Proposed Integrated Watershed TMDL Indicator and Dashboard Products

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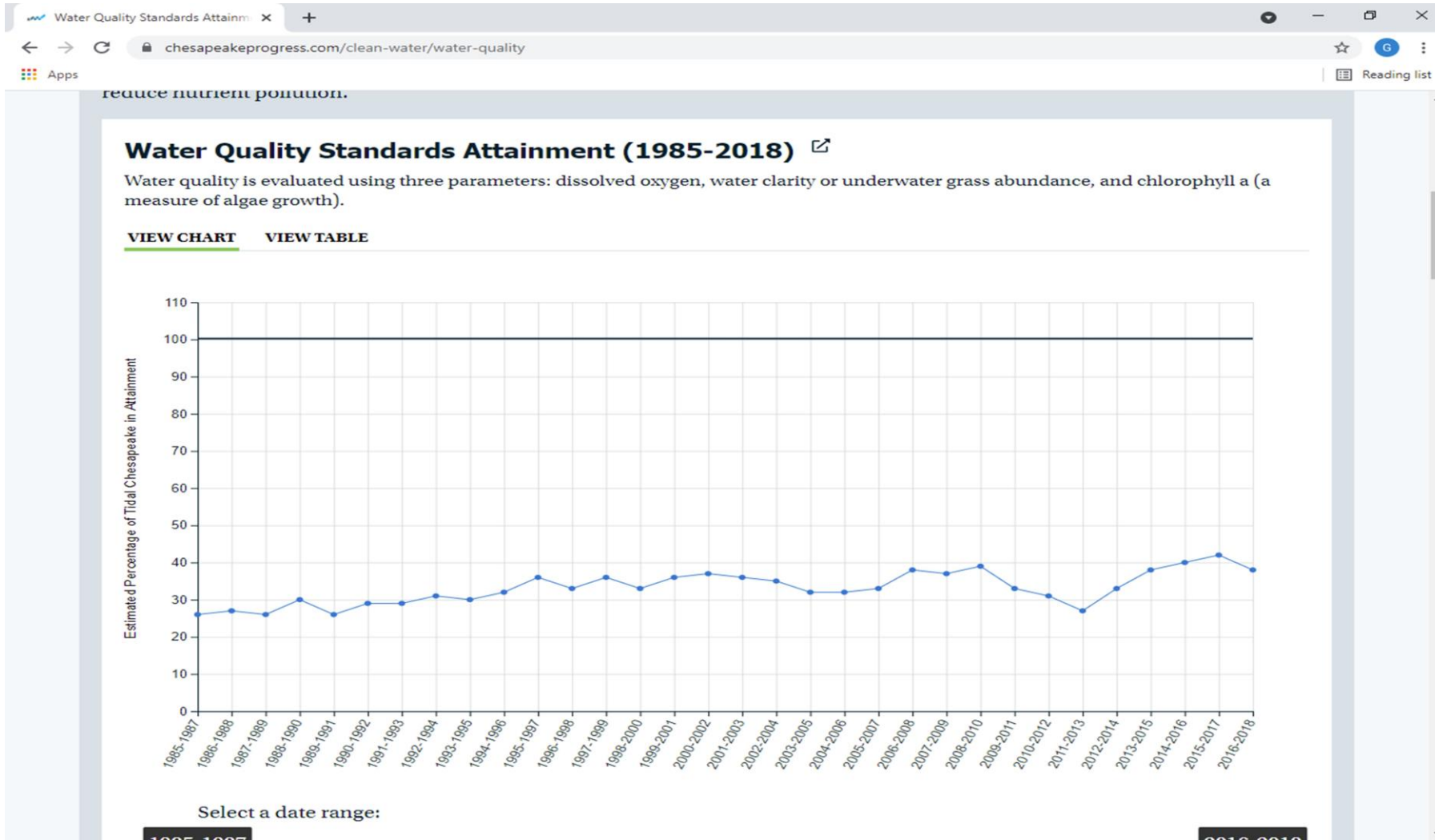
WQGIT

11/14/2022

Purpose of presentation

- Build understanding
- Get feedback
  - This is not your last chance for feedback!
- Make progress toward an approved indicator and data dashboard product

Tidal Water TMDL Indicator

WIP Indicator

We've almost hit the target level of implementation?

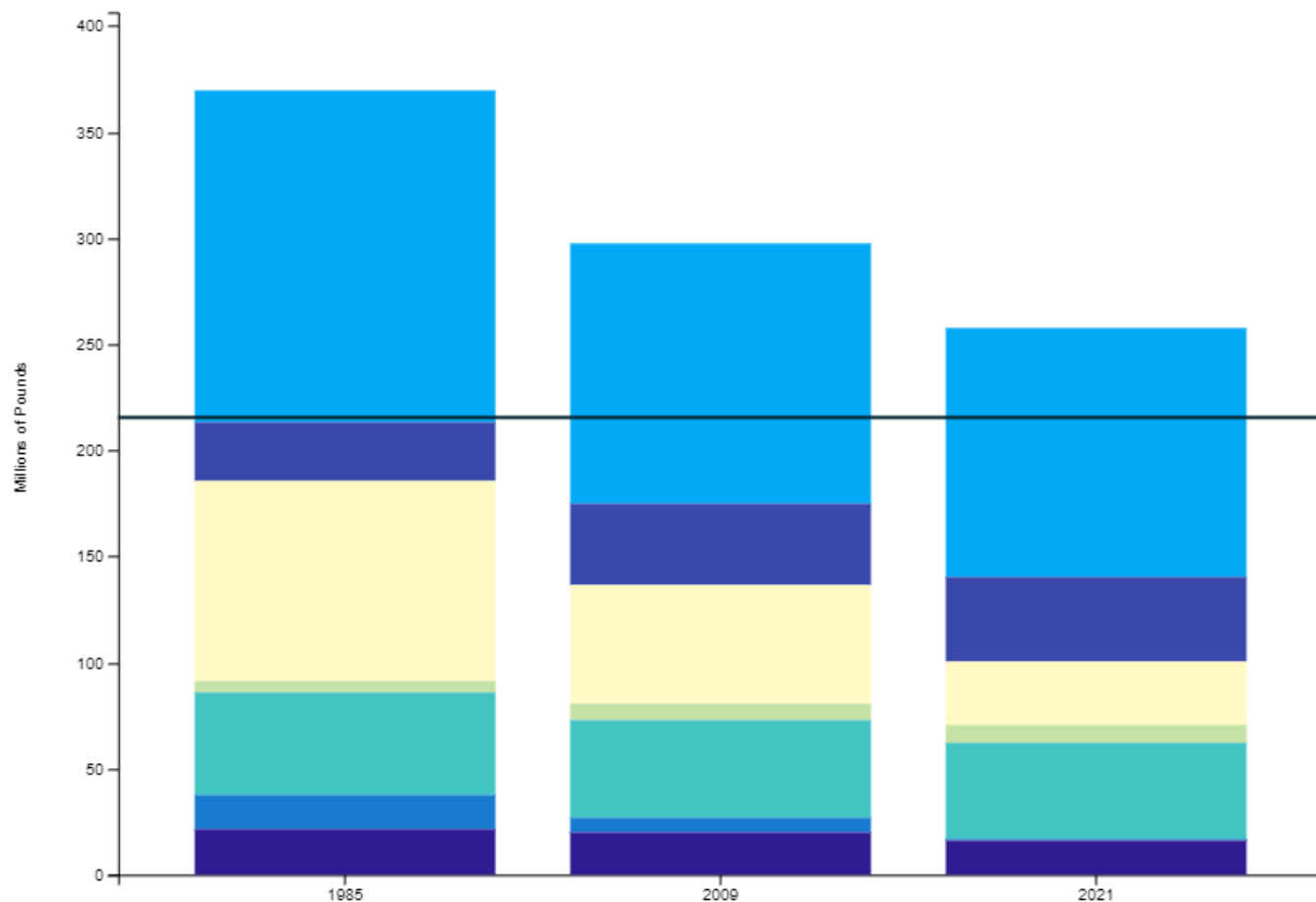**Modeled Nitrogen Loads to the Chesapeake Bay (1985-2021)**

Loads simulated using CAST19 and jurisdiction-reported data on wastewater discharges. *The natural sector wetlands which are preferable land use types with the lowest loading rates among sources.

VIEW CHART   VIEW TABLE

Loads by Source   Loads by Jurisdiction

Legend:
- Agriculture
- Developed
- Wastewater
- Septic
- Natural
- Atmospheric Deposition to Watershed
- Atmospheric Deposition to Tidal Water

Nontidal Load Indicator

Extreme variability
No Clear Trend

Pollution Loads and River Flow to the Chesapeake Bay (1990-2019)

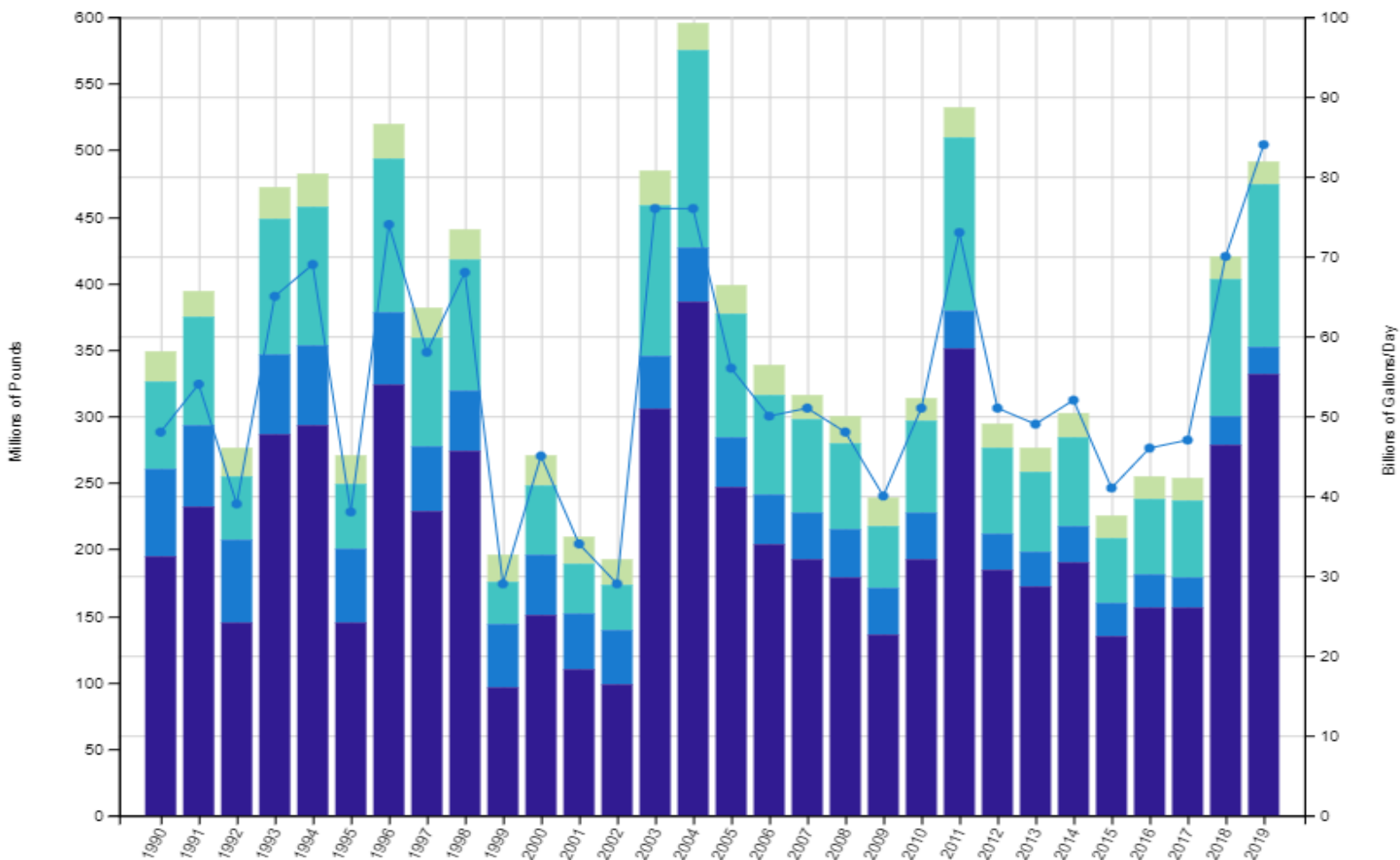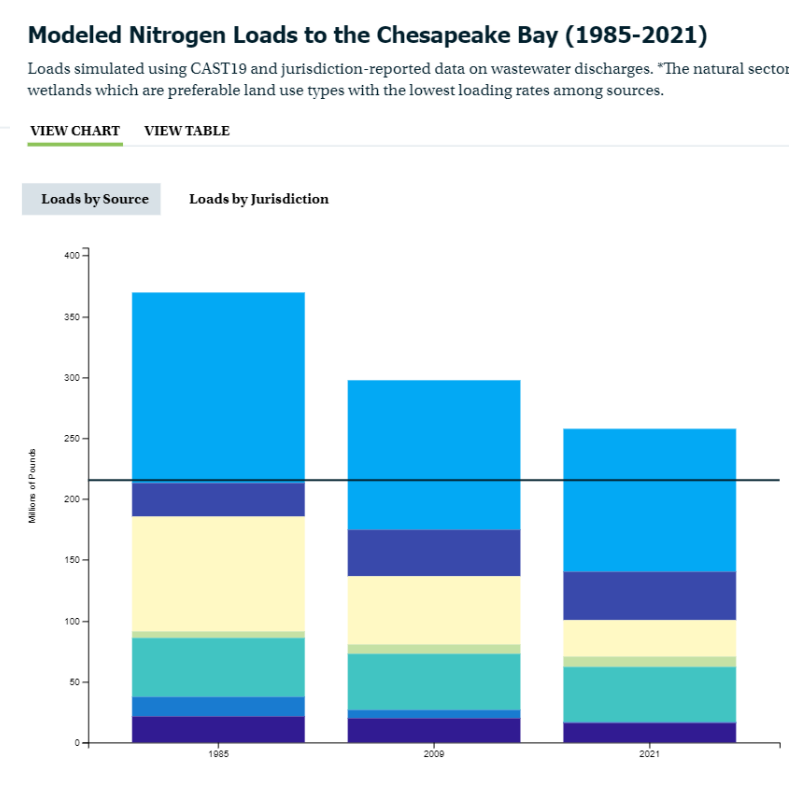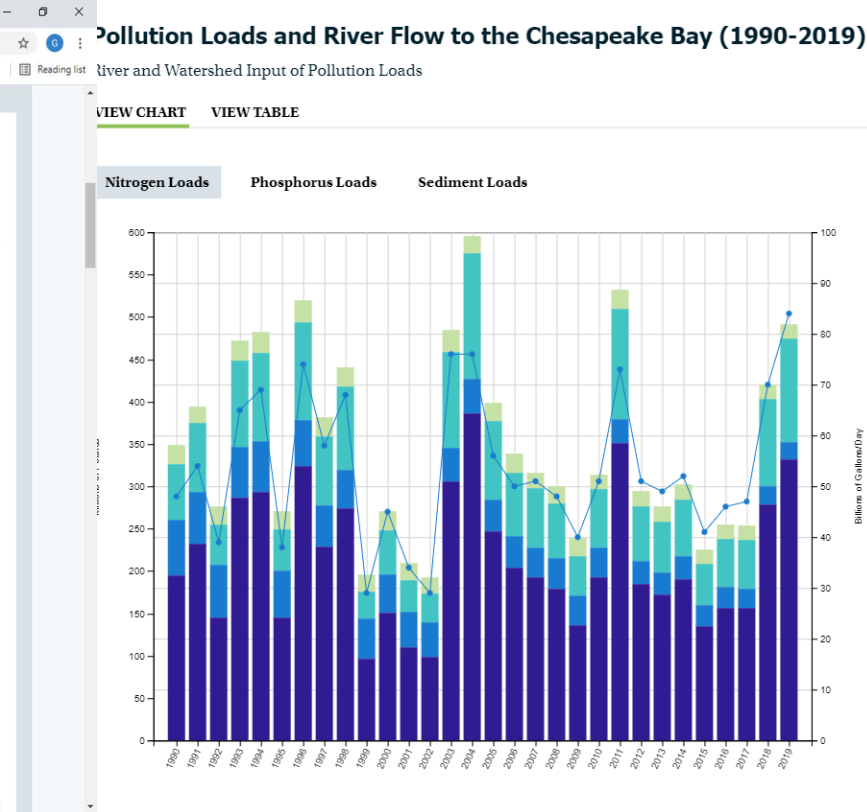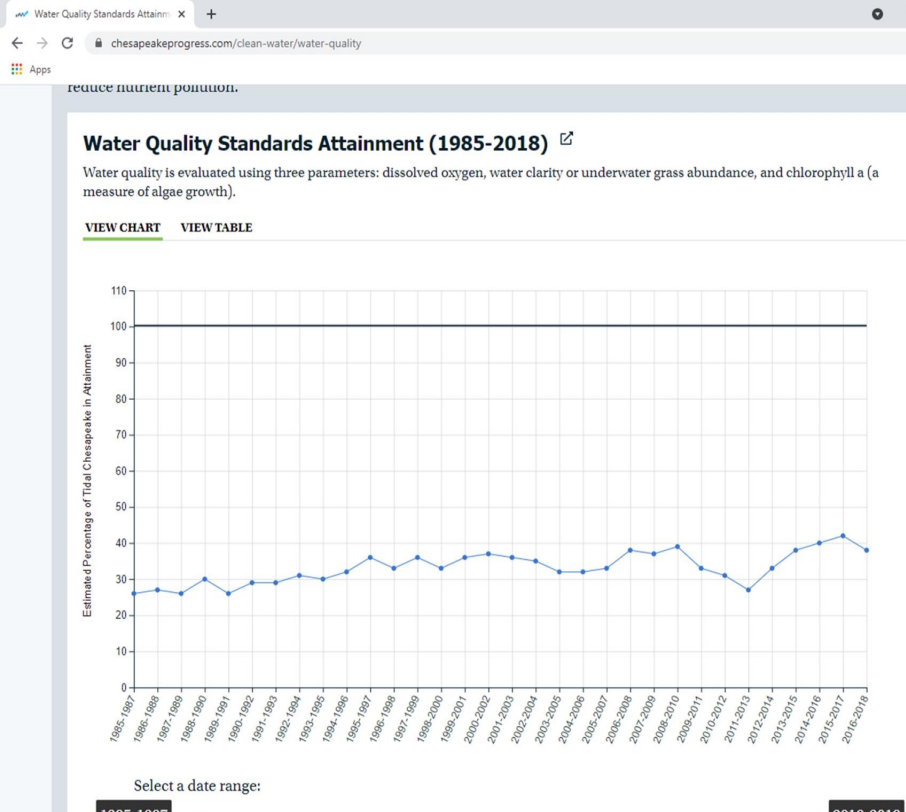River and Watershed Input of Pollution Loads

