What wastewater improvements will achieve the best dissolved oxygen outcome in the Delaware Estuary?

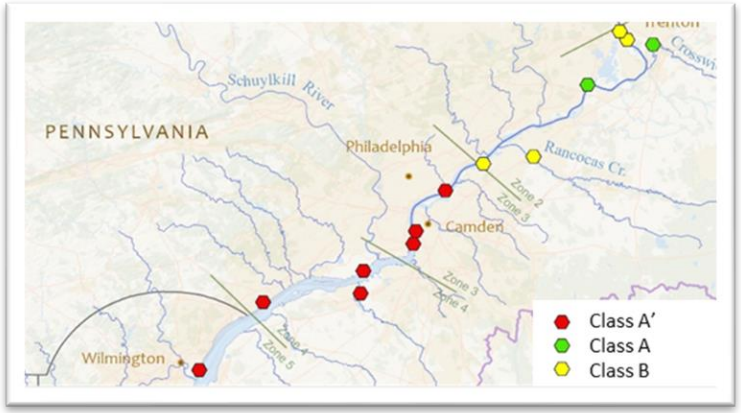
Sarah Beganskas, PhD

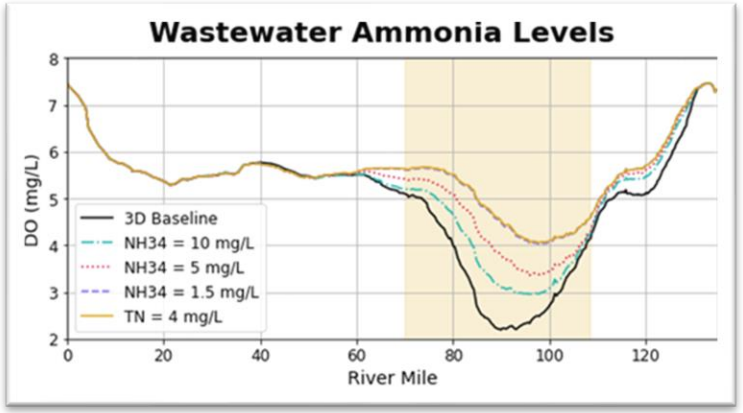
Water Resource Scientist

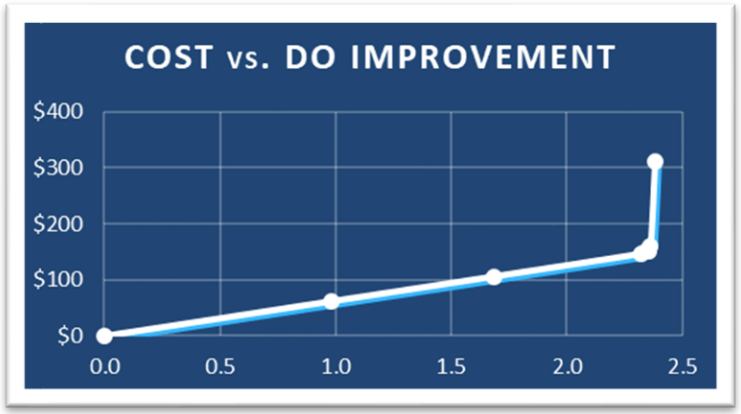
Delaware River Basin Commission

Partnership for the Delaware Estuary Science and Environmental Summit

January 30, 2023







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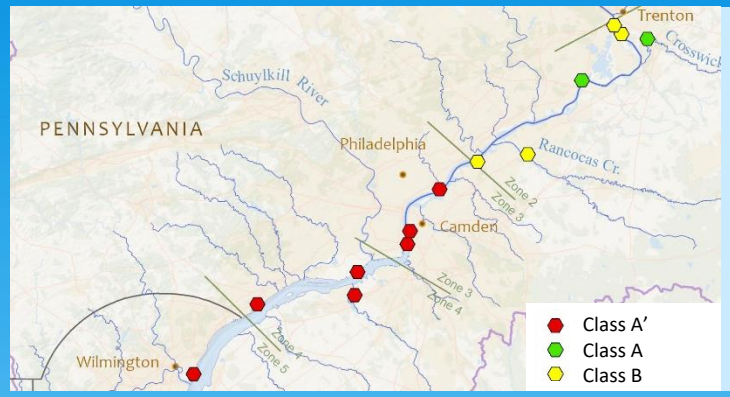
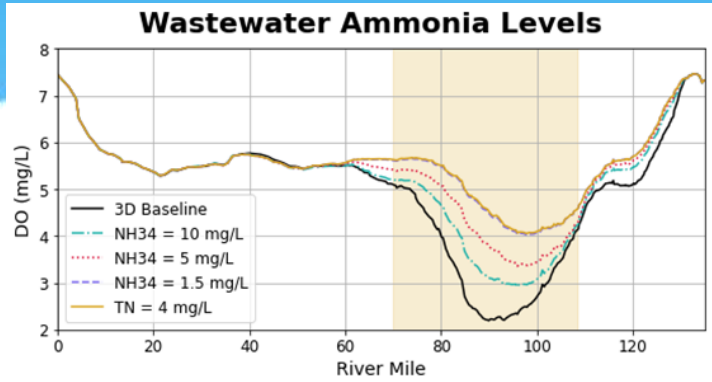


Which wastewater discharges are most important for DO?



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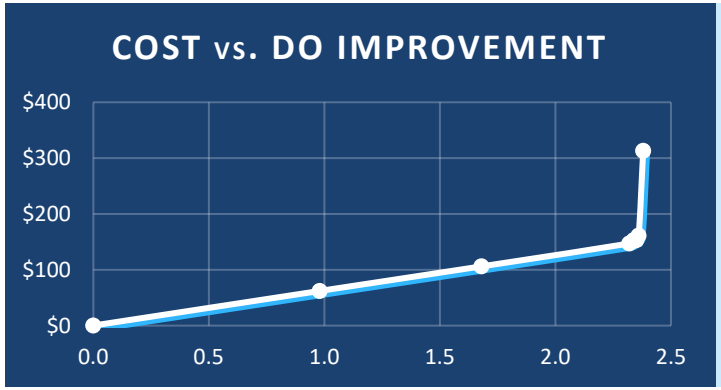

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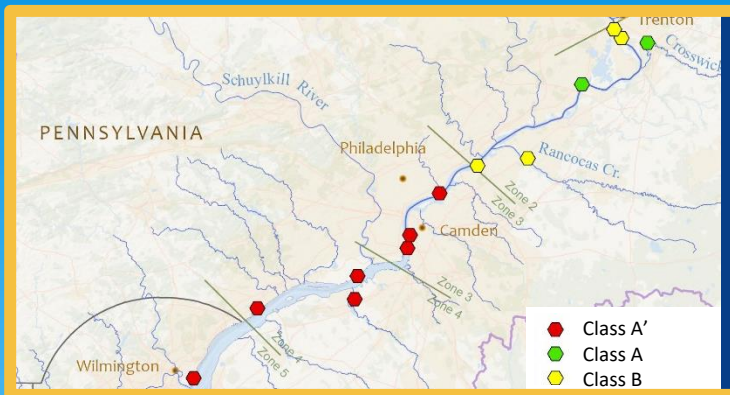

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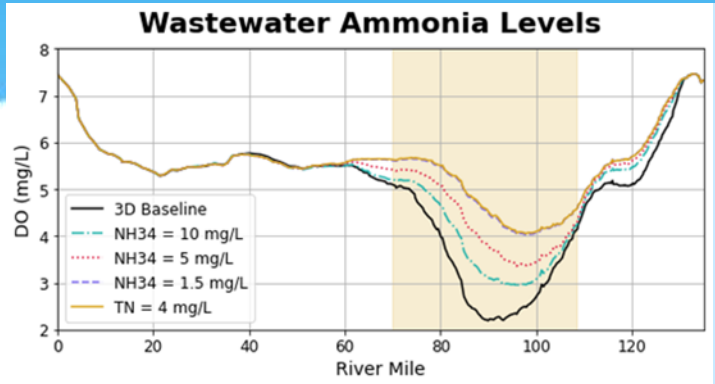

