Application of the 2017 Phase 6 Models

Water Quality Goal Implementation Team
November 27, 2017

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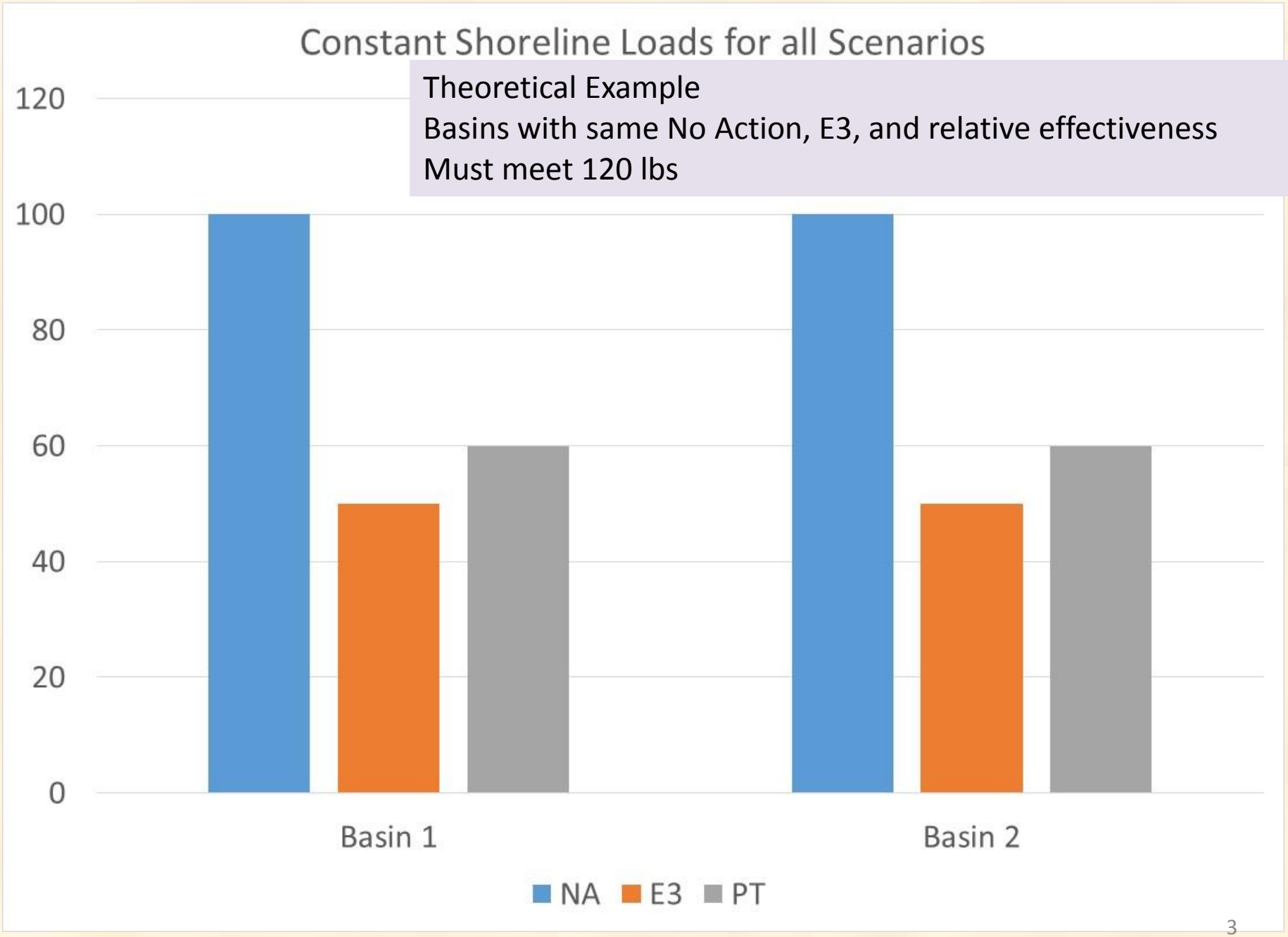
Carl Cerco, and the CBP Modeling Team

Chesapeake Bay Program
Science, Restoration, Partnership

Overview

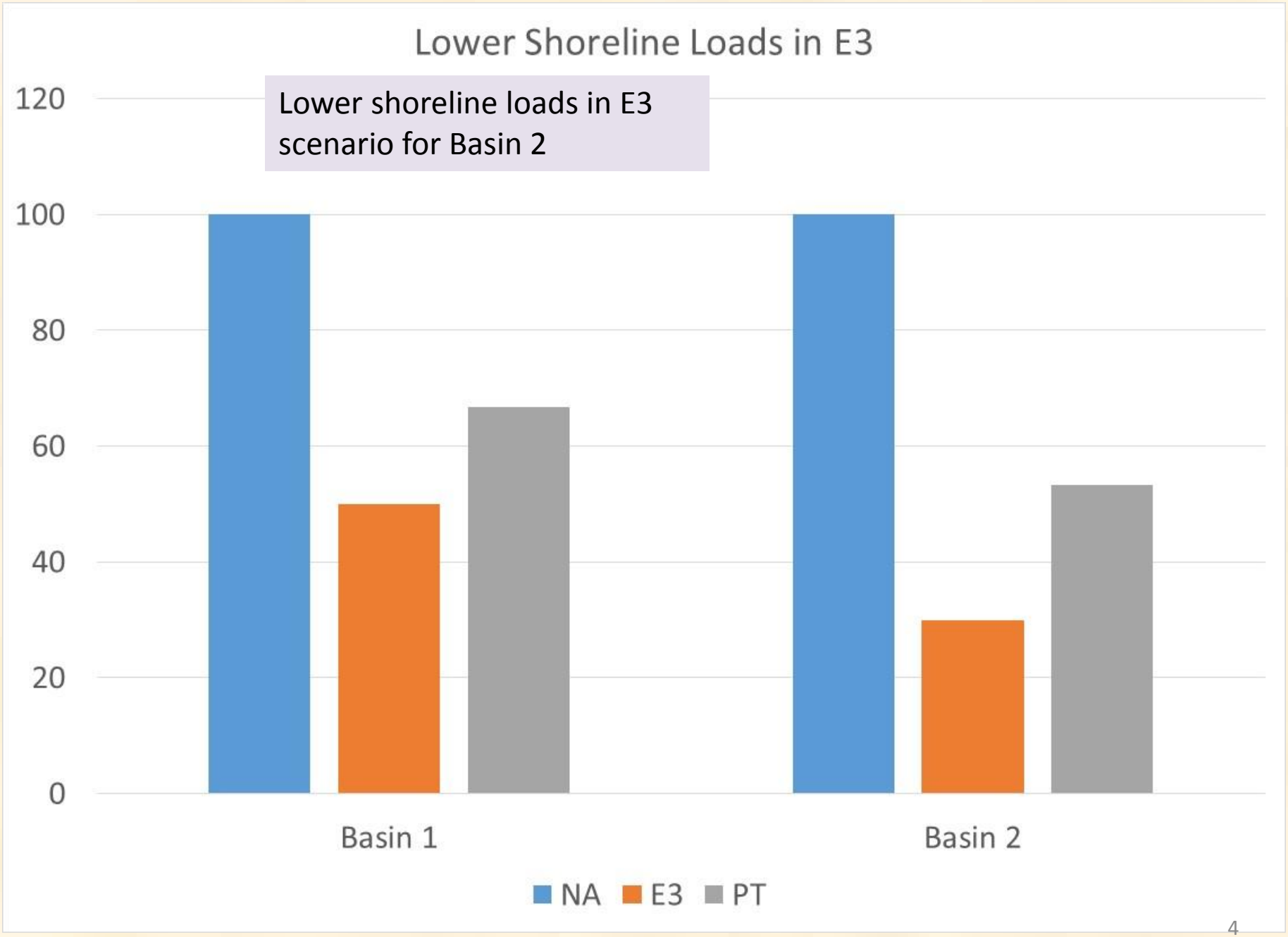
- Tidal Shoreline Loads
- Phase 6 Watershed Model Final
- Community Air Quality Model Inputs
- Water Quality Sediment Transport Model Final
- Key scenarios
- Conclusions



Theoretical Example

Basins with same No Action, E3, and relative effectiveness

Must meet 120 lbs


Lower Shoreline Loads in E3
Lower shoreline loads in E3 scenario for Basin 2
120
100
80
60
40
20
0
Basin 1
Basin 2
NA
E3
PT

Some options to consider

- Theory behind the planning target calculation is that jurisdictions are responsible for a certain fraction of what can be done.

- “Default” - Define a No Action and E3 and treat just like any other BMP
- “Extra Credit” – No part in planning target calculations, but credit is given for implementation

Considerations

- Credit received for shoreline loads to date are in the low 100s of pounds of N and P
  - 0.05% of the Shoreline loads
- No Action and E3 are difficult to define for Shoreline protection
  - Credit not given for many ‘hard’ practices
  - What is a reasonable coverage?
- Shoreline protection is done to protect the shoreline, not for nutrient reduction

CBPO recommended option

- Keep No Action and E3 at 2008 implementation levels as currently defined.
- Responsibility for implementing shoreline and tidal BMPs are taken out of the planning target calculation.
- Tidal states can count shoreline protection reductions toward goals.

