Factoring in Climate Change into the Jurisdictions' Phase III WIPs

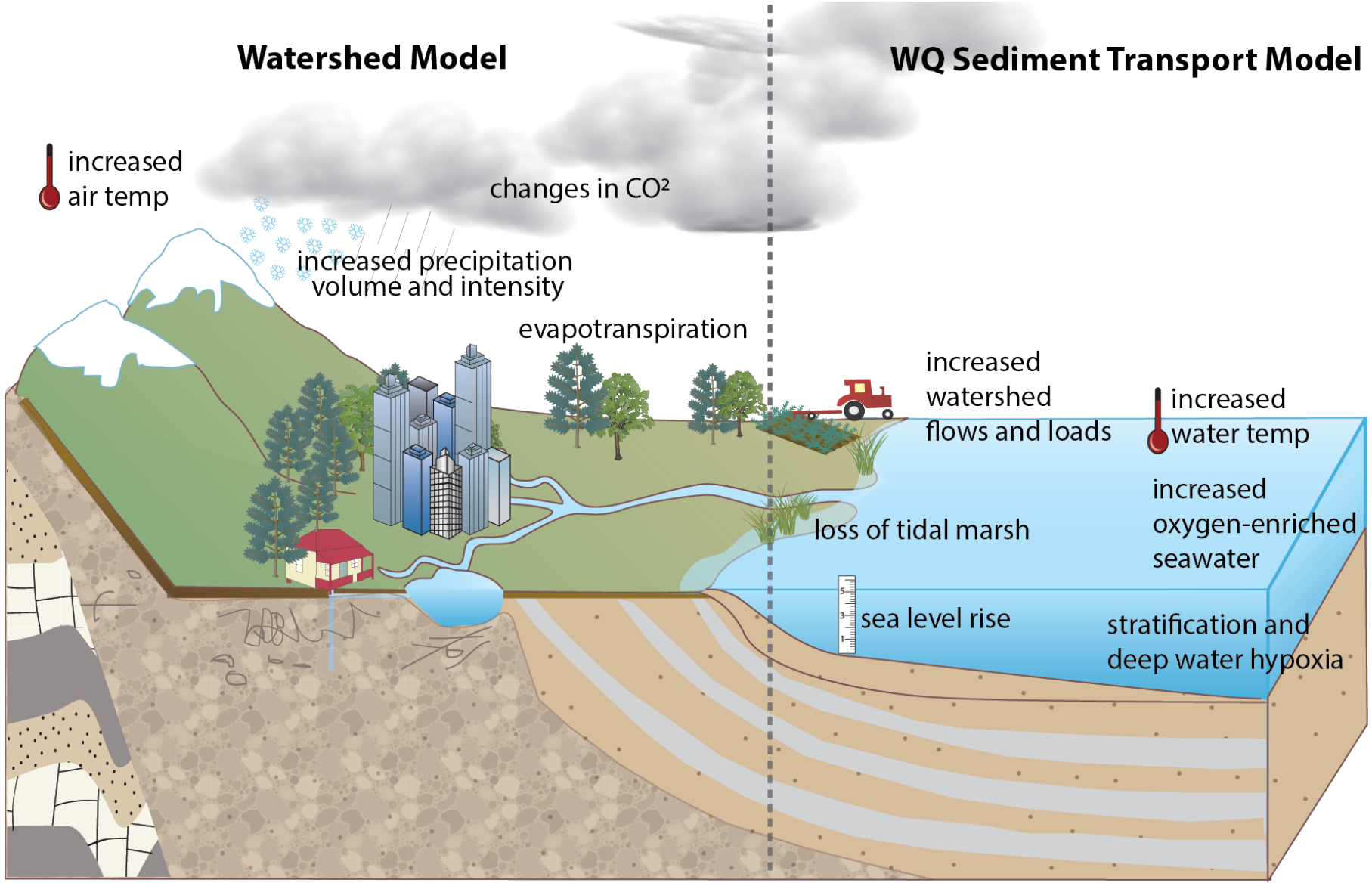
Mark Bennett, CBP Climate Resiliency Workgroup Co-Chair

Accounting for the Changing Conditions

- The Climate Resiliency Workgroup and the Modeling Workgroup have been working to account for changing conditions occurring in the watershed and the Bay's tidal waters in a scientifically defensible manner.

- The WQGIT has recommended that the Partnership take into account the cumulative responses of climate change (watershed and estuary) and not view impacts separately or in isolation.

Accounting for Changing Conditions



Impact of Changing Conditions on Bay and Watershed Increase Through Time

- Based on STAC Guidance (2016), we are using projections for 2025 that have a high level of confidence.
    - Selection of projections for sea level rise and precipitation change were based on past records of observed climatic and resultant river flow conditions.
    - There is less uncertainty in downscaled temperature projections for 2025.

