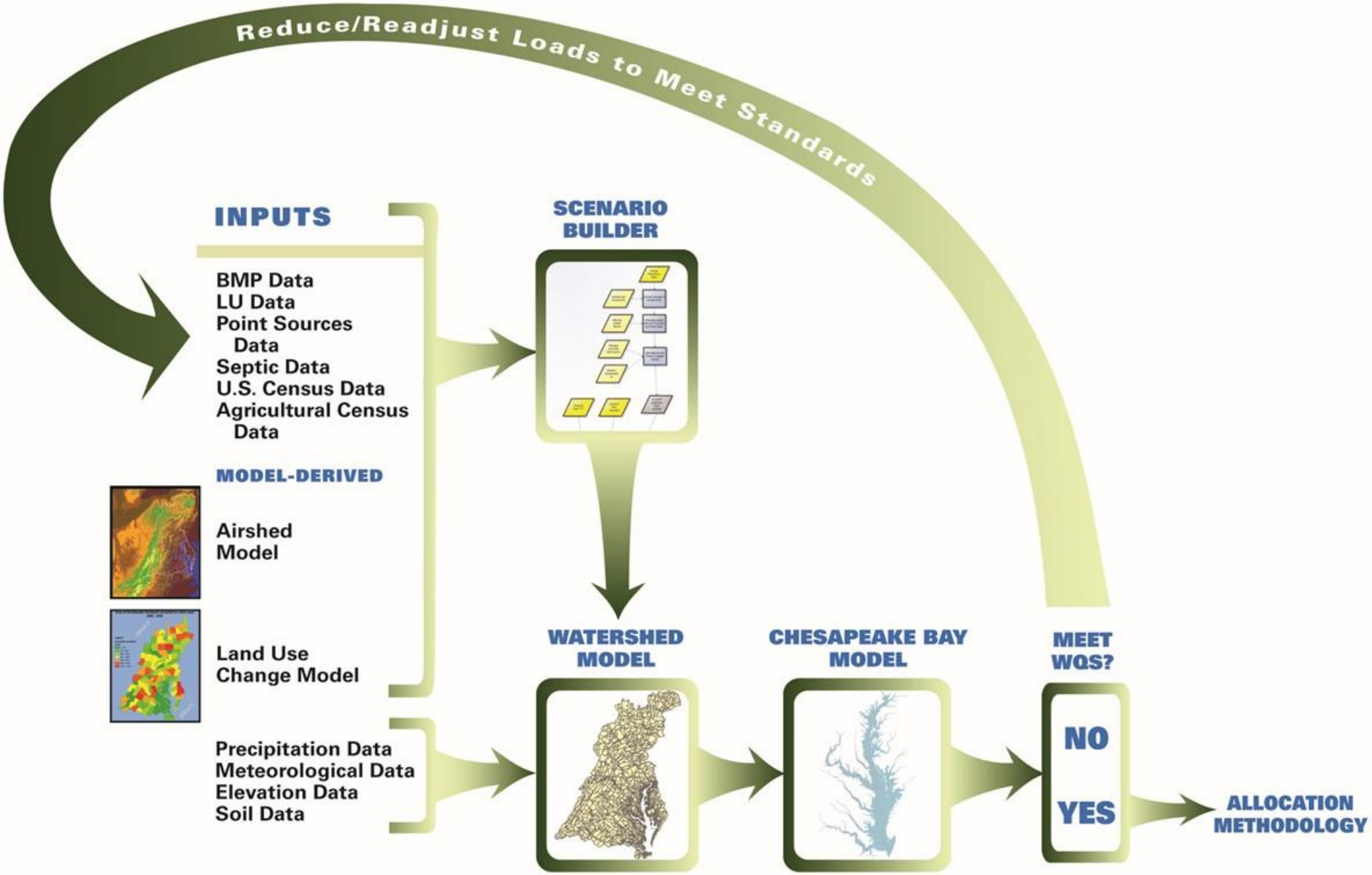
Chesapeake Bay Partnership Models



CBP Modeling Tools

Interaction Tools

NEIEN
Environmental Information exchange Network

CAST

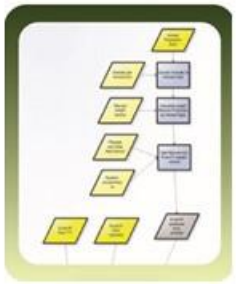
ChesapeakeStat
BayTAS
Chesapeake Bay TMDL Tracking and Accounting System