Phase 6 Watershed Model

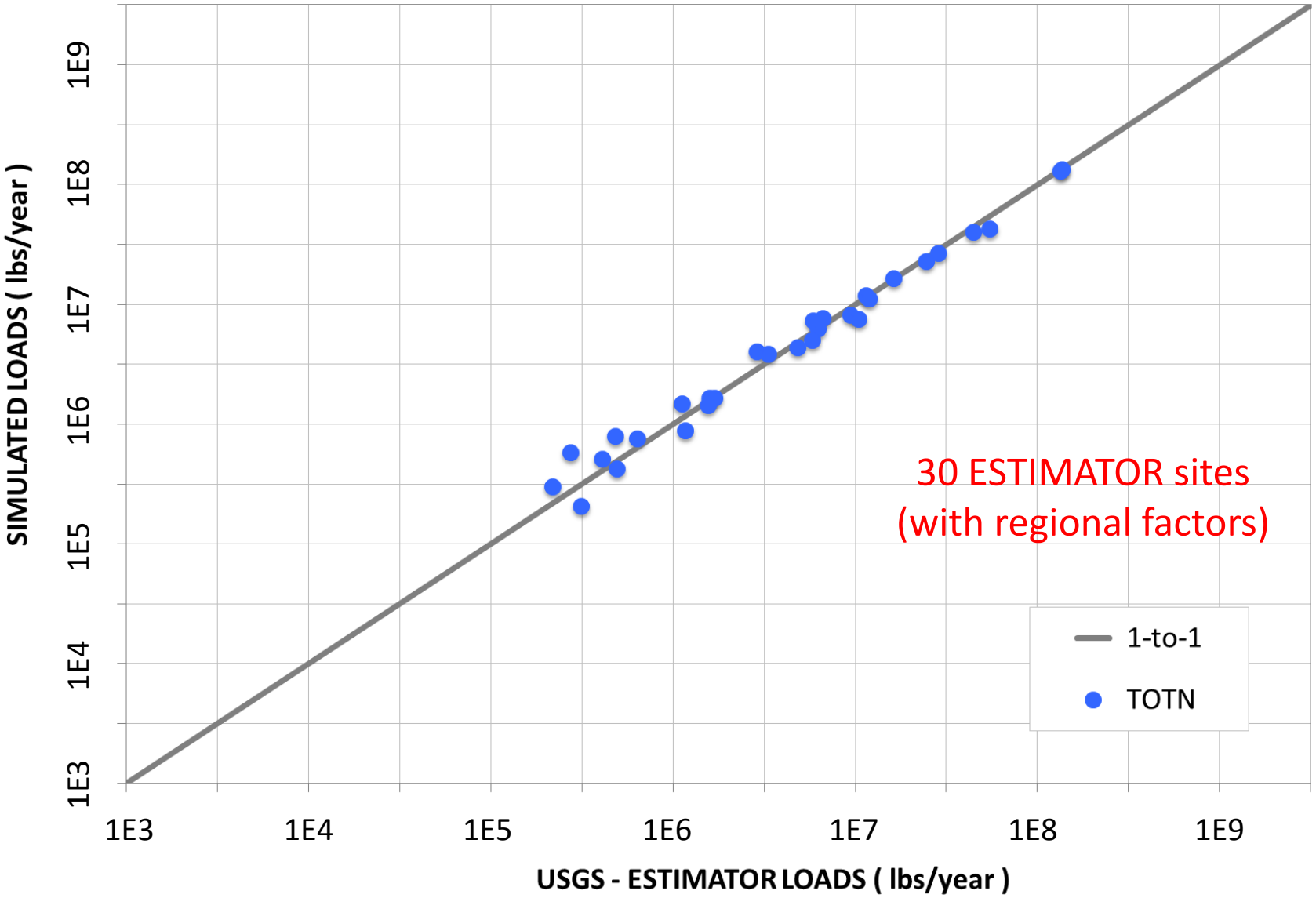
October 2017 Final Calibration

Model performance across spatial scales

average annual loads at WRTDS sites

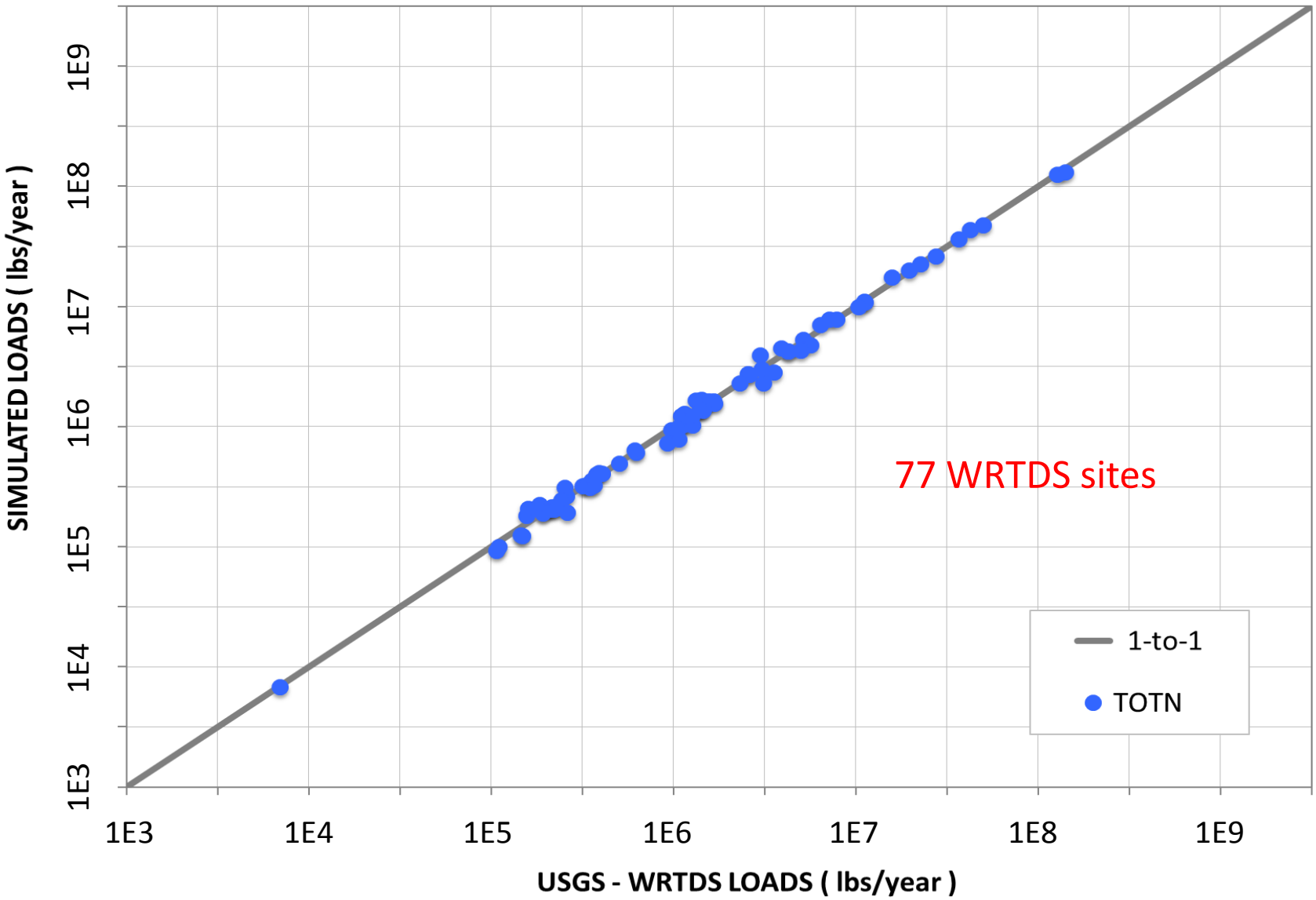
PHASE 5

NITROGEN



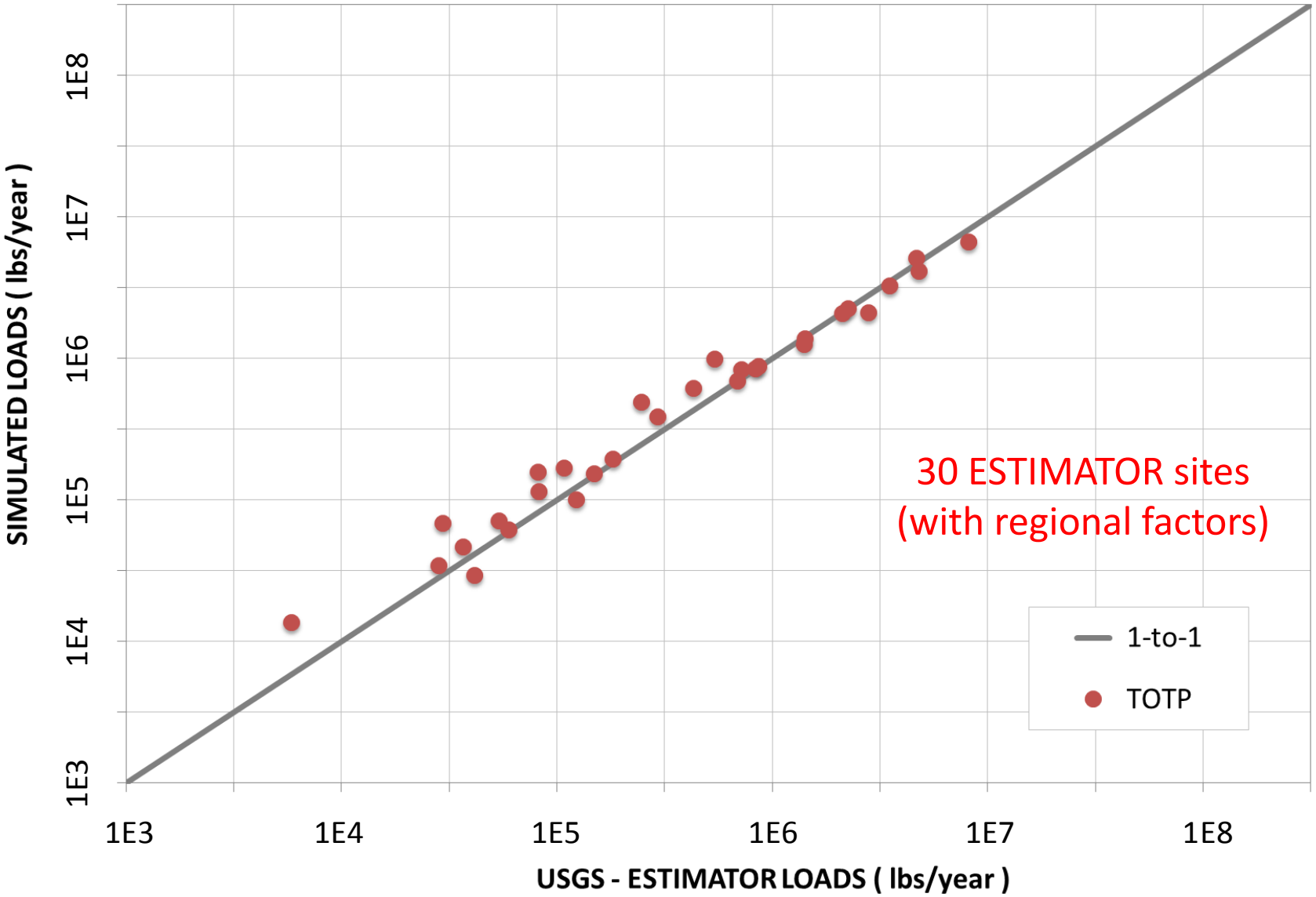
PHASE 6

NITROGEN



PHASE 5

PHOSPHORUS



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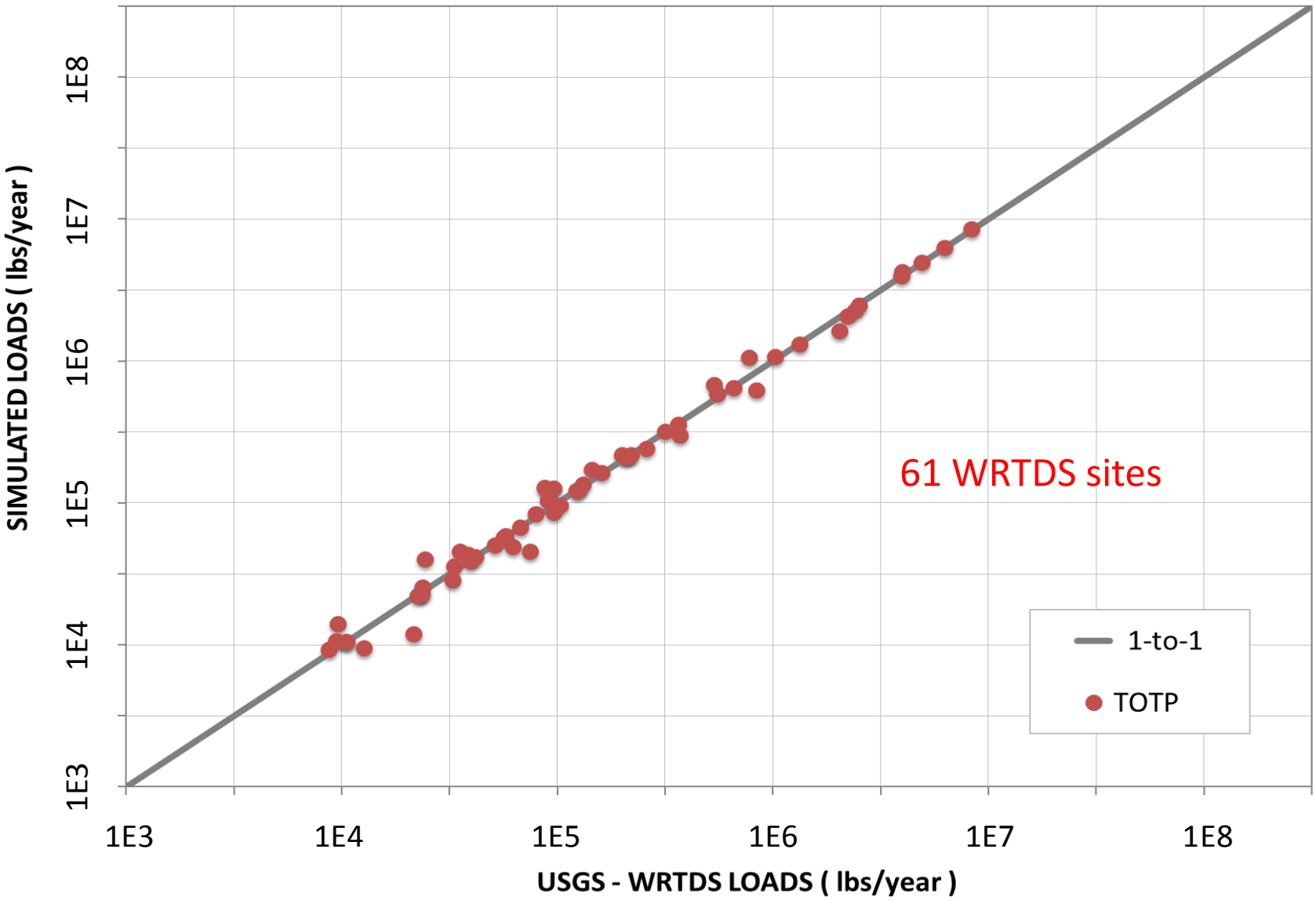

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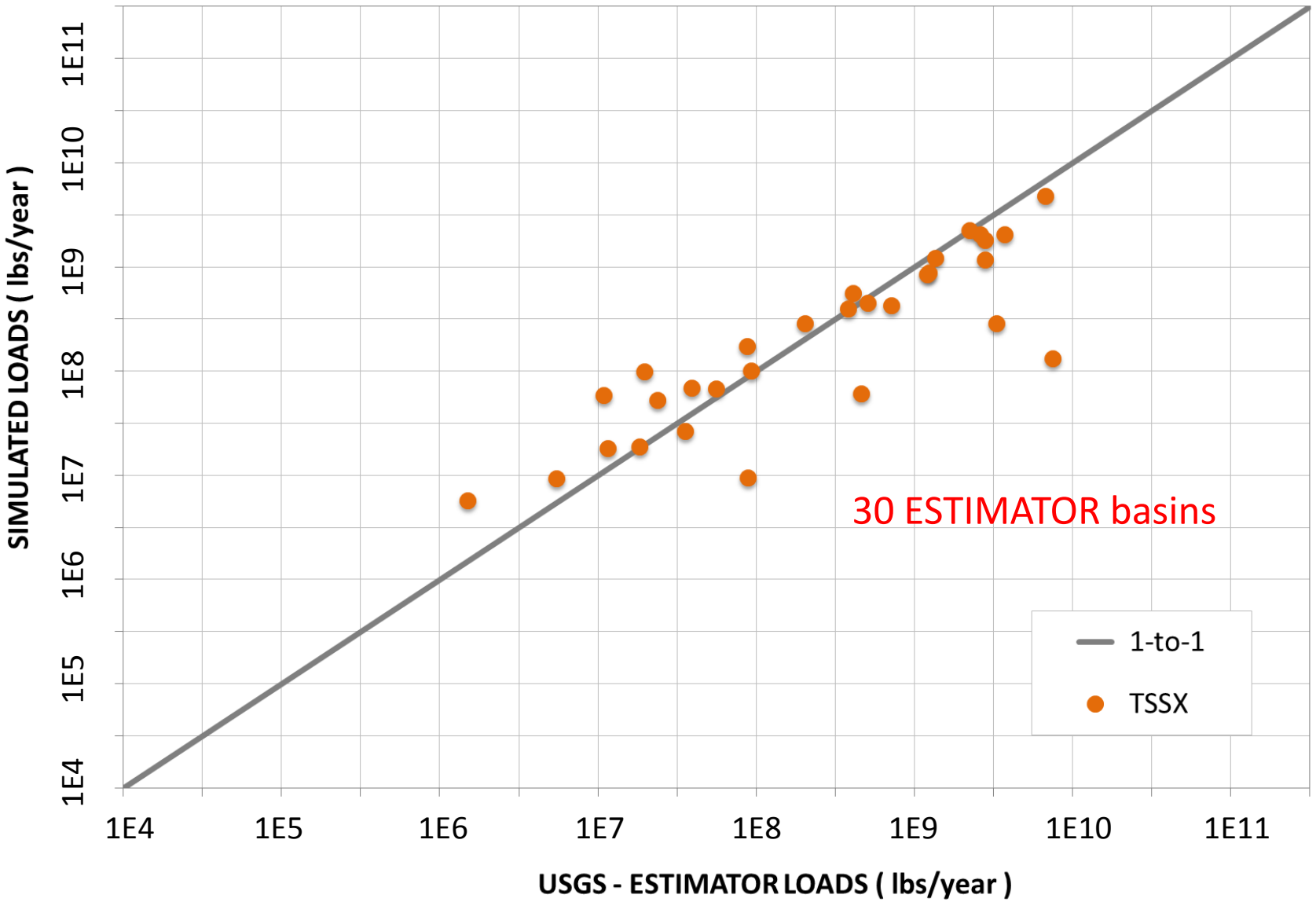
SEDIMENT



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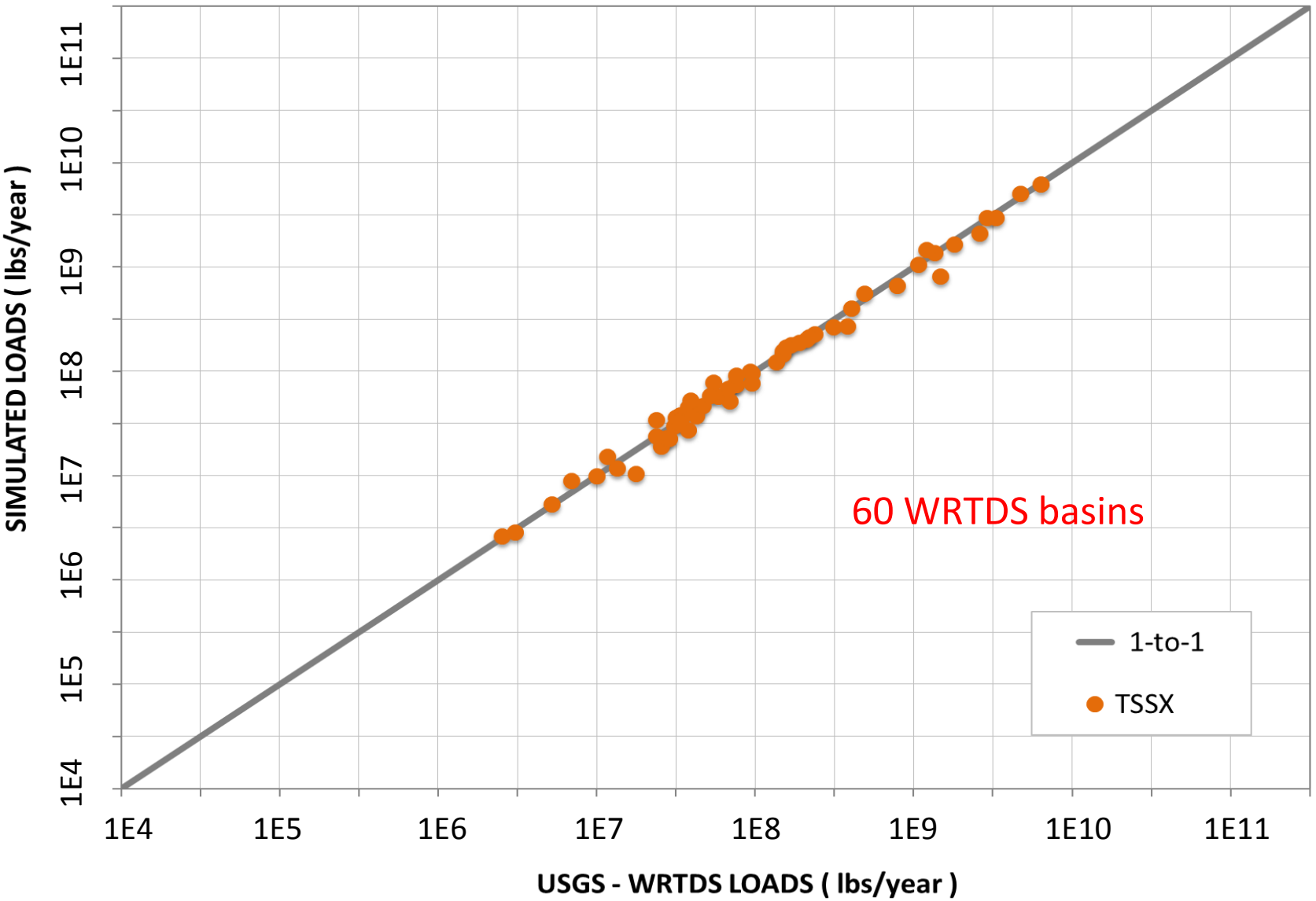
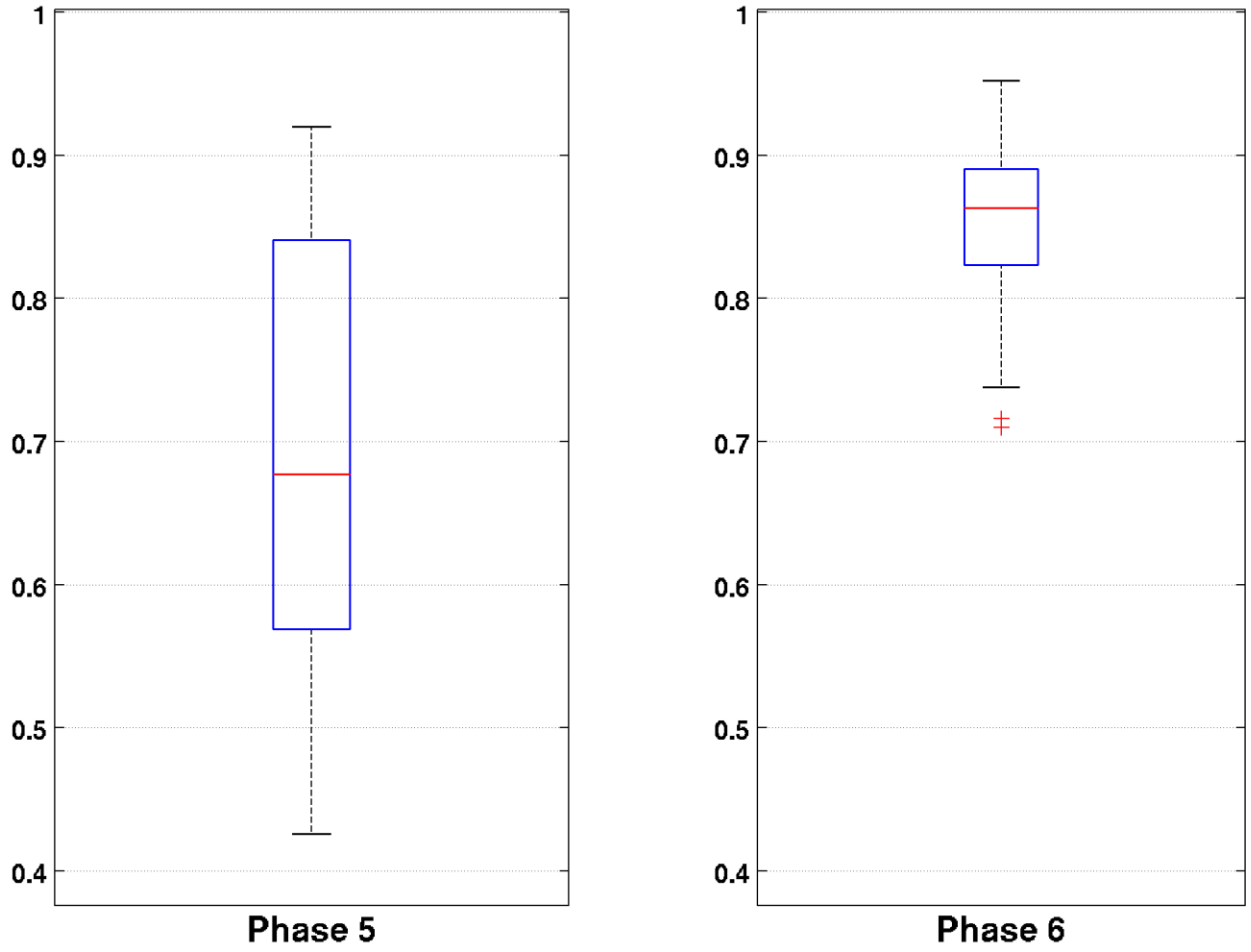
SEDIMENT