VIEW CHART   VIEW TABLE

Nitrogen Loads   Phosphorus Loads   Sediment Loads

Differences due to:
Averaging periods
Lag times
Temperature effects
Errors in both estimates

Differences due to:
Normalization for flow
Lag times
Non-management factors
Errors in both estimates

Ator, S.W., Blomquist, J.D., Webber, J.S. and Chanat, J.G., 2020. Factors driving nutrient trends in streams of the Chesapeake Bay watershed. *Journal of Environmental Quality*, *49*(4), pp.812-834.
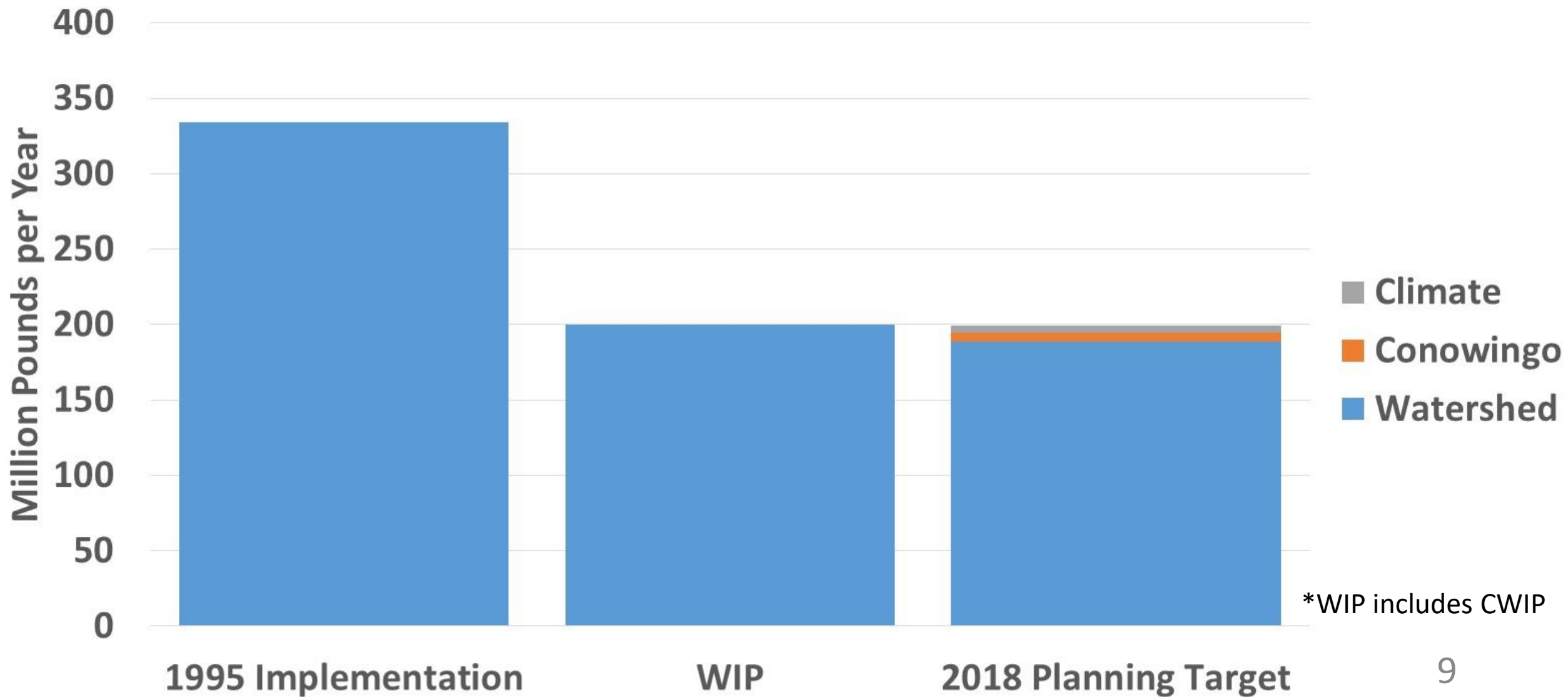
6

Purpose: Build an indicator that is:

- Relevant to the TMDL
- Based on monitored changes in load to the extent possible
- Bridges monitoring and modeling by assessing lag time and other effects

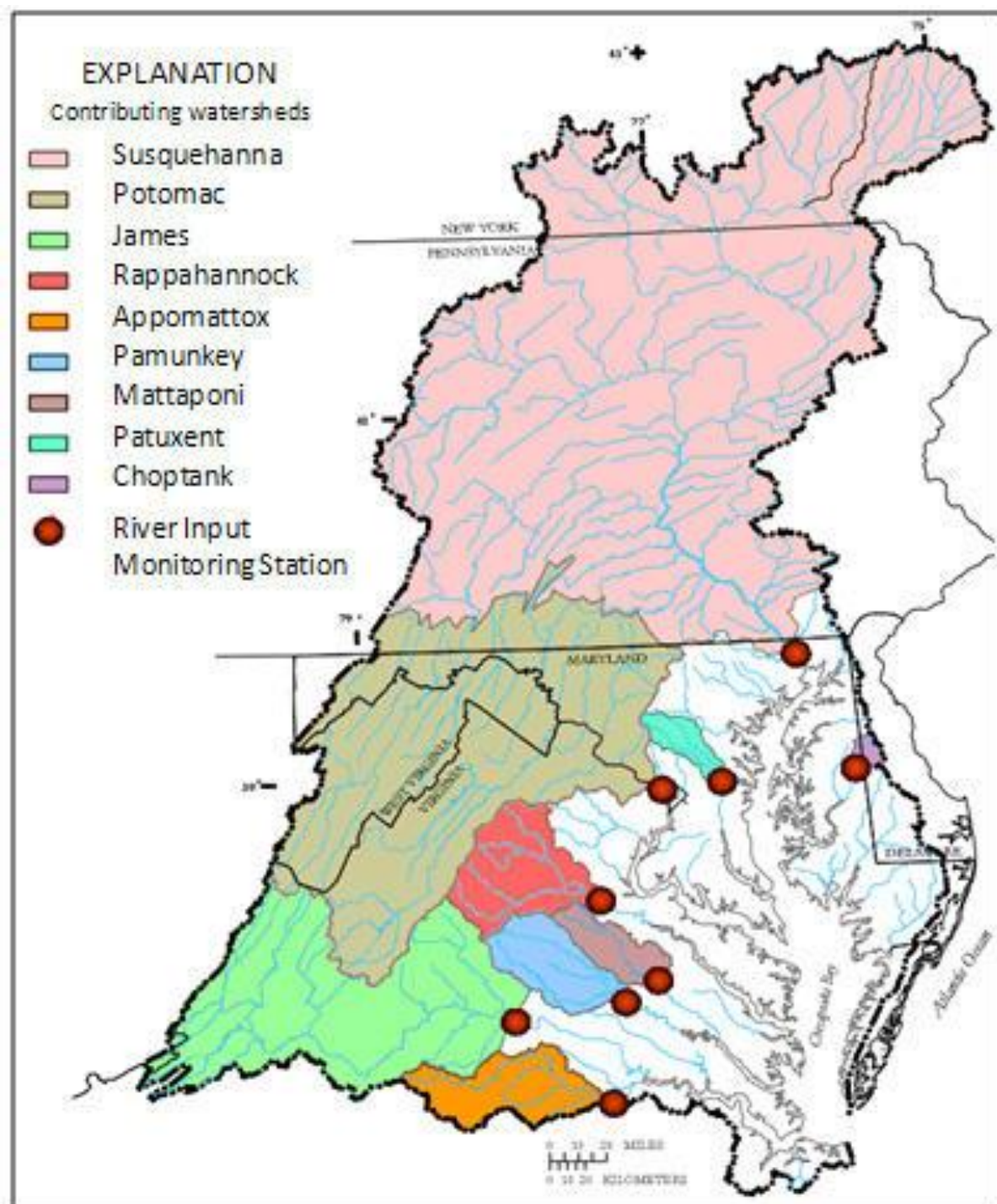# TMDL question: What level of load reduction from 1995 will be necessary to meet water quality standards?
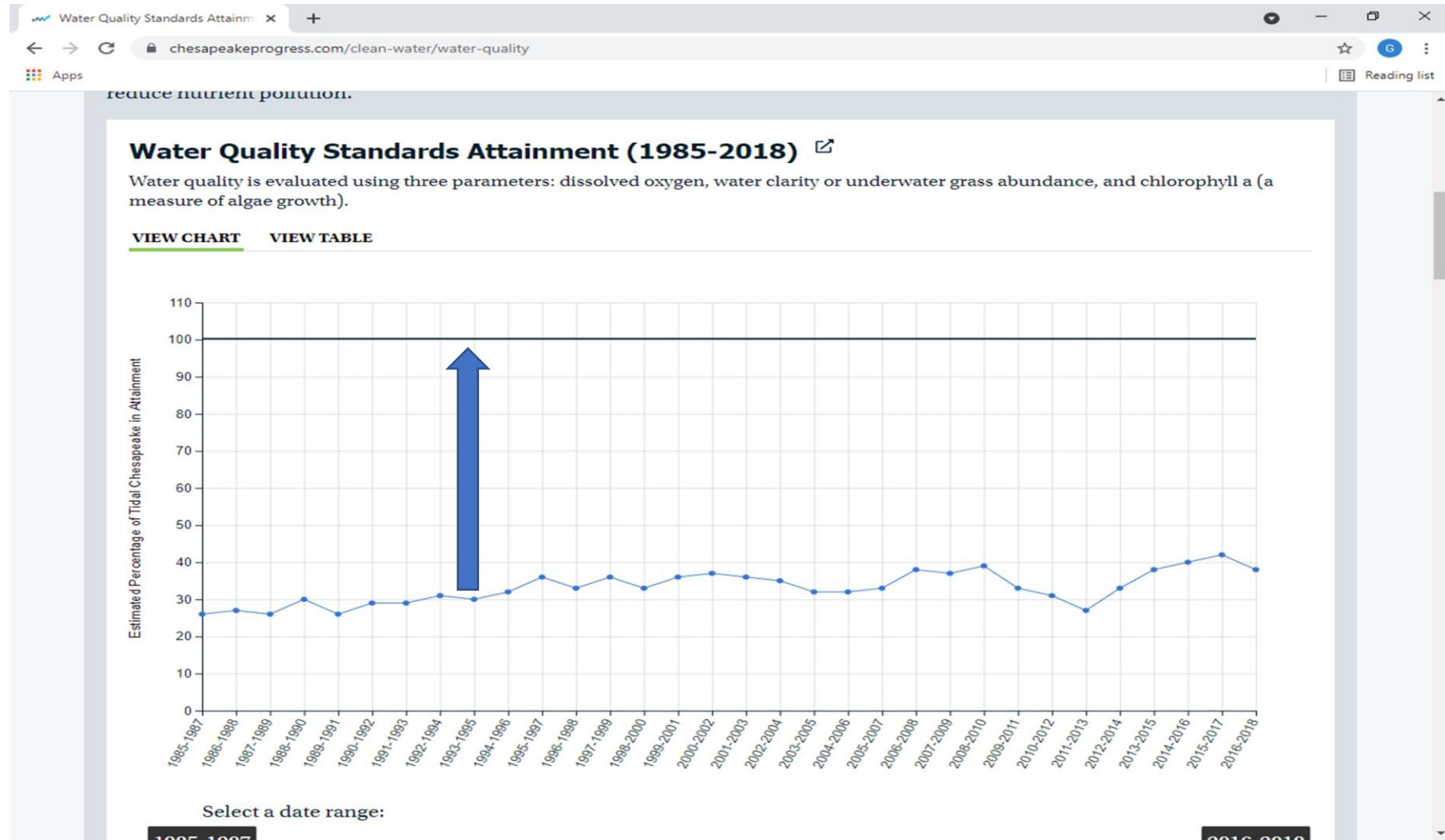
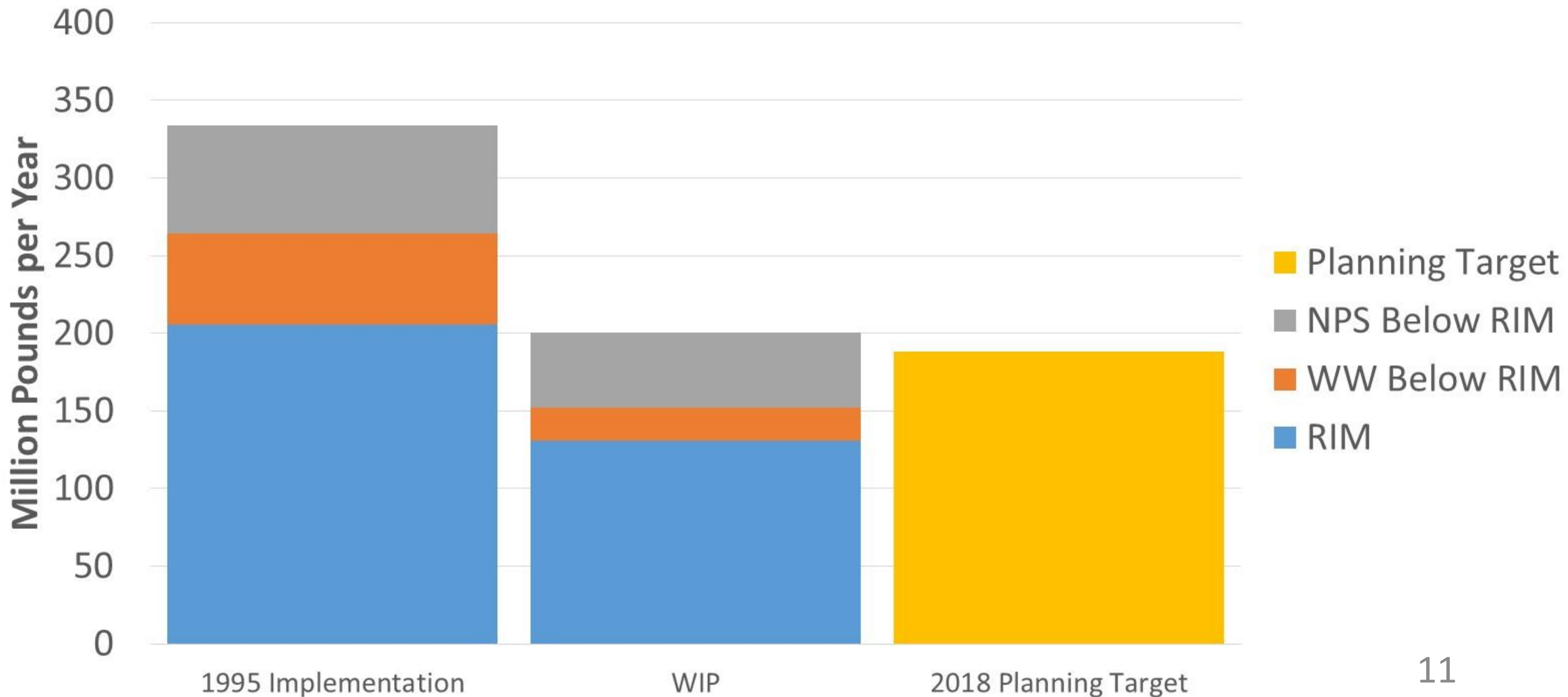# Loads required to meet TMDL Goals