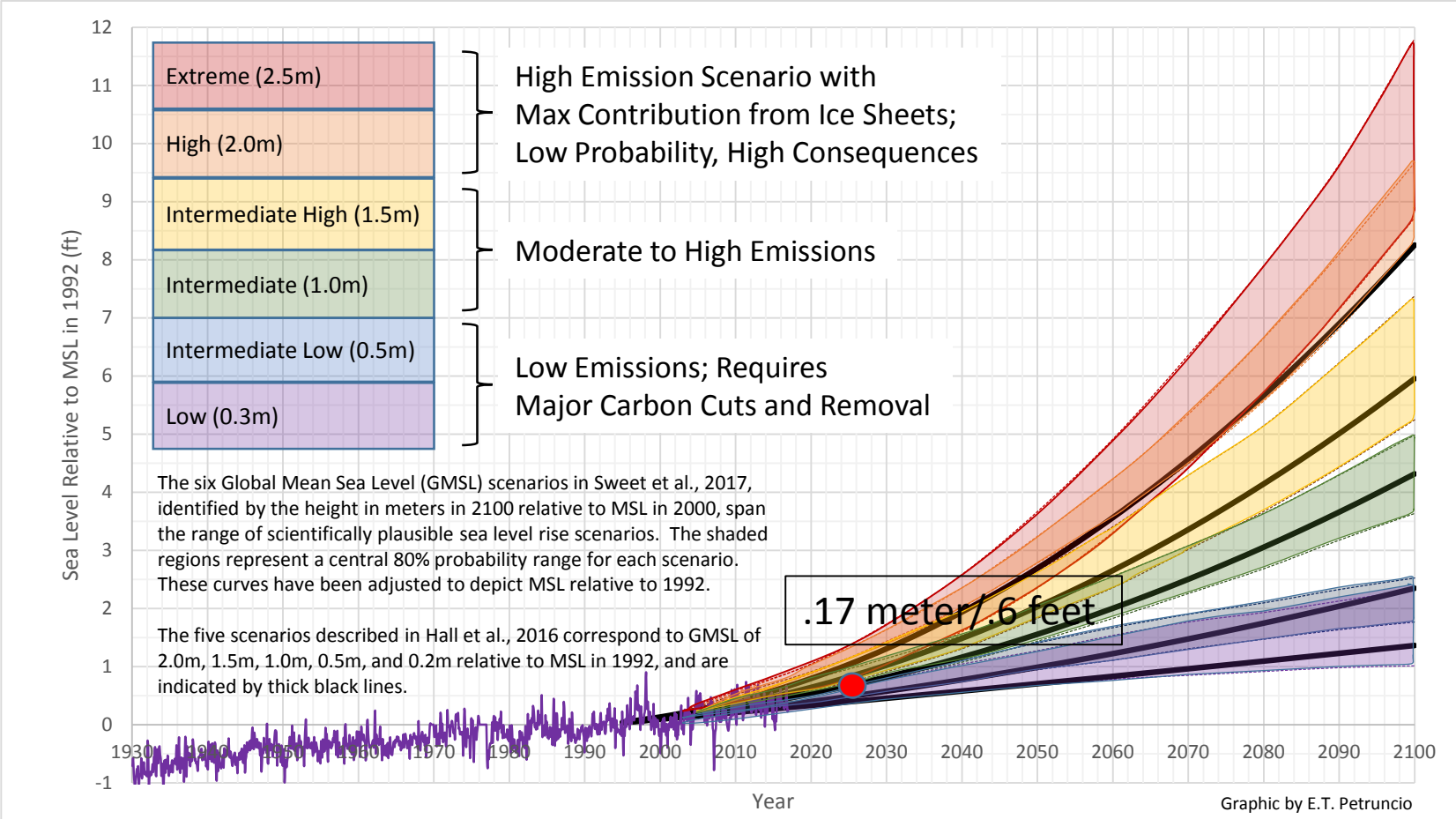
- According to the NCA (2017), impacts associated with precipitation, temperature and sea level are all expected to increase beyond 2025.

- The Chesapeake Bay Watershed is already experiencing impacts associated with sea level rise (e.g., coastal storm impacts and nuisance flooding) as well as heavy precipitation events (STAC, 2016).

- Recent findings of the 4th National Climate Assessment (November 2017), “Heavy precipitation events in most parts of the United States have increased in both intensity and frequency since 1901 (high confidence). There are important regional differences in trends, with the largest increases occurring in the northeastern United States (high confidence).

Relative Sea Level Rise

(2025 CRWG Recommended Projection: .17 meter/.6 feet)



