Chesapeake Bay: the Science, the TMDL, the Models

Your Tour Guides for the Next 14 Hours:

James Davis-Martin

Chesapeake Bay Manager

Virginia Department of Environmental Quality

and

Rich Batiuk

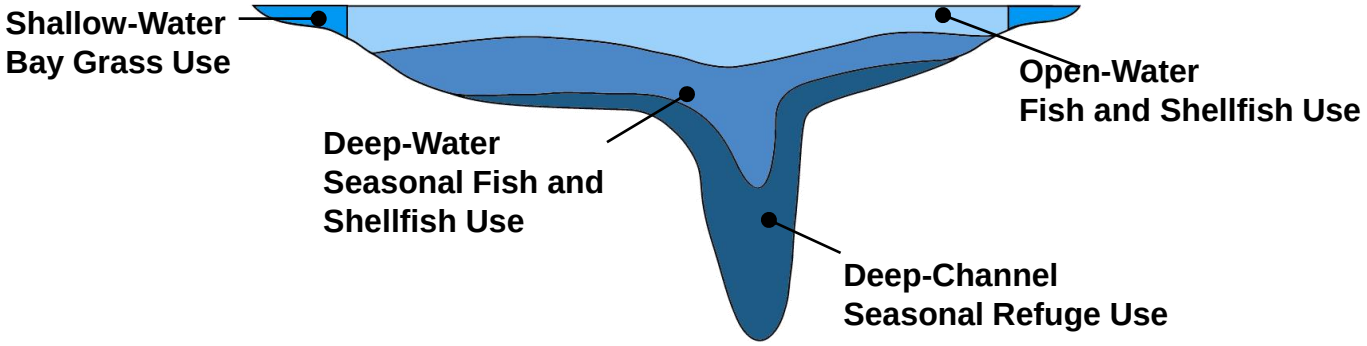
Associate Director for Science

U.S. EPA Chesapeake Bay Program Office

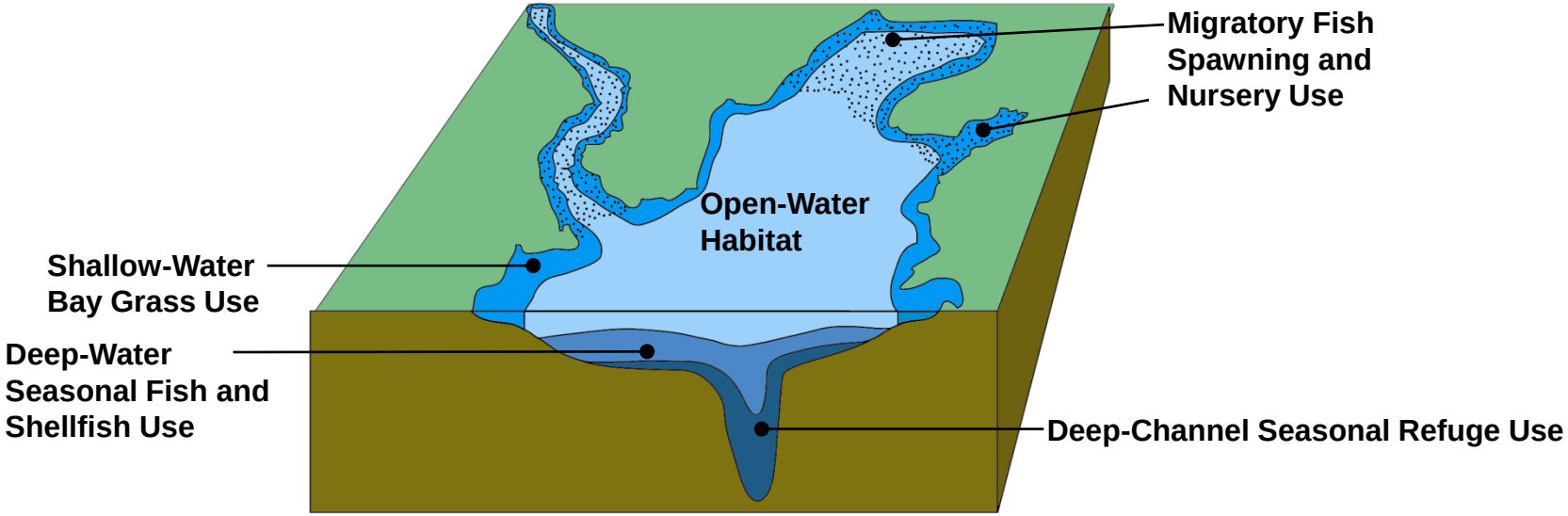
First, a Chesapeake Bay TMDL Primer

Clean Water Act Requires Protection of Designated Uses

A. Cross Section of Chesapeake Bay or Tidal Tributary



B. Oblique View of the “Chesapeake Bay” and its Tidal Tributaries



Source: U.S. EPA 2003

States Adopt Water Quality Standards to Protect Designated Uses

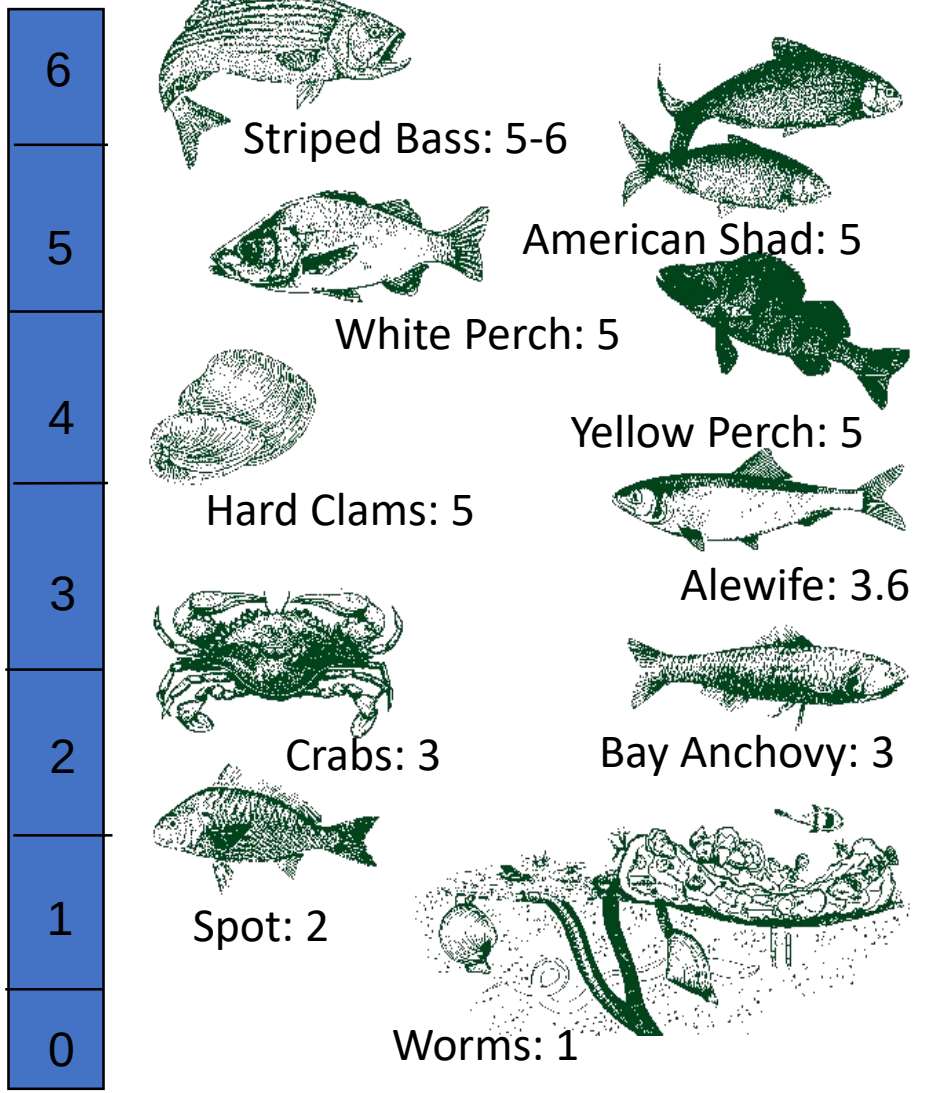
Minimum Amount of Oxygen (mg/L) Needed to Survive by Species

