According to the US Census Bureau, the 2006 population of Harford County was 241,402. The population has increased by nearly 100,000 people since 1980 and by 2020, it is estimated to rise by 35,000 more residents. The federal government's Base Realignment and Closure (BRAC) program also has the potential to bring an additional 6,500 households to the county. Among the challenges associated with this projected growth are treating the additional wastewater and limiting the effects of increased impervious surface area (roads, rooftops, and parking lots). Impervious surface area will likely increase from 10.8% to 14.2%, a level believed to severely degrade aquatic resources. The subsequent increases in stormwater runoff could impact underwater grasses and other aquatic resources in the Bush River by carrying sediment and excess nutrients into the river.

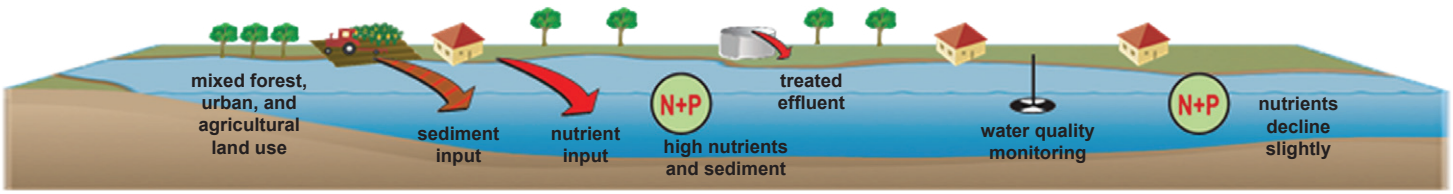
Water Quality Monitoring Reveals Cause for Concern

The Maryland Department of Natural Resources (DNR) began conducting intensive shallow water monitoring on the Bush River in 2003. Continuous Monitors, which record data every 15 minutes, are installed at two locations: Otter Point Creek and Lauderick Creek. Water Quality Mapping cruises, which utilize an onboard system of probes to map water quality conditions along the entire tidal portion of the river, were conducted monthly from 2003 – 2005. The combined results of these monitoring efforts have helped characterize the water quality conditions throughout the surface and shallow water areas of the Bush River.

The area surrounding lower Otter Point Creek is highly developed and has a large amount of impervious surfaces. During rainstorms, precipitation flows over these surfaces and into storm sewers that empty directly into streams, rather than soaking into the ground naturally. These runoff events have the potential to carry large concentrations of sediment, nutrients, bacteria, and toxins into the Bush River. The river is subject to influxes of suspended materials during these events, as indicated by corresponding spikes in the turbidity (cloudiness) of the water recorded by the Otter Point Creek continuous monitor. Additionally, water quality mapping surveys have shown that maximum turbidity levels are typically found near the mouth of Otter Point Creek. Data from DNR's Long-Term Monitoring station indicate that nutrient levels in the Bush River had decreased earlier in this decade, but have recently climbed back to levels seen in the mid-1980's.

Blue/green algae bloom (Photo by Glenn R. Duddarer)

Algae blooms have been reported on the Bush River in each year since the Shallow Water Monitoring program began in 2003. These are usually the result of excess nutrients in the system, resulting in an over-abundance of naturally occurring algae. Most bloom events have been blue-green algae (cyanobacteria) that turn the water a bright green color, release toxins that are harmful to animals and humans, and have the potential to cause severe drops in dissolved oxygen when they decompose.