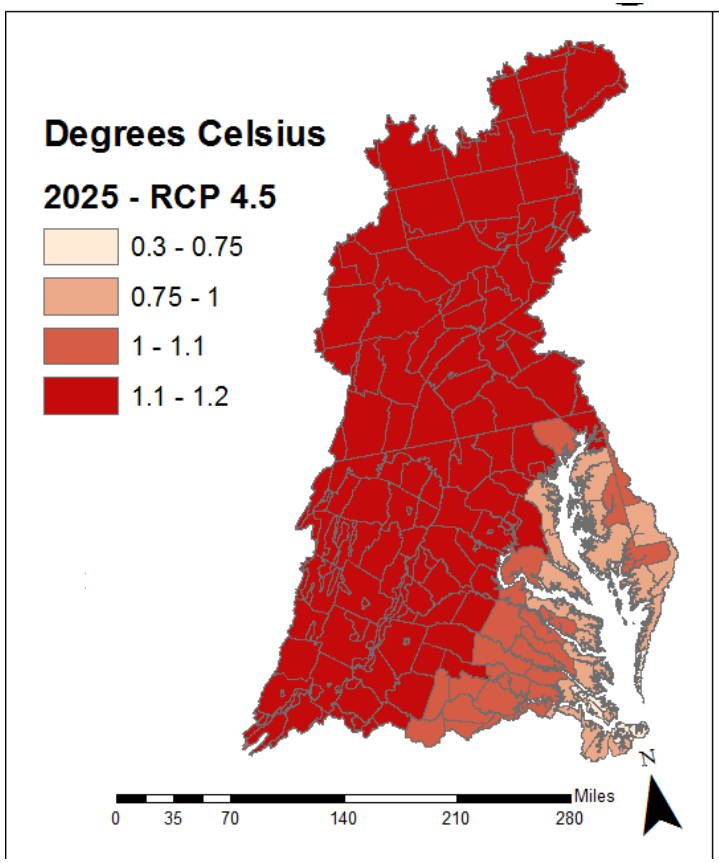
Relative Sea Level Rise Scenarios for Annapolis from Hall et al. (2016) and Sweet et al. (2017)

with Annapolis Monthly Mean Sea Level Data for 1930-2016

Temperature Change

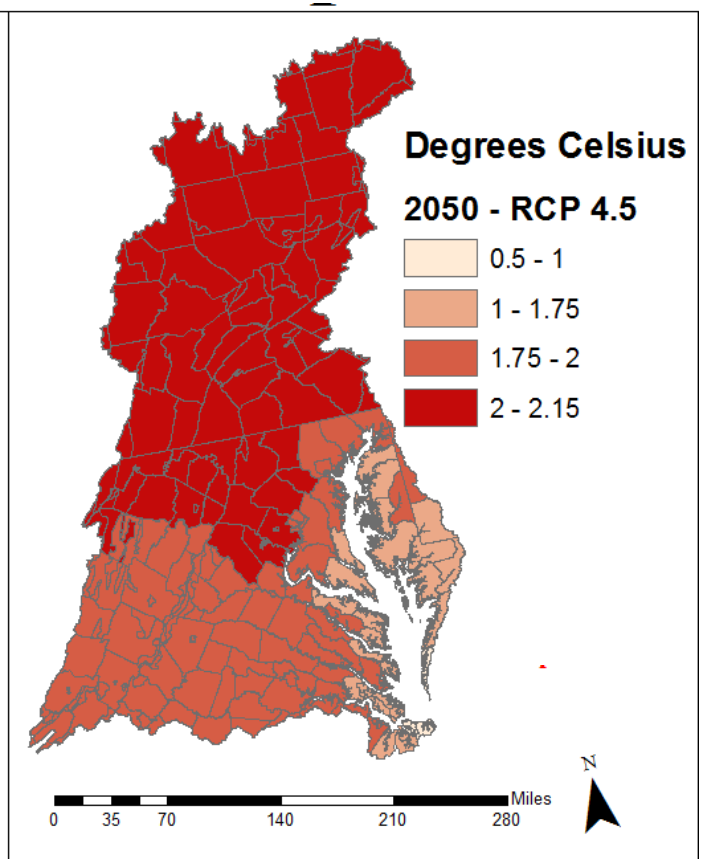
2025/2050 STAC Recommended Projections

1995-2025



1.98° F / 1.1° C Increase in Average Annual Temp

1995-2050

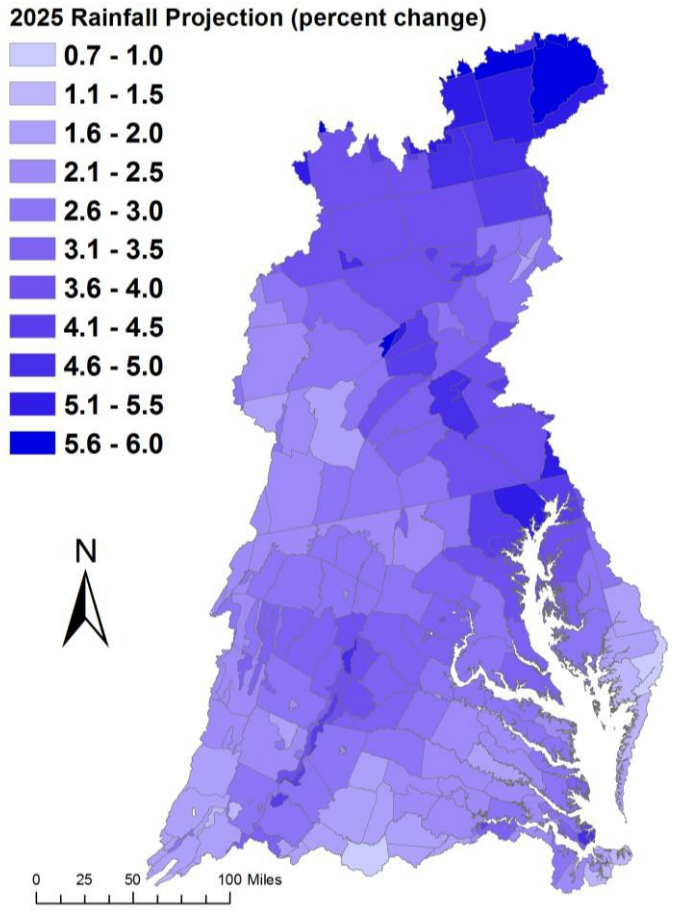


3.5° F / 1.94° C Increase in Average Annual Temp

Source: Kyle Hinson (CRC)

