

Chesapeake Bay Monitoring and Modeling

Presentation to the
Rio de Janeiro
Delegation

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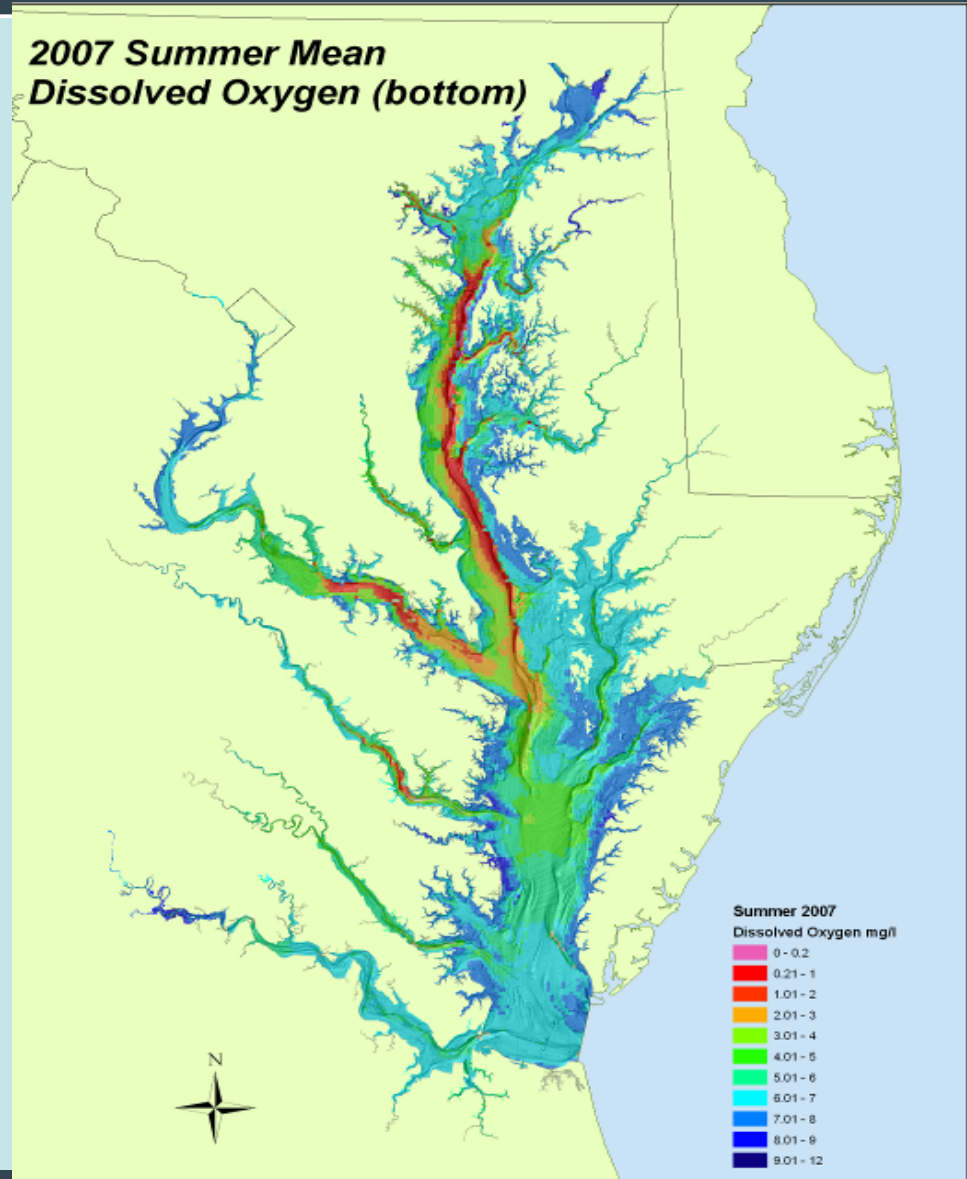
www.eyesonthebay.net

Maryland Water Quality Monitoring

Chesapeake Bay Challenges:

The Bay is Impaired for Water Quality

Extensive low to no summer dissolved oxygen conditions persist throughout the Chesapeake Bay and its Tidal Tributaries



Chesapeake Bay Challenges

Nutrient and sediment pollution from:

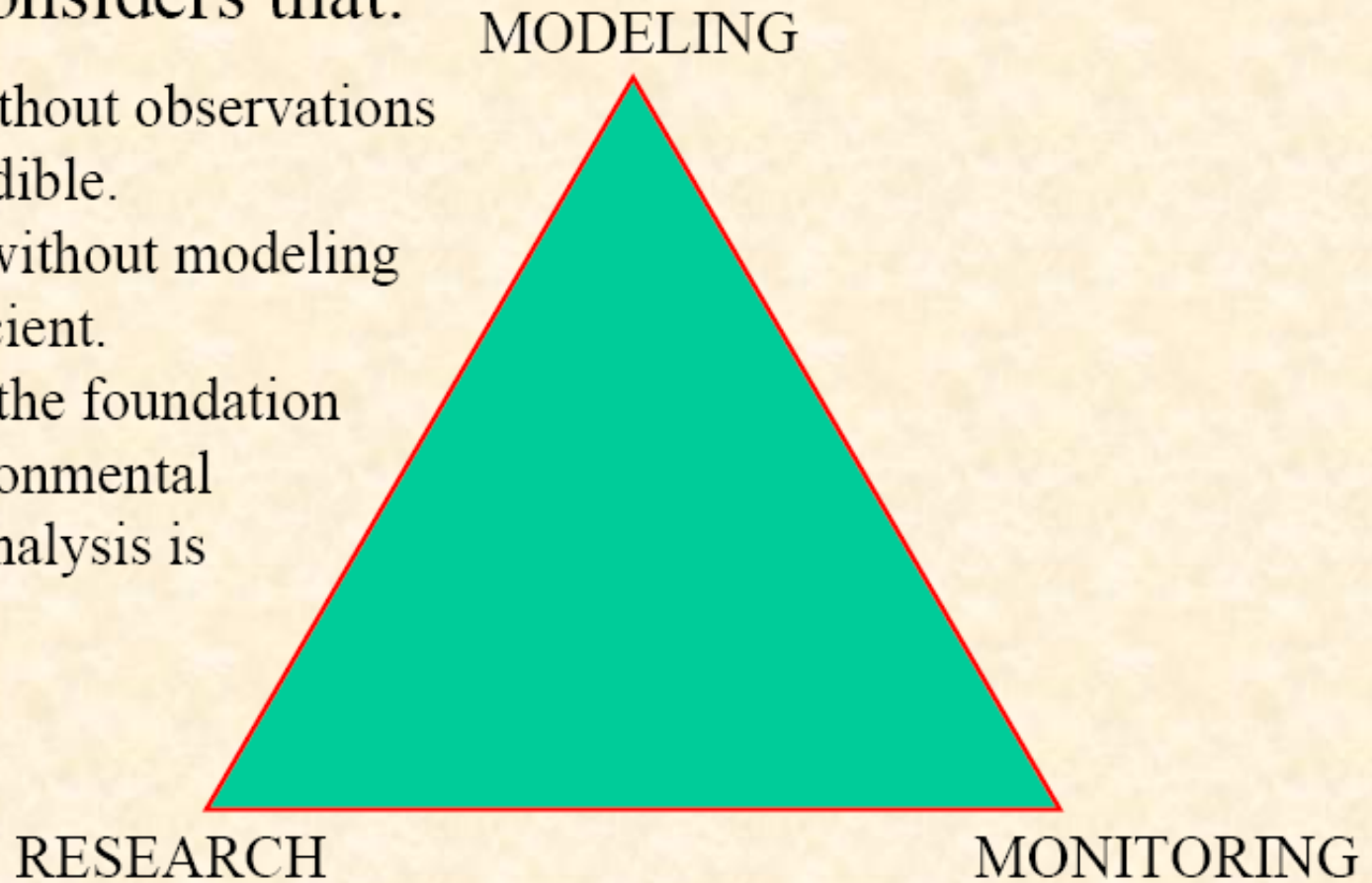
- Wastewater (sewage treatment),
- Septic Systems,
- Urban/suburban runoff – storm water, sediment erosion),
- Industrial pollution (power plants, manufacturing)
- Dredging,
- Agriculture



