

A satellite image showing a large, well-defined hurricane with a clear eye and dense, swirling cloud bands. The hurricane is positioned over the Chesapeake Bay region, with the surrounding landmasses of the Eastern United States and parts of Canada visible in shades of green and brown. The ocean is a deep blue, and the hurricane's clouds are bright white and grey.

Hurricane Irene and Tropical Storm Lee: Impacts to the Chesapeake Bay

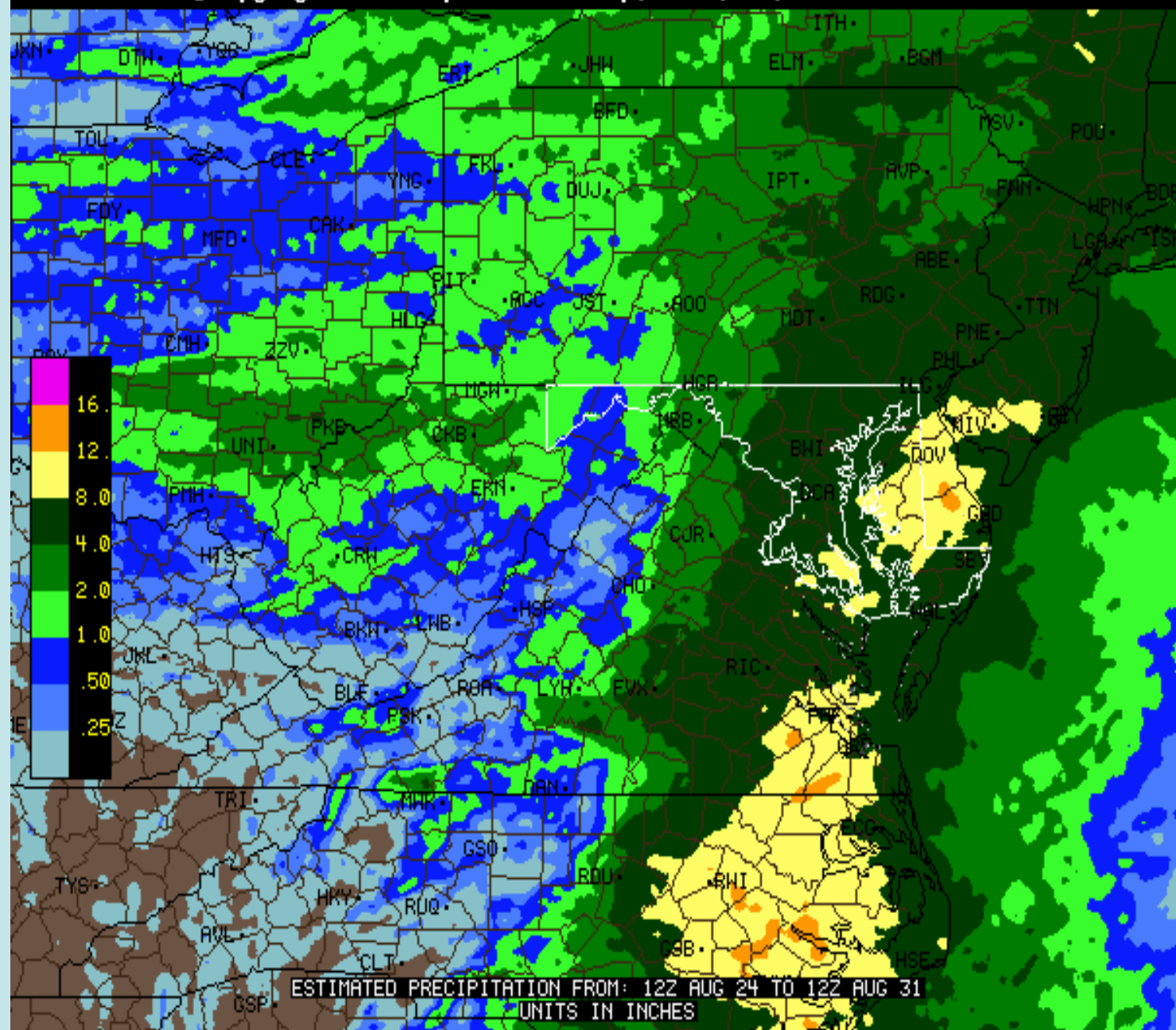
Tom Parham
Maryland Department of Natural
Resources