Migratory Fish Spawning & Nursery Areas

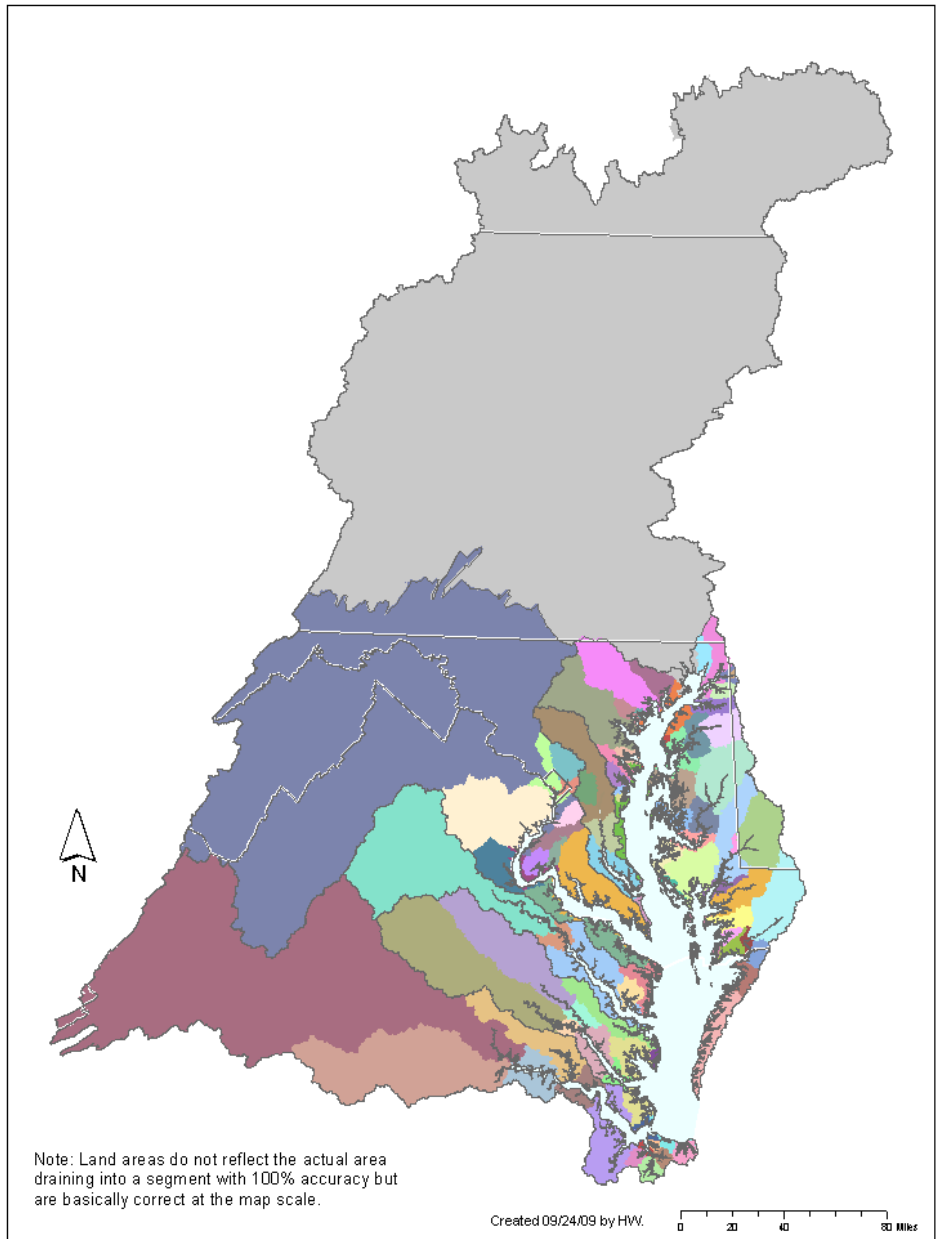
Shallow and Open Water Areas

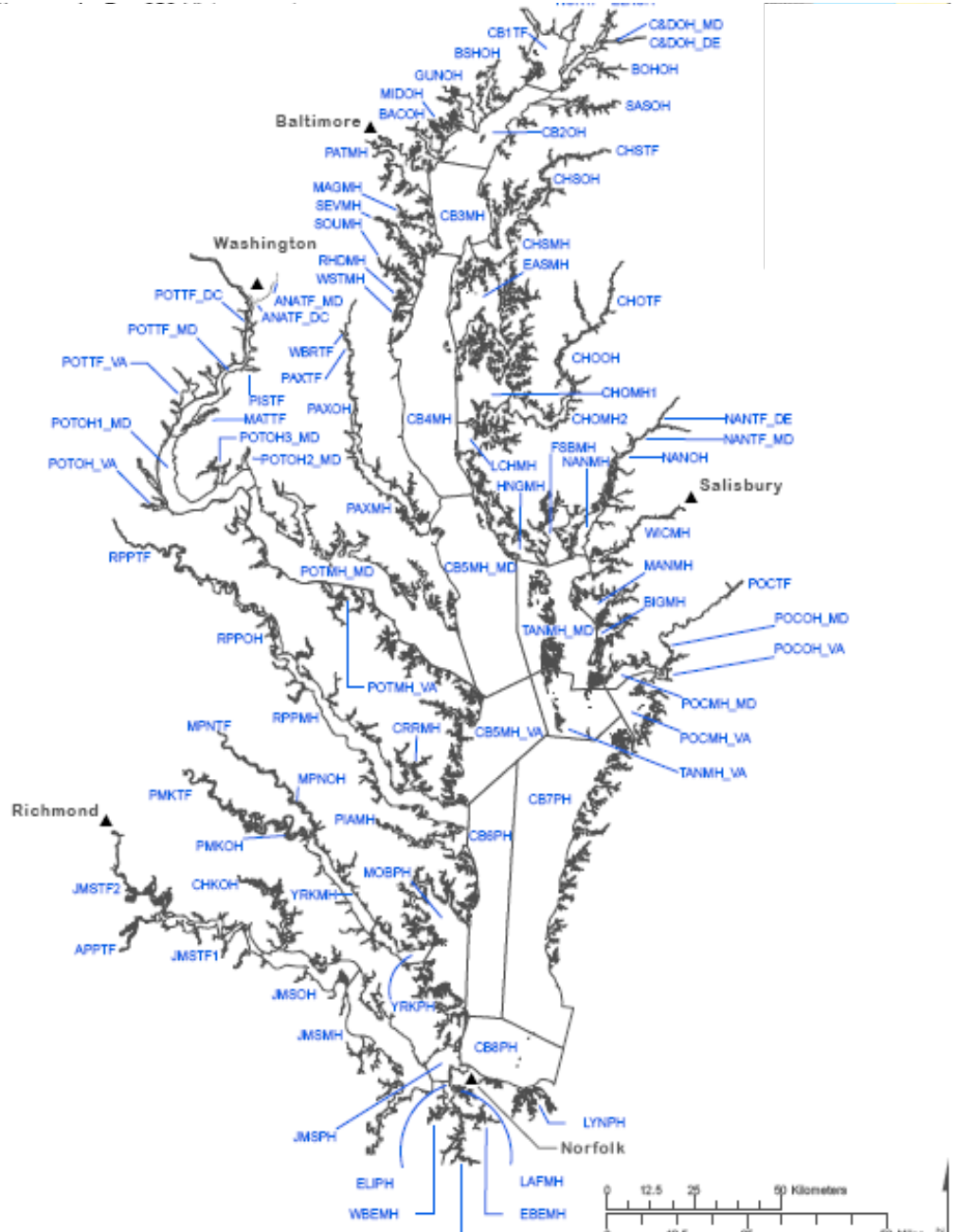
Deep Water

Deep Channel

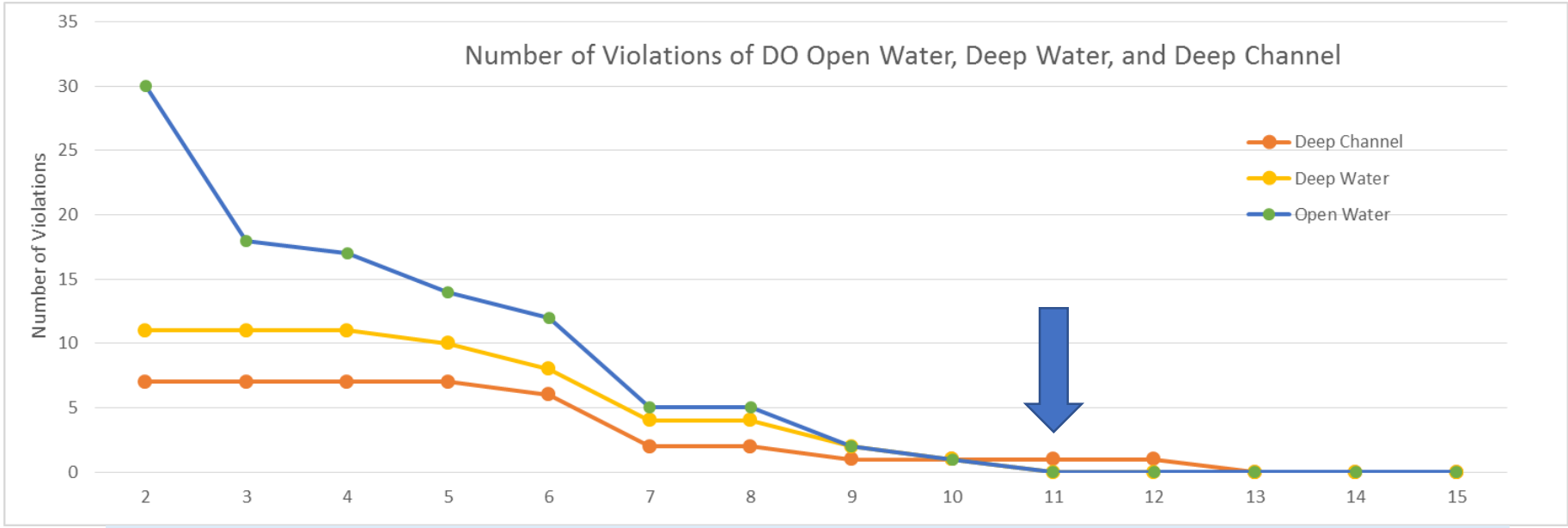


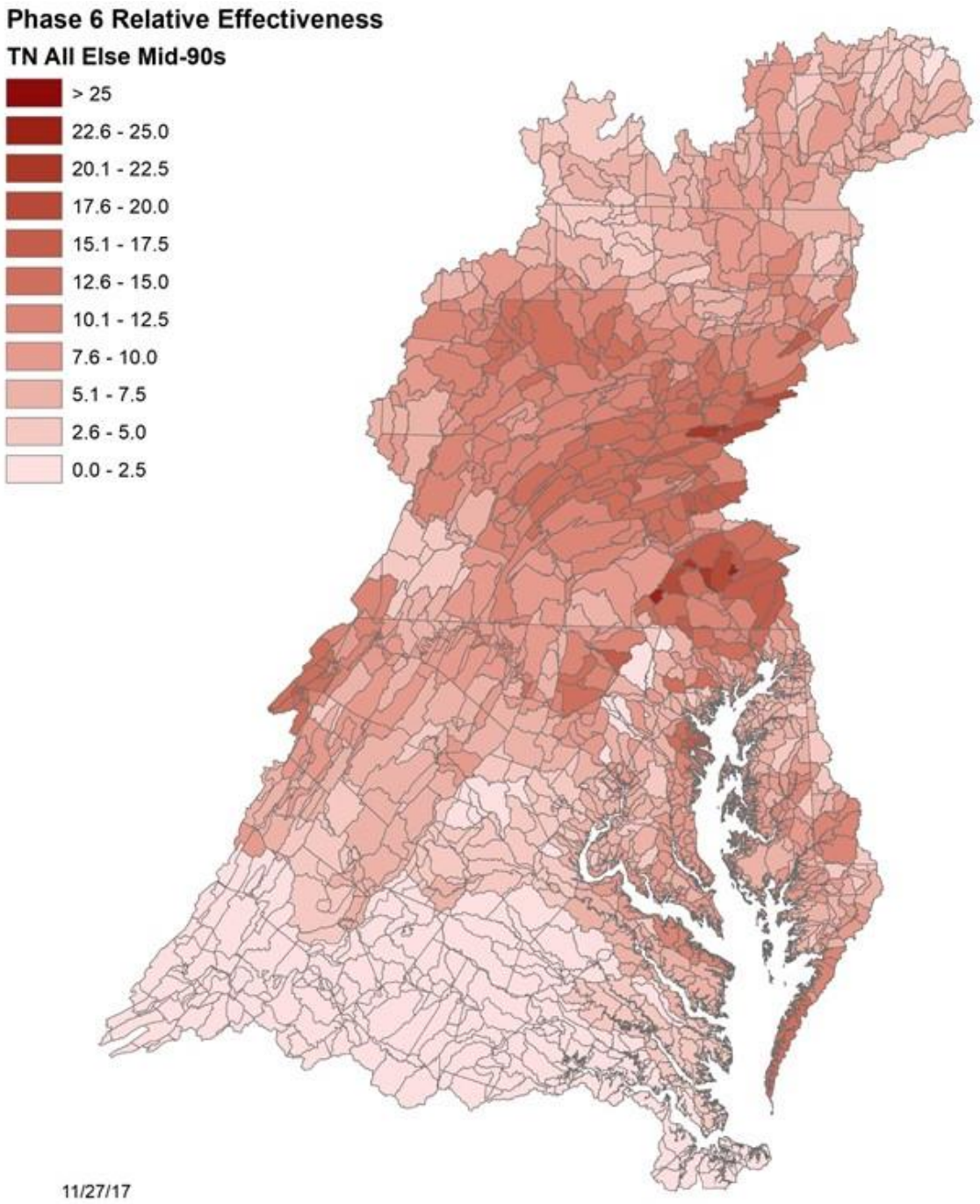
The Partners Established a Pollution Diet for Each Tidal Water Segment





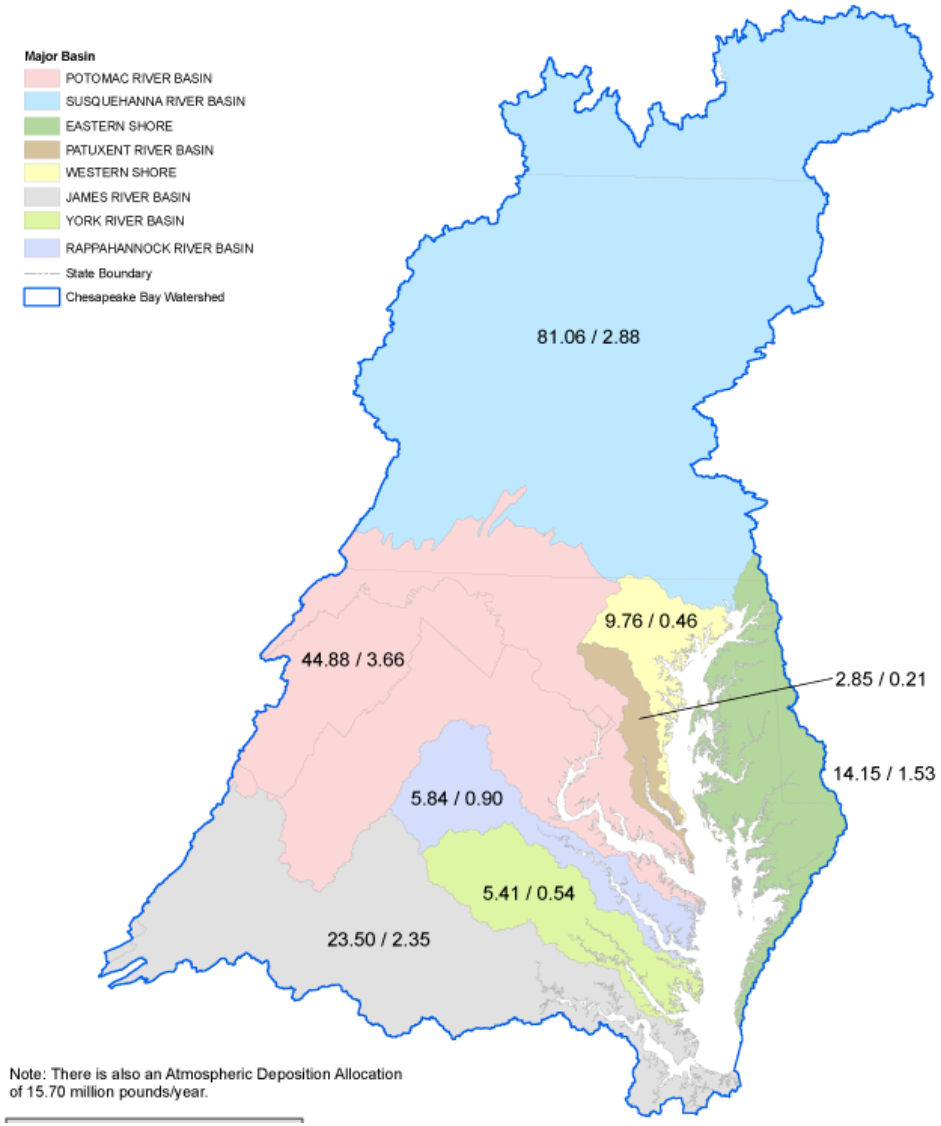
The Partners Uses a Suite of Models to Determine the Nutrient Loads Achieving the States' Water Quality Standards



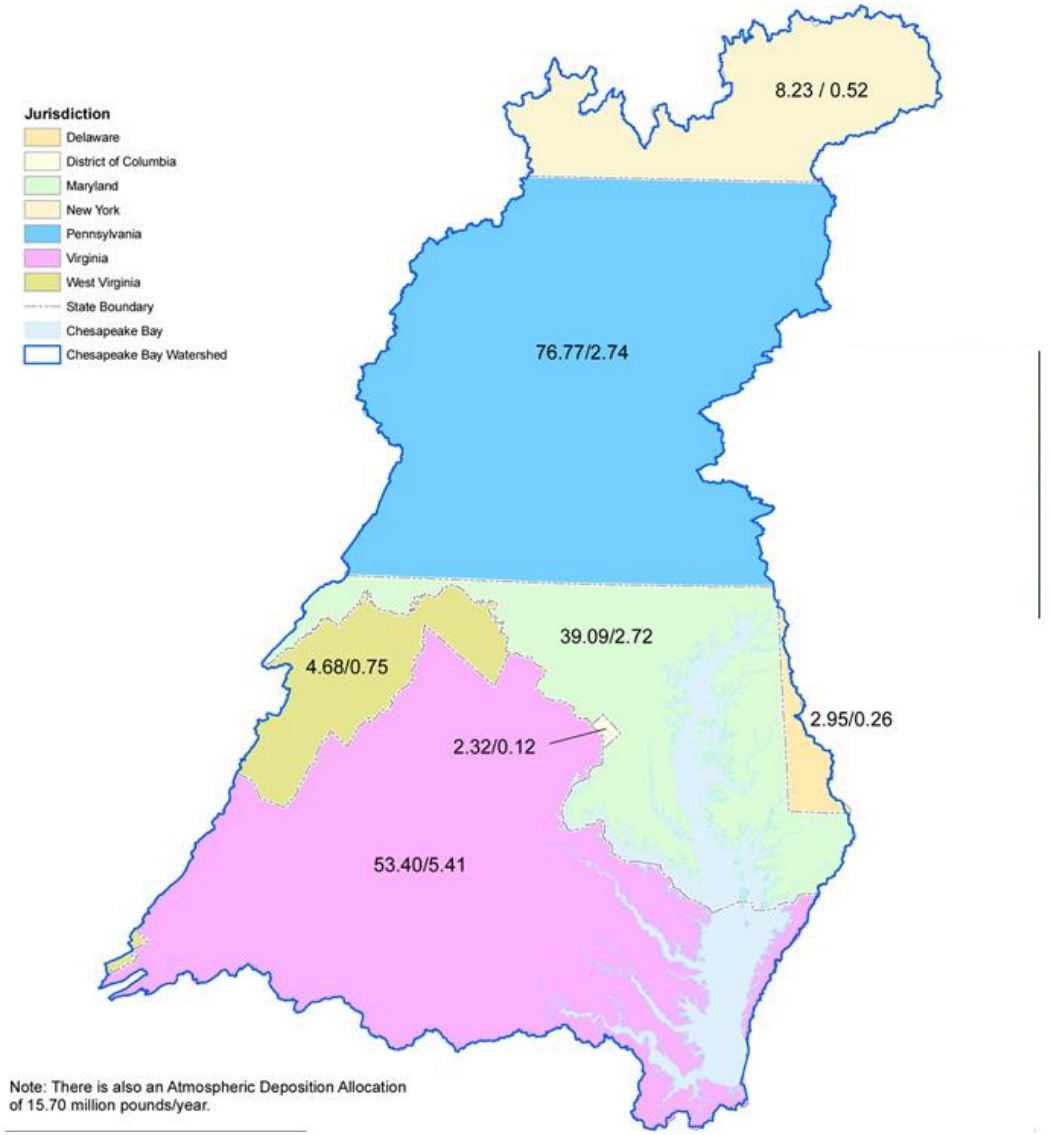


The Partnership uses a science-based approach to allocating responsibility for reducing nutrient and sediment loads necessary to meet states' Chesapeake Bay water quality standards

Pollution Diet by River



Pollution Diet by State

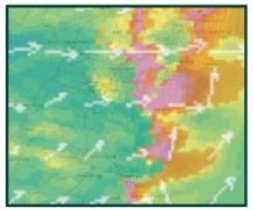


The Chesapeake Bay Program Partnership Uses a Suite of Models to Support Collaborative Decision Making…

Data and Model Inputs

Pollution Control Data
Land Use Data
Point Sources Data
Septic Data
U.S. Census Data
Agricultural Data