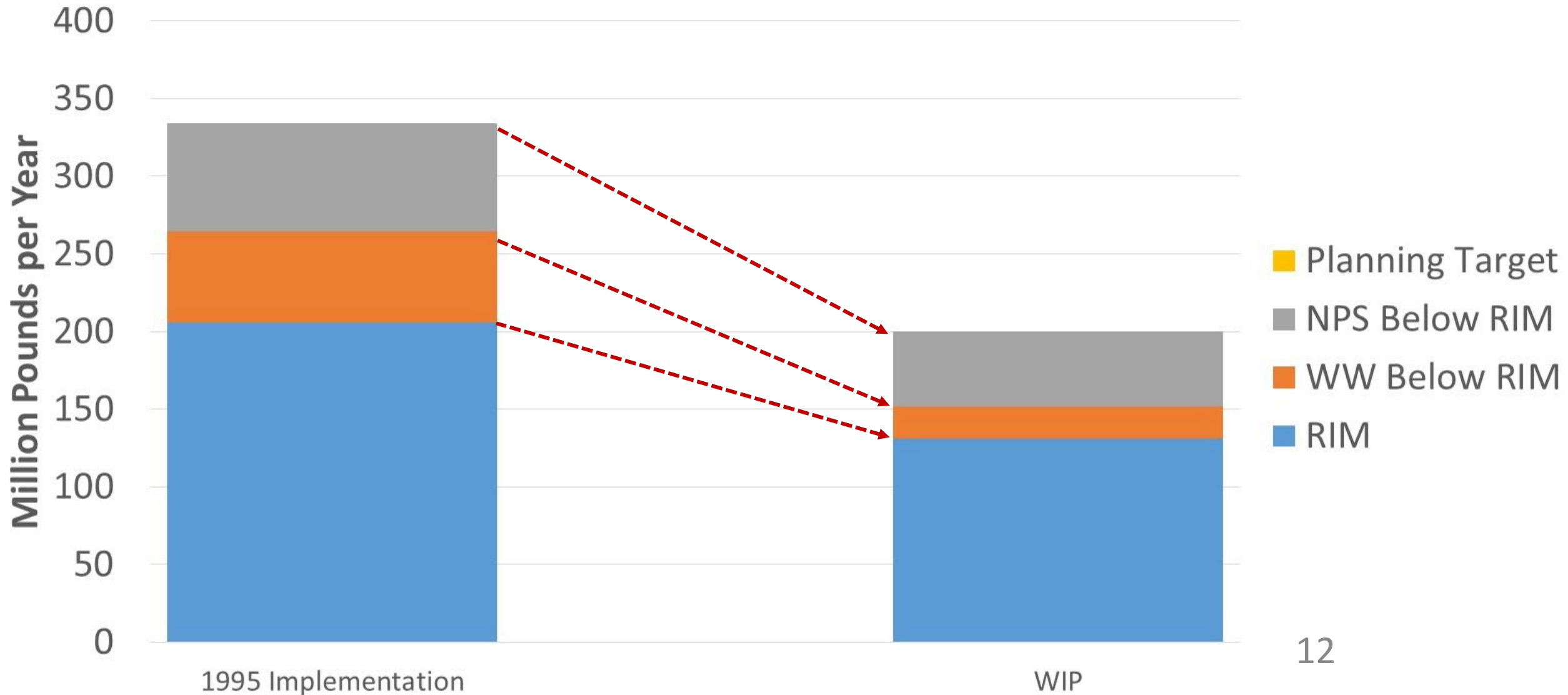*WIP includes CWIP

River Input Monitoring (RIM)

- Covers most of the CB watershed
  - 80% of land
  - 60% of load
- Many large WWTP are below RIM stations

Reductions required to meet TMDL Goals

Reductions required to meet TMDL Goals
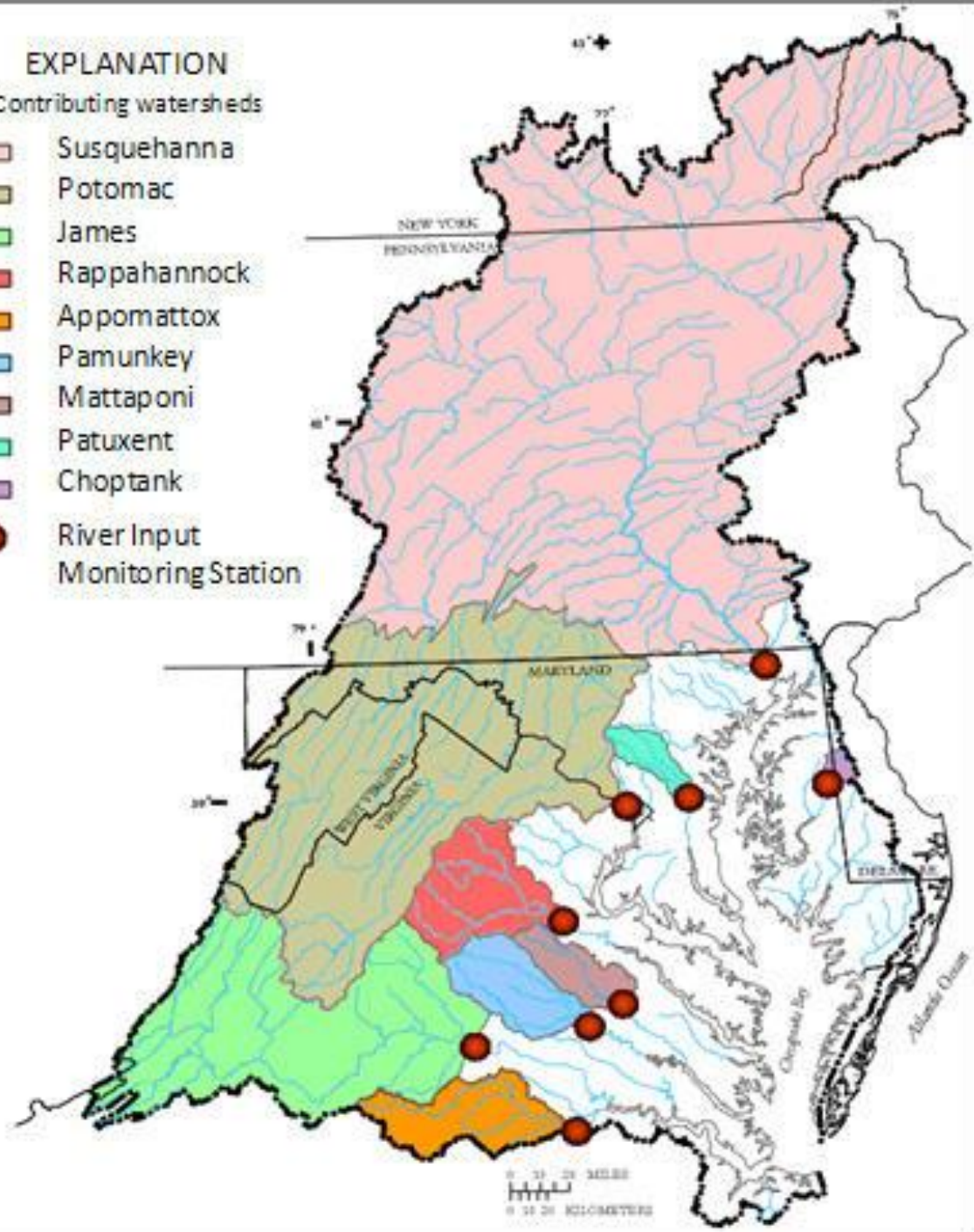
84% of Expected Reduction is Monitored
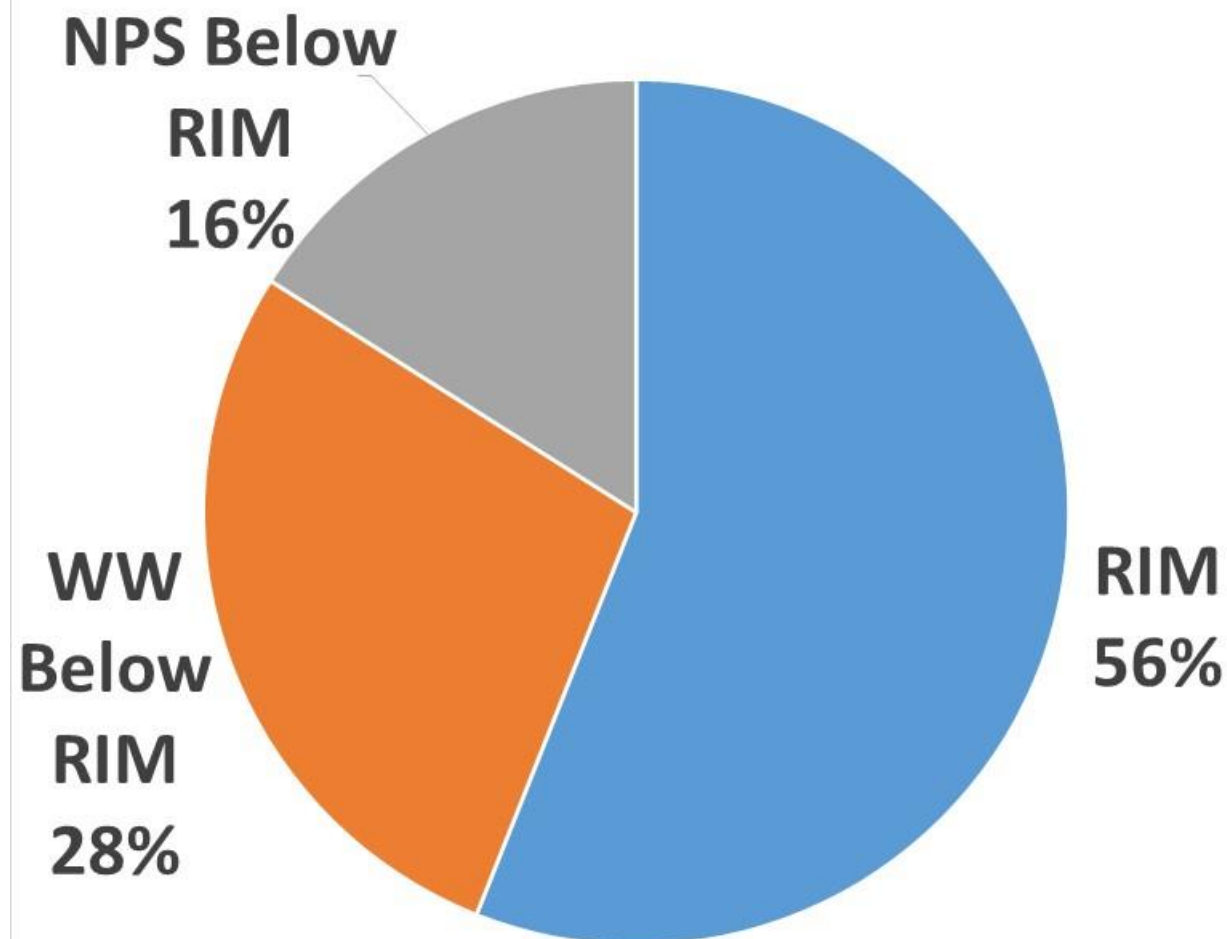
Loads and Flow-Normalized Loads