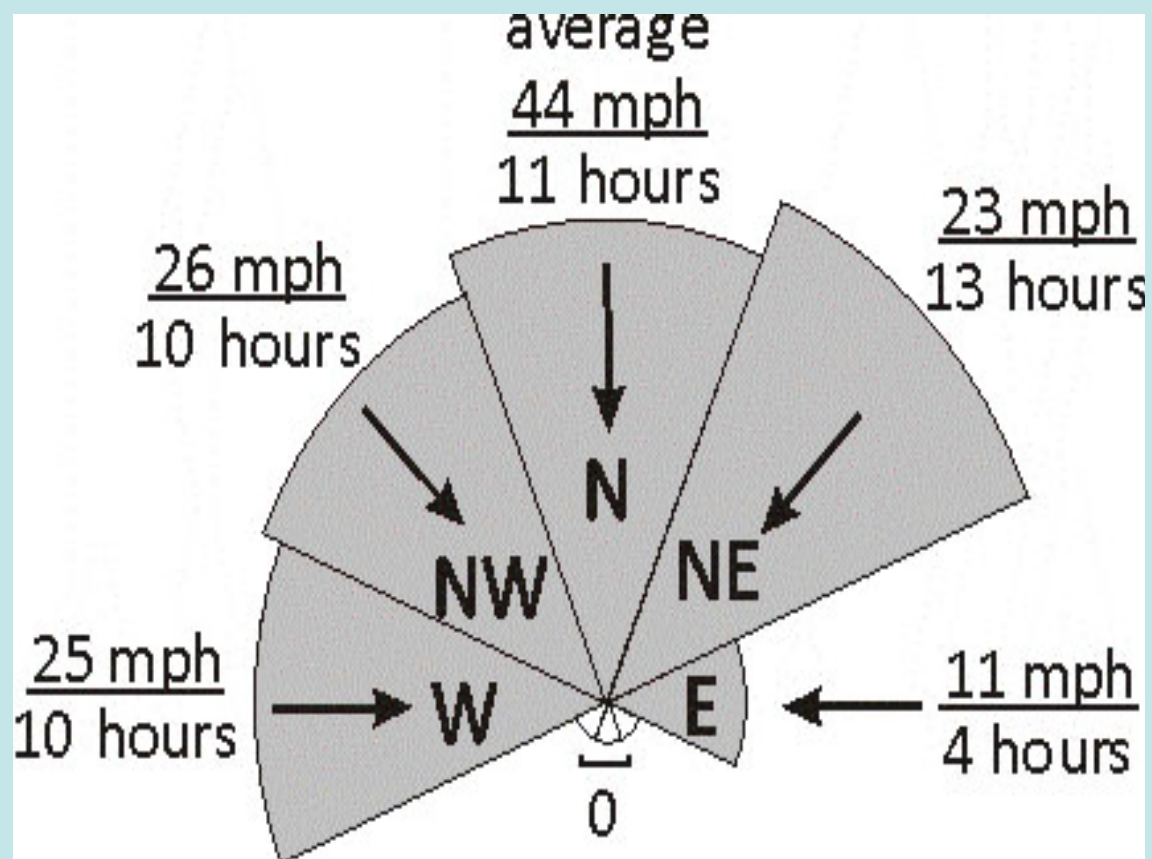
October 18th, 2011

*Hurricane Irene departing the Delmarva Peninsula – August 28, 2011
Image courtesy of MODIS Rapid Response Project at NASA/GSFS (250m resolution, True color)*

Hurricane Irene

- August 27-28, 2011
- Precipitation centered on lower eastern shore
- High flows on some areas of Eastern shore (Choptank River)
- High north/northwest winds



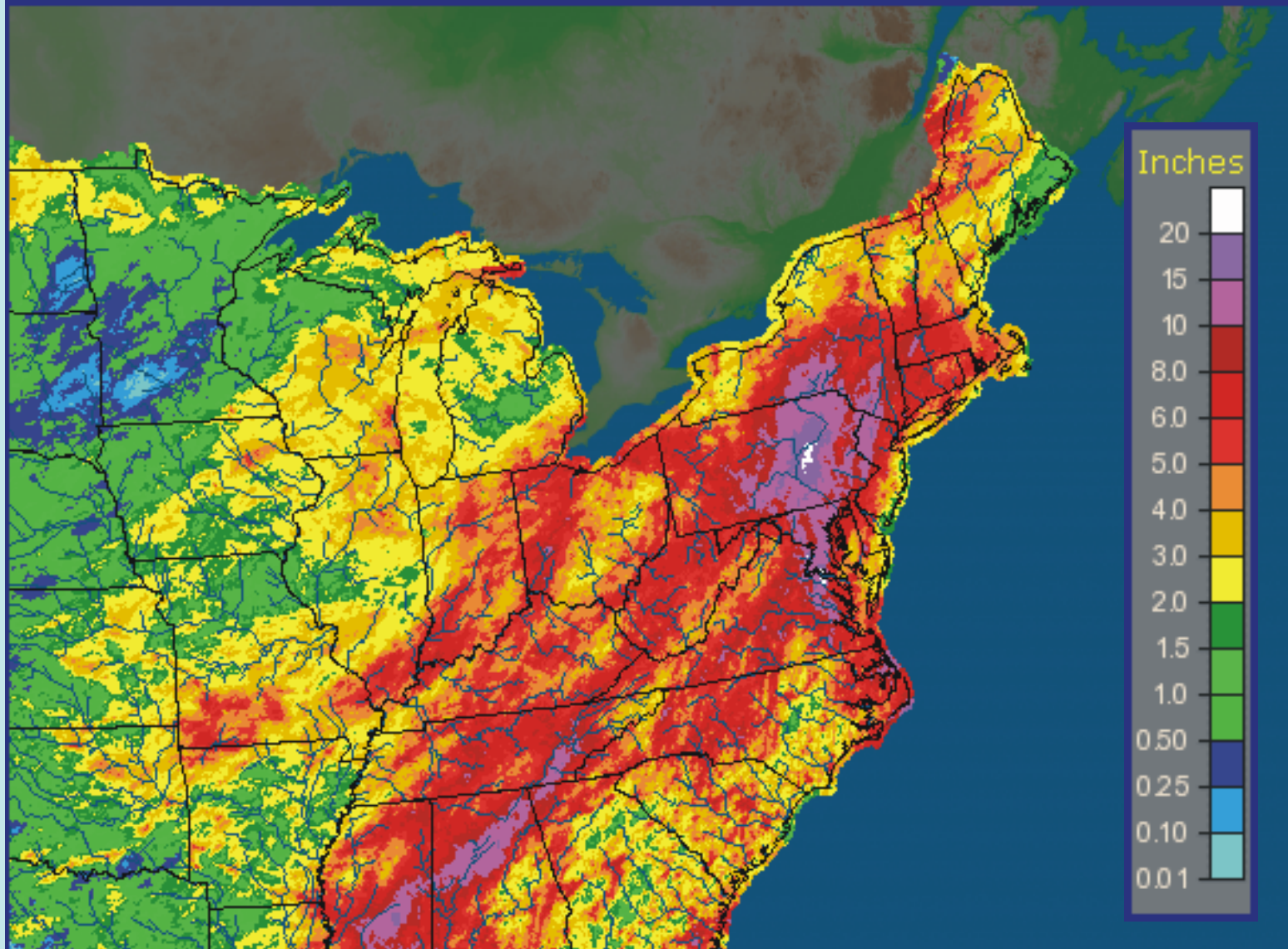


Wind rose showing wind direction (45-degree increments), duration (length of wedge and average wind velocity recorded on August 27-28, 2011 at Thomas Point Light in the Chesapeake Bay (near Annapolis). (DRAFT data for analysis from NOAA National Buoy Data Center.)