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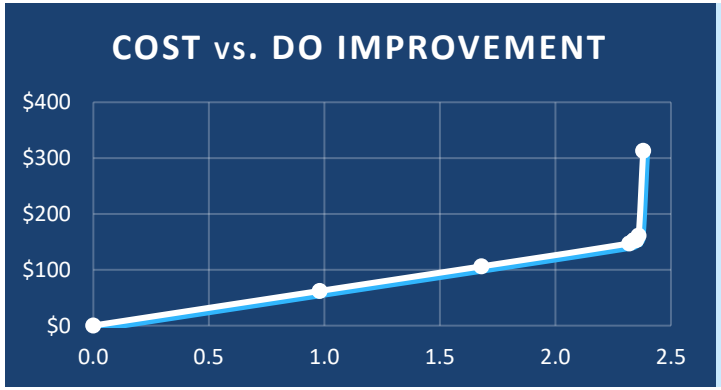
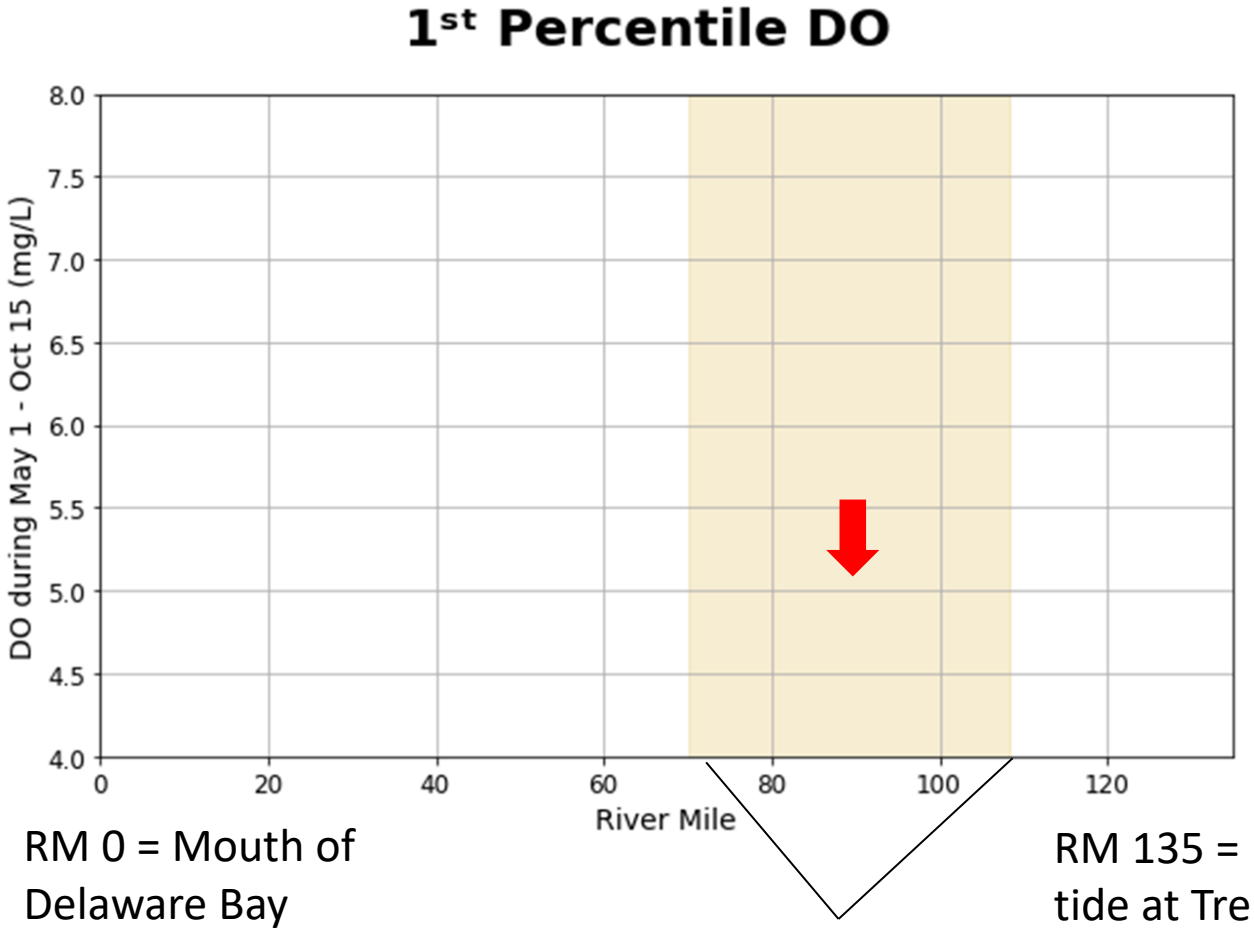
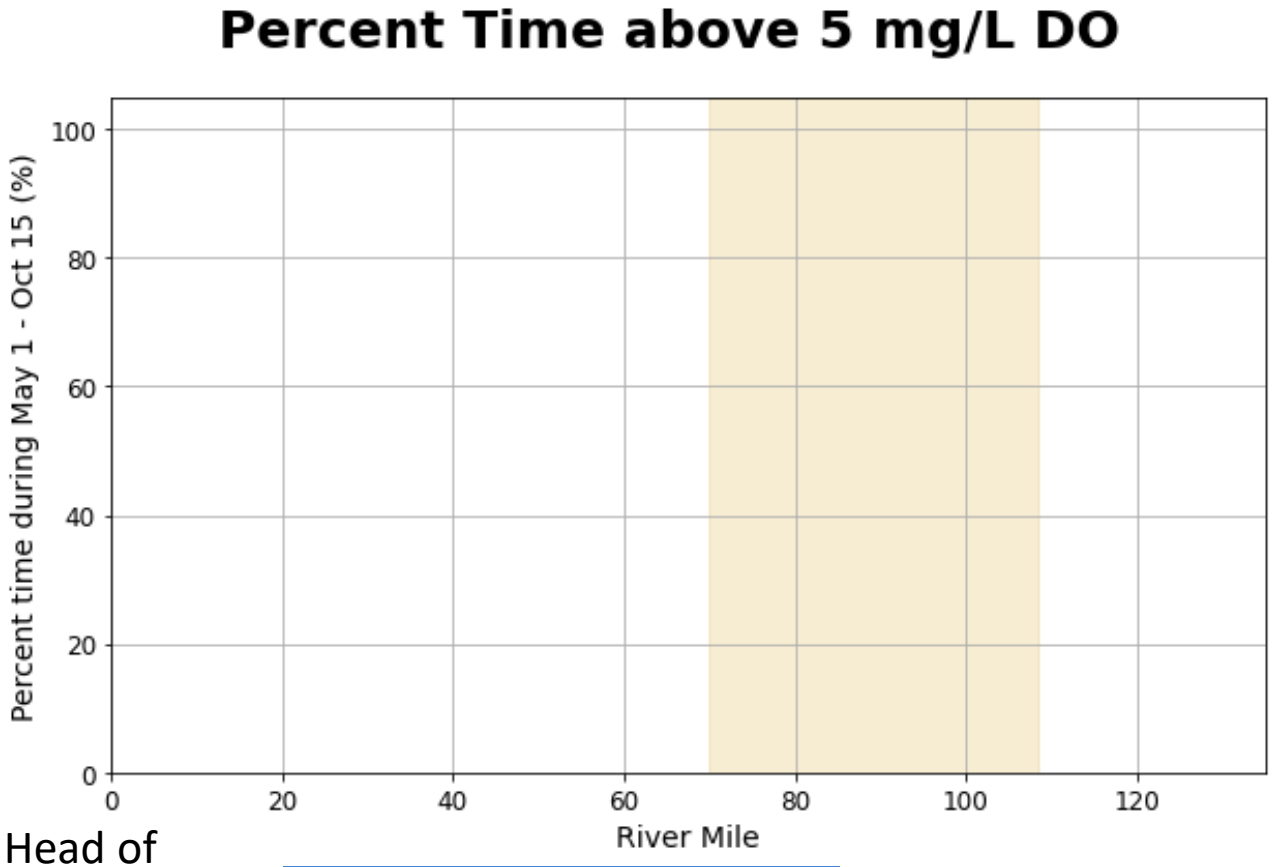


What are the associated costs?

How does **ammonia reduction from an individual discharge** impact low DO in the FMA?





RM 0 = Mouth of Delaware Bay

RM 135 = Head of tide at Trenton, NJ

Fish Maintenance Area: RM 70–108.4

For both metrics: Higher is better!

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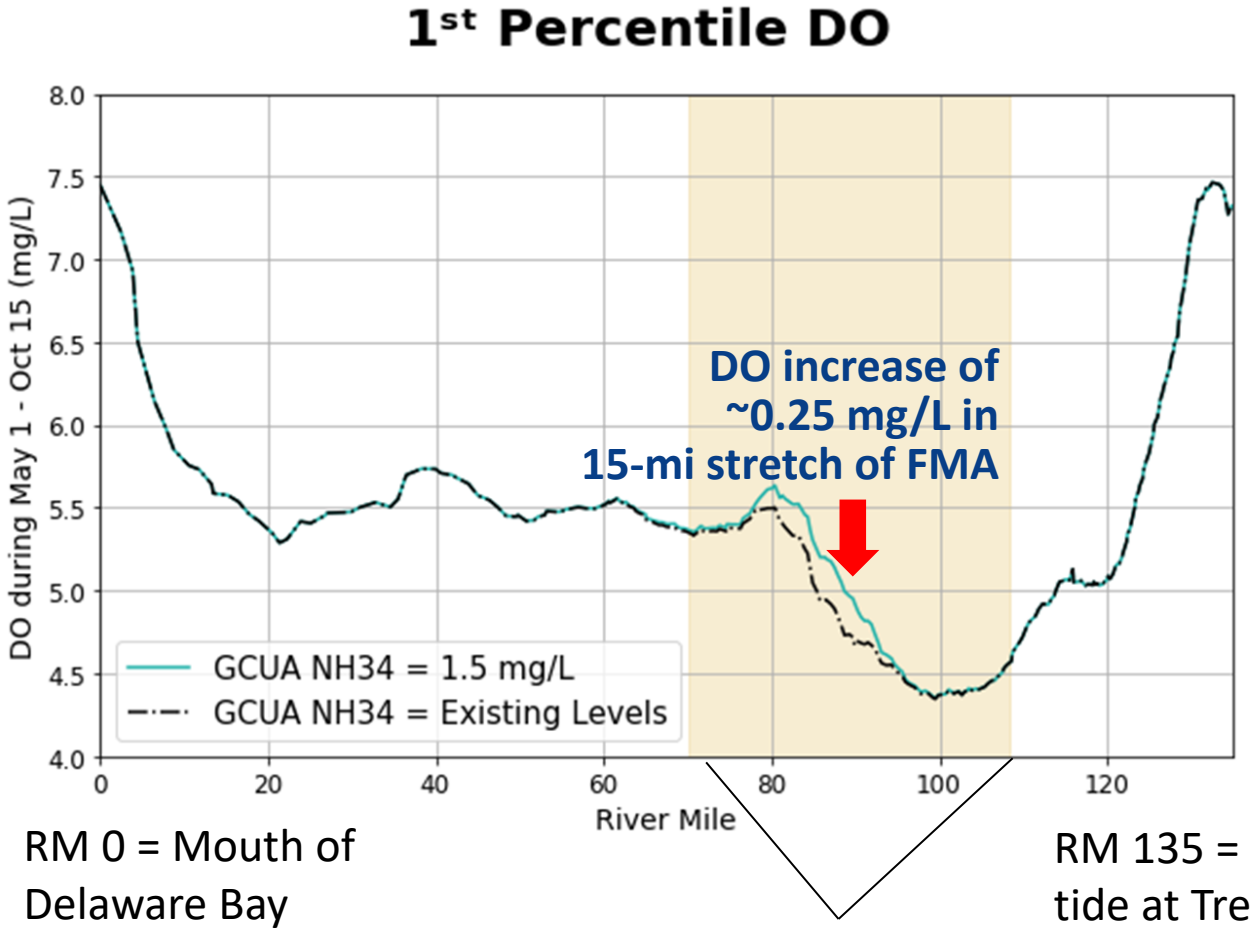
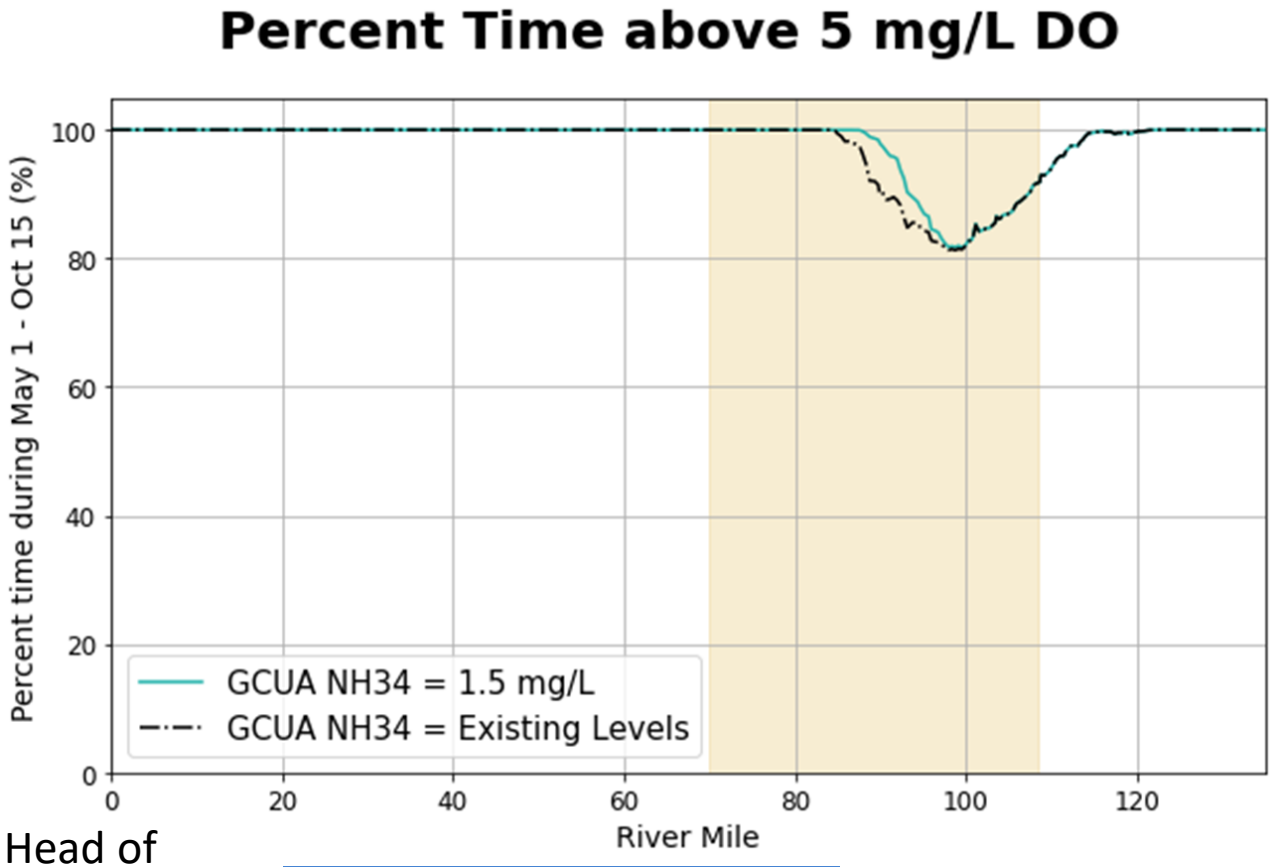
Class A' discharges have a **major impact** on low DO in the FMA