Decision Models/ Databases

Land Use Change Model

CMAQ
NOAA
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

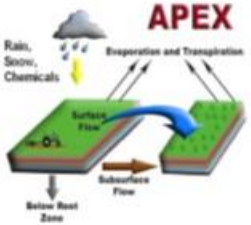
SCENARIO BUILDER



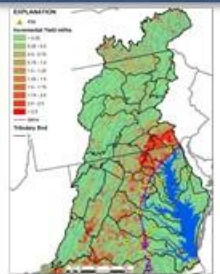
WATERSHED MODEL

Bay WQSTM

Related Tools



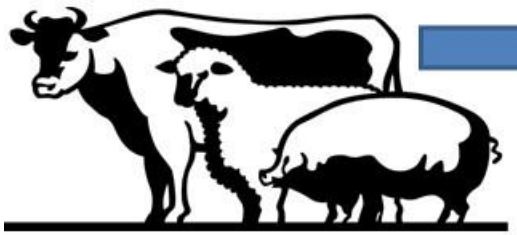
APLE



sparrow

Scenario Builder

Livestock



BMPs

Manure storage practice

BMPs

Crops

Pasture

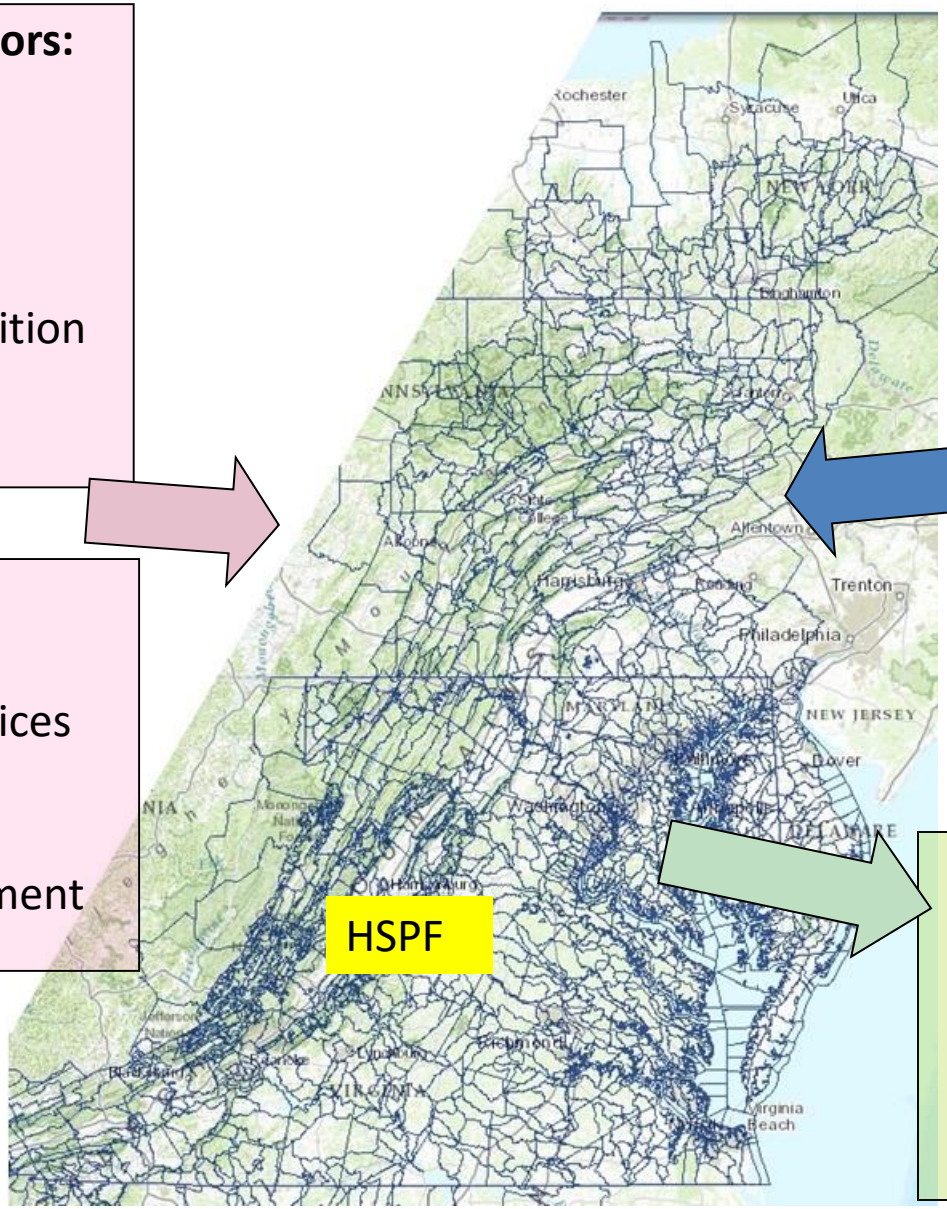
Fertilizer

Image Credits
https://utextension.tennessee.edu/lincoln/4-H/Pages/Livestock-Skillathons-%28Beef,-Sheep-and-Swine%29.aspx
Rebelwoodsranch.com
Seaburst.com
http://pubs.ext.vt.edu/442/442-308/442-308.html

CBP Partnership Watershed Model

Anthropogenic factors:
Land Use Acreage
Fertilizer
Manure
Crop types
Atmospheric deposition
Waste water
Septic

Management:
Land Use Changes
Conservation Practices
Urban BMPs
Emission changes
Waste water treatment



Hourly or daily values of Meteorological factors:

Precipitation
Temperature
Evapotranspiration
Wind
Solar Radiation
Dew point
Cloud Cover

Management Effect on Loads

Home | ChesapeakeStat

stat.chesapeakebay.net

States | Basins | Segments | Permitted Facilities

Go to: State, zip, address, etc. Go

Streets | Imagery

Phase II WIP Planning Targets

Show Original TMDL Allocations

Click on a map or chart feature or select from options below to view information by State.

Select: Watershed-Wide

Nitrogen | Phosphorus | Total Suspended Solids

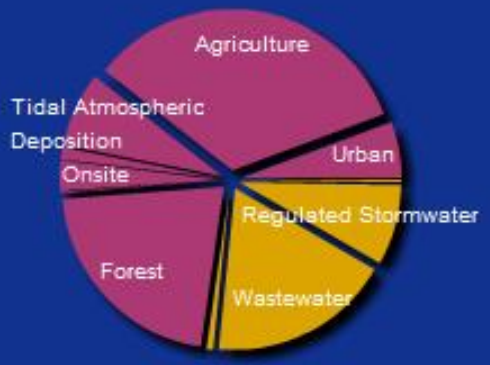
Watershed-Wide

Total 2025 Planning Target for Nitrogen:

208,071,430 lbs/year

Download Data

Total Nitrogen 2025 Planning Target by Sector:



Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by Bay jurisdictions.

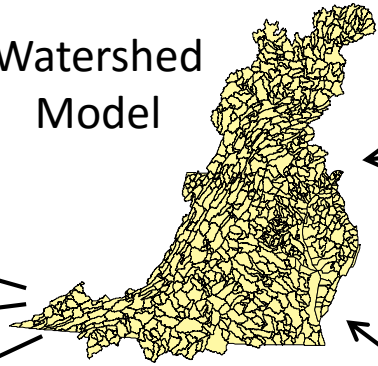
Lake Ontario
Toronto
Rochester
Buffalo
Erie
Lake Erie
Cleveland
Allentown
Philadelphia
Baltimore
Washington
Dover
Newport News
Virginia Beach
Norfolk
Chesapeake
Charlotte
300 km
100 mi
bing

TMDL Accountability Framework

1. Watershed Implementation Plans identify nutrient and sediment targets that meet water quality standards.

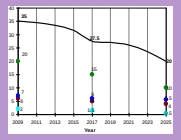
CAST

Watershed Model

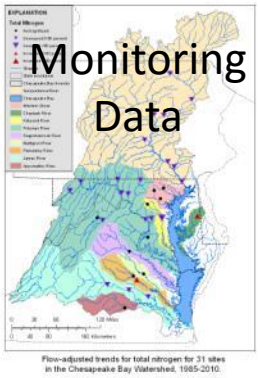


Land Change Model

2. 2-Year Milestones with programmatic and pollutant reduction commitments

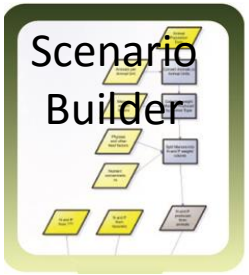


Monitoring Data



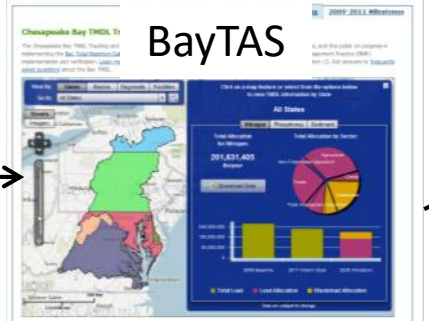
Flow-adjusted trends for total nitrogen for 31 sites in the Chesapeake Bay Watershed, 1985-2010.

