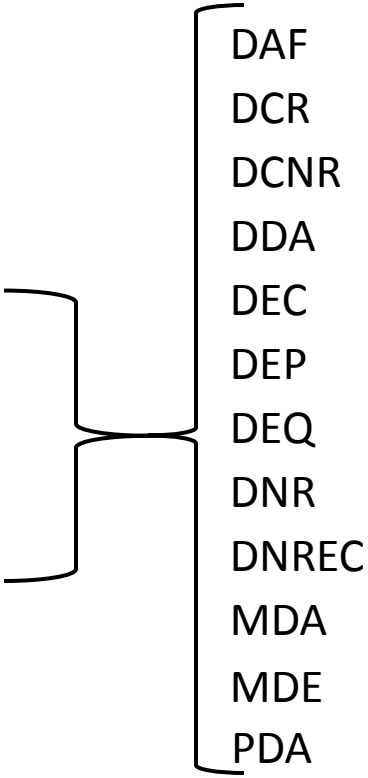
Development of the Chesapeake Bay Program's Watershed Model for 2017

Gary Shenk – USGS - Chesapeake Bay Program

9/20/16

Chesapeake Bay Program Partnership

- Federal agencies
  - Environmental Protection Agency (EPA)
  - US Department of Agriculture (USDA)
  - US Forest Service (USFS)
  - US Geological Survey (USGS)
  - US Fish and Wildlife Service (USFWS)
  - **And more**
- State agencies
  - Natural Resources/Environmental departments
  - Agricultural departments
  - Parks and Recreation groups
  - Fish and Wildlife agencies
- Local Governments



Chesapeake Bay Program Partnership

- Non-profit organizations
  - Chesapeake Bay Foundation
  - Center for Watershed Protection
  - Ducks Unlimited
  - National Fish and Wildlife Foundation
  - And more
- Academic institutions
  - Land grant universities
  - Cooperative Extension programs
  - Sea Grant programs
  - Research centers and consortiums
  - And more

CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

1983

1987

40% goal

2000

TMDL
WQ goals

TMDL
2010

2014

accountability

Chesapeake Bay Program
A Watershed Partnership

1960s

1970s

1980s

1990s

2000s

2010s

TMDL Timeline

- 1999 – Lawsuit by American Canoe Association and American Littoral Society
- 2010 – TMDL put in place
- 2017 MidPoint Assessment
  - 60% of the management practices implemented
  - Mid-Course Correction?
- 2025 TMDL Goal Date
  - 100% of the management practices implemented

Model Timeline

- 1999 – Lawsuit by Am
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1980s – Phase 0, Phase 1

1990s – Phase 2, Phase 4

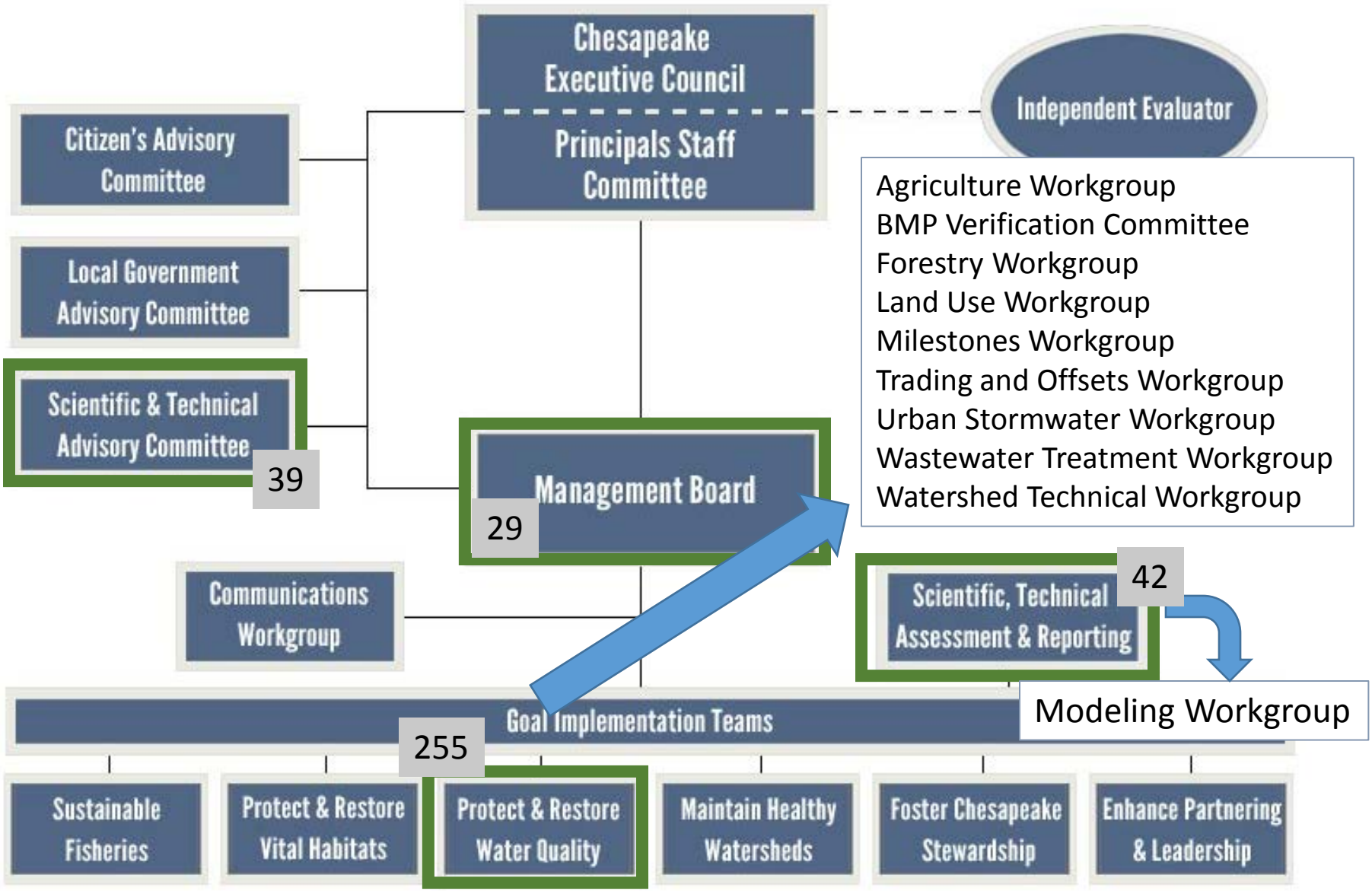
2000s – Phase 4 versions

2010 – Phase 5

2017 – Phase 6

Model related Membership as of 7/2013 – 365 individuals

Chesapeake Bay Program



Partnership Feedback on Modeling

- **Water Quality Managers**
  - Need more **transparent and easier** to understand decision-support tools to enable successful engagement of local partners