Triad of Modeling, Monitoring, and Research

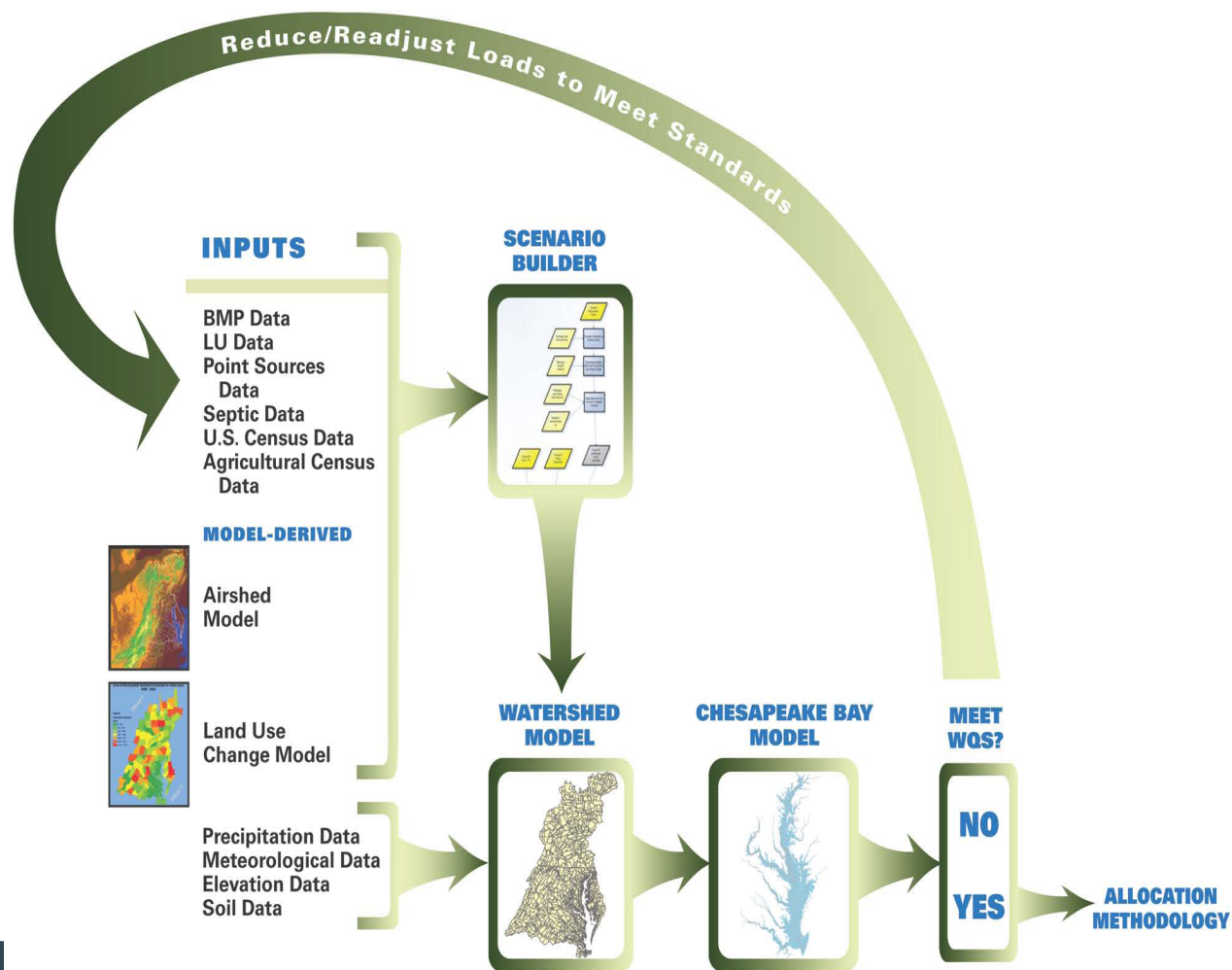
The current state of the science considers that:

- Modeling without observations to be not credible.
- Monitoring without modeling to be insufficient.
- Research is the foundation that all environmental restoration analysis is built on.



- The Chesapeake Bay Program models are used by government partners and private stakeholders to:
 - project the flow and loads of pollution
 - and simulate how changes to pollution controls, land use, atmospheric deposition and precipitation could impact the ecosystem, particularly water quality and living resources like fish and wildlife.

Chesapeake Bay Partnership Models

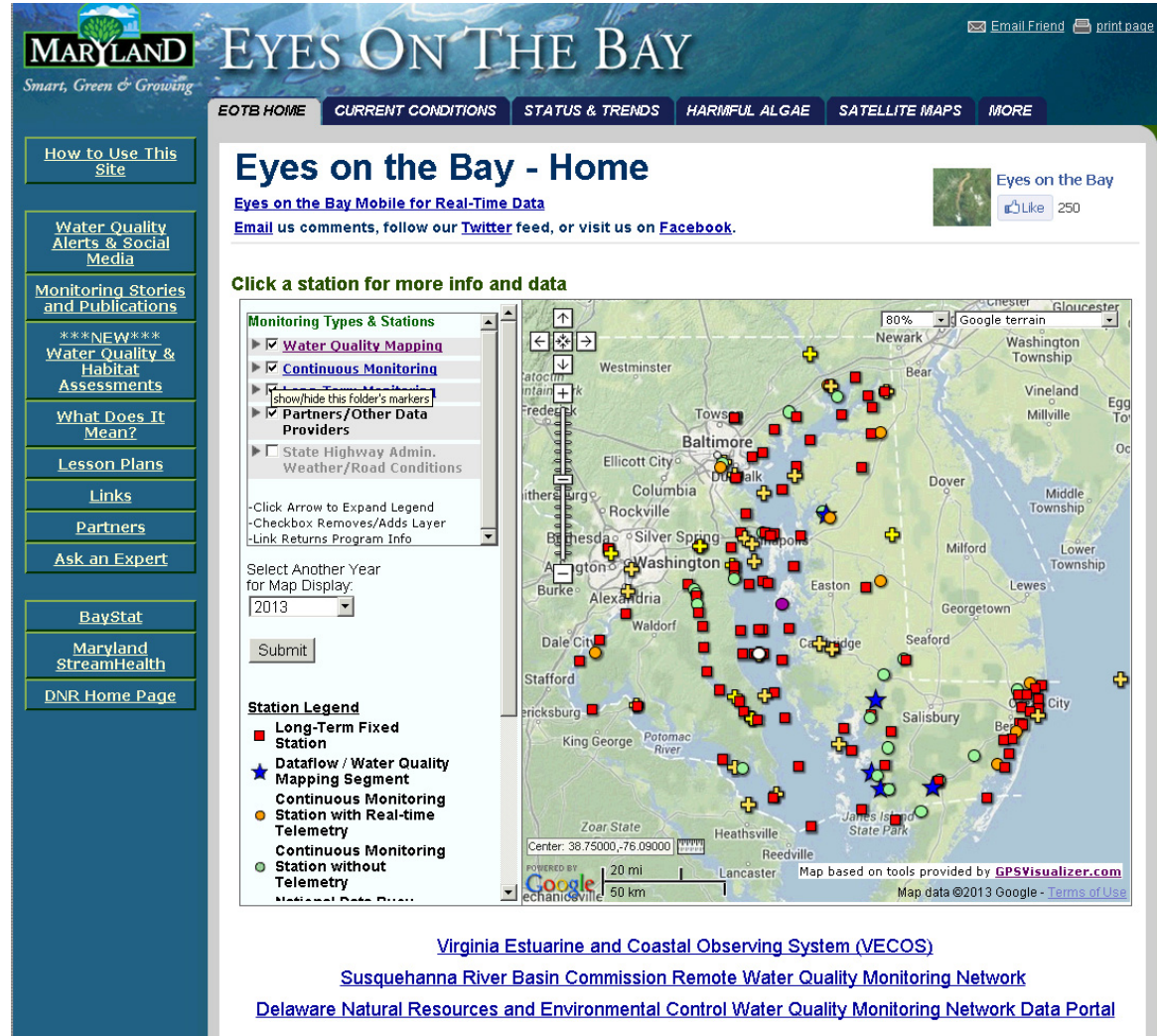


Monitoring Program Objectives

- Long-term Fixed
 - Status - Characterize existing conditions; water quality criteria
 - Trends - Evaluate changes in response to nutrient reductions
 - Understand ecosystem processes as they relate to management actions
 - Model support
 - Research and education
- Continuous Monitoring
 - Represents upstream and downstream conditions
 - Provides temporal resolution for evaluating water quality criteria
 - Calibration for water quality mapping
 - Event based monitoring – fish kills, algal blooms, storm impacts
- Water Quality Mapping
 - Provides spatial resolution for evaluating new WQ criteria
 - Targeting submerged aquatic vegetation (SAV) restoration activities
 - Assessing habitat for fish and other living resources
 - Biweekly calibration, light attenuation, chlorophyll and total suspended solids