Potomac River Nitrogen

https://cbrim.er.usgs.gov/
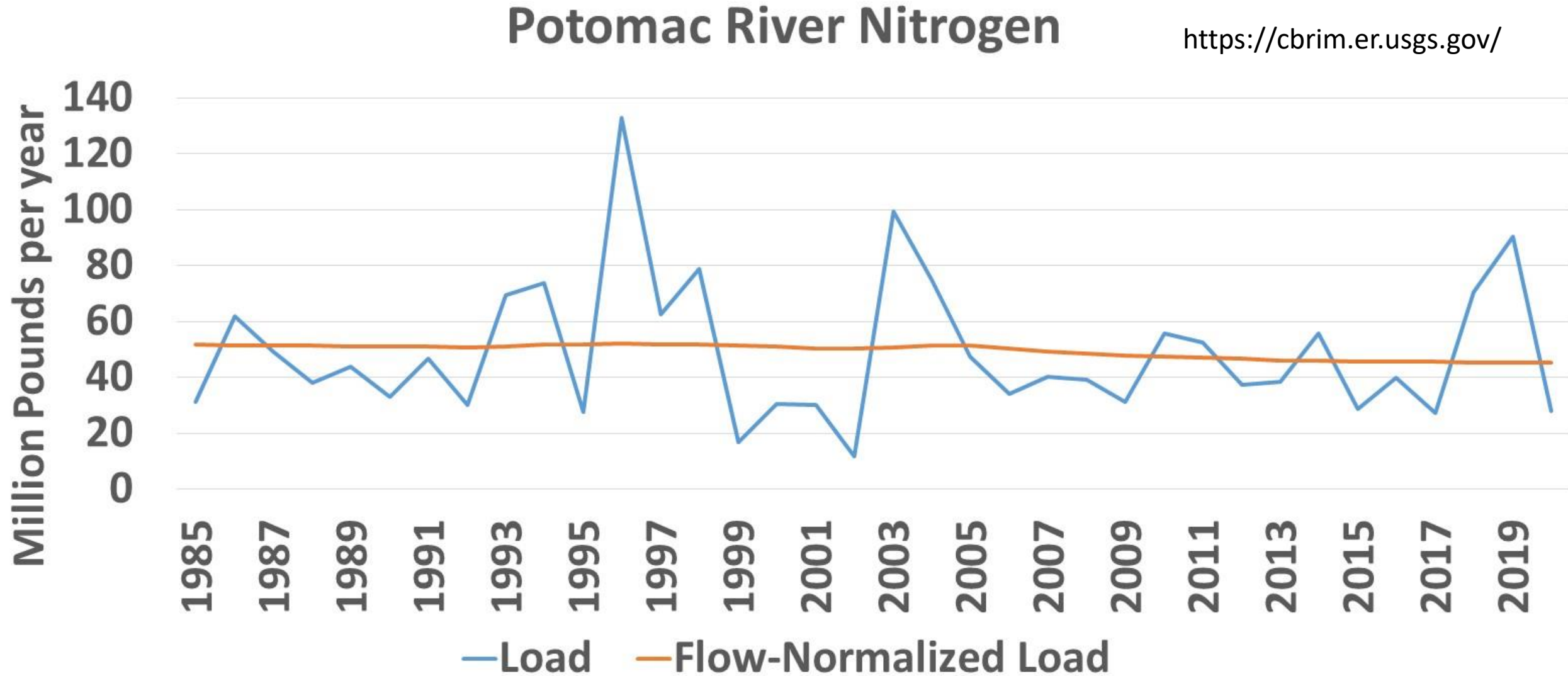
Wastewater is easy to measure and successful

Below RIM NPS is about half implemented and is not fully monitored
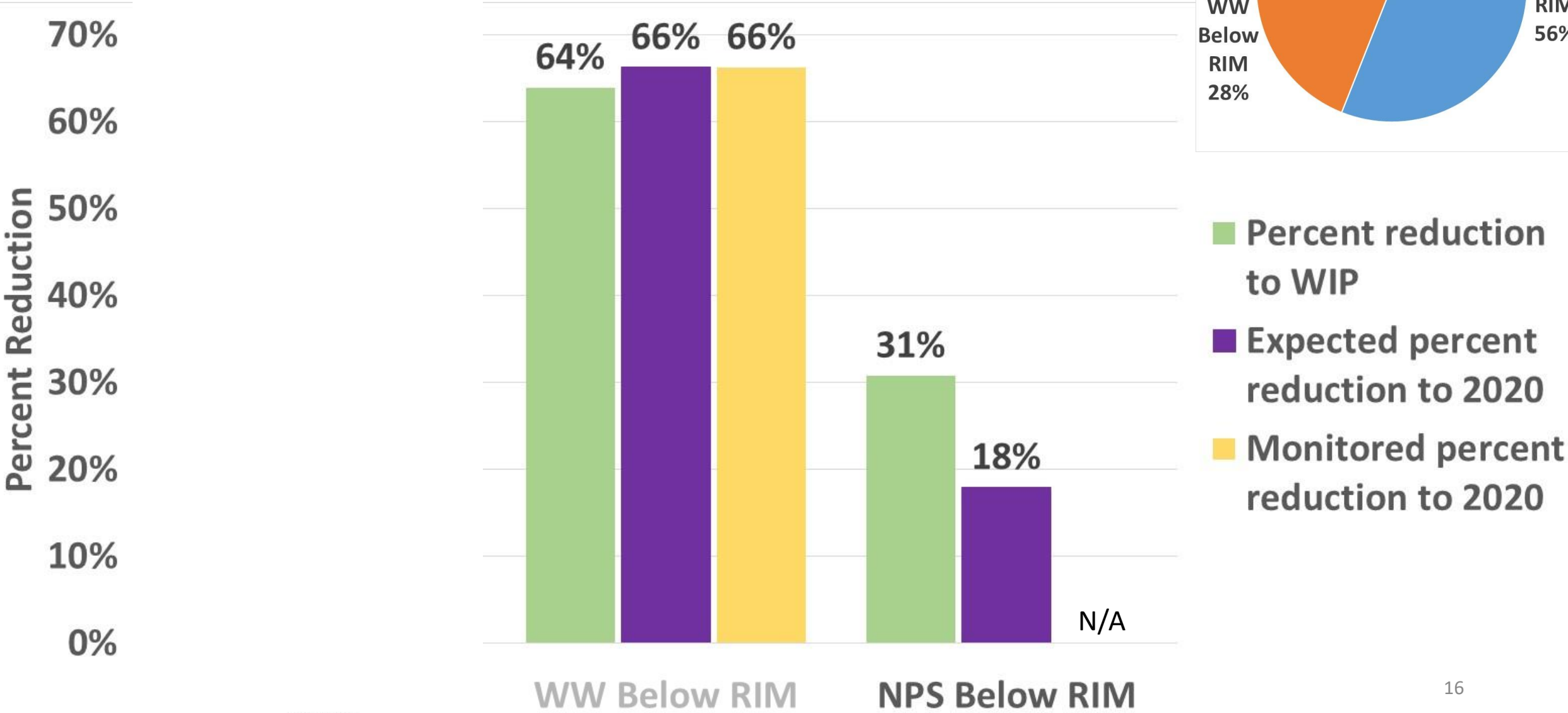
Above RIM is about half implemented, but monitoring shows only a small reduction

Why are monitoring and modeling not showing the same thing?

- Uncertainty in CAST
  - BMPs implemented
  - BMP effectiveness
  - Nutrient applications
  - Watershed response
- Uncertainty in "monitored" loads
- Lag time
- Competing factors such as
  - Climate change
  - Conowingo

Pie chart labels: NPS Below RIM 16%, WW Below RIM 28%, RIM 56%
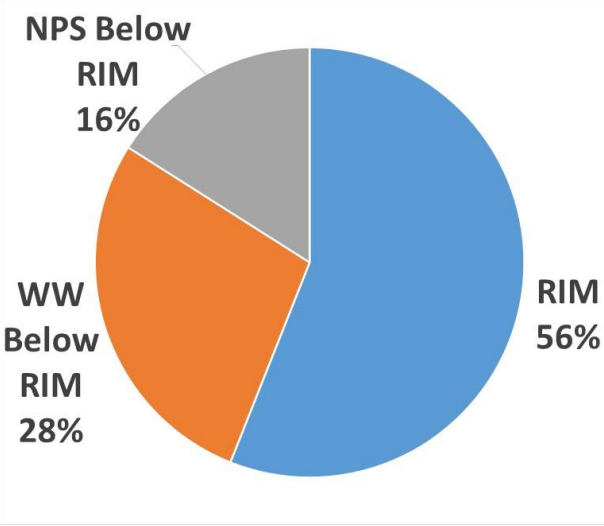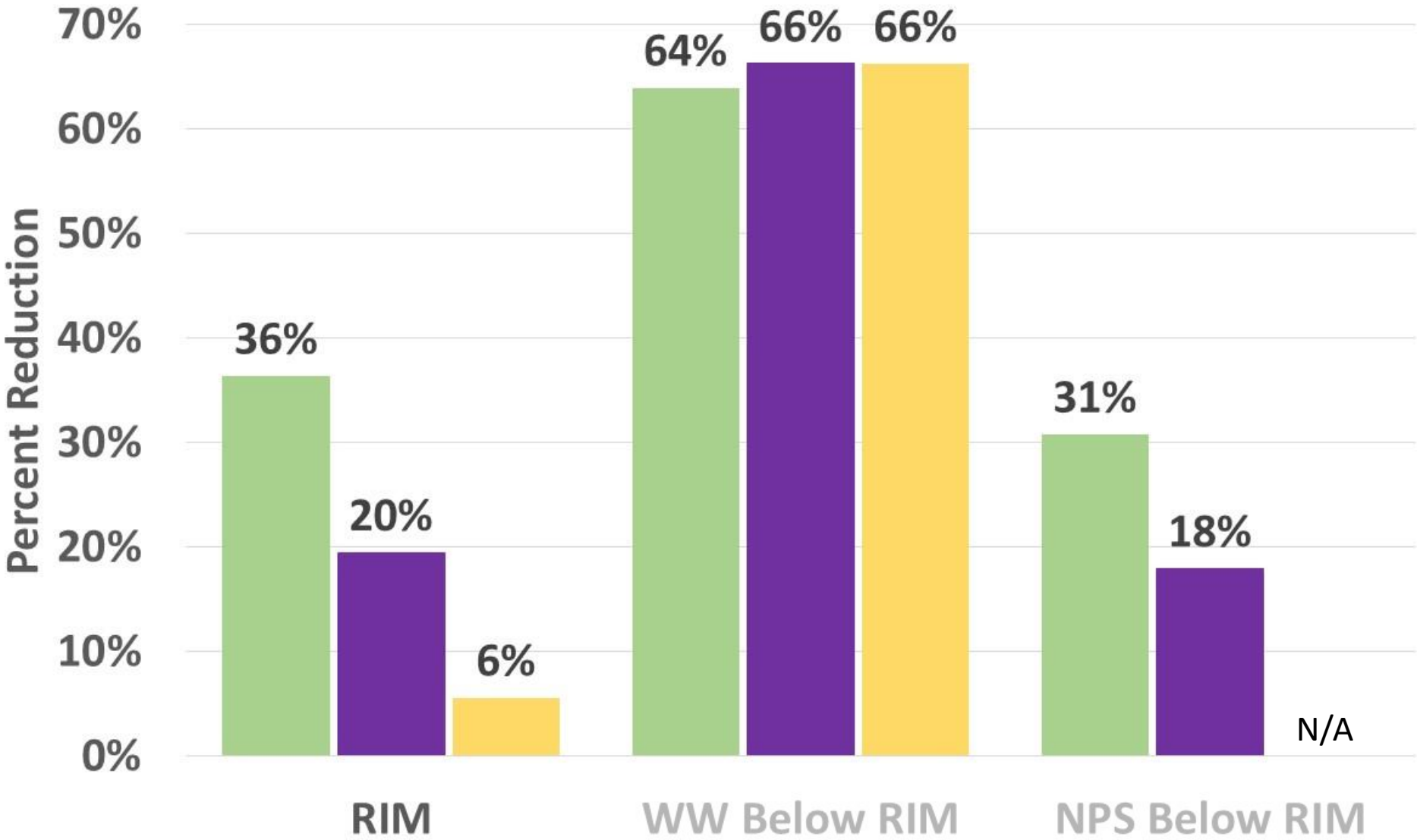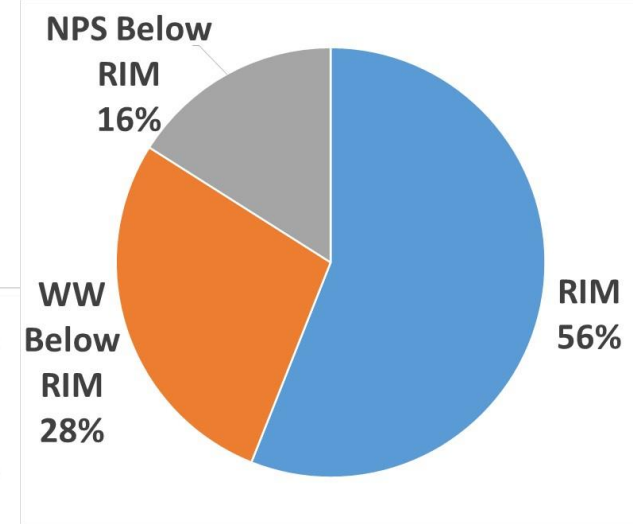
Legend:
- Percent reduction to WIP
- Expected percent reduction to 2020
- Monitored percent reduction to 2020

Bar chart values: 36%, 20%, 6% — RIM

Ator, S.W., Blomquist, J.D., Webber, J.S. and Chanat, J.G., 2020. Factors driving nutrient trends in streams of the Chesapeake Bay watershed. *Journal of Environmental Quality*, *49*(4), pp.812-834.