Scenario Builder



3.Track and Assess Progress implementing WIPs and milestones

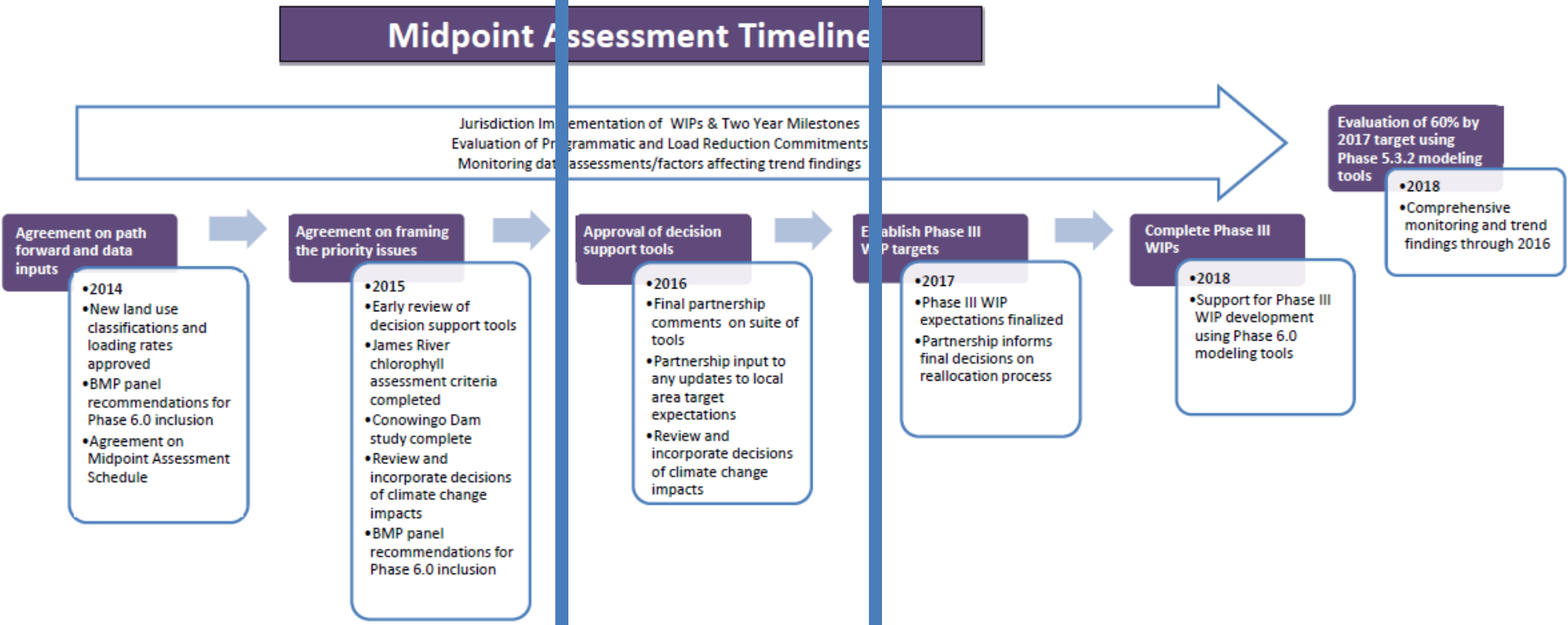
BayTAS



NEIEN

Environmental Information eXchange Network

4. Federal Actions if insufficient Watershed Implementation Plans or 2-year milestones



CREATE The Models

REVIEW The Models

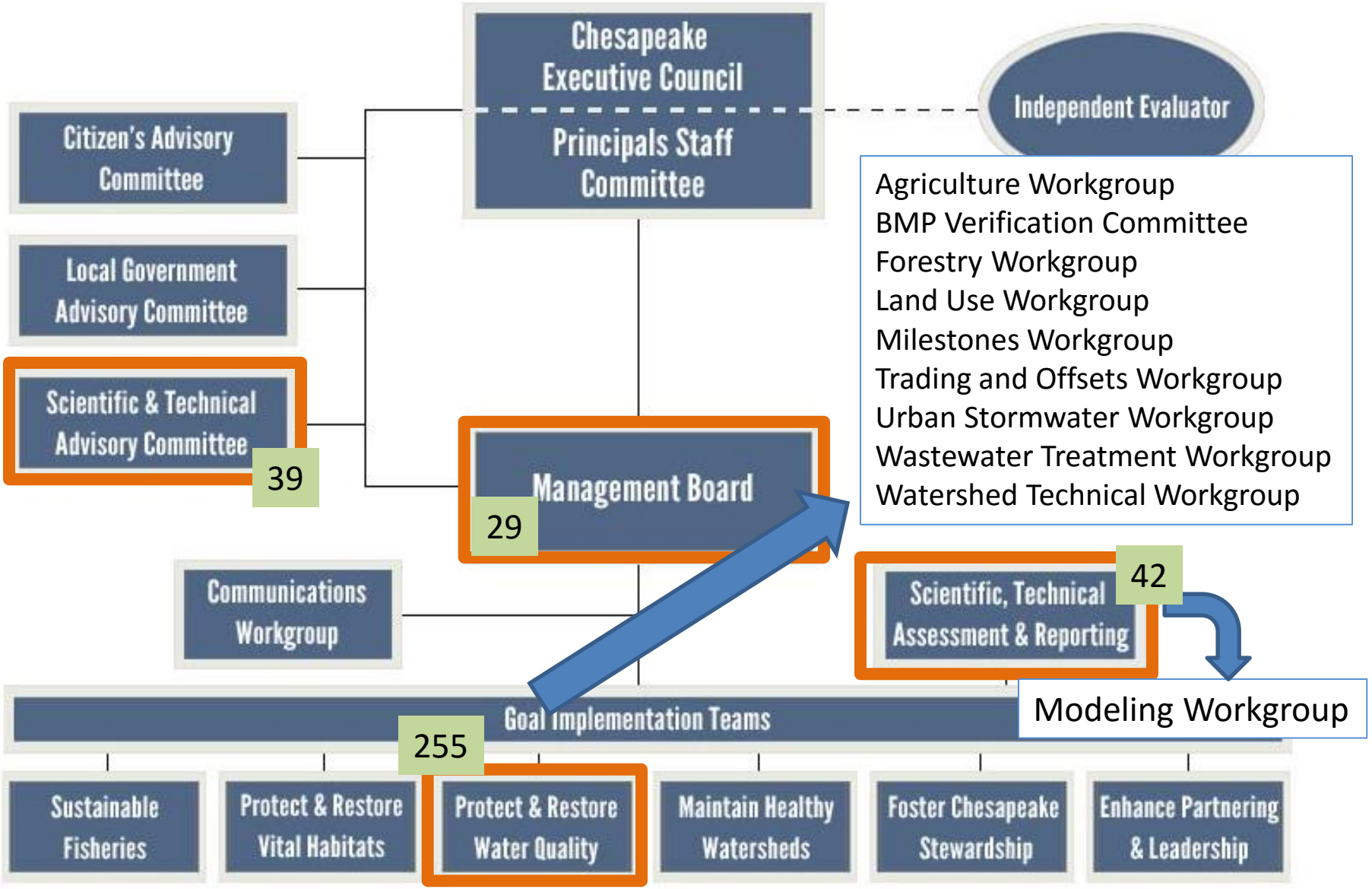
USE The Models

4 months of development to go

Expect changes

Model related Membership as of 7/2013 – 365 individuals

Chesapeake Bay Program Partnership



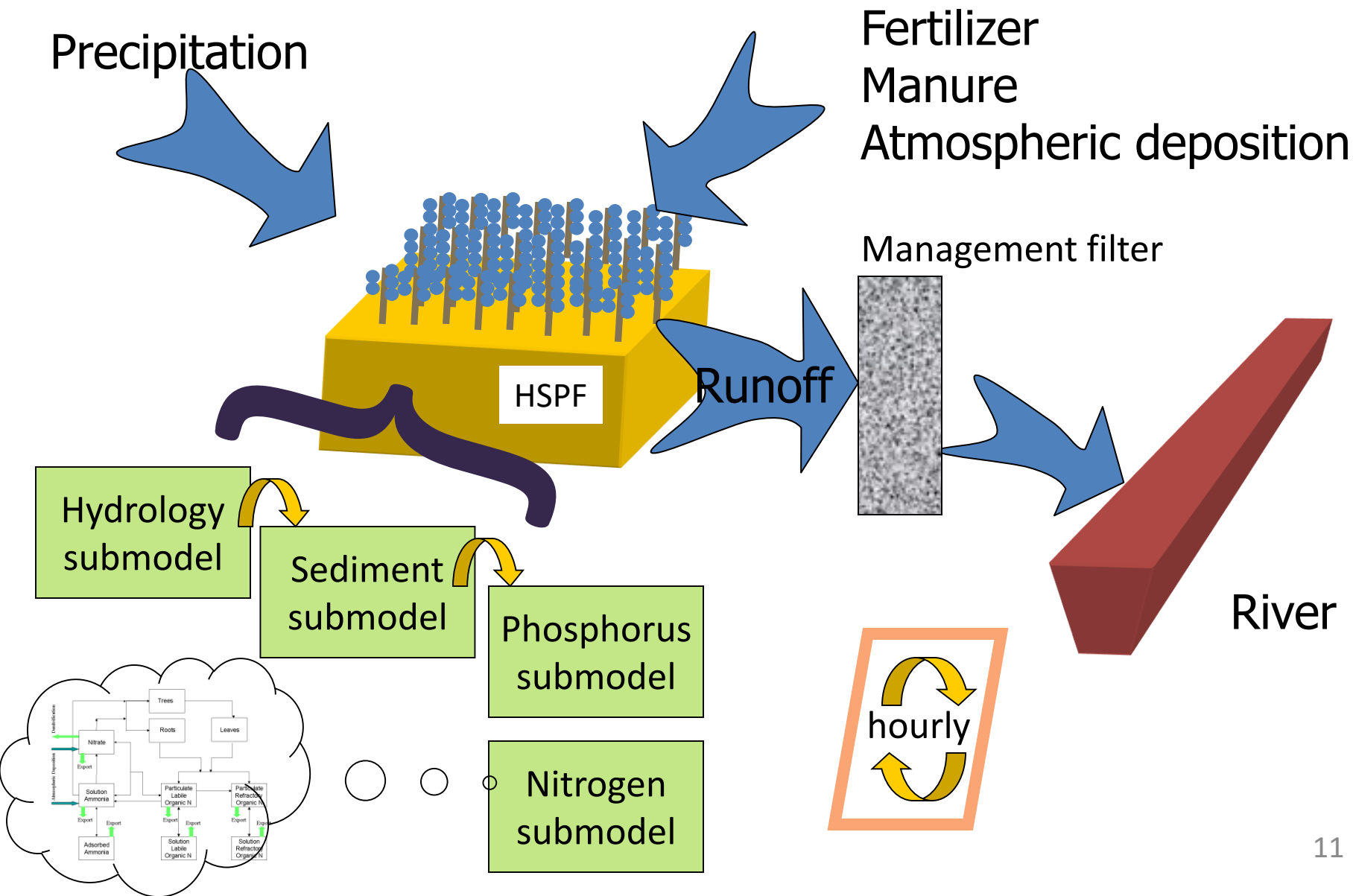
Motivation

- Partnership needs to be able to engage local partners in order to get practices on the ground