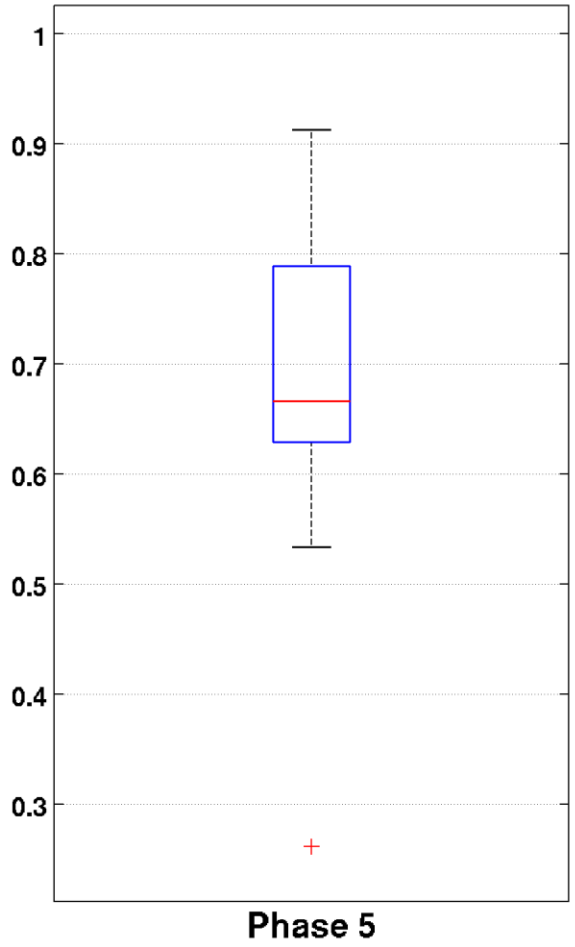
Temporal/seasonal model performance

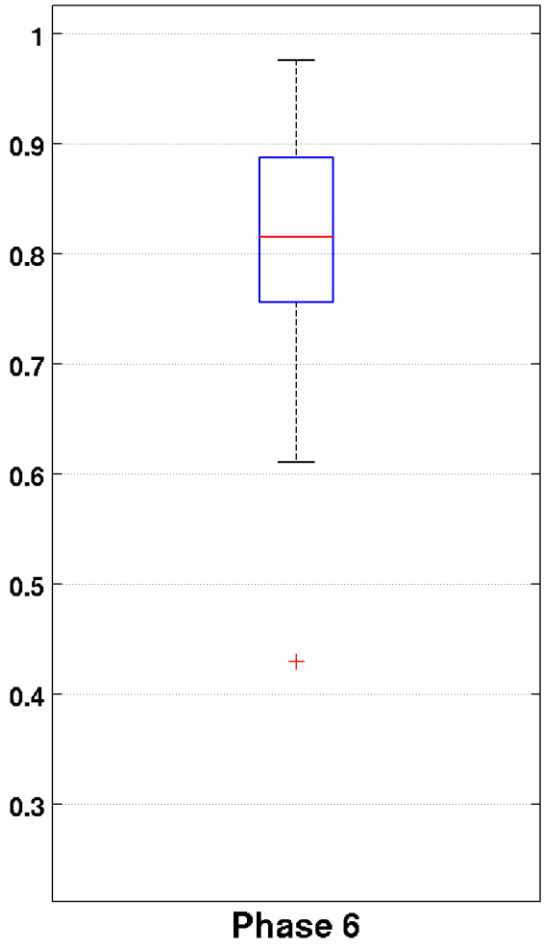
correlation between monthly loads at WRTDS sites

Monthly loads: total nitrogen

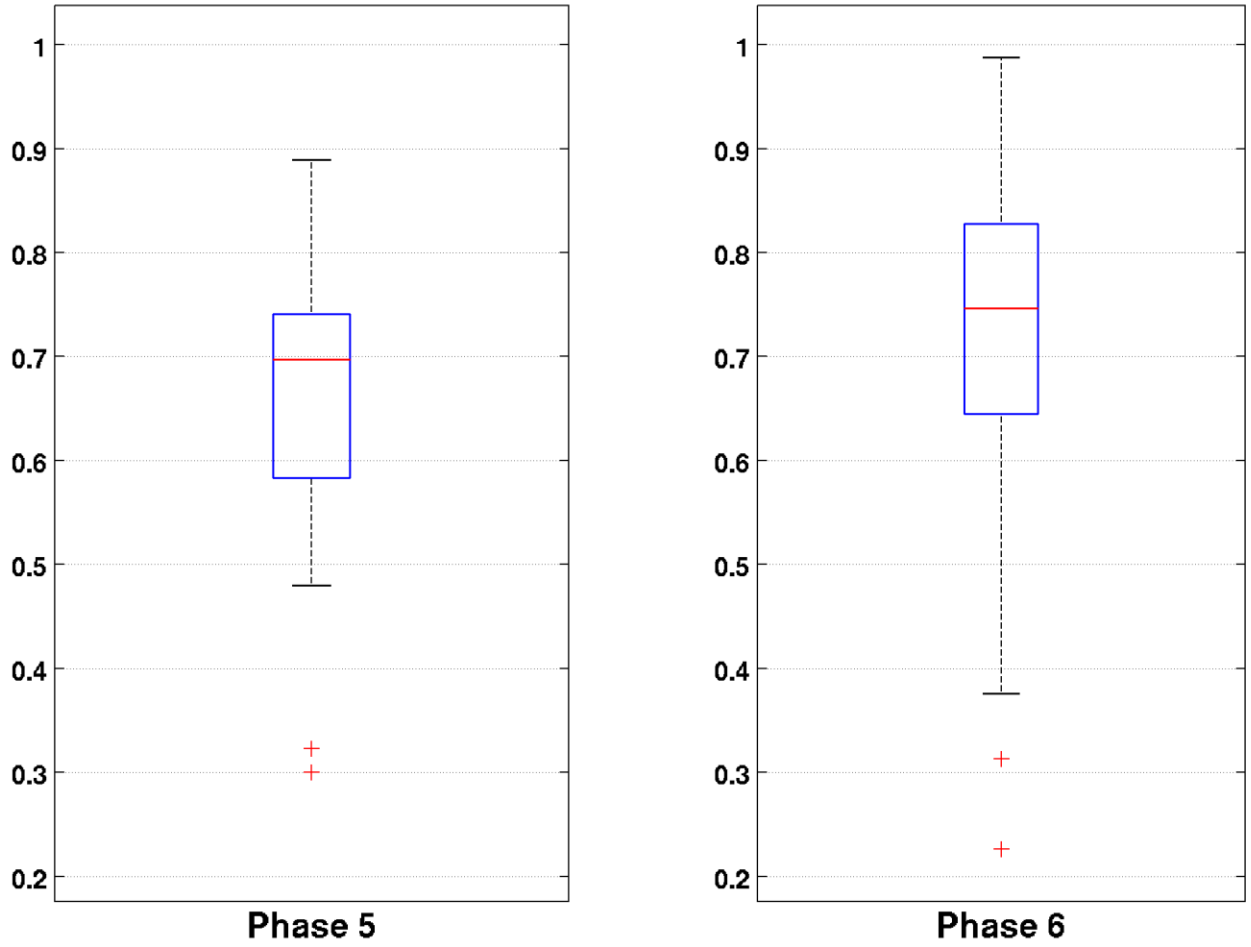


Monthly loads: total phosphorus





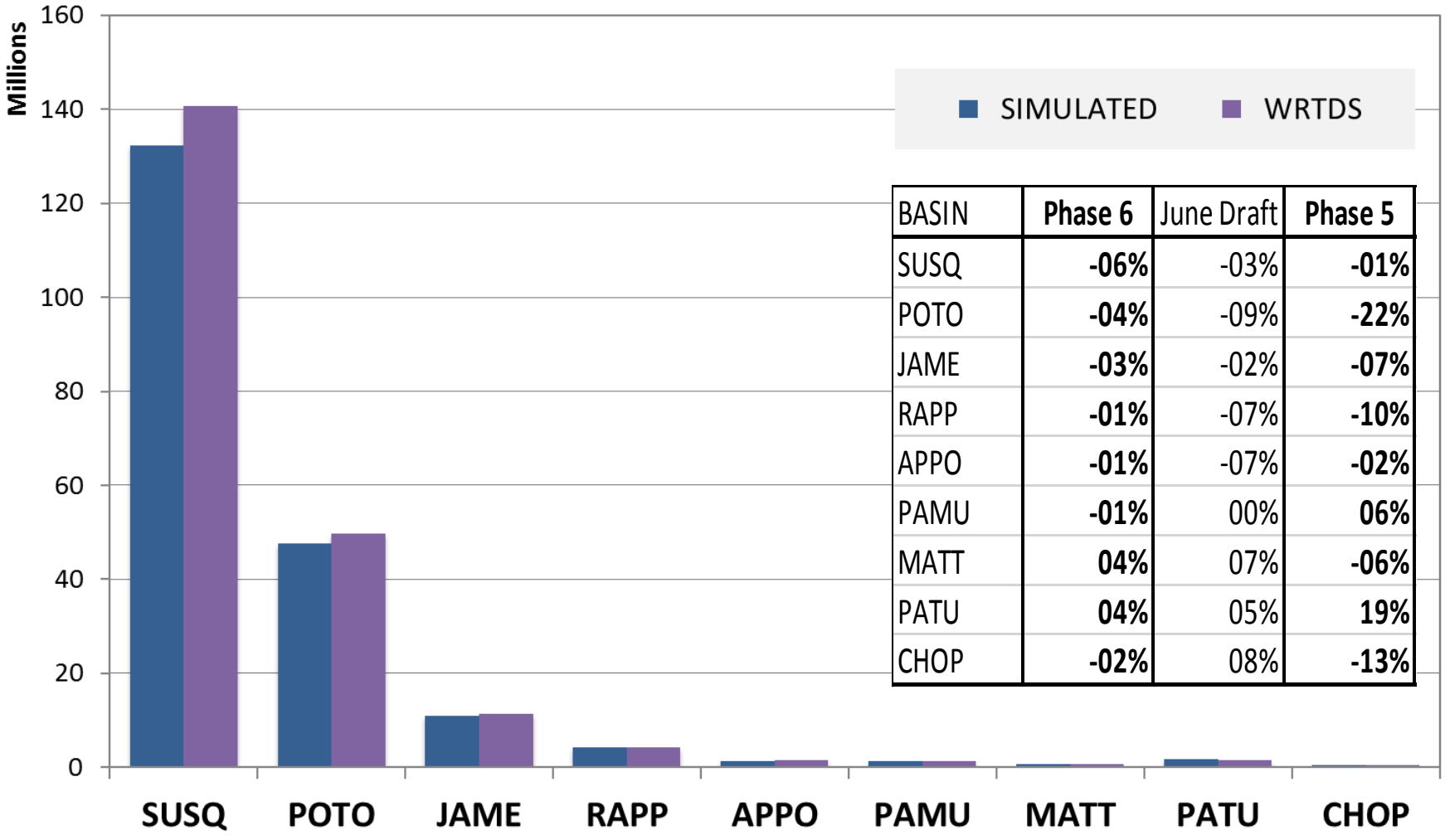
Monthly loads: sediment



Model performance in loading estuarine model

average annual loads at RIM sites

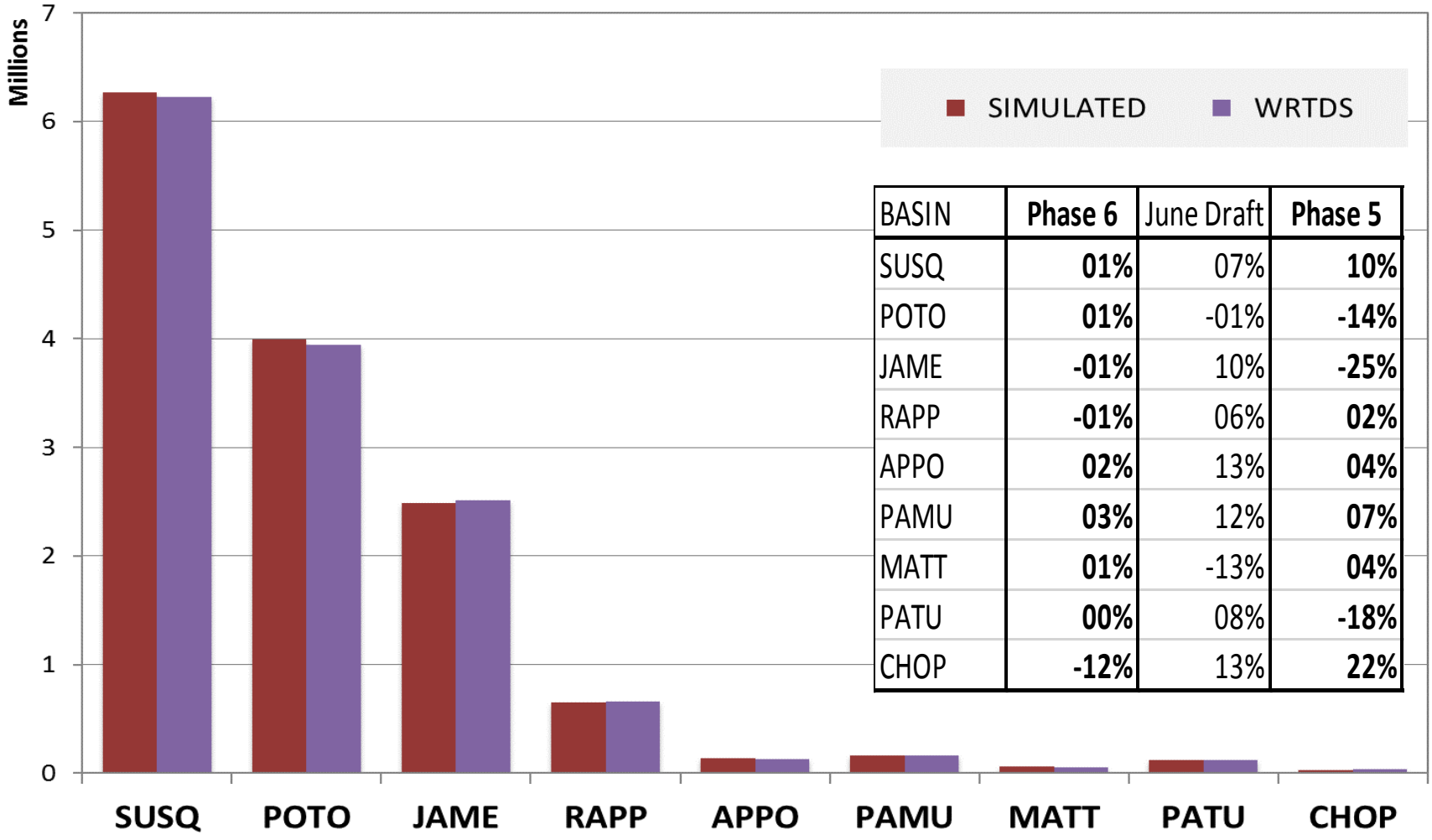
RIM loads: total nitrogen



BASIN	Phase 6	June Draft	Phase 5
SUSQ	**-06%**	-03%	**-01%**
POTO	**-04%**	-09%	**-22%**
JAME	**-03%**	-02%	**-07%**
RAPP	**-01%**	-07%	**-10%**
APPO	**-01%**	-07%	**-02%**
PAMU	**-01%**	00%	**06%**
MATT	**04%**	07%	**-06%**
PATU	**04%**	05%	**19%**
CHOP	**-02%**	08%	**-13%**

assuming +/- 10% uncertainty in WRTDS estimates

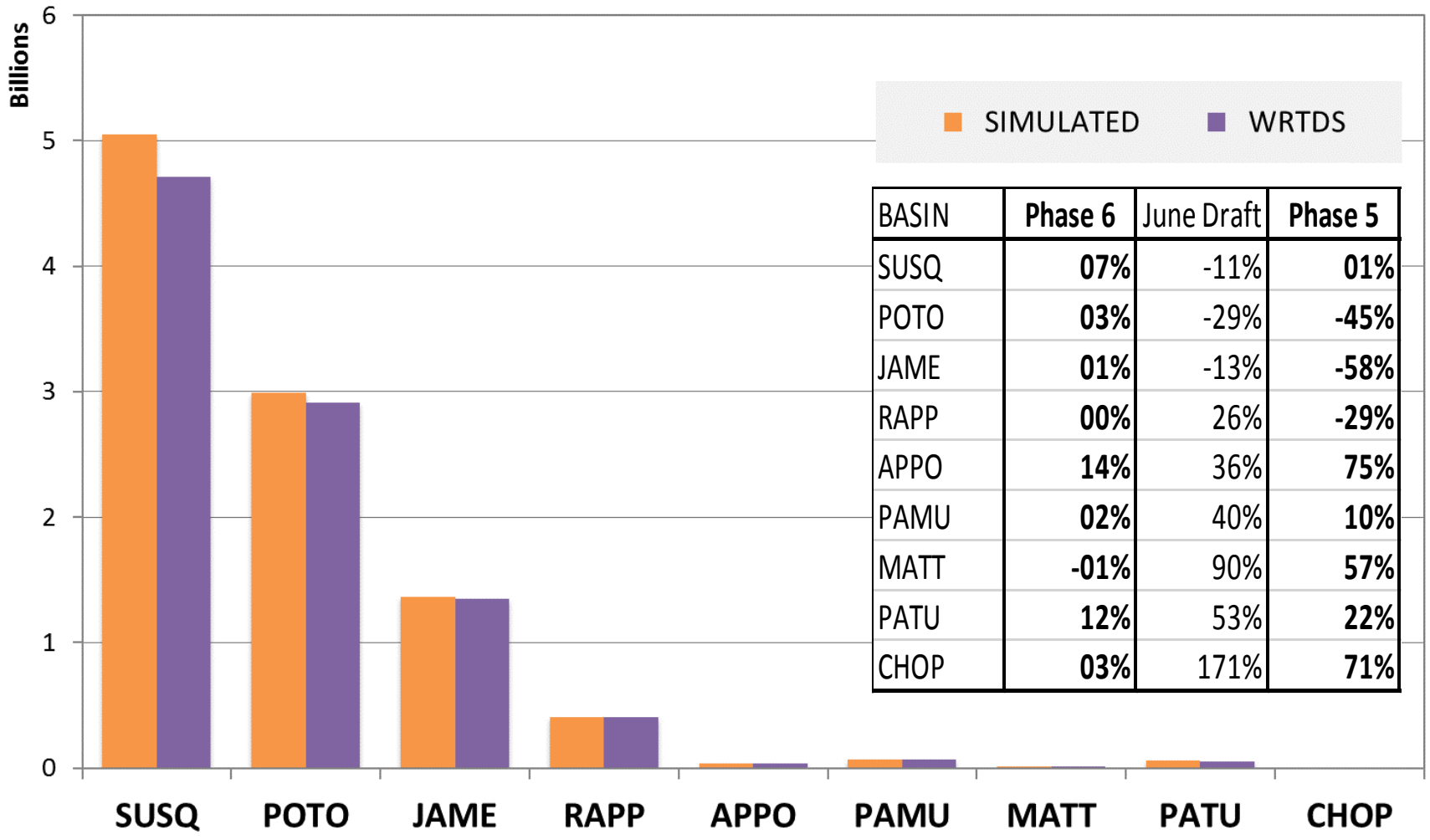
RIM loads: total phosphorus



BASIN	Phase 6	June Draft	Phase 5
SUSQ	**01%**	07%	**10%**
POTO	**01%**	-01%	**-14%**
JAME	**-01%**	10%	**-25%**
RAPP	**-01%**	06%	**02%**
APPO	**02%**	13%	**04%**
PAMU	**03%**	12%	**07%**
MATT	**01%**	-13%	**04%**
PATU	**00%**	08%	**-18%**
CHOP	**-12%**	13%	**22%**