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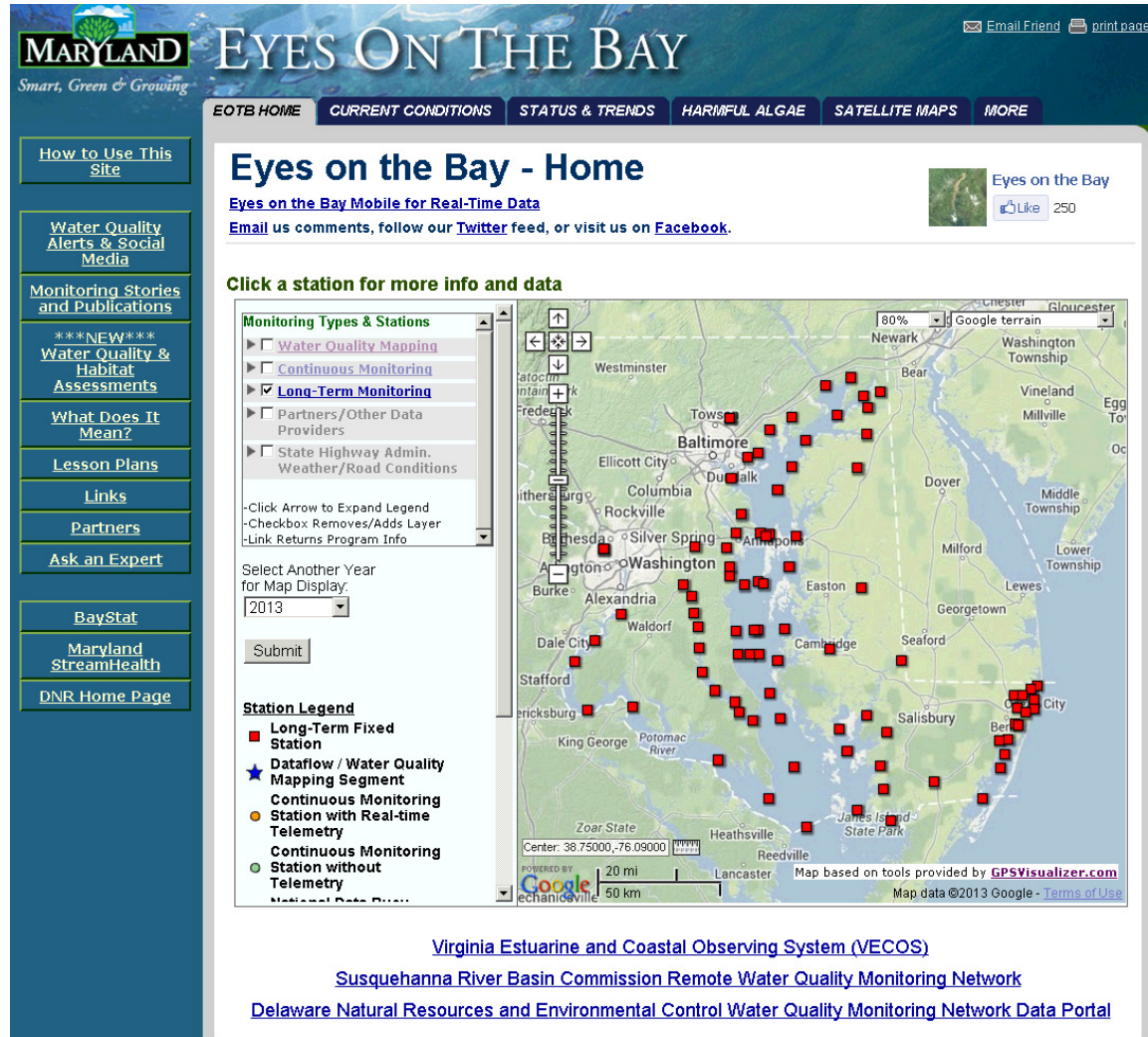
- Portal for Maryland DNR water quality data and analyses, harmful algal blooms maps, and satellite imagery/data



The screenshot shows the 'EYES ON THE BAY' website. The header includes the Maryland logo and navigation tabs: EOTB HOME, CURRENT CONDITIONS, STATUS & TRENDS, HARMFUL ALGAE, SATELLITE MAPS, and MORE. The main content area is titled 'Eyes on the Bay - Home' and features a map of the Chesapeake Bay region with various monitoring stations marked. A sidebar on the left contains navigation links such as 'How to Use This Site', 'Water Quality Alerts & Social Media', and 'Monitoring Stories and Publications'. Below the map, there is a 'Station Legend' and a 'Select Another Year for Map Display' dropdown menu set to 2013. At the bottom, there are links to external monitoring networks: Virginia Estuarine and Coastal Observing System (VECOS), Susquehanna River Basin Commission Remote Water Quality Monitoring Network, and Delaware Natural Resources and Environmental Control Water Quality Monitoring Network Data Portal.

Long-term Monitoring Sites (1985-present)

- Monitored monthly or twice monthly
- Full suite of nutrients, sediment and chlorophyll
- Water quality profiles

EYES ON THE BAY

Smart, Green & Growing

EOTB HOME CURRENT CONDITIONS STATUS & TRENDS HARMFUL ALGAE SATELLITE MAPS MORE

Eyes on the Bay - Home

[Eyes on the Bay Mobile for Real-Time Data](#)
[Email us comments, follow our \[Twitter\]\(#\) feed, or visit us on \[Facebook\]\(#\).](#)

Click a station for more info and data

Monitoring Types & Stations

- Water Quality Mapping
- Continuous Monitoring
- Long-Term Monitoring
- Partners/Other Data Providers
- State Highway Admin. Weather/Road Conditions

-Click Arrow to Expand Legend
 -Checkbox Removes/Adds Layer
 -Link Returns Program Info

Select Another Year for Map Display:
 2013

Submit

Station Legend

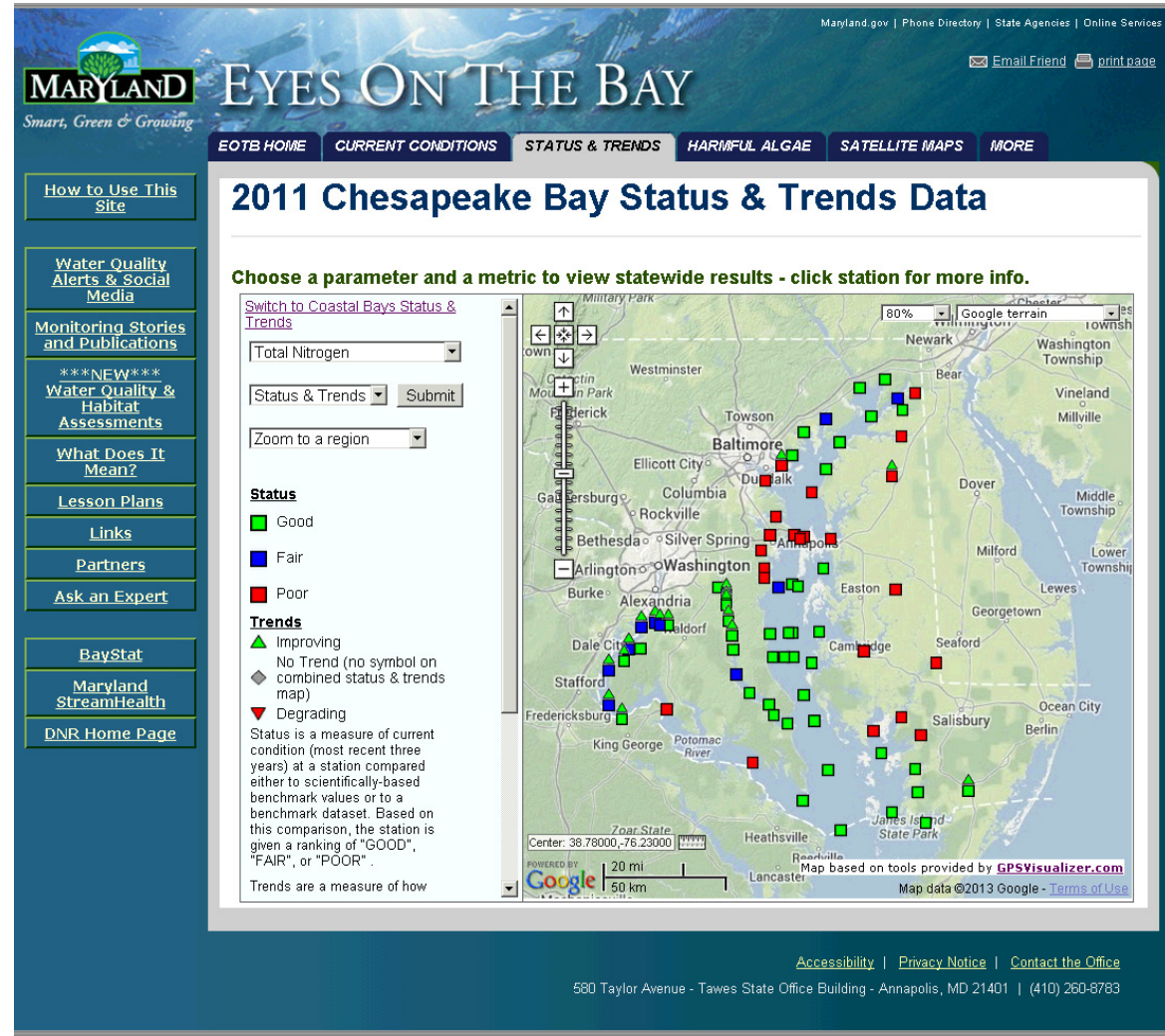
- Long-Term Fixed Station
- ★ Dataflow / Water Quality Mapping Segment
- Continuous Monitoring Station with Real-time Telemetry
- Continuous Monitoring Station without Telemetry

Virginia Estuarine and Coastal Observing System (VECOS)
 Susquehanna River Basin Commission Remote Water Quality Monitoring Network
 Delaware Natural Resources and Environmental Control Water Quality Monitoring Network Data Portal

Maryland Water Quality Monitoring

Status & Trends

- Parameters: TN, TP, TSS, DO, chl, secchi
- Status – Measure of latest 3 years (good, fair or poor)
- Trends – Measure of improving, degrading or no trend since 1985 or 1999. Can be linear or non-linear



EYES ON THE BAY

2011 Chesapeake Bay Status & Trends Data

Choose a parameter and a metric to view statewide results - click station for more info.

Switch to Coastal Bays Status & Trends

Total Nitrogen

Status & Trends Submit

Zoom to a region

Status

- Good
- Fair
- Poor

Trends

- Improving
- No Trend (no symbol on combined status & trends map)
- Degrading

Status is a measure of current condition (most recent three years) at a station compared either to scientifically-based benchmark values or to a benchmark dataset. Based on this comparison, the station is given a ranking of "GOOD", "FAIR", or "POOR".