- Current suite of modeling tools is used as a wedge
- Evolution of models will allow us to work with key partners
- Healthy step in adaptive management process

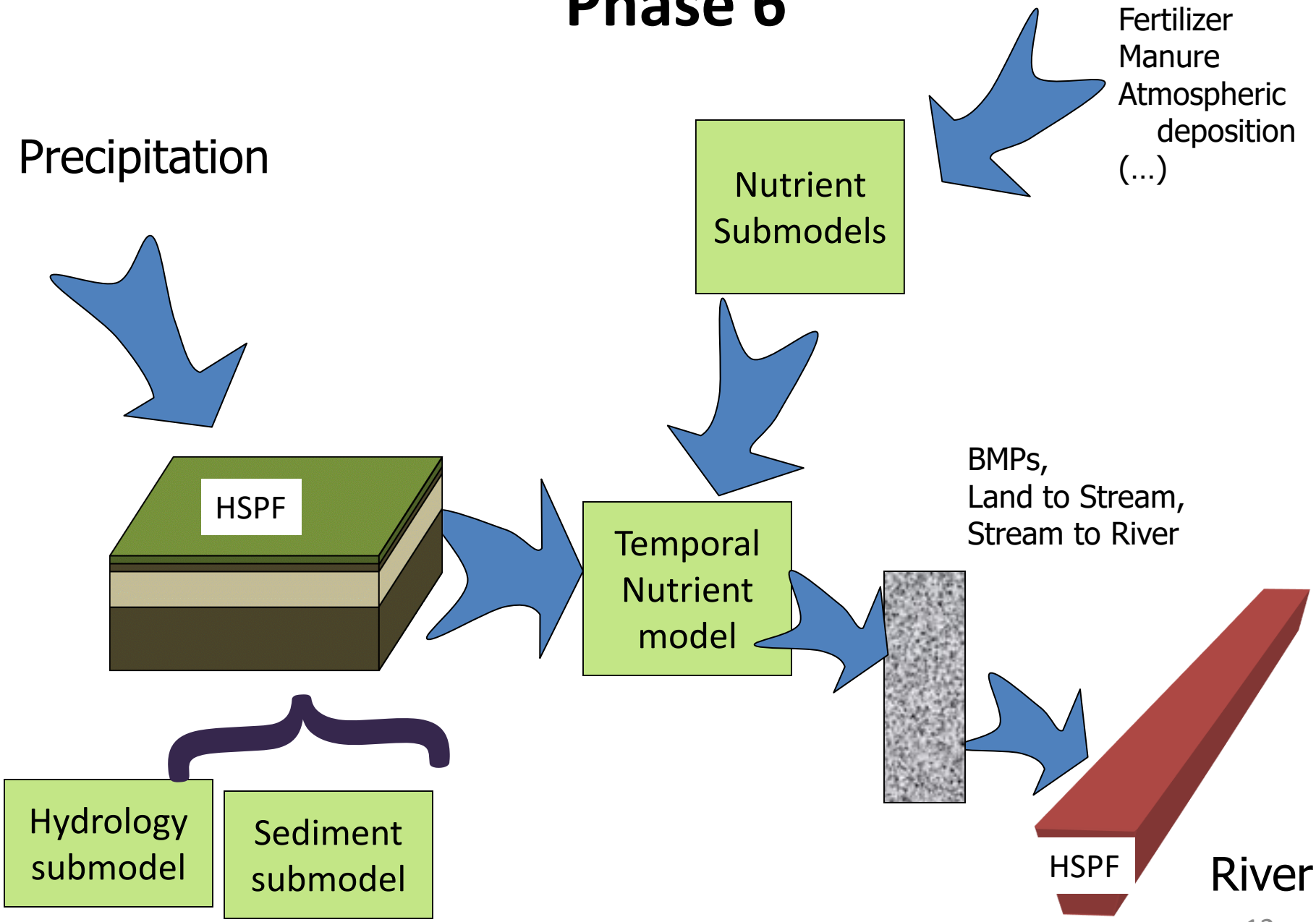
PSC input

- Revisit model calibration methods and assumptions so modeling results better align with **monitoring data**
- Incorporate better model **input data** from local partners, particularly for current, historic and future land uses and their associated pollution loading rates
- Make CBP models more **transparent**, easier to understand, and better decision-support tools