Land Use Change Model



Airshed Model

Precipitation Data
Meteorological Data
Elevation Data
Soil Data

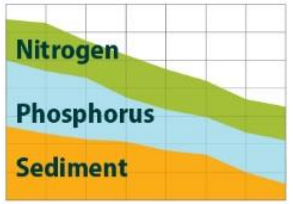
Phase 6 Watershed Model/CAST

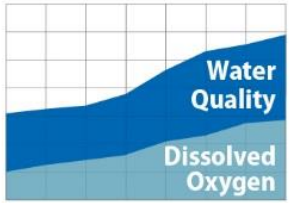
Estuary Model

Model Outputs

Prediction of Impacts

BMP Implementation Results





…But Most Partners Think in Terms of the Chesapeake Bay Watershed Model as THE MODEL

Phase 6 Model Structure

Average Load + Δ Inputs * Sensitivity

*

Land Use Acres

*

BMPs

*

Land to Water

*

Stream Delivery

*

River Delivery

Direct Loads

Phase 6

Keep It Simple

Average Load + ΔInputs * Sensitivity

*

Land Use Acres

*

BMPs

*

Land to Water

*

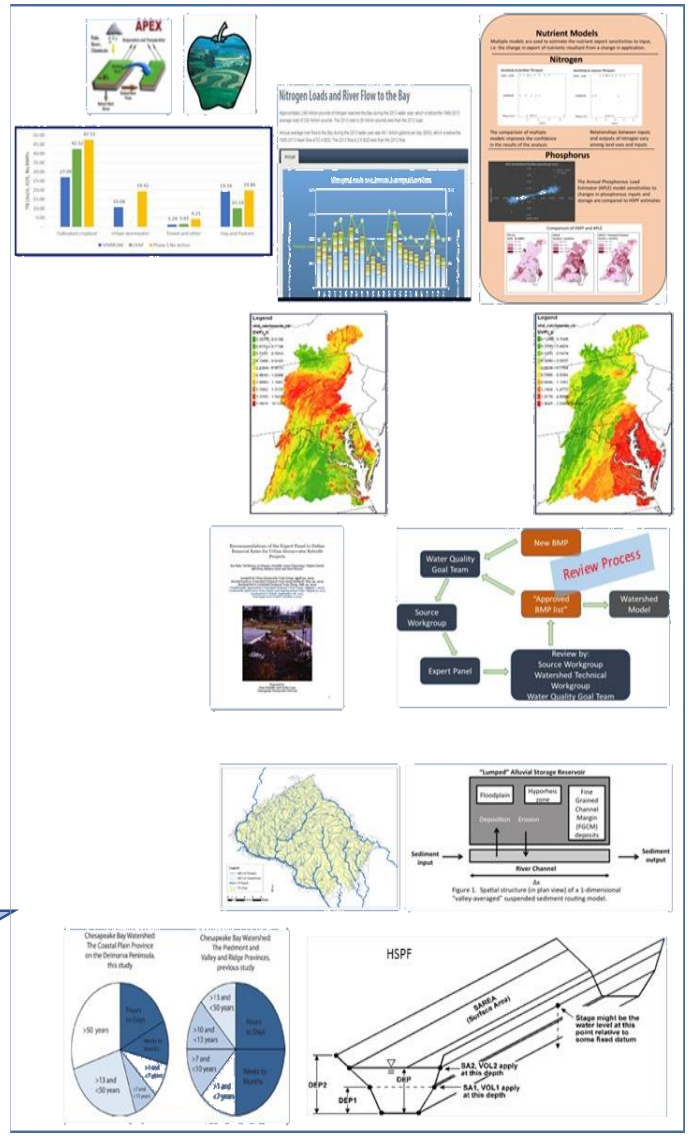
Stream Delivery

*

River Delivery

Direct Loads

Include Everything



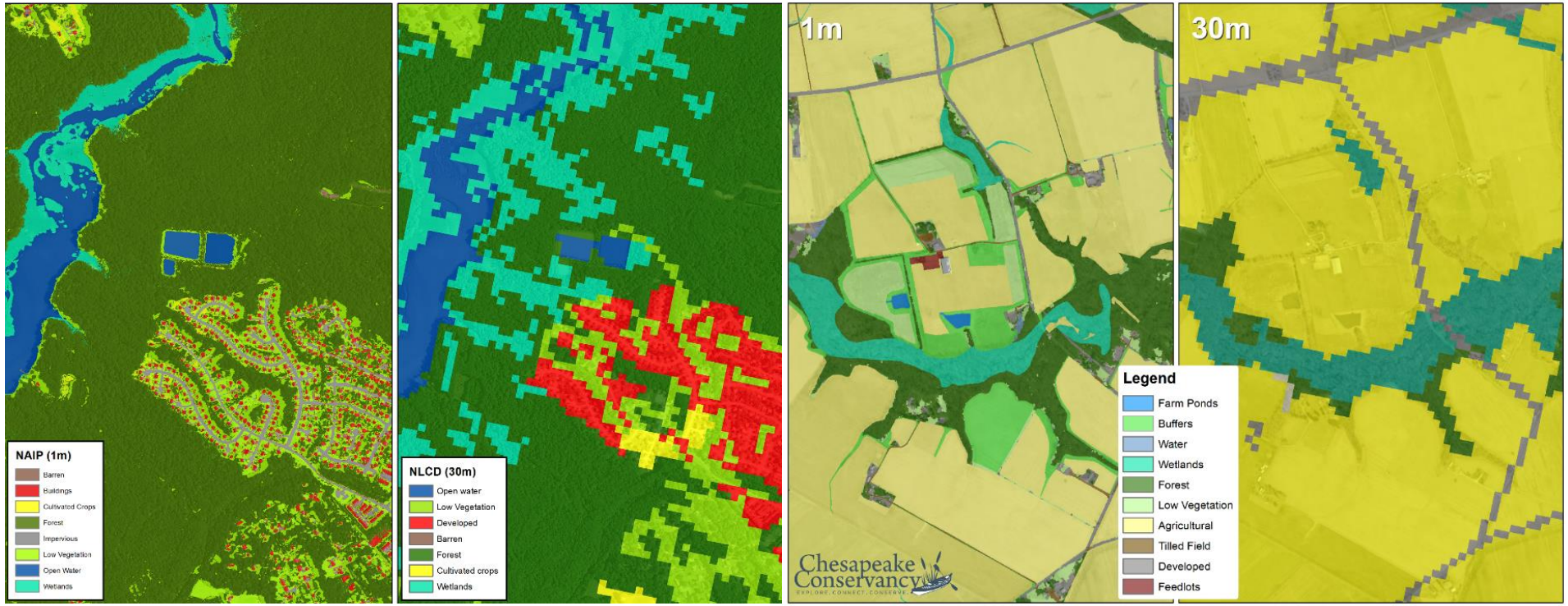
Models

- CBP Phase 5.3.2
- USGS SPARROW
- USDA CEAP
- HSPF
- APLE
- RUSLE
- USGS-Modflow

Let's Briefly Explore How the Partners Have Used Science, Data, and Monitoring to Confidently Simulate the Watershed

Partnership's Phase 6 Watershed Model is Built on High Resolution & Local Land Cover and Land Use Data