Lag times

Nitrate in groundwater
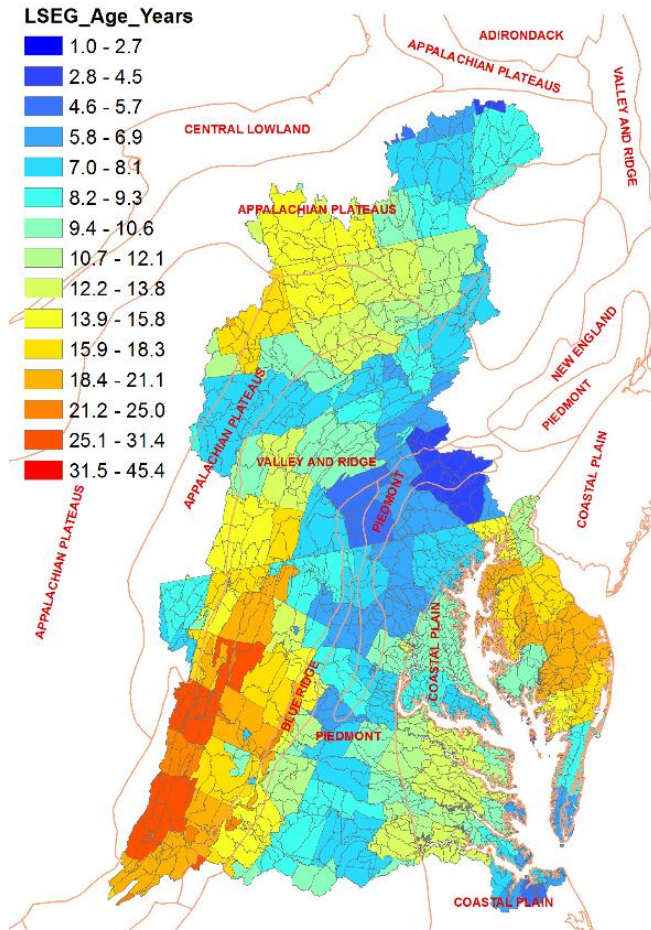
Phase 6 CAST documentation

Phosphorus in soils
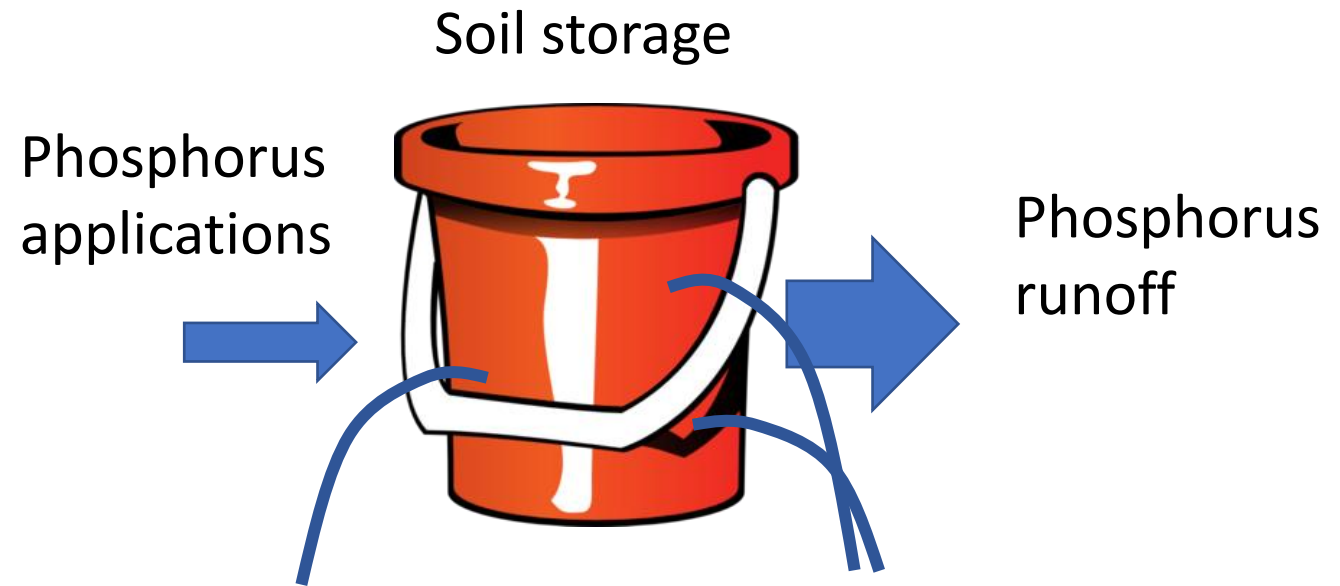
Soil storage

Phosphorus applications

Phosphorus runoff

Conowingo effect

Estimated Loads to the Bay with Conowingo Dam and Reservoir at Infill Conditions

Additional Nitrogen Load: 13 million pounds

➕

Additional Phosphorus Load: 1.8 million pounds

⬇

DO Variances

Deep Water or Deep Channel

Lags and Conowingo account for major differences between Modeling and Monitoring

No approved method of aggregating uncertainty across RIM stations
Initial estimate for monitored reduction by Zhang, Bertani, Shenk at +/- 6%

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Conowingo effect

Estimated Loads to the Bay with Conowingo Dam and Reservoir at Infill Conditions

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+

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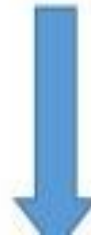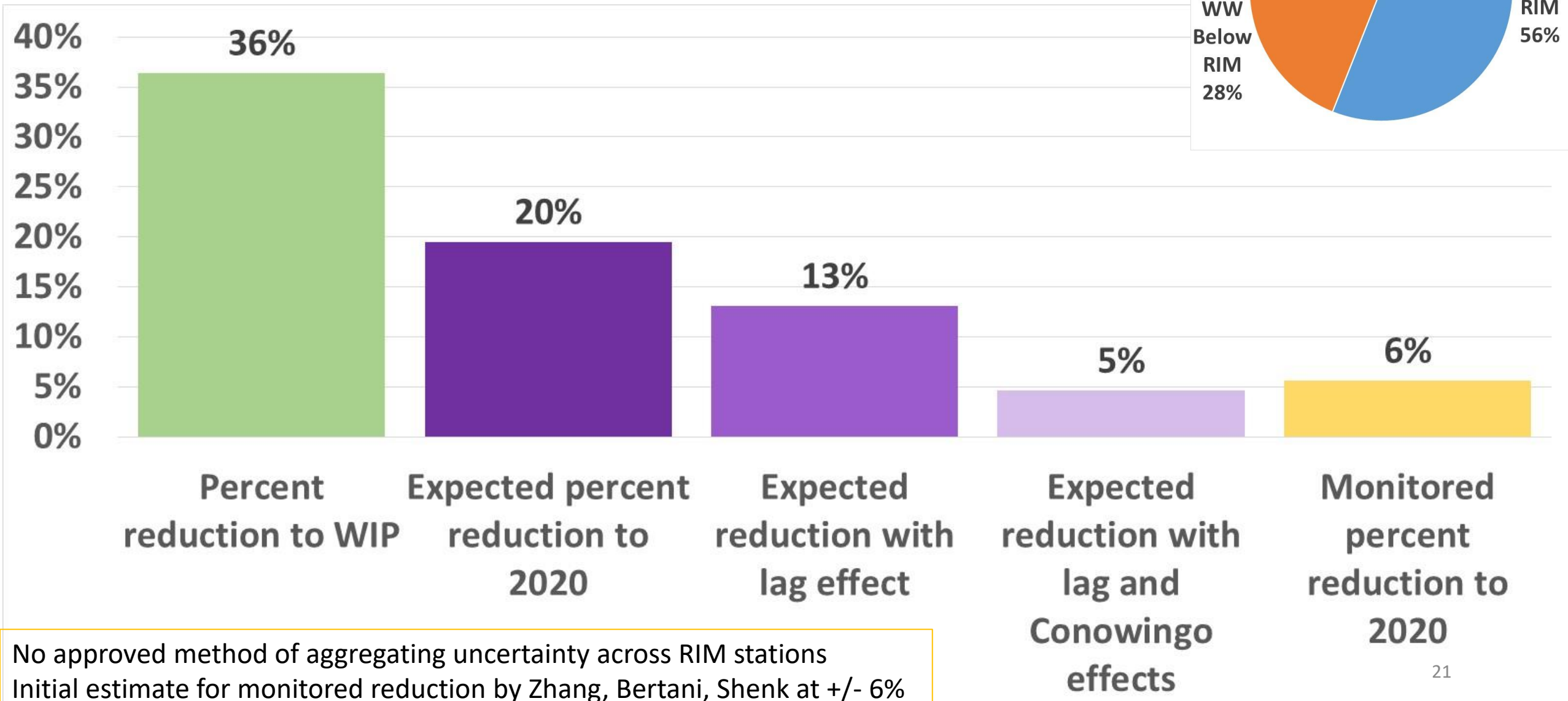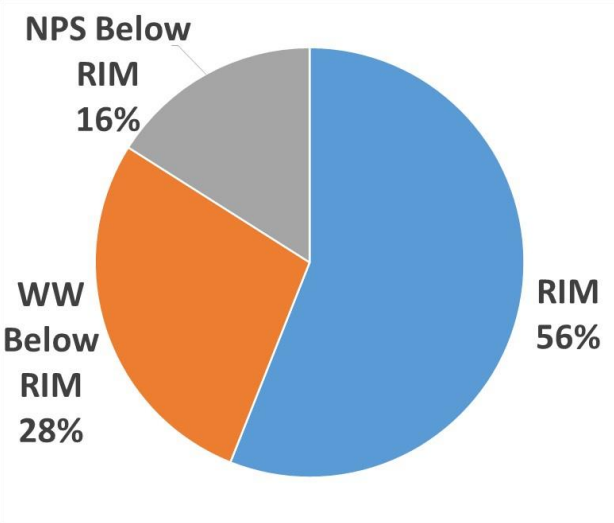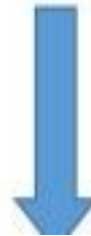
HOWEVER: These are less bioavailable nutrients and its delivery to Bay is dependent on large storm events. Reduction equivalent to 6 million pounds of Nitrogen and 0.26 million pounds of Phosphorus

Conowingo infill raises the assimilative capacity
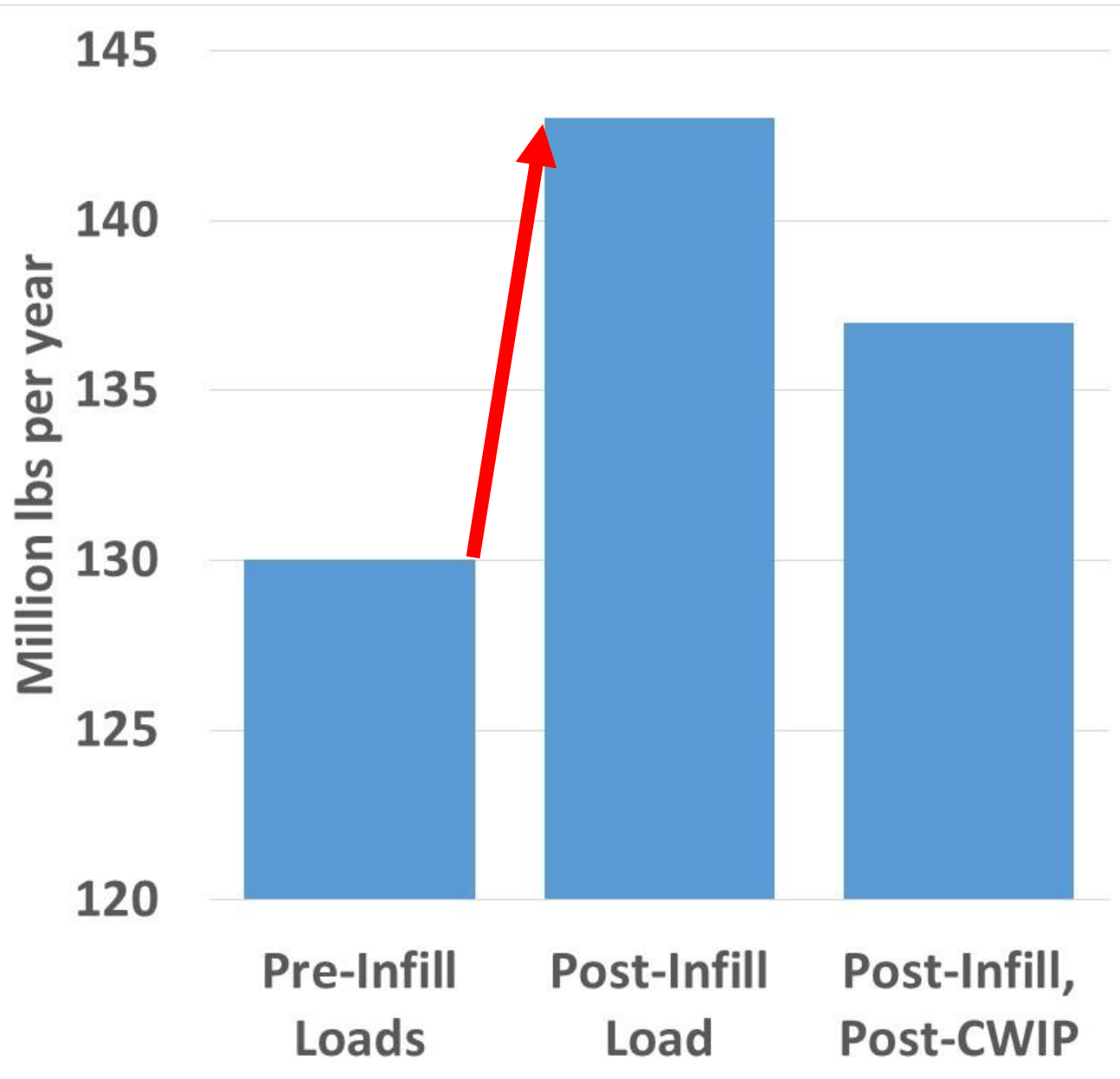
All else being equal, Conowingo raised loads by 13 million (mostly organic and non-summer) lbs

Conowingo infill raises the assimilative capacity
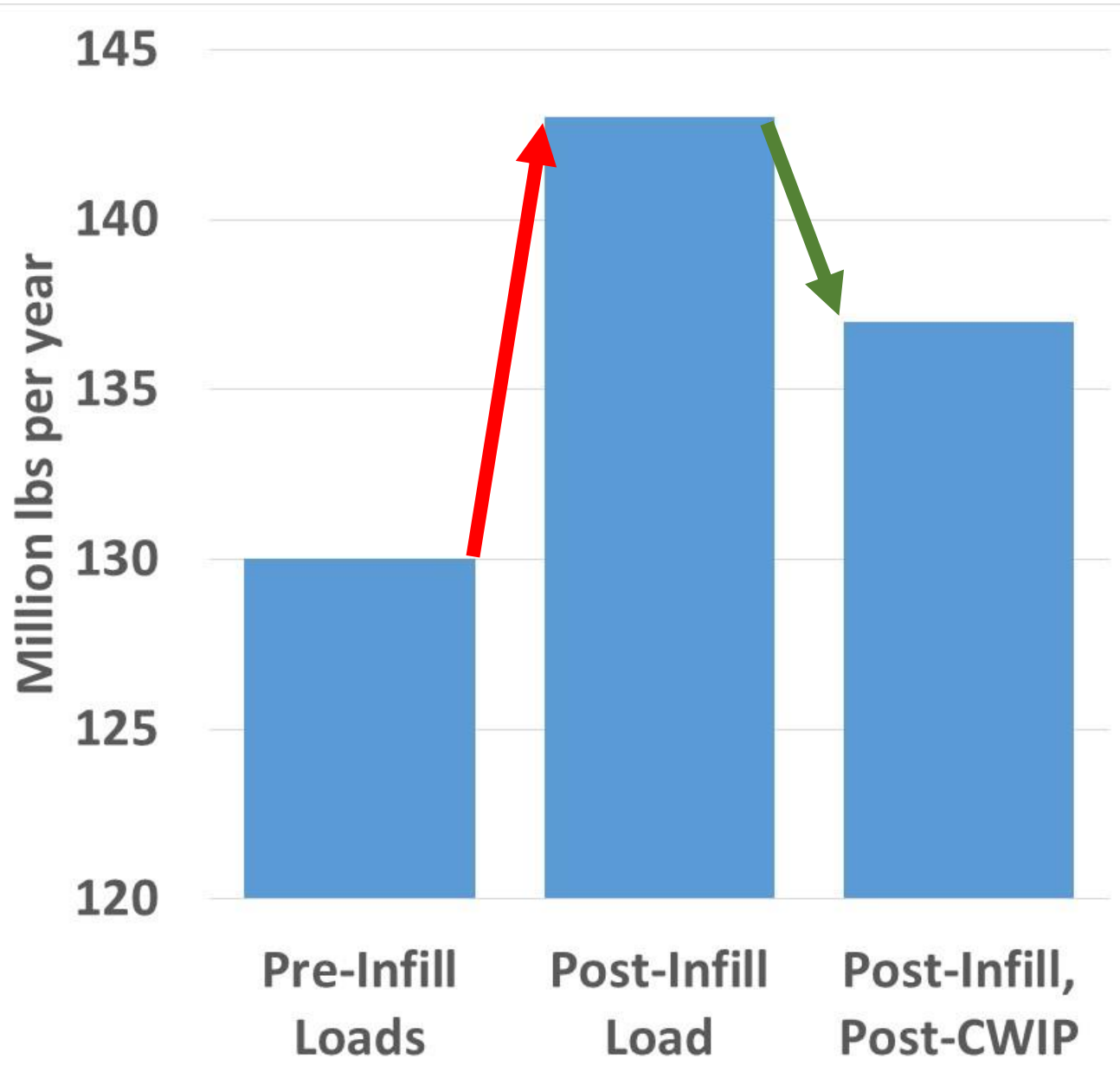
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The infill effect can be removed by a watershed reduction of 6 million (more inorganic and summer) lbs