Precipitation Change

2025 STAC Recommended Projection: Trends in 88-years of annual PRISM[1] data



Change in Rainfall Volume
2021-2030 vs. 1991-2000

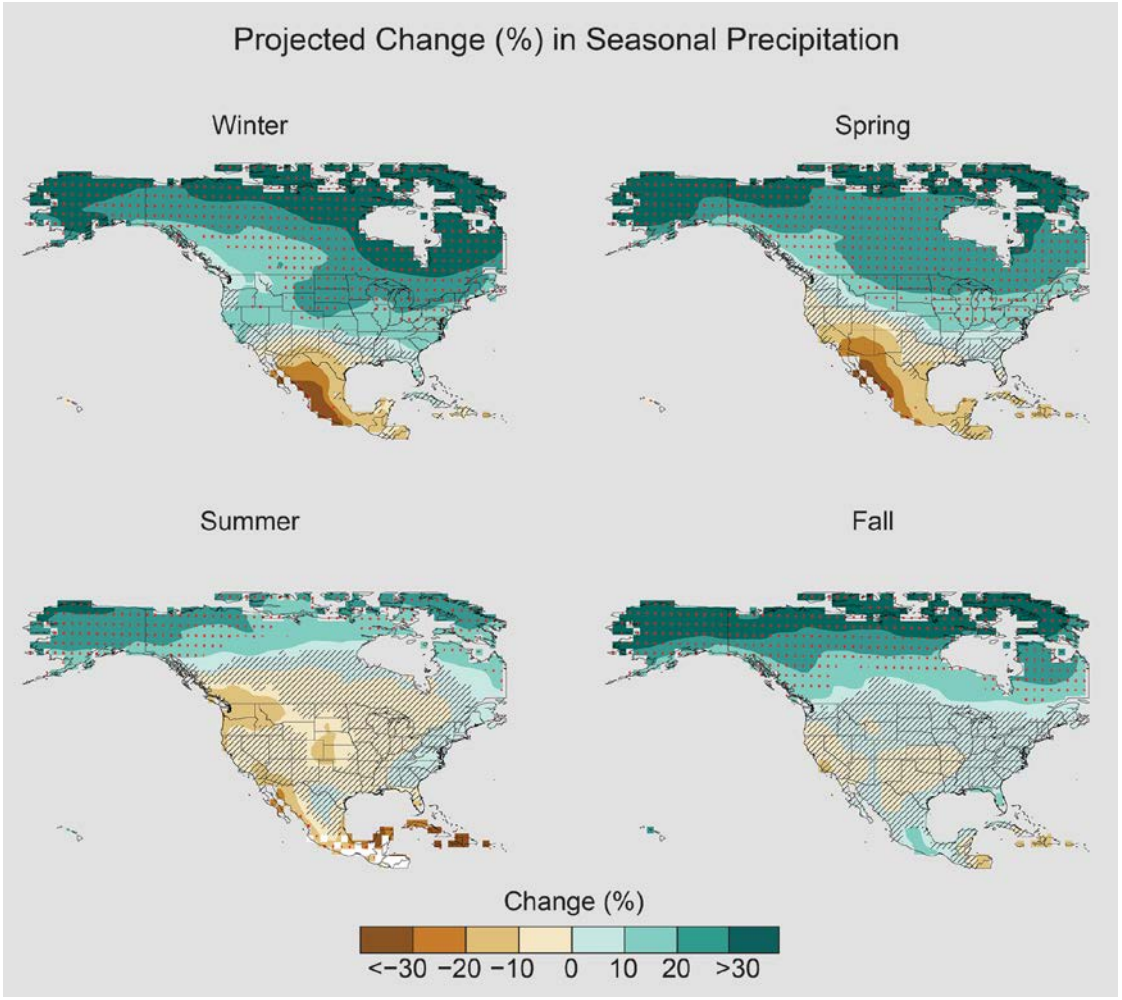
Major Basins	PRISM Trend
Youghiogheny River	2.1%
Patuxent River Basin	3.3%
Western Shore	4.1%
Rappahannock River Basin	3.2%
York River Basin	2.6%
Eastern Shore	2.5%
James River Basin	2.2%
Potomac River Basin	2.8%
Susquehanna River Basin	3.7%
Chesapeake Bay Watershed	**3.1%**

Source: Kyle Hinson (CRC)

[1] Parameter-elevation Relationships on Independent Slopes Model

Precipitation Change

4th NCA Future Seasonal Patterns (2070 – 2099)