Trends are a measure of how

Map based on tools provided by [GPSVisualizer.com](#)

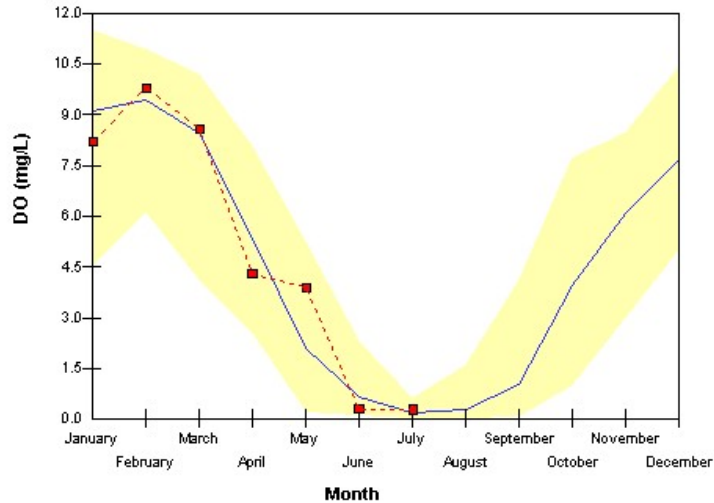
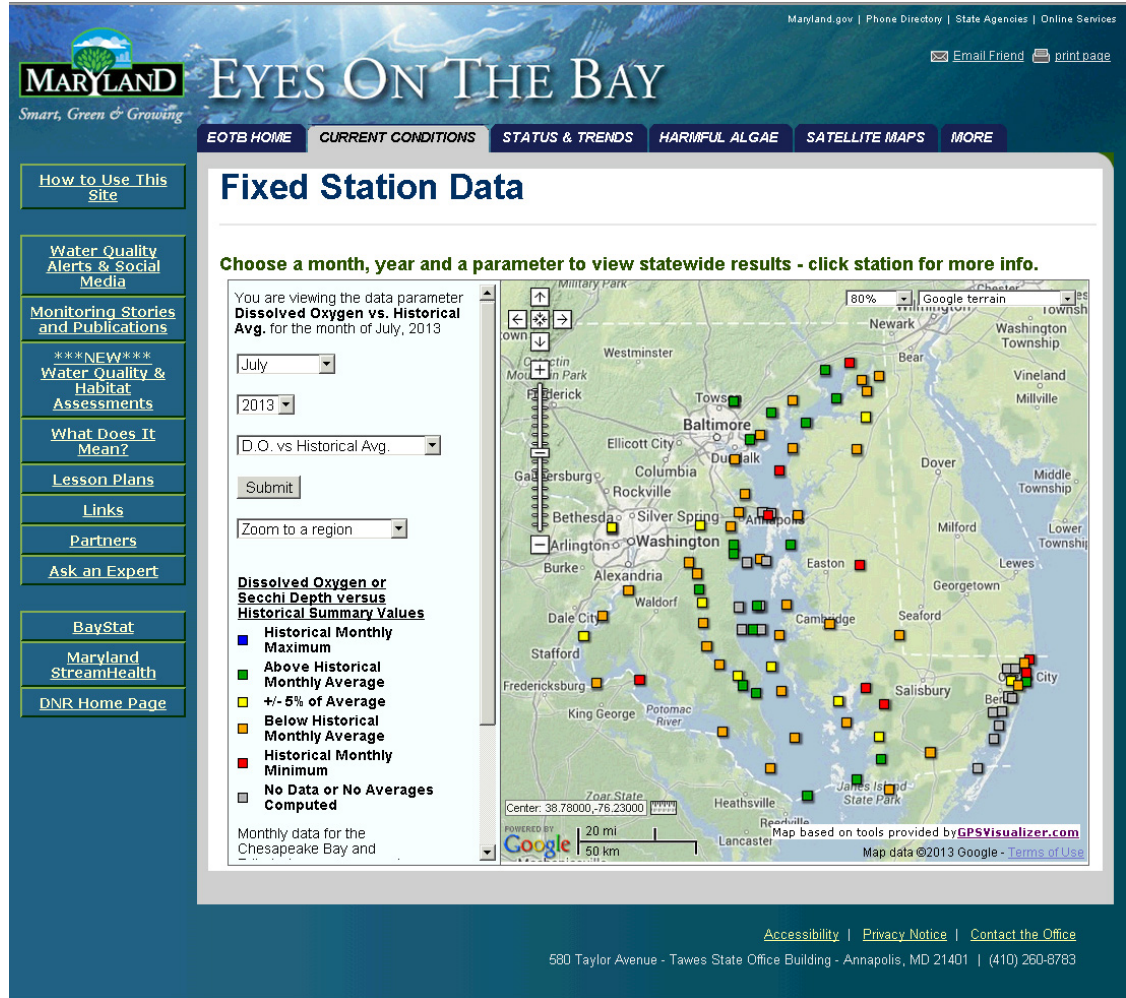
Map data ©2013 Google - [Terms of Use](#)

580 Taylor Avenue - Tawes State Office Building - Annapolis, MD 21401 | (410) 260-8783

Current Conditions

- Compare current data to long-term averages and ranges.

2013 **Bottom Water Dissolved Oxygen**
Chesapeake Bay Mainstem / MD Mid Bay (CB4.2C)

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Navigation: [EOTB HOME](#) | [CURRENT CONDITIONS](#) | [STATUS & TRENDS](#) | [HARMFUL ALGAE](#) | [SATELLITE MAPS](#) | [MORE](#)

Fixed Station Data

Choose a month, year and a parameter to view statewide results - click station for more info.

You are viewing the data parameter **Dissolved Oxygen vs. Historical Avg.** for the month of July, 2013

Month: Year: Parameter:

Zoom to a region:

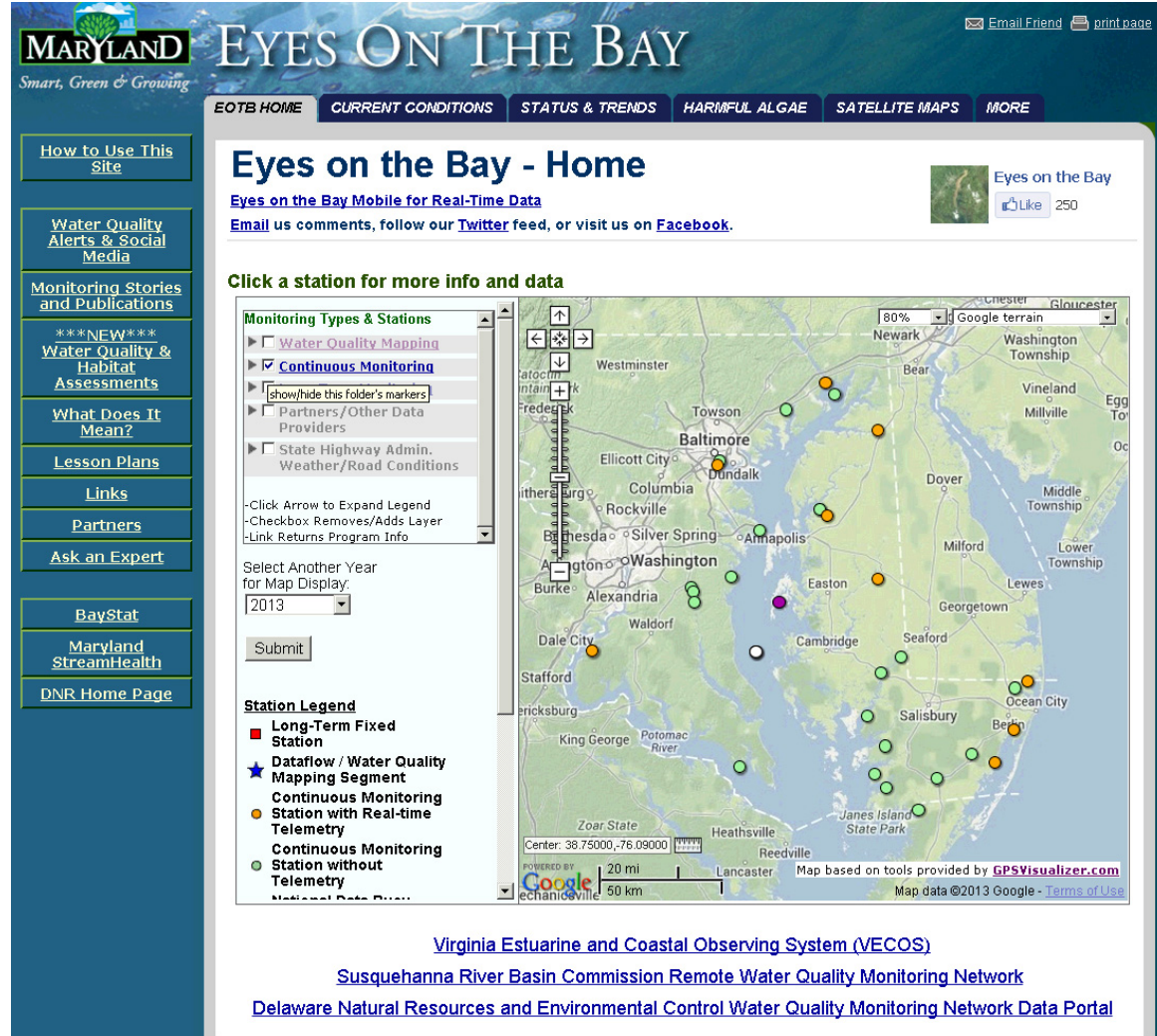
Dissolved Oxygen or Secchi Depth versus Historical Summary Values