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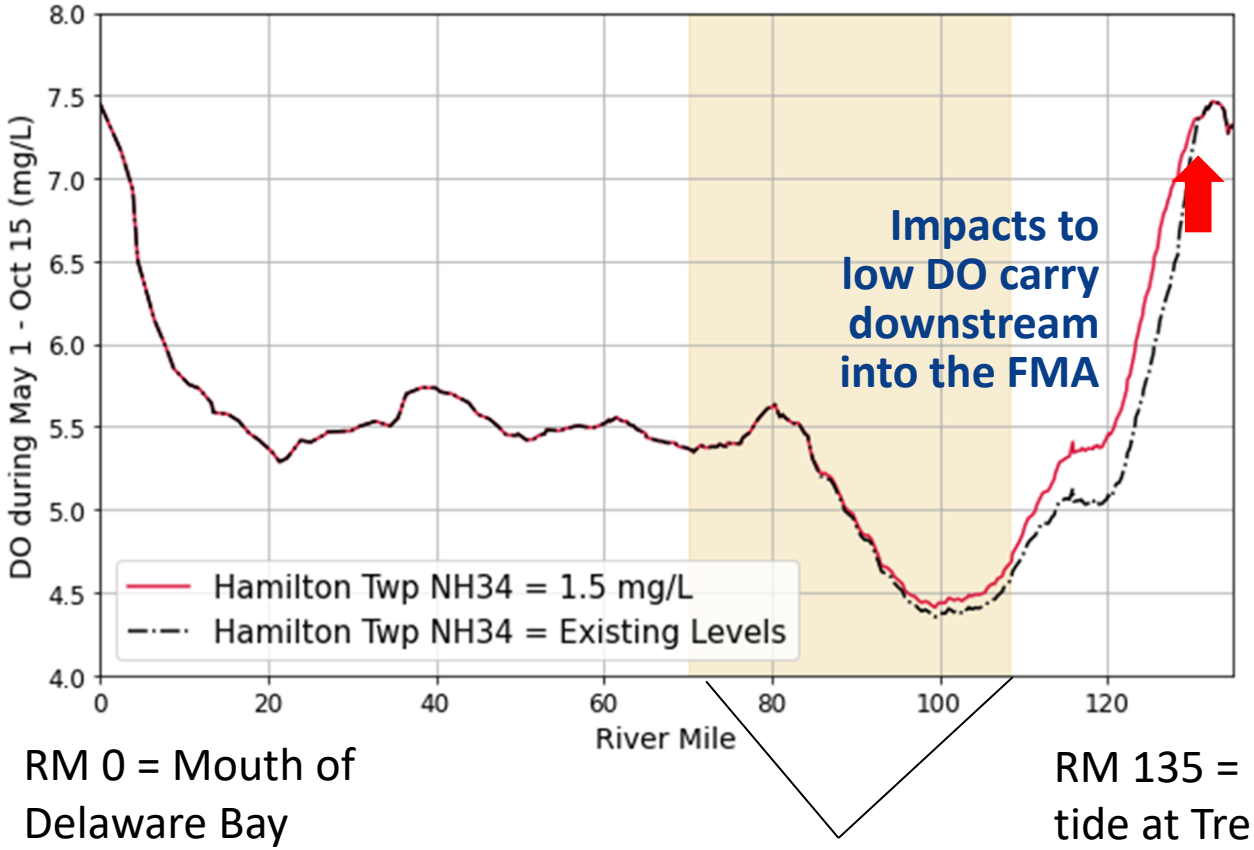
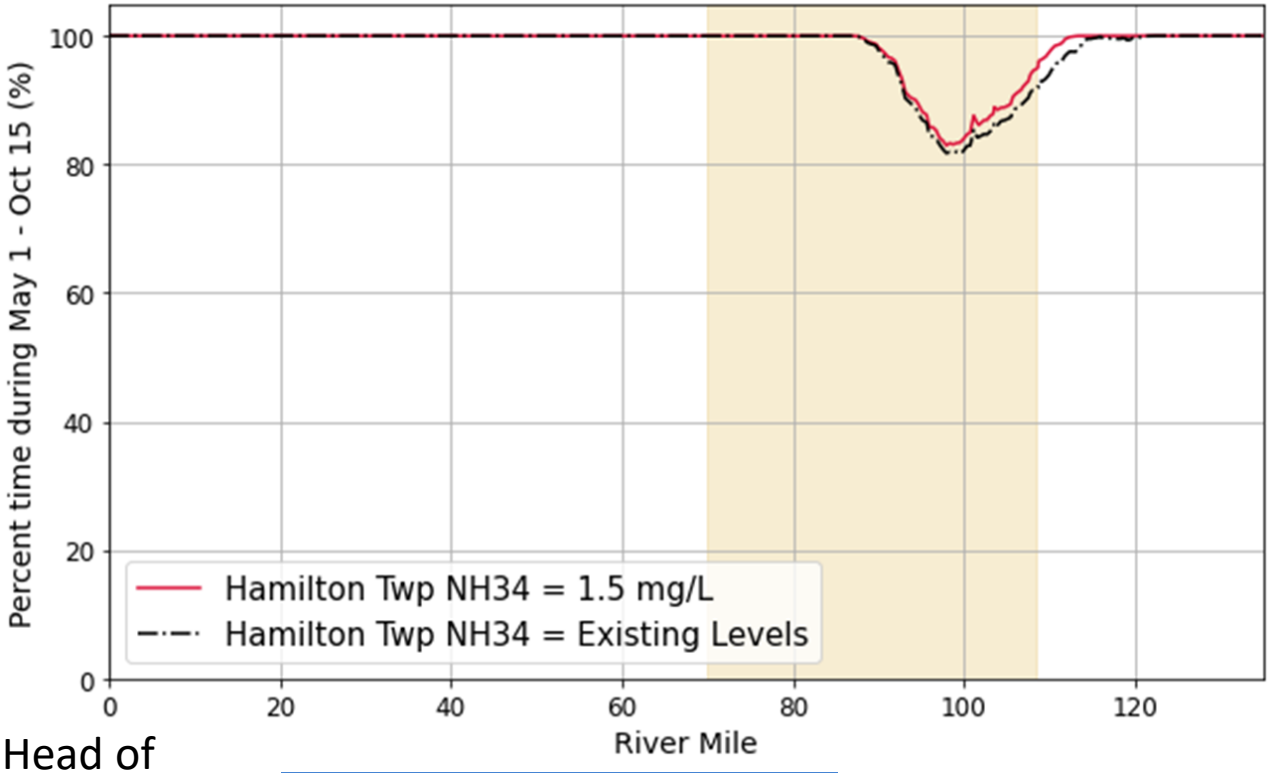
Class A discharges have a **marginal impact** on low DO in the FMA

1st Percentile DO



Percent Time above 5 mg/L DO



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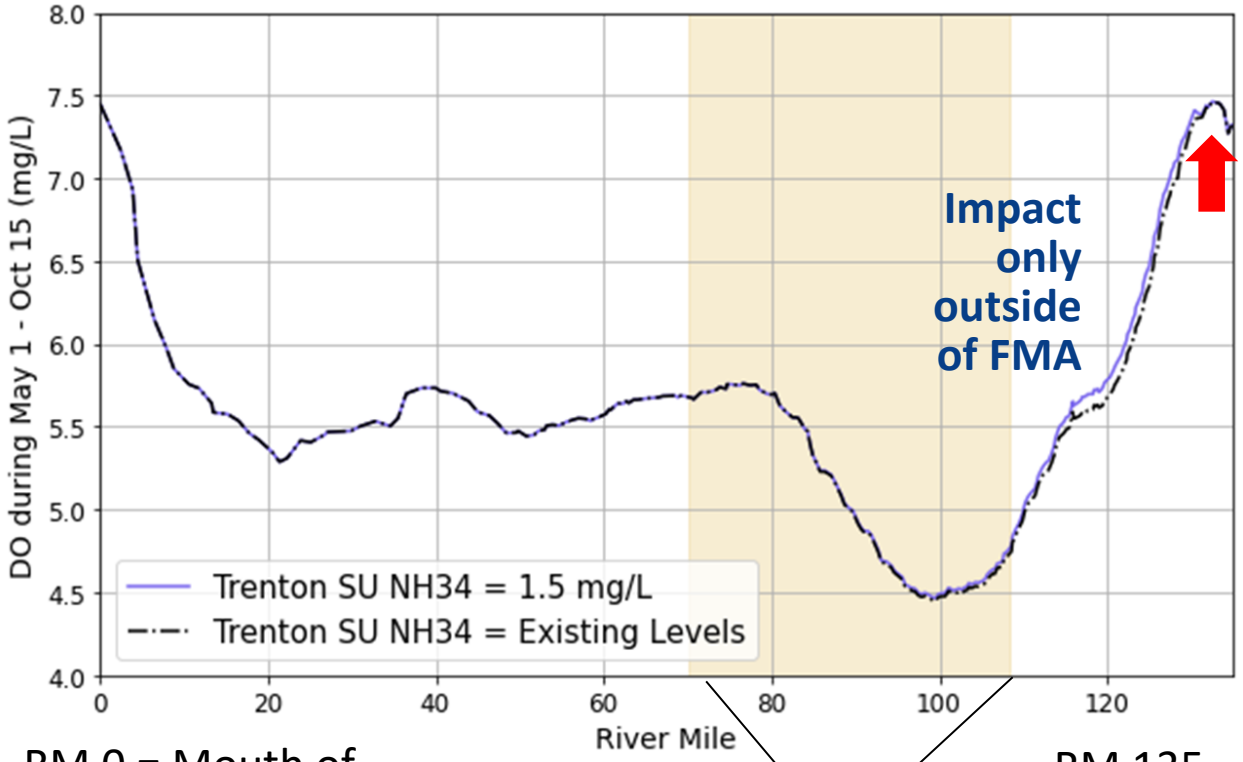
Class B discharges have **no measurable impact** on low DO in the FMA