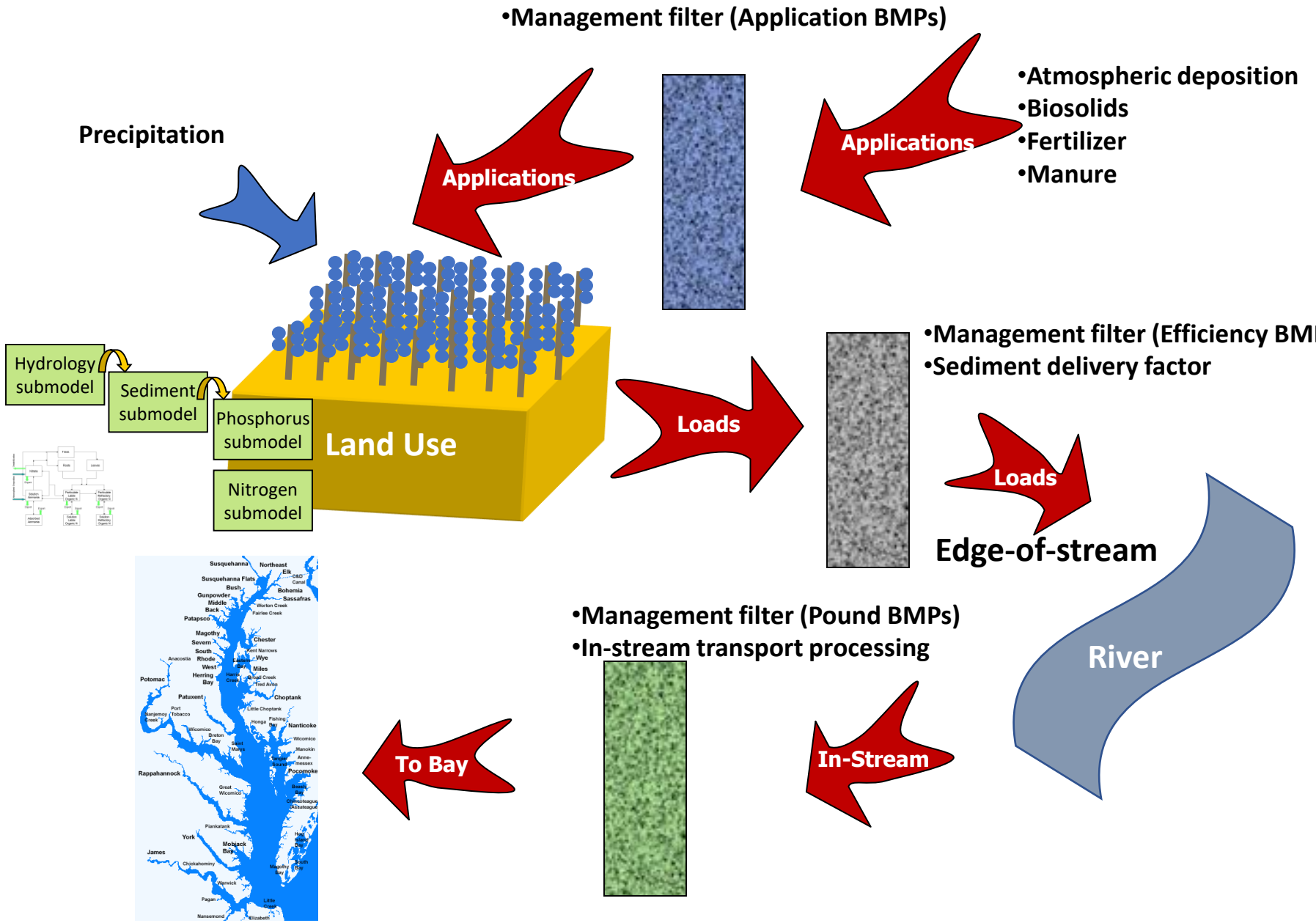
1 Meter | 30 Meter | 1 Meter | 30 Meter



Urban/Suburban Settings | **Rural Settings**

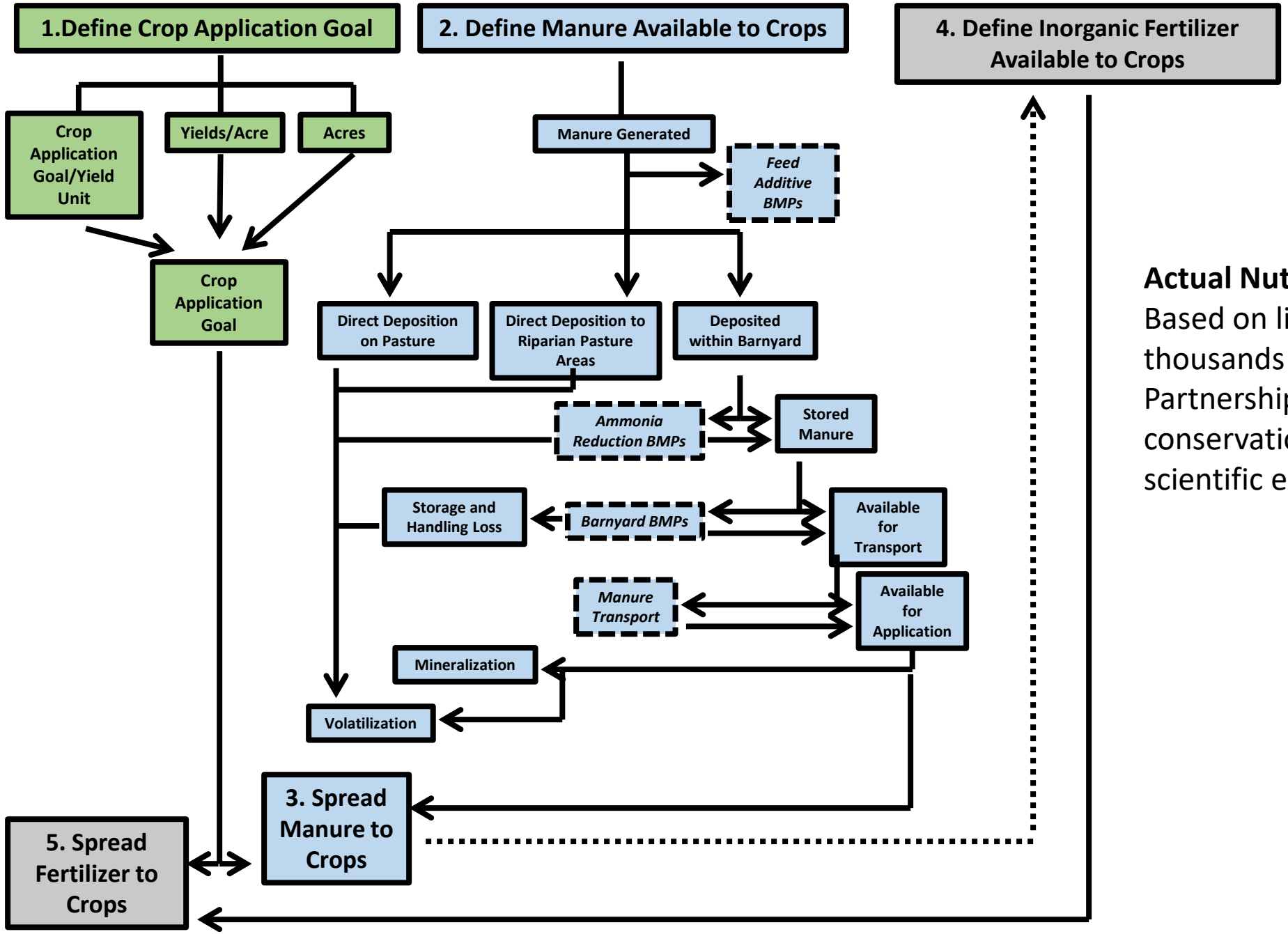
1 meter resolution land cover data for entire Bay watershed and all of Virginia supplemented by local government's submission of local land cover, land use, planning and zoning data

How the Partners Account for Estimated Reductions Based on Reported Practices



Nutrient Spread Components: Easy Version

1) Define Crop Application Goal
2) Define Manure Available to Crops
3) Spread Manure to Crops
4) Define Inorganic Fertilizer Available to Crops
5) Spread Inorganic Fertilizer to Crops

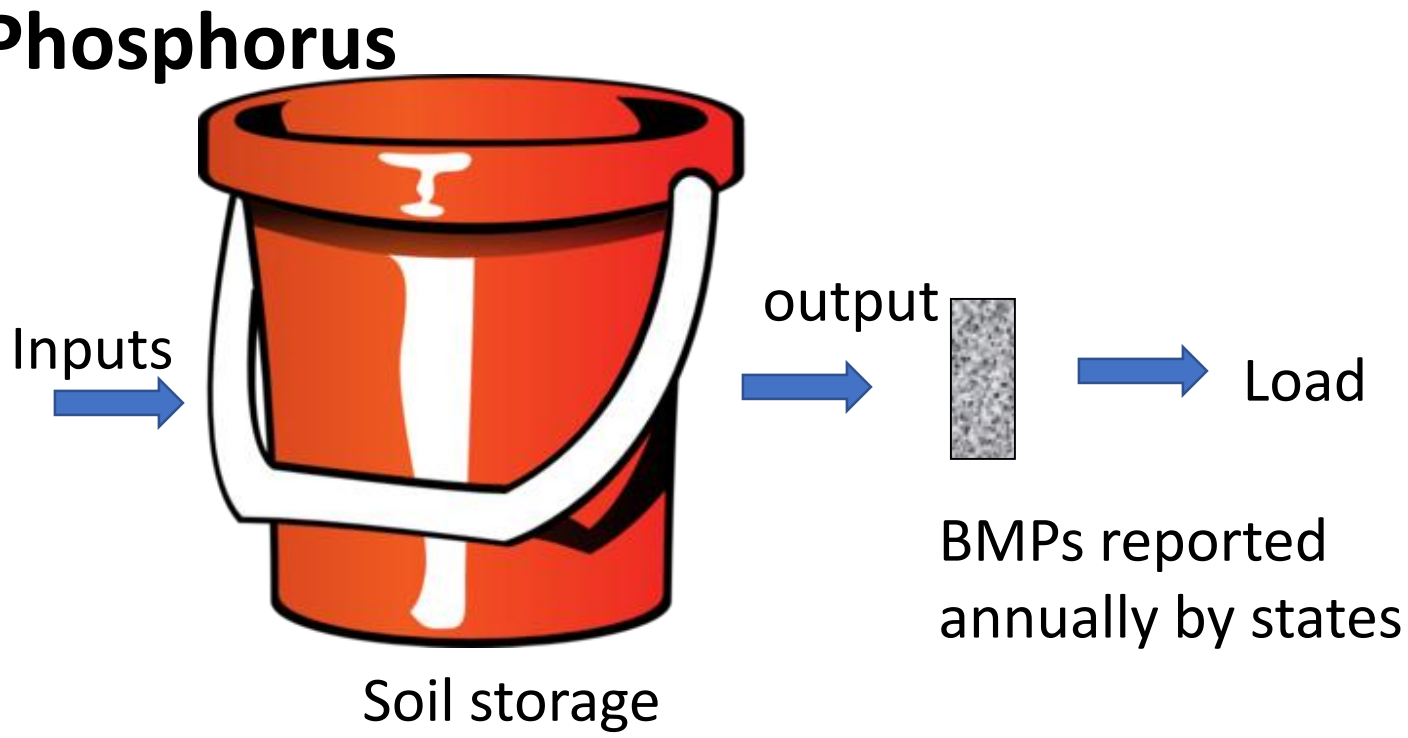


Actual Nutrient Spread:
Based on literally thousands of decisions by Partnership agency, conservation district and scientific experts

How Phosphorus is Modeled

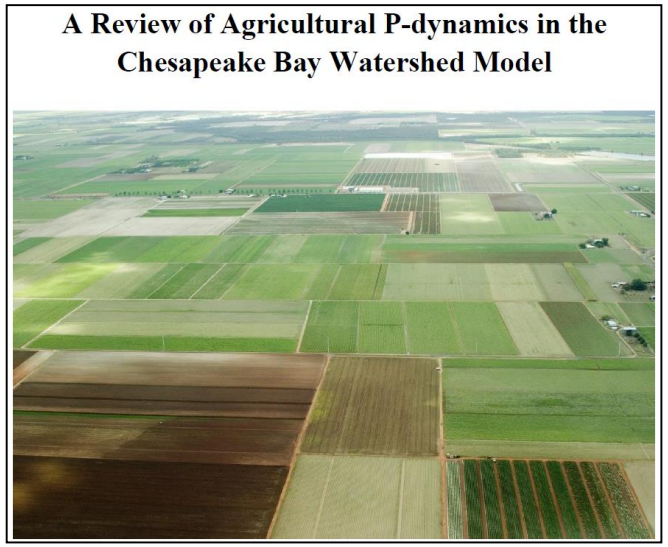
Inputs:
- Fertilizer
- Manure

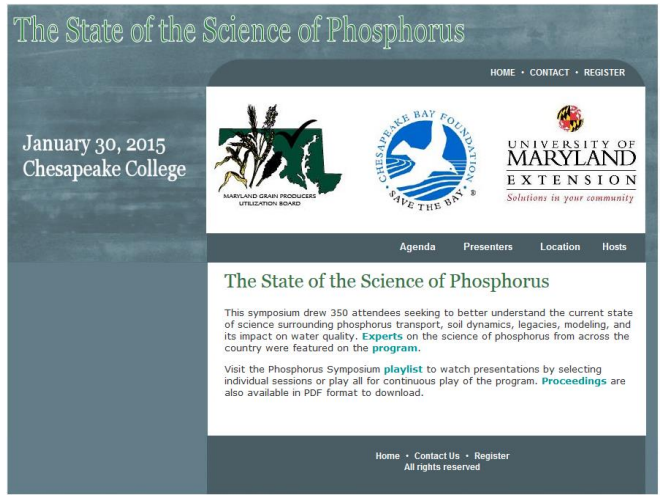
Influenced by:
- Fertilizer sales
- Ag animal populations
- % Nutrient Management plans