assuming +/- 15% uncertainty in WRTDS estimates

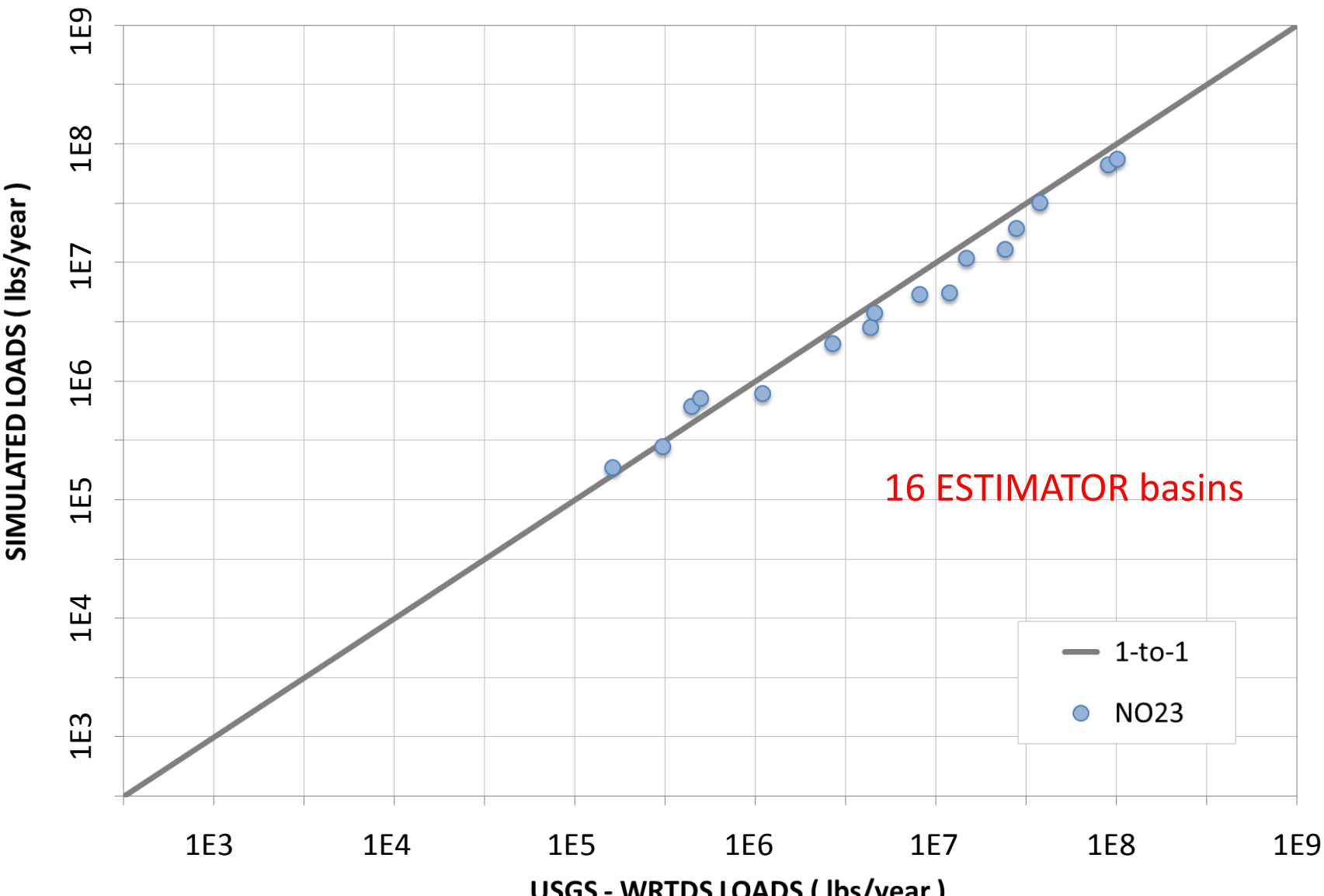
RIM loads: sediment



BASIN	Phase 6	June Draft	Phase 5
SUSQ	**07%**	-11%	**01%**
POTO	**03%**	-29%	**-45%**
JAME	**01%**	-13%	**-58%**
RAPP	**00%**	26%	**-29%**
APPO	**14%**	36%	**75%**
PAMU	**02%**	40%	**10%**
MATT	**-01%**	90%	**57%**
PATU	**12%**	53%	**22%**
CHOP	**03%**	171%	**71%**

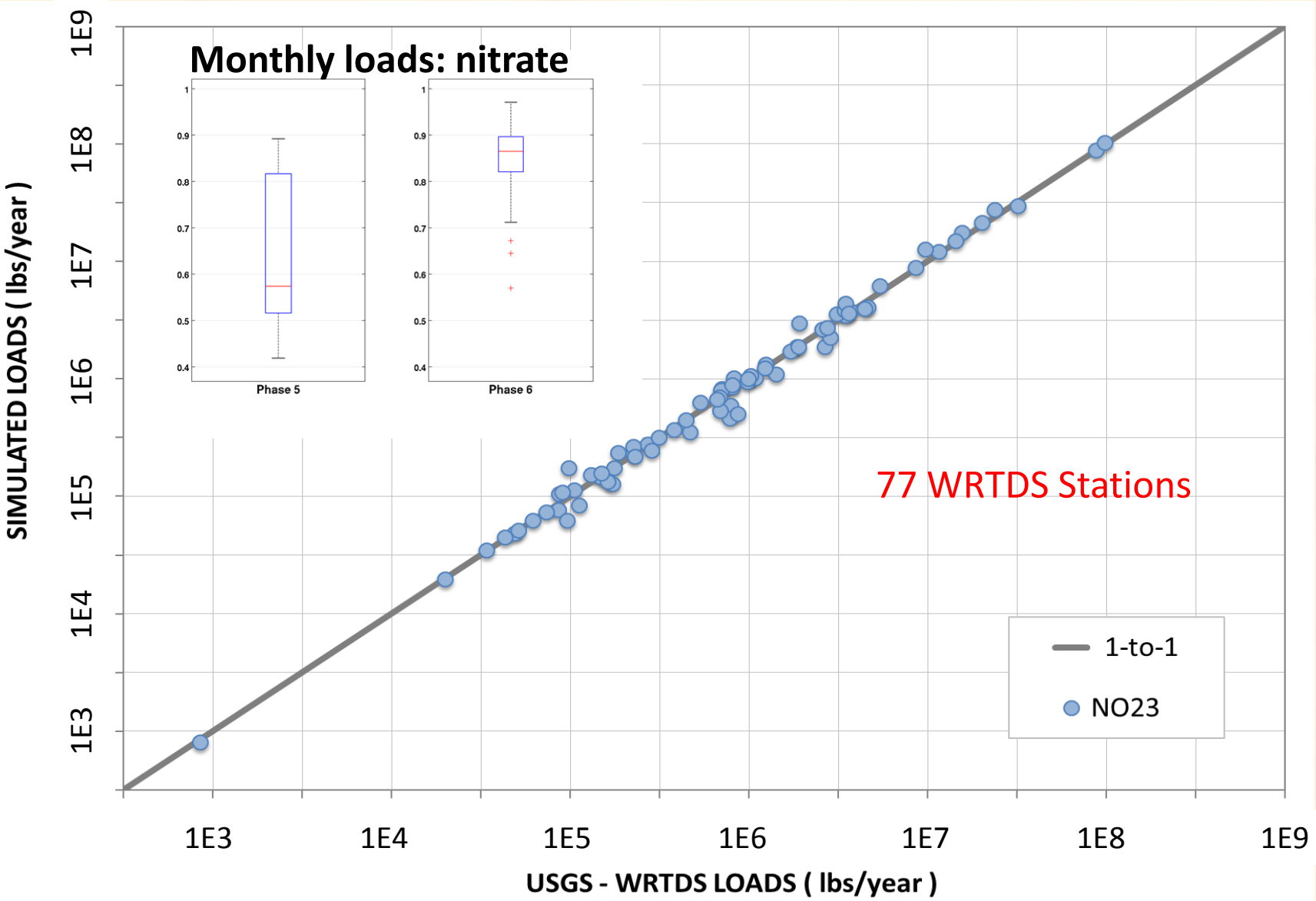
PHASE 5

NITRATE



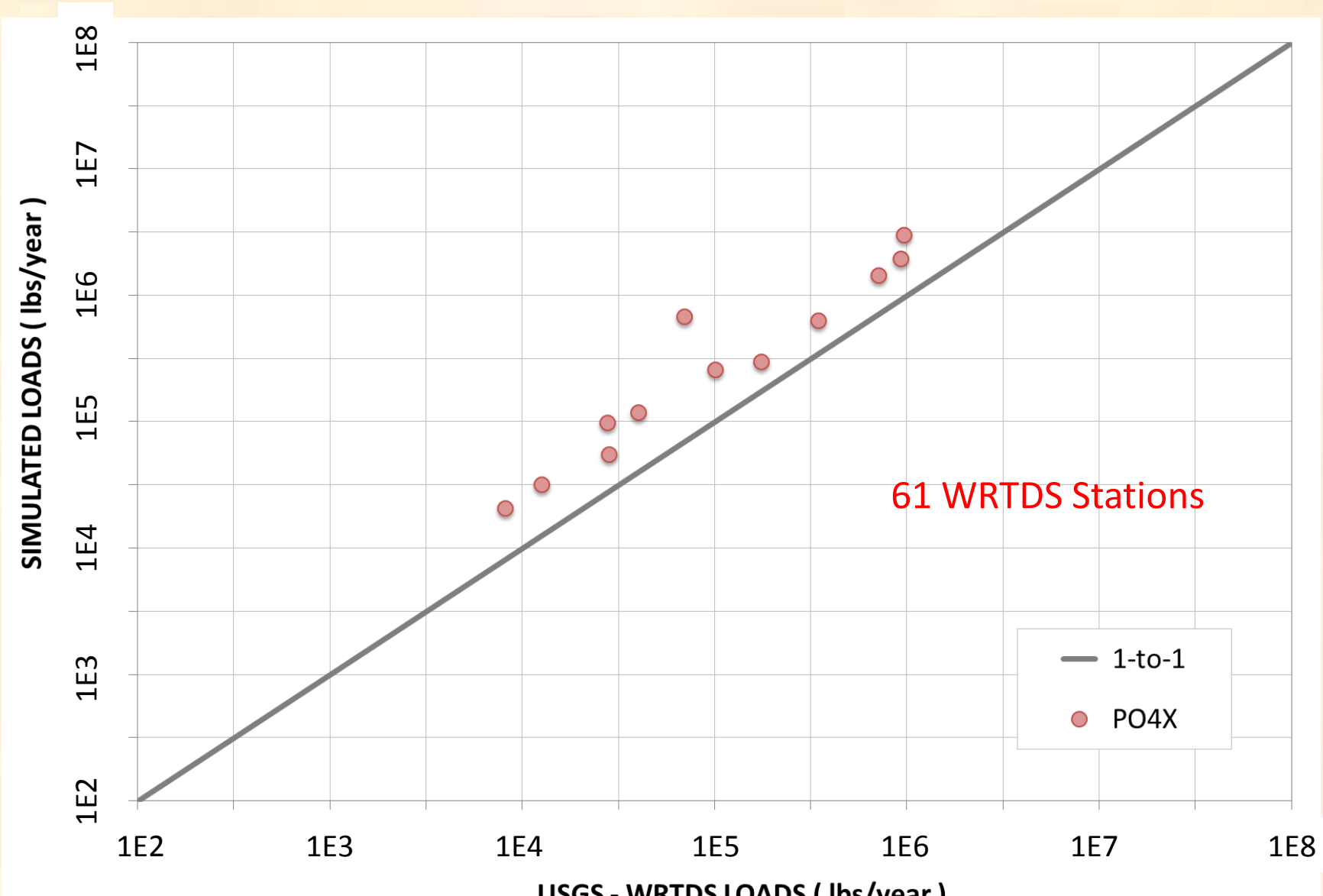
PHASE 6

NITRATE



PHASE 5

DISSOLVED PHOSPHATE



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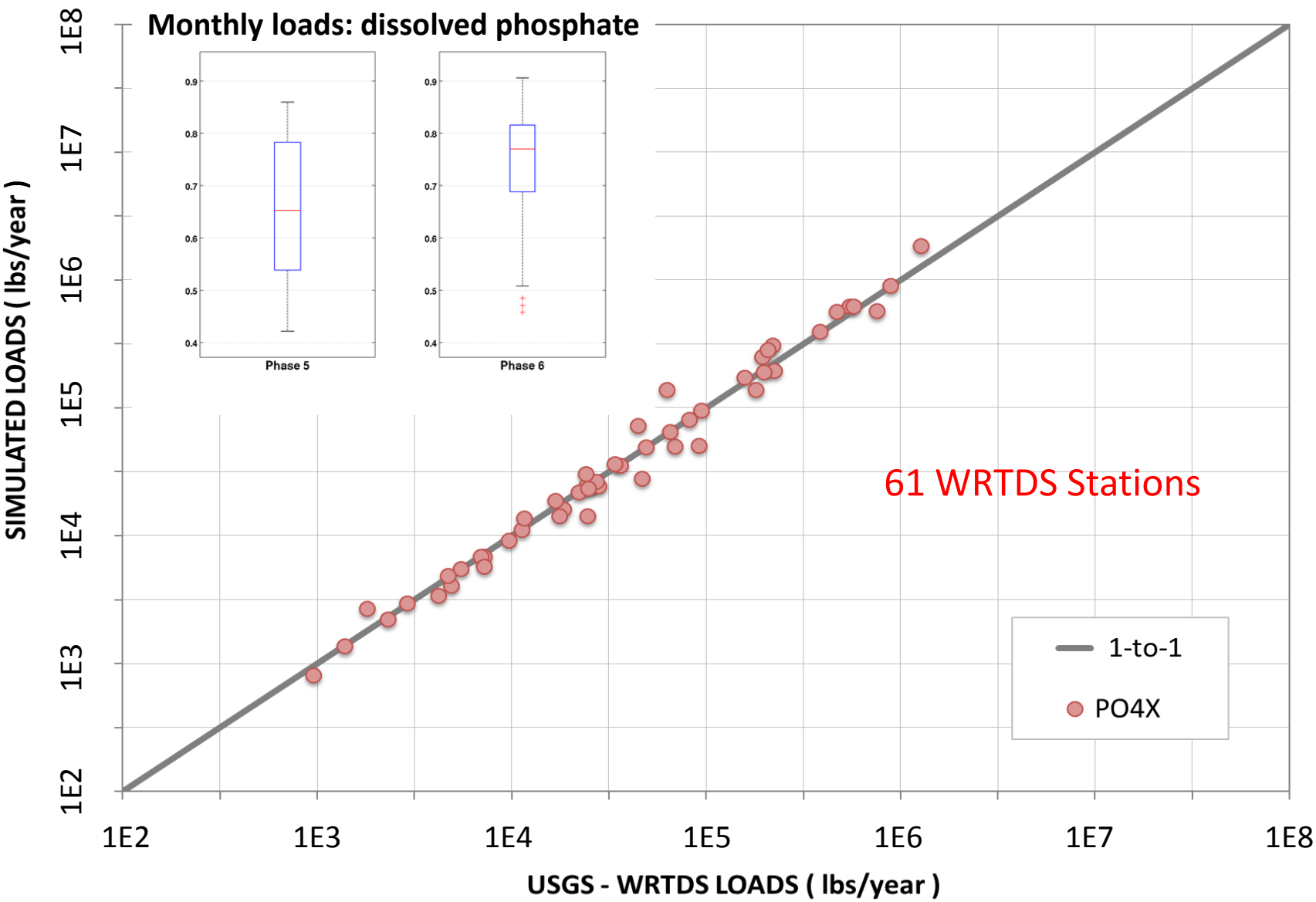
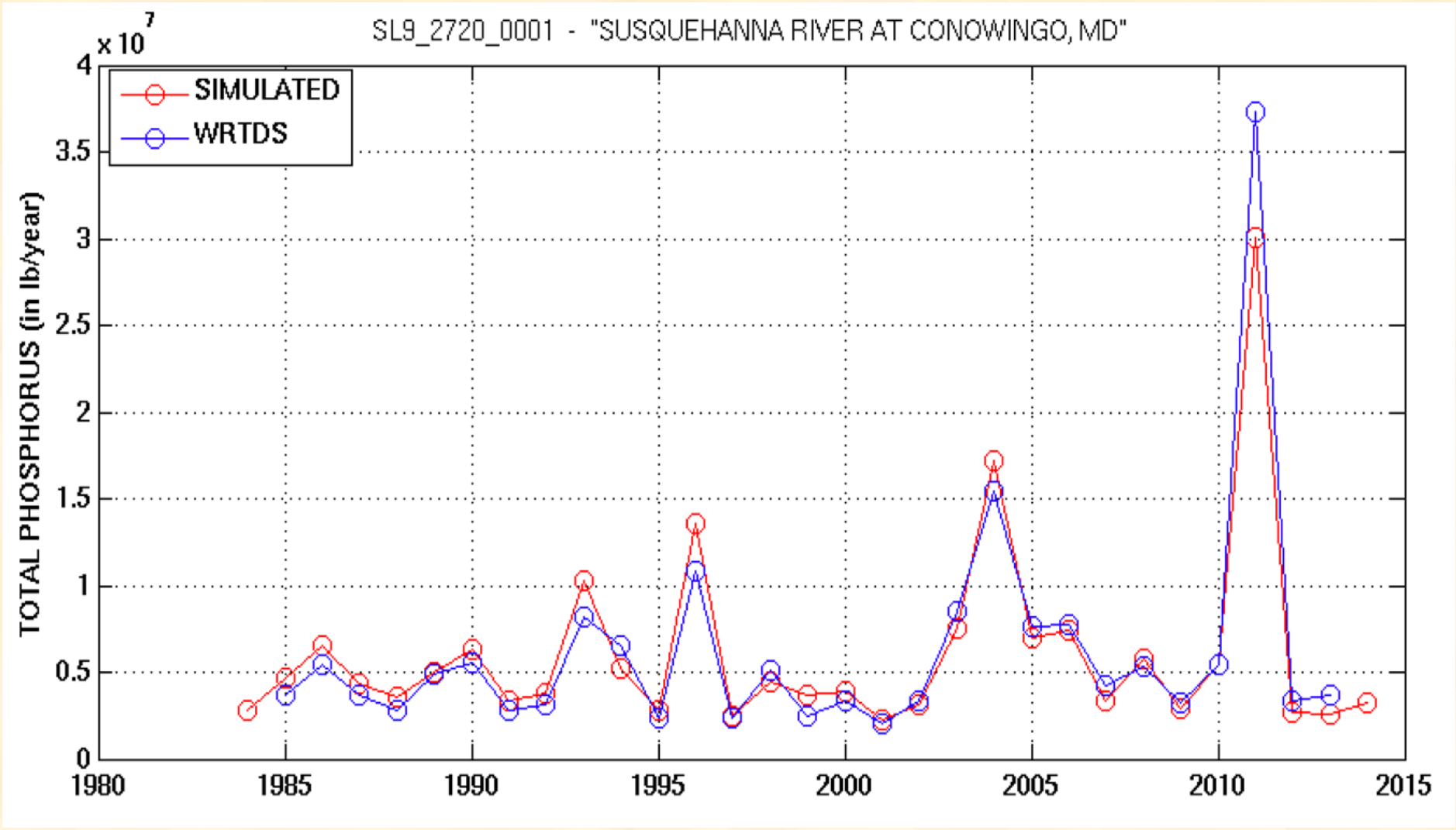
DISSOLVED PHOSPHATE



A well founded simulation of Conowingo infill provides estimates of the discharge from Conowingo at all states of infill from the mid-1980s to the present and at dynamic equilibrium.