1st Percentile DO



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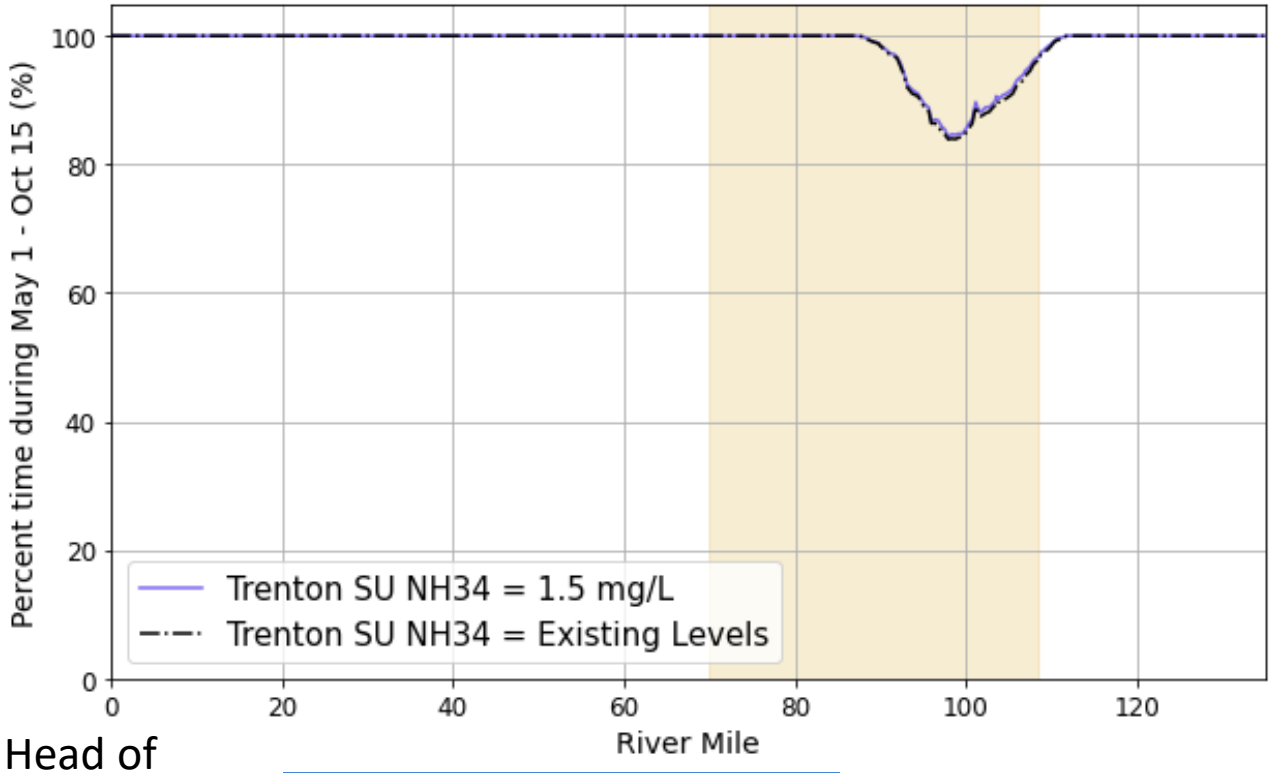

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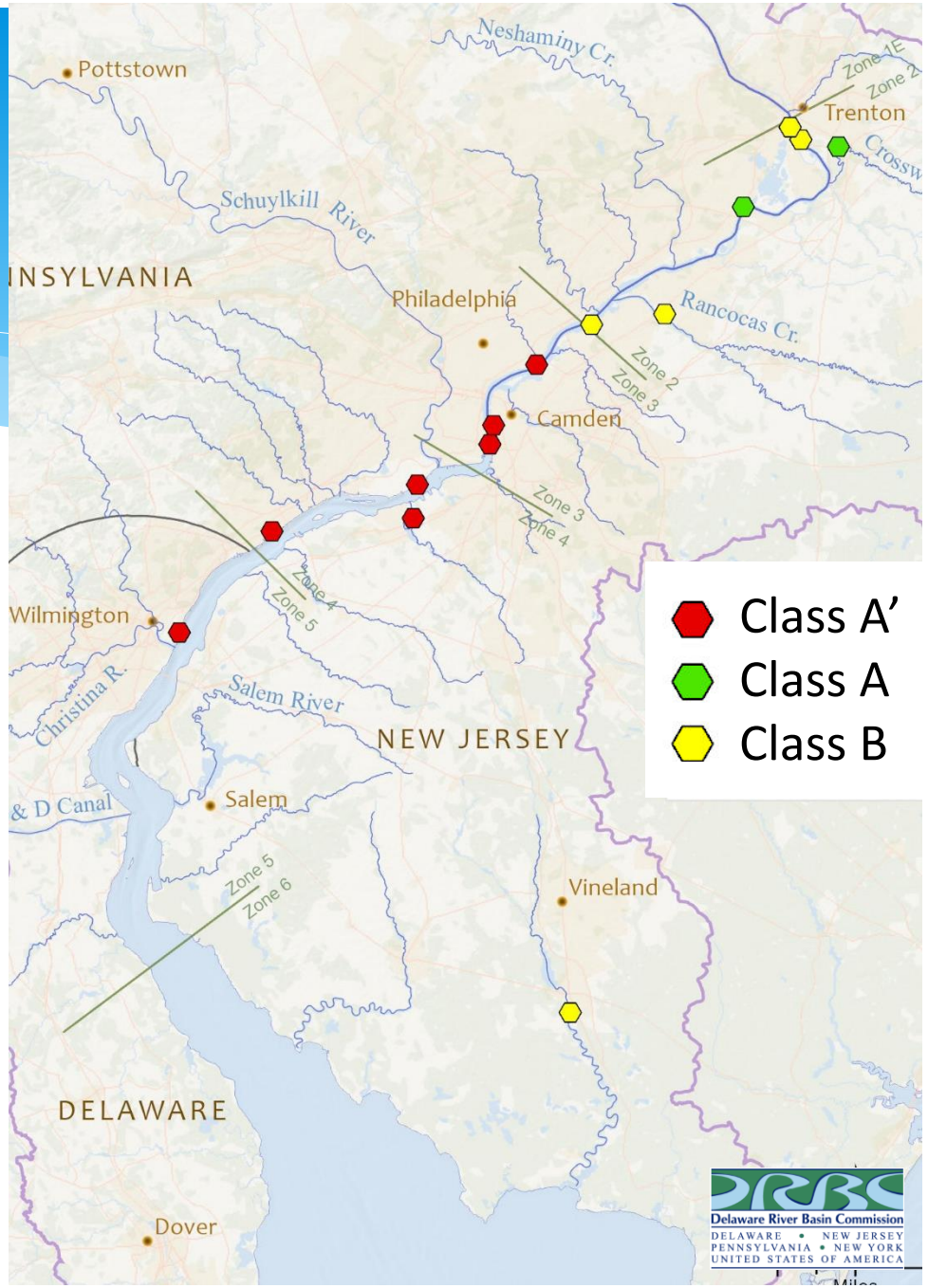
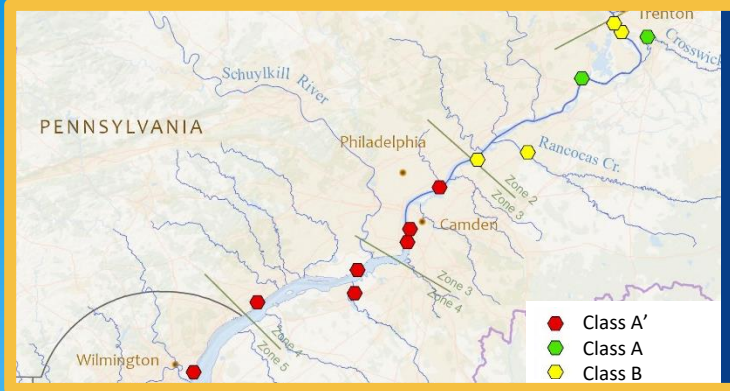
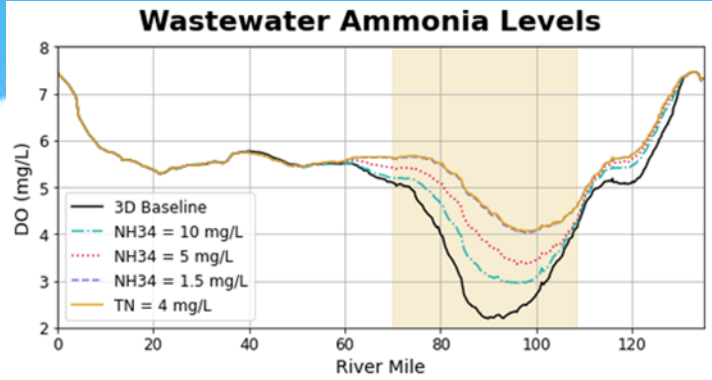
Discharges by Class

Class	Discharge Name	Zone	River Mile	Permitted Flow (MGD)	Effluent Ammonia (mg/L)
A' (7)	PWD Northeast	3	103.9	210	4.4
	Camden County MUA	3	97.9	80	17.3
	PWD Southeast	3	96.7	112	8.6
	PWD Southwest	4	90.7	200	19.0
	Gloucester County UA	4	89.9	27	23.9
	DELCORA	4	80.4	70	3.8
	City of Wilmington	5	71.6	134	9.5
A (2)	Hamilton TWP WPCF	2	128.4	16	27.0
	Lower Bucks JMA	2	121.9	10	19.7
B (58)	Morrisville BMA	2	132.5	7	9.7
	Trenton SU	2	131.8	20	5.4
	Willingboro WPCP	2	111.4	5	1.4
	Cinnaminson SA	2	108.7	2	16.0
	…	…	…	…	…





Nine wastewater discharges have great potential to **improve DO in the FMA**



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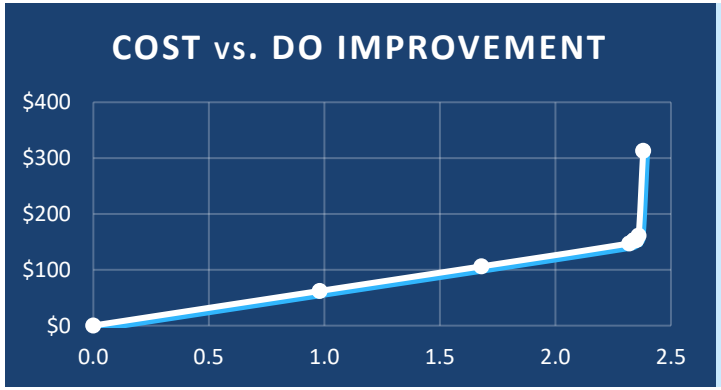

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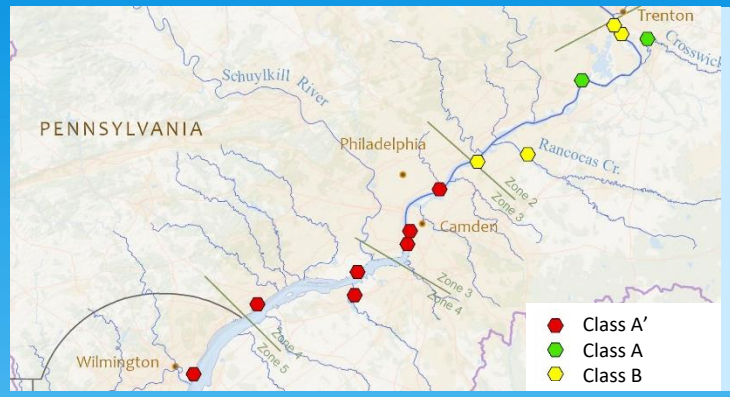

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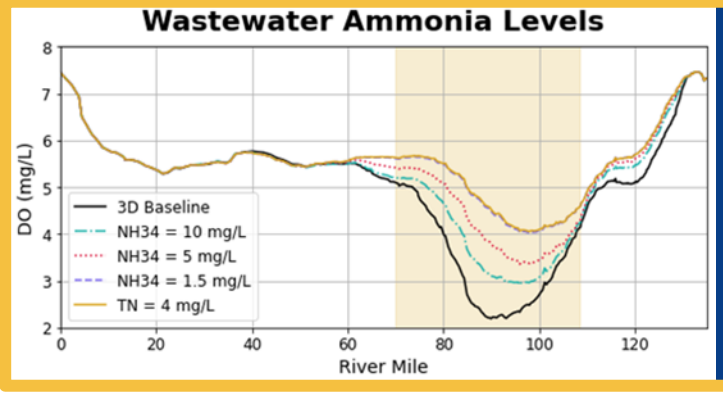