- **Scientific and Technical Advisory Committee**
  - Multiple Models
  - Phosphorus
  - Complex Reservoir Dynamics
  - Fine-scale processes

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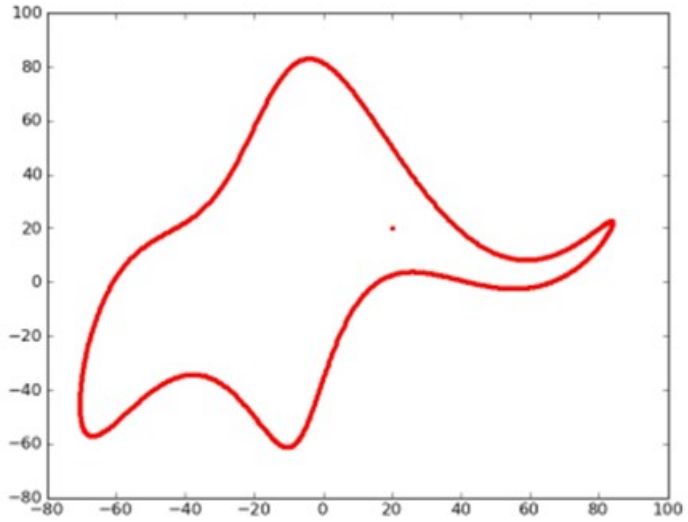
Keep it Simple!!

Include Everything!!!

Model Complexity

- Von Neumann: With four parameters I can fit an elephant, and with five I can make him wiggle his trunk.



"Drawing an elephant with four complex parameters" by Jurgen Mayer, Khaled Khairy, and Jonathon Howard, Am. J. Phys. 78, 648 (2010), DOI:10.1119/1.3254017





Phase 6 Model Structure

Average Load + Δ Inputs * Sensitivity

*

Land Use Acres

*

BMPs

*

Land to Water

*

Stream Delivery

*

River Delivery

Direct Loads

Phase 6

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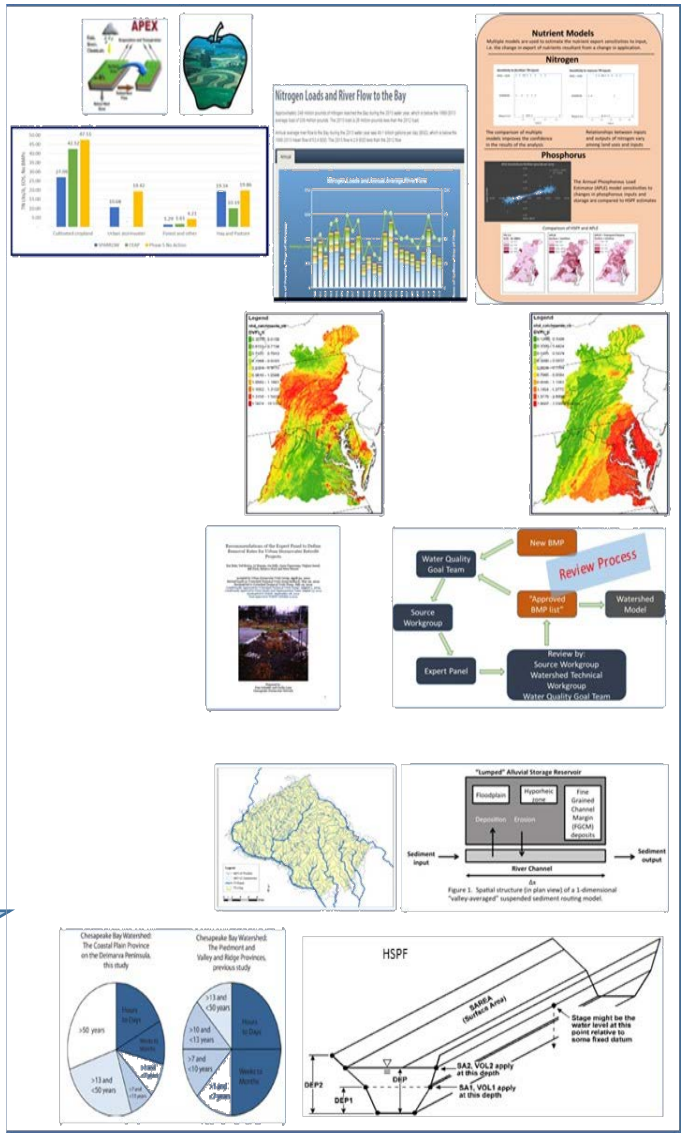
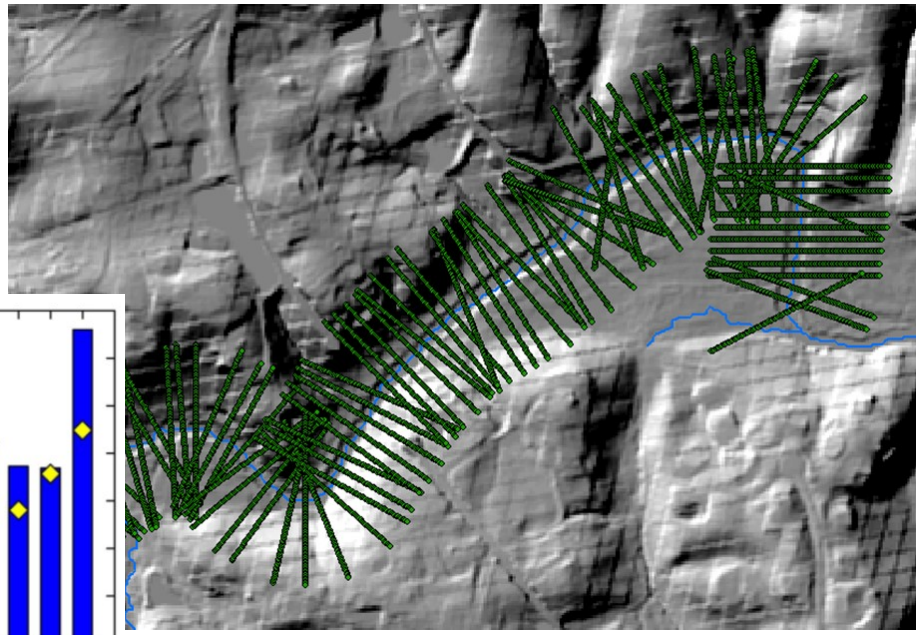