Phase 6 CMAQ* Airshed Model

2017 Atmospheric Deposition Inputs

An assessment of atmospheric deposition loads to the watershed and tidal Bay including estimates under 2050 climate conditions

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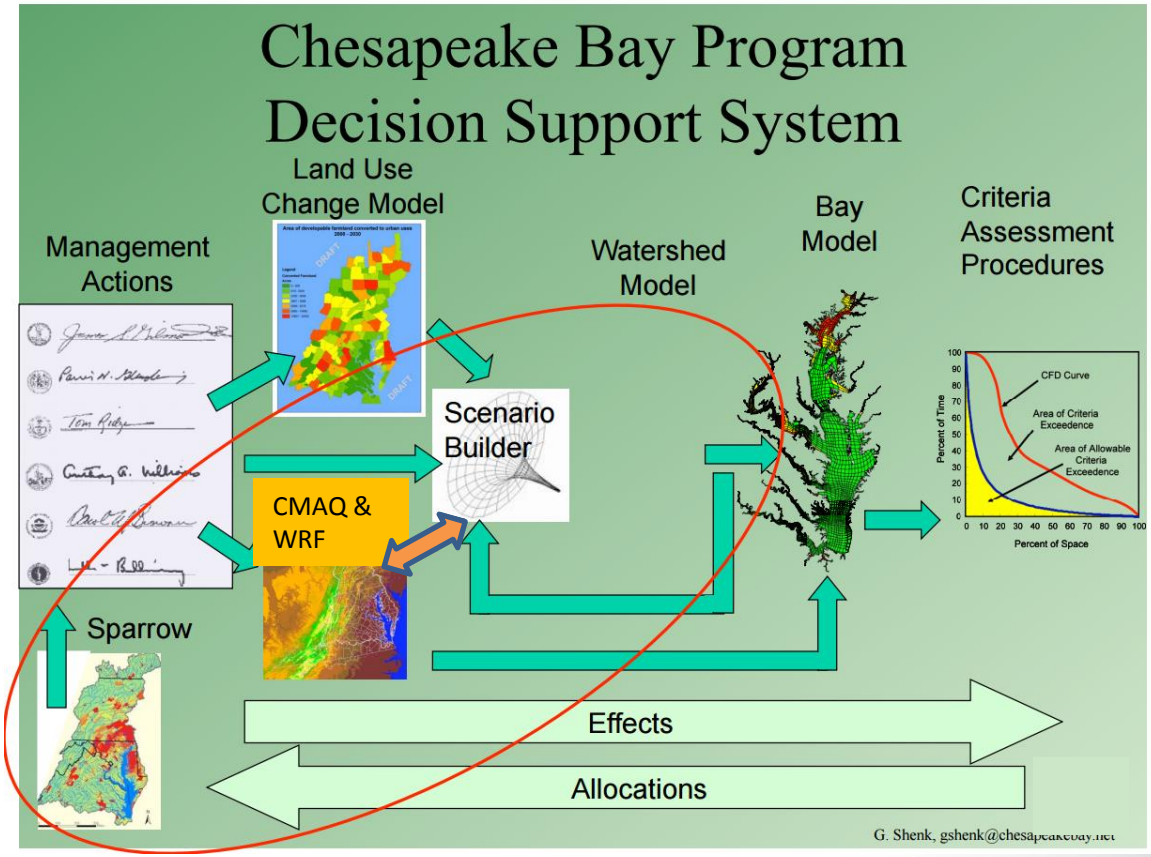
* Community Multiscale Air Quality Model

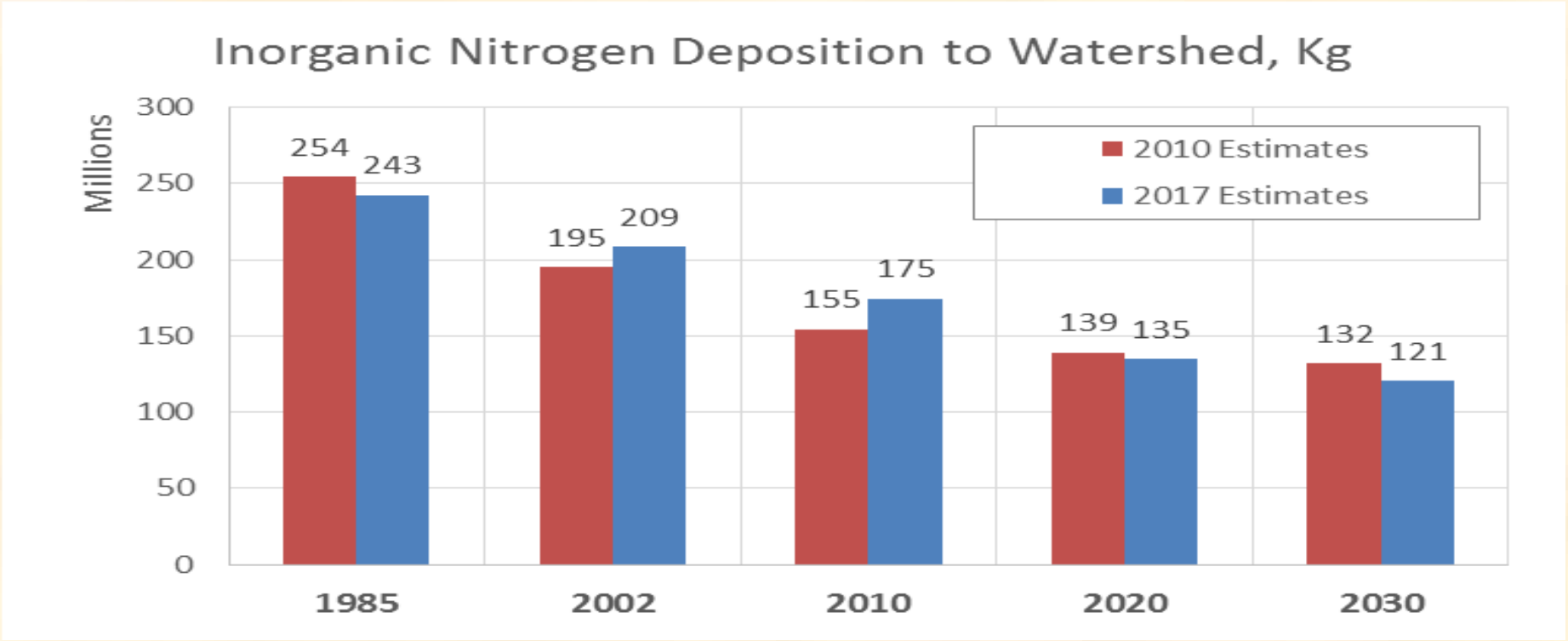
Linked Ecosystem Modeling System

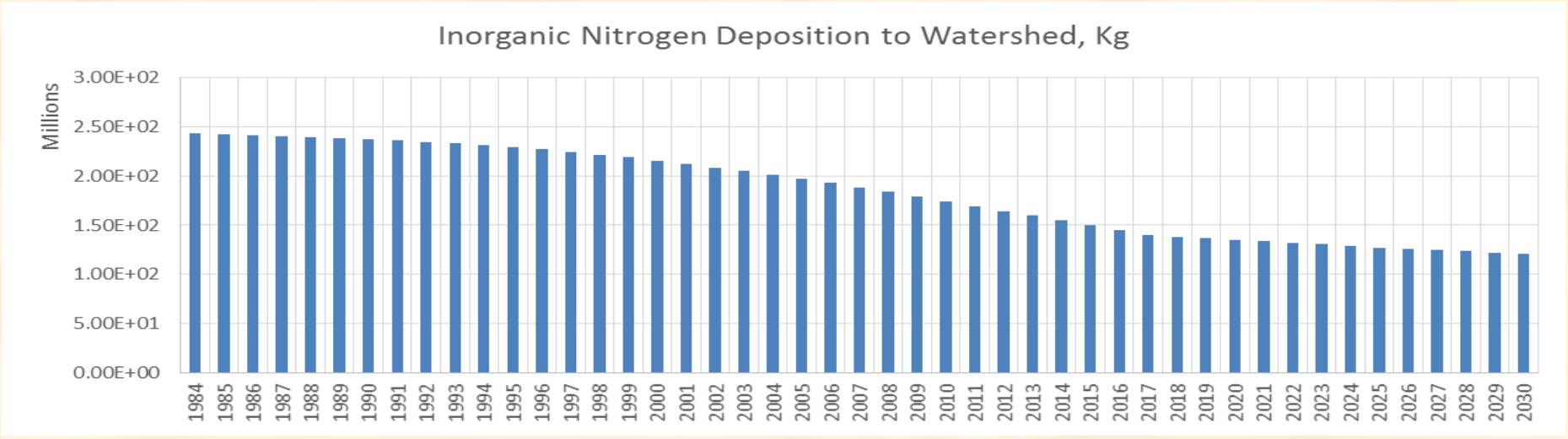
- The Chesapeake Bay modeling system connects management decisions with land use, air quality, water quality and ecosystem services/health
- NERL's Community Multiscale Air Quality (CMAQ) model is an integral part of this system
- This linked modeling system is used to assess the water quality and ecosystem health of the Chesapeake Bay
- CMAQ and the Weather Research and Forecasting (WRF) models were modified to have more consistent physical parameterizations



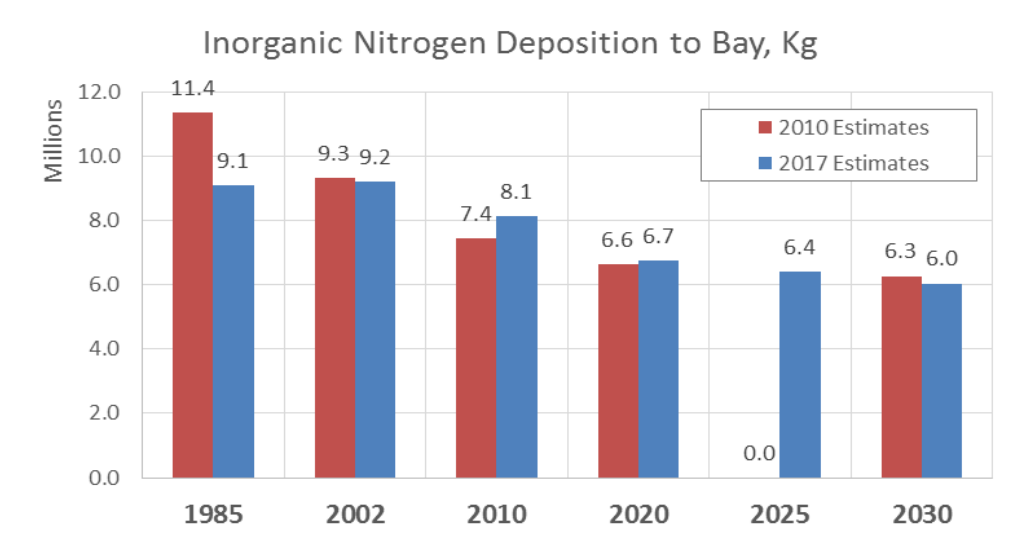
Source: Jesse Bash CBP Air Modeling Webinar October 31, 2017

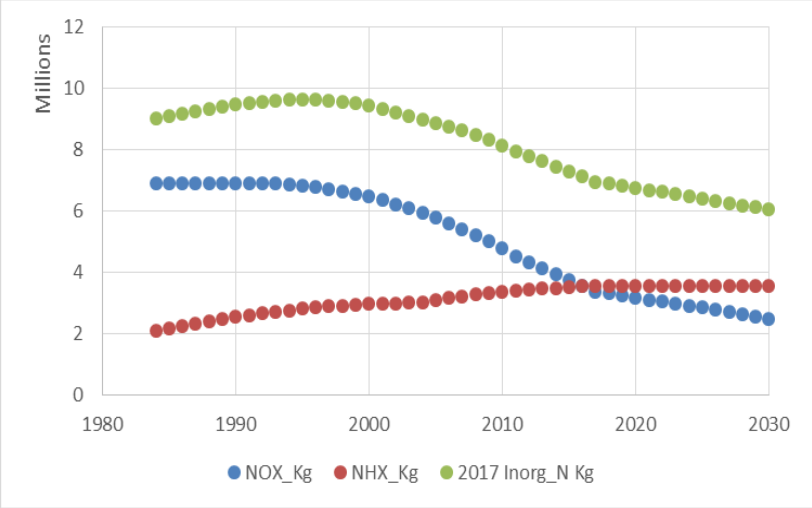
Watershed Loads of Atmospheric Deposition of Nitrogen



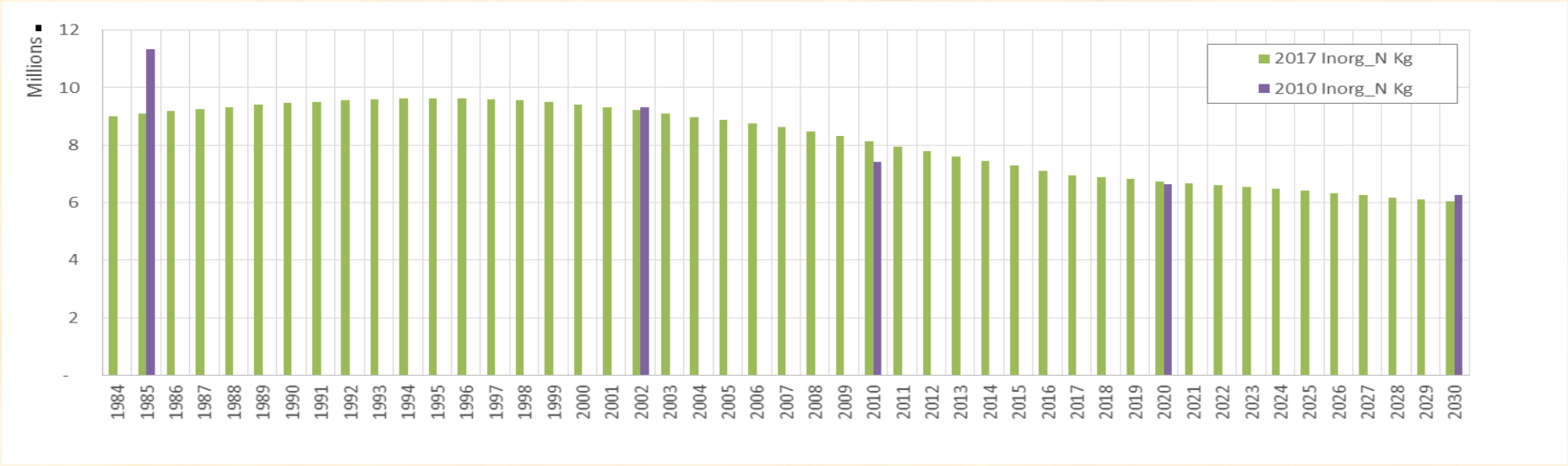


Tidal Bay Loads of Atmospheric Deposition of Nitrogen





The EPA Air Allocation is 15.7 million pounds (TN) to the tidal waters of the Chesapeake Bay. The Phase 6 estimate of TN deposition to tidal waters is 15.6 million pounds in 2025 and 14.8 million pounds in 2030.



Climate and the Bay

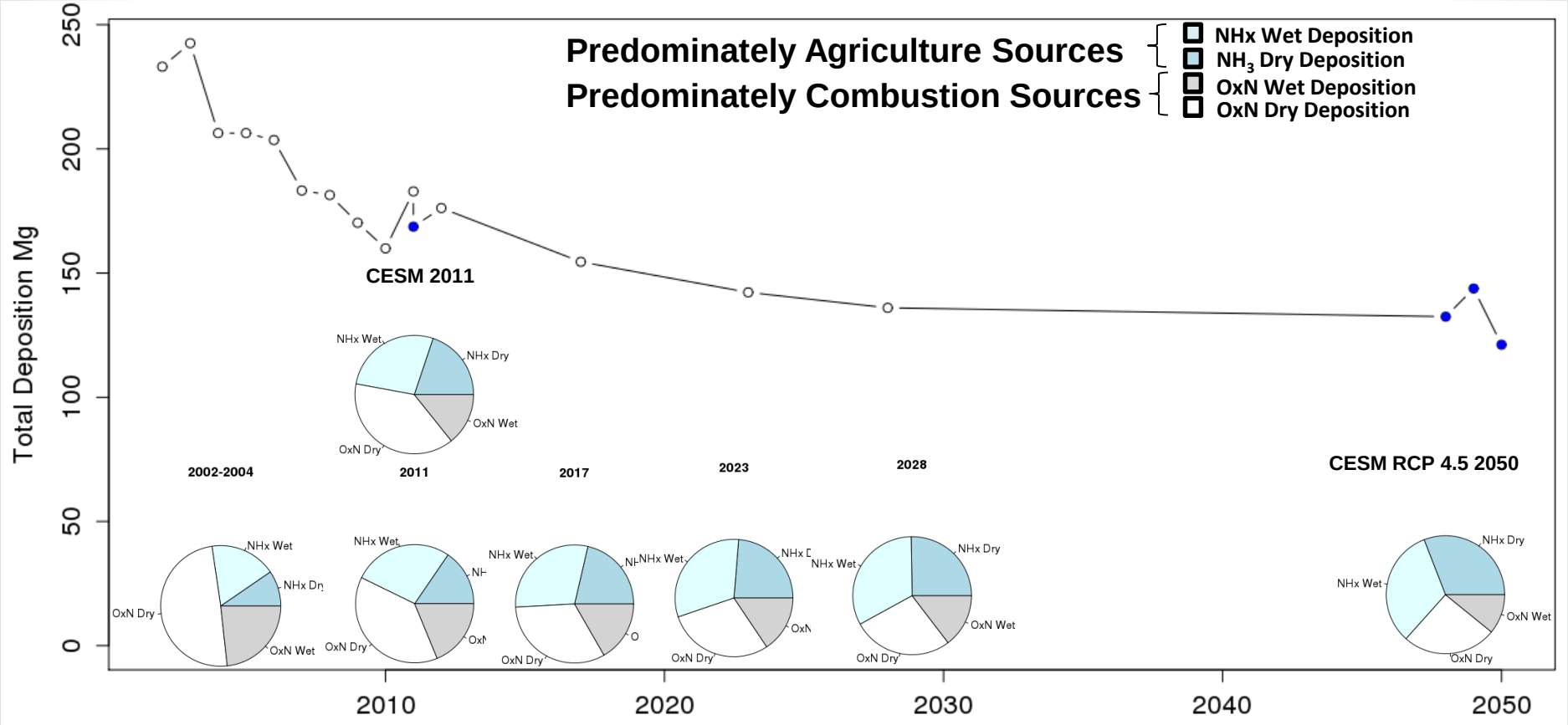
"Changes in climate systems are expected to alter key variables and processes within the Watershed and should be examined in concurrence with land use changes that will interact with and potentially exacerbate climate impacts."