Tropical Storm Lee

- Precipitation centered on upper western shore north to New York
- Freshwater flow from Tropical Storm Lee ranks 2nd all-time in recorded freshwater flow behind Tropical Storm Agnes (1972)
- Heavy scouring of sediment behind Conowingo Dam

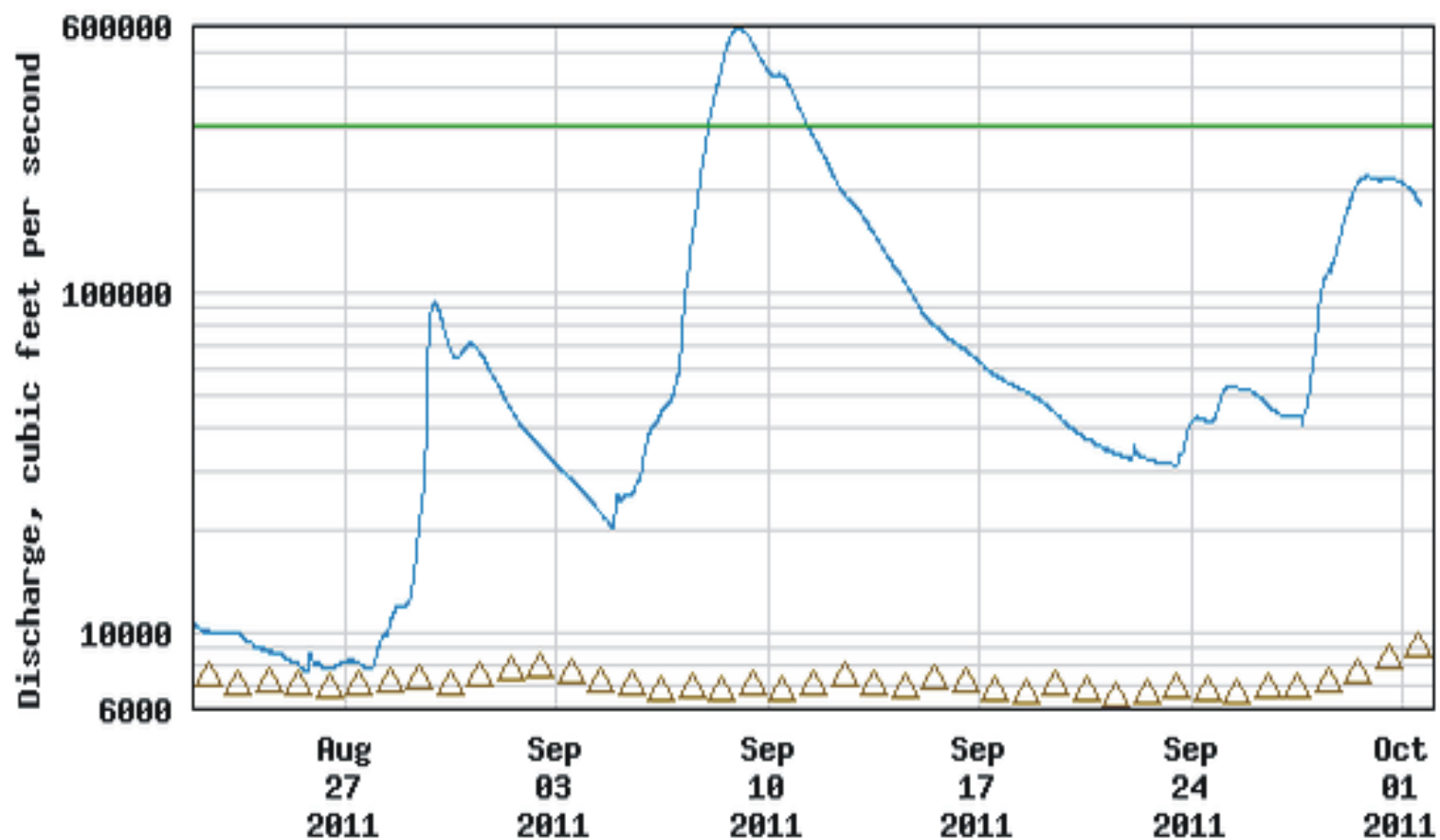
NWS Eastern Region: Current 30-Day Observed Precipitation
Valid at 9/29/2011 1200 UTC - Created 9/30/11 0:05 UTC



September 2011 rainfall estimate (including Tropical Storm Lee but not Hurricane Irene) <http://water.weather.gov/precip/>