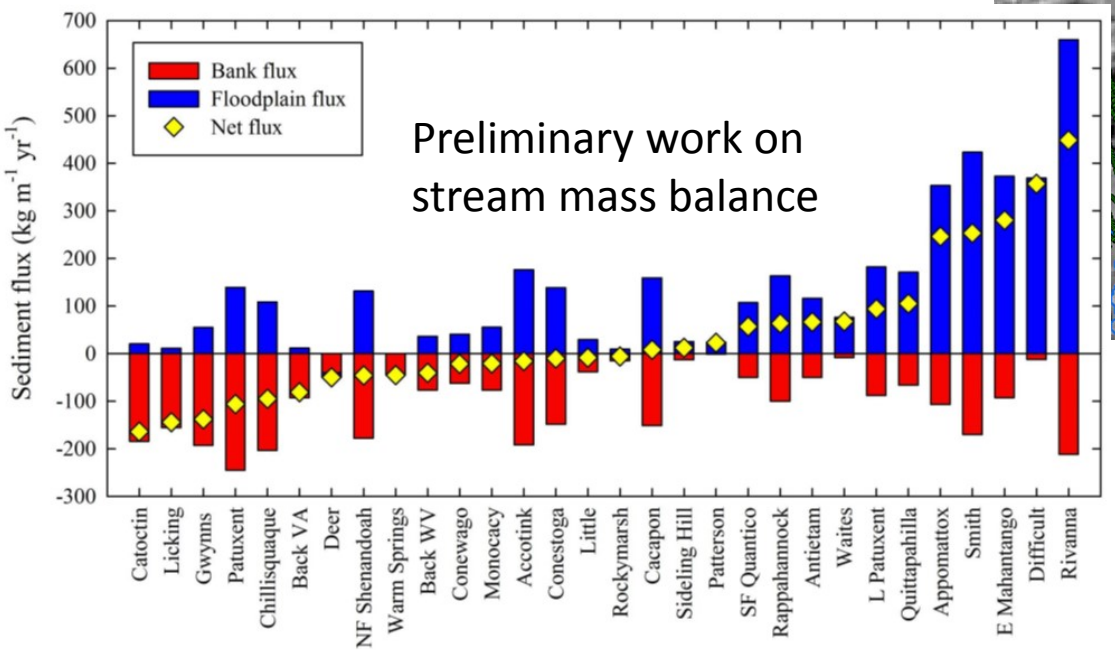
Use of Multiple Models
for Nitrogen Export Rate

Sector	Crop	Pasture/ Hay	Developed	Natural
CBP Phase 5 model	47.5	19.9	19.4	4.2
USDA-CEAP Model	42.5	10.2	Not used	1.6
USGS- SPARROW Model	22.9	10.2	8.9	0.4
Average Ratio to Crop Rate	1.00	0.37	0.40	0.05

Contributions from new research

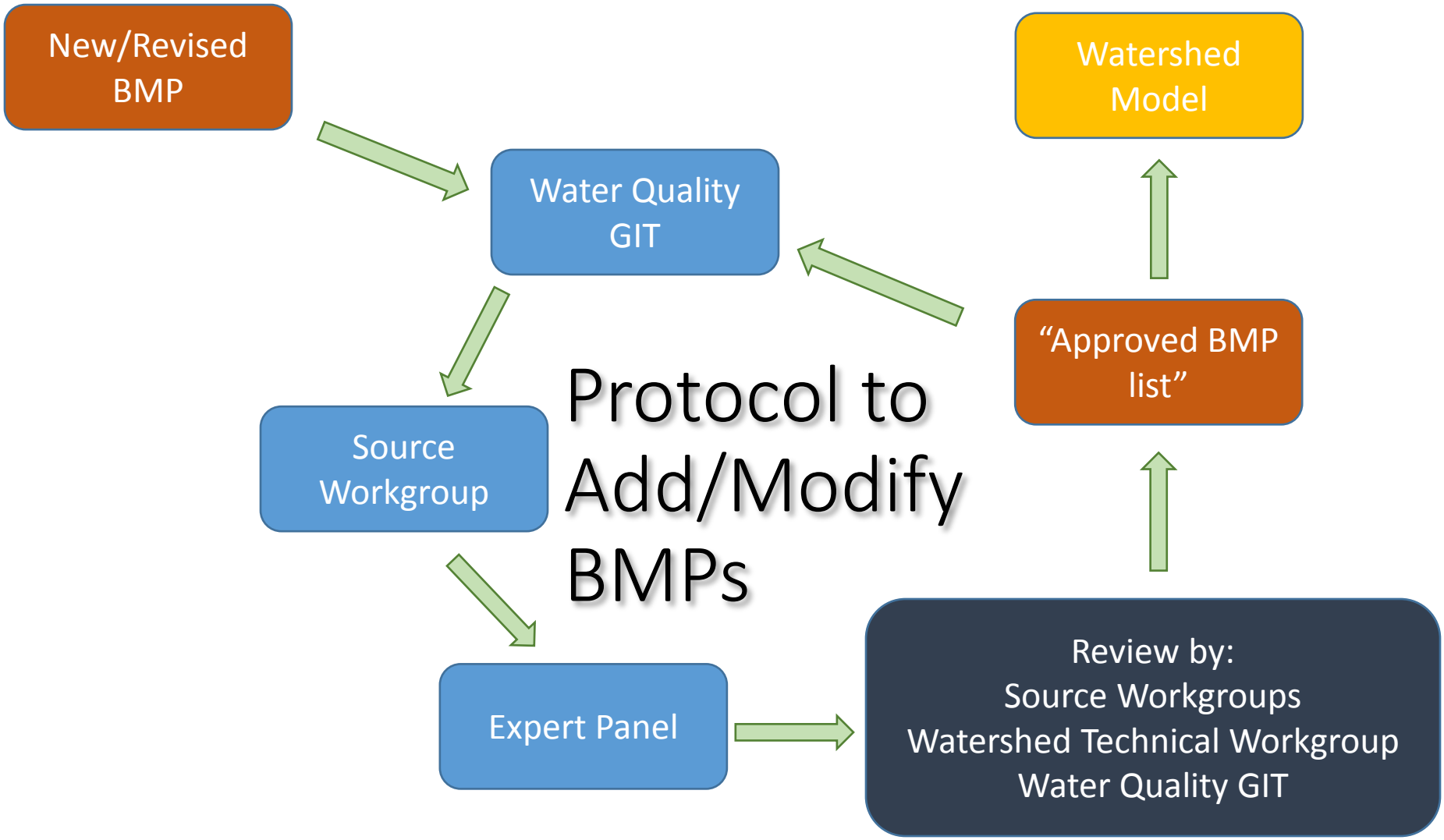
- Lidar over 166,000 km^2
- Regression of Stream mass balance against morphology