Scientific and Technical Advisory Committee (STAC)

Key scientific question: How do changes in climate, land use, and emissions impact regional meteorological drivers and nutrient deposition loading important to the Chesapeake Bay's water quality and ecosystem health?

Source: Jesse Bash CBP Air Modeling Webinar October 31, 2017

Total N Deposition



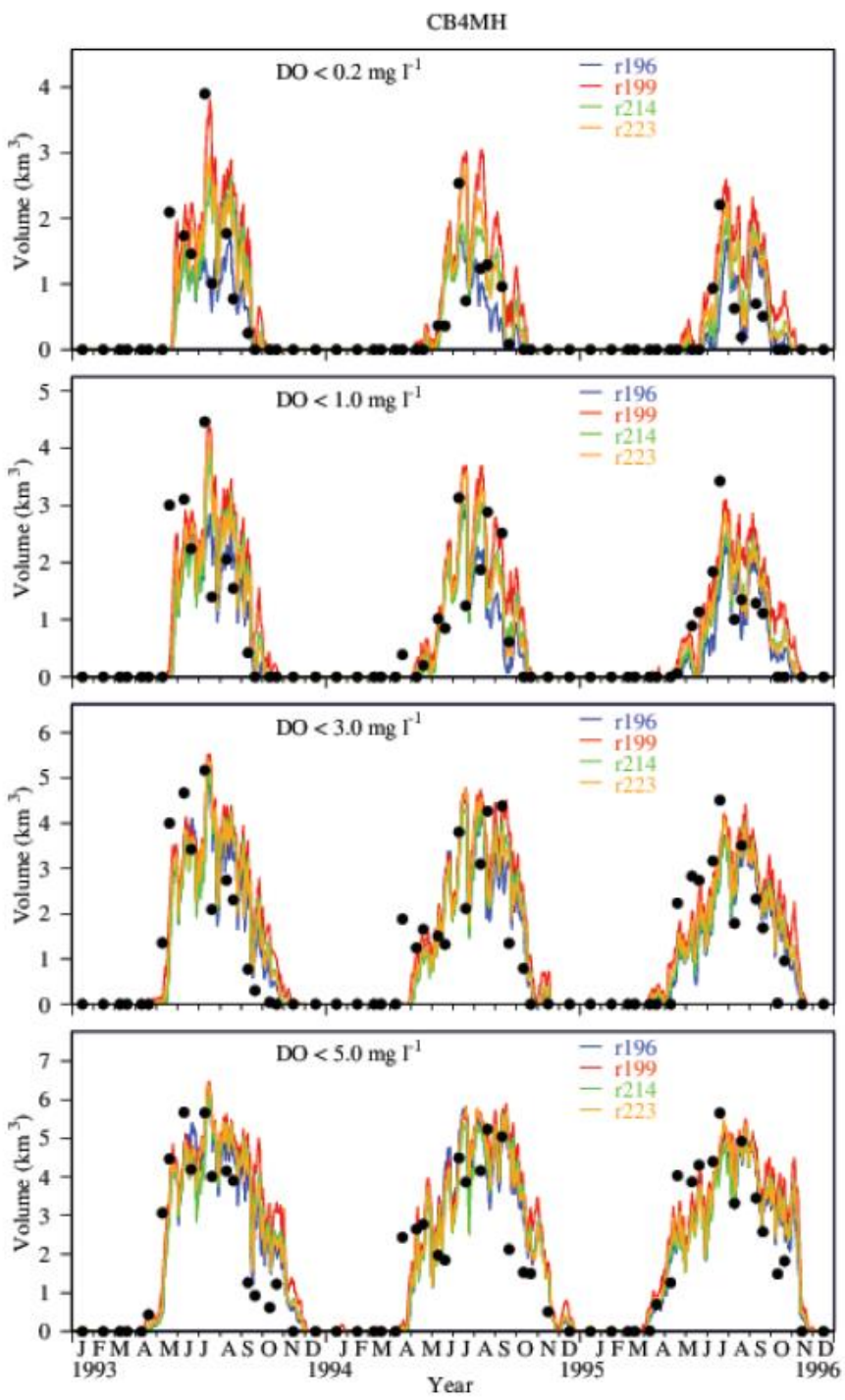
Source: Jesse Bash CBP Air Modeling Webinar October 31, 2017

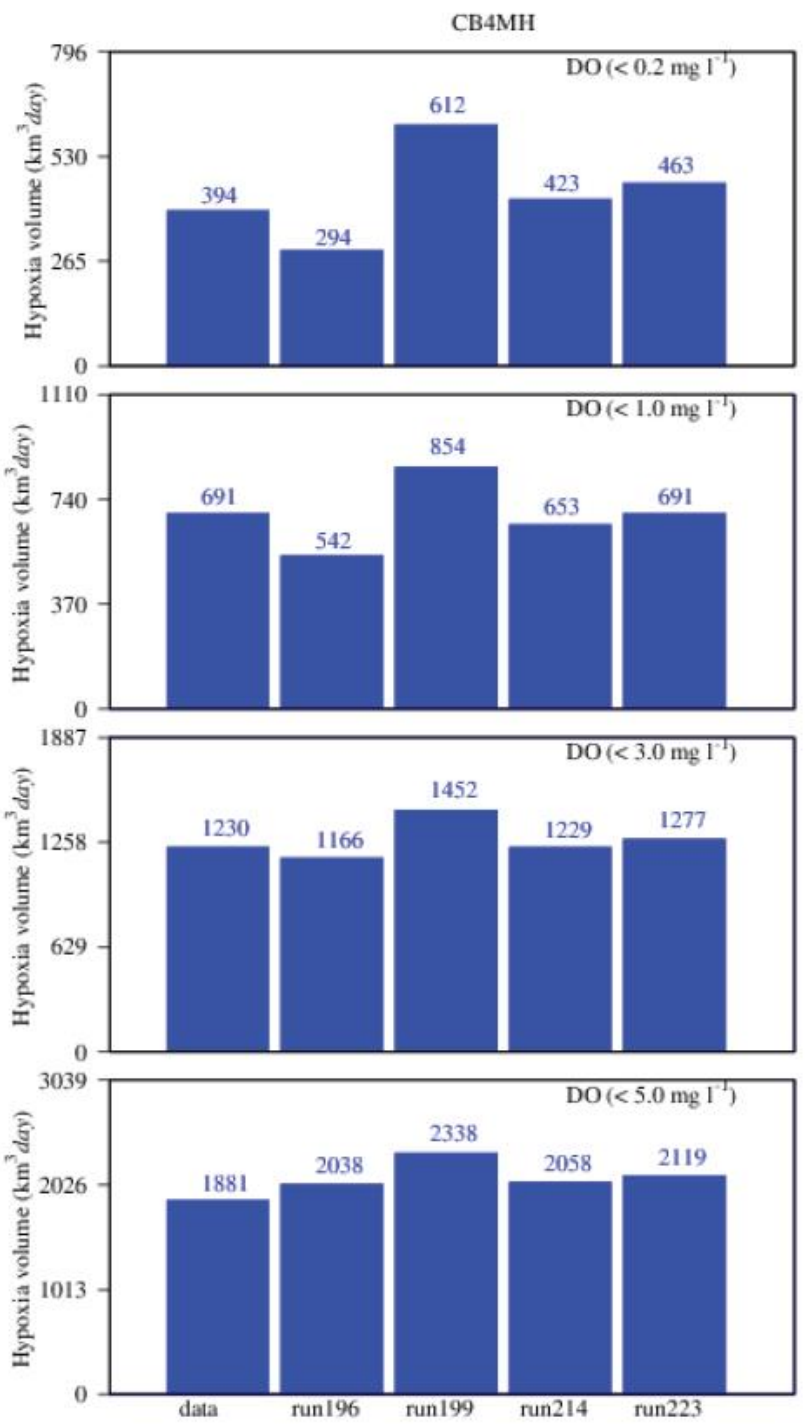
Phase 6 WQSTM* Bay Model

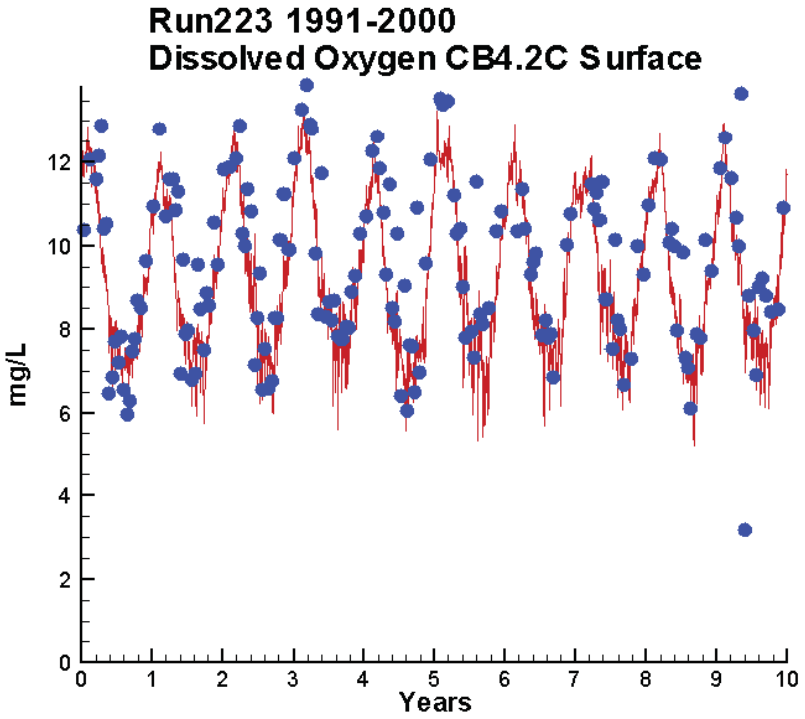
2017 Estimated Water Quality
Standard Achievement

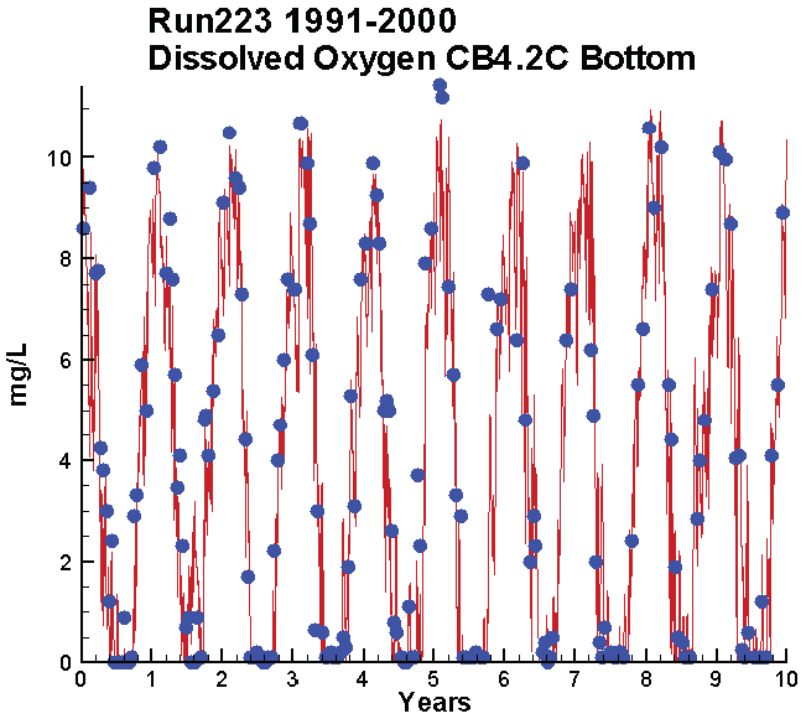
Final calibration and key scenarios

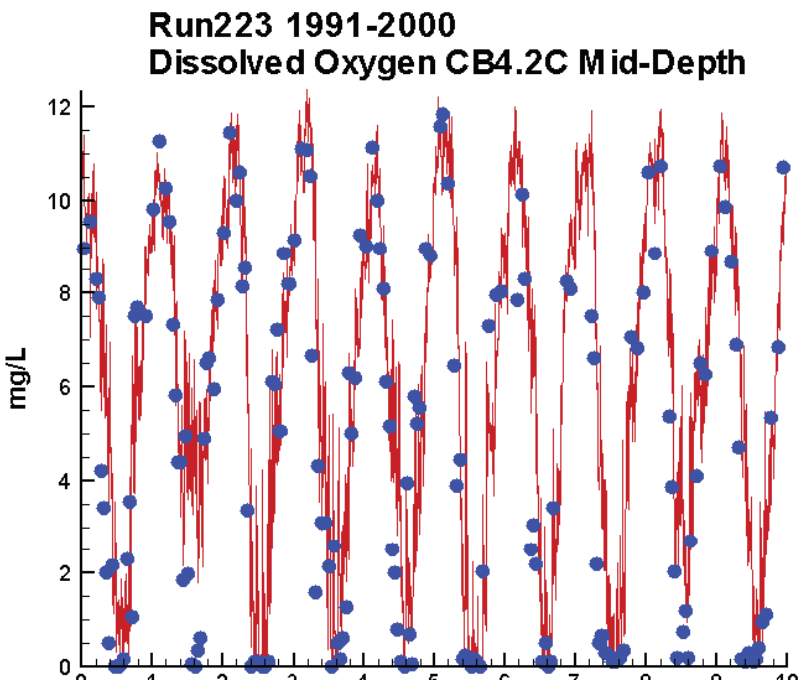
* Water Quality and Sediment Transport Model


CB4MH
DO < 0.2 mg l-1
DO < 1.0 mg l-1
DO < 3.0 mg l-1
DO < 5.0 mg l-1
r196
r199
r214
r223
Volume (km 3)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1993
1994
1995
1996
Year


CB4MH
DO (< 0.2 mg l-1)
DO (< 1.0 mg l-1)
DO (< 3.0 mg l-1)
DO (< 5.0 mg l-1)
Hypoxia volume (km3 day)
796
530
265
0
394
294
612
423
463
1110
740
370
691
542
854
653
691
1887
1258
629
1230
1166
1452
1229
1277
3039
2026
1013
1881
2038
2338
2058
2119
data
run196
run199
run214
run223



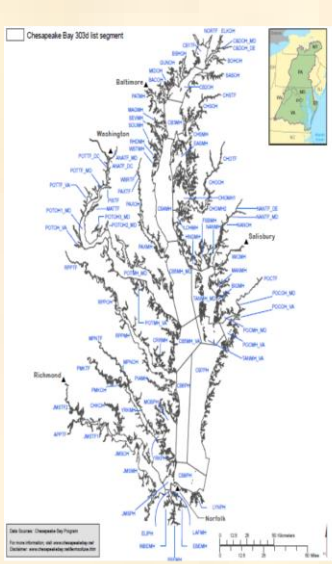


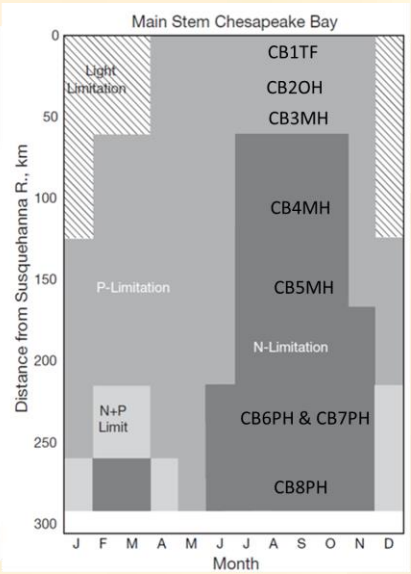


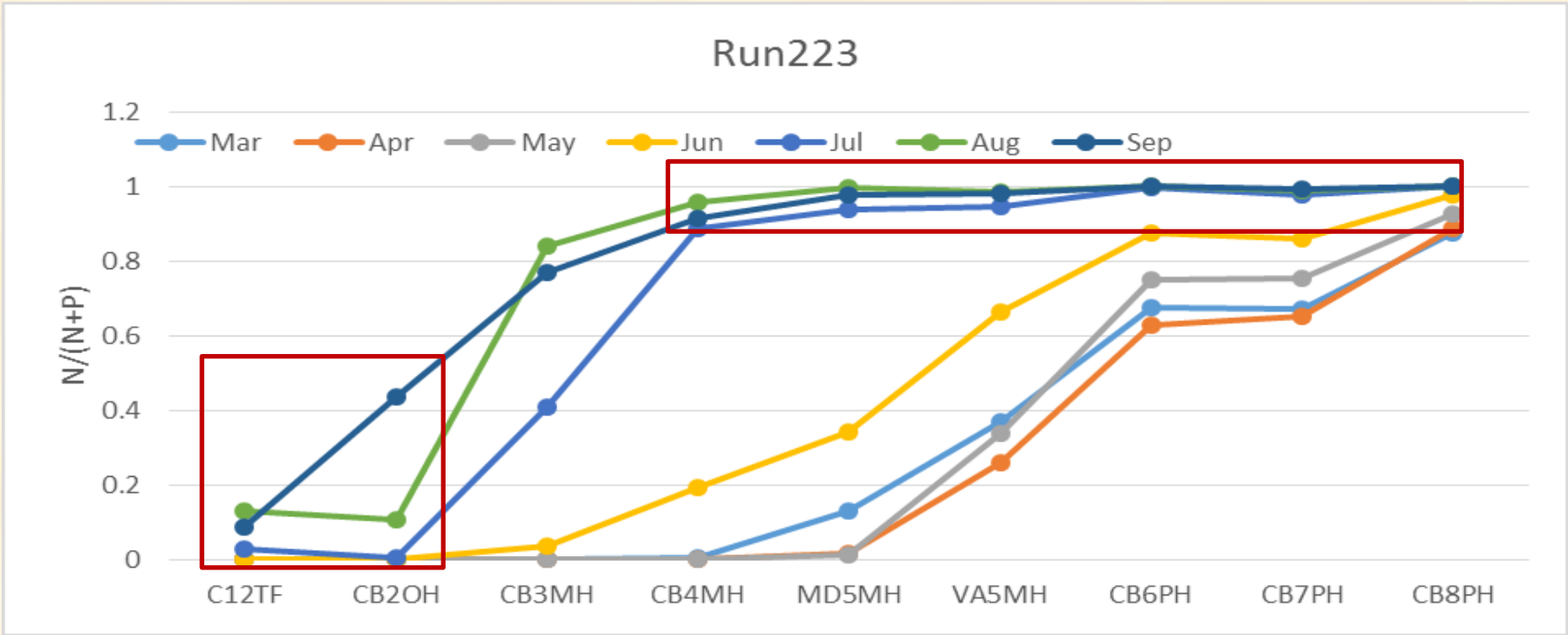
	Mean Difference	Absolute Mean Differen
Top DO	-0.5205	0.9002
Mid DO	1.0038	1.4866
Bot DO	-0.4165	0.9393