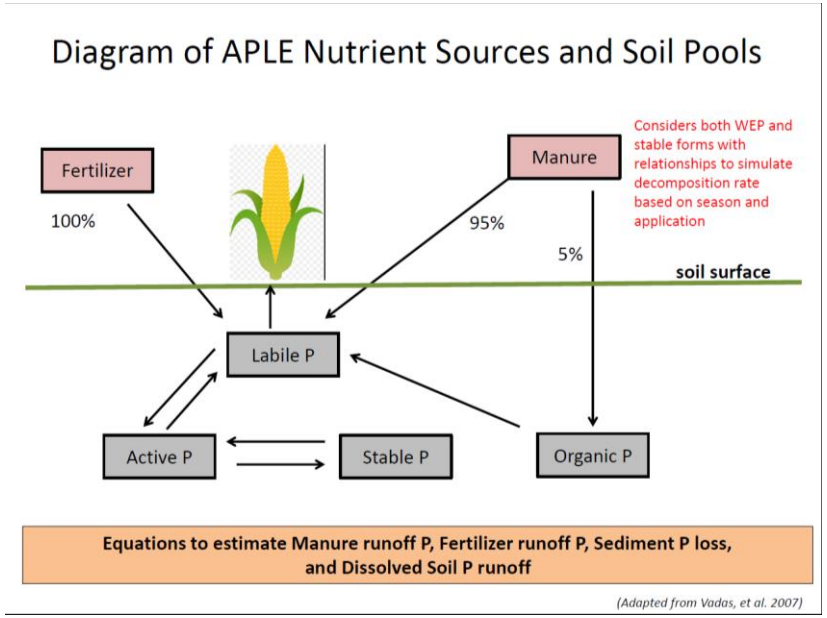
- State P soil test data
- USDA APLE model
- Expert advice from external reviewers

Scientific Direction on Modeling Phosphorus

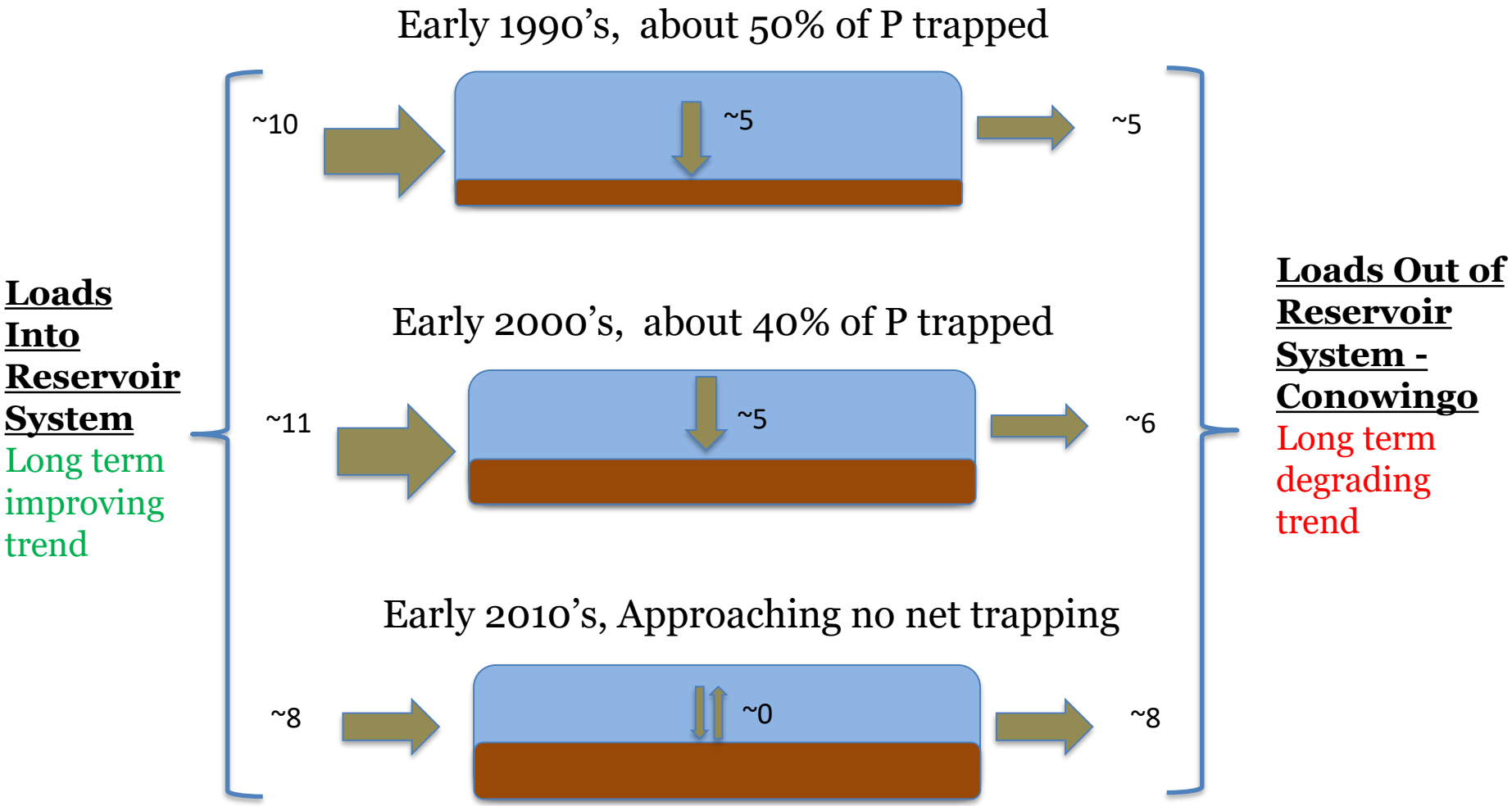




- **Track drawdown and buildup of soil P reservoirs by segment as a source of P runoff**
- **Get better manure, fertilizer, application method, and soil P data**
- **Account for management (method, timing, tillage, etc)**



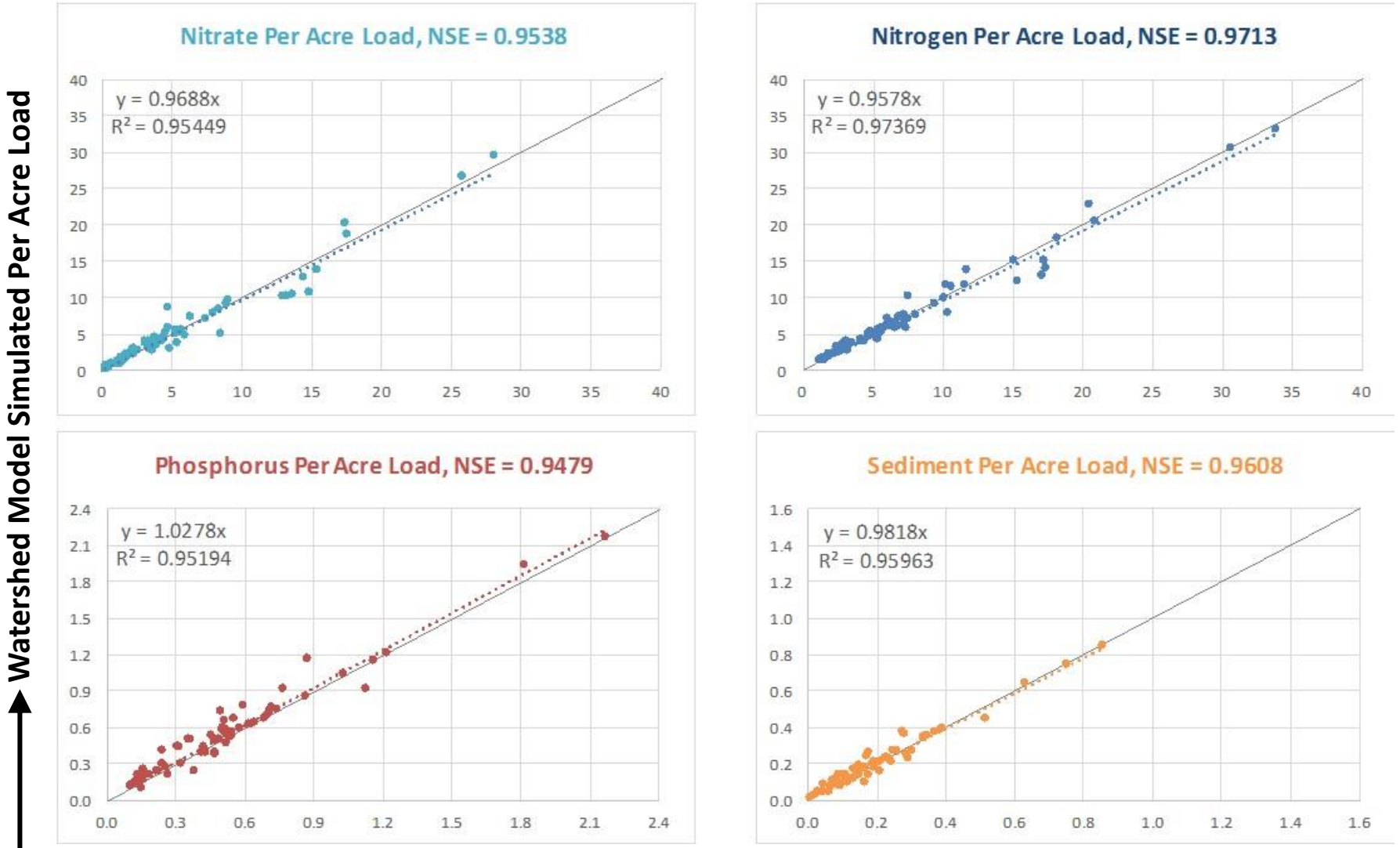
The Partnership's Model Simulate the Loss of Trapping Capacity Behind Conowingo Dam to Support Policy Decision Making



