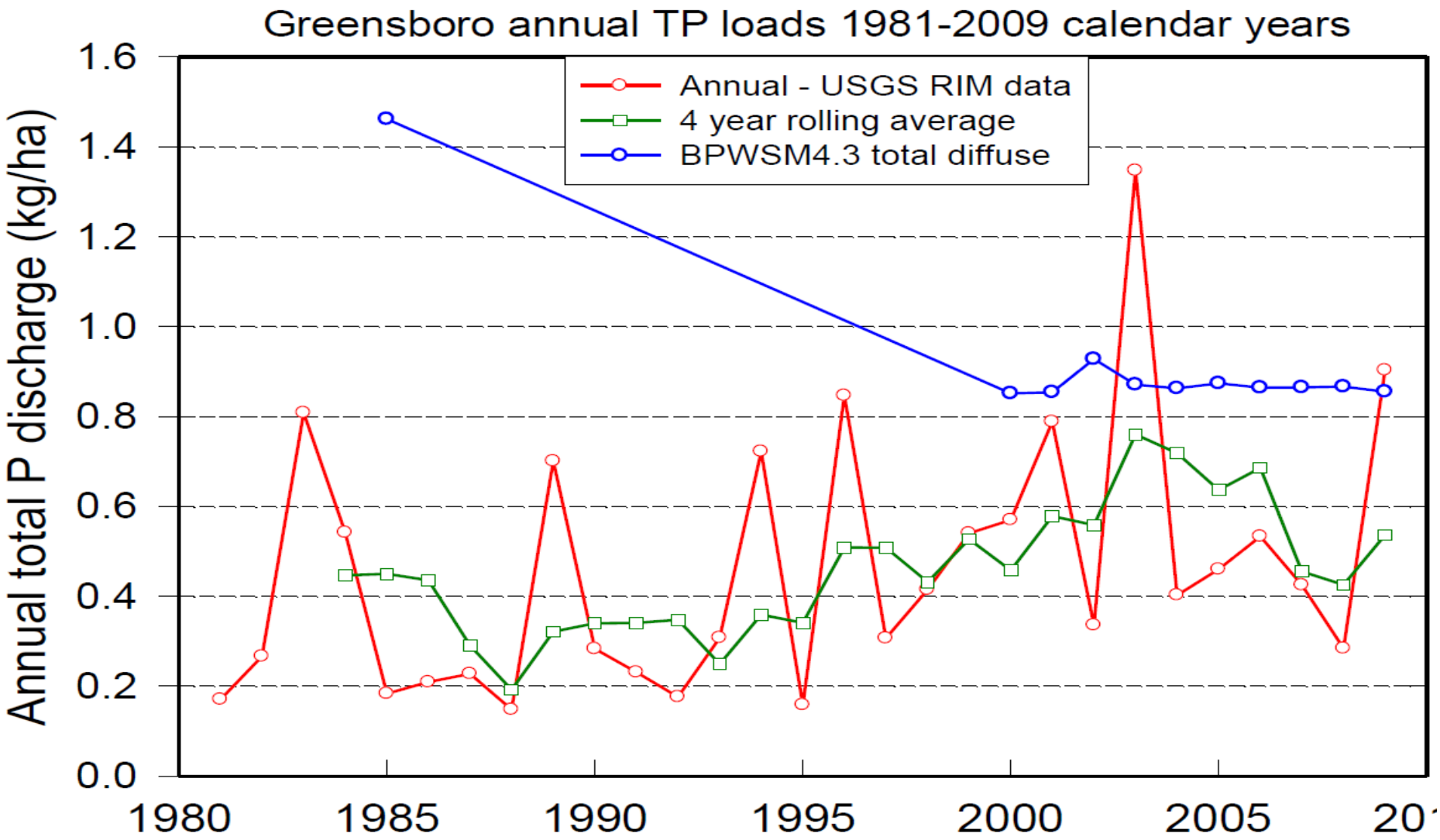
Management Board Response to STAC "Review of Agricultural P-dynamics in the Chesapeake Bay Watershed Model"

Gary Shenk

Chesapeake Bay Program Office

6/9/15

STAC meeting - Sept 13, 2011



From Russ Brinsfield at Dec 2011 STAC

STAC P Workgroup	
Scott Ator	U.S. Geological Survey
Russell Brinsfield	STAC Representative
Anthony Buda	USDA – ARS
Quirine Ketterings	Cornell University
Peter Kleinman	USDA – ARS
Gary Shenk	EPA – Chesapeake Bay Program Office
Tom Sims	University of Delaware
Kenneth Staver, Chair	University of Maryland – Wye REC

