Overview of Phase 6 Beta 3 Modeling Effort

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8/9/16

Documentation

- See MWG Webpage
- http://www.chesapeakebay.net/groups/group/modeling_team
- Will be periodically updated
- Webinars here too

Phase 6 Model Structure

Average Load + Δ Inputs * Sensitivity

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Land Use Acres

*

BMPs

*

Land to Water

Direct Loads

*

Stream Delivery

*

River Delivery

Phase 6

Setting

Calculation

Science Quality

Delivered Load from a land use =

Avg No BMP Nutrient Load

+

Sensitivity * Change in Inputs

*

Land to water
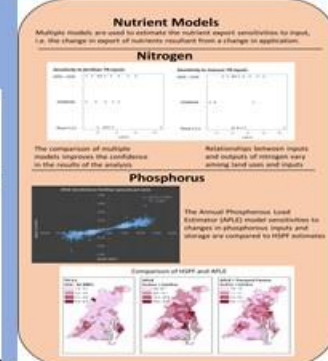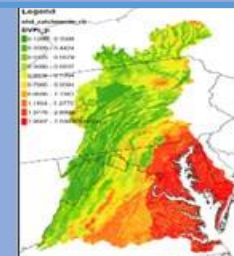
SPARROW
For nitrogen:
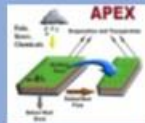Soil, vegetation,
and climate variables
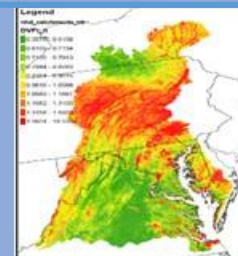
SPARROW
For Phosphorus
Soil, slope,
and climate
variables

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BMPs

Effect of BMPs

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Stream Delivery
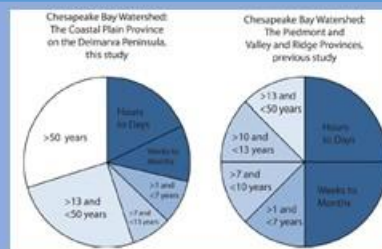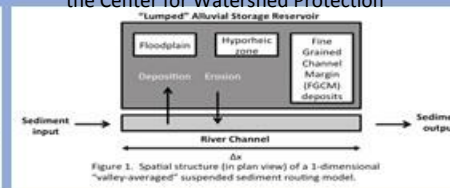
Sparrow

Potential models from USGS and
the Center for Watershed Protection
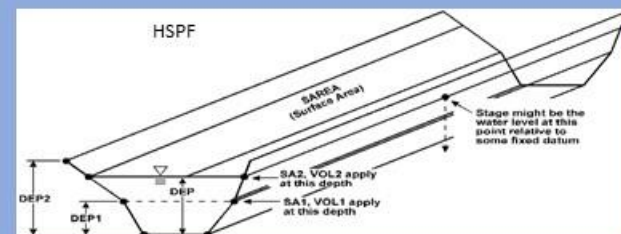
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River Delivery

Phase 6 Processes and Dependencies

Finished
Potentially Finished
Planned Update in 2016
Planned Update in 2015
Area of Concern