Projected change (%) in total seasonal precipitation from CMIP5 simulations for 2070–2099. The values are weighted multimodel means and expressed as the percent change relative to the 1976–2005 average. These are results for the higher scenario (RCP8.5). Source: NOAA NCEI (NCA 2017)

Accounting for Changing Conditions

Cumulative Assessment of Hypoxic Impact

Watershed Model

increased precipitation volume =

increased precipitation intensity =

increase in temp and evapotranspiration =

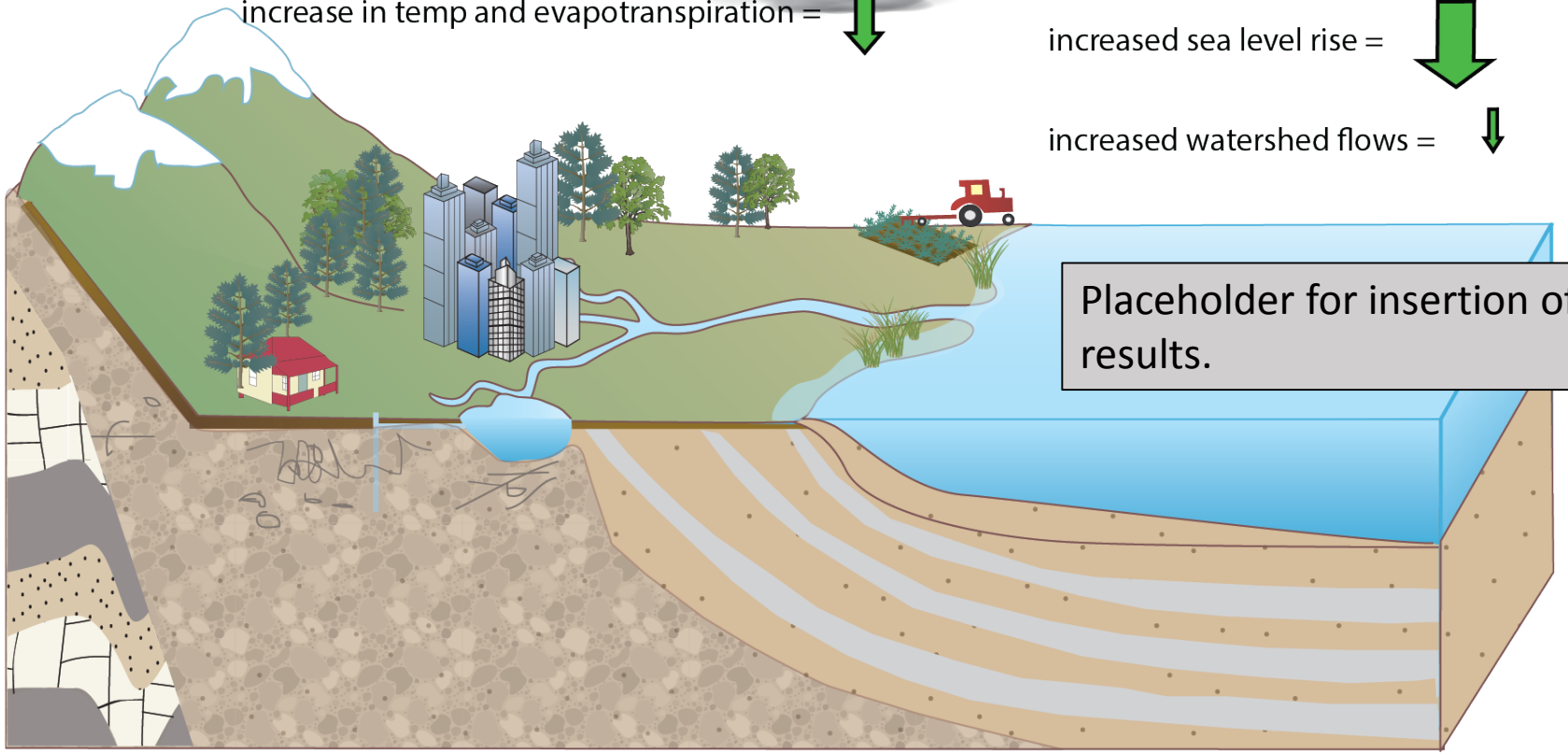
WQ Sediment Transport Model

increased watershed loads =

increased temperature =

increased sea level rise =

increased watershed flows =



Placeholder for insertion of final summary results.