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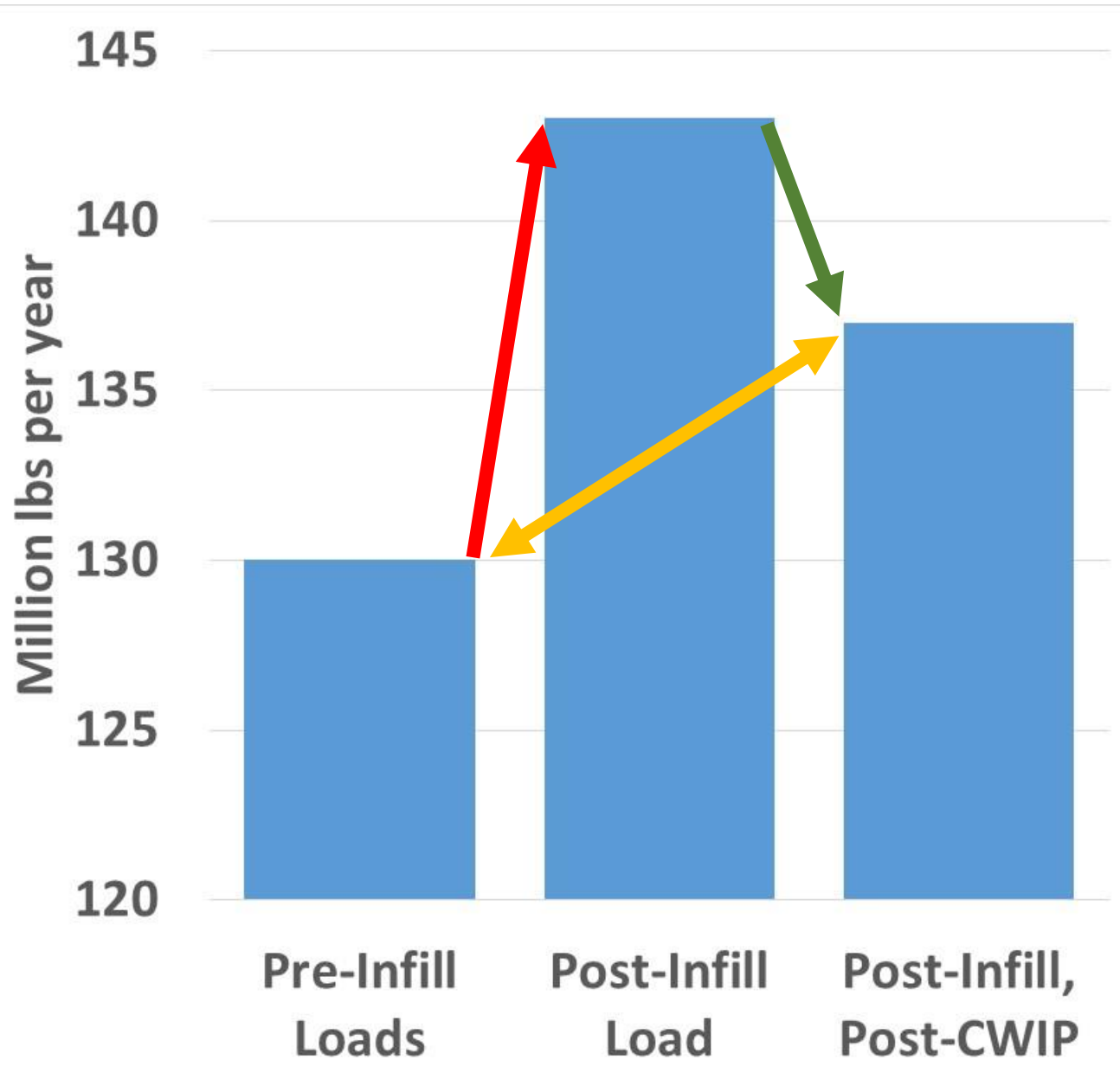
All else being equal, Conowingo raised loads by 13 million (mostly organic and non-summer) lbs

The infill effect can be removed by a watershed reduction of 6 million (more inorganic and summer) lbs

The TMDL water quality is equivalent at 130 pre-infill and 137 post-infill

The water quality change "Seen" by the Bay is greater than the monitoring results by 7 million pounds because of the infill effect

Lags and Conowingo account for major differences between Modeling and Monitoring

Putting it all together

Below-RIM Unimplemented

Below-RIM Lagged

Below-RIM Estimated

Below-RIM WW addn'l

Tidal Deposition

Tidal Dep future

WIP Shortfall

RIM Unimplemented

RIM Unimplemented Conowingo

RIM Lagged

Below-RIM WW

RIM Monitored

RIM Conow conversion

Model underestimate subtracted from 'Unimplemented

NPS Below RIM 16%

WW Below RIM 28%

RIM 56%

27
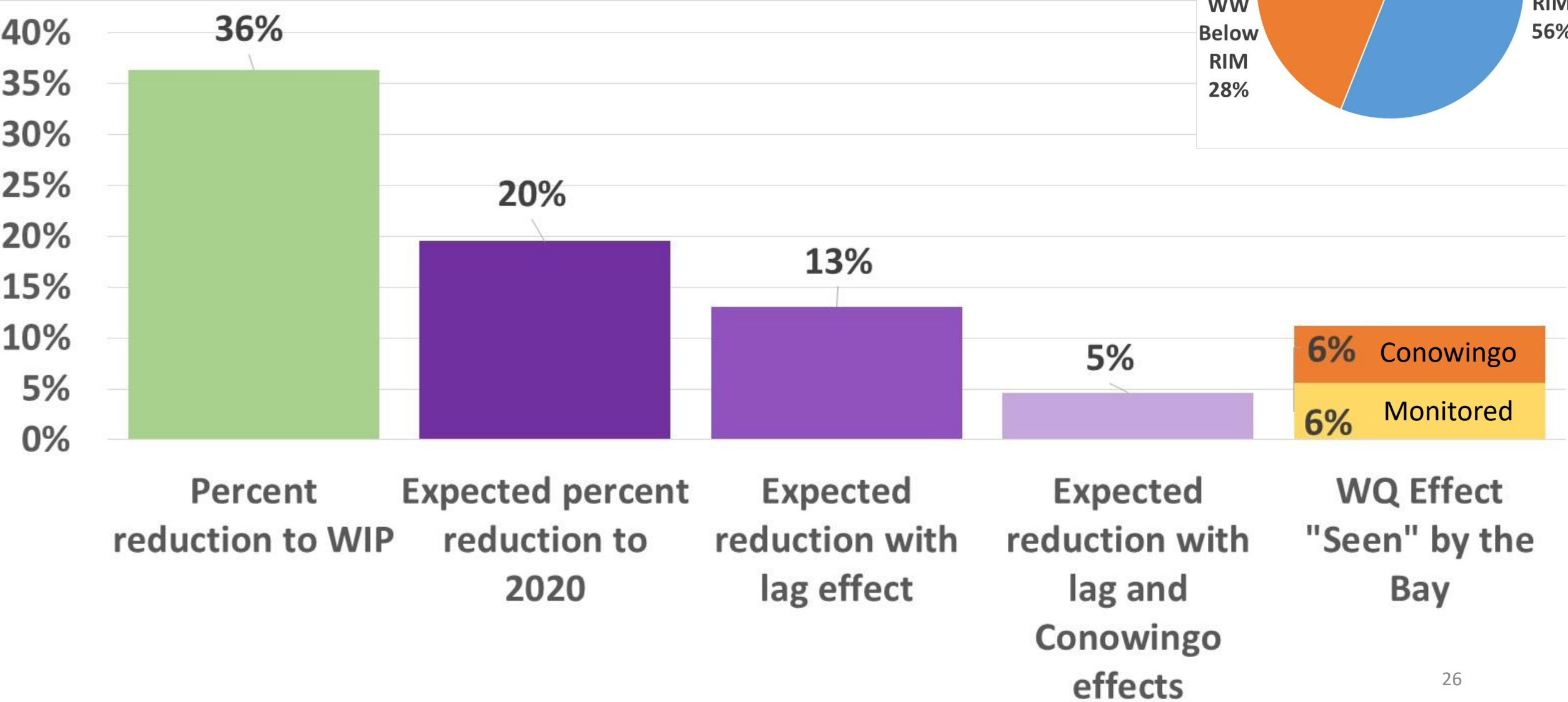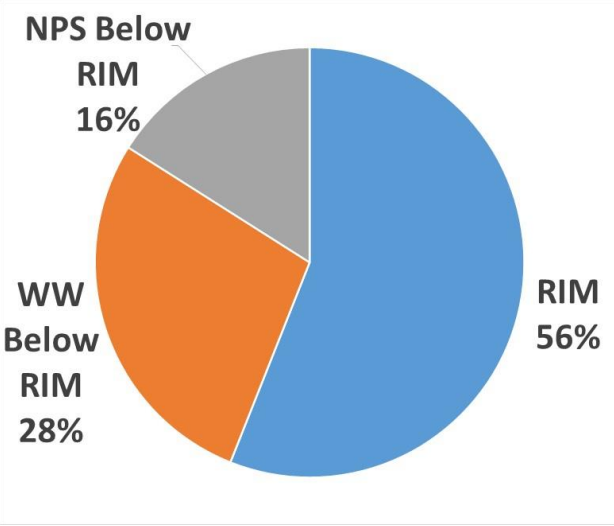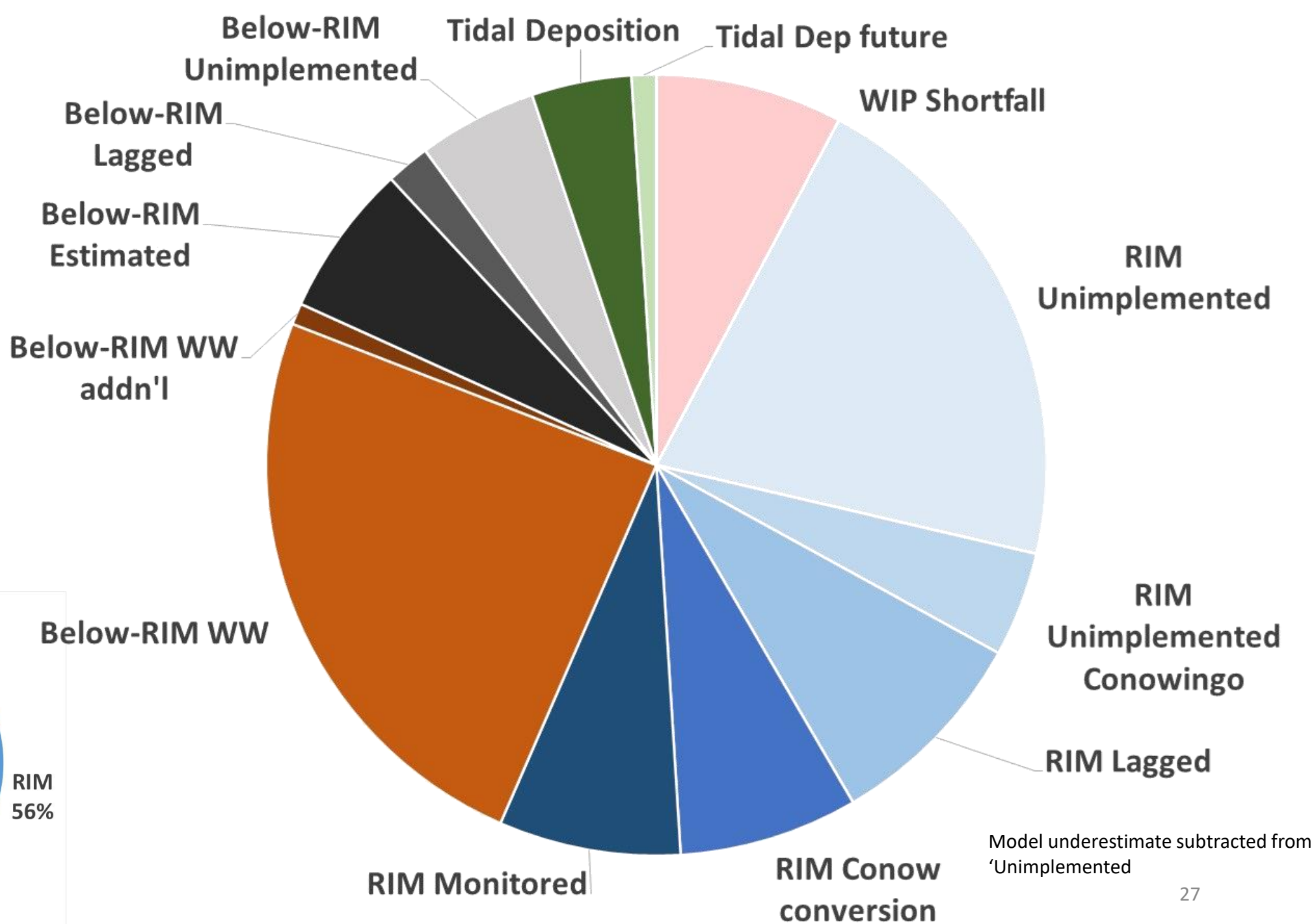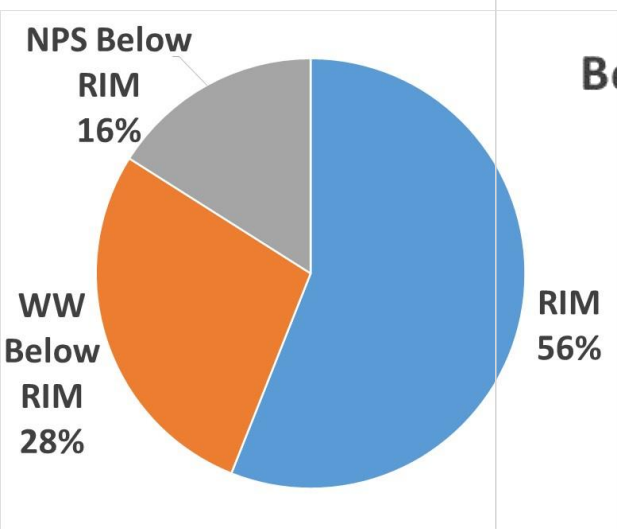
The bay has seen 51% of needed reductions