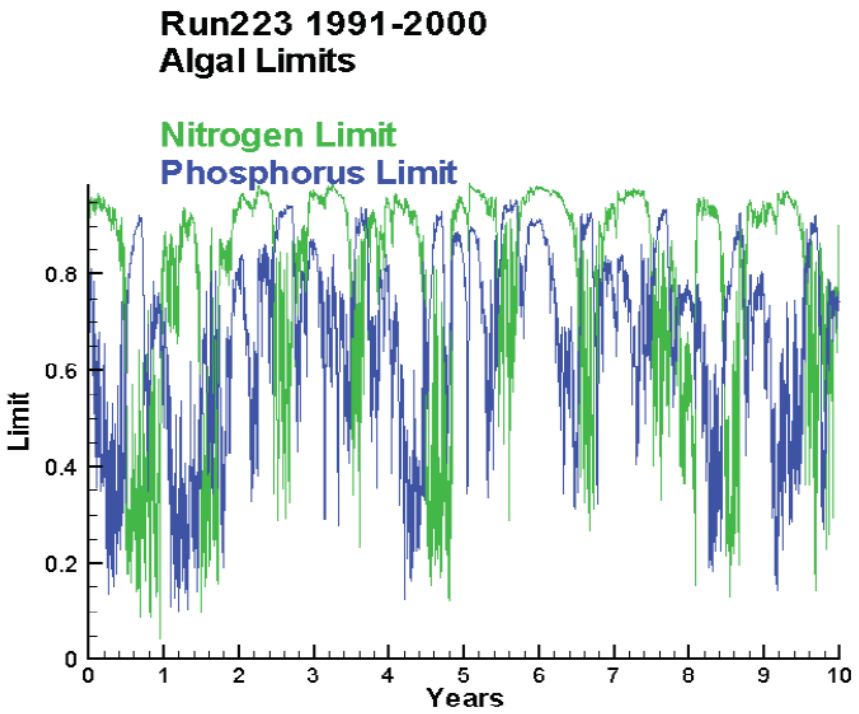
Final WQSTM assessment of nutrient limitation

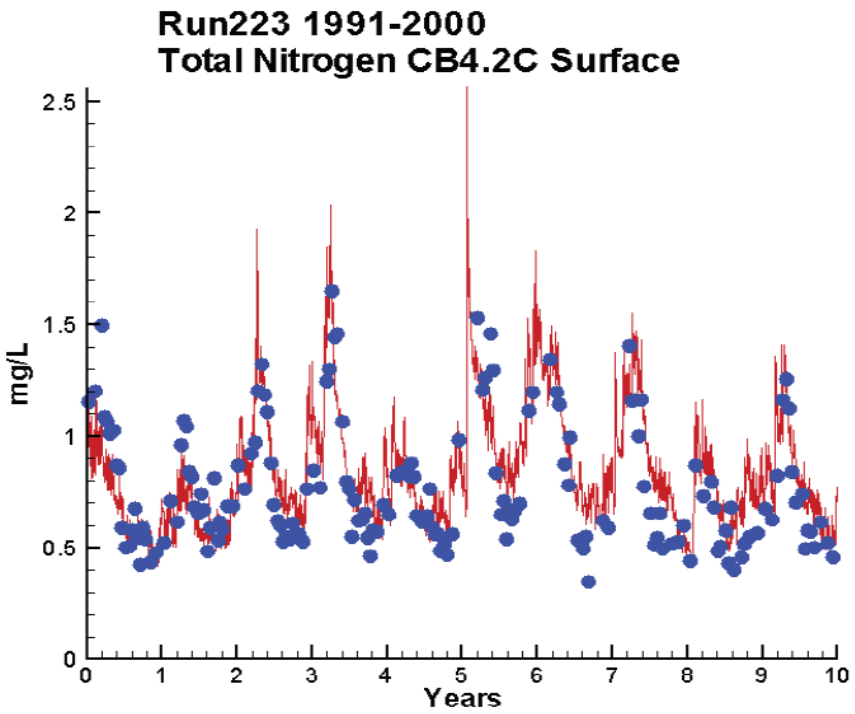
- Appropriate representation of P limitation in the upper Bay (CB1 & CB2 should be P limited at all times).
- Appropriate N limitation in the lower Bay (CB4, CB5, CB6, CB7, and CB8 should be N limited in July, August, and September).

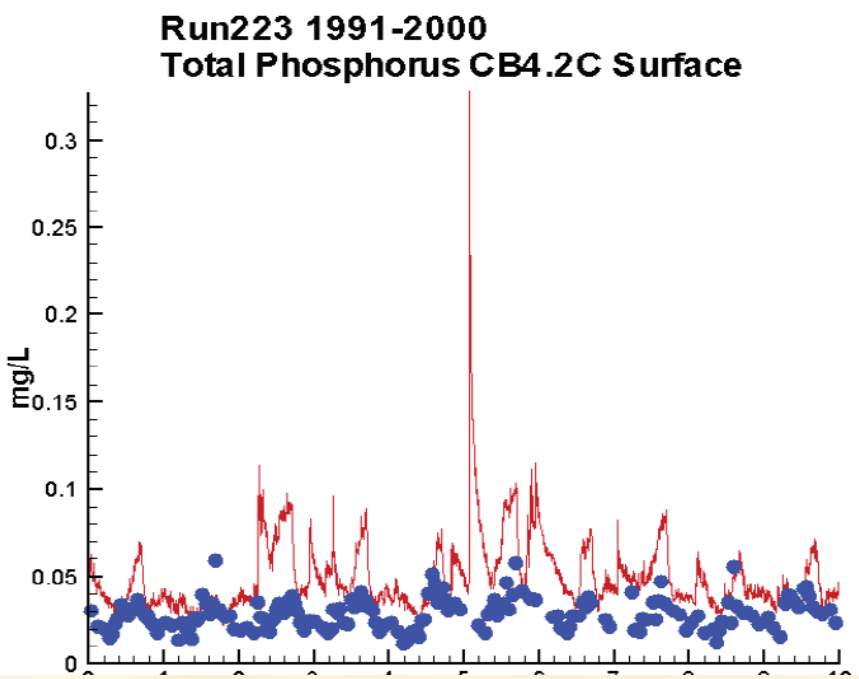












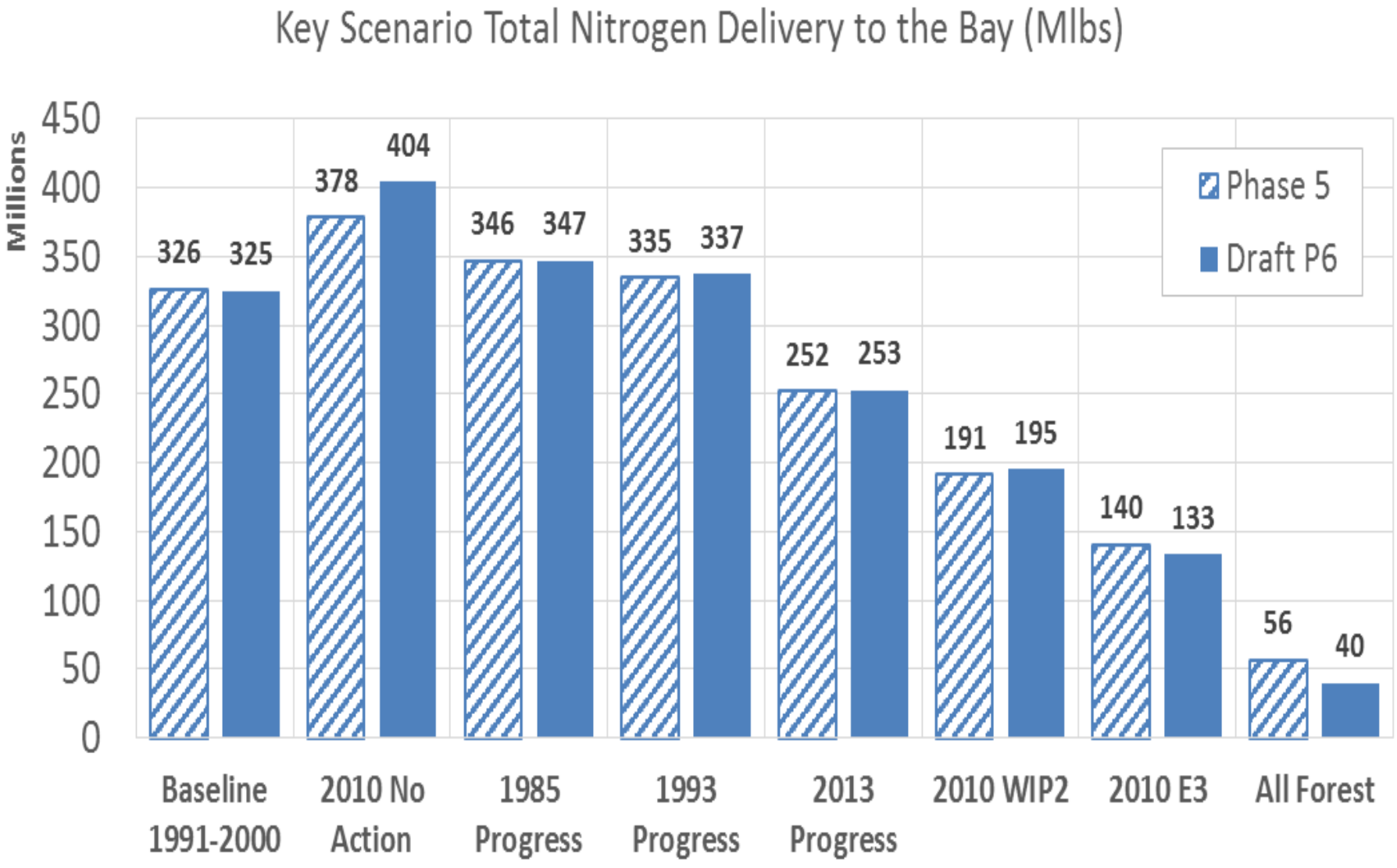
	Mean Difference	Absolute Mean Diffe
Chl	2.4157	5.0535
DIN	-0.0053	0.1028
KE	0.3059	0.3607
DIP	0.0062	0.0071
TP	0.0207	0.0214
TN	0.0625	0.1384

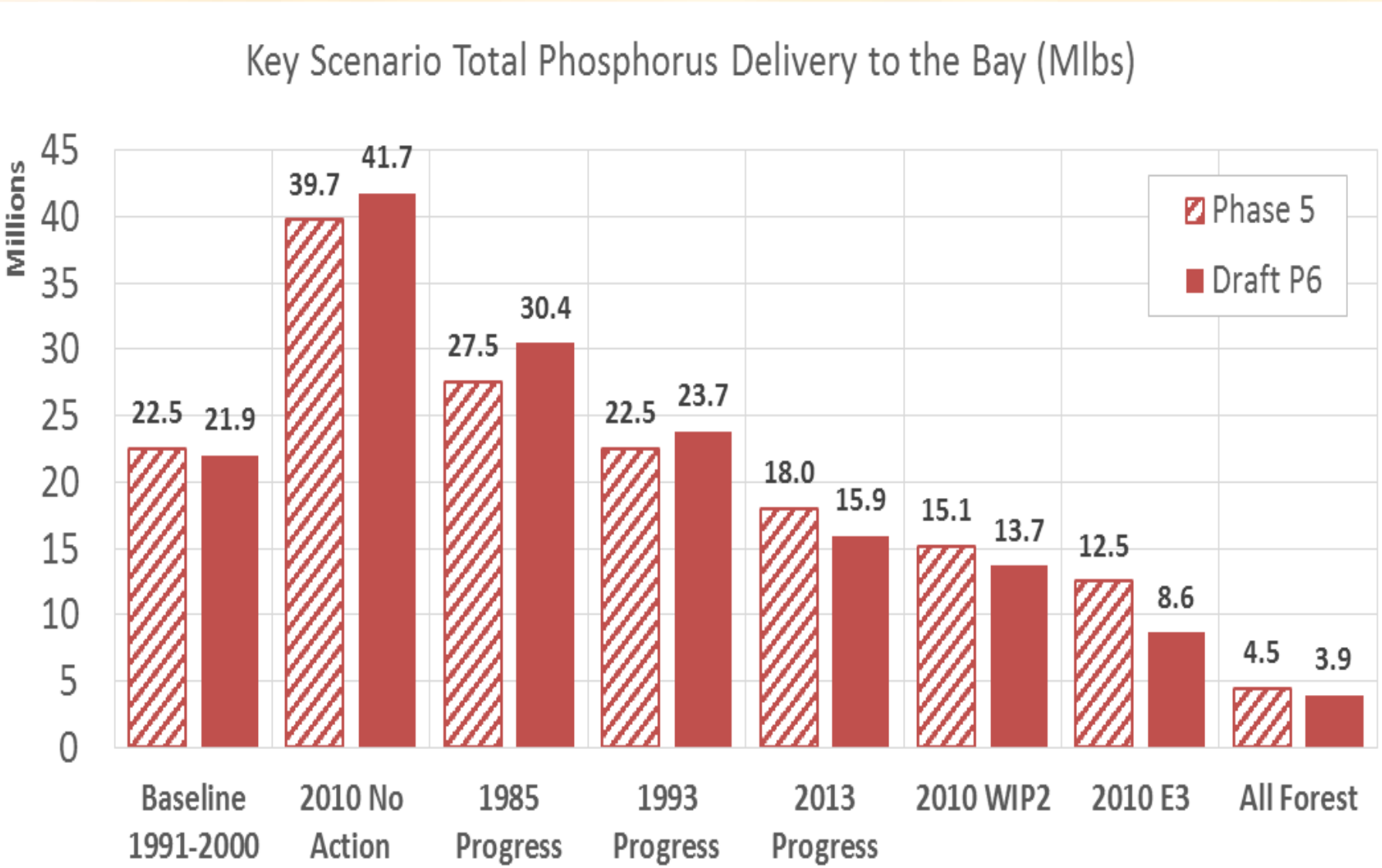
Key Scenarios

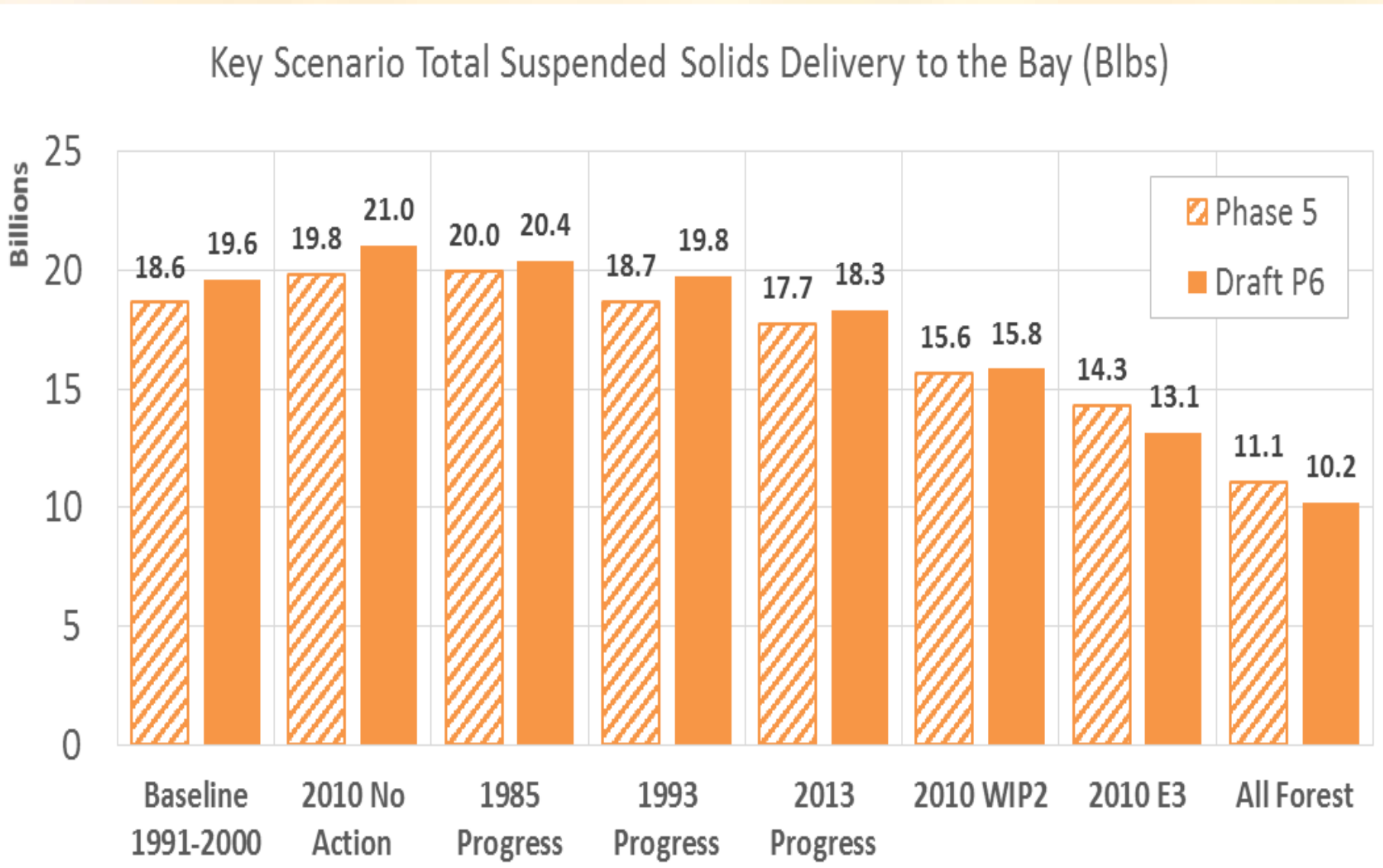
Phase 6 Estimated Loads and Water Quality Standard Achievement