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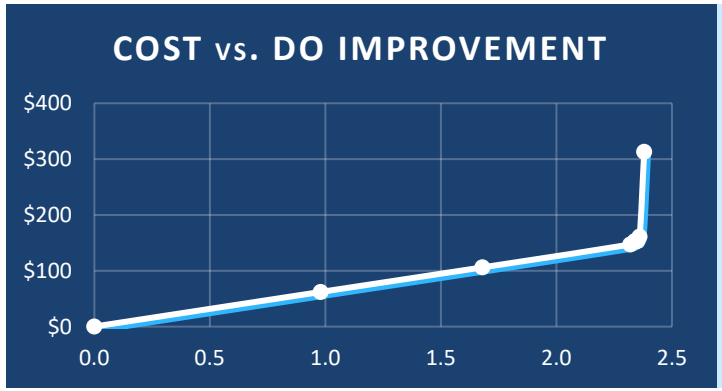
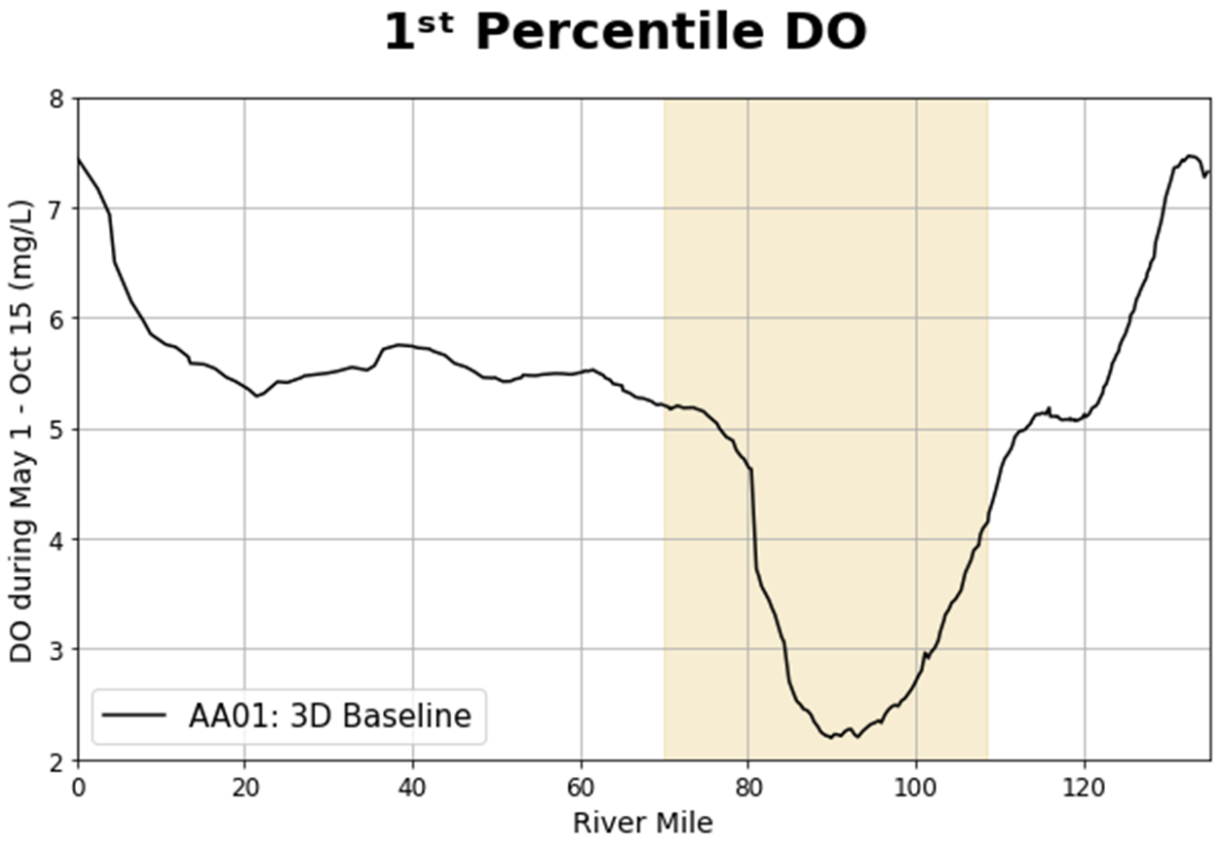
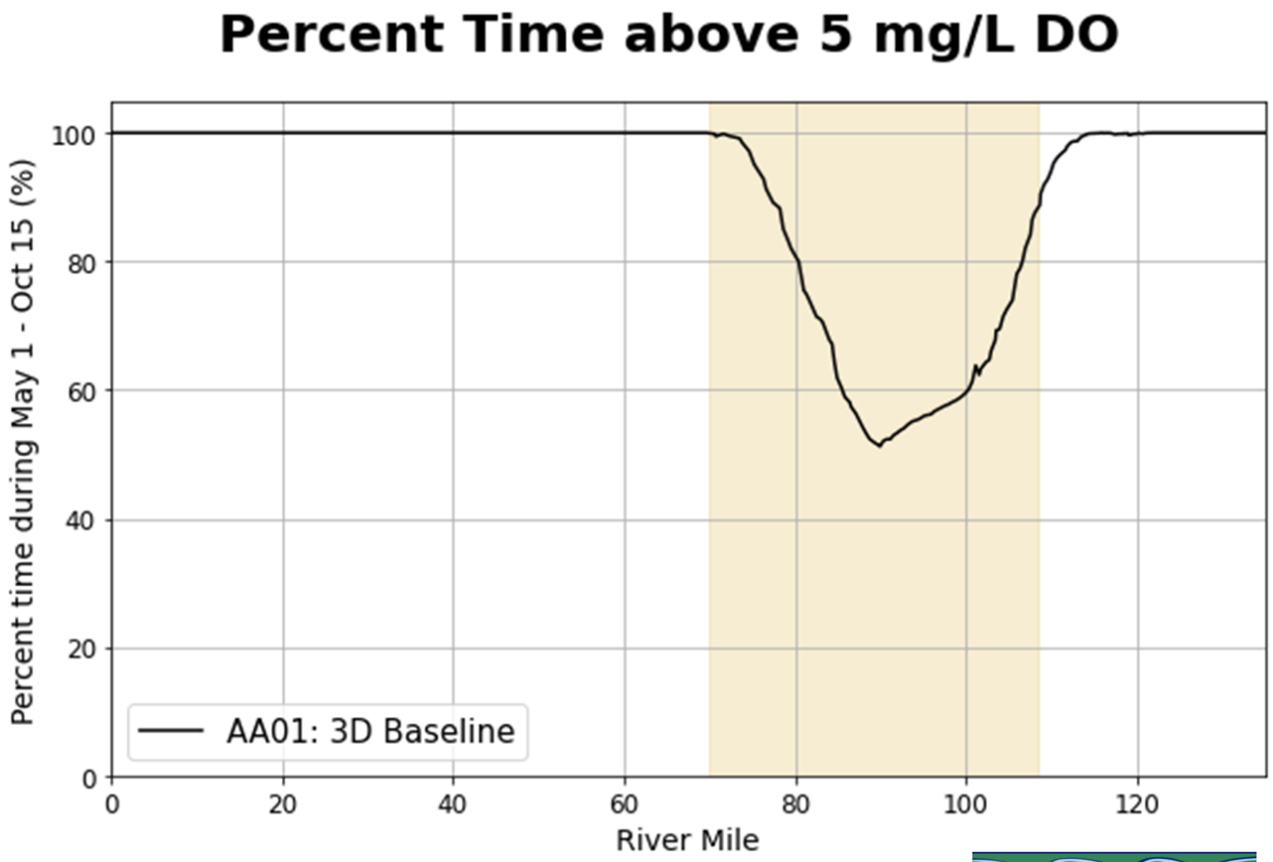


What are the associated costs?

Baseline design condition represents **protection of existing water quality and uses**