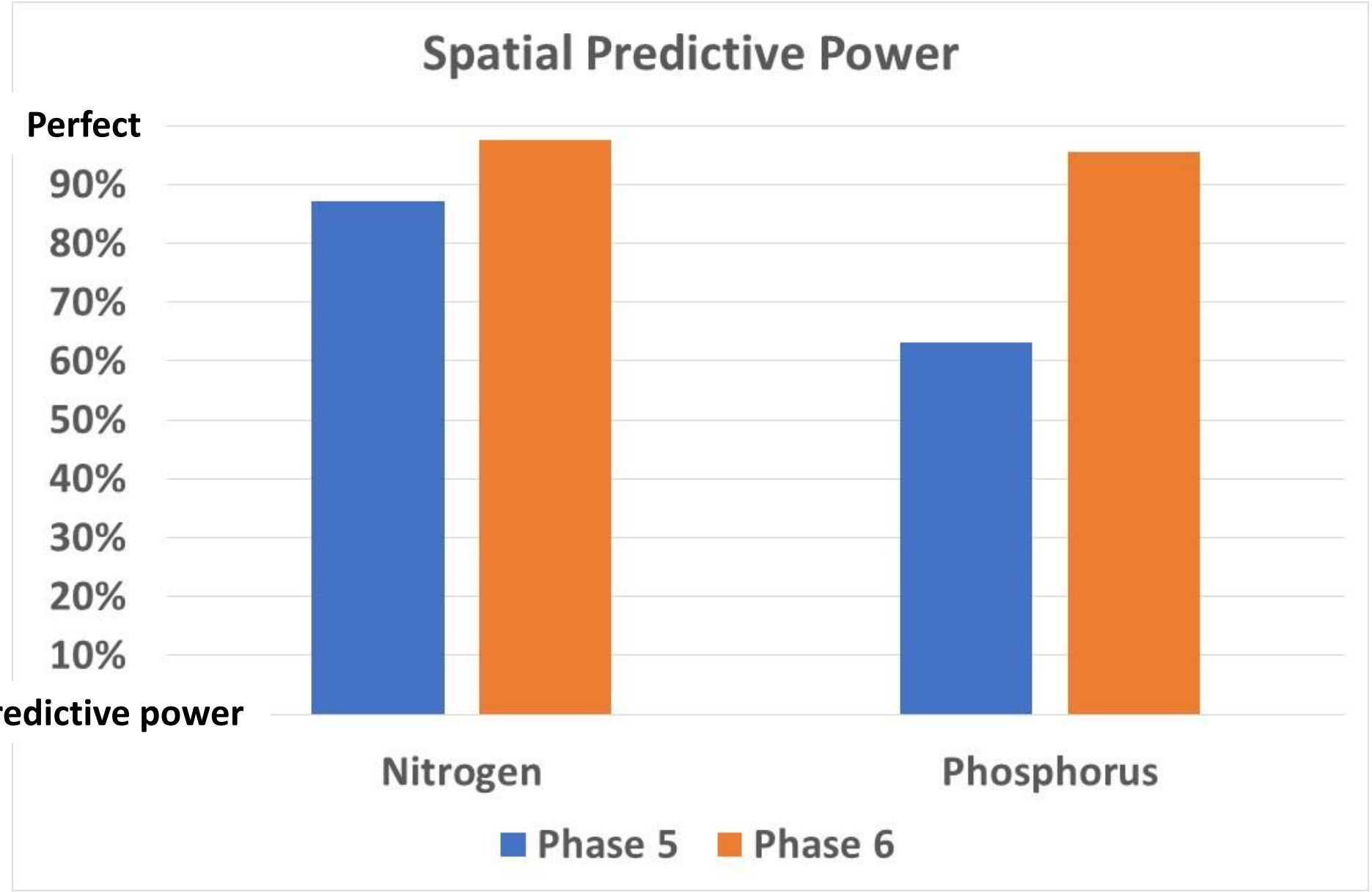
Source: Data from USGS (2016), http://cbrim.er.usgs.gov/loads_query.html
loads are approximate and in units of million lbs/year using estimates for 1992, 2002, and 2012

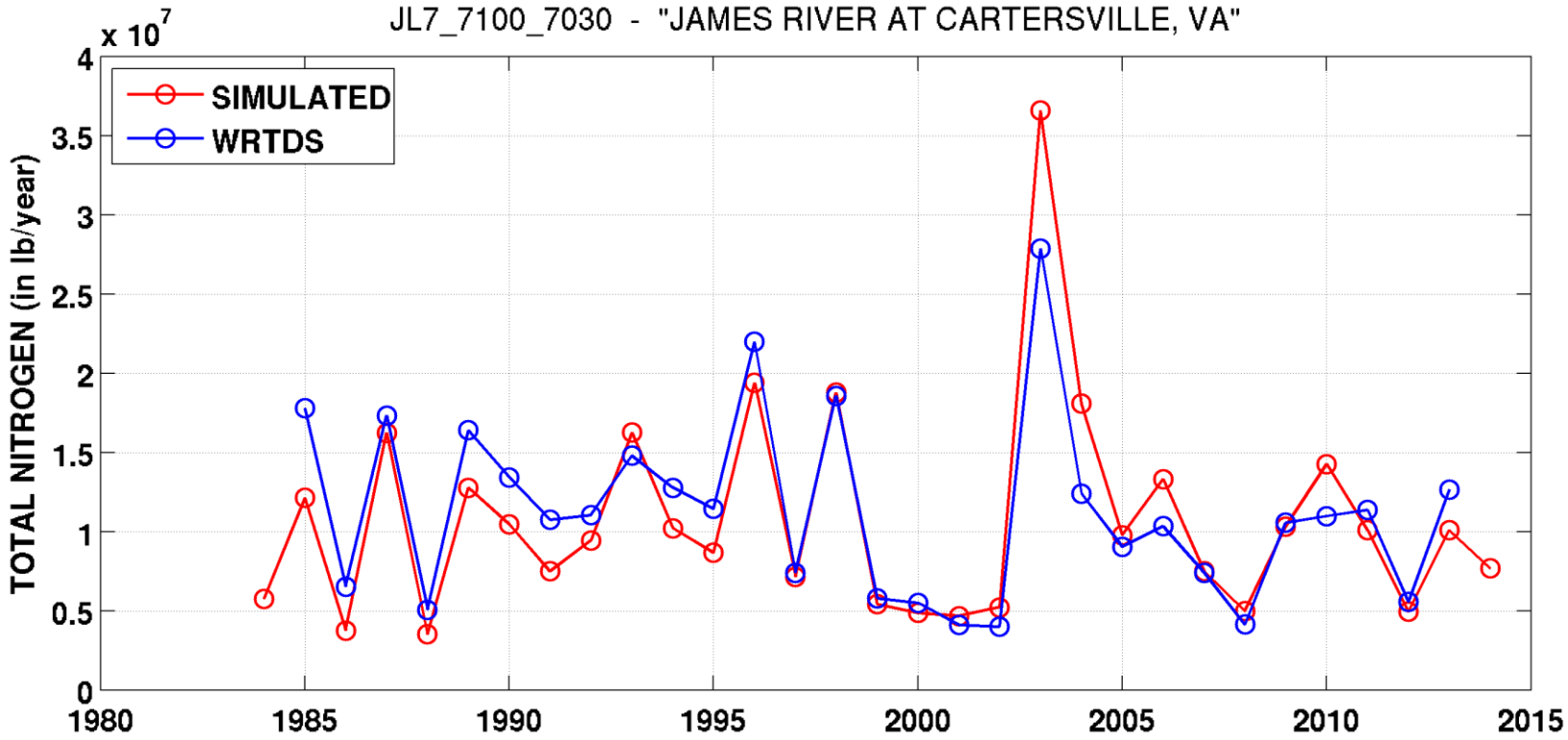
The Partnership Depends on Decades of Monitoring Data at Hundreds of Stations Across the Bay and Watershed to Calibrate its Models

Phase 6 Watershed Model Calibrated Using A LOT of Monitoring Data from Hundreds of Stations