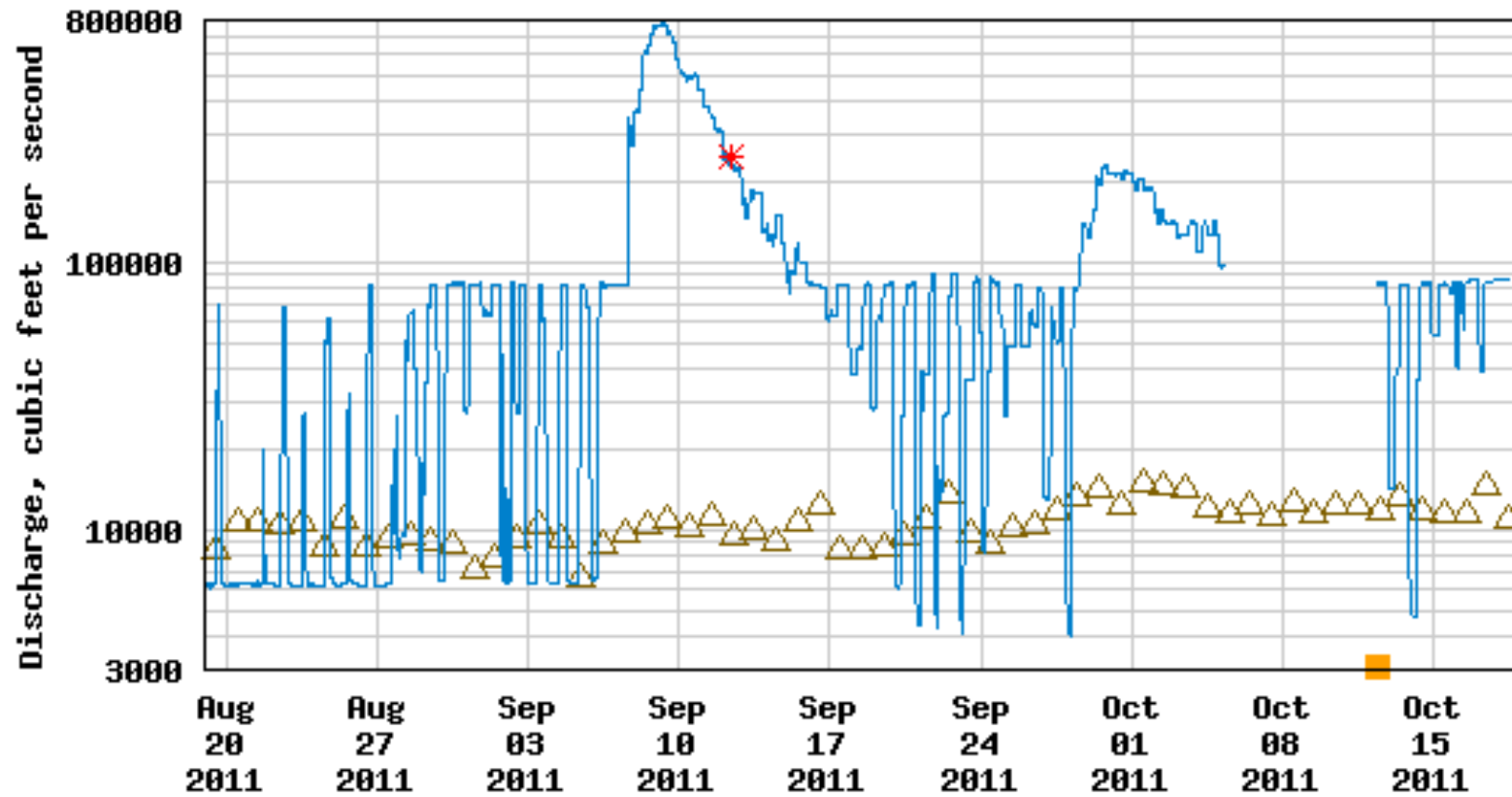


USGS 01570500 Susquehanna River at Harrisburg, PA





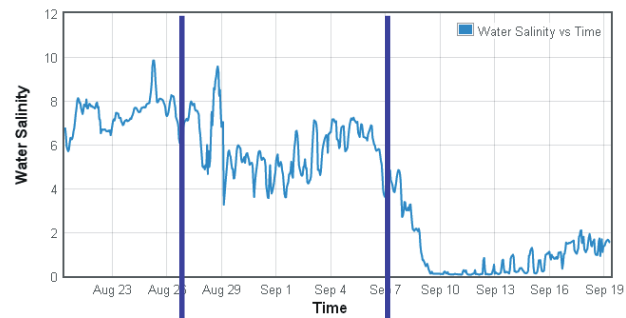
USGS 01578310 SUSQUEHANNA RIVER AT CONOWINGO, MD



----- Provisional Data Subject to Revision -----

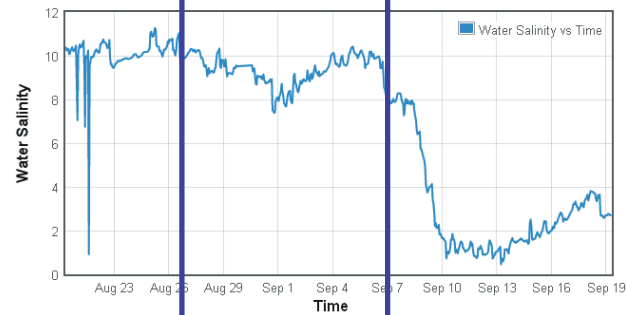
- △ Median daily statistic (43 years)
- Data temporarily unavailable
- Discharge
- * Measured discharge

Patapsco



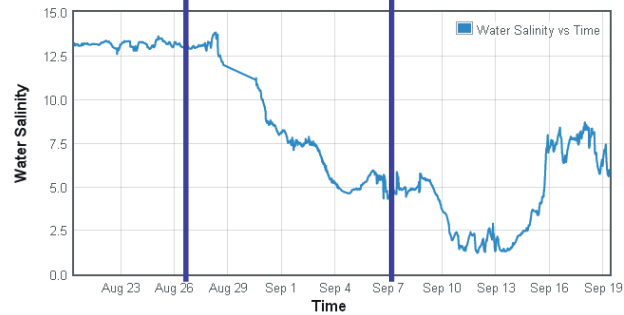
From: 2011-08-20 09:00:00 To: 2011-09-19 09:00:00