Below-RIM Unimplemented

Tidal Deposition

Tidal Dep future

WIP Shortfall

Below-RIM Lagged

Below-RIM Estimated

Below-RIM WW addn'l

RIM Unimplemented

Below-RIM WW

RIM Unimplemented Conowingo

RIM Lagged

RIM Monitored

RIM Conow conversion

NPS Below RIM 16%

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RIM 56%

28
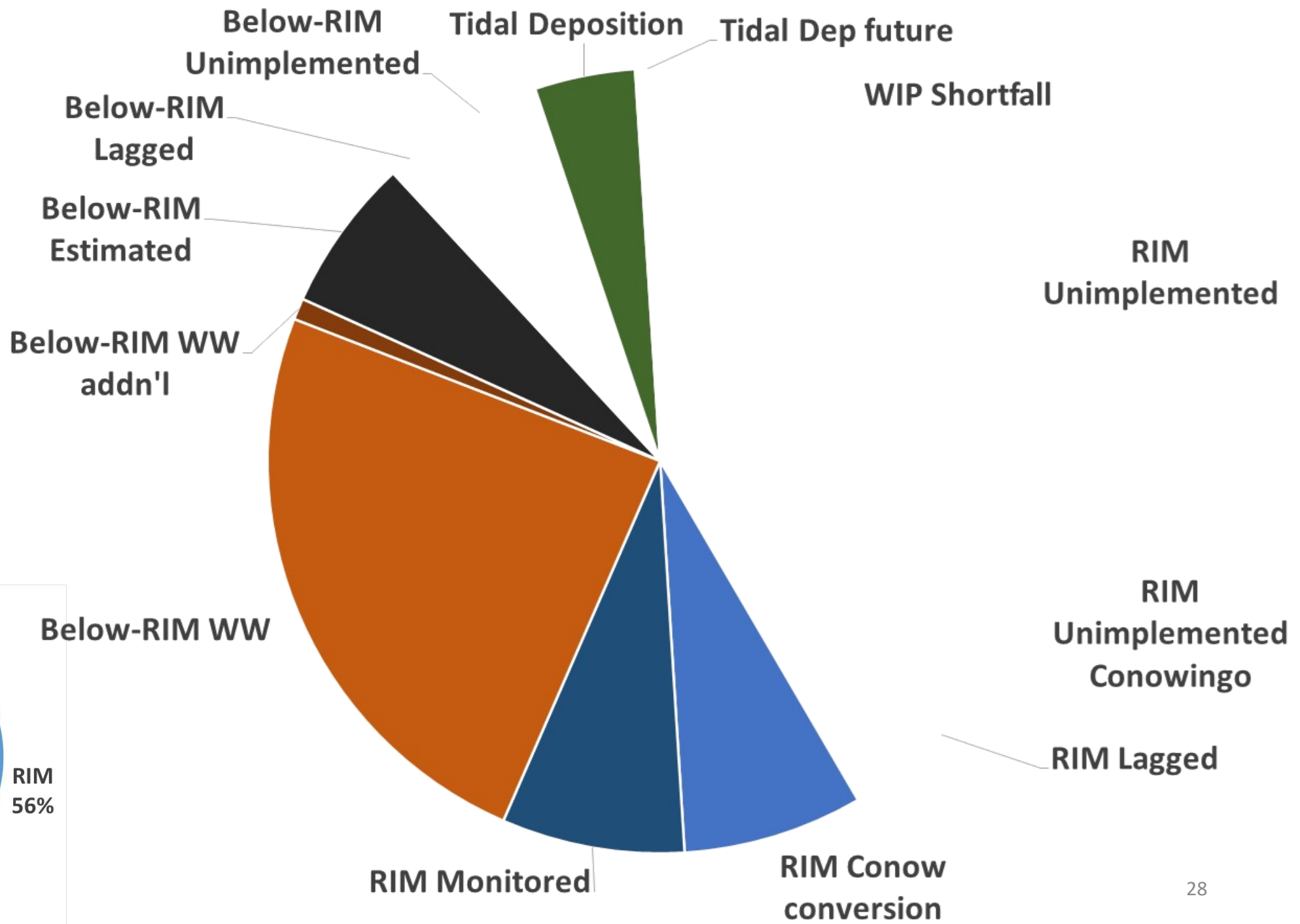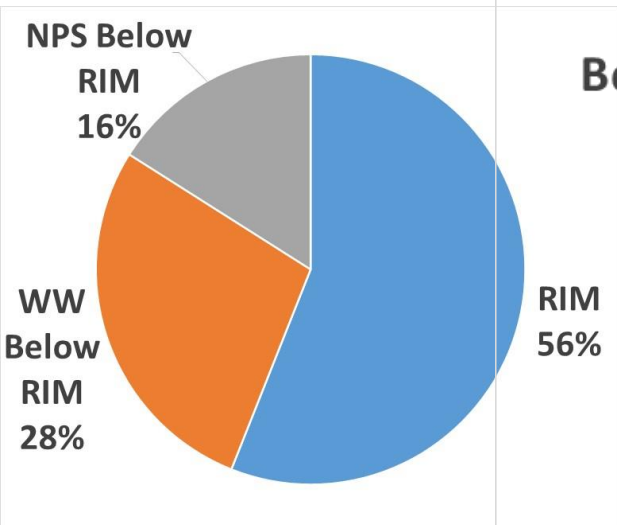
39% is unplanned or unimplemented

Below-RIM Unimplemented

Tidal Deposition

Tidal Dep future

WIP Shortfall

Below-RIM Lagged

Below-RIM
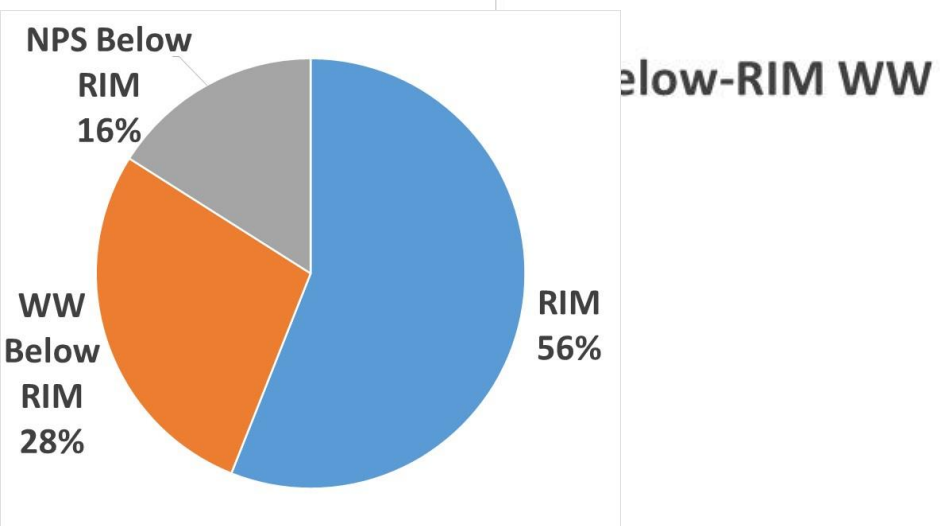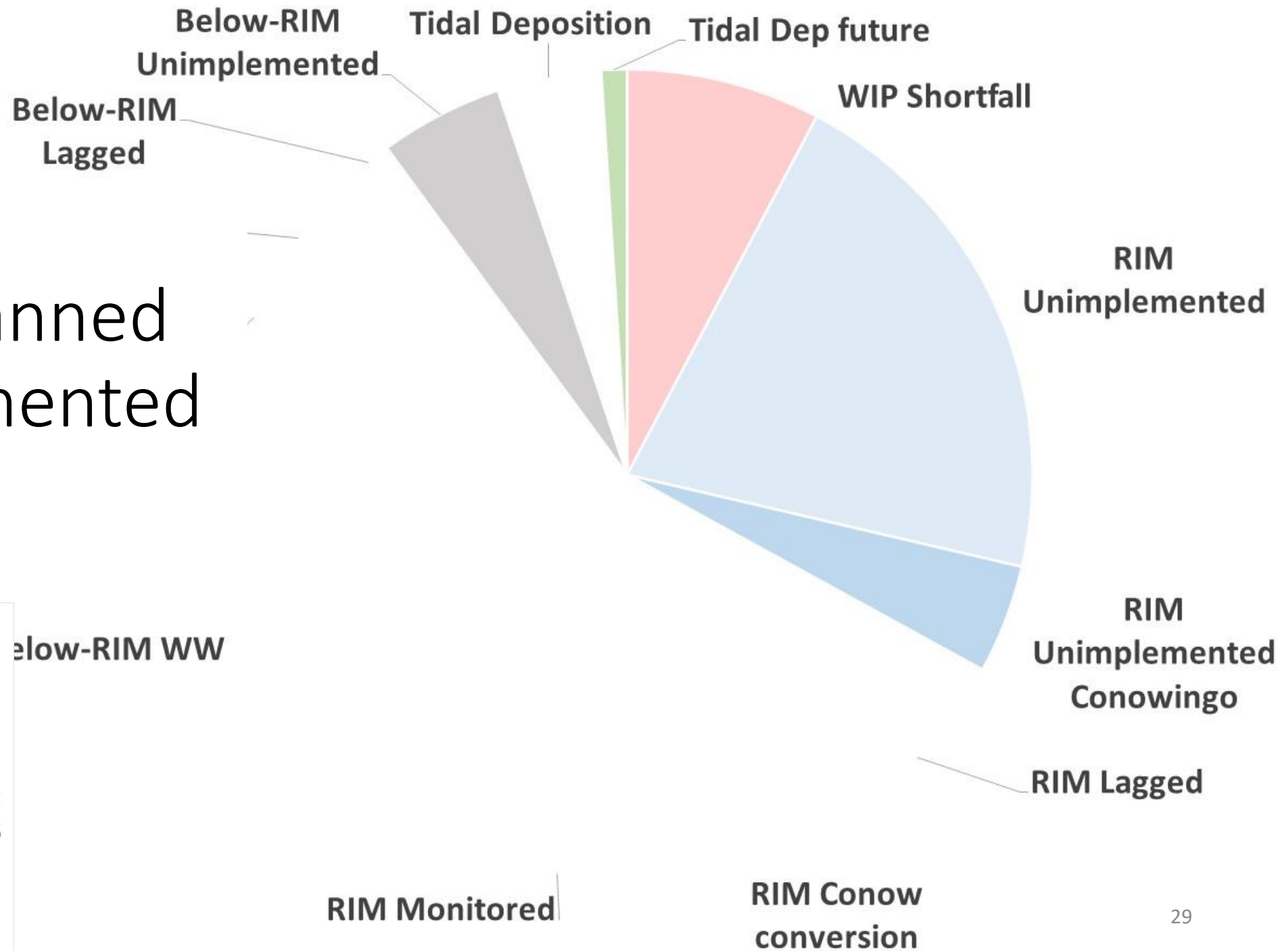
RIM Unimplemented

10% is lagged
WW not lagged

NPS Below RIM 16%

WW Below RIM 28%

RIM 56%

Below-RIM WW

RIM Unimplemented Conowingo

RIM Lagged

RIM Monitored

RIM Conow conversion

Proposed Public Indicator

Legend:
- Watershed reduction realized
- Implented but lagged
- Future implementation
- RIM expected but not monitored
- Unplanned

Partnership Product for Data Dashboard

Category	1995	2000	2005	2010	2015	2020
WIP Shortfall	0.9	3.8	6.6	9.4	10.2	11.1
RIM Unimplemented	68.3	53.6	45.4	31.1	28.0	32.1
RIM Unimplemented Conowingo	6.7	6.7	6.7	6.7	6.7	6.7
RIM Expected but not monitored	0.0	0.0	0.0	0.0	0.0	0.0
RIM Lagged	0.0	8.9	17.9	19.3	20.2	13.2
RIM Conowingo Conversion	0.0	4.0	8.3	11.8	11.8	11.4
RIM Monitored	0.0	1.9	-3.3	6.0	8.3	11.6
Below-RIM PS Implemented	0.0	11.2	17.6	20.6	30.0	38.8
Below-RIM PS Unimplemented	37.4	26.2	19.9	16.8	7.4	-1.4
Below-RIM Estimated	0.0	-1.8	-0.6	2.8	6.3	9.7
Below-RIM Lagged	0.0	1.9	5.1	5.1	4.2	2.8
Below-RIM Unimplemented	21.4	21.3	17.0	13.5	10.9	8.9
Tidal Deposition Reduction Realized	0.0	0.5	1.7	3.3	5.2	6.4
Tidal Deposition Reduction Unrealized	7.9	7.5	6.2	4.6	2.7	1.6