* *see sources on last page*

1917 Aberdeen Proving Ground established

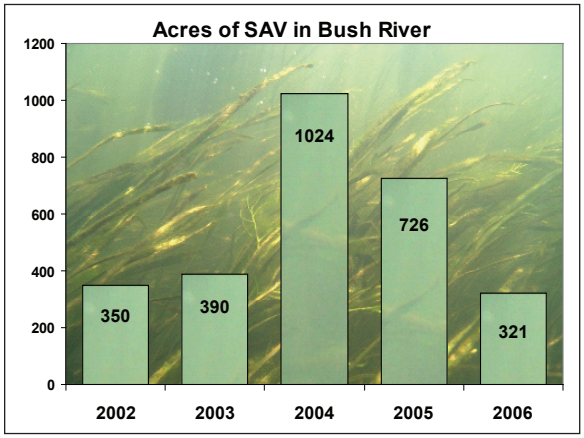
1942 Atkisson Reservoir established

1969 Sod Run WWTP online

1984 DNR Tributary Monitoring established

1985 Bush River Management Plan published

Underwater Grasses Abundant but Declining in Bush River



Underwater grasses, known as submerged aquatic vegetation (SAV), are an important component of estuarine ecosystems. They provide habitat for fish and shellfish, supply food for waterfowl, oxygenate the water, and help stabilize bottom sediments. Little or no SAV was found in the Bush River in the 1990's. Underwater grasses reappeared in the Bush River in 2000 and maintained a constant presence in the river through 2006. From 2002 to 2004, the SAV acreage in the Bush River steadily increased from 350 acres to 1,024 acres. During this time, SAV beds were concentrated in the upper reaches of Church Creek, Otter Point Creek, and Dove Cove. SAV coverage expanded by 164% between 2003 and 2004 and additional beds were observed along the main stem of the Bush River. During these three years, SAV beds were diverse, with as many as ten species of underwater grasses observed in a single year, and of moderate to high density.

SAV reached its highest level in the Bush River in 2004 and then declined during 2005 and 2006. The number of species of SAV observed in the river dropped from ten species in 2004 to the following four core species in 2006: Coontail (*Ceratophyllum demersum*), Hydrilla (*Hydrilla verticillata*), Eurasian Watermilfoil (*Myriophyllum spicatum*), and Wild Celery (*Vallisneria americana*). The decline in SAV during the last three years coincided with the Bush River failing to meet several important SAV habitat criteria. These criteria were formulated from a three year water quality assessment which accounts for yearly variability in hydrographic conditions including precipitation and river inflow. From 2004 to 2006, the Bush River met the SAV criteria for phosphorus, but failed to meet criteria for water clarity and chlorophyll (algae) and was borderline for total suspended solids (TSS) concentrations.

Otter Point Creek is Part of National Reserve System

The Otter Point Creek component of the Chesapeake Bay National Estuarine Research Reserve (NERR) consists of 736 acres of open water, tidal marshes, forested wetlands, and upland hardwood forests, surrounded by highways, homes, and commercial development. These diverse environments contain many species of plants and animals and are often used as natural laboratories for research and education. Current projects include the monitoring of fish larvae and underwater grasses within Otter Point Creek and the Bush River, and researchers are also tracking box turtles. Most recently, a project to study hydrology and nutrient dynamics at the terrestrial-aquatic interface in Otter Point Creek was initiated.

Sunset canoe trip on Otter Point Creek (Anita C. Leight Center)

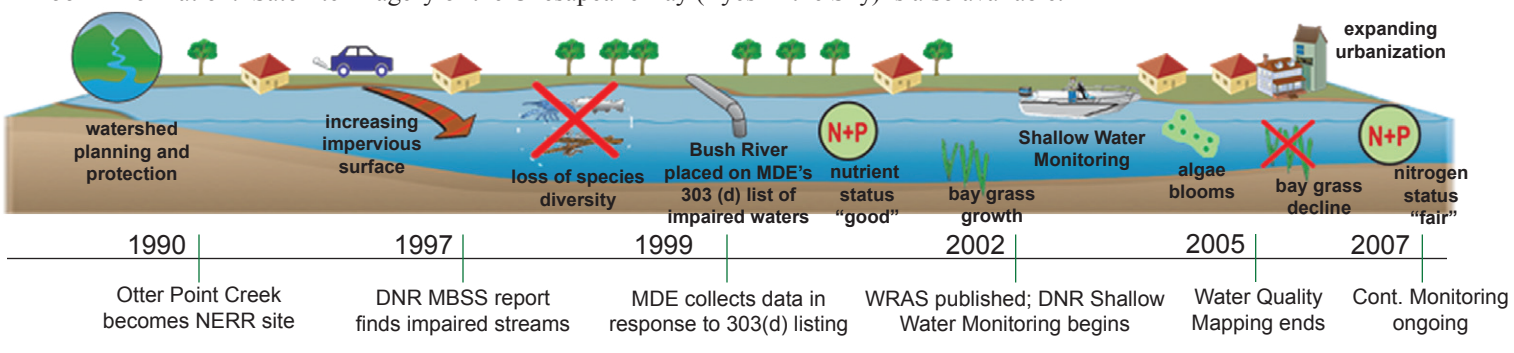
Bush River Home to Trout and Rare Minnow