Chesapeake Bay Program
A Watershed Partnership

Collaborative Stakeholder Processes







Phase 6 Model Structure

Average Load + Δ Inputs * Sensitivity

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Land Use Acres

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Stream Delivery

*

River Delivery

Direct Loads

Phase 6





Phase 6 Model Documentation

Section 2: Average Loads + Section 3: Inputs * Section 4: Sensitivity

*

Section 1: Overview

Section 5: Land Use

*

Section 6: BMPs

*

Section 8: Direct Loads

Section 7: Land to Water

*

Section 9: Stream Delivery

*

Section 10: River Delivery

Section 11: Applications

Stakeholder Science

- Transparent science is more palatable to stakeholders
- Multiple lines of evidence has scientific support

… but does it work?

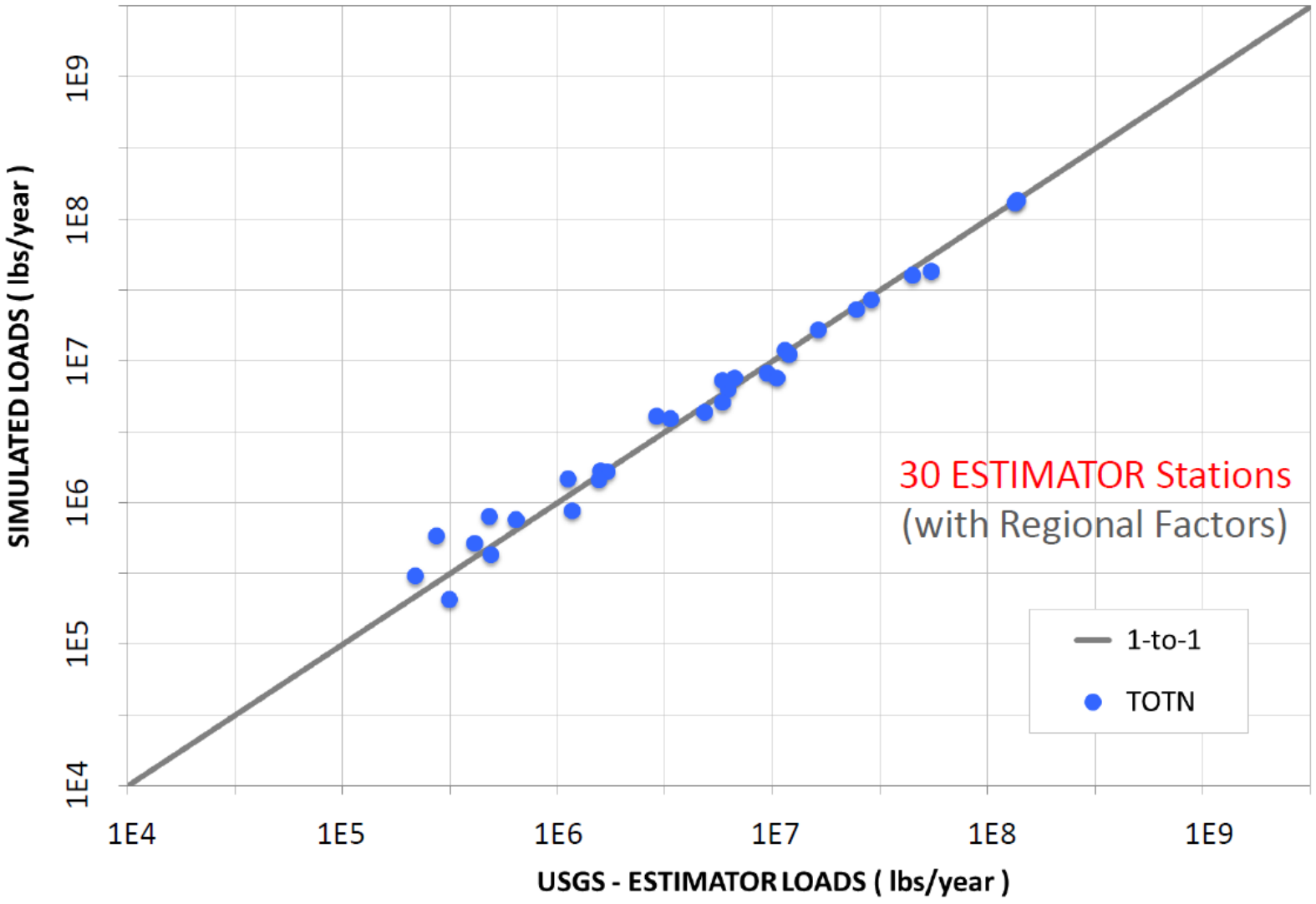
Compare

Heavily-Calibrated Process Model

Lightly-Calibrated Stakeholder Model

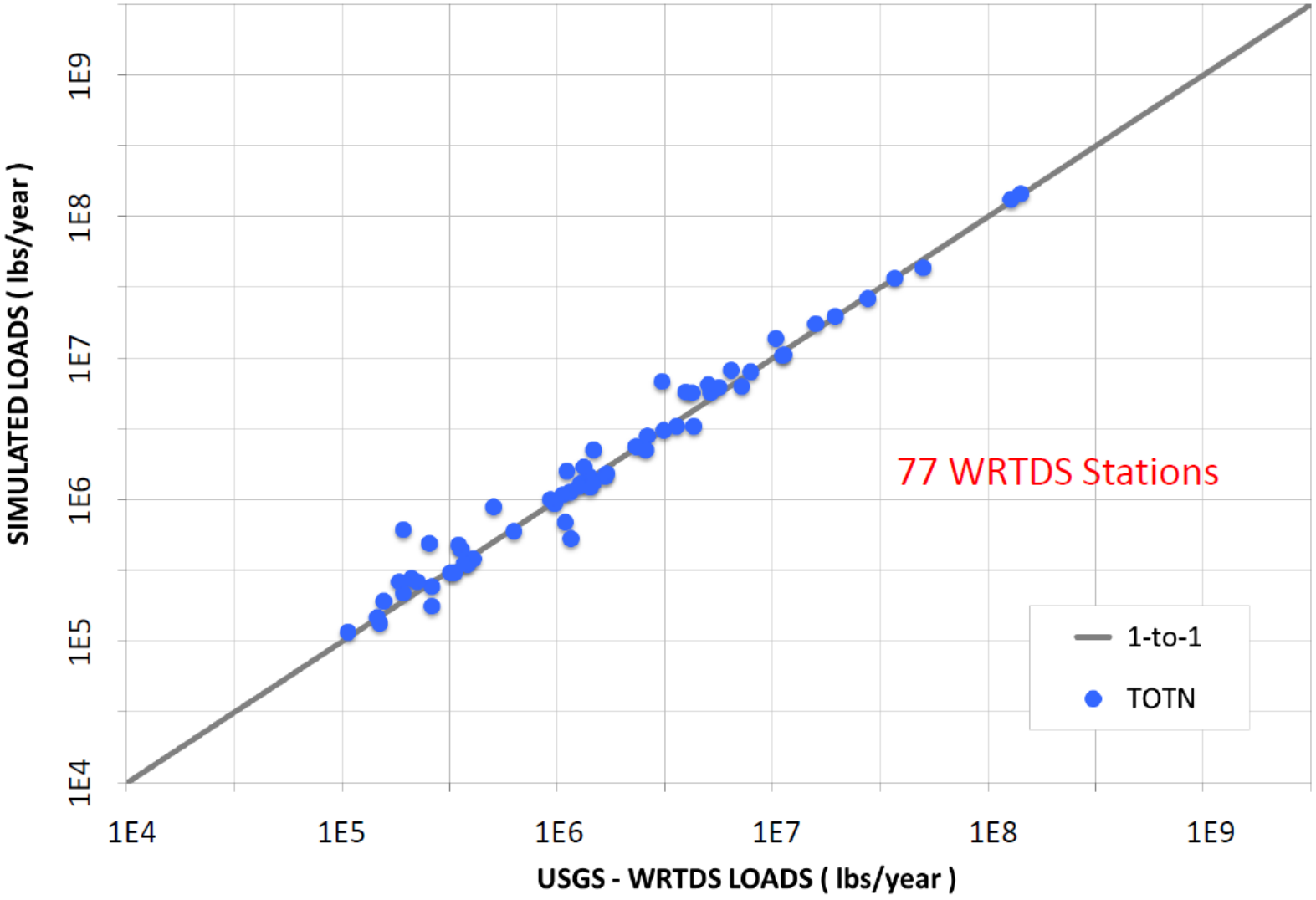