Annapolis



From: 2011-08-20 08:00:00 To: 2011-09-19 08:00:00

Gooses Reef



Irene Lee :20:00

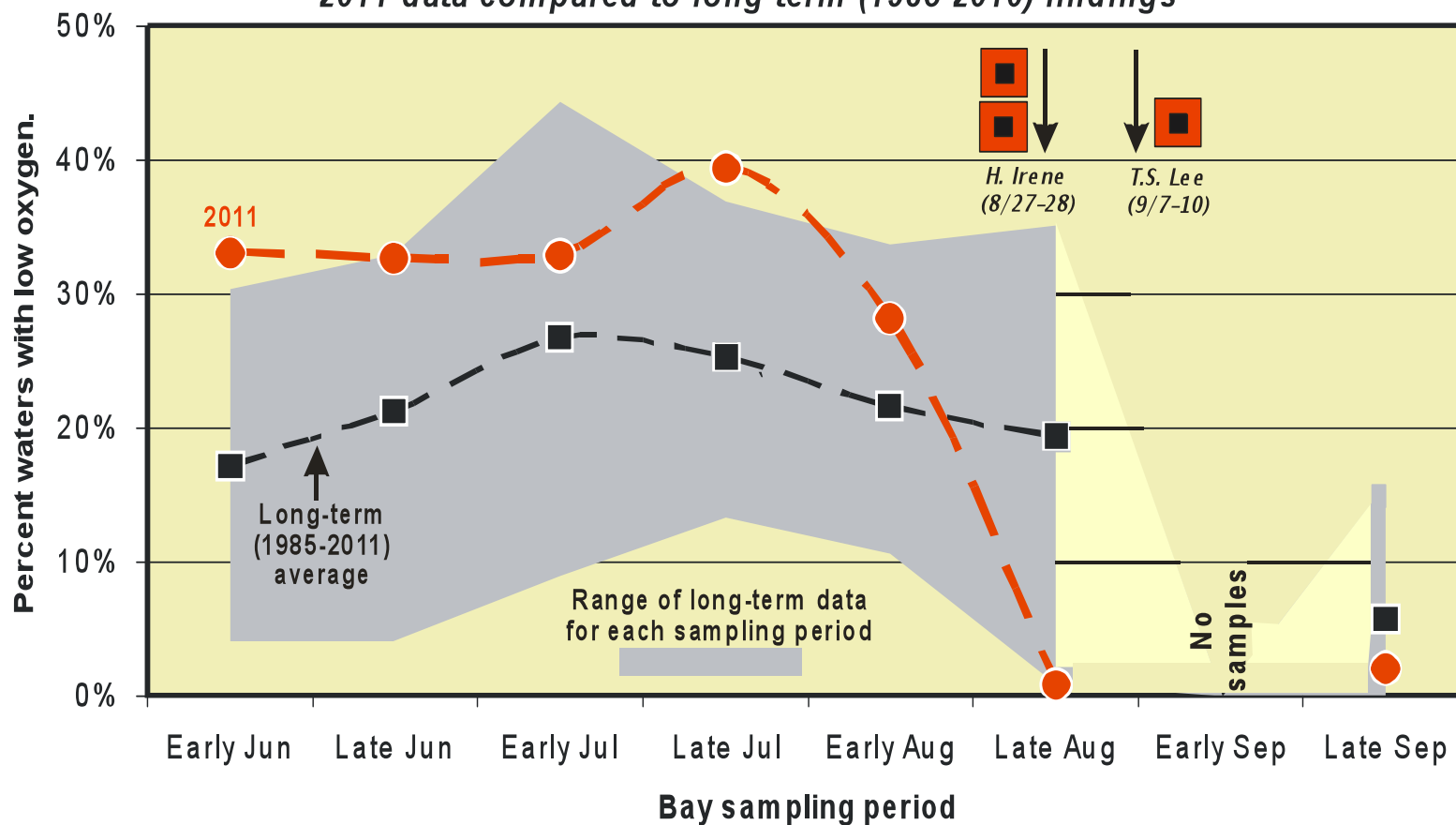
September 10-14th



October 5-9th
October 15th



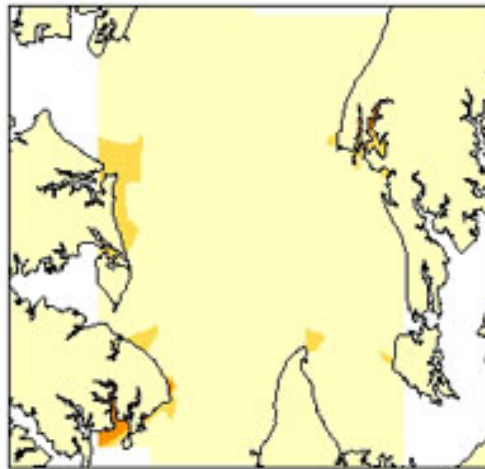
Seasonal volume of low dissolved oxygen waters (< 2 mg/L)
 in Maryland portion of mainstem Chesapeake Bay
 2011 data compared to long-term (1985-2010) findings



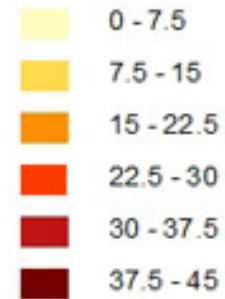
Bottom line... Volume of low dissolved oxygen water in Chesapeake Bay was above average until late August when strong winds of Hurricane Irene mixed the oxygen-rich surface waters and deep, low oxygen waters of the Bay

Water Quality Mapping Turbidity

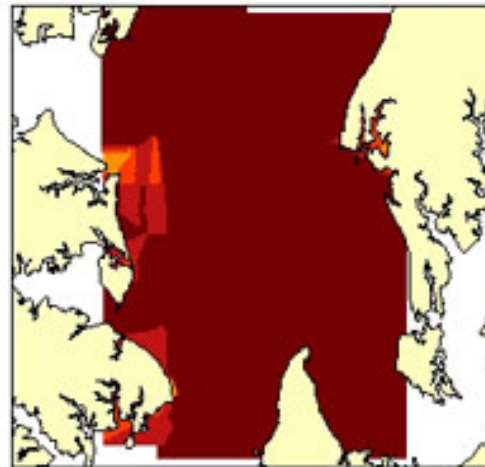
Chesapeake Bay Segment 3 (North of Bay Bridge to Above Patapsco River)



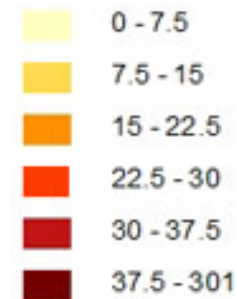
Turbidity (NTU)



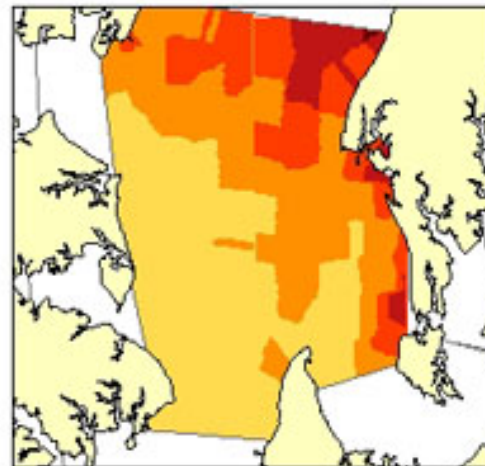
8/17/2011



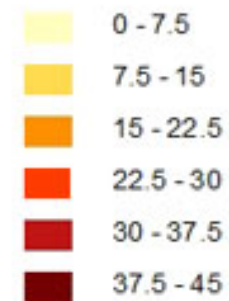
Turbidity (NTU)



9/14/2011



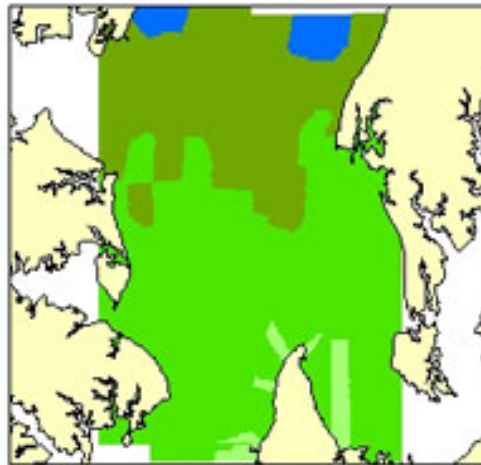
Turbidity (NTU)