Comely Shiner (Notropis amoenus)
Illustration by David Neely

Bynum Run, a tributary to Bush River, is listed as a Class III trout stream. The Maryland Biological Stream Survey (MBSS) found rainbow trout in its 1996 survey of upper Bynum Run. Maryland DNR reported stocking 750 trout into Forest Hill Pond on Bynum Run in the Spring of 2007. Also of interest, the comely shiner – a species of minnow considered rare in Maryland – was found by MBSS in Lower Winters Run and Atkisson Reservoir. Maryland DNR considers this species to be at risk of local elimination.

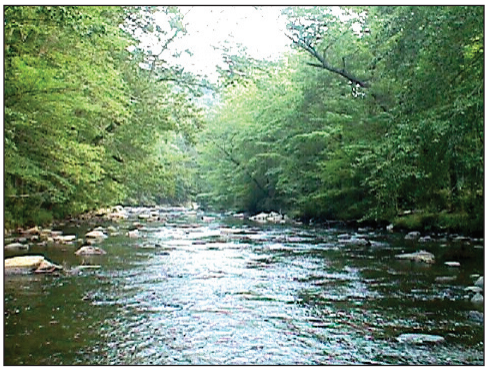
Eyes on the Bay: Water Quality Information Available on the Web

The Maryland Department of Natural Resources' Eyes on the Bay website, www.eyesonthebay.net, provides easy access to water quality and habitat data for the Chesapeake and Coastal Bays. The website is a portal for all of the state's tidal water quality monitoring data including Continuous Monitoring, Water Quality Mapping, Long-Term Fixed Site Monitoring, and Harmful Algal Bloom information. Satellite imagery of the Chesapeake Bay (Eyes in the Sky) is also available.



More Information and Acknowledgements

- Watershed Profiles can be found on DNR's Surf Your Watershed page: www.dnr.state.md.us/watersheds/surf/index.html
- The Bush River is part of the Upper Western Shore Tributary Team. The team meets on the fourth Monday of each month. Call 410-260-8711 for more information. www.dnr.state.md.us/bay/tribstrat/
- Harford Land Trust is a non-profit organization that seeks to protect tracts of agricultural and natural landscapes in Harford County: www.harfordlandtrust.org
- Learn about local land trusts and conservation easements available to landowners on the Maryland Environmental Trust (MET) website: www.dnr.state.md.us/met/
- Information on how MDE assesses impaired water bodies is available on their website: www.mde.state.md.us/Programs/WaterPrograms/TMDL/index.asp
- The Maryland DNR has information on the Chesapeake Bay National Estuarine Research Reserve (NERR) System, including Otter Point Creek: www.dnr.state.md.us/bay/cbnerr
- The Anita C. Leight Estuary Center is a research and education facility on Otter Point Creek dedicated to increasing appreciation and understanding of estuaries: www.otterpointcreek.org
- Harford County partners with DNR to maintain the Continuous Monitoring station at Lauderick Creek. www.harfordcountymd.gov/waterresources



Winters Run flows through the Harford Glen Outdoor Education Center in Bel Air.

- Icons for the Bush River Timeline (pp 2-3) courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science: www.ian.umces.edu/symbols
- The following sources were utilized to assess land use in Harford County:

1. Heroux-Bynum, M. 2006. The Potential Impact of Base Realignment on Surface Runoff in Harford County. MS Thesis.
2. Bush River Watershed Management Plan. April 2003. Harford County Department of Public Works.
3. Bush River Watershed Characterization. September 2002. Maryland Department of Natural Resources in partnership with Harford County.
4. Bush River Basin Current Status of Wadeable Streams. Maryland Department of Natural Resources.
5. Base Relocation and Closure (BRAC) Report. December 2006. Maryland Department of Planning.