Process Model

NITROGEN



Stakeholder Model

NITROGEN



On Line Version -- CAST

About CAST | Scenarios | Costs | Scenario Worksheets | Scenario Results | Log Out | Edit Profile

Dauphin County
Summary Results

Help

Description: Irseg base loads
Initial Conditions: 2017, revised: 4/2016
Date Created: 5/4/2016 10:25:23 AM

Download Results | Compare Scenarios

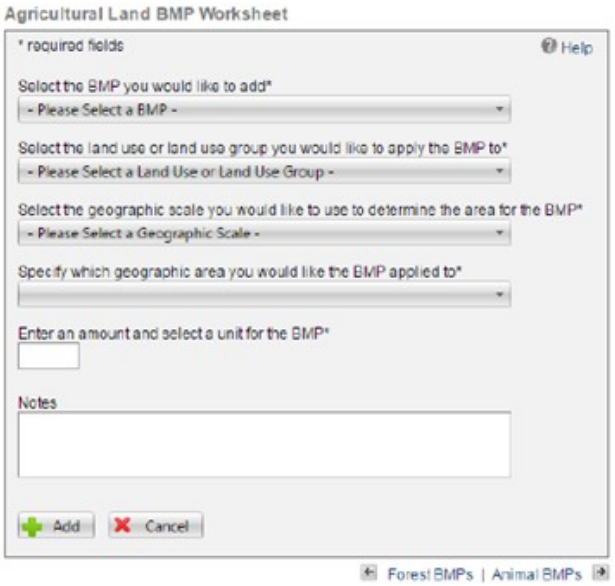
Total Loads

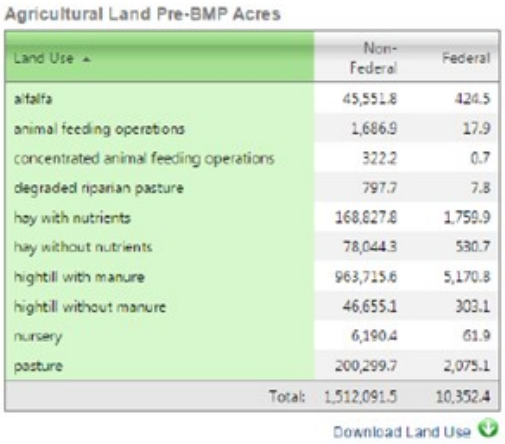
Load Type	Lbs Nitrogen Edge of Stream	Lbs Nitrogen Delivered	Lbs Phosphorus Edge of Stream	Lbs Phosphorus Delivered	Lbs Sediment Edge of Stream	Lbs Sediment Delivered
Landuse	6,513,592.7	5,271,385.8	197,995.9	76,354.8	137,419,842.9	53,823,104.8
Septic	141,079.6	114,690.5	0.0	0.0	0.0	0.0
Waste Water and Combined Sewer Output	1,487,025.4	1,236,710.8	216,146.1	83,354.6	12,325,864.3	4,827,660.2
Total:	8,141,697.7	6,622,787.1	414,142.0	159,709.4	149,745,707.2	58,650,765.0