Estimated Changes in Watershed Loads by 2025 Due to Climate Change

Pollutant of Concern	Change in Delivery to Rivers	Change in Delivery to Bay
Nitrogen	+1.72%	+.34%
Phosphorus	+1.08%	+.04%
Sediment	+9.07%	+4%

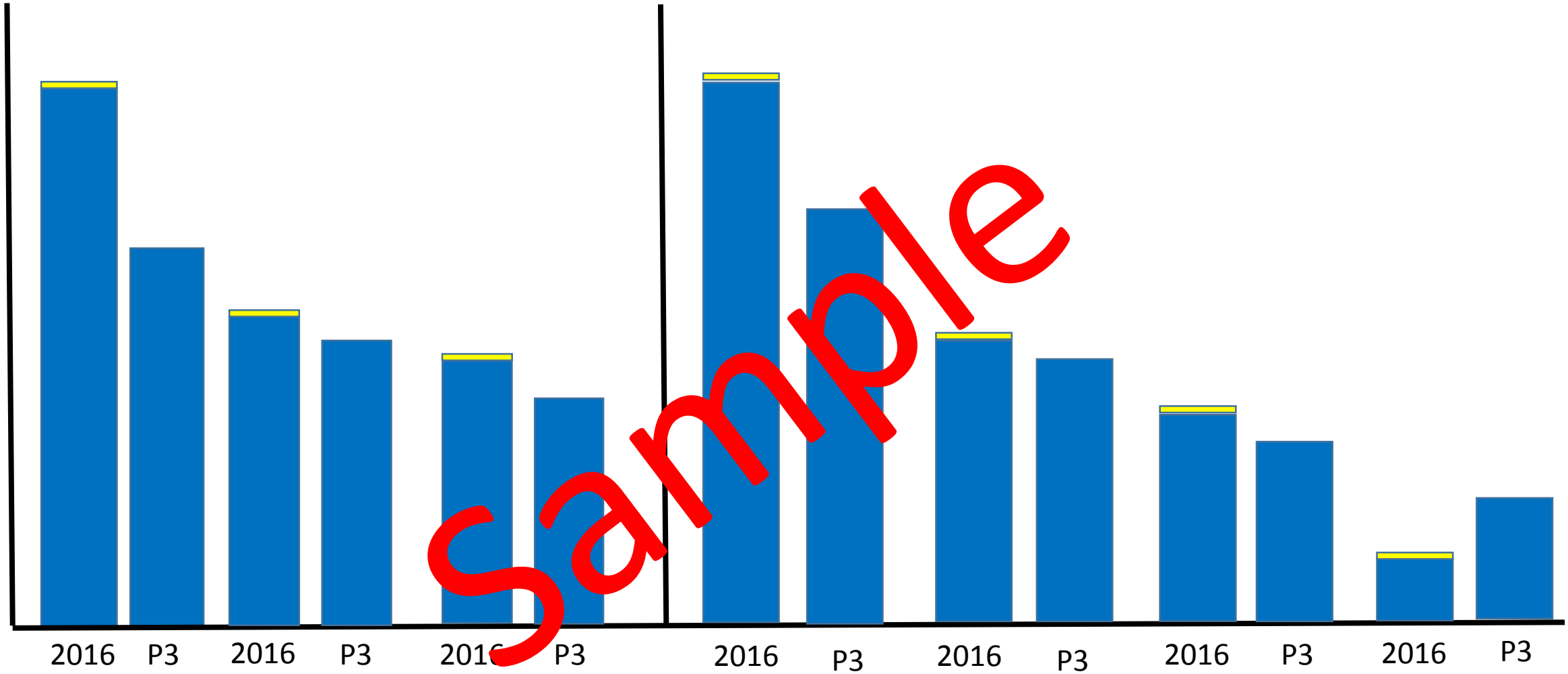
Estimated Bay Water Quality Responses by 2025 Due to Climate Change

Placeholder for summary of the changes in dissolved oxygen criteria attainment for open-water, deep-water and deep-channel due to the accounting of climate-based changed conditions.