Each box represents a dataset, model, or process

9/3/15

Average Load + Δ Inputs * Sensitivity

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Land Use Acres

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BMPs

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Land to Water

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Stream Delivery

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River Delivery

Direct Loads

Phase 6

Beta 2 – April 2016

Finished

Potentially Finished

Planned Update in 2016

Planned Update in 2015

Area of Concern

Each box represents a dataset, model, or process

http://www.vectorhq.com/psd/green-liquid-psd-433097

Legend:
- Hydrology
- Sediment
- Temperature
- EOS Nutrients
- Lag Nutrients
- Small Scale Factors
- River
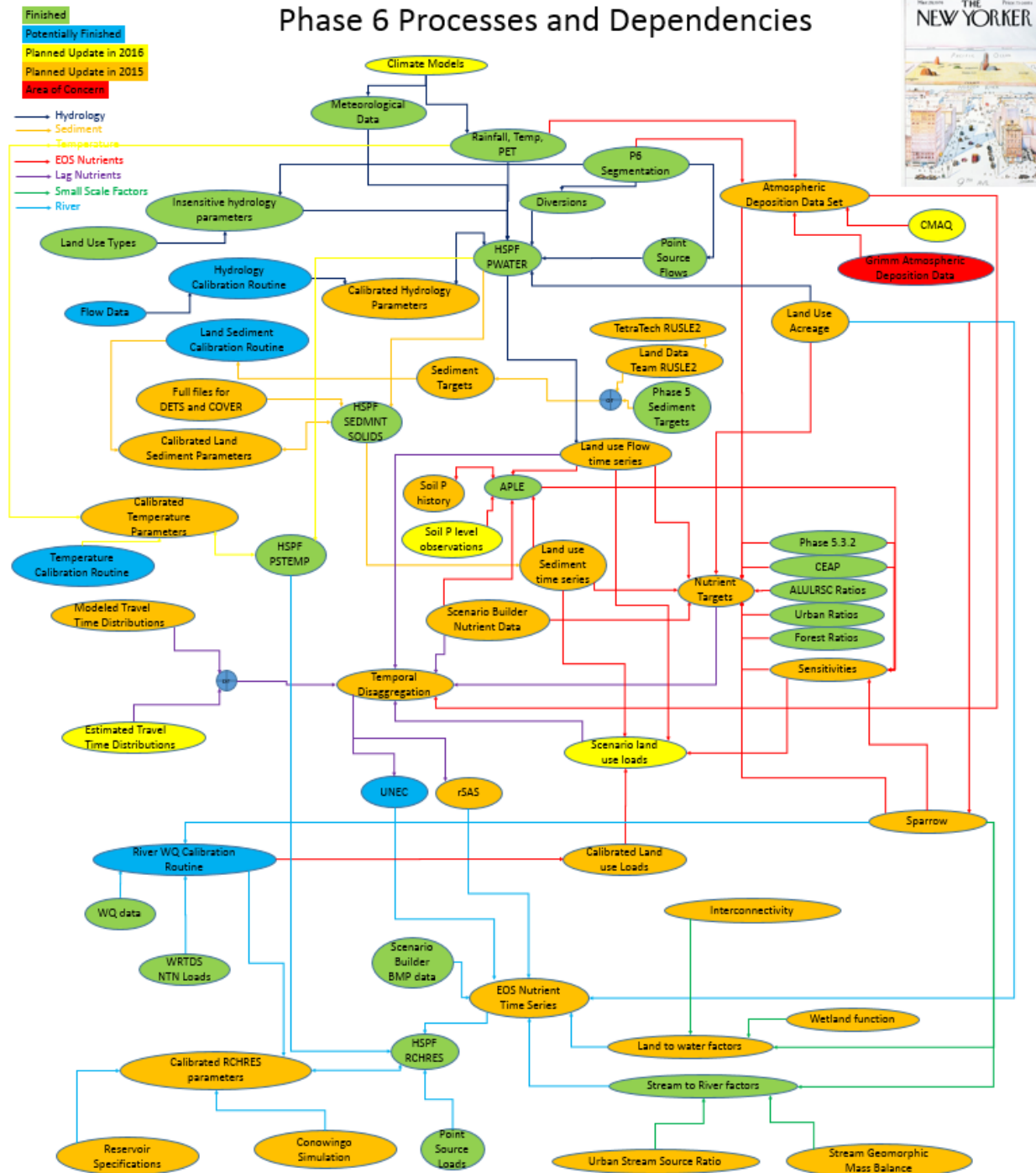
Beta 3 – August 2016

Average Load + △ Inputs * Sensitivity
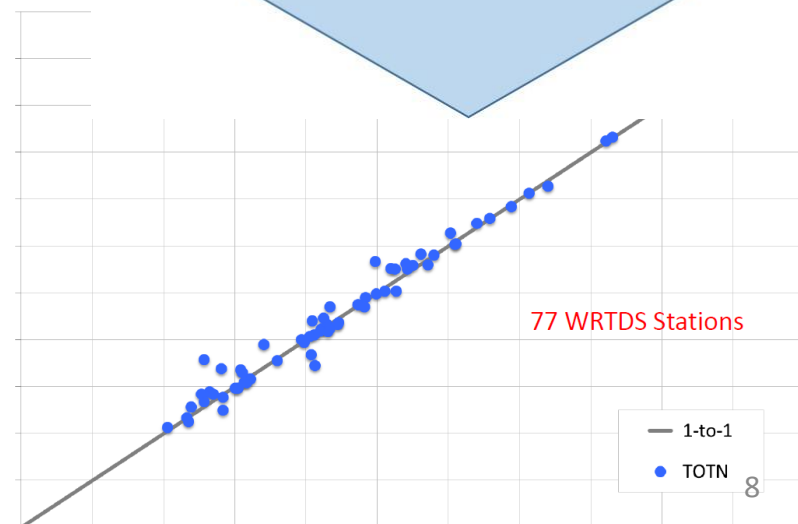
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Land Use Acres