Phosphorus Reductions
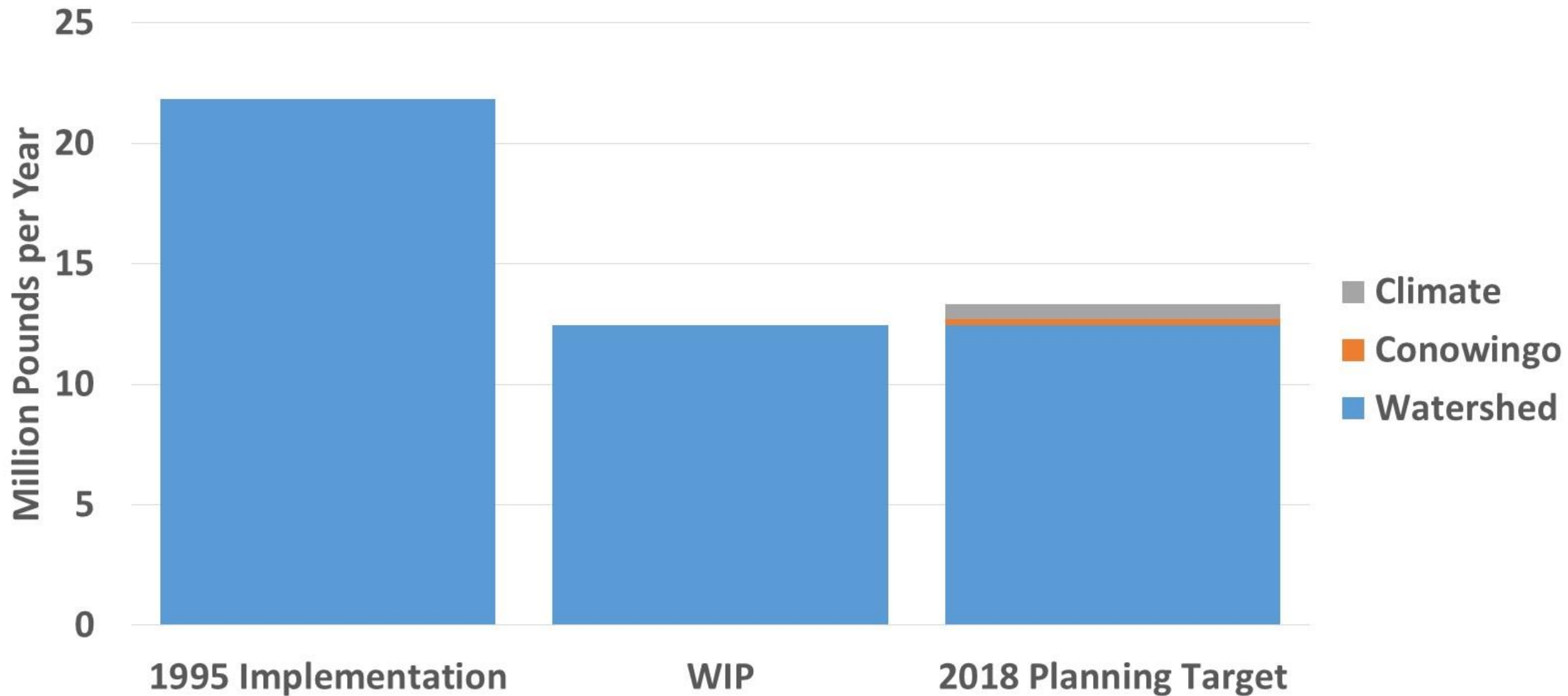
Phosphorus is mostly implemented, but monitoring results show increases
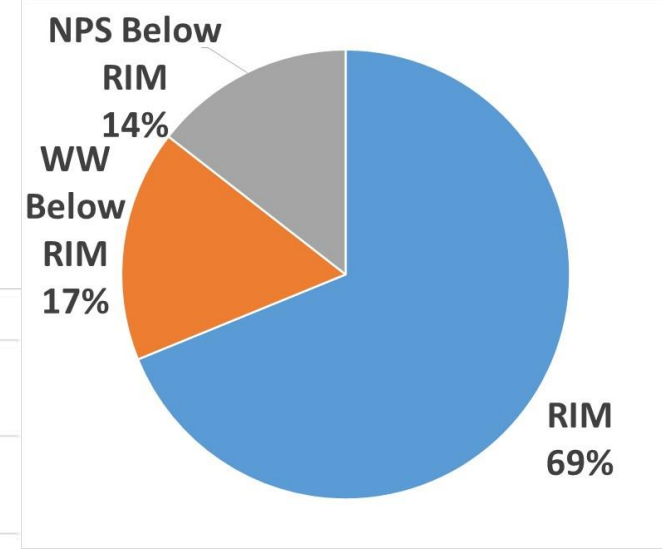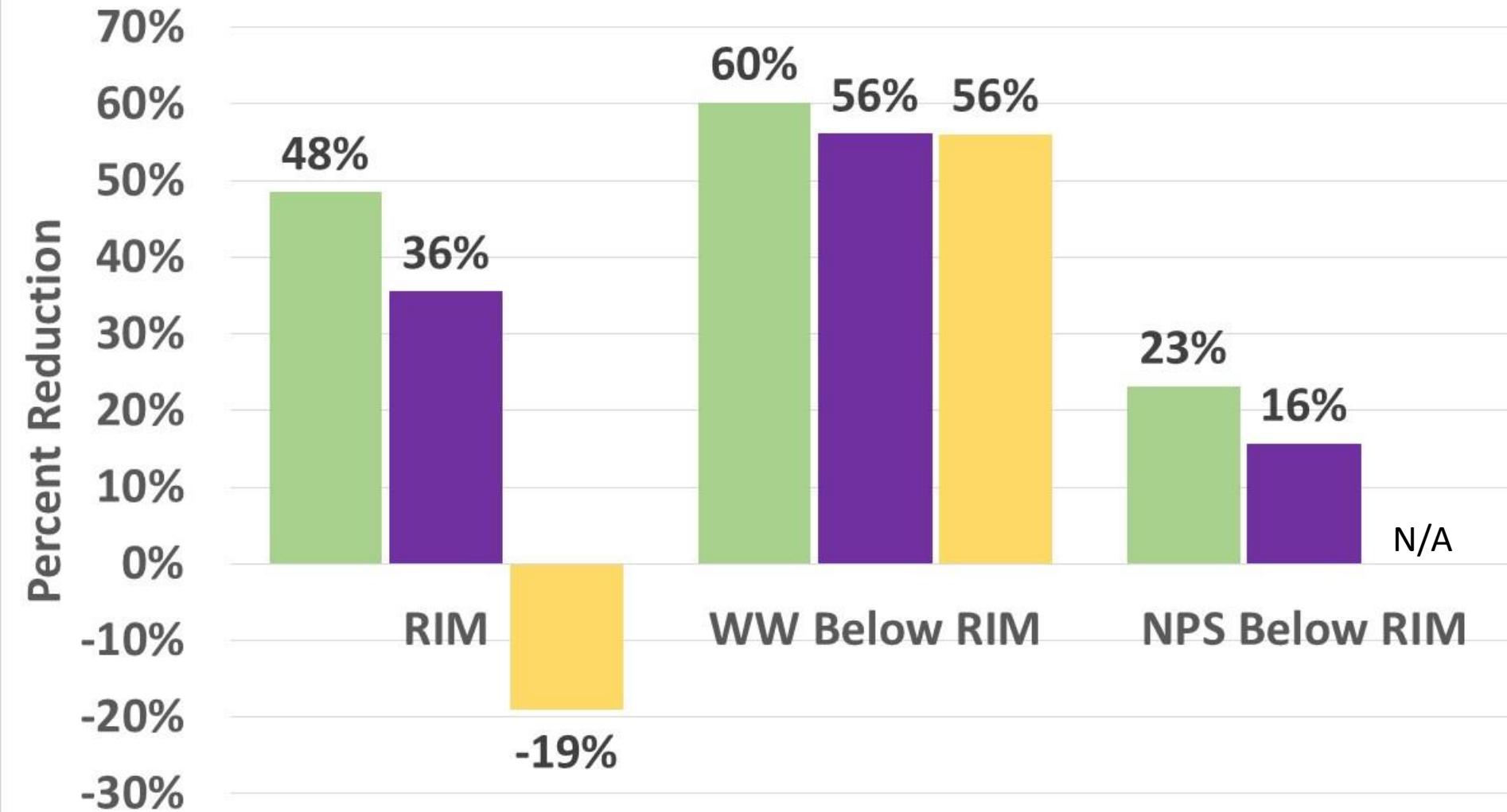
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Lags and Conowingo account for more than half of the difference

Pie chart:
- RIM 69%
- NPS Below RIM 14%
- WW Below RIM 17%

Bar chart:
- Percent reduction to WIP: 48%
- Expected percent reduction to 2020: 36%
- Expected reduction with lag effect: 19%
- Expected monitored reduction without infill: 0%
- Monitored percent reduction to 2020: -19%

No approved method of aggregating uncertainty across RIM stations
Initial estimate for monitored reduction by Zhang, Bertani, Shenk at +/- 20%

35

Lags and Conowingo account for major differences between Modeling and Monitoring

Pie chart:
- RIM 56%
- WW Below RIM 28%
- NPS Below RIM 16%

Bar chart:
- Percent reduction to WIP: 48%
- Expected percent reduction to 2020: 36%
- Expected reduction with lag effect: 19%
- Expected reduction with lag and Conowingo effects: 0%
- WQ Effect "Seen" by the Bay: 17% Conowingo, -19% Monitored

Proposed Public Indicator - Phosphorus
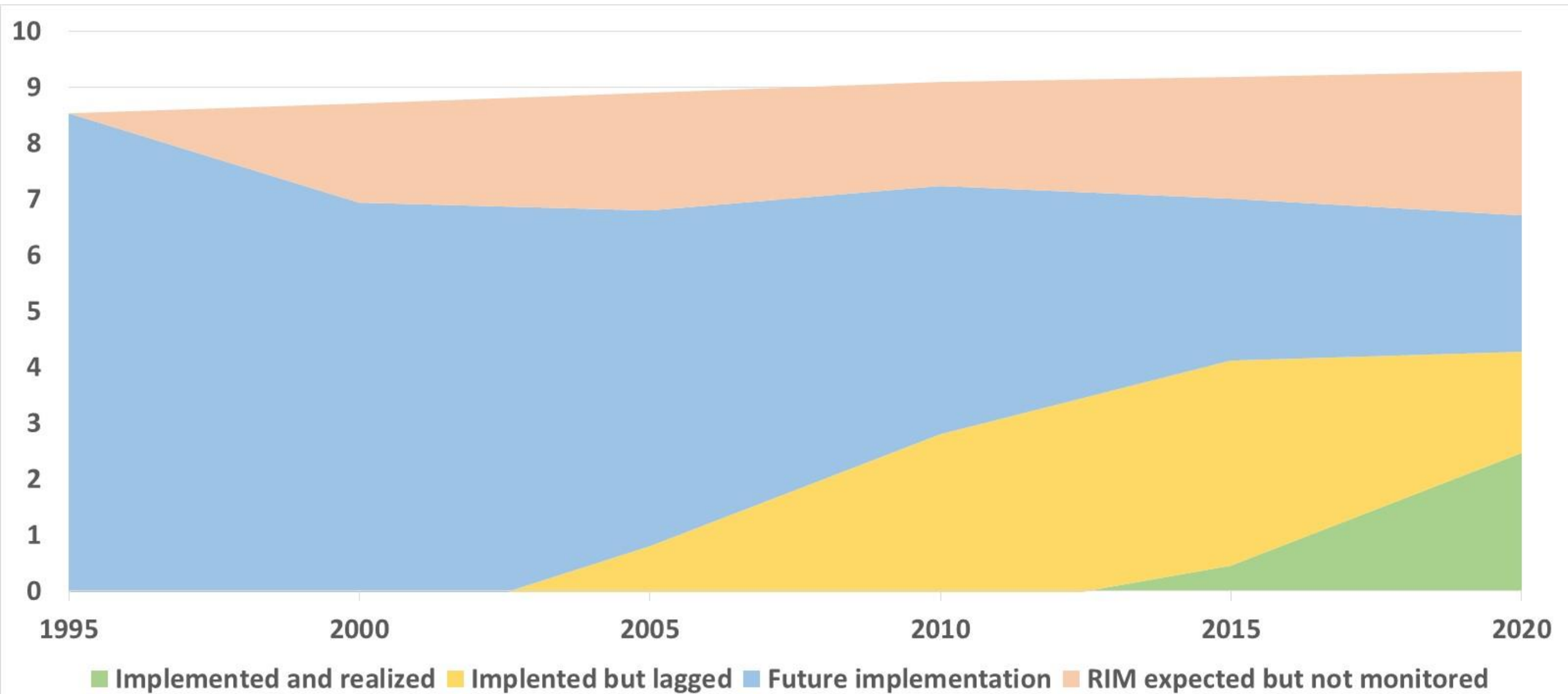
Legend: Implemented and realized | Implented but lagged | Future implementation | RIM expected but not monitored

Partnership Product for Data Dashboard

Category	1995	2000	2005	2010	2015	2020
WIP Shortfall	-0.87	-0.68	-0.50	-0.31	-0.21	-0.11
RIM Unimplemented	6.33	5.76	4.28	3.27	2.18	1.85
RIM Unimplemented Conowingo	0.14	0.14	0.14	0.14	0.14	0.14
RIM Expected but not monitored	0.00	1.77	2.10	1.86	2.18	2.58
RIM Lagged	0.00	1.00	2.26	3.17	3.45	2.15
RIM Conowingo Conversion	0.00	0.71	1.62	2.98	2.89	2.29
RIM Monitored	0.00	-2.93	-3.94	-4.94	-4.38	-2.54
Below-RIM PS Implemented	0.00	0.26	0.32	0.84	1.25	1.46
Below-RIM PS Unimplemented	1.57	1.30	1.25	0.73	0.32	0.11
Below-RIM Estimated	0.00	0.48	0.87	0.66	0.70	1.26
Below-RIM Lagged	0.00	-0.40	-0.33	0.10	0.21	-0.34
Below-RIM Unimplemented	1.36	1.28	0.82	0.60	0.46	0.44

Future Work

Any Station

X% probability that seeing expected reductions
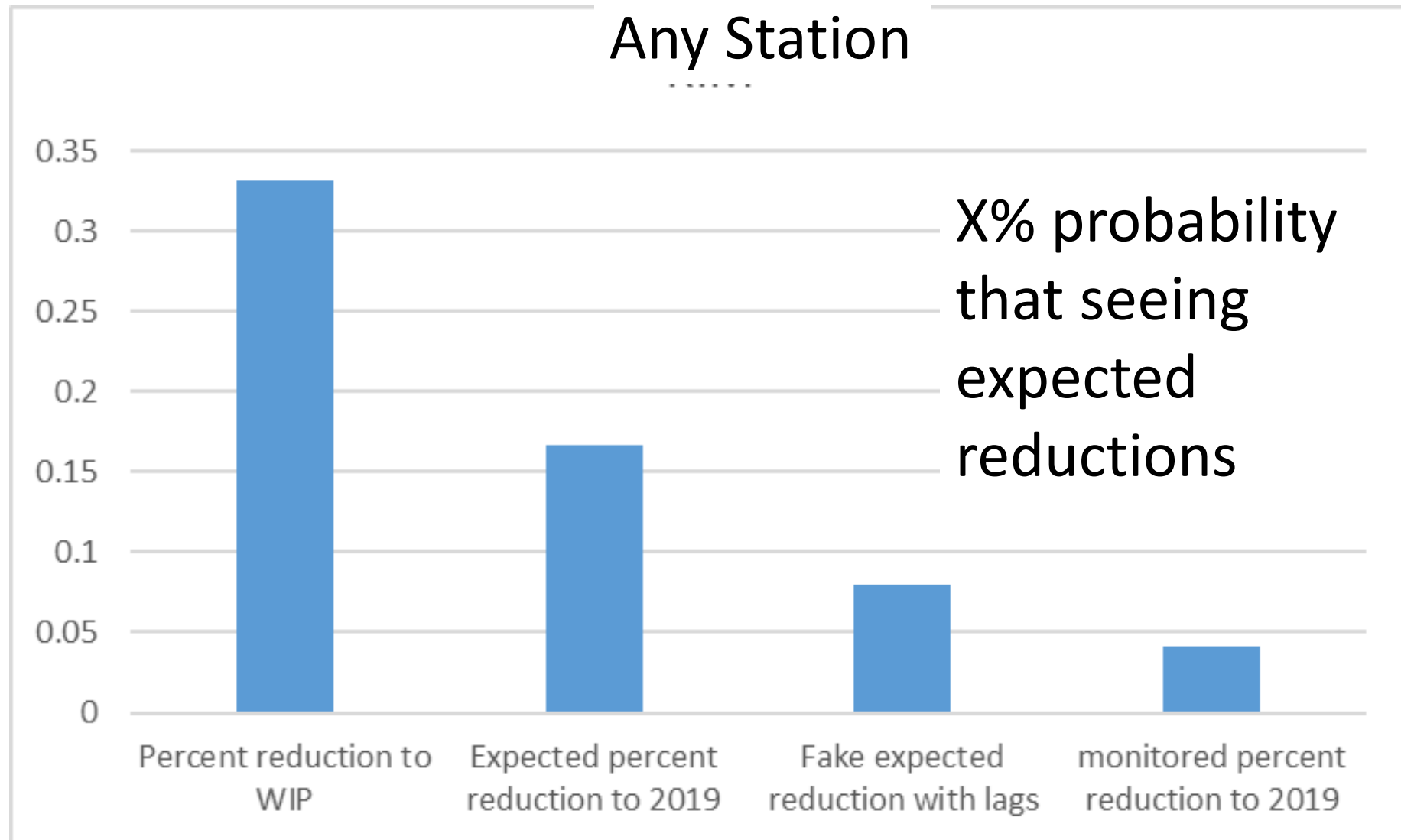
Future Work

- Add a wastewater category in the RIM loads
- Show Climate and Conowingo increase in reduction expected

Summary

- Indicator summarizes N and P progress toward the TMDL
  - Implemented and realized
  - Implemented but unrealized due to lag
  - Implemented but unrealized due to uncertainty
  - Not implemented
  - Unplanned
- More detailed products for Watershed Data Dashboard
  - Tables for RIM
  - Individual nontidal network Station analyses