10/3/2011

Water Quality Mapping Salinity

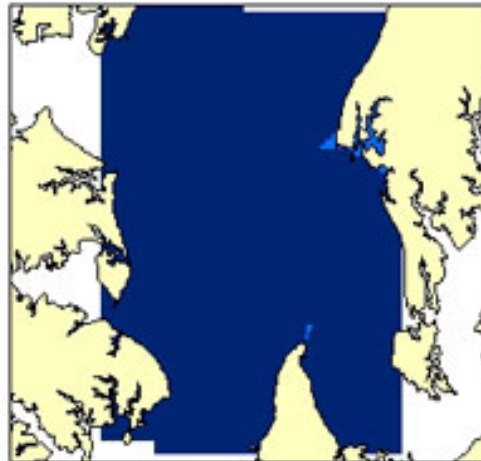
Chesapeake Bay
Segment 3
(North of Bay Bridge to
Above Patapsco River)



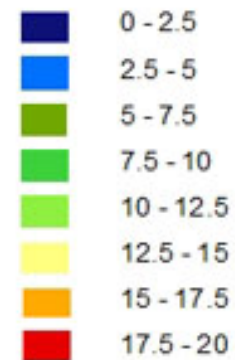
Salinity (ppt)



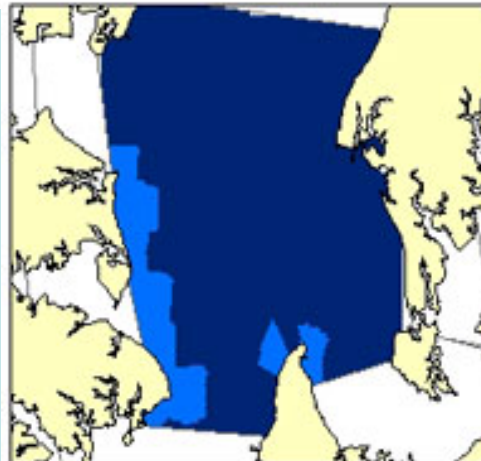
8/17/2011



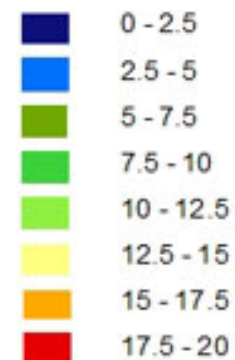
Salinity (ppt)



9/14/2011

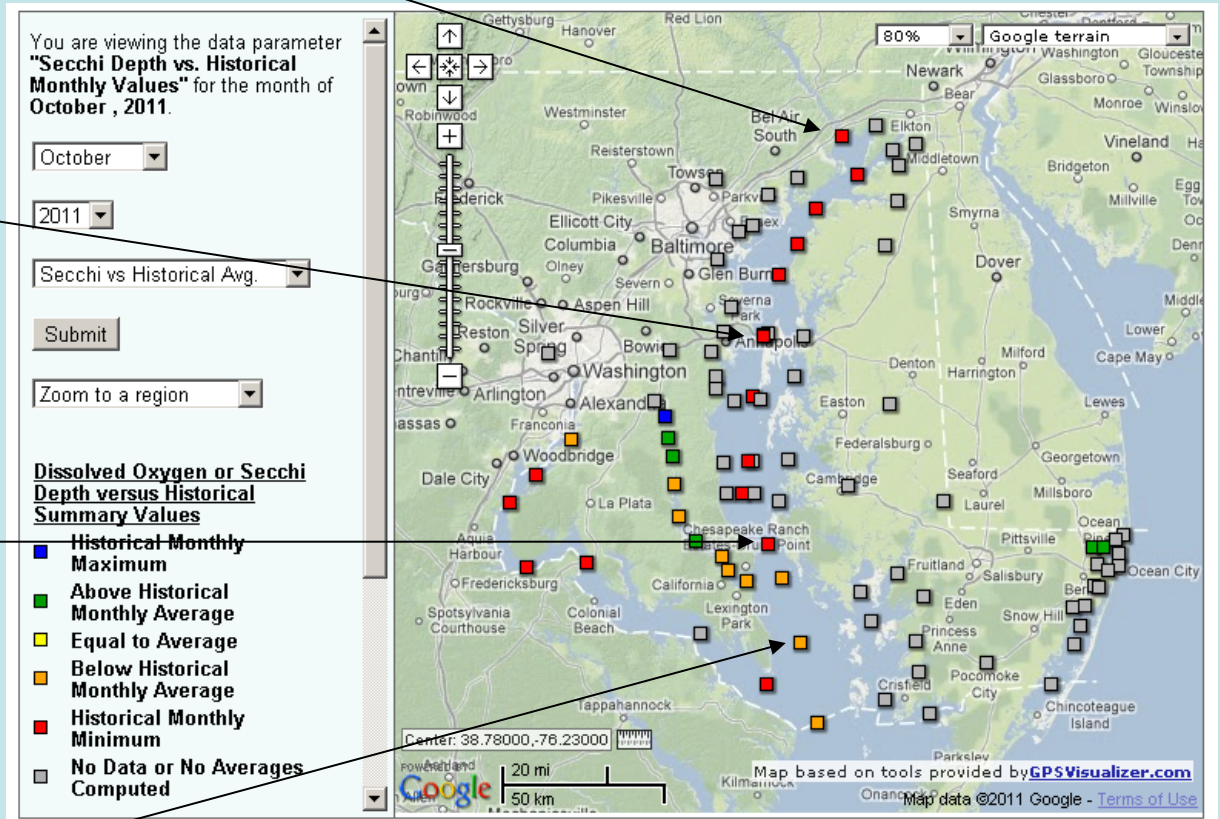
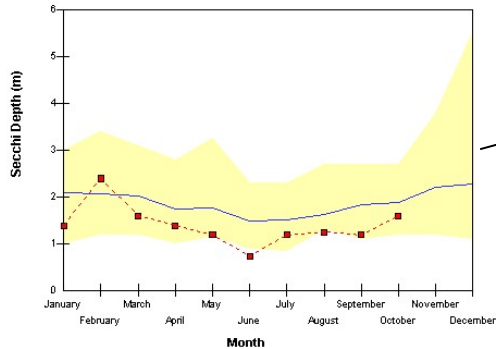
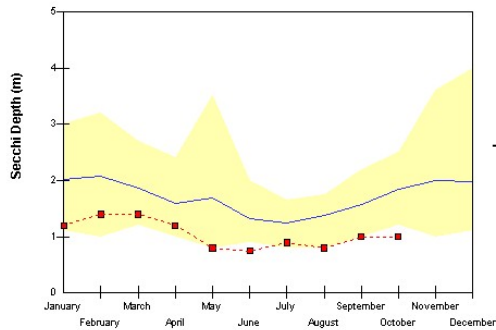
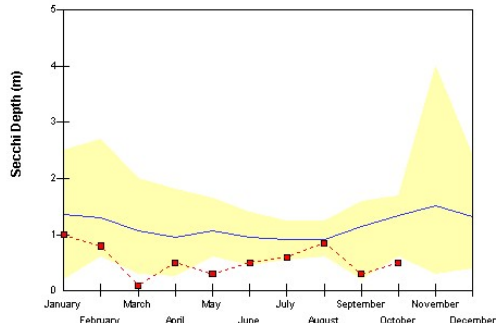
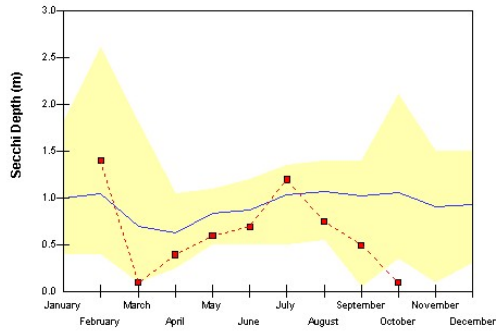