What Can You Do?

There are many things you can do to help improve water quality in the Bush River.

- **Plant trees along streamside property**. Tree roots will slow erosion and absorb the flow of nutrient runoff.
- **Pump out septic tanks regularly** (every 3-5 years). A failing system can contaminate groundwater.
- **Conserve water.** Use rainwater for plants, take shorter showers, and turn off the faucet when brushing your teeth.
- **Drain gutter spouts into rain barrels or grassy areas**. This will reduce erosion, which adds sediment to the river.
- **Carpool, or try biking or walking**. Exhaust fumes contain nitrogen oxides, which can end up in the river and bay.
- **Dispose of household chemicals properly**. Toxic chemicals poured down the drain could end up in the river.
- **Use fertilizer sparingly**. If you must fertilize, try doing it in autumn, when it will have less of an impact on the river.
- **Support land protection initiatives**. Preserving existing green space is much easier than restoring degraded areas.
- **Get involved**. Let state, county, and local officials know that Bush River water quality is important to you.

Bush River water quality data is available on the web:

www.eyesonthebay.net

Please report fish kills, algae blooms, or any other events or problems to the toll-free Chesapeake Bay Safety and Environmental Hotline at 1-877-224-7229

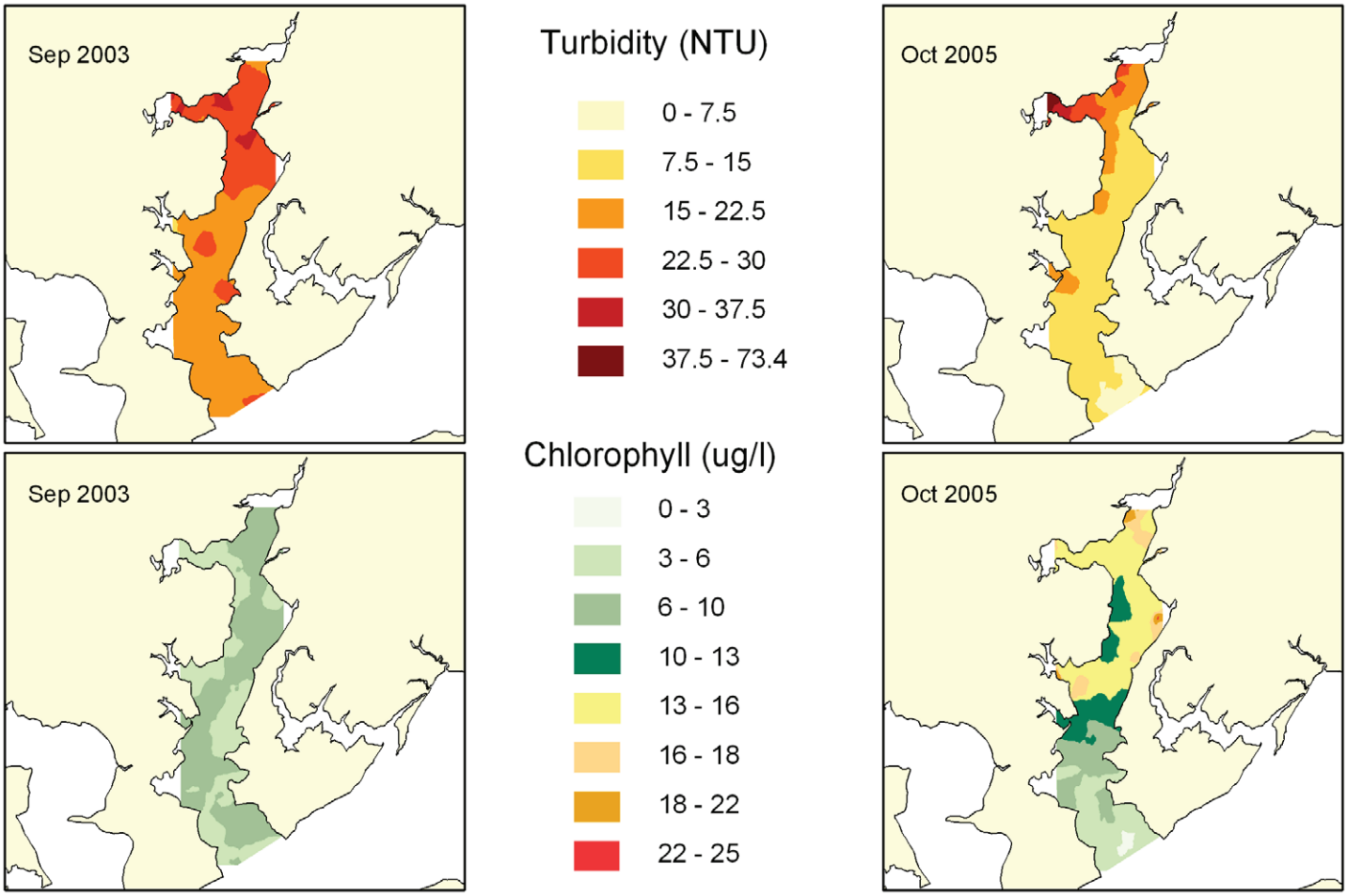
Martin O'Malley, Governor

John R. Griffin, DNR Secretary

Maryland Department of Natural Resources; Tawes State Office Building; 580 Taylor Avenue; Annapolis, Maryland 21401
Toll free : 1-(877)- 620-8DNR(8638) in Maryland Out of state call: 410-260-8638 TTY users call via the Maryland Relay
www.dnr.maryland.gov

This document prepared by the DNR Intensive Monitoring Assessment and Development Team
Mark Trice—Program Manager, mtrice@dnr.state.md.us
Chris Aadland, Julie Baldizar, Ben Cole, Matt Hall, and Chris Trumbauer

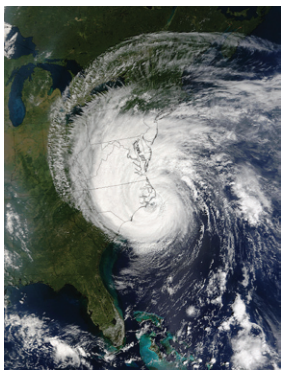
Water Quality Mapping Data Is Used to Investigate Sources of Cloudy Water



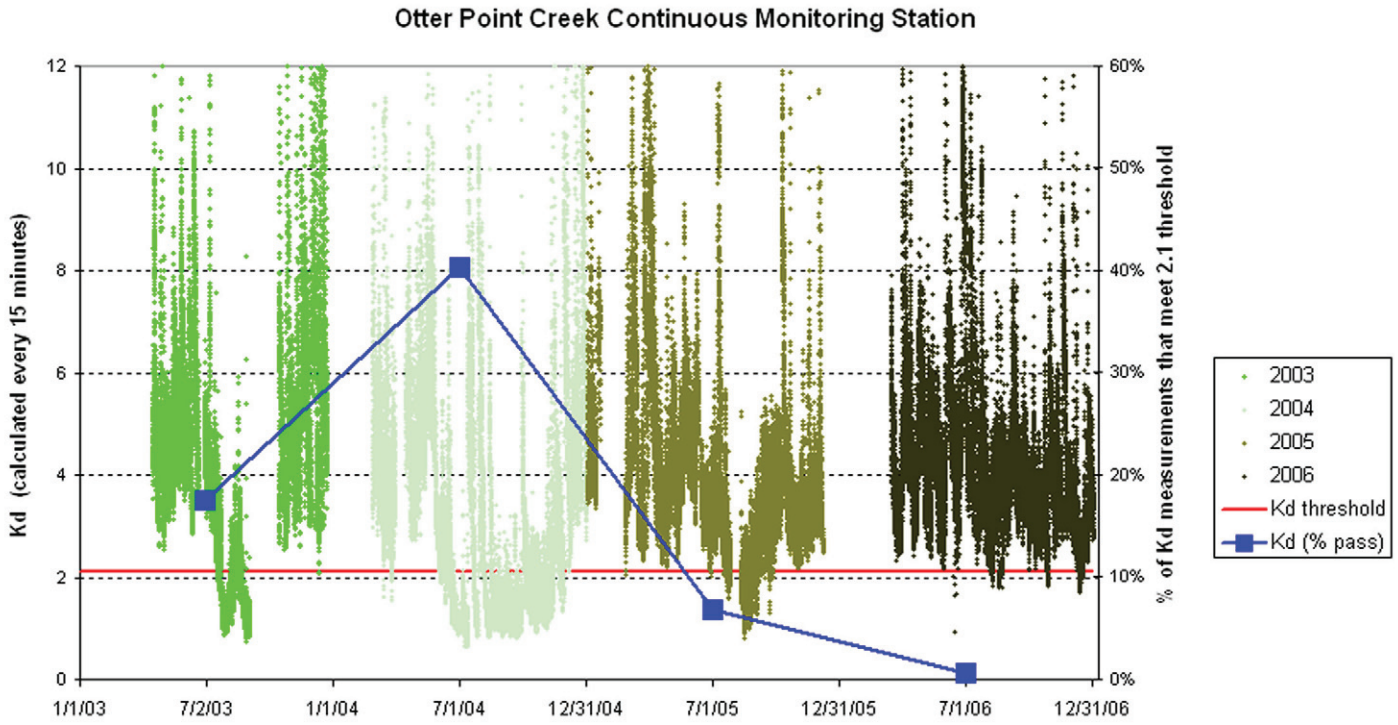
Water Quality Mapping data for turbidity (top) and chlorophyll (bottom) from September 2003 (left) and October 2005 (right)