- Historical Monthly Maximum
- Above Historical Monthly Average
- +/- 5% of Average
- Below Historical Monthly Average
- Historical Monthly Minimum
- No Data or No Averages Computed

Map data ©2013 Google. Terms of Use

Continuous monitoring

- Up to 50 sites / year
- Measurements every 15 minutes
- Dissolved oxygen, pH, chl, turbidity, salinity, water temperature
- Serviced every 2 weeks with calibration samples and profiles taken

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Click a station for more info and data

Monitoring Types & Stations

- Water Quality Mapping
- Continuous Monitoring
- Partners/Other Data Providers
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Select Another Year for Map Display: 2013

Submit

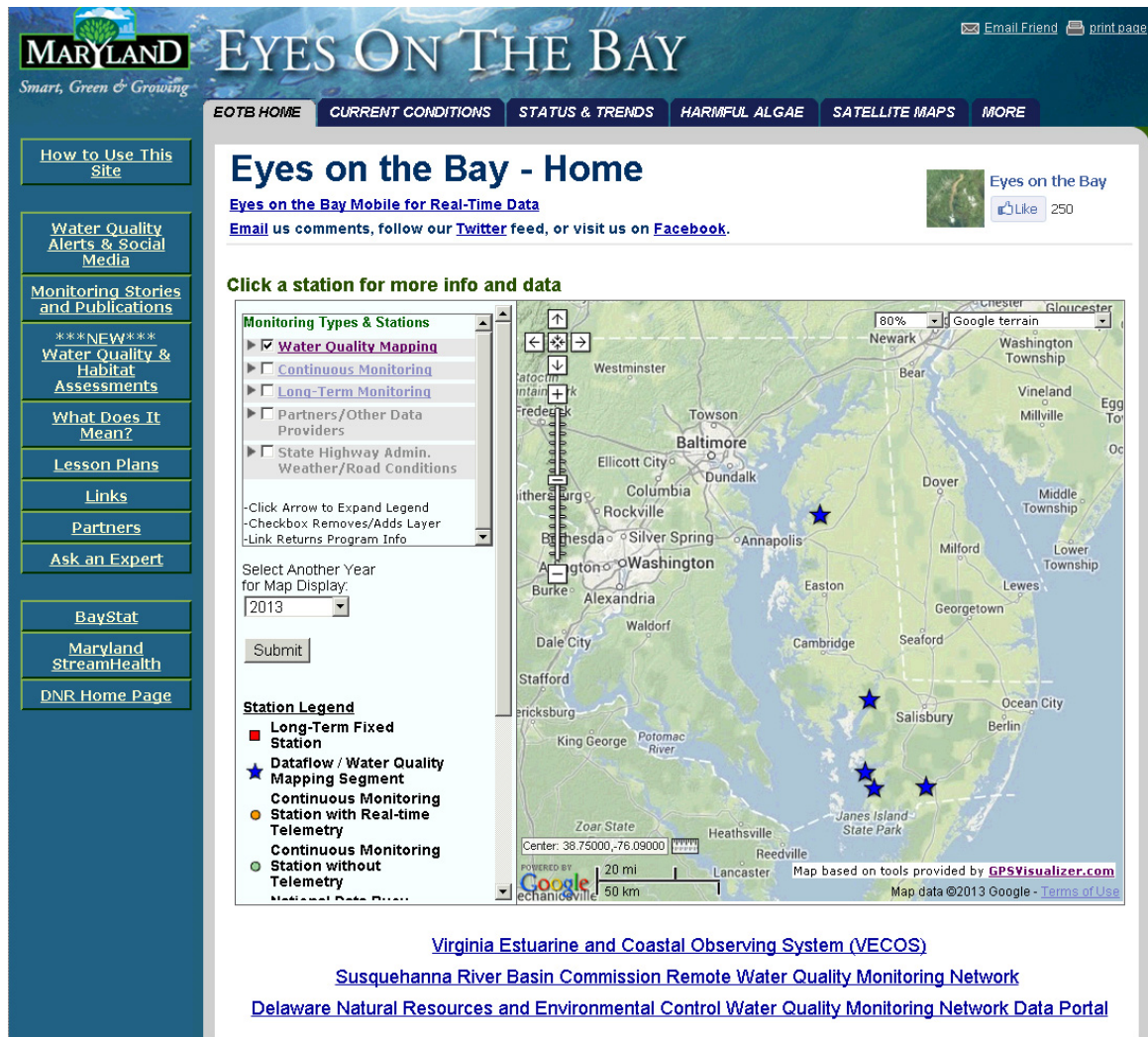
Station Legend

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Virginia Estuarine and Coastal Observing System (VECOS)
 Susquehanna River Basin Commission Remote Water Quality Monitoring Network
 Delaware Natural Resources and Environmental Control Water Quality Monitoring Network Data Portal

Water Quality Mapping

- Readings every 4 seconds at speeds of up to 25kts.

EYES ON THE BAY
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How to Use This Site
Water Quality Alerts & Social Media
Monitoring Stories and Publications
NEW Water Quality & Habitat Assessments
What Does It Mean?
Lesson Plans
Links
Partners
Ask an Expert
BayStat
Maryland StreamHealth
DNR Home Page

Eyes on the Bay - Home
Like 250

Click a station for more info and data

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Maryland Water Quality Monitoring