Salinity (ppt)



10/3/2011

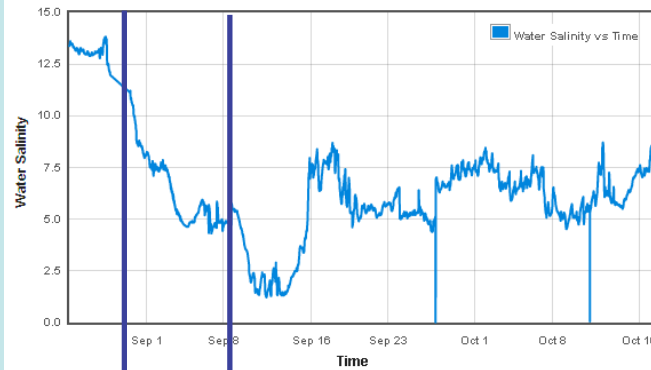
Record Low Water Clarity Throughout Year



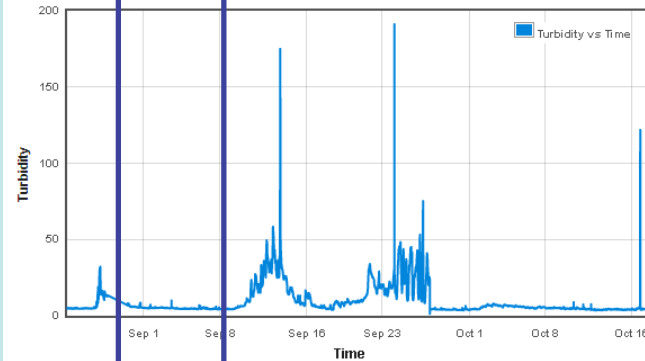
**NOAA/DNR
Dominion Gooses Reef
Buoy**

(www.buoybay.org)

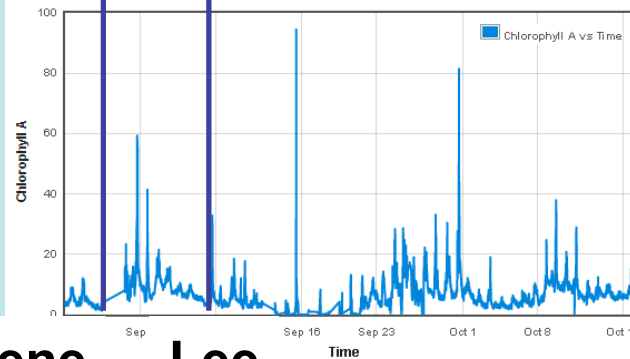
Gooses Reef



From: 2011-08-25 00:00 To: 2011-10-17 23:59



From: 2011-08-25 00:00 To: 2011-10-17 23:59



From: 2011-08-25 00:00 To: 2011-10-17 23:59

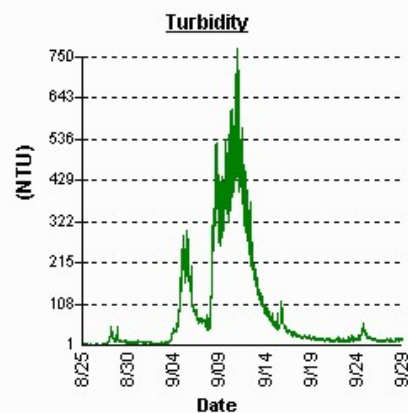
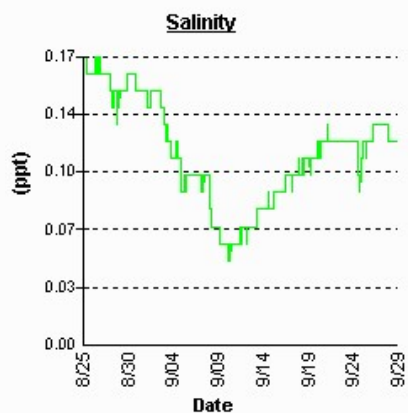
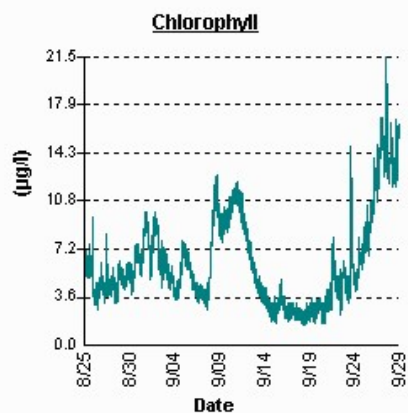
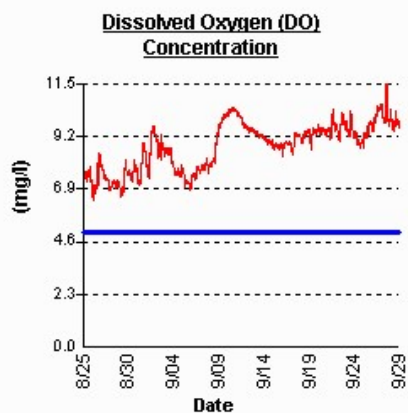
Irene Lee