Decision Rules and Variances

- Round to whole numbers.
- Consider nonattainment of 1 percent to be, in fact, attainment to allow for a degree of uncertainty in the overall WQS assessment.
- Variances based on MD and VA's WQ Standard regulations:
  - Middle Ches. Bay Mainstem (CB4MH): 7% for deep-water use
  - Middle Ches. Bay Mainstem (CB4MH): 2% for deep-channel use
  - Patapsco River (PATMH): 7% for deep-water use
  - Lower Chester River (CHSMH): 16% for deep-channel use
  - Eastern Bay (EASMH): 2% for deep-channel use
- The 30-day mean DO criterion for Open Water is 4 mg/L mg/L for these segments:
  - Upper Pocomoke (POCTF)
  - Middle Pocomoke-Maryland (POCOH_MD)
  - Middle Pocomoke-Virginia (POCOH_VA)
  - Lower Pocomoke-Maryland (POCMH_MD)
  - Lower Pocomoke-Virginia (POCMH_VA)
  - Upper Mattaponi (MPNTF)
  - Lower Mattaponi (MPNOH)
  - Upper Pamunkey (PMKTF)
  - Lower Pamunkey (PMKOH)


Key Scenario Total Nitrogen Delivery to the Bay (Mlbs)
Millions
450
400
350
300
250
200
150
100
50
0
Phase 5
Draft P6
326
325
378
404
346
347
335
337
252
253
191
195
140
133
56
40
Baseline 1991-2000
2010 No Action
1985 Progress
1993 Progress
2013 Progress
2010 WIP2
2010 E3
All Forest


Key Scenario Total Phosphorus Delivery to the Bay (Mlbs)
Millions
45
40
35
30
25
20
15
10
5
0
Phase 5
Draft P6
22.5
21.9
39.7
41.7
27.5
30.4
22.5
23.7
18.0
15.9
15.1
13.7
12.5
8.6
4.5
3.9
Baseline 1991-2000
2010 No Action
1985 Progress
1993 Progress
2013 Progress
2010 WIP2
2010 E3
All Forest


Key Scenario Total Suspended Solids Delivery to the Bay (Blbs)
Billions
25
20
15
10
5
0
Phase 5
Draft P6
18.6
19.6
19.8
21.0
20.0
20.4
18.7
19.8
17.7
18.3
15.6
15.8
14.3
13.1
11.1
10.2
Baseline 1991-2000
2010 No Action
1985 Progress
1993 Progress
2013 Progress
2010 WIP2
2010 E3
All Forest

Deep Channel DO Water Quality Standard Attainment (< 1 mg/l DO)

		Base	No Action	1985 Progress	1993 Progress	2013 Progress	WIP2 + 5%	WIP2	WIP2 - 5%	WIP2 + Cono Infill	E3	All Forest
Run 223		325TN	404TN	347TN	337TN	253TN	205TN	195TN	185TN	208TN	133TN	40TN
11/27/17		21.9TP	41.7TP	30.4TP	23.7	15.9TP	14.4	13.7TP	13.0TP	15.4	8.6TP	3.9TP
CAST Loads		1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	1993-1996	1993-1995	1993-1996	1993-1995	1993-1995	1993-1995
Cbseg	State	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel
CB3MH	MD	16.0%	12.7%	9.4%	7.6%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CB4MH	MD	46.0%	53.0%	48.0%	46.2%	27.2%	8.8%	5.9%	3.4%	8.0%	0.0%	0.0%
CB5MH	MD/VA	14.2%	19.6%	15.7%	14.7%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHSMH	MD	37.4%	26.0%	20.0%	17.9%	6.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
POTMH	MD/VA	20.2%	21.1%	17.9%	16.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
POMMH	MD	20.4%	21.3%	18.0%	17.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RPPMH	VA	19.0%	25.4%	19.1%	16.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
EASMH	MD	25.4%	27.3%	21.3%	18.7%	13.3%	7.8%	6.2%	5.1%	6.9%	0.0%	0.0%
MD5MH	MD	21.7%	26.5%	23.0%	21.8%	4.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
VA5MH	VA	4.5%	10.3%	5.8%	5.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PATMH	MD	24.8%	40.3%	32.7%	23.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Grey background for CB segments unassessed because of model limitations.
Yellow background for when variances are applied.

Deep Water DO Water Quality Standard Attainment (< 3 mg/l DO)

		Base	No Action	1985 Progress	1993 Progress	2013 Progress	WIP2 + 5%	WIP2	WIP2 - 5%	WIP2 + Cono Infill	E3	All Forest
Run 223		325TN	404TN	347TN	337TN	253TN	205TN	195TN	185TN	208TN	133TN	40TN
11/27/17		21.9TP	41.7TP	30.4TP	23.7	15.9TP	14.4	13.7TP	13.0TP	15.4	8.6TP	3.9TP
CAST Loads		1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	1993-1996	1993-1995	1993-1996	1993-1995	1993-1995	1993-1995
Cbseg	State	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water
CB3MH	MD	2.1%	2.7%	1.8%	1.4%	0.3%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%
CB4MH	MD	21.0%	25.2%	21.1%	19.6%	9.6%	5.6%	5.0%	4.4%	5.5%	1.1%	0.0%
CB5MH	MD/VA	4.2%	4.7%	3.4%	3.2%	1.3%	0.5%	0.3%	0.1%	0.4%	0.0%	0.0%
CB6PH	VA	0.0%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CB7PH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHSMH	MD	25.7%	11.3%	8.3%	3.5%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
EASMH	MD	5.9%	25.4%	9.8%	2.2%	1.2%	0.5%	0.5%	0.5%	0.5%	0.4%	0.0%
PAXMH	MD	6.3%	17.1%	12.1%	8.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
POTMH	MD/VA	4.1%	7.0%	4.7%	4.4%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
POMMH	MD	4.1%	7.1%	4.8%	4.5%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RPPMH	VA	5.9%	10.7%	6.9%	5.9%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SBEMH	VA	0.0%	3.5%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YRKPH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MD5MH	MD	8.5%	9.3%	7.0%	6.5%	3.0%	1.4%	0.9%	0.6%	1.1%	0.0%	0.0%
VA5MH	VA	0.5%	0.7%	0.4%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PATMH	MD	12.4%	17.3%	9.6%	6.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MAGMH	MD	51.0%	56.1%	51.0%	51.0%	13.1%	5.4%	1.2%	0.3%	5.4%	0.3%	0.0%
SOUMH	MD	18.6%	28.0%	20.3%	21.4%	3.0%	7.6%	3.0%	3.0%	7.6%	0.0%	0.0%
SEVMH	MD	6.1%	7.8%	6.4%	6.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

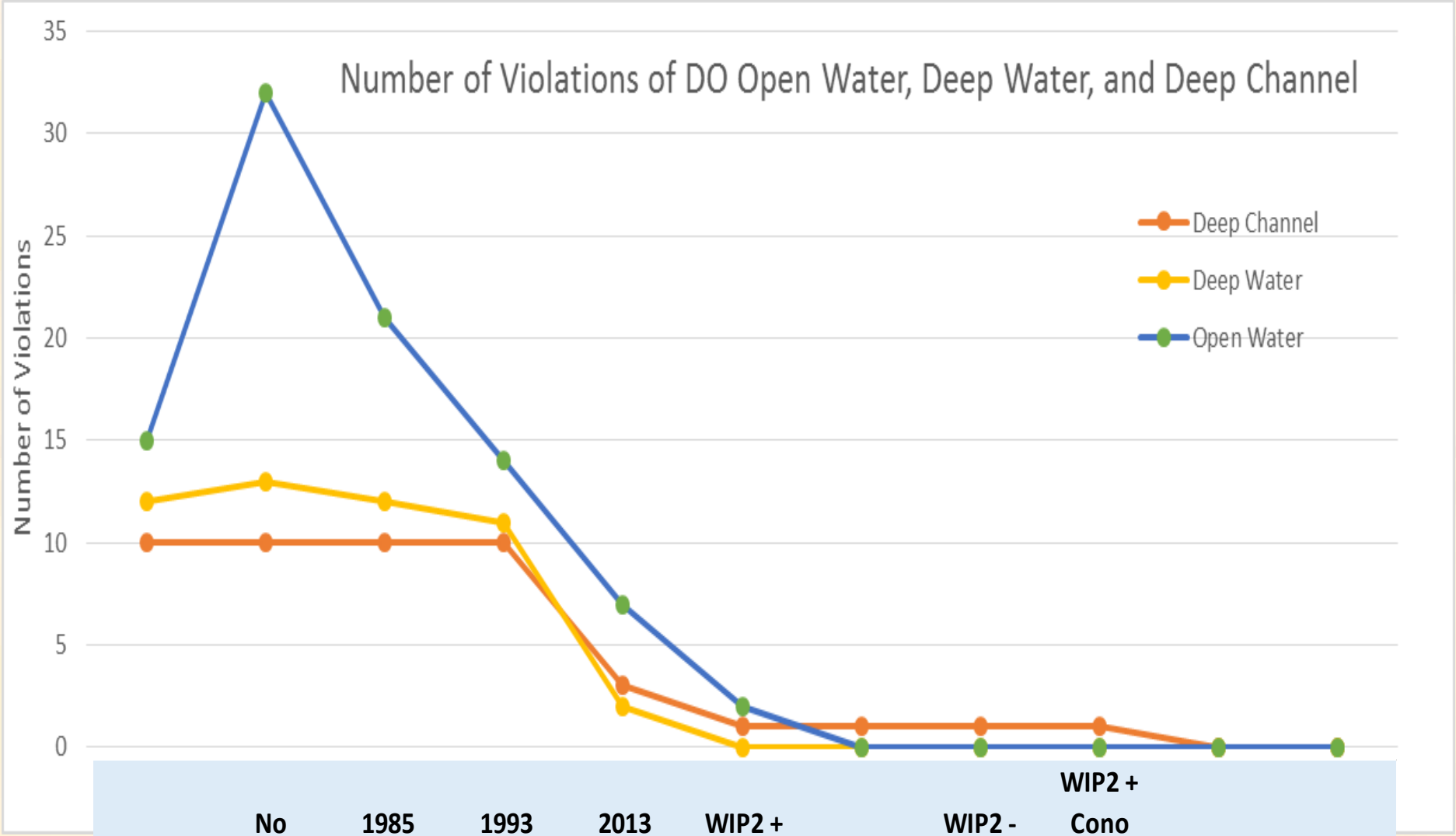
Grey background for CB segments unassessed because of model limitations.
Yellow background for when variances are applied.

Open Water DO Water Quality Standard Attainment (< 5 or 4 mg/l DO)

Run 223		Base	No Action	1985 Progress	1993 Progress	2013 Progress	WIP2 + 5%	WIP2	WIP2 - 5%	WIP2 + Cono Infill	E3	All Forest
		325TN	404TN	347TN	337TN	253TN	205TN	195TN	185TN	208TN	133TN	40TN
11/27/17		21.9TP	41.7TP	30.4TP	23.7	15.9TP	14.4	13.7TP	13.0TP	15.4	8.6TP	3.9TP
CAST Loads		1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	1993-1996	1993-1995	1993-1996	1993-1995	1993-1995	1993-1995
Cbseg	State	Open Water	Open Water	Open Water	Open Water	Open Water	Open Water	Open Water	Open Water	Open Water	Open Water	Open Water
CB1TF	MD	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CB2OH	MD	0.0%	6.0%	0.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CB3MH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CB4MH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CB5MH	MD/VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CB6PH	VA	2.4%	3.7%	2.9%	2.7%	0.8%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%
CB7PH	VA	5.5%	7.5%	6.1%	5.8%	2.6%	0.4%	0.3%	0.2%	0.3%	0.0%	0.0%
CB8PH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHOMH1	MD	1.7%	2.8%	1.9%	1.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHOMH2	MD	4.0%	12.8%	6.2%	4.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHOOH	MD	0.5%	10.4%	1.5%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHOTF	MD	0.0%	8.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHSMH	MD	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHSOH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHSTF	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
EASMH	MD	0.0%	3.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
EBEMH	VA	22.7%	25.7%	23.1%	22.7%	18.5%	11.1%	8.2%	6.7%	11.1%	0.0%	0.0%
ELIPH	VA	4.5%	6.3%	4.9%	4.5%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
JMSMH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
JMSOH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
JMSPH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
JMSTF	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
JMSTFL	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
JMSTFU	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MOBPH	VA	0.5%	0.8%	0.6%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MPNOH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MPNTF	VA	1.3%	1.3%	1.3%	1.3%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PAXMH	MD	2.0%	8.8%	4.6%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PAXOH	MD	20.7%	33.1%	28.7%	21.2%	1.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
PAXTF	MD	9.1%	9.4%	9.2%	9.4%	2.9%	7.9%	7.8%	7.7%	7.8%	0.0%	0.0%
PIAMH	VA	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PMKOH	VA	1.0%	7.4%	0.4%	0.7%	0.6%	0.6%	0.5%	0.5%	0.5%	0.0%	0.1%
PMKTF	VA	11.0%	15.6%	8.6%	11.0%	8.6%	8.6%	8.6%	6.9%	8.6%	4.6%	0.0%
POCMH	MD/VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MPCMH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
VPCMH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
POTMH	MD/VA	0.0%	3.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
POMMH	MD	0.0%	3.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
POTOH	MD/VA	0.9%	6.3%	1.6%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PO1OH	MD	1.1%	6.8%	1.8%	1.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
POTTF	MD/DC	0.0%	8.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
DCPTF	DC	0.2%	3.6%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MDPTF	MD	0.0%	9.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RPPMH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RPPOH	VA	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RPTOH	VA	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SBEMH	VA	35.2%	37.1%	36.7%	33.9%	24.8%	18.8%	17.8%	15.8%	18.0%	8.2%	4.5%
TANMH	MD/VA	0.5%	2.5%	0.8%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
TAMMH	ND	0.0%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
TAVMH	VA	2.0%	5.7%	2.7%	2.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
WBEMH	VA	11.1%	15.3%	7.8%	7.8%	7.8%	7.8%	7.8%	7.8%	7.8%	3.3%	0.0%
YRKMH	VA	23.9%	30.6%	27.2%	26.5%	9.2%	1.9%	0.8%	0.6%	1.4%	0.0%	0.0%
YRKPH	VA	2.2%	4.6%	1.9%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
APPTF	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BACOH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BIGMH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BOHOH	MD	0.4%	0.4%	0.4%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BSHOH	MD	0.7%	7.5%	0.0%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CNDOH	MD/DE	0.0%	10.6%	2.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHKOH	VA	0.0%	0.0%	0.0%	0.0%	4.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CRRMH	VA	24.5%	26.4%	24.5%	24.5%	15.8%	5.2%	5.2%	5.2%	5.2%	1.8%	0.0%
ELKOH	MD	0.0%	4.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
FSBMH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
GUNOH	MD	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	0.0%	0.0%
LCHMH	MD	0.1%	0.4%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MAGMH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MANMH	MD	0.6%	0.4%	0.4%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
MATTF	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MD5MH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MIDOH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
NANMH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
NANOH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
NANTF	MD/DE	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
NORTF	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PATMH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PISTF	MD	4.4%	4.6%	4.5%	4.4%	4.4%	1.0%	0.8%	0.5%	0.7%	0.0%	0.0%
POCOH	MD/VA	42.0%	47.1%	47.1%	42.0%	32.5%	32.3%	32.3%	32.3%	32.3%	17.9%	24.2%
MPCOH	MD	42.7%	47.1%	47.1%	42.7%	32.6%	32.3%	32.3%	32.3%	32.3%	17.9%	23.9%
VPCOH	VA	41.1%	47.1%	47.1%	41.1%	32.4%	32.3%	32.3%	32.3%	32.3%	17.9%	24.6%
POCTF	MD	43.4%	47.1%	47.1%	43.4%	32.5%	32.3%	32.3%	32.3%	32.3%	17.9%	23.8%
RHDMH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SASOH	MD	7.4%	29.5%	17.5%	9.2%	0.0%	0.6%	0.6%	0.0%	0.6%	0.0%	0.0%
SEVMH	MD	0.0%	2.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SOUMH	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
VA5MH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
WICMH	MD	11.2%	11.2%	11.2%	11.2%	11.2%	5.0%	5.0%	4.7%	5.0%	4.7%	0.7%
WSTMH	MD	2.9%	0.5%	0.0%	2.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
DCATF	DC	18.0%	25.4%	19.1%	19.1%	12.6%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%
MDATF	MD	27.9%	18.1%	25.1%	28.2%	25.5%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%
DENTF	DE	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MDNTF	MD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Grey background for CB segments unassessed because of model limitations.

Yellow background for when variances are applied.



Base	No Action	1985 Progress	1993 Progress	2013 Progress	WIP2 + 5%	WIP2	WIP2 - 5%	WIP2 + Cono Infill	E3	All Forest
325TN	404TN	347TN	337TN	253TN	205TN	195TN	185TN	208TN	133TN	40TN
21.9TP	41.7TP	30.4TP	23.7	15.9TP	14.4	13.7TP	13.0TP	15.4	8.6TP	3.9TP

Conclusions:

- All 2017 assessment methods are quantitatively better than their 2010 equivalents
- By and large, the estimated WIP2 implementation loads achieve all DO water quality standards in the Chesapeake except for in CB4MH Deep Channel.
- The nonattainment in CB4MH Deep Channel is estimated to be 6 percent under the WIP2 loads, 8 percent under the WIP2 loads plus Conowingo infill, and about 10 percent under WIP2 loads plus Conowingo Infill and conditions of 2025 temperature, precipitation, and sea level rise.
- Geographic Isolation Scenarios are now complete.
- Phase 3 WIP draft target loads are under development.