How the Phase 5 Model Works

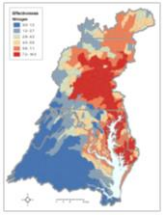


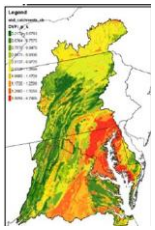
Phase 6


Fertilizer
Manure
Atmospheric deposition
(…)
Precipitation
Nutrient Submodels
HSPF
Temporal Nutrient model
BMPs,
Land to Stream,
Stream to River
Hydrology submodel
Sediment submodel
HSPF
River

Phase 6 New Elements

Simple relationships between input and output informed by multiple models





Nutrient Submodels

Temporal Nutrient model

BMPs,
Land to Stream,
Stream to River

Spatial variability parameters
Informed by models, analyses, and calibration

Estimate of lag time
Does not change the overall load

Load for a land use in a segment =

Estimated Average Load + Sensitivity * Δ Inputs

*

BMPs

*

Watershed Delivery Variance

*

Stream Delivery

*

River Delivery

Phase 6

Multiple Lines of Evidence And multiple models

Estimated Average Load + **Sensitivity** * **Δ Inputs**

Multiple models

*

BMPs ← Scenario Builder

*

Estimated with Sparrow
Estimated by Land Data team

Watershed Delivery Variance

*

Estimated with Sparrow
Estimated by USGS / WVU / Land Data team

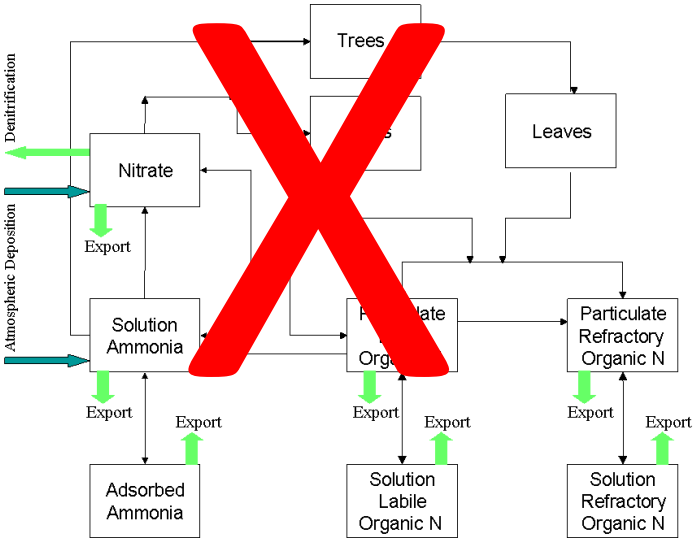
Stream Delivery

*

Simulated in HSPF
Calibrated with data, WRTDS, and Sparrow

River Delivery

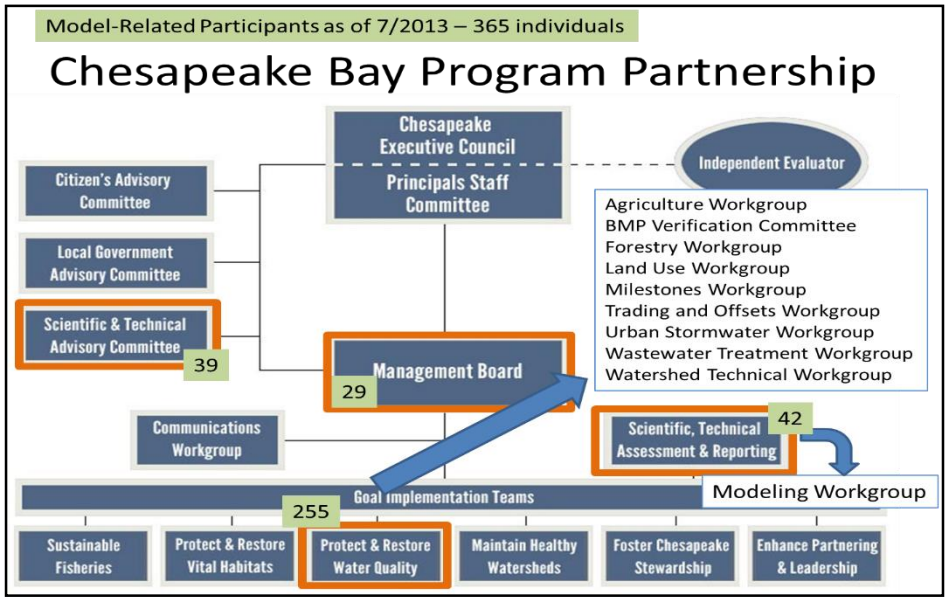
No overly complex models



No specialized platforms

No revealed wisdom

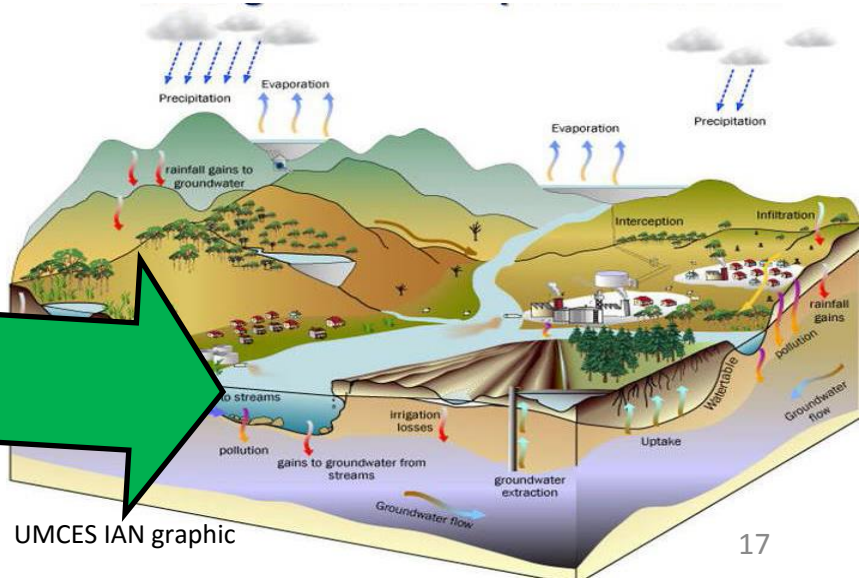
Extensive partnership involvement…



…Which Leads to a robust model of the watershed

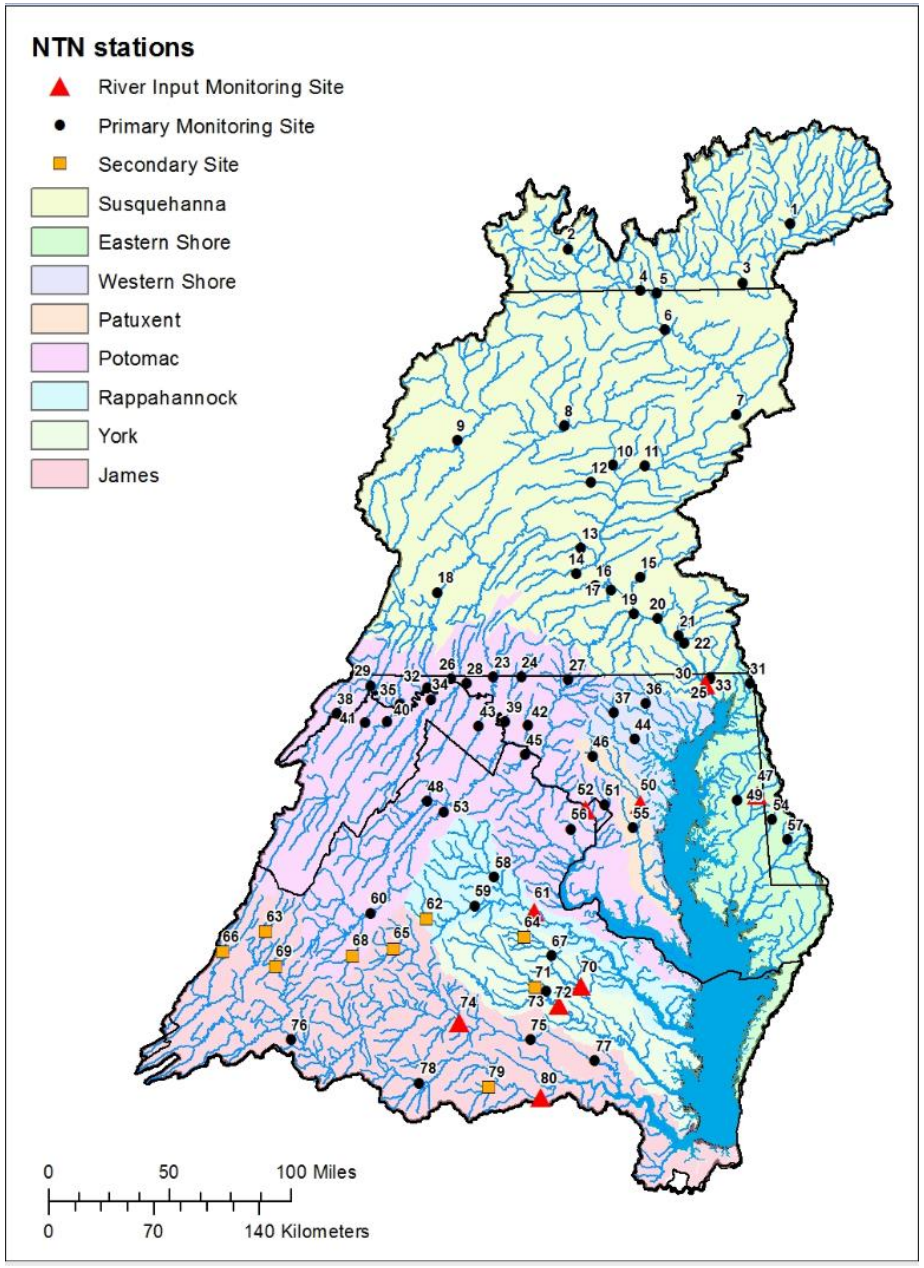
…Leads to collaborative thinking…

http://www.theatlantic.com/health/archive/2011/12/is-the-expansion-of-knowledge-endangering-genius/249735/



UMCES IAN graphic

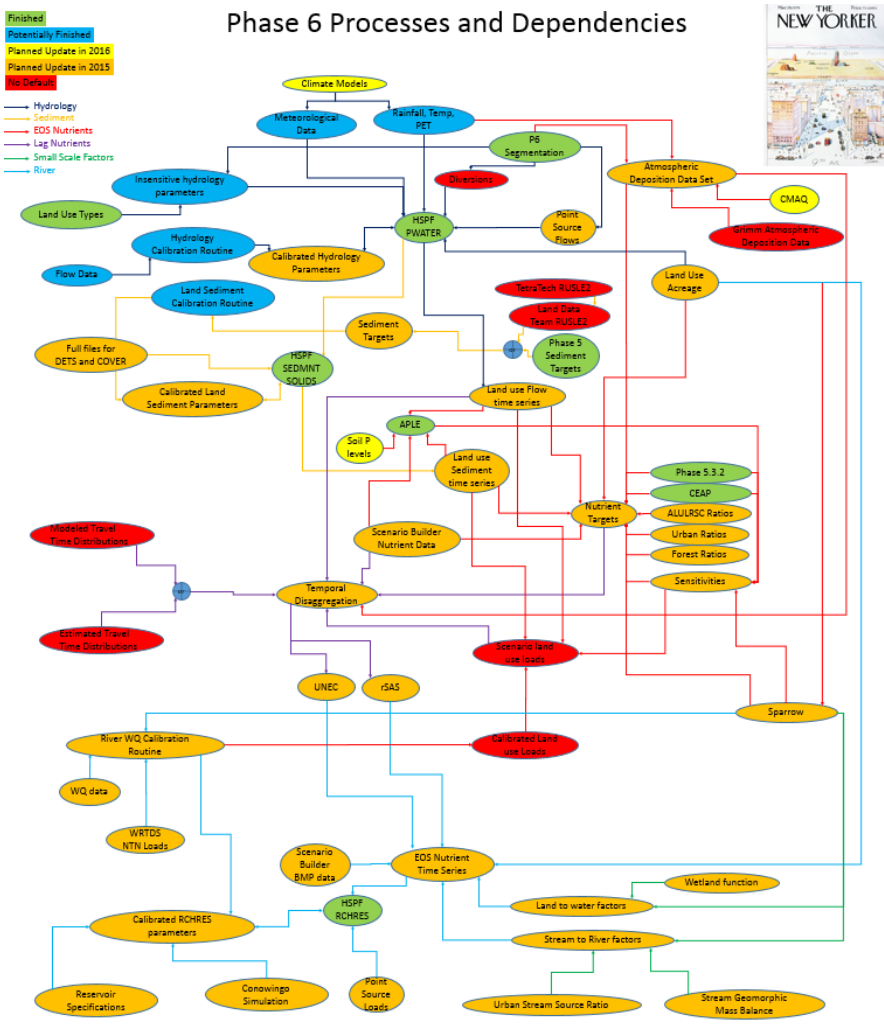
Chesapeake Bay Nontidal Monitoring Network