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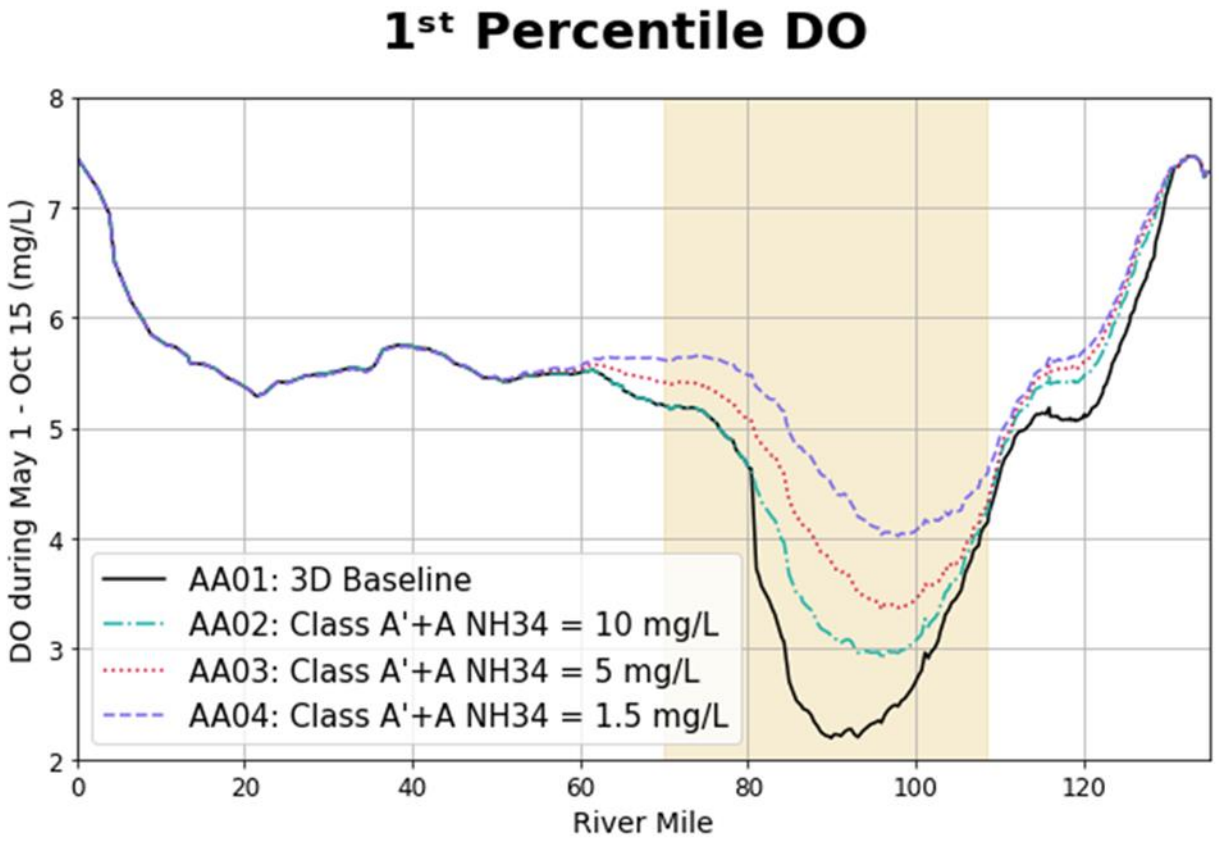
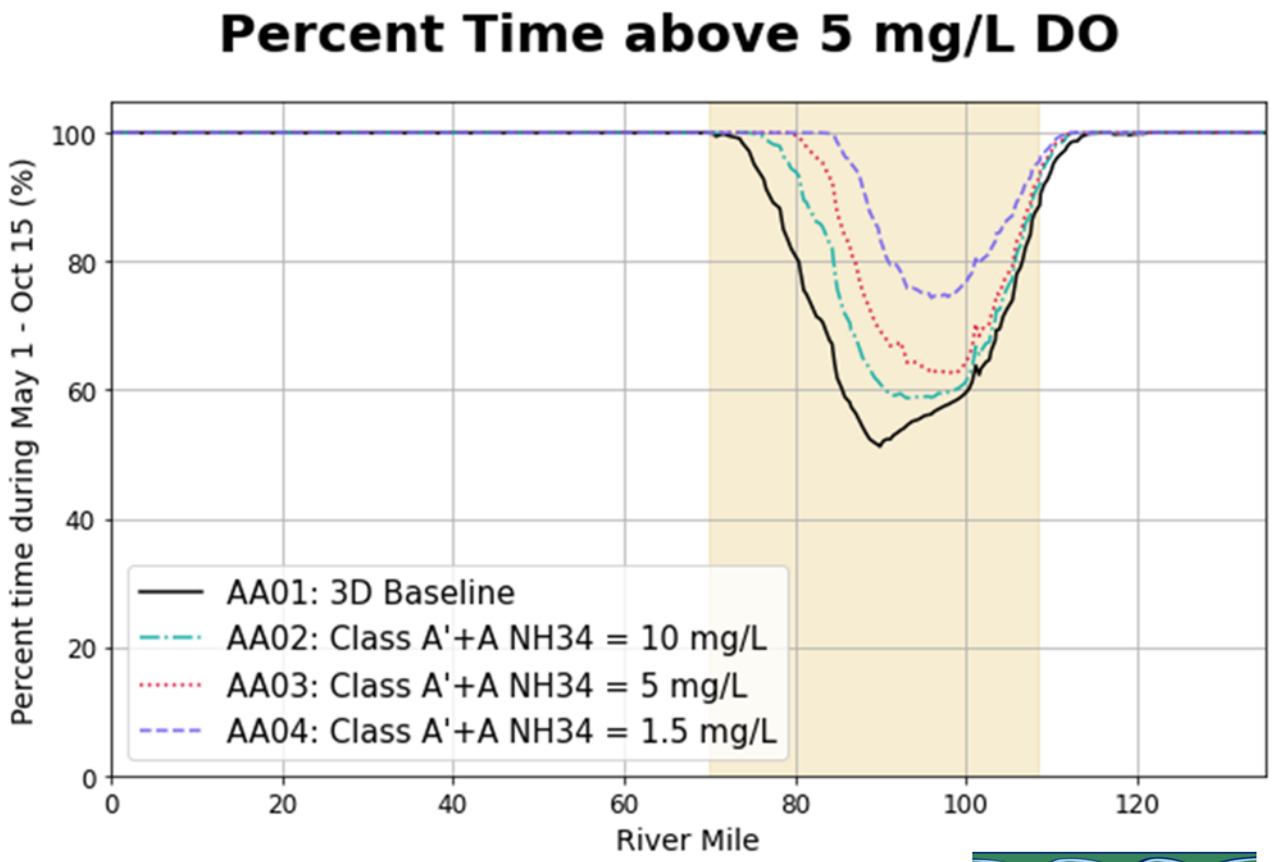
Bringing minimum DO above 4 mg/L requires **reducing effluent ammonia to 1.5 mg/L**





"Summer" (May through October) effluent NH4-N, CBOD, NO3-N, and DO were adjusted

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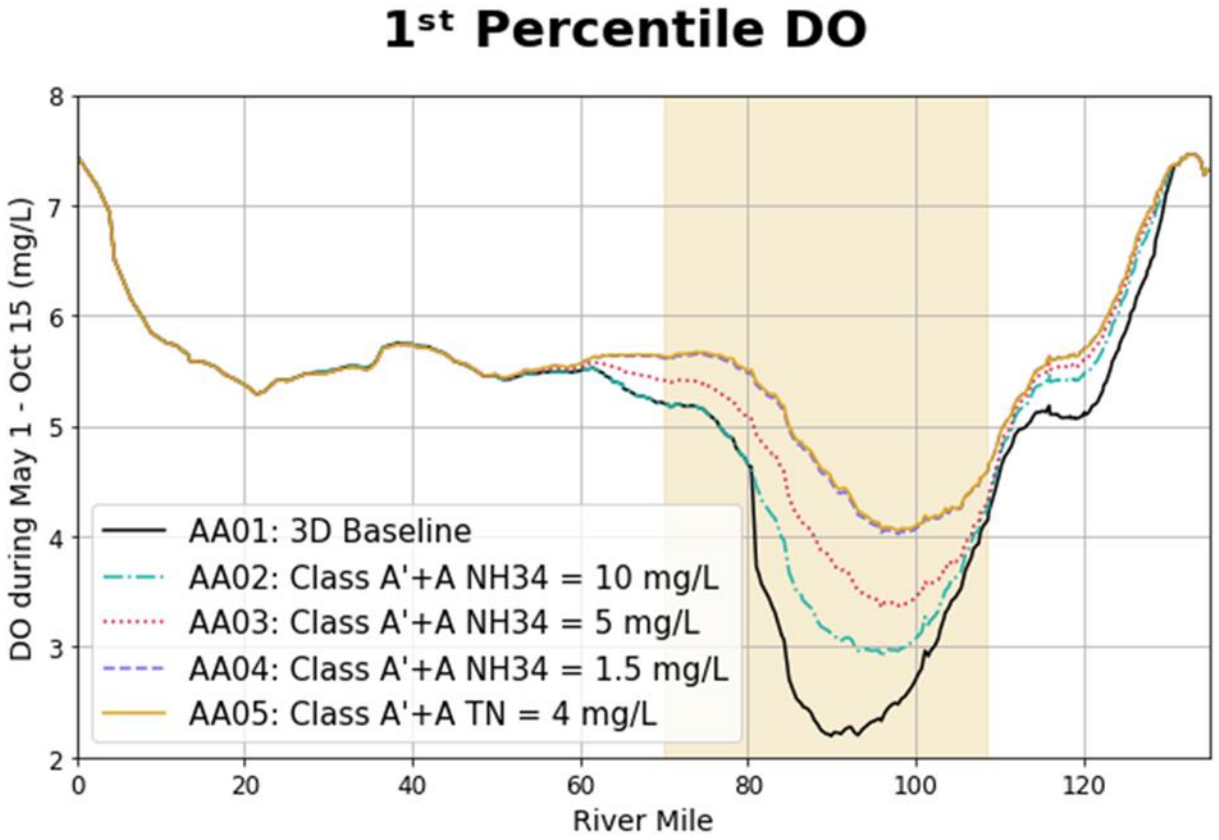
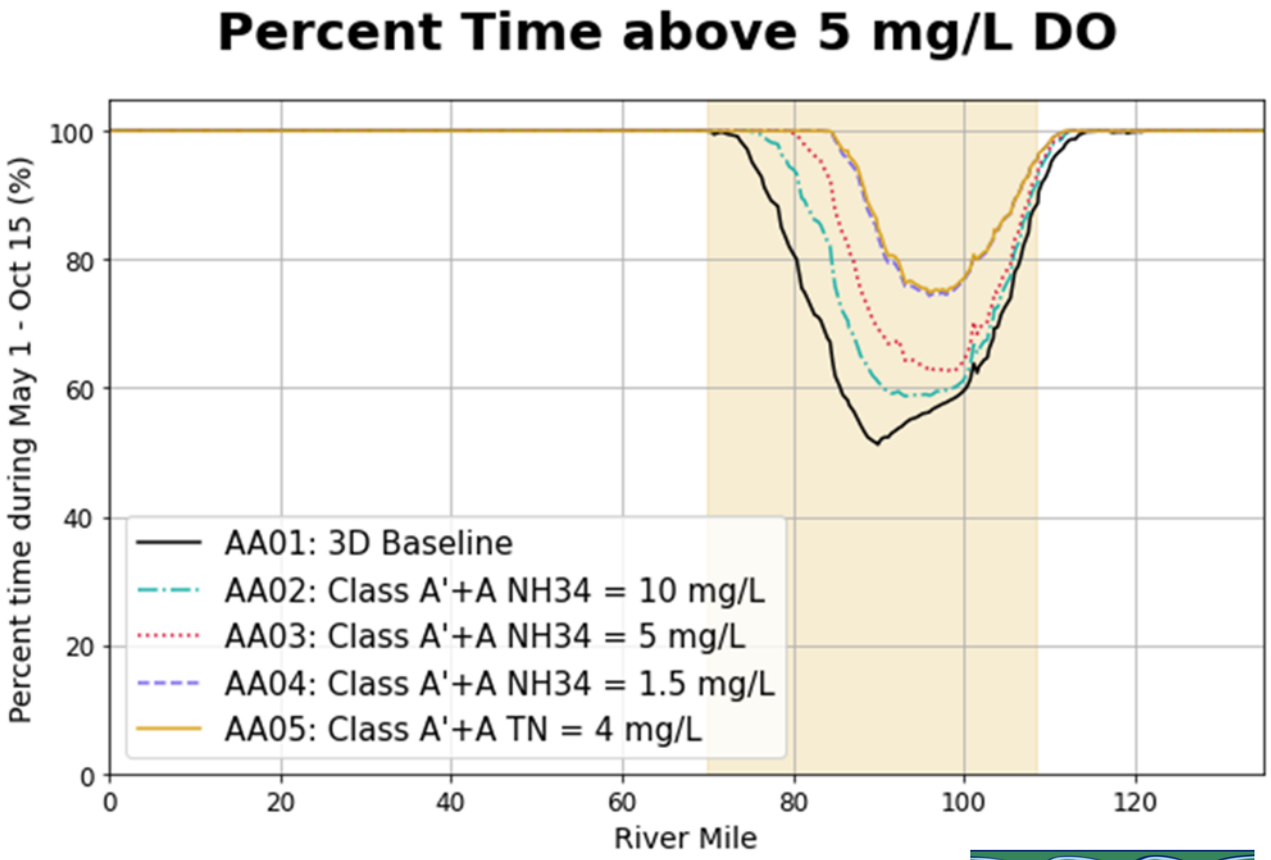
Reducing total nitrogen (TN) **brings no additional benefit to low DO**