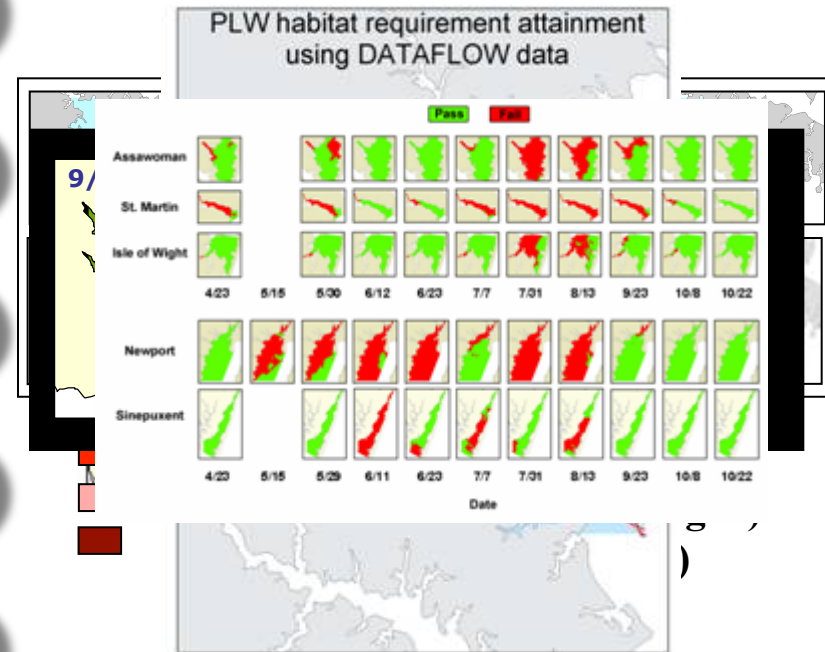
1. Water Quality Criteria Assessment

2. Input Data for SAV Restoration Models

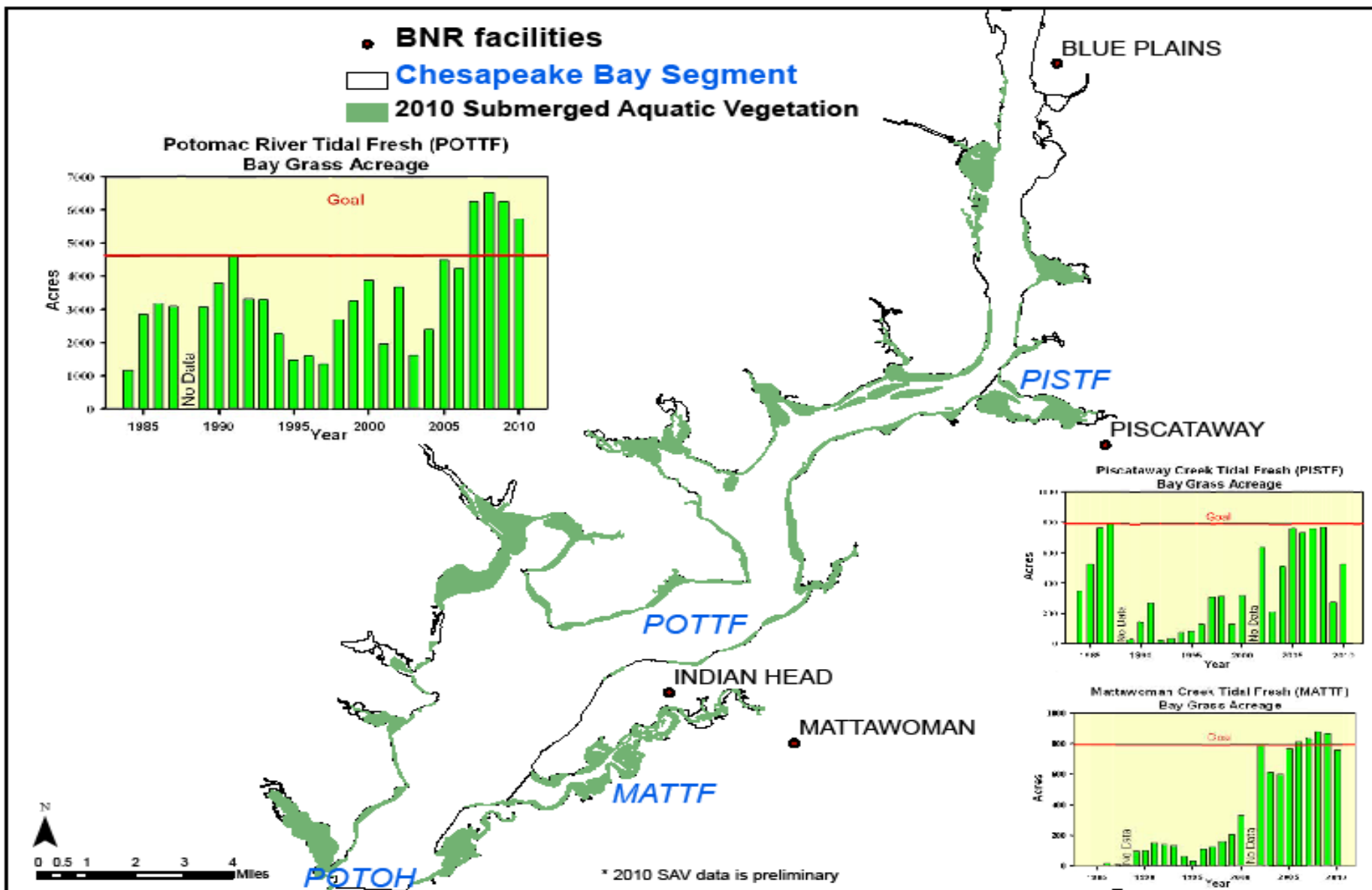
3. Monitor Episodic Events

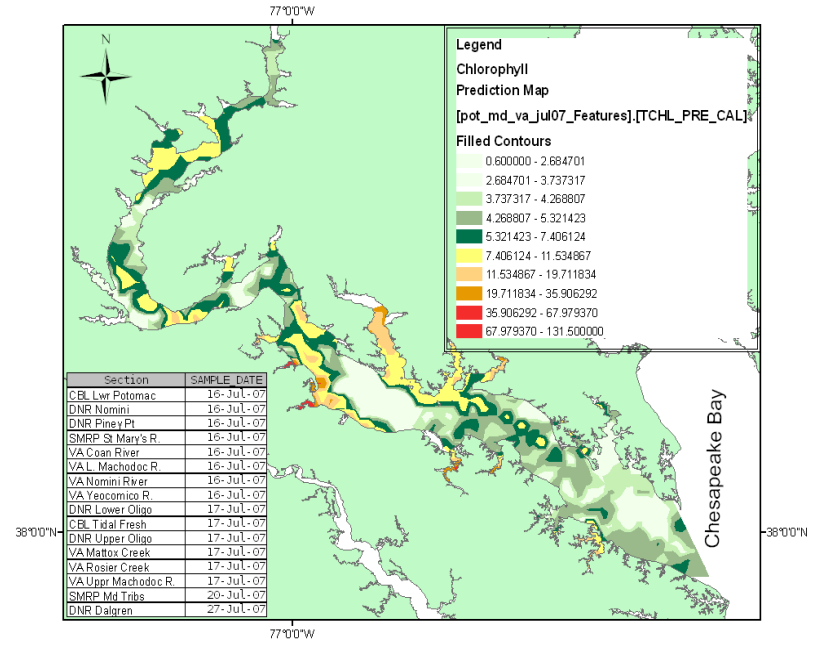
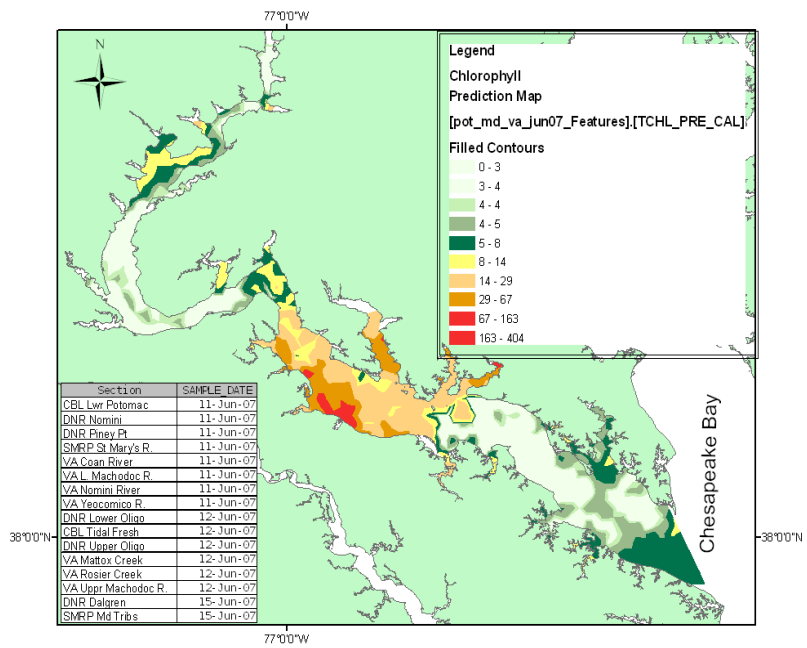
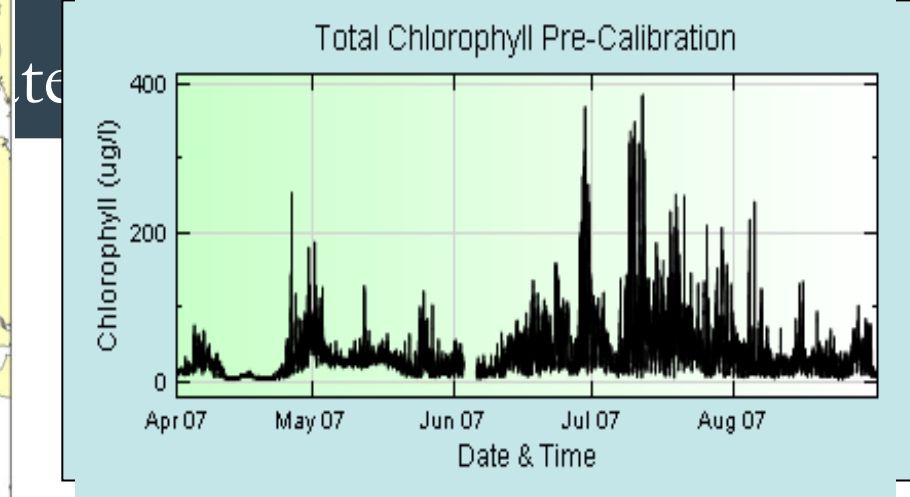
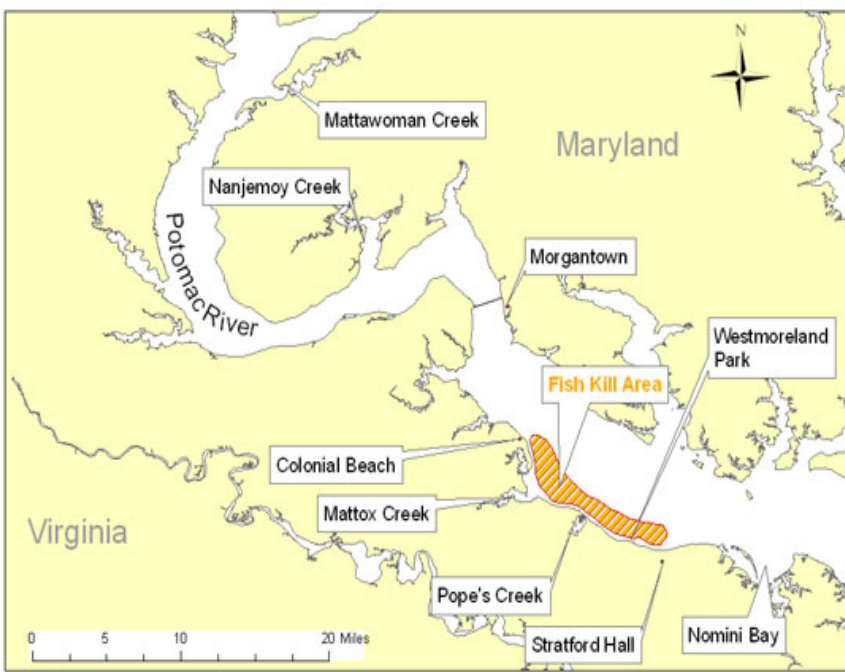
4. Monitor Habitat for Living Resources

