

## **Upper Western Shore Water Quality and Habitat Assessment Overall Condition 2010-2012**

Healthy rivers and bays support a diverse population of aquatic life as well as recreational uses, such as swimming and fishing. To be healthy, rivers and bays need to have good water and habitat quality. High levels of nutrients and sediment lead to poor water quality. Poor water quality reduces habitat quality, including water clarity (how much light can get to the bottom) and the amount of dissolved oxygen in the water. In turn, habitat quality affects where plants and animals can live. The Maryland Department of Natural Resources (DNR) is responsible for monitoring water and habitat quality in the Chesapeake Bay and rivers, as well as the health of aquatic plants and animals. DNR staff use this information to answer common questions like “How healthy is my river?”, “How does my river compare to other rivers?”, “What needs to be done to make my river healthy?” and “What has already been done to improve water and habitat quality in my river?”

The Upper Western Shore includes the Bush, Gunpowder and Middle rivers. The upper region of the basin drains to the Susquehanna River, but this river is not included in the Upper Western Shore basin Water Quality and Habitat Assessment due to the overwhelming influence of the portions of the river’s watershed that are in Pennsylvania and New York. The central region of the basin drains to the Bush River. The lower region of the basin drains to the Gunpowder and Middle Rivers.

Human population density is moderate in the upper region, moderate to high in the central region and lower region, and very high in the outskirts of Baltimore City. In the upper and lower region, land use is roughly one-third urban, one-third forest and one-third agricultural uses. In the central region urban land uses comprise approximately half of the basin.

In the Bush River watershed, point sources are the most important contributor of nitrogen and phosphorus and the largest sources of sediment are urban runoff and agricultural land uses. In the Gunpowder watershed, agriculture is the largest source of nitrogen and sediment loads and urban runoff is the largest source of phosphorus loads. In the Middle River watershed, point sources are the largest source of nitrogen and phosphorus loads, though there are no major wastewater treatment plants that discharge to the river. Urban runoff is the largest source of sediment loads to Middle River.

## *How healthy are the Upper Western Shore Rivers?*

**Bush River** Water quality in the tidal Bush river is fair due to high sediment levels and is worsening due to increasing phosphorus levels. Habitat quality for underwater grasses is poor due to poor water clarity and high algal densities; algal densities also increased. Underwater grasses covered 67% of the area designated as the restoration goal in 2010 and almost 80% in 2011, but in 2012 grass bed area had dropped to 34% of the goal. Summer bottom dissolved oxygen levels are good but have decreased. Bottom dwelling animals are healthy in some areas of the upper river but are unhealthy in some areas of the lower river.

**Gunpowder River** Nitrogen and sediment loadings from the watershed to the non-tidal Gunpowder River have increased. Water quality in the non-tidal river is fair due to nitrogen concentrations that are too high. Nitrogen levels have increased but phosphorus and sediment levels decreased.

Water quality in the tidal Gunpowder River is fair due to sediment levels that are too high and is worsening due to increasing nitrogen levels. Habitat quality for underwater grasses is poor due to high algal density and poor water clarity. Underwater grasses covered 71% of the area designated as the restoration goal in 2010, but dropped to 57% in 2011 and to 32% in 2012. Summer bottom dissolved oxygen levels are good and bottom dwelling animals are healthy in many areas of the river.

**Middle River** Water quality in the Middle River is good but degrading due to increases in phosphorus levels and maybe increases in sediment levels. Habitat quality for underwater grasses is poor due to high algal densities and poor water clarity, and water clarity has decreased. Underwater grasses covered 75% of the restoration goal in 2010, but dropped to 35% of the goal in 2011-2012. Summer bottom dissolved oxygen levels are good.

**Table 1. Summary of tidal habitat quality and water quality indicators.**

Algal densities, water clarity, inorganic phosphorus and sediment either 'Meet' or 'Fail' SAV habitat requirements for 2010-2012. Dissolved nitrogen levels below the level for nitrogen limitation 'Meet' criteria, otherwise 'Fail' criteria. Summer bottom dissolved oxygen levels above 3 mg/l 'Meet' criteria, otherwise 'Fail' criteria. Annual trends for 1999-2012 either 'Increase' or 'Decrease' if significant at  $p \leq 0.01$  or 'Maybe Increase' or 'Maybe Decrease' at  $0.01 < p < 0.05$ ; blanks indicate no significant trend. Improving trends are in green, degrading trends are in red. Nitrogen trends are for total nitrogen, phosphorus trends are for total phosphorus, water clarity trends are for Secchi depth.

| River     | Water Quality    |                  |                   | Habitat Quality  |                  |                                |
|-----------|------------------|------------------|-------------------|------------------|------------------|--------------------------------|
|           | Nitrogen         | Phosphorus       | Sediment          | Algal densities  | Water Clarity    | Summer Bottom Dissolved Oxygen |
| Bush      | Meet             | Meet<br>Increase | Fail              | Fail<br>Increase | Fail             | Meet<br>Decrease               |
| Gunpowder | Meet<br>Increase | Meet             | Fail              | Fail<br>Increase | Fail<br>Decrease | Meet                           |
| Middle    | Meet             | Meet<br>Increase | Meet<br>Maybe Inc | Fail             | Fail<br>Decrease | Meet                           |

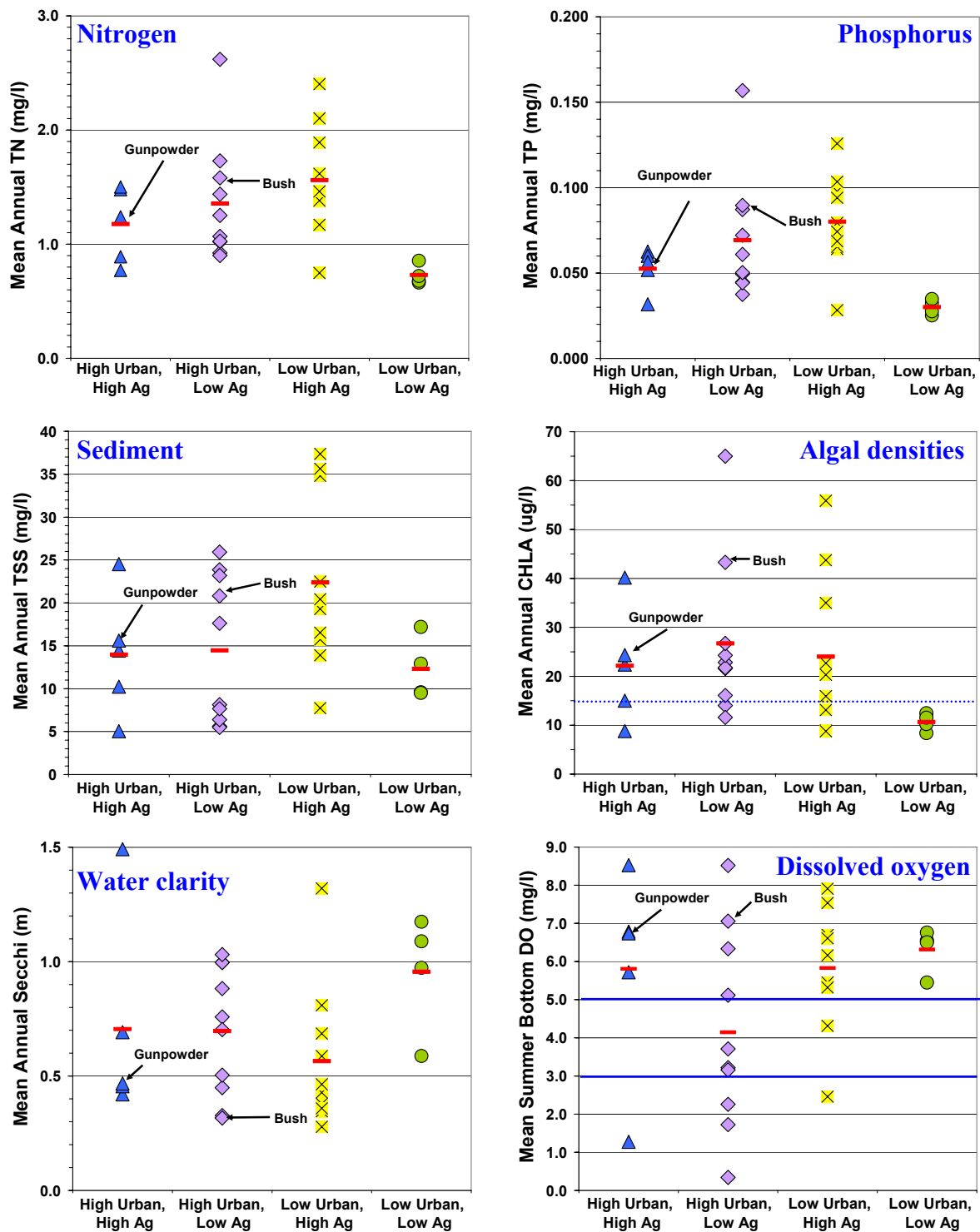
### ***How do the Upper Western Shore basin Rivers compare to other Maryland rivers?***

The Bush River is in the ‘High Urban, Low Agriculture’ land use category. Nitrogen and sediment levels are moderate and phosphorus levels are high compared with other high urban systems, but algal densities are among the highest of all Maryland rivers and bays (Figure 1). Water clarity is among the worst of all rivers.

The Gunpowder River is in the ‘High Urban, High Agriculture’ land use category. Middle River is included as part of the Gunpowder River watershed for land use assessments, so it is not separately comparable to the other Maryland rivers and bays. Compared to other similar systems, the Gunpowder has moderate nitrogen, phosphorus and sediment levels and algal densities. Water clarity is among the worst of the high urban systems.

### ***What needs to be done to make the Upper Western Shore Rivers healthy?***

The most important problems that should be addressed are phosphorus and sediment loadings, high sediment levels in the tidal waters, and the large amounts of impervious surfaces in the watershed. Efforts to lower nutrient and sediment loadings from urban and agricultural areas are needed, especially to reduce turbidity in the shallow water areas. Reducing nitrogen loadings from septic systems should also be a priority. With lower nutrients and sediment levels, water clarity should improve which will improve habitat quality for underwater grasses. Reductions in nutrients will also lead to lower algal densities and reduce the frequency and duration of harmful algal blooms. While habitat quality is already good for bottom dwelling animals, reductions in nutrients are expected to lead to more diverse and stable populations.



**Figure 1. Comparison of the Bush River and Gunpowder River to similar rivers.**

The mean annual concentration or depth (bottom dissolved oxygen is only summer) for 2010-2012 data. Total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS), chlorophyll *a* (CHLA), Secchi depth and summer bottom dissolved oxygen (DO). Red bars indicate the mean of all systems within a category. Reference lines are included on the CHLA and summer bottom DO graphs. Middle River is included as part of the Gunpowder River watershed for land use assessments, so it is not separately compared to the other Maryland rivers and bays.

### ***What has already been done to improve water and habitat quality in the Upper Western Shore Rivers?***

A variety of actions have already been taken to lower nitrogen, phosphorus and sediment loadings from urban lands. While specific goals have not been set for this basin, improvements are being made. Upgrades to the largest wastewater treatment plant that discharges to the Bush River are under construction and will be completed by 2014. Previous upgrades to the facility have already reduced the nitrogen loadings by half. Upgrades at the largest treatment plant that discharges to the Gunpowder River will be complete in 2013. Previous upgrades drastically reduced both nitrogen and phosphorus loads. No major wastewater treatment plants discharge to the Middle River. Stormwater retrofits have reduced nitrogen loadings and prevented nearly 50,000 pounds of nitrogen from entering the rivers since 2003, and more than 200 septic system retrofits were completed between 2008-2011.

To address nutrient inputs from agricultural lands, additional management actions have been taken. In 2011 there were more than 22,000 acres of cover crops planted in between growing seasons to absorb excess nutrients and prevent sediment erosion. Fencing on over 15,100 acres of farmland was used to keep livestock out of streams and prevent streambank erosion. More than 460 containment structures had been built to store animal wastes to allow these nutrients to be applied to the land in the most effective manner at the appropriate time. Almost 3,670 acres of stream buffers were also in place, allowing areas next to streams to remain in a natural state with grasses, trees and wetlands.

Maryland also has a number of programs in place to reduce the impacts of continued development and increasing amounts of impervious surfaces in the Upper Western Shore basin. Program Open Space projects have conserved nearly 1,380 acres of land for outdoor recreation opportunities. Rural Legacy Program projects have protected more than 9,300 acres, with special focus on areas with important cultural sites and natural resources and to ensure large areas of habitat. Maryland Environmental Trust projects have helped individual land owners protect 5,550 acres. Maryland Agricultural Land Preservation Program projects have preserved more than 3,450 acres of agricultural land from development.

**For more information**

An integrative assessment of the water and habitat quality of the Upper Western Shore Rivers is available online at <http://mddnr.chesapeakebay.net/eyesonthebay/tribsums.cfm>.

The full report includes:

- a. Information on land use and human population densities within the basin, including the health of streams and location of Maryland Trust Fund Priority watersheds
- b. Information on land use in 2010, change in land use since 2000 and percent impervious surfaces in watershed
- c. Nutrient and sediment loadings information, including breakdown of nitrogen, phosphorus and sediment load by source (agriculture, urban runoff, point source, etc.).
- d. Loadings information for major wastewater treatment plants including status of upgrades and progress toward loading caps
- e. Water and habitat quality results for non-tidal streams and tidal waters from long-term monitoring programs
- f. Shallow-water monitoring results including percent failures of dissolved oxygen, chlorophyll and turbidity thresholds and comparison to long-term monitoring stations
- g. Submerged aquatic vegetation coverages
- h. Benthic program results
- i. Appendices with station locations, analysis methods and tabular results

Current water and habitat quality information is also available from Maryland DNR's Eyes on the Bay website [www.eyesonthebay.net](http://www.eyesonthebay.net)