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BMPs

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Direct Loads

Land to Water

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Stream Delivery

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River Delivery

77 WRTDS Stations

— 1-to-1
● TOTN

http://dsfe.wikia.com/wiki/File:Chief_Inspector_brb.png

Average Loads

Average Loads – Average edge-of-small-stream loading rate for a given land use for the entire CB watershed

Estimate Total Non-point Source
Modeling Workgroup
Monitoring Data
      subtract point source
      divide by transport
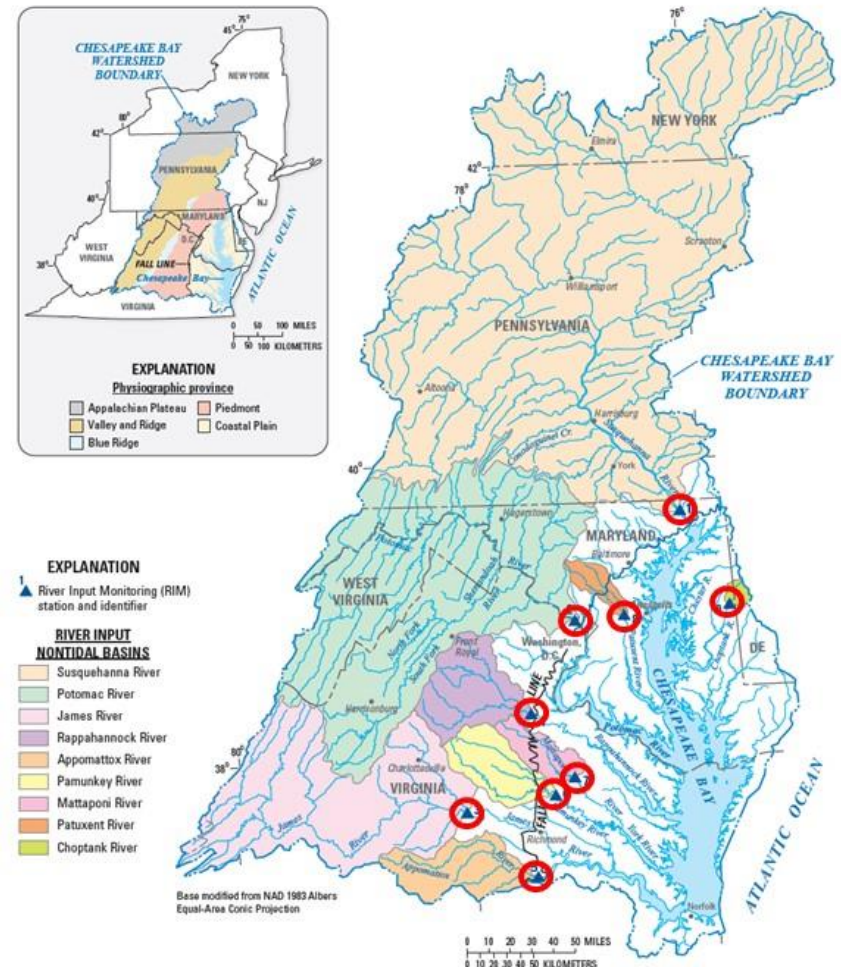
Average Loads

Average Loads – Average edge-of-small-stream loading rate for a given land use for the entire CB watershed
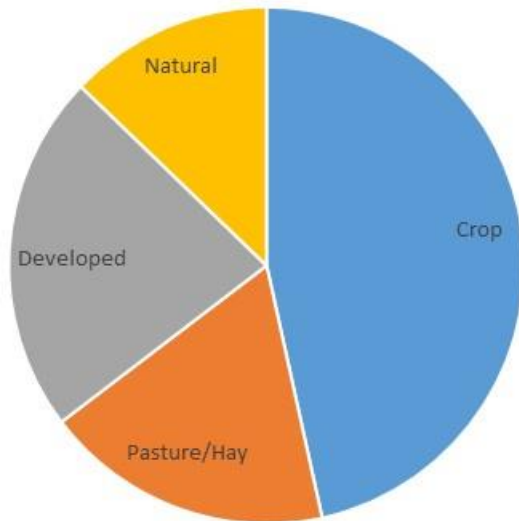
Divide into Broad Classes
Modeling Workgroup
Multiple models
Phase 5.3.2
Sparrow
CEAP