5. Detect Harmful Algal Blooms / Hypoxia



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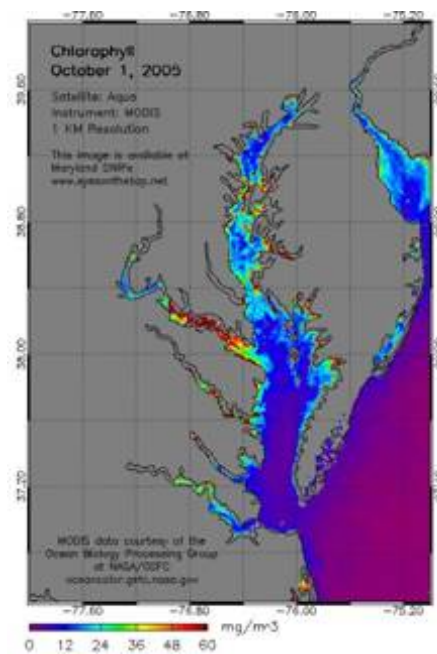
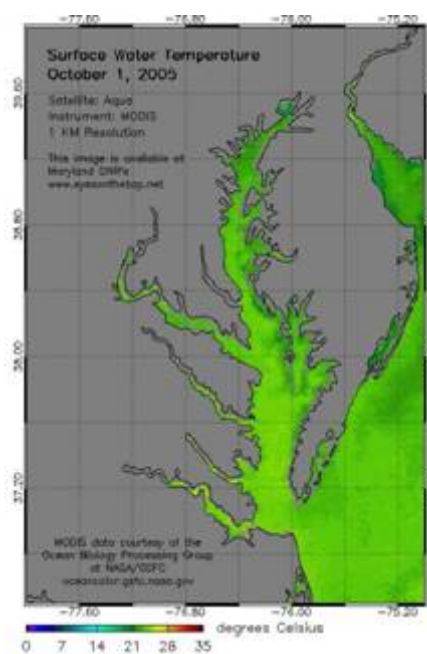




Incorporating New Technologies - Remote Sensing



mddnr.chesapeakebay.net/NASAIMagery/EyesInTheSky.cfm



July 2, 2006

This image is Available at
Maryland DNR's
www.eyesonthesky.net

Image courtesy of
MODIS Aqua
Rapid Response Project
at NASA/GSFC
250 meter resolution

<http://rapidfire.sci.gsfc.nasa.gov/>
subasta.TAERONET.Wallops/

Maryland Water Quality Monitoring

Major N reductions have occurred near large and small urban centers in the Chesapeake Bay Watershed.

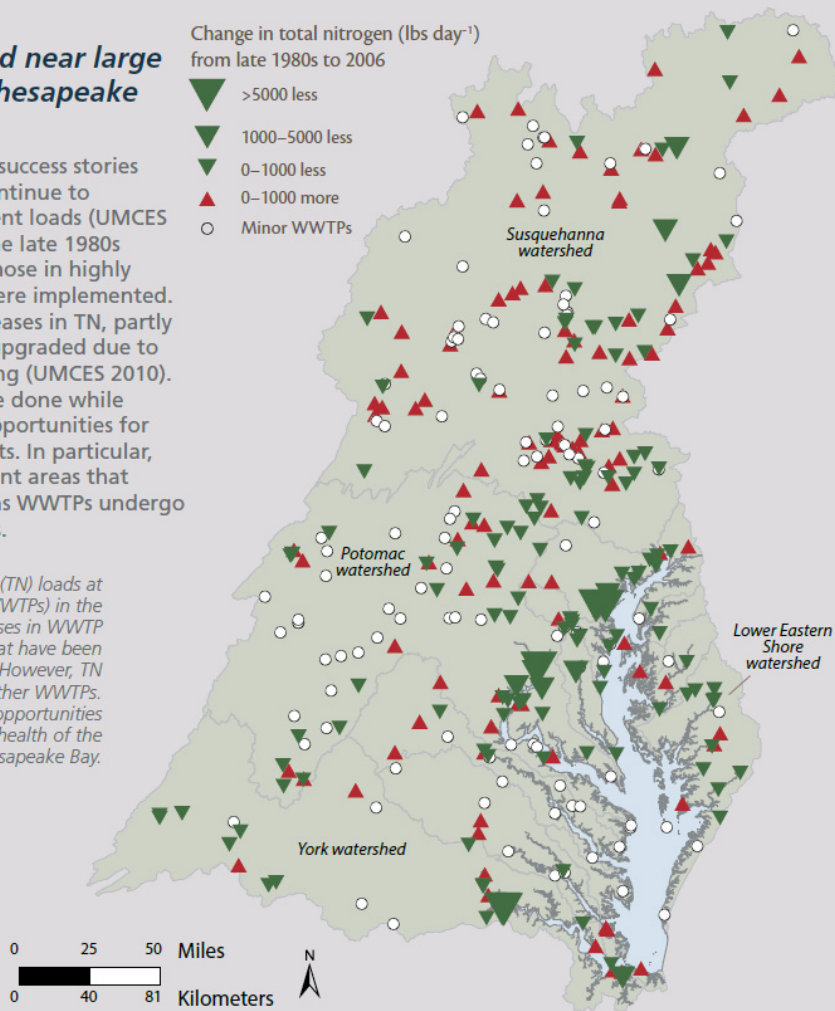
Upgrades in WWTPs represent many of the success stories within The Watershed, but point sources continue to contribute approximately 20% of the nutrient loads (UMCES 2010). Figure [X] illustrates progress from the late 1980s to 2012. TN at some WWTPs—particularly those in highly populated areas—decreased as upgrades were implemented. However, other areas are experiencing increases in TN, partly resulting from WWTPs that have yet to be upgraded due to long implementation times or lack of funding (UMCES 2010). The map reveals that much work is yet to be done while simultaneously demonstrating promising opportunities for significant and relatively rapid improvements. In particular, the James, Potomac and Back Rivers represent areas that would likely see continuing improvements as WWTPs undergo Enhanced Nutrient Removal (ENR) upgrades.

Figure X. Changes in total nitrogen (TN) loads at major wastewater treatment plants (WWTPs) in the Chesapeake Bay Watershed. The decreases in WWTP TN loads illustrate the advances that have been made as WWTPs have been upgraded. However, TN loads have increased at numerous other WWTPs. These WWTPs represent significant opportunities for even greater improvement in the health of the Chesapeake Bay.

Lyerly, C.M., A.L. Hernandez Cordero, K.L. Foreman, S.W. Phillips, W.C. Dennison (eds.). 2013. *Lessons from Chesapeake Bay Restoration Efforts: Understanding the role of nutrient reduction activities in improving water quality.*

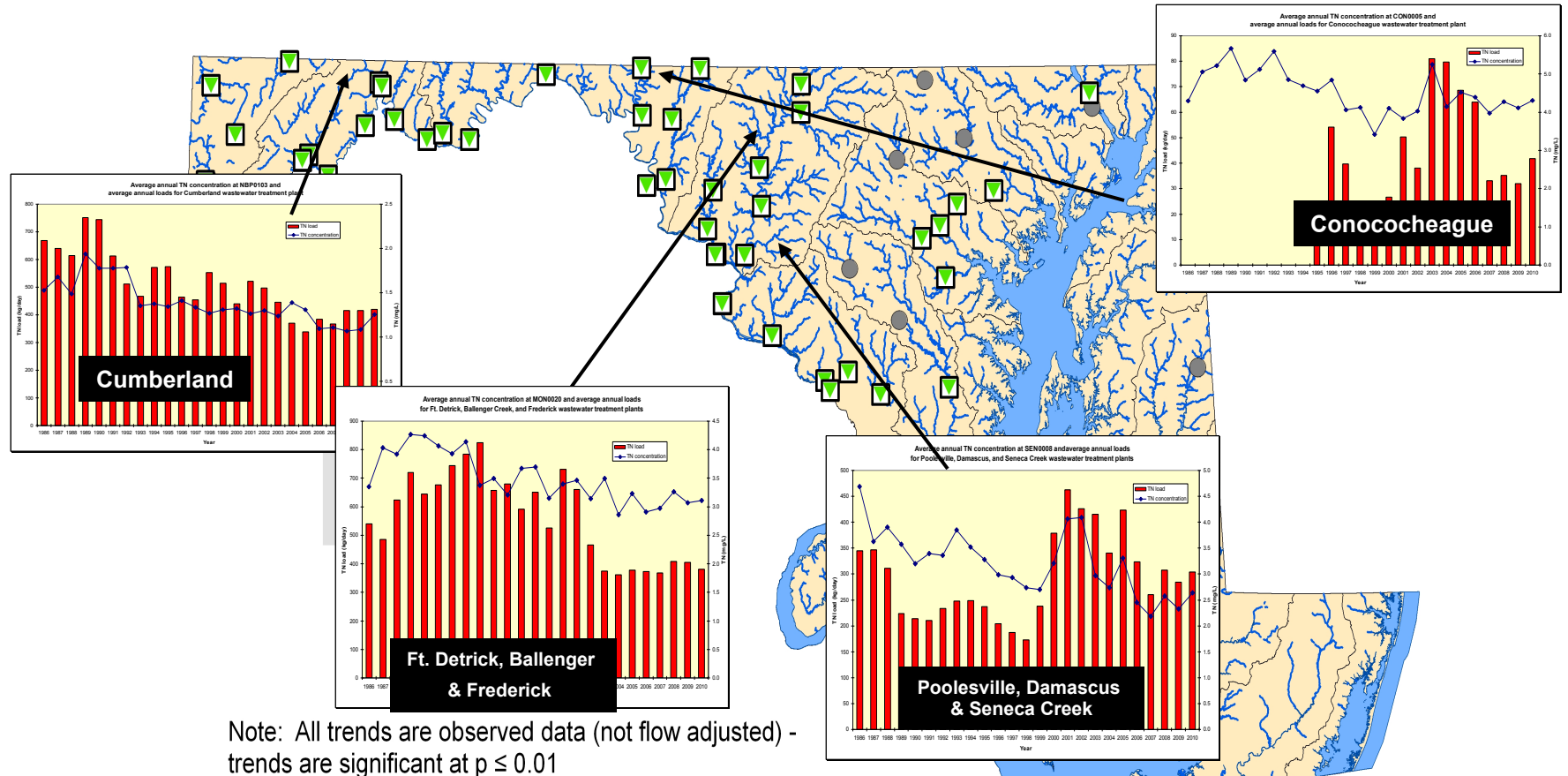
Change in total nitrogen (lbs day⁻¹) from late 1980s to 2006