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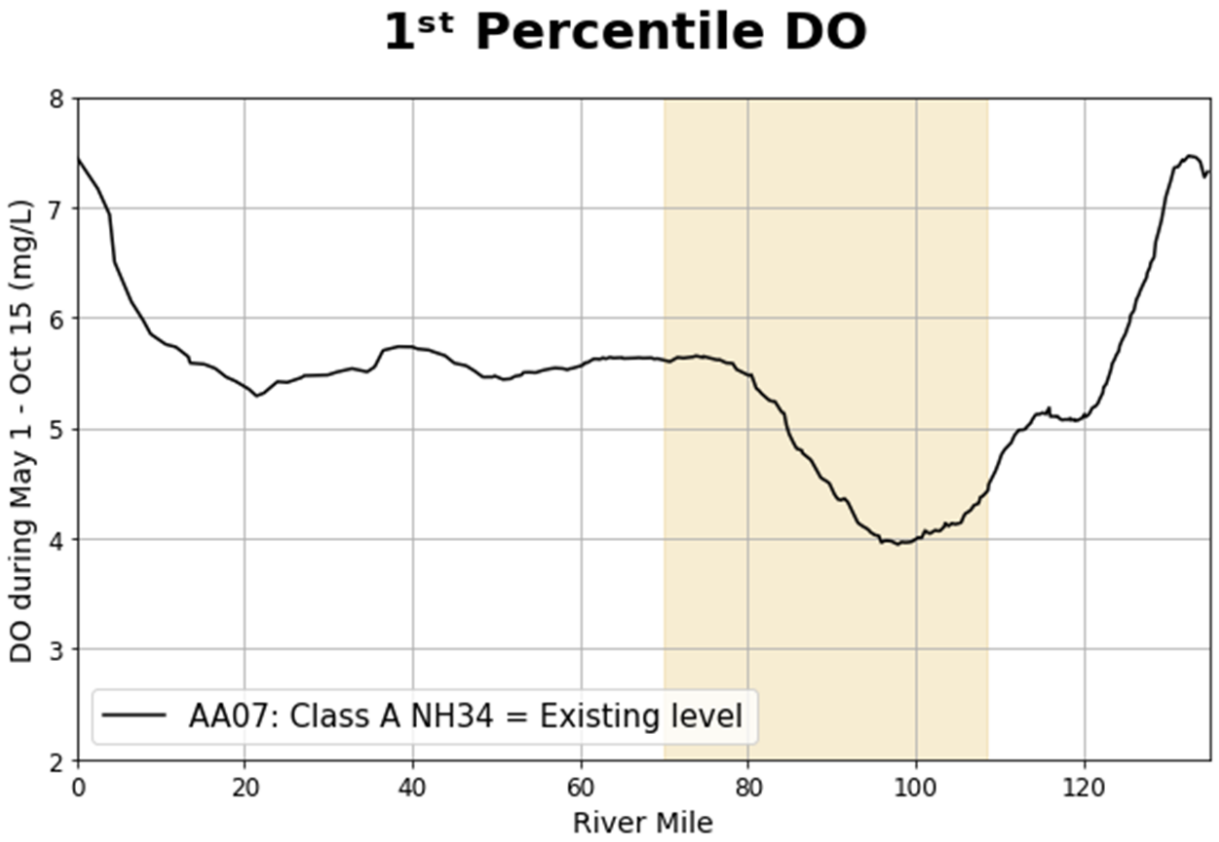
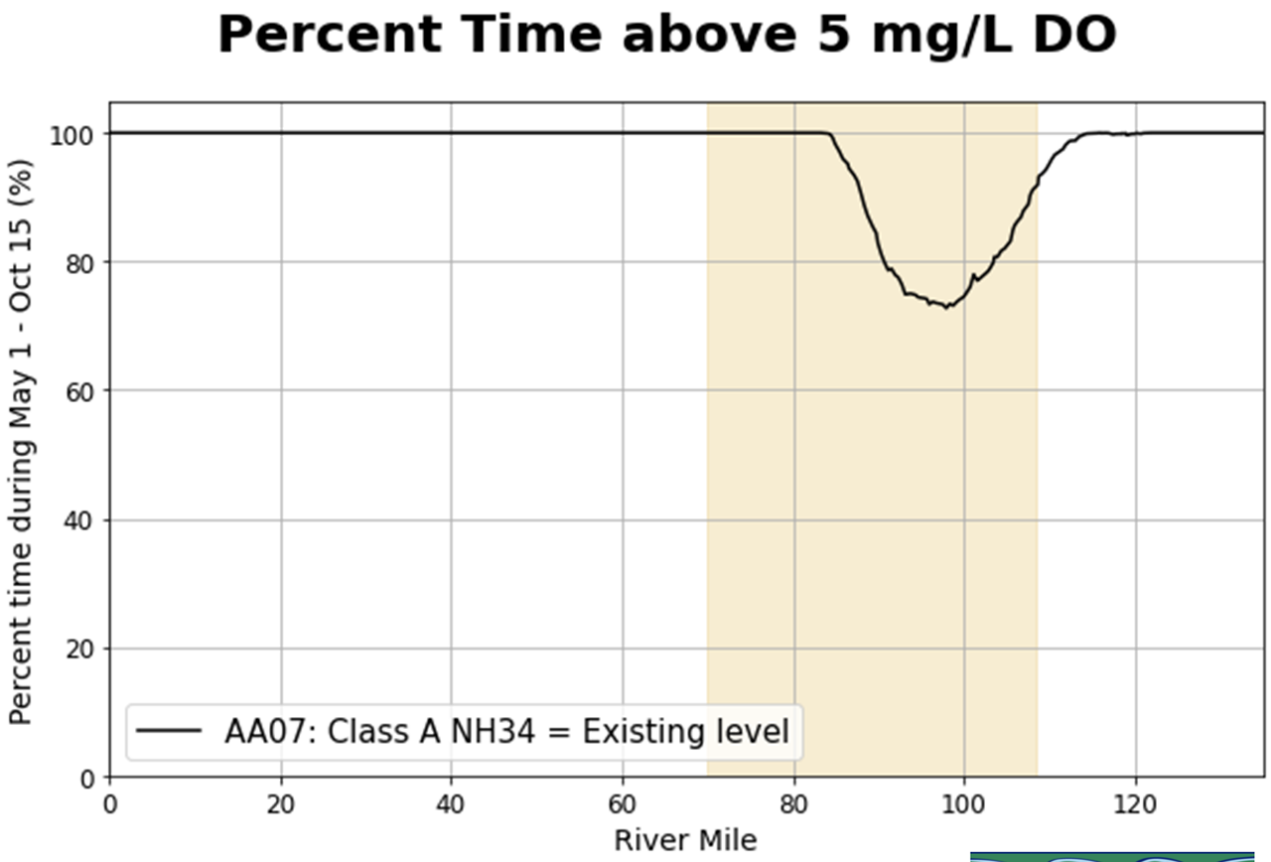
How sensitive is low DO to **Class A ammonia levels**?

(with Class A' ammonia = 1.5 mg/L)





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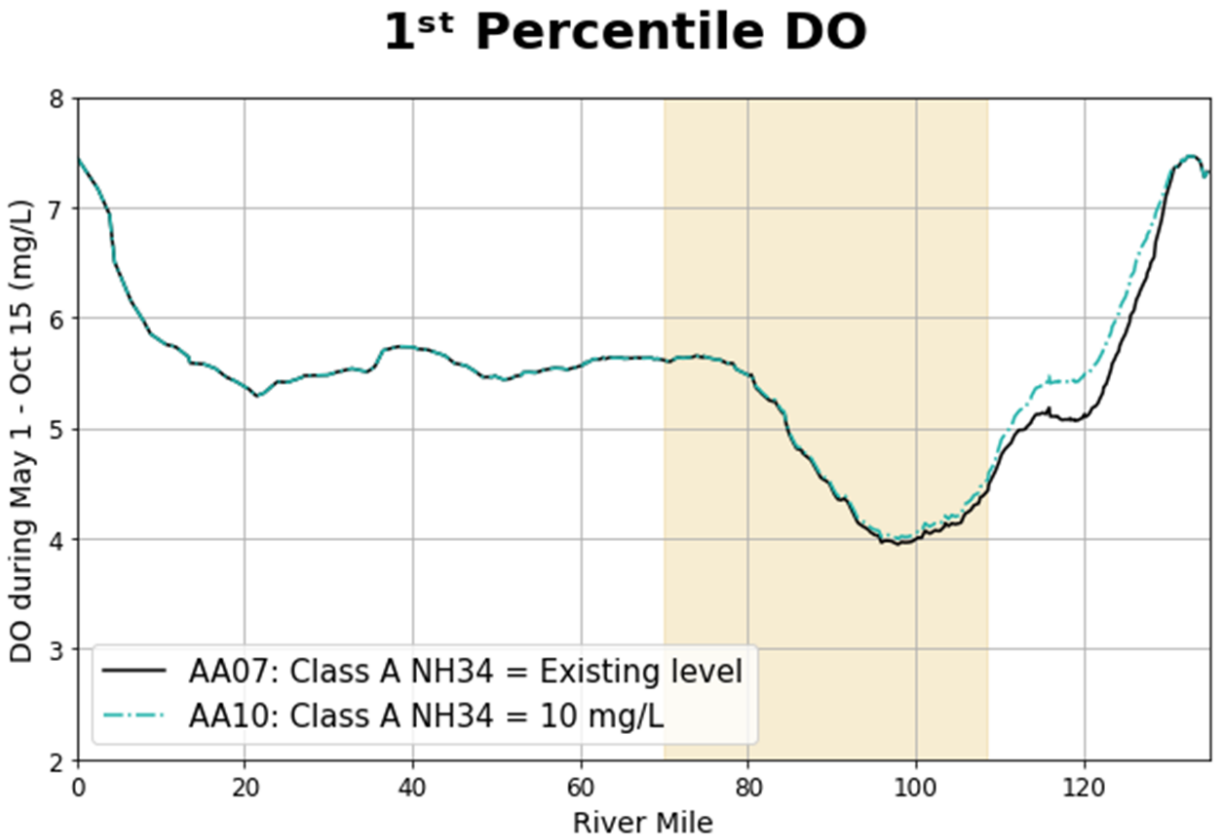