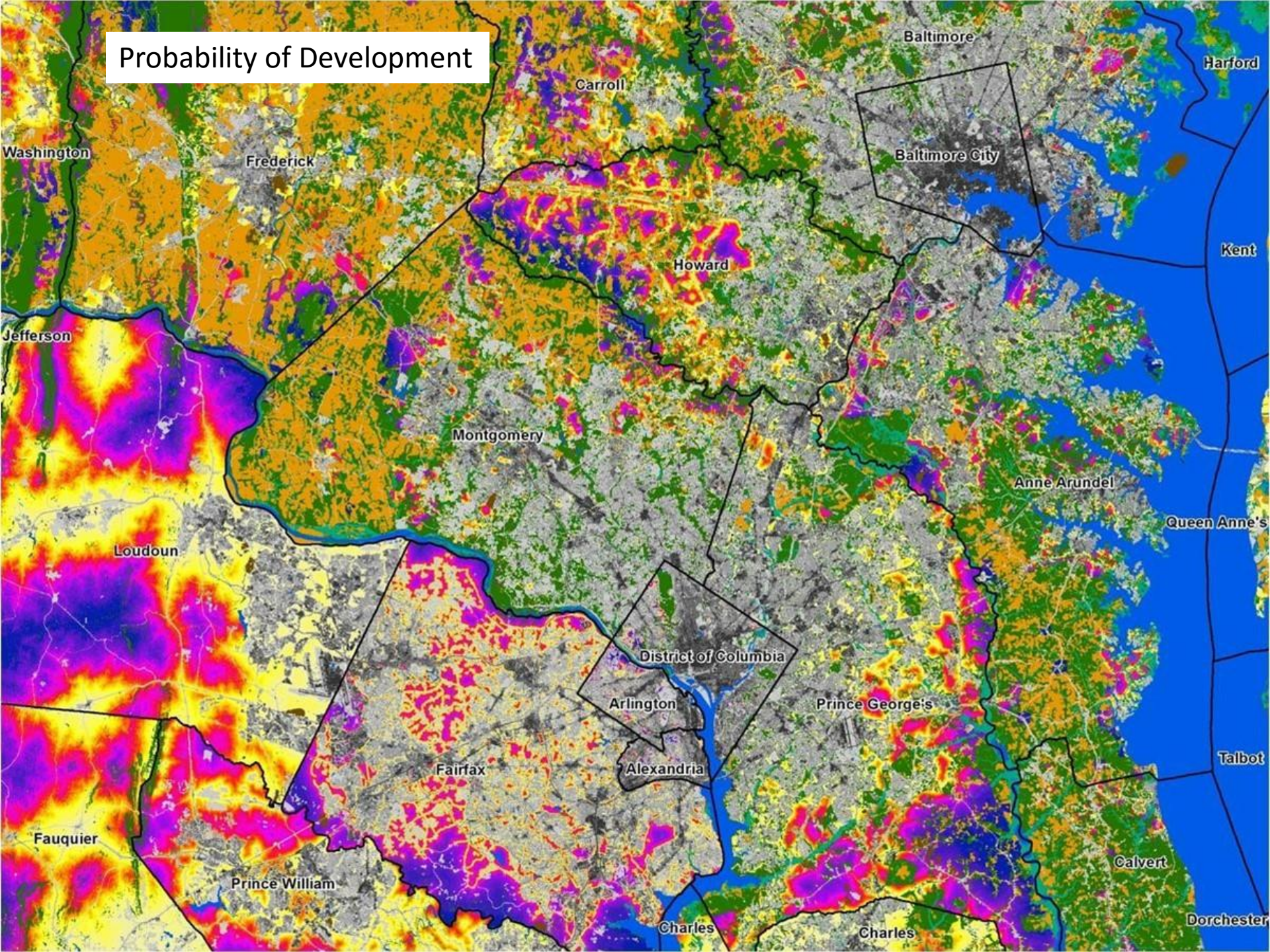


- 1990s – begin widespread monitoring
- 2000s – create nontidal network
- Early 2010s – develop method to determine trends
- Mid-2010s – explain trends
  - BMPs
  - land use change
  - atmospheric deposition
  - lag times
  - natural factors

Better Input Data

- **Many** data sets
- Focus on a few
  - Land Use
  - BMP Effectiveness
  - BMP Implementation




Probability of Development
Baltimore
Harford
Carroll
Washington
Frederick
Baltimore City
Kent
Howard
Jefferson
Montgomery
Anne Arundel
Queen Anne's
Loudoun
District of Columbia
Arlington
Prince George's
Talbot
Fairfax
Alexandria
Fauquier
Calvert
Prince William
Charles
Dorchester
Charles

P6 Land Use Database Versions

Version 1 (July 2015)

- Based exclusively on national/regional data

Version 2 (October 2015)

- Incorporates local land use/cover data
- Includes multiple wetland classes
- Initial estimates of new sediment delivery factors in the Piedmont and Valley & Ridge provinces
- Marginally reviewed by local governments and federal agencies

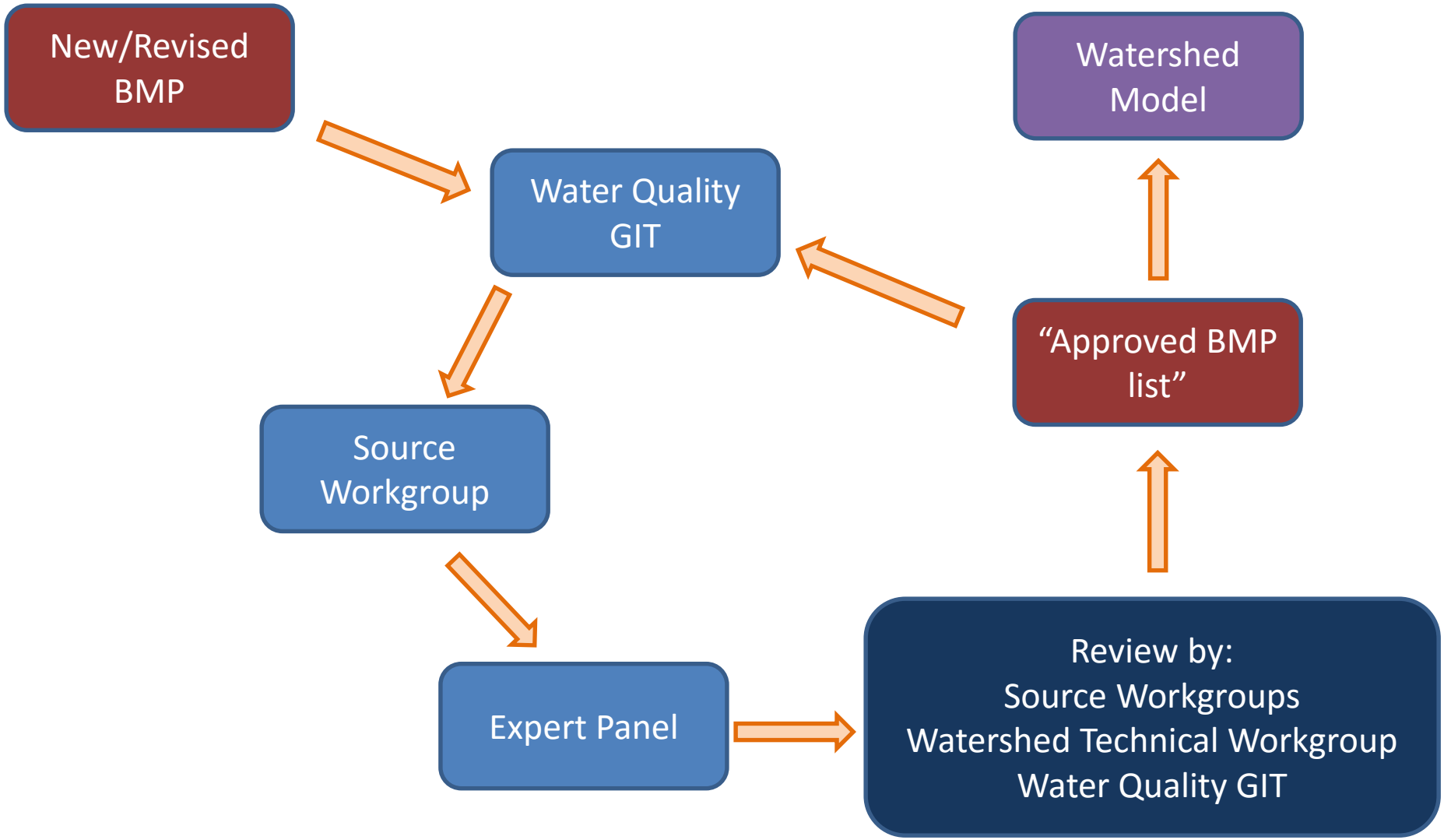
Version 3 (August 2016)

- Incorporates local land use/cover data
- Incorporates high-resolution land cover, everywhere
- Includes Tree Canopy over Roads and Tree Canopy over Impervious (other)
- Includes new sediment delivery factors
- Includes wetland efficiencies
- Extensively reviewed