Divide into broad classes -- Nitrogen

Sector	Crop	Pasture/ Hay	Developed	Natural
Acres*	4,361,964	5,156,450	5,289,606	24,788,695
P532 Export Rate (pounds per acre)	47.5	19.9	19.4	4.2
CEAP Export Rate (pounds per acre)	42.5	10.2	Not used	1.6
SPARROW Export Rate with BMP effects removed (pounds per acre)	22.9	10.2	8.9	0.4
Average Ratio to Crop Rate	1.00	0.37	0.40	0.05
Average Sector Export Rate (pounds per acre)	46.65	15.36†	18.62	2.26

Note that no target is calculated for 1,148,100 acres in the land uses: permitted feeding space, non-permitted feeding space, and combined sanitary sewer and water.
† The afo/cfo load of 9,063,059 pounds is removed from pasture.
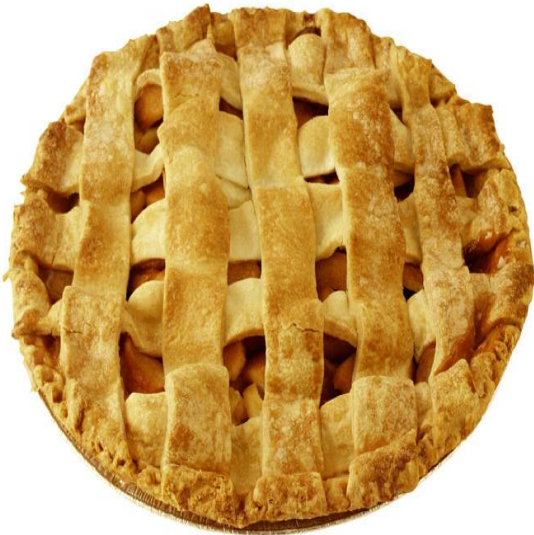
Average Loads

Average Loads – Average edge-of-small-stream loading rate for a given land use for the entire CB watershed
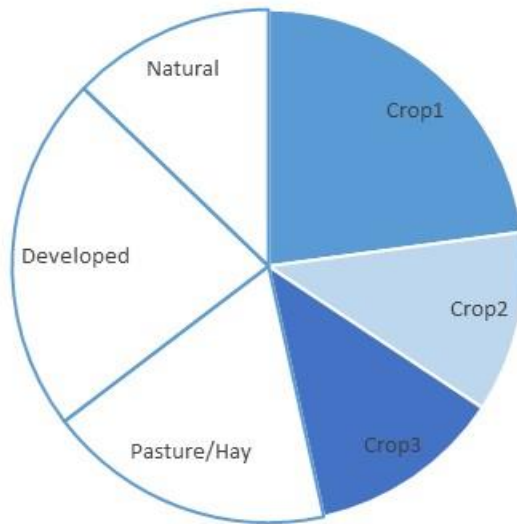
Split Classes into individual land uses
WQGIT Workgroups
Multiple lines of evidence to develop ratios
   - for example silage is 16% higher than grain
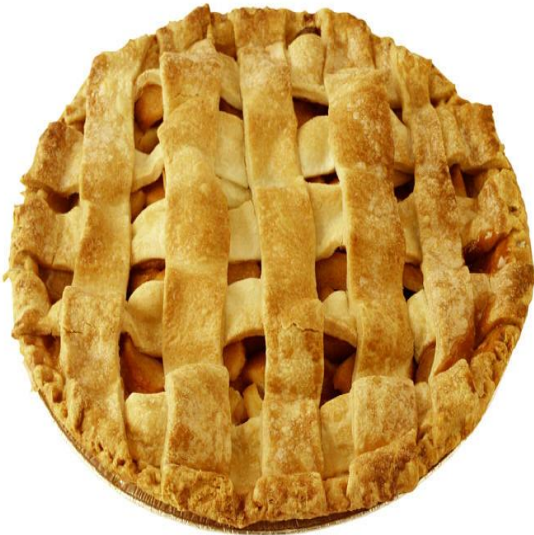
Split classes into individual land uses – Crop Nitrogen