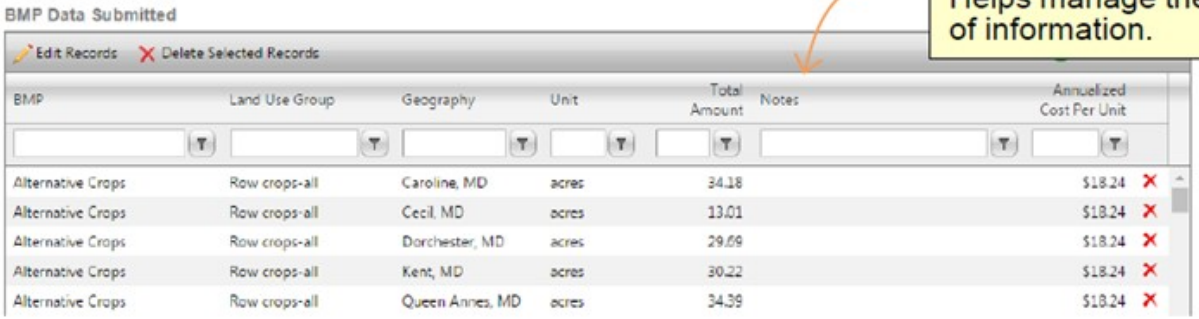
Total Annualized Costs

Sector	Total Annualized Cost
Urban Land	
Septic	

Screenshots – Agriculture



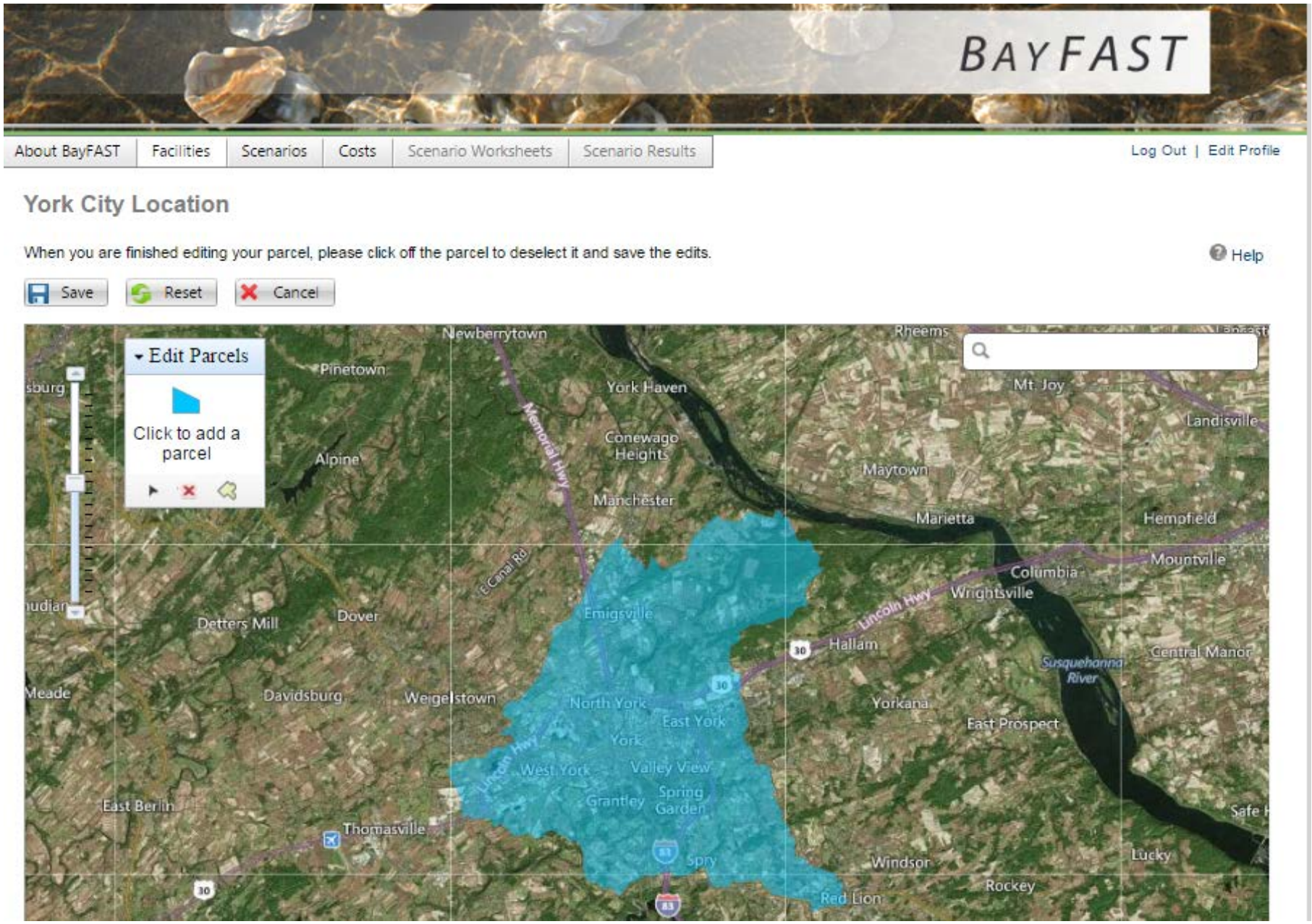




Comment field to put consistent information that explains rationale behind numbers. Helps manage the large amount of information.