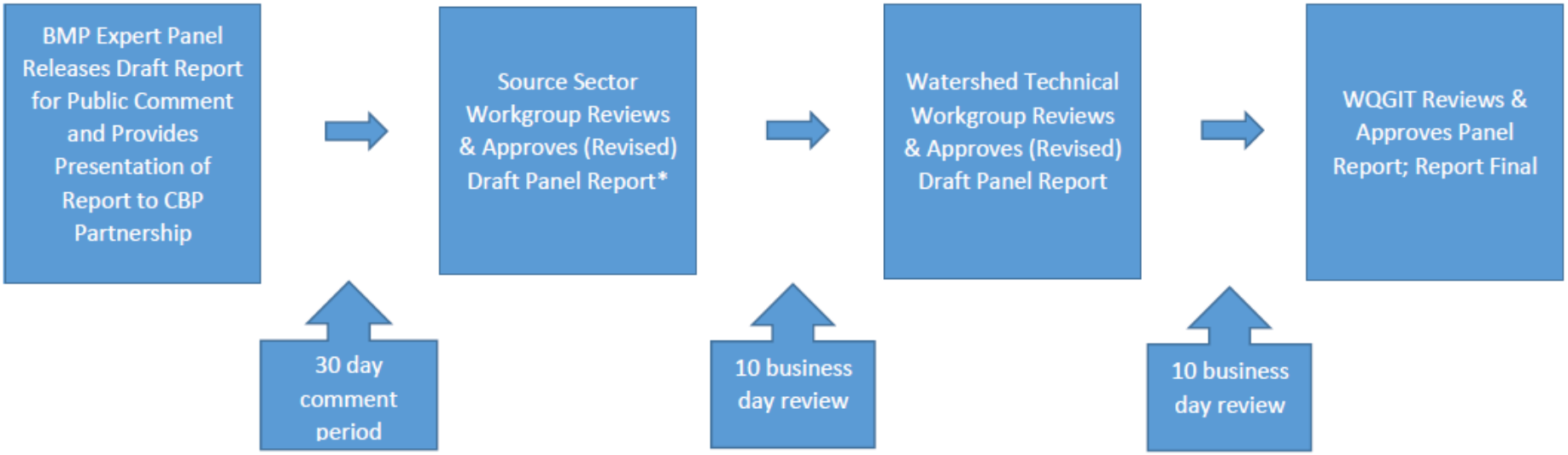
USGS

Chesapeake Bay Program
A Watershed Partnership

Protocol for Adding/Modifying BMPs



Appendix I: CBP Partnership Review Process for BMP Expert Panels



CBP Partnership has Opportunity to Review and Comments on Draft Panel Report during Each Stage of Review Process

To better ensure effective resolution of comments, all interested partners, groups or individuals are encouraged to submit their comments during the first review and comment period. New comments at later stages will be considered, but the Panel can more effectively address substantive comments the earlier they receive them.

*The Panel Chair and Coordinator are responsible for developing a "Response to Comments" document based on feedback received through partnership review. The "Response to Comments" document will be attached to the final Panel report.

Status of Current and Upcoming BMP Expert Panels of the Chesapeake Bay Program Partnership

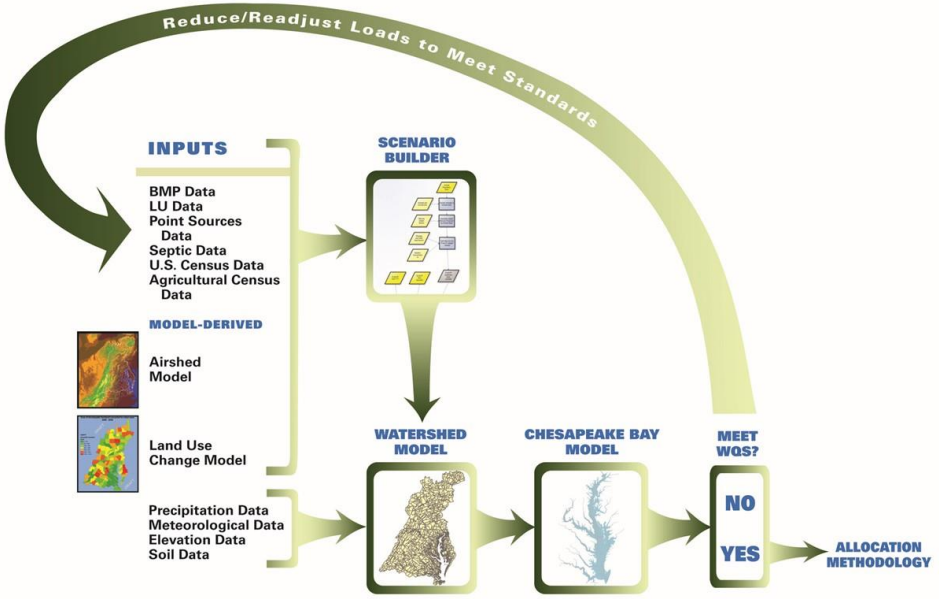
The Chesapeake Bay jurisdictions implement Best Management Practices (BMPs) to achieve the goals set forth in the 2010 Chesapeake Bay TMDL. Through the Protocol for Development, Review and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls, newer practices and technologies are considered and evaluated for inclusion in the Chesapeake Bay Program partnership modeling tools by expert panels. Existing practices are re-evaluated to ensure they reflect the best available scientific data and information. Below is a table identifying those BMPs that are currently undergoing the expert panel process. A list of completed expert panels can be found on Chesapeake Stat: http://stat.chesapeakebay.net/?q=node/130&quicktabs_10=3

BMP Expert Panel	Key Contact(s)	Description	Current Status	Next Steps
Current Panels				
Nutrient Application Management ***Start Date: 2011*** ***Anticipated End Date: May 2015***	Agriculture Workgroup: Chris Brosch and Mark Dubin	The Expert Panel was charged with defining the effectiveness of nutrient management on reducing nutrient and sediment pollution. The panel has organized the practice into three tiers, each building on the previous tier in succession.	The Nutrient Management Panel held a webinar on August 20th to brief the Partnership on the feedback received during the open comment period and to provide an overview of the Panel's responses. The final report is undergoing the Partnership approval process.	The report received partial approval from the AgWG on August 17th. The WTWG will be asked to approve the technical appendix on September 3rd, and the WQGIT will be asked to approve the report on September 14th.
Manure Technologies ***Start Date: December 2014*** ***Anticipated End Date: December 2015***	Agriculture Workgroup and Virginia Tech: Jeremy Hanson	Expert Panel will determine pollution control performance measure estimates for the following six (6) prioritized manure technology BMPs: Microbial Digestion (aerobic/anaerobic); Chemical Treatments – Dry Manure; Thermal (or Thermochemical) Treatment; Solid-Liquid Separation; Composting; and Chemical Treatments – Wet Manure	The expert panel is compiling draft sections of their report.	The panel plans to release its full set of recommendations for partnership review in Fall 2015.

Continues for 5 Pages

Historical BMPs

- Submission of all historical BMP data (1985 through June 30, 2014) to NEIEN by September 30, 2015
- Needed to
  - Calibrate the Phase 6 Watershed Model
  - Target future implementation
  - Understand trends in monitoring data
- Resource-intensive process

Goal – Stakeholder understanding

- Understandable model
- Inclusive process
- Better and more local input data
- More monitoring data