Q&A – Guido Yactayo - UMCES at CBPO

STAC P Workgroup Timeline

January, 2012	Initial meeting to inform workgroup on current P simulation approach in the Bay watershed model - Gary Shenk will lead and coordinate Bay Program modeling input.
February, 2012	Workgroup discussions via e-mail and phone on restructuring simulation approach to more accurately reflect current understanding of P transport mechanisms.
March, 2012	Workgroup discussion via e-mail and phone regarding available and needed data sets for supporting restructured P simulation approach.
April, 2012	Delivery of final report.

…more of a slow burn

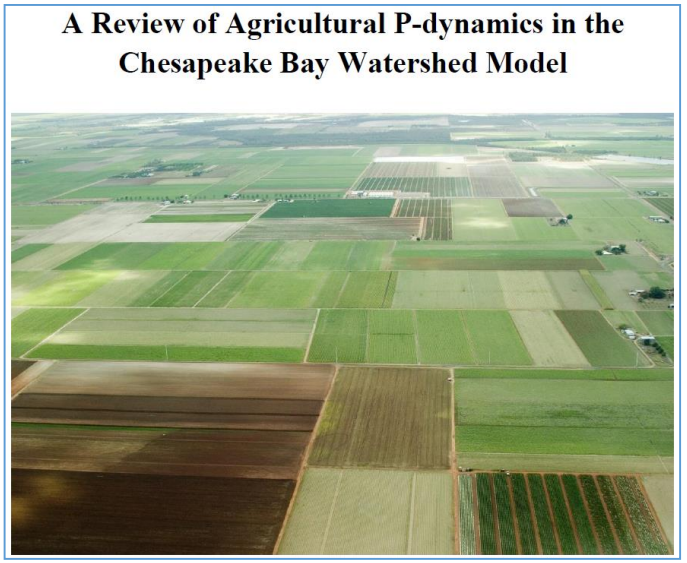
- Nov 2010 – Discussions between Ken Staver and CBPO begin
- Sept 2011 – STAC creates workgroup
- Feb 2012 – First meeting and questions for CBPO
- Feb 2013 – Questions answered
- 2013-2014 – more Q&A, writing, and editing
- August 2014 – Report delivered – STAC => CBP
- February 2015 – Response delivered – CBP => STAC

1. Account for soil P reservoirs as a source of P to runoff on a segment-by-segment basis.
2. Track segment P balanc[illegible] to determine whether soil P reservoirs are increasing or decreasing.
3. Describe the tempor[illegible]mics of the effects of drawdown/build-up of soil P reservoirs on P losses in runoff.
4. Account for diffe[illegible]ethods, including whether manure is left on the soil surface, incorporated by til[illegible]with low soil disturbance full-width applicators, or injected in bands.
5. Apply manure at rates and [illegible]rshed or regional information.
6. Improve representation of prac[illegible]ing P runoff potential by adjusting the timing of P applications.
7. Account for P stratification that develo[illegible]ous no-till.
8. Account for interaction between tillage a[illegible]n on potential for P losses as particulate and dissolved P fractions in overland and sub-surf[illegible]
9. Identify the fraction of P losses associated with s[illegible] management strategies.
10. Model functions should be capable of scaling down t[illegible]d field guidance on drivers of P.
11. Shift away from using model-generated values and proxy [illegible]rameters.
12. Consider changing weather patterns associated with climate [illegible]
13. Better represent and report uncertainty in data sources and mod[illegible]
14. Differentiate between surface and sub-surface transport pathways o[illegible]for the role of drainage intensity.
15. Baseline soil P levels.
16. Information on P application methods.
17. Spatial and temporal data on manure application.
18. Inorganic P application rates, including those associated with high-value row and hortic[illegible].
19. More systematic storm water sampling in predominantly agricultural watersheds for use in [illegible] calibration.
20. Improved mapping of features that restrict water infiltration and promote “saturation excess” runoff.
21. Improved mapping of drainage intensity as an indicator of hydrologic connectivity and P delivery potential.

21 Recommendations!!!

Overall result

- Most of the changes being made to the phosphorus simulation in the CBWM for the 2017 Midpoint Assessment are a direct result of:
  - this report
  - other STAC activities as noted in the report
  - the interaction between CBP Office staff STAC-affiliated scientists from Universities, USDA-ARS, and USGS necessary to produce these reports



Modeling Recommendations Related to Soil P

- Spatially account for soil P reservoirs as a source of runoff P.
- Track segment P balances to determine whether soil P reservoirs are increasing or decreasing.
- Describe the temporal dynamics of the effects of drawdown/build-up of soil P reservoirs on P losses in runoff.