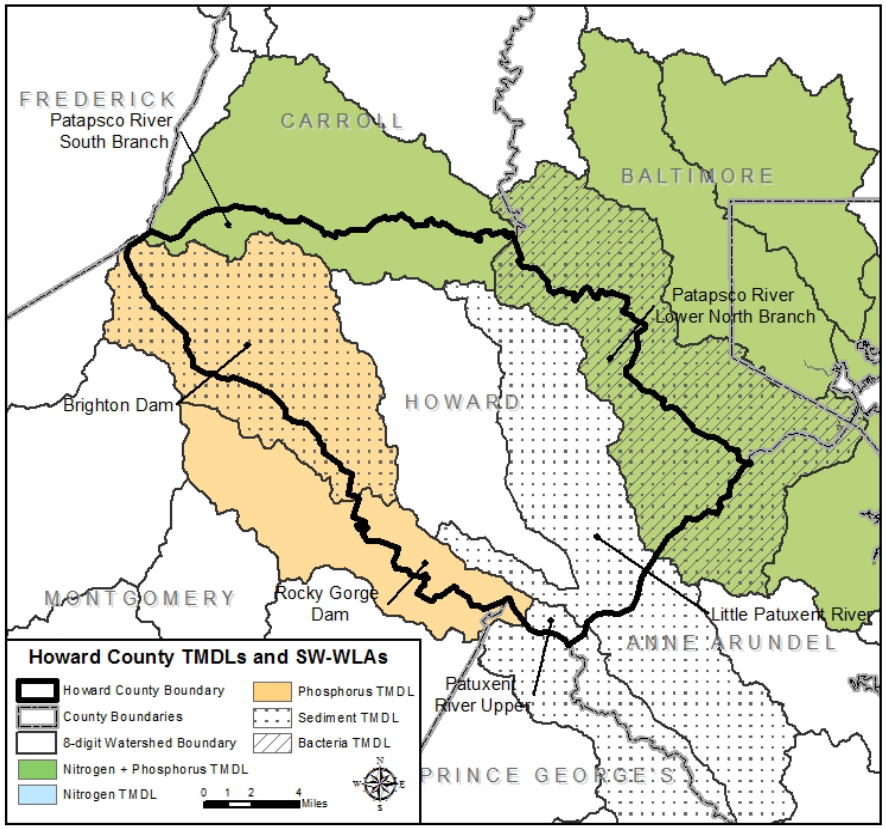
Slide from Robin Pellicano

On Line Version -- BayFAST



Howard County (BayFAST)

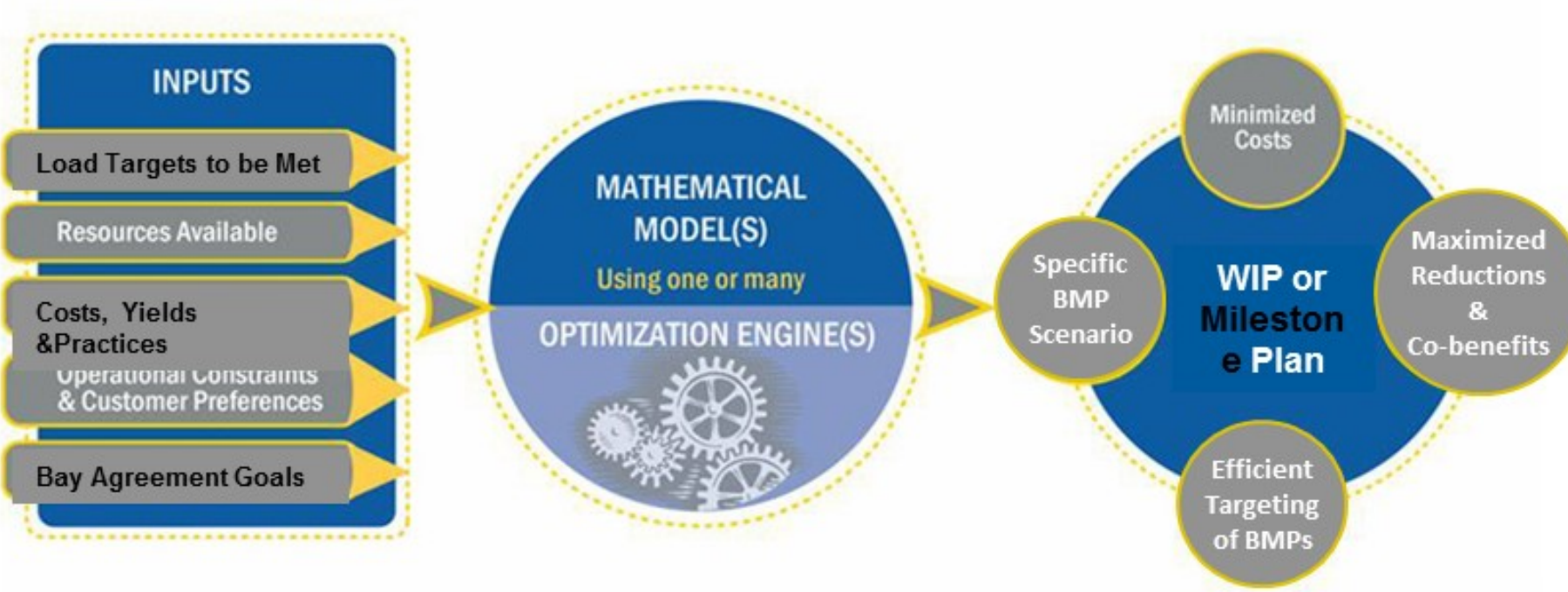
- Seven Local TMDLs:
  - Baltimore Harbor
  - Little Patuxent
  - Patapsco LNB
  - Upper Patuxent
  - Rocky Gorge
  - Triadelphia



William Frost, PE, D.WRE, *Senior Water Resources Engineer, KCI Technologies, Inc.*
Megan Crunkleton, CE, *Project Scientist, KCI Technologies, Inc.*

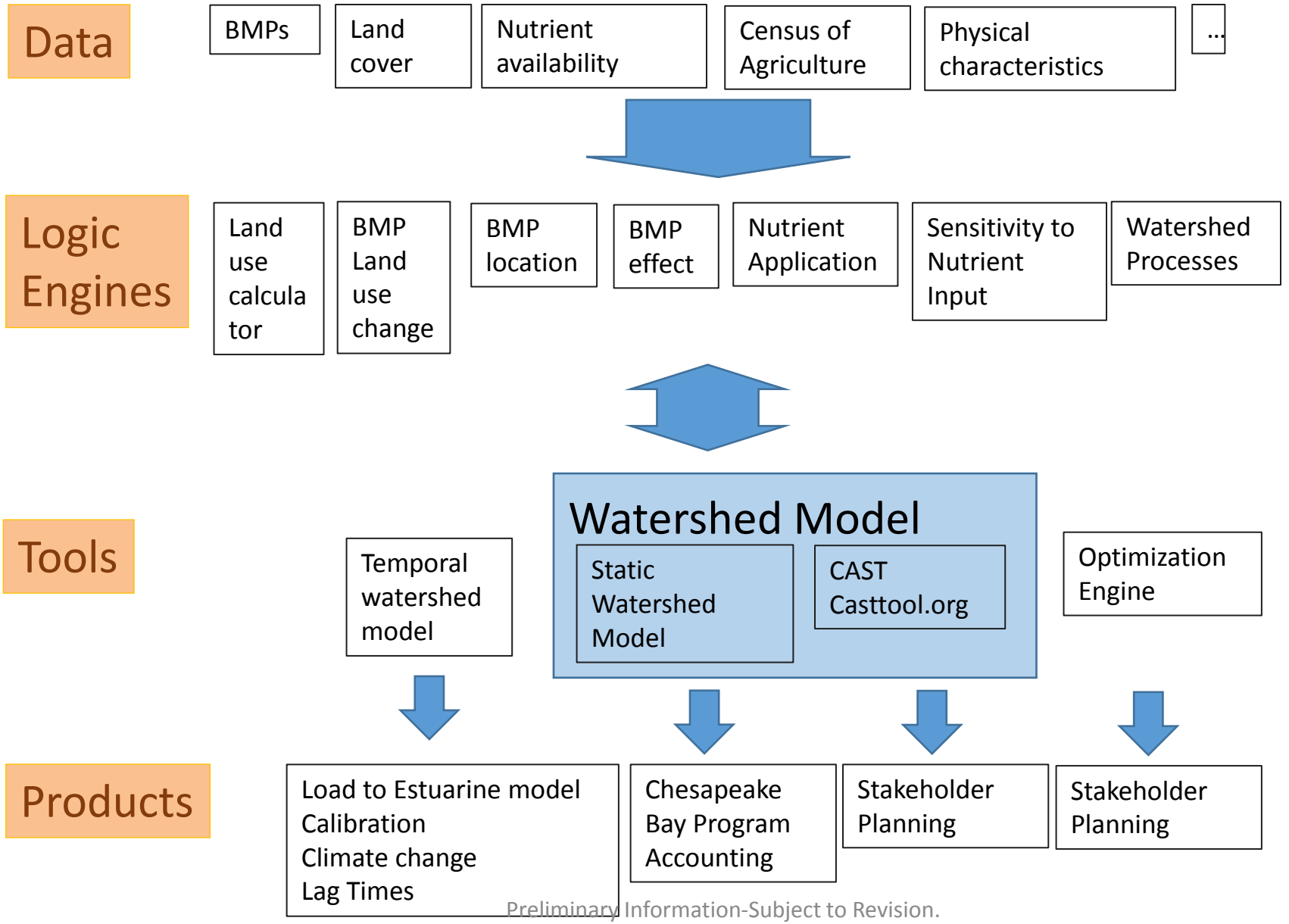
OPTIMIZATION Calculation Engine

Users input objectives, tool outputs BMPs in the plan that maximize effectiveness at minimum cost.

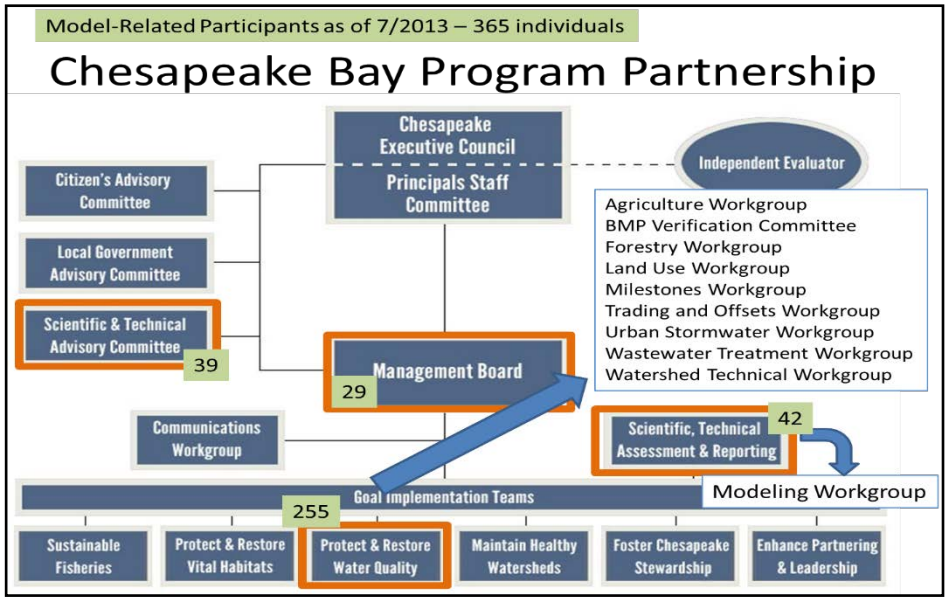


* Still in vaporware stage

CAST = WSM = Scenario Builder



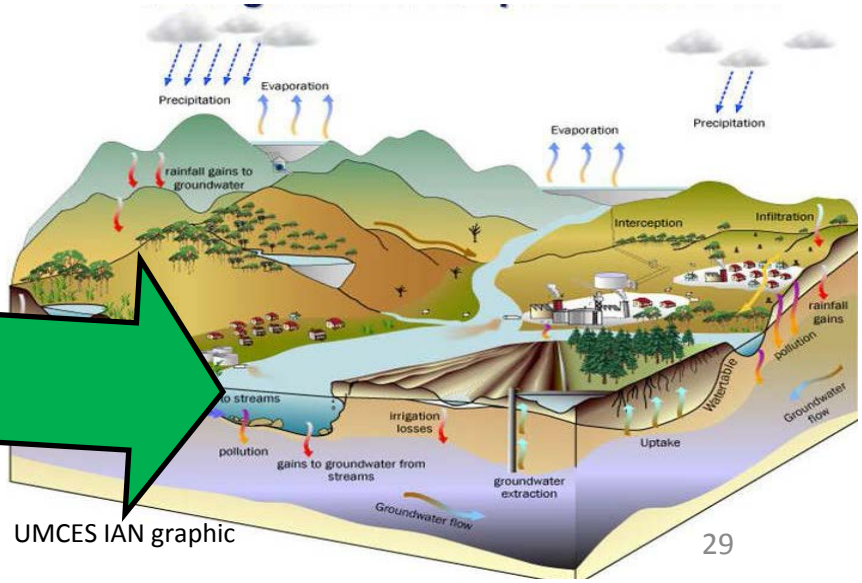
Extensive partnership involvement…



…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