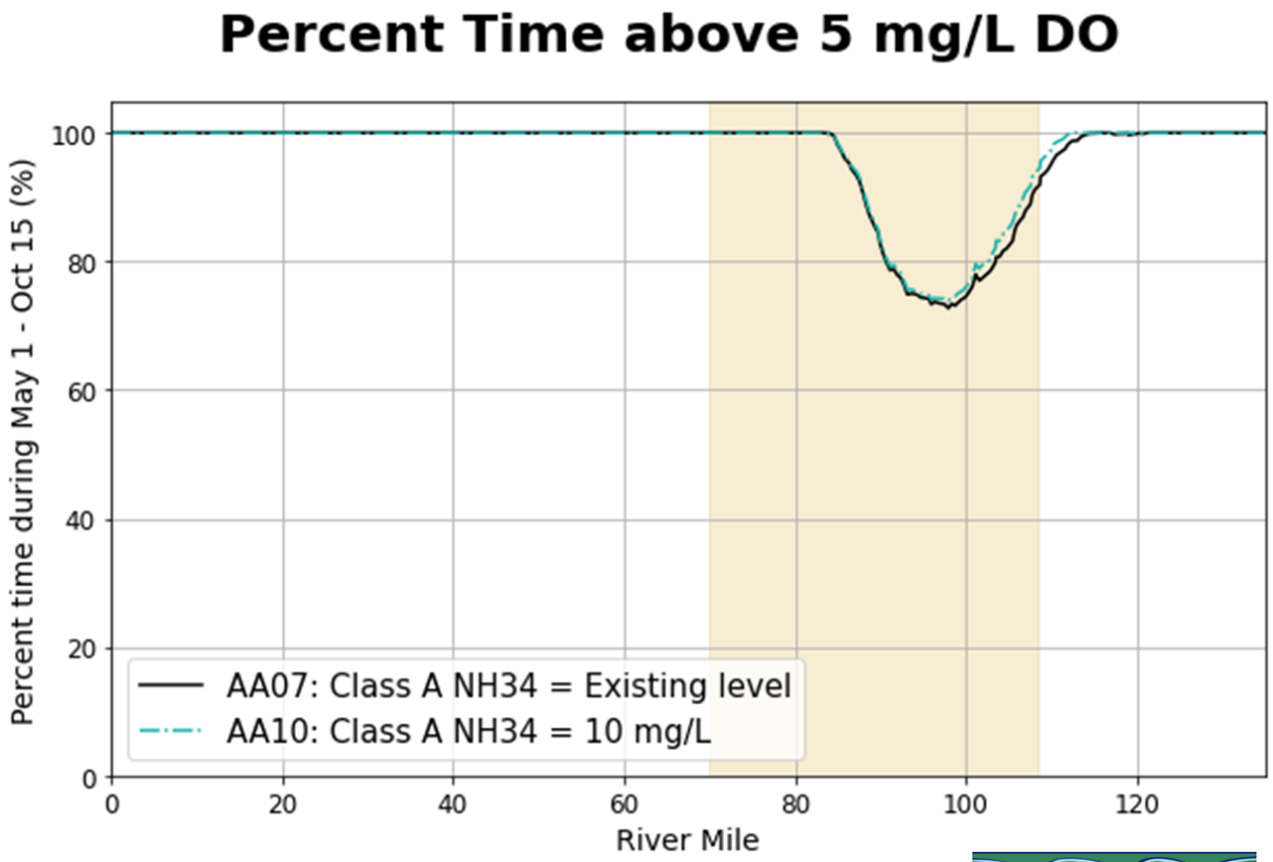

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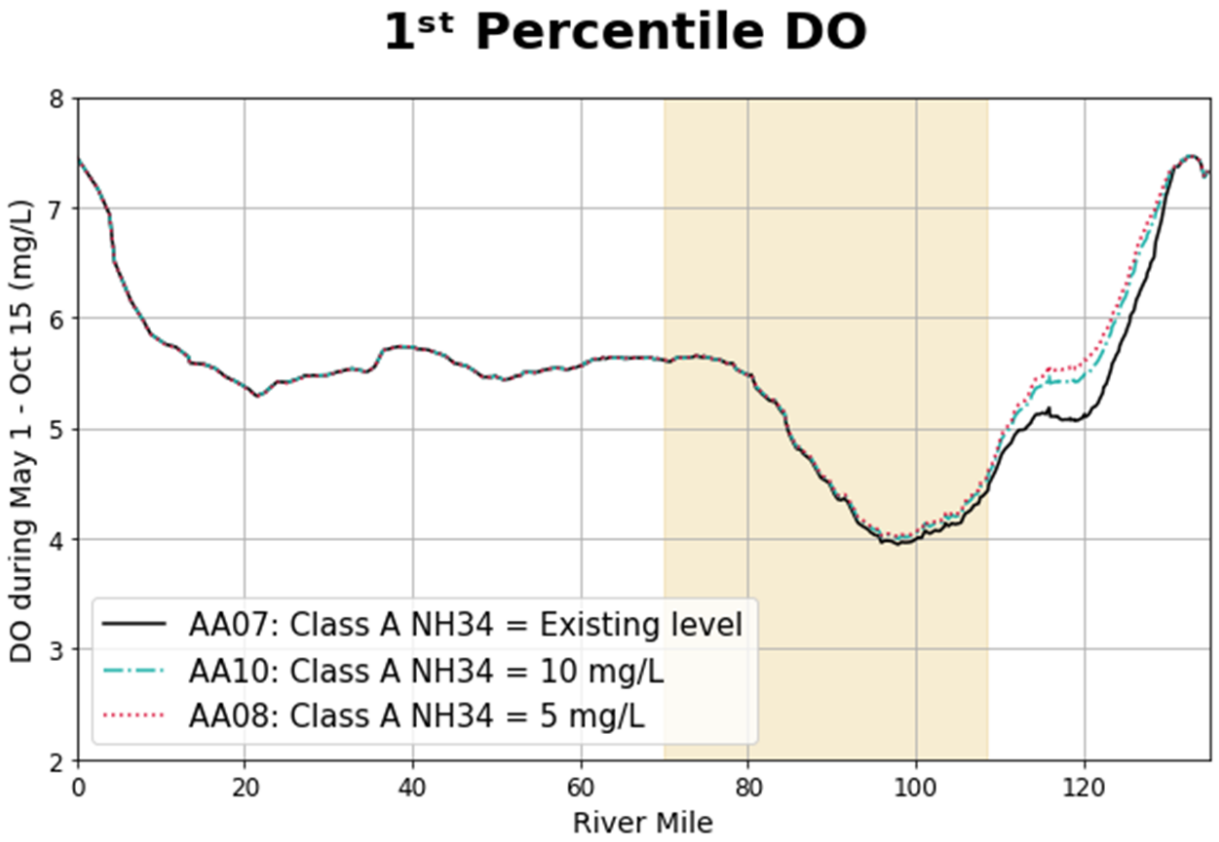

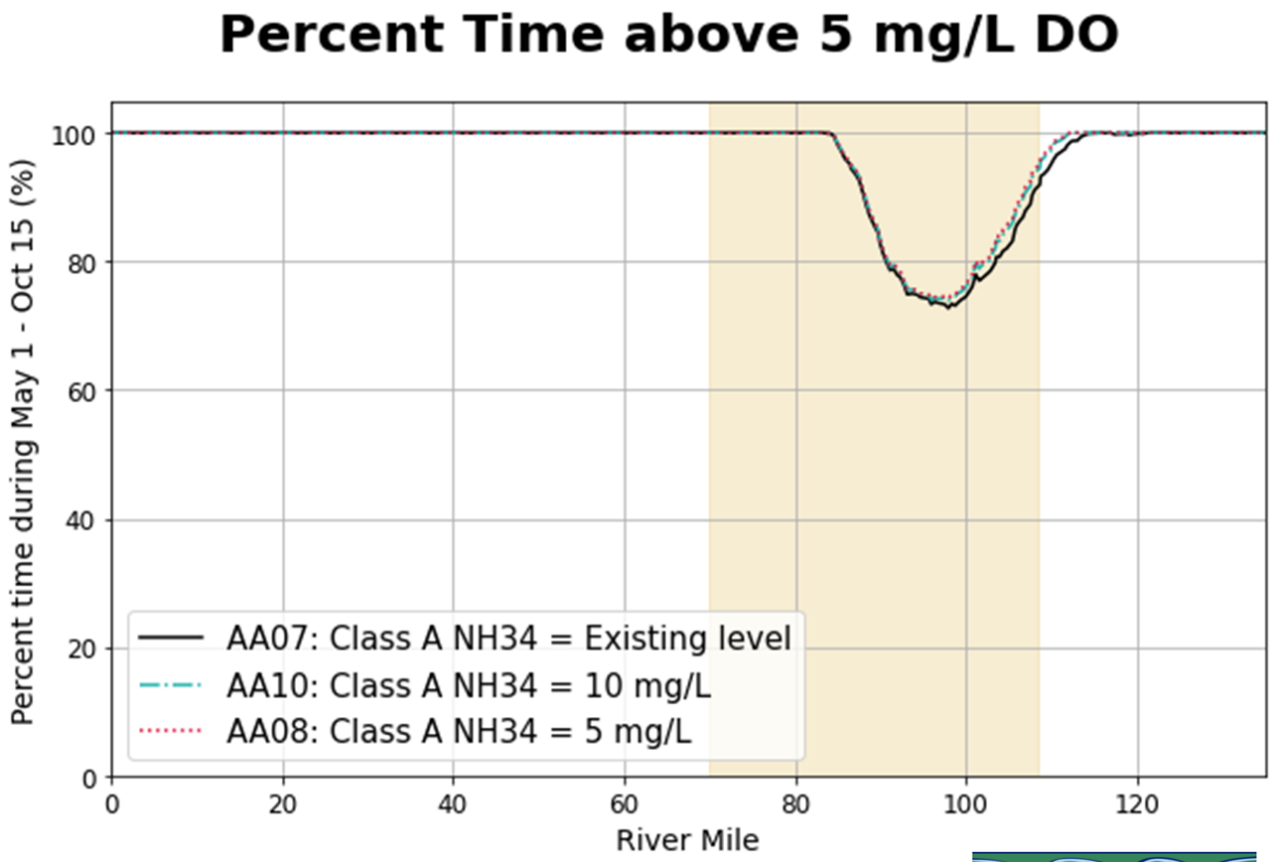

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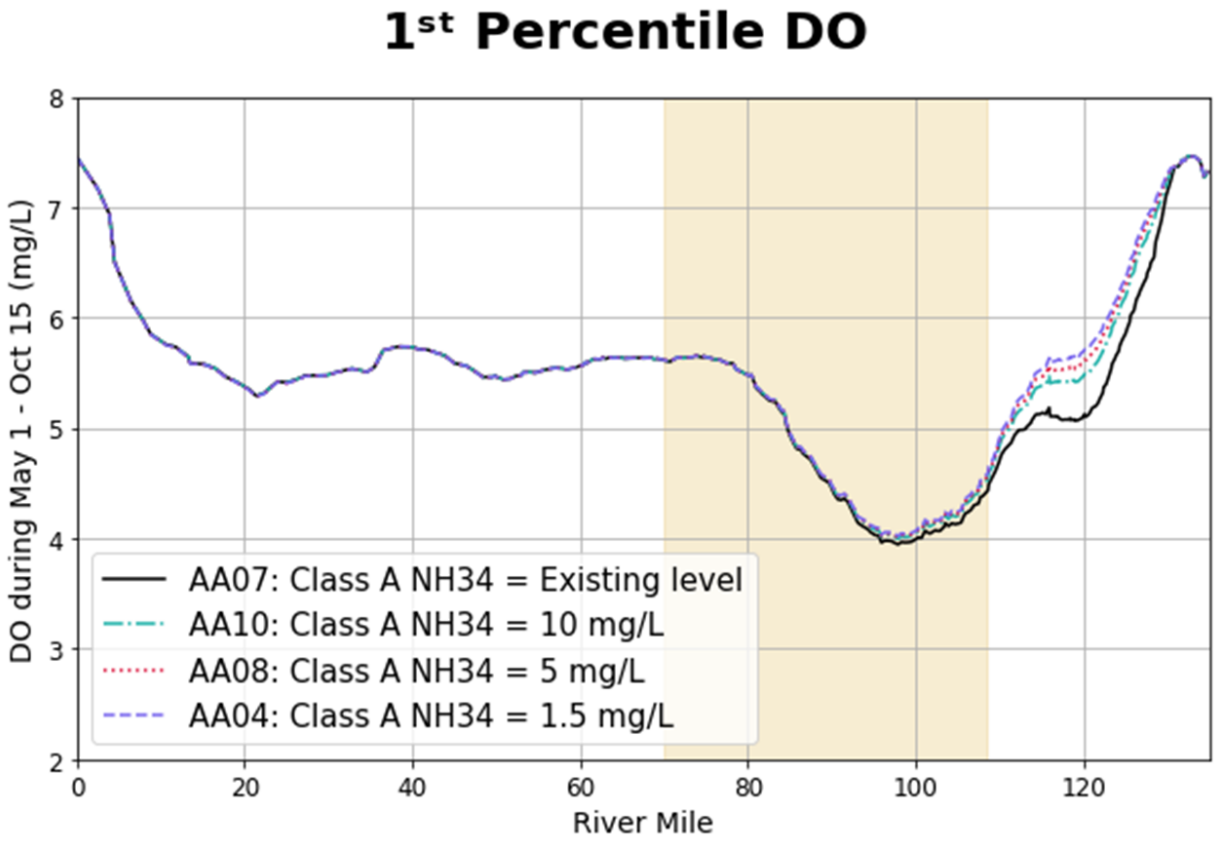