CBP is Implementing APLE

- Best representation of the body of P literature
- Used to estimate variability in export due to
  - Soil P levels
  - P inputs
  - Plant Uptake
  - Physical characteristics

Annual Phosphorus Loss Estimator

APLE *is a spreadsheet model that simulates dissolved and sediment bound phosphorus loss in surface runoff.*

CBP is Implementing APLE

- Gathered soil P data on a county basis
- Investigating response lag to change in P inputs
  - STAC P dynamics report
  - STAC lag time report
- Compared to other models (M3)

Annual Phosphorus Loss Estimator

APLE *is a spreadsheet model that simulates dissolved and sediment bound phosphorus loss in surface runoff.*

Modeling Recommendations Related to Management of P Inputs

- Account for different P application methods:
  - left on surface, incorporated or injected.
- Apply manure at rates and times based on watershed or regional information.
- Improve representation of practices adjusting the timing of P applications.
- Account for P stratification that develops in soils in continuous no-till.
- Account for interaction between tillage and manure application on P losses as particulate and dissolved P fractions in overland and sub-surface flow.

Modeling Recommendations Related to Management of P Inputs

- Account for different P application methods:
  - left on surface, incorporated or injected.

Manure Injection/Incorporation BMP Panel
…to be formed…

- Account for P stratification that develops in soils in continuous no-till.
- Account for interaction between tillage and manure application on P losses as particulate and dissolved P fractions in overland and sub-surface flow.

Modeling Recommendations Related to Management of P Inputs

- Account for different P application methods:
  - left on surface, incorporated or injected.

- Improve representation of practices adjusting the timing of P applications.

Nutrient Management BMP Panel

Will be included in the phase 6 panel

Modeling Recommendations Related to Management of P Inputs

- Apply manure at rates and times based on watershed or regional information.

Ag Modeling Subcommittee

General Modeling Recommendations

- Identify the fraction of P losses associated with short versus long-term management strategies.
  - Working with APLE to understand long-term drawdown
  - Most BMPs are short-term, but don't address nutrient balance
- Model functions should be capable of scaling down to provide segment and field guidance on drivers of Phosphorus loss
  - APLE is a field-scale model, but the CBP doesn't have the data available to model every field

General Modeling Recommendations

- Shift away from using model-generated values and proxy data for key input parameters.
  - Gathering county-level soil P data
  - Mass balance of manure and commercial fertilizer
  - Ag Modeling Subcommittee is pursuing this strategy
- Consider changing weather patterns associated with climate change
  - Climate change will be evaluated as part of the 2017 midpoint assessment. Process-based simulation of hydrology and sediment in HSPF and phosphorus in APLE will be used.

General Modeling Recommendations

- Better represent and report uncertainty in data sources and model output.
  - …looking forward to the workshop!
- Differentiate between surface and sub-surface transport pathways of P loss and account for the role of drainage intensity.
  - Sub-surface transport is an area of active research. No model is simulating this well at the moment, but total loads will still be calibrated to observations. CBP is anticipating better coastal plain monitoring data.

Future Data Needs to Support Changes in Modeling Approach

- Baseline soil P levels
  - County-level data now available
- Information on P application methods.
- Spatial and temporal data on manure application.
- Inorganic P application rates, including those associated with high-value row and horticulture crops
  - The Ag Modeling Subcommittee is working on getting these data sets for the phase 6 watershed model

Future Data Needs to Support Changes in Modeling Approach

- More systematic storm water sampling in predominantly agricultural watersheds for use in model calibration.
  - Non-Tidal Network is now about 10 years old
  - Three USGS-USDA ‘showcase’ watersheds
  - Working with UMCES to get additional coastal plain P loads

Future Data Needs to Support Changes in Modeling Approach

- Improved mapping of features that restrict water infiltration and promote “saturation excess” runoff.
- Improved mapping of drainage intensity as an indicator of hydrologic connectivity and P delivery potential.
  - 10m and 1m DEMs are available for the CBP watershed. Fine scale land use will be available in 2016
  - MWG and CBPO Modeling teams collaborating on NSF-funded research that includes identifying and scaling up hydrologic landscape properties that affect the transport of phosphorus