Target Sector	Land Use	Export Rate Ratio	Export Rate (pounds per acre per year)
Cropland	Full Season Soybeans	0.71	54
	Grain with Manure	1.4	106
	Grain without Manure	1	76
	Other Agronomic Crops	0.45	34
	Silage with Manure	1.62	122
	Silage without Manure	1.16	88
	Small Grains and Grains	0.84	64
	Small Grains and Soybeans	0.79	60
	Specialty Crop High	1.34	101
	Specialty Crop Low	0.31	23
Pasture	Ag Open Space	0.43	9
	Legume Hay	0.74	16
	Other Hay	1.04	23
	Pasture	1	22

Beta 2

Target Sector	Land Use	Export Rate Ratio	Export Rate (pounds per acre per year)
Developed	Non-Regulated Tree Canopy over Impervious	0.91	40
	Non-Regulated Tree Canopy over Turfgrass	0.38	17
	Non-Regulated Turf Grass	0.5	22
Natural	True Forest	1	3

Beta 2 pie was too large

- Modifications to method for Beta 3
  - Assumed lower attenuation in rivers
  - Updated point source values

Estimate Total Non-point Source
Modeling Workgroup
Monitoring Data
      subtract point source
      divide by transport

Attenuation in Rivers

- Phase 5 riverine processing was similar to previous phases of the watershed model and in agreement with statistical models of river attenuation such as Seitzinger and others 2002b.

Table 2. Characteristics of the sixteen watershed river networks, and base case (RF1$_m$ + NHD') and reduced scale (RF1 only) model predictions of proportion of N inputs to the river network that are removed by in-river processes

Watershed[1]	Watershed area[2] km^2	Discharge[2] m^3 s^{-1}	River export[2] kg TN km^{-2} y^{-1}	Number of reservoirs	RF1 total reach length km	NHD total reach length km	Number of reaches	% N input removed RF1$_m$ + NHD' Base case	% N input removed RF1 only Reduced scale
Penobscot	20,109	375	317	22	4,344	19,798	5,917	68	59
Kennebec	13,994	251	333	14	2,716	12,182	3,651	63	52
Androscoggin	8,451	171	404	8	1,076	5,737	1,938	52	44
Saco	3,349	71	389	5	644	2,896	880	47	33
Merrimack	12,005	224	499	13	1,070	12,784	3,509	61	38
Charles	475	9	644	0	78	626	205	37	15
Blackstone	1,115	23	1,140	0	108	1,148	317	53	22
Connecticut	25,019	509	538	18	4,748	23,173	7,380	66	55
Upper Hudson	11,942	236	502	5	2,213	8,420	2,384	58	50
Mohawk	8,935	155	795	6	1,677	8,471	2,704	60	47
Delaware	17,560	304	961	13	2,612	14,228	5,011	60	48
Schuylkill	4,903	76	1,755	2	550	3,625	966	52	31
Susquehanna	70,189	1,084	977	21	9,612	69,248	17,499	76	63
Potomac	29,940	312	897	3	5,089	25,105	8,624	68	60
Rappahannock	4,134	47	470	0	844	3,041	806	57	42
James	16,206	209	314	3	3,322	15,375	4,885	72	61

[1] see Figure 1 for watershed delineations.
[2] From Boyer et al. (2002).

Attenuation in Rivers

- Sparrow models estimate much lower river attenuation.
  - Alexander and others 2008
  - Alexander and others 2009
  - Preston and others 2011
  - Ator and others 2011
- Measured denitrification
  - Bohlke and others 2009
  - Seitzinger 1988.

Beta 3 values

Target Sector	Land Use	Beta 3 N	Beta 3 P
Cropland	Full Season Soybeans	24	1.4
	Grain with Manure	48	1.5
	Grain without Manure	33	1.5
	Other Agronomic Crops	16	2.0
	Silage with Manure	54	1.6
	Silage without Manure	38	1.6
	Small Grains and Grains	28	1.2
	Small Grains and Soybeans	34	1.5
	Specialty Crop High	43	2.8
	Specialty Crop Low	11	2.2
Pasture	Ag Open Space	4	1.1
	Legume Hay	7	0.6
	Other Hay	10	0.6
	Pasture	9	0.8

- More Difficult
- River 'Knob' is much smaller
- Forces modeling team to look more closely at all assumptions

Average Load + Δ Inputs * Sensitivity
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Land Use Acres
*
BMPs
*
Land to Water
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Stream Delivery
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River Delivery

Direct Loads

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