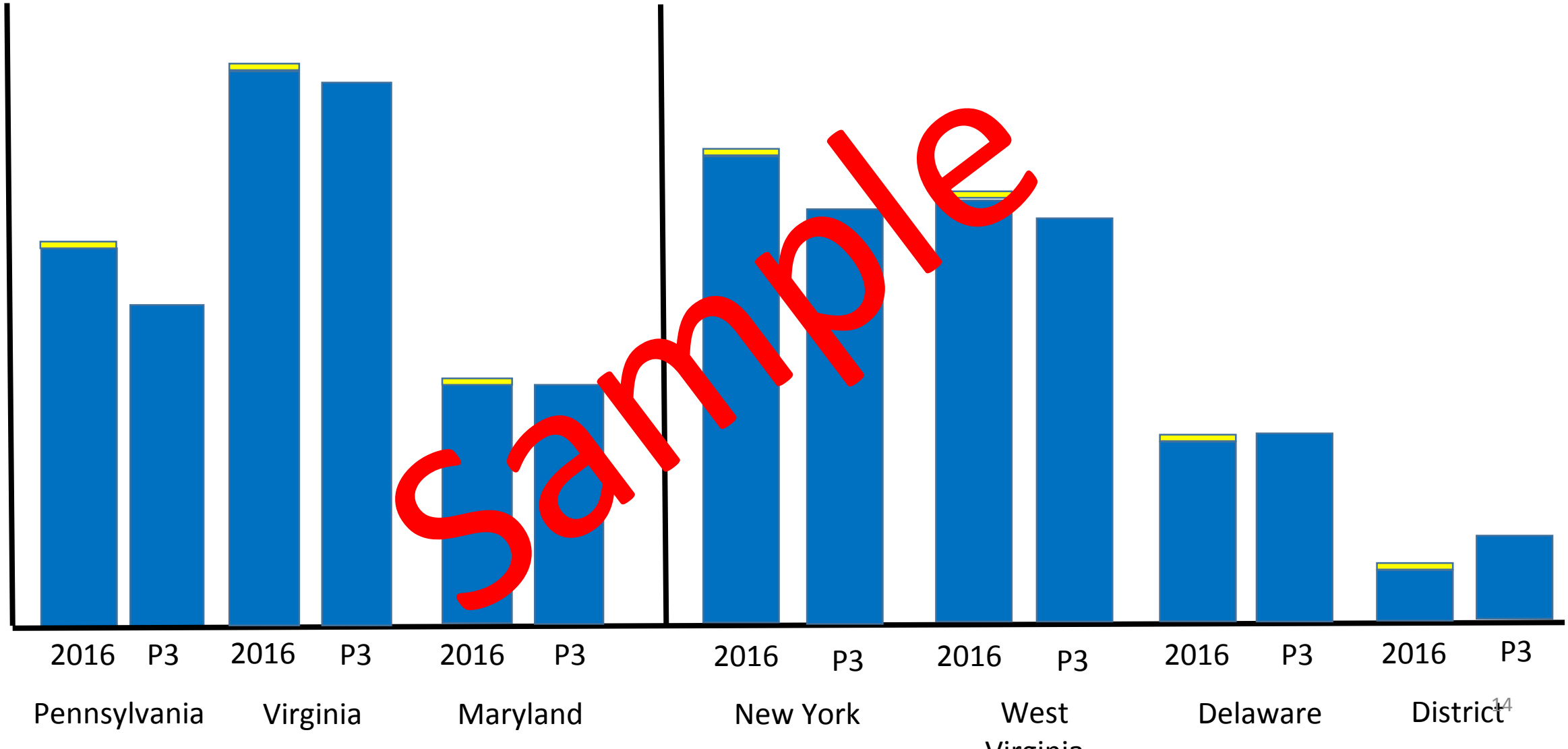
Estimated Changes in Watershed Loads by 2025 by Jurisdiction Due to Climate Change

Jurisdiction	Nitrogen Load	Nitrogen as Percent of Phase III WIP Planning Target/Remaining Loads to be Reduced	Phosphorus Load	Phosphorus as Percent of Phase III WIP Planning Target/Remaining Loads to be Reduced	Sediment Load	Sediment as Percent of Phase III WIP Planning Target/Remaining Load to be Reduced
New York	X	A%/B%	Y	C%/D%	Z	E%/F%
Pennsylvania	X	A%/B%	Y	C%/D%	Z	E%/F%
Maryland	X	A%/B%	Y	C%/D%	Z	E%/F%
West Virginia	X	A%/B%	Y	C%/D%	Z	E%/F%
District of Columbia	X	A%/B%	Y	C%/D%	Z	E%/F%
Delaware	X	A%/B%	Y	C%/D%	Z	E%/F%
Virginia	X	A%/B%	Y	C%/D%	Z	E%/F%
Watershed	X	A%/B%	Y	C%/D%	Z	E%/F%

Estimated Changes in Watershed Loads by 2025 by Jurisdiction Due to Climate Change: Nitrogen