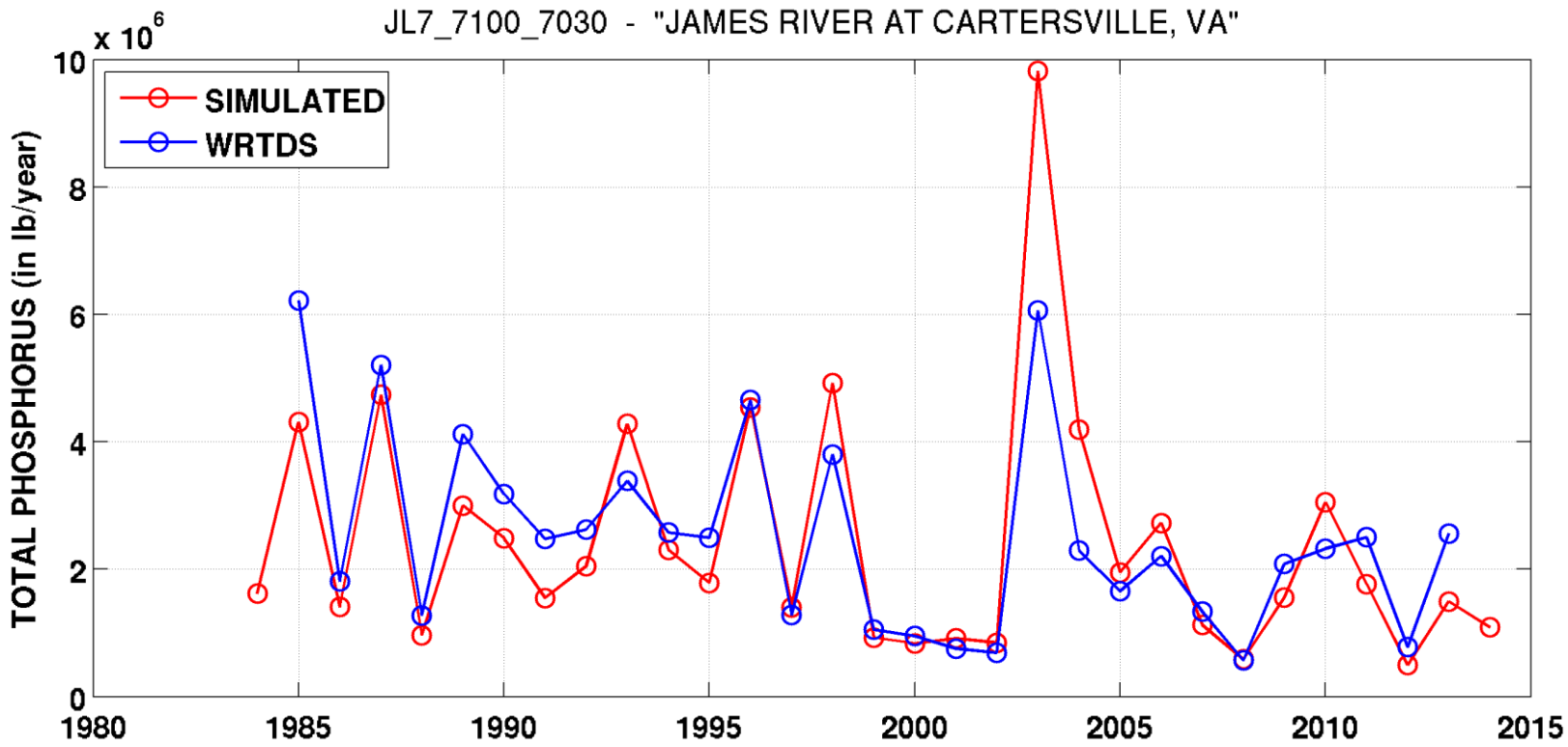


Phase 6 Model Much Improved over Phase 5 Model





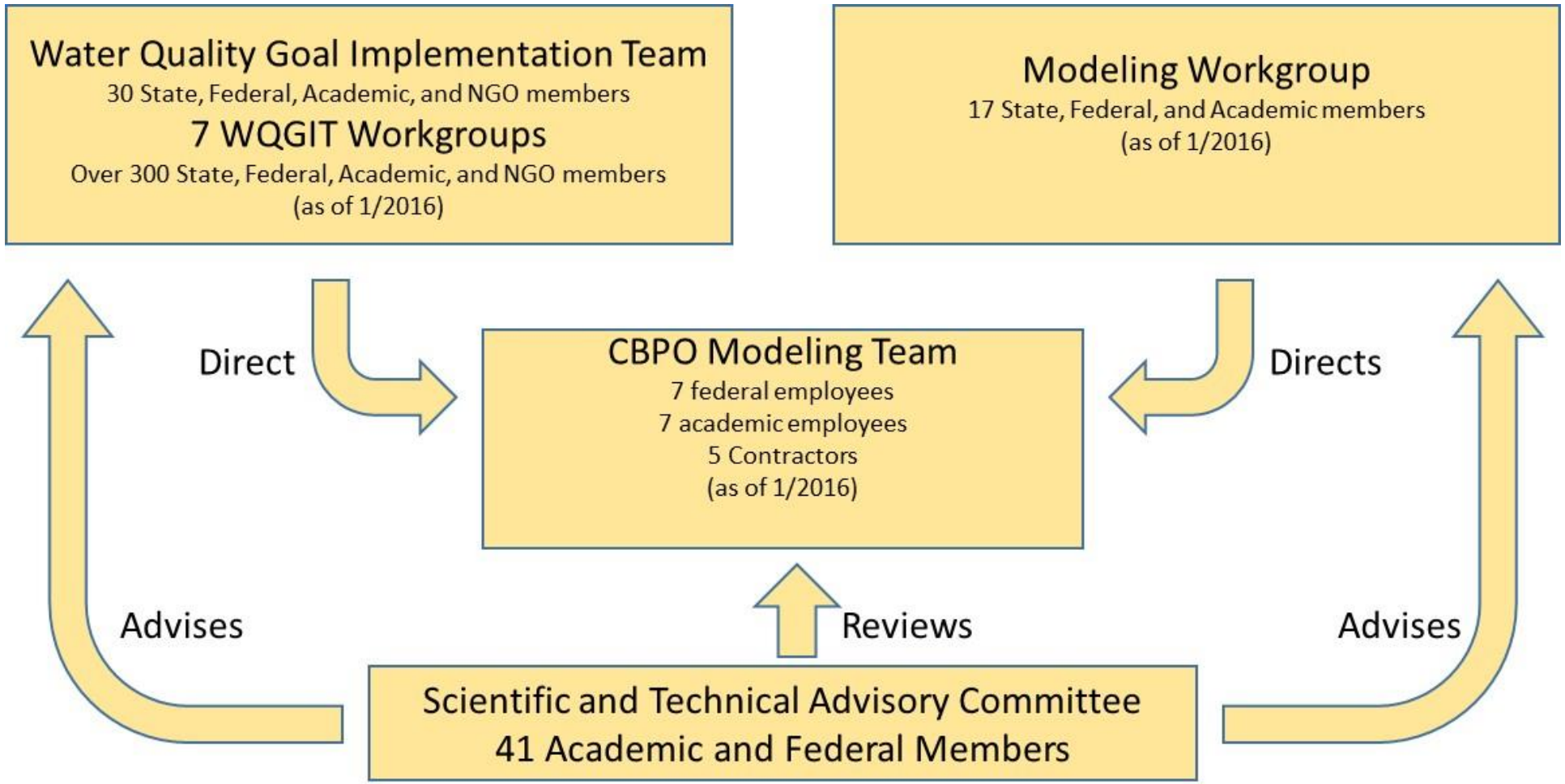
NSE of monthly nitrogen load	= 0.716
NSE of annual nitrogen load	= 0.737



NSE of monthly phosphorus load = 0.574

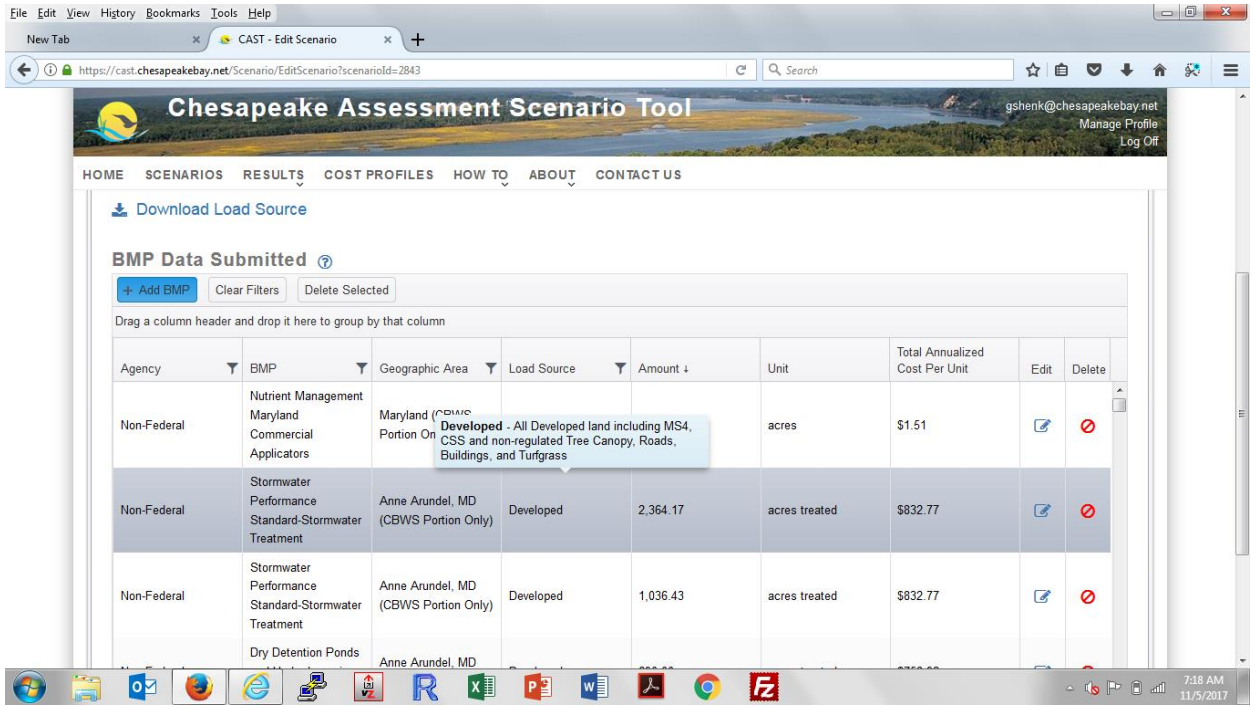
NSE of annual phosphorus load = 0.547

Partnership-Based Model Development, Review and Management Application



Chesapeake Bay Program Partnership's Phase 6 Watershed Model = CAST

- All users access the same Phase 6 Ches. Bay Watershed Model
- Users can generate their own scenarios
- Users can query output of their own or official Partnership scenarios
- Anyone can get an account
- Training available



Cast.chesapeakebay.net

Questions








Contact us for More Information:

Rich Batiuk

Associate Director for Science

U.S. EPA Chesapeake Bay Program Office

410-267-5731 Work

443-223-7823 Mobile

batiuk.richard@epa.gov

www.chesapeakebay.net

James Davis-Martin

Chesapeake Bay Manager

Virginia Department of Environmental Quality

(804) 698-4298 Work

James.Davis-Martin@deq.virginia.gov

www.deq.virginia.gov

Chesapeake Bay Program
Science. Restoration. Partnership.

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY