

## Water Quality Monitoring in Harris Creek

Harris Creek is a tributary of the Choptank River, located on the Eastern Shore of the Chesapeake Bay. Together with the Little Choptank River and the Tred Avon River, Harris Creek is part the Choptank River complex, an area that has been targeted for intensive oyster restoration efforts. Numerous federal, state, local and non-profit partners have teamed together to establish new oyster reefs, seed the area with oyster spat, and monitor progress on the growth and survival of oyster populations. The Nature Conservancy, National Fish and Wildlife Foundation, Oyster Recovery Partnership and State of Maryland have provided support for water quality monitoring equipment and efforts.

Water quality is an important factor influencing the success of the oyster restoration efforts. In support of the restoration plan, the Maryland Department of Natural Resources (DNR) has established three water quality monitoring stations in Harris Creek, located at up-, mid-, and down- stream locations (Figure 1). Each station is equipped with a monitoring instrument (data sonde) that collects information on salinity, temperature, pH, turbidity, and chlorophyll. The station at the mid location includes vertical profiling equipment that allows the data sonde to take readings at multiple depths through the water column. The vertical profiler was the first station to be deployed in Harris Creek starting in June 2012. The upstream and downstream stations were added in September 2013. Deployment dates for all three stations are listed in Table 1.



**Figure 1. Map of MD DNR continuous monitoring stations in Harris Creek.**

**Table1. Dates of continuous monitor deployment in Harris Creek.**

Station location	Station code	Years Deployed	Start Date	End Date
Harris Creek - Upstream	XFG6431	2013	3-Sep-2013	14-Jan-2014*
		2014	27-Mar-2014	16-Dec-2014
		2015	2-Apr-2015	present
Harris Creek – Mid (Vertical Profiler)	XFG4618	2012	27-Jun-2012	22-Jan-2013*
		2013	30-Apr-2013	19-Dec-2013
		2014	27-Mar-2014	16-Dec-2014
		2015	10-Apr-2015	present
Harris Creek – Downstream	XFG2810	2013	3-Sep-2013	14-Jan-2014*
		2014	21-Apr-2014	16-Dec-2014
		2015	2-Apr-2015	present

\* The monitoring season extended into the next calendar year.

## Monitoring Program Design and Instrumentation

Traditional water quality monitoring typically involves collecting water samples or data readings during field visits to designated locations. Continuous monitoring differs from this approach in that monitoring equipment is deployed at a site and left in place to constantly monitor water quality conditions. The resulting data are very temporally intensive and are capable of showing the variability in water quality conditions that can occur within weeks, days, and even hours. With the deployment of multiple stations in Harris Creek, spatial variability, or the differences that occur from one station to the next, can also be detected.

The continuous monitoring program in Harris Creek uses data sondes equipped with specific probes to monitor water temperature, salinity, pH, dissolved oxygen, chlorophyll, and turbidity (Figure 2). Continuous monitors at the upstream and downstream stations in Harris Creek are secured at a fixed depth 0.3 meters above the creek bottom and collect water quality data every 15 minutes. The data sonde at the mid location is attached to a vertical profiling system. The profiler uses a winch attached to a floating pontoon to raise and lower the data sonde in the water column (Figure 3). The vertical profiler at the mid station collects water quality data every hour, with readings taken at depths of 0.5, 1.0, 1.5, and 2.0 meters below the surface.



**Figure 2. Continuous monitoring data sonde.**

Monitoring equipment is maintained with regular site visits to Harris Creek. Every two weeks, DNR personnel visit the monitoring stations and replace each data sonde with a freshly calibrated one. This helps to ensure data integrity and minimize data errors due to biofouling and instrument malfunction. The data sondes that are removed are then returned to the laboratory for cleaning and recalibration. During site visits, grab samples are also taken at each site for laboratory analysis of chlorophyll, total suspended solids, nutrients, and alkalinity.

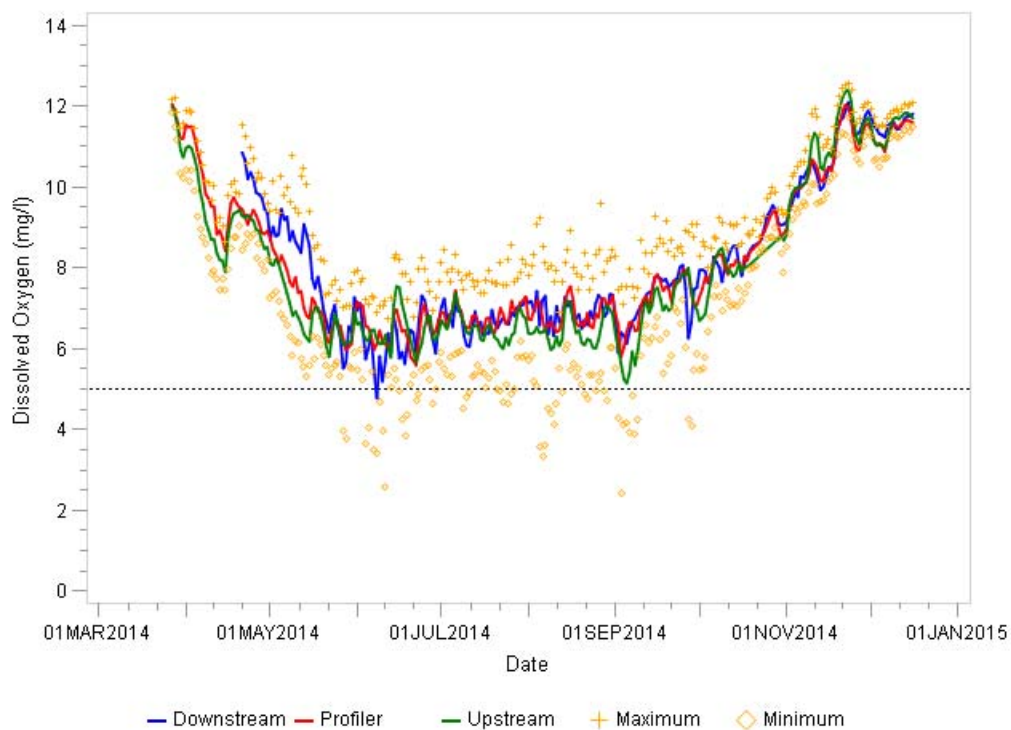


**Figure 3. DNR vertical profiling instrument in Harris Creek.**

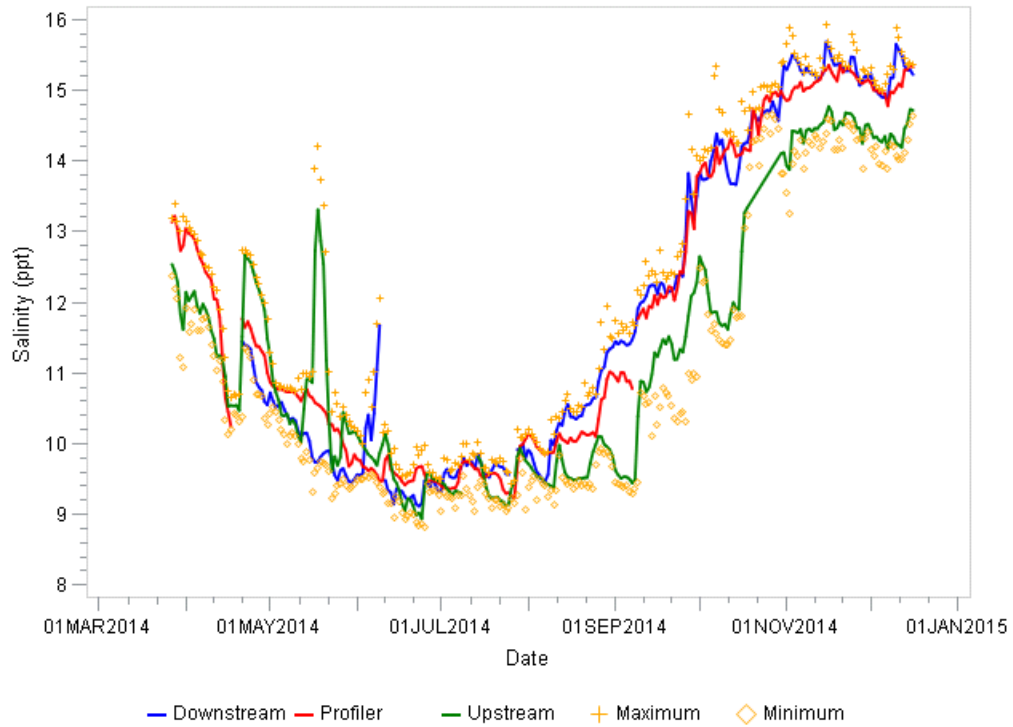
Harris Creek water quality data are displayed and made available for download through DNR's "Eyes on the Bay" website ([www.eyesonthebay.net](http://www.eyesonthebay.net)). The vertical profiler in Harris Creek is equipped with a telemetry unit that allows the recorded data to be transmitted in near real-time to a DNR computer server. Data from the profiler are posted to the "Eyes on the Bay" website every six hours. For the upstream and downstream stations, DNR collects the data records directly from the monitoring sondes and posts the results to the website on a bi-weekly basis.

## Monitoring Results

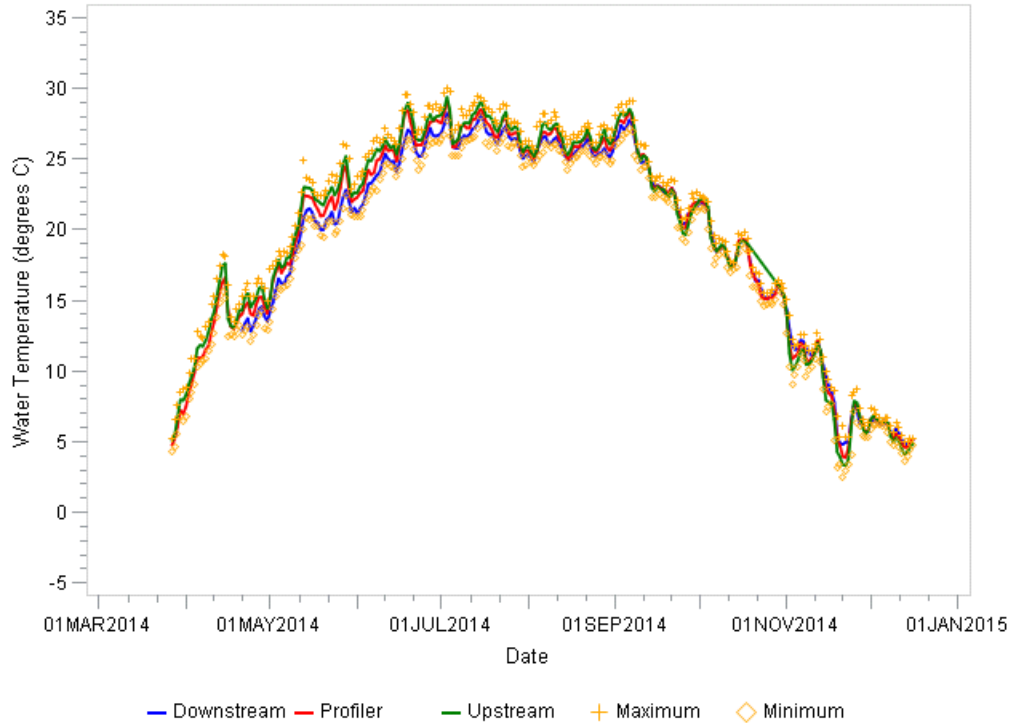
Monitoring data for all three Harris Creek stations are displayed in Figures 4-8. Only the most recent year of data (2014) was used in the analysis, since 2014 was the first complete year of data collection at all three locations. To allow for the most appropriate comparison between stations, only the bottom depth readings from the vertical profiler (2 meters) were used for the mid-station. The monitors at the upstream and downstream stations were at a depth of approximately 3 to 3.5 meters below the surface and varied due to tides and weather conditions. The plots show the daily average for each parameter by station location. Also included on the plots are the maximum and minimum values that were observed (at any station) in Harris Creek on each day.



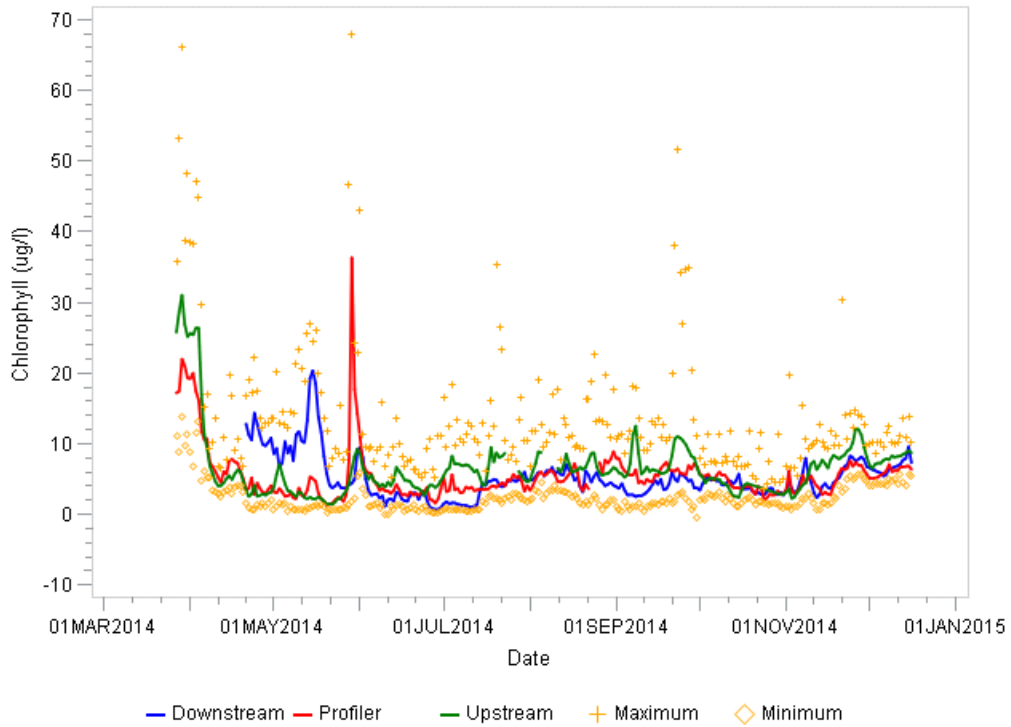
**Figure 4. Daily average bottom water dissolved oxygen concentrations in Harris Creek.**



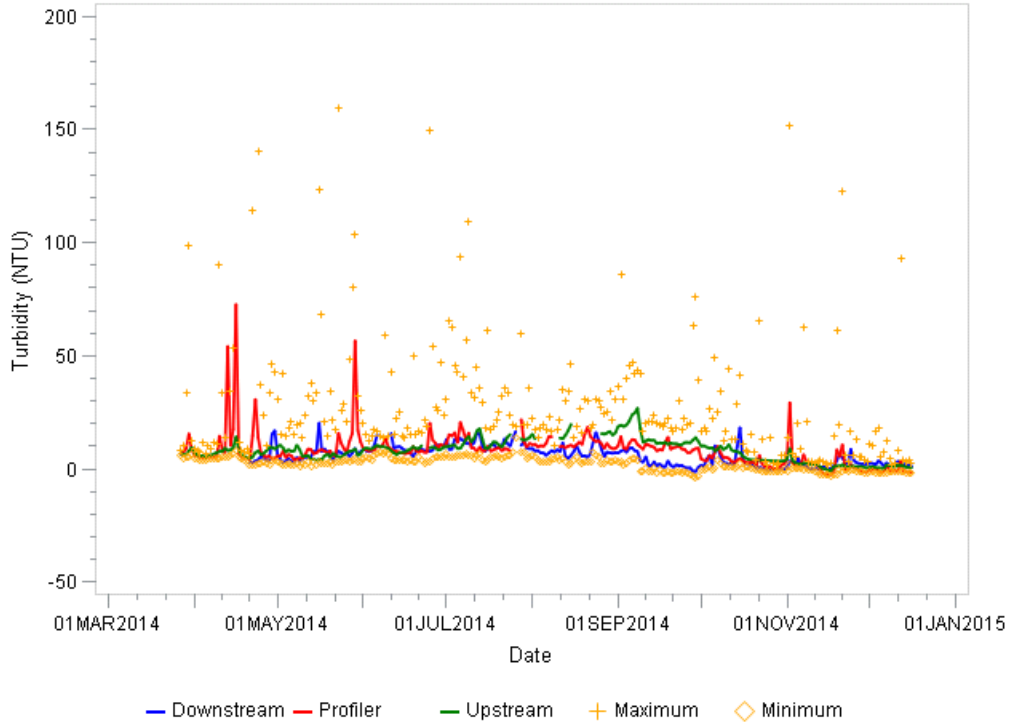
**Figure 5. Daily average bottom water salinity concentrations in Harris Creek.**



**Figure 6. Daily average bottom water temperature in Harris Creek.**



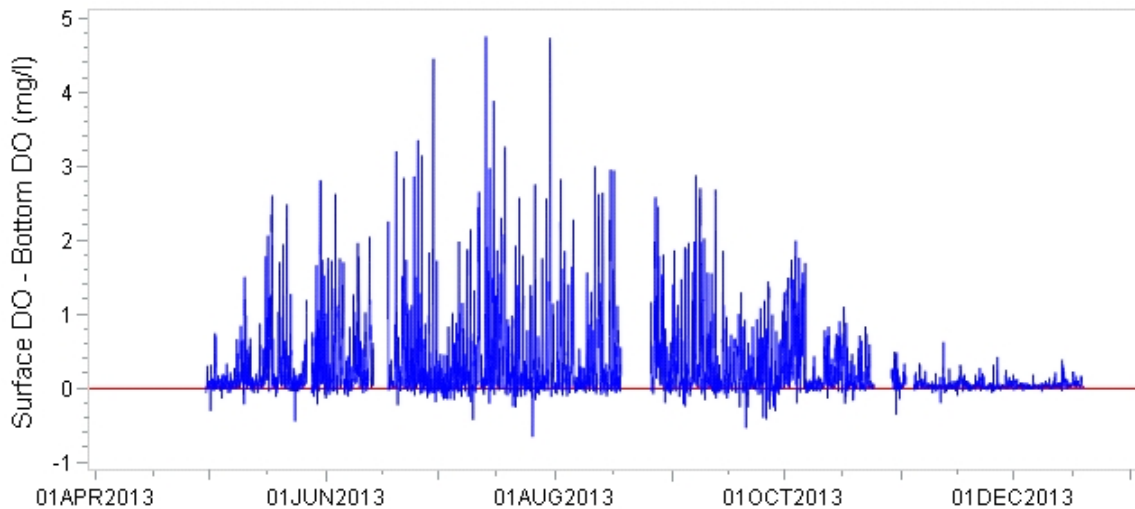
**Figure 7. Daily average bottom water chlorophyll concentrations in Harris Creek.**



**Figure 8. Daily average bottom water turbidity values in Harris Creek.** (The following maximum turbidity values are not visible on the plot: (13APR2014, 537.6 NTU); (16APR2014, 340.4 NTU); (23APR2014, 241.3 NTU).

In the above plots, seasonal variability is apparent in the data for dissolved oxygen, salinity, and temperature. Both dissolved oxygen and salinity values decrease through the summer season, while water temperatures increase. Only small differences in water quality occur between stations. The most discernable difference is in salinity, with salinity values at the upstream station lower than those observed at the mid and downstream stations by approximately 1 ppt for the period August through December. The daily maximum and minimum data values provide an indication of the observed range in water quality conditions on each day. Dissolved oxygen, chlorophyll, and turbidity show the greatest ranges, while salinity and water temperature values appear more stable through each day.

In addition to monitoring the differences that occur over time and between locations, the deployment of a vertical profiler in Harris Creek helps to determine water quality differences at varying depths. Data for 2013 were used to calculate the difference between the dissolved oxygen concentration at the surface (0.5m) and at the bottom (2.0m) of the water column as measured by the vertical profiler (Figure 9).



**Figure 9. Calculated difference between surface dissolved oxygen concentration and bottom dissolved oxygen concentration at the vertical profiler station.**

As can be seen in Figure 9, conditions in the surface and bottom waters of the mid station are most dissimilar during the summer months of June through September. Surface water dissolved oxygen values were usually at least 1 mg/l higher than bottom dissolved oxygen levels. Occasionally, the difference between surface and bottom values was more than 3 mg/l in 2013.