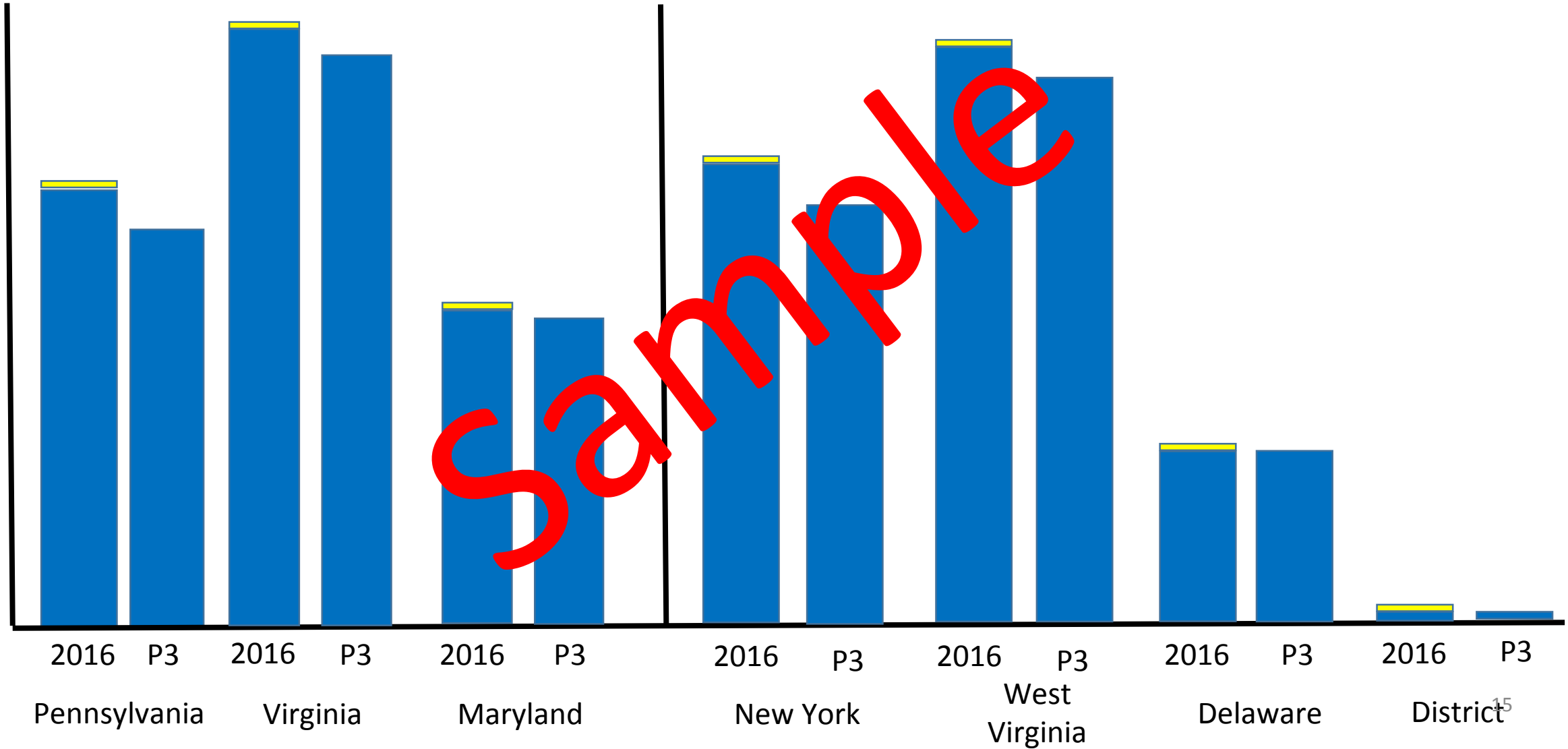


Estimated Changes in Watershed Loads by 2025 by Jurisdiction Due to Climate Change: Phosphorus



WQGIT and Modeling Workgroup's Recommendations

Proposed Draft Phase III WIP Sediment Planning Targets by Jurisdiction



Policy Approaches for Accounting for Climate Change in the Jurisdictions' Phase III WIPs

Two Policy Approaches

Numeric

And/Or

Programmatic

Numerical Approach

- A quantitative, numerical approach that could (depending on final model outputs) result in a changed level of effort necessary to meet water quality standards.

- Implementation of the approach would be informed by final Watershed and Water Quality Sediment Transport Model results.
  - The WQGIT recommended that the assessment of climate change on assimilative capacity (WQSTM modeling results) be a factor in establishing changes in loads.

- This approach would treat the estimated cumulative effect of changed conditions due to climate change similarly to the approach being taken to account for growth: building the findings into the calculation of the Bay's assimilative capacity.

Numerical Approach: Pros & Cons

Pros	Cons
• Comprehensive, straight-forward approach • Demonstrates Partnership's commitment 2014 Chesapeake Bay Agreement) Climate Resiliency Goal • Potentially small level of increased effort necessary • Near-term response • Implemented in sequence with development of the Phase III WIPs	• Potential change in the level of effort required to meet water quality standards • If implemented in isolation, would not address the anticipated impacts of climate change on BMPs.

Programmatic Approach

- An “adaptive management approach” that would be implemented through the two-year milestone process.
- If implemented alone, would not change a jurisdictions' planning targets.
- Directs the Partnership to collect and consider new information on the performance of BMPs, including the contribution of seasonal, inter-annual climate variability, and weather extremes.
- Jurisdictions would assess this information and adjust plans, over-time, to better mitigate anticipated changes in loads and impacts on the performance of BMPs.
- Would require the inclusion of a narrative strategy in Phase III WIPs, describing a jurisdictions’ programmatic commitments to address climate change.
- The Partnership has approved “*Guiding Principles*” for incorporating climate considerations in both Phase III WIP development and implementation. A sample “*narrative strategy*” would be provided to jurisdictions to guide implementation.

Programmatic Approach: Pros & Cons

Pros	Cons
• Adaptively managing for long-term change • Allows for use of local expertise and knowledge • Provides for learning across jurisdictions about methods and results • Allows for flexibility in jurisdictions' approaches to addressing climate change • Provides standard elements to be addressed	• If implemented in isolation, delays substantive action to address climate change in the near-term • Lack of specific technical understanding to guide implementation • Requires additional monitoring and assessment efforts • Inconsistency in implementation across jurisdictions

Two Policy Approaches

Numeric

And/Or

Programmatic

WQGIT Recommendation
Dec. 4-5, 2017

- Decision Point #1: Recommend policy approach to guide Jurisdictions' development and implementation of Phase III Watershed Implementation Plans.

- Decision Point #2: Recommend the level of flexibility among jurisdictions, as well as commitments for CBP programmatic support (e.g., guidance, data, funding, etc.), for implementation of climate change policies that exceed the Partnership approved policy.