Salinity

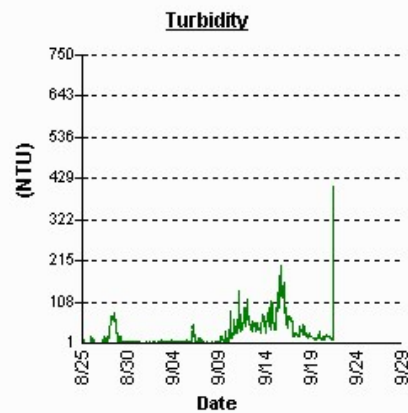
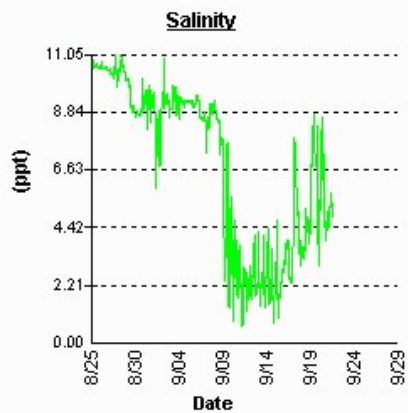
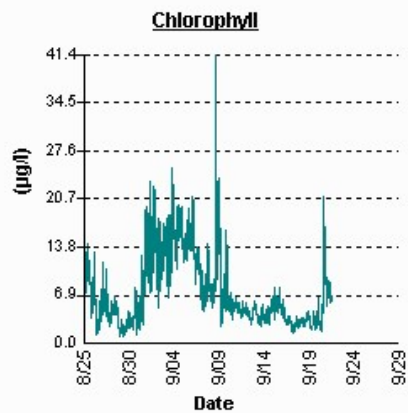
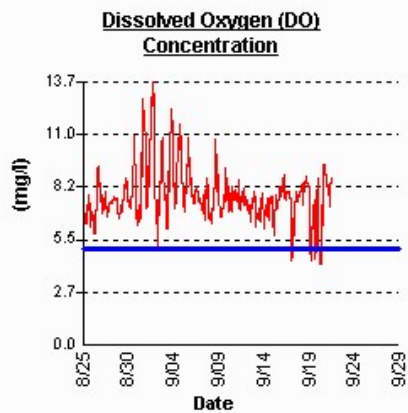
Turbidity

Algae

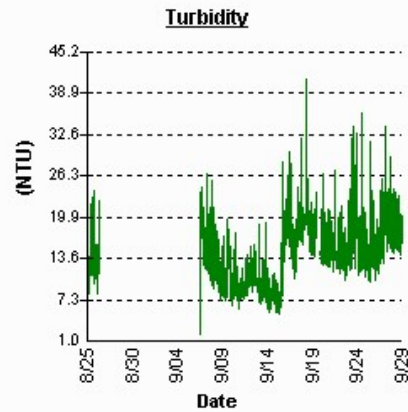
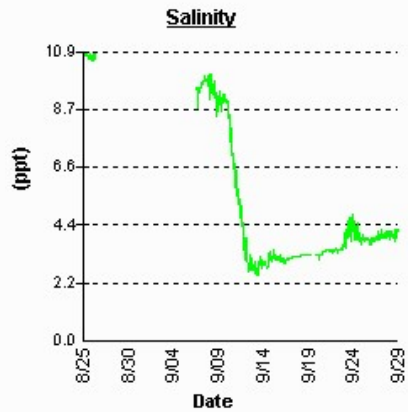
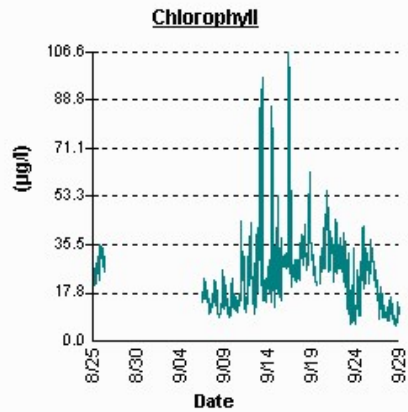
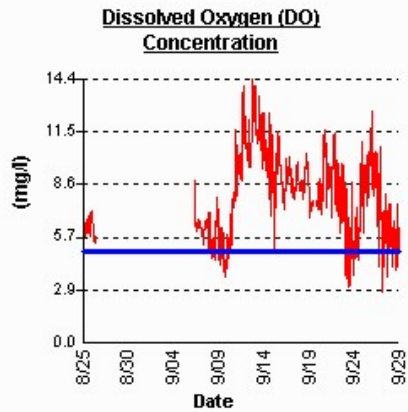
Havre de Grace



Love Point



West River



Summary

- Elevated Turbidity in Susquehanna River from September 7th, 2011 to present
- Dead Zone eliminated by Hurricane Irene
- Anoxic conditions reset after Tropical Storm Lee
- This muddy water contained large amounts of nutrients capable of fueling large algal blooms which could rob the waters of dissolved oxygen when the algae would die and settle to the bottom to decompose.
- This large discolored freshwater plume could have major impacts to the Bay's fish, shellfish and underwater grass communities by smothering habitat, blocking light and decreasing salinity levels for an extended time.

**For more current water quality conditions
of Maryland's tidal waters,**

- *visit us on the web: Eyesonthebay.net*
- *On Twitter: [@eyesonthebay](https://twitter.com/eyesonthebay)*
- *On Facebook: [Eyes on the bay](https://www.facebook.com/Eyesonthebay)*