Turbidity is the scientific term for water cloudiness, and DNR shallow water quality instruments measure turbidity in NTU's (Nephelometric Turbidity Units) by detecting how much light is reflected from suspended particles in the water. Turbidity values of less than approximately 5.5 NTU will allow adequate light penetration for submerged aquatic vegetation (SAV) growth at a depth of one meter, all other factors being equal. However, average turbidity was found to exceed 7 NTU during a majority of water quality mapping cruises over a three-year period (2003-2005). Sediments, either washed into a river or stirred up from the bottom, tend to contribute to turbidity during and after storm events. Algal blooms, measured as high chlorophyll levels by water quality mapping instruments, also contribute to high turbidity readings and block sunlight from penetrating through the water.

The September 2003 mapping cruise was conducted the week following Hurricane Isabel's trek up the Bay. The storm surge and rainfall associated with that major hurricane were the cause of the observed high turbidity during this cruise. The high turbidity water that dominated the upper portion of the Bush River in October 2005, however, was associated with chlorophyll concentrations exceeding 15 µg/L for the same cruise (see map). This indicates that algae populations were contributing to the overall turbidity. Such investigation of the data generated by shallow water quality mapping can give Chesapeake Bay scientists valuable information about how and when algal blooms and sedimentation occur, to what extent these phenomena cover the river, and what role they may play in the Bush River ecosystem as a whole, including the recovery of SAV.



For more Bush River Water Quality Mapping data, please visit www.eyesonthebay.net.



Using turbidity, chlorophyll and salinity data from the Continuous Monitoring stations, DNR scientists can calculate the coefficient of light attenuation (Kd). Light attenuation measures how far light travels through the water column. Clear water has a low Kd, while cloudy water has a high Kd. Underwater grasses (SAV) depend on light penetrating the water column, so abundance of grasses can be related to the Kd values. For the Bush River, Kd values at or below 2.1 are considered optimal for SAV growth in depths of one meter or less. Graphing the Kd data for the 4 year period 2003 – 2006 (above) shows that 2004 was the best year for Kd, with a steady decline in the two following years. The graph on page three shows a similar declining trend in SAV acreage.

Continuous Monitoring data also shows a highly variable dissolved oxygen range in Otter Point Creek (below). High oxygen levels are observed when a large algal community produces oxygen during daylight hours. At night, when the algae respire, the oxygen is consumed, resulting in very low oxygen levels. The wide variability in the oxygen levels observed at Otter Point Creek suggests a substantial algal community, and many algae blooms have been observed over the last several years.