- ▼ >5000 less
- ▼ 1000–5000 less
- ▼ 0–1000 less
- ▲ 0–1000 more
- Minor WWTPs



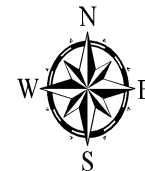
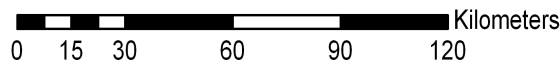
Maryland Water Quality Monitoring

TN Trends (1986-2010) at Non Tidal Monitoring Stations – 46 of 54 Show Improvement



 Improving
 No trend

Note: All trends are observed data (not flow adjusted) - trends are significant at $p \leq 0.01$



Maryland Water Quality Monitoring

- EPA Chesapeake Bay Program
- NOAA Chesapeake Bay Program
- NOAA National Estuarine Research Reserve (NERR), Patuxent and Bush
- Chesapeake Biological Laboratory, Patuxent and Upper Potomac
- St. Mary's College, Lower Potomac
- Smithsonian Environmental Research Center, Rhode
- Harford County Government, Bush
- Anne Arundel Government, Severn
- National Aquarium in Baltimore, Patapsco

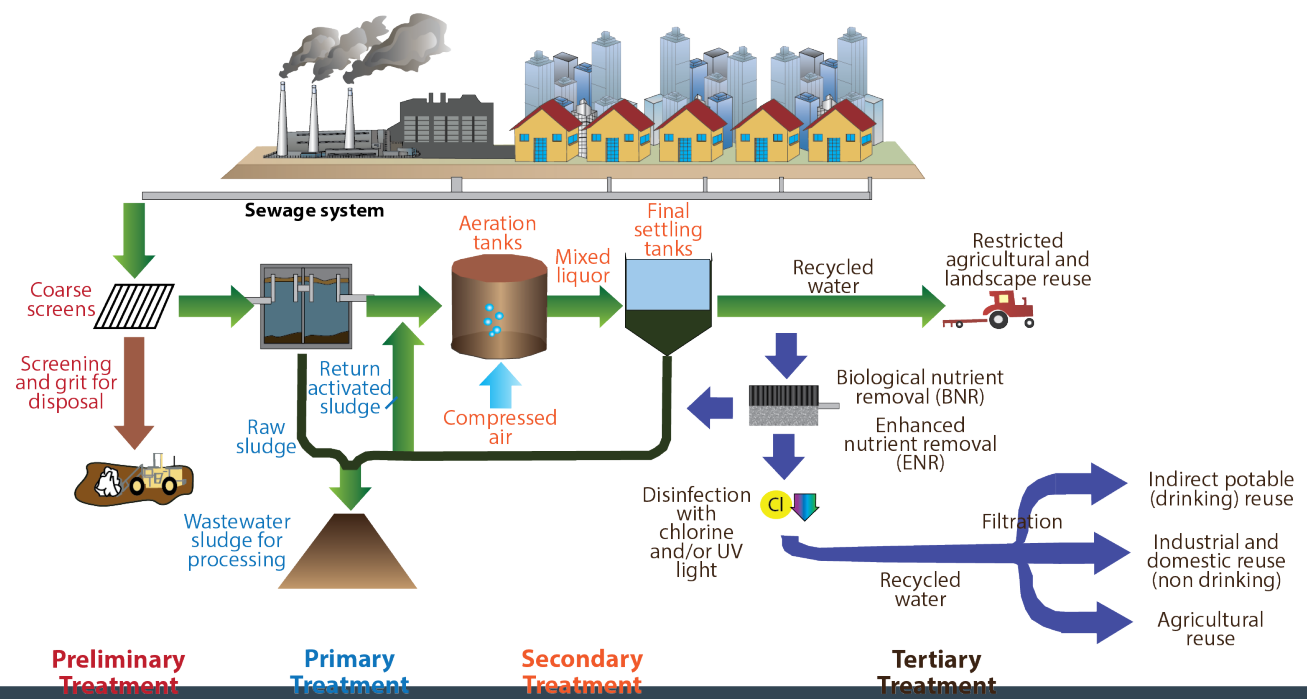




Lessons from Chesapeake Bay Restoration Efforts: Understanding the role of nutrient reduction activities in improving water quality

Lesson 1

- Upgrades in both nitrogen and phosphorus wastewater treatment result in rapid local water quality improvements



Case Studies

- Back River Estuary
- Gunston Cove
- Potomac River
- Mattawoman Creek
- Patuxent River



Photo credit: Alexandra Fries, IAN Image Library

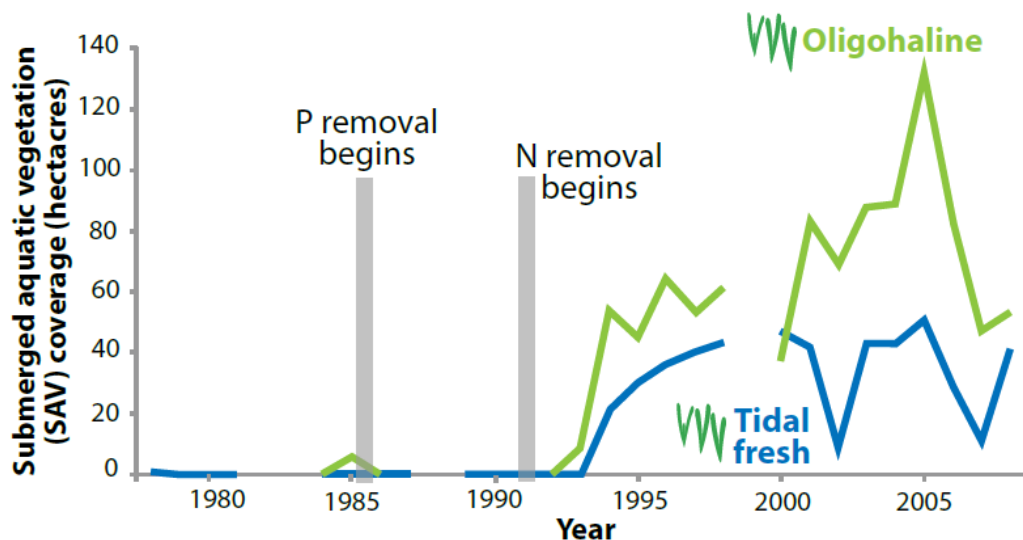


Photo credit: Cassie Gurbisz, UM
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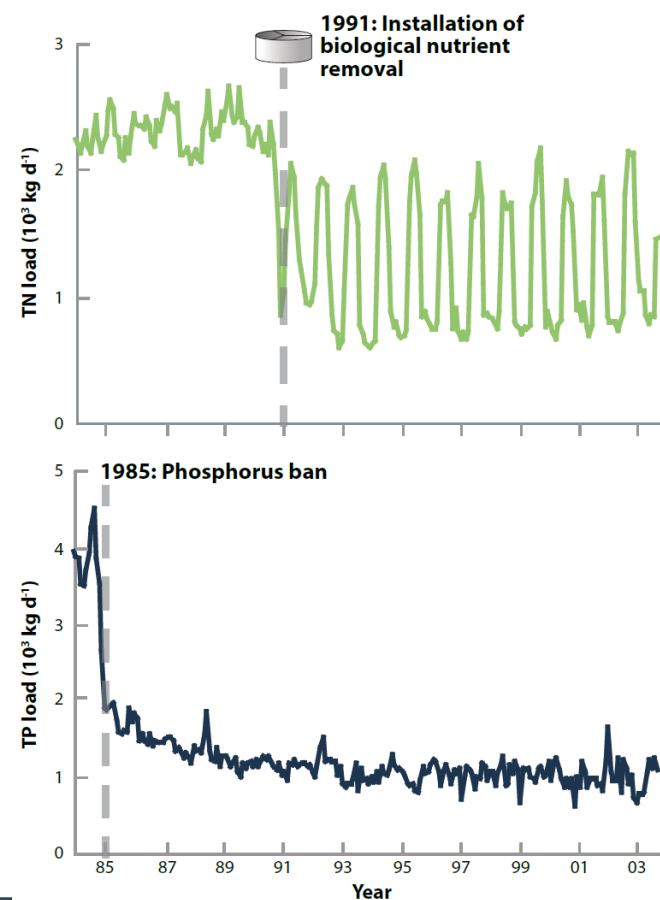
Upper Patuxent River

- Nutrient removal upgrades at WWTPs
- Decreases in phytoplankton, N and P
- Increases in SAV

Changes in SAV (1978-2008)



Changes in TN and TP Concentrations (1984-2004)



Data from Testa et al., 2008

Key Messages

- Chesapeake Bay is responding to Baywide TMDL and nutrient reduction strategies in some locations
- Must link nutrient source load reductions to water quality and habitat improvements
- Most nutrient reduction responses are due to point source upgrades on Maryland's western shore
- Non point source water quality improvements will take longer to achieve
- Must manage expectations for immediate response
- Need commitment to long-term monitoring to document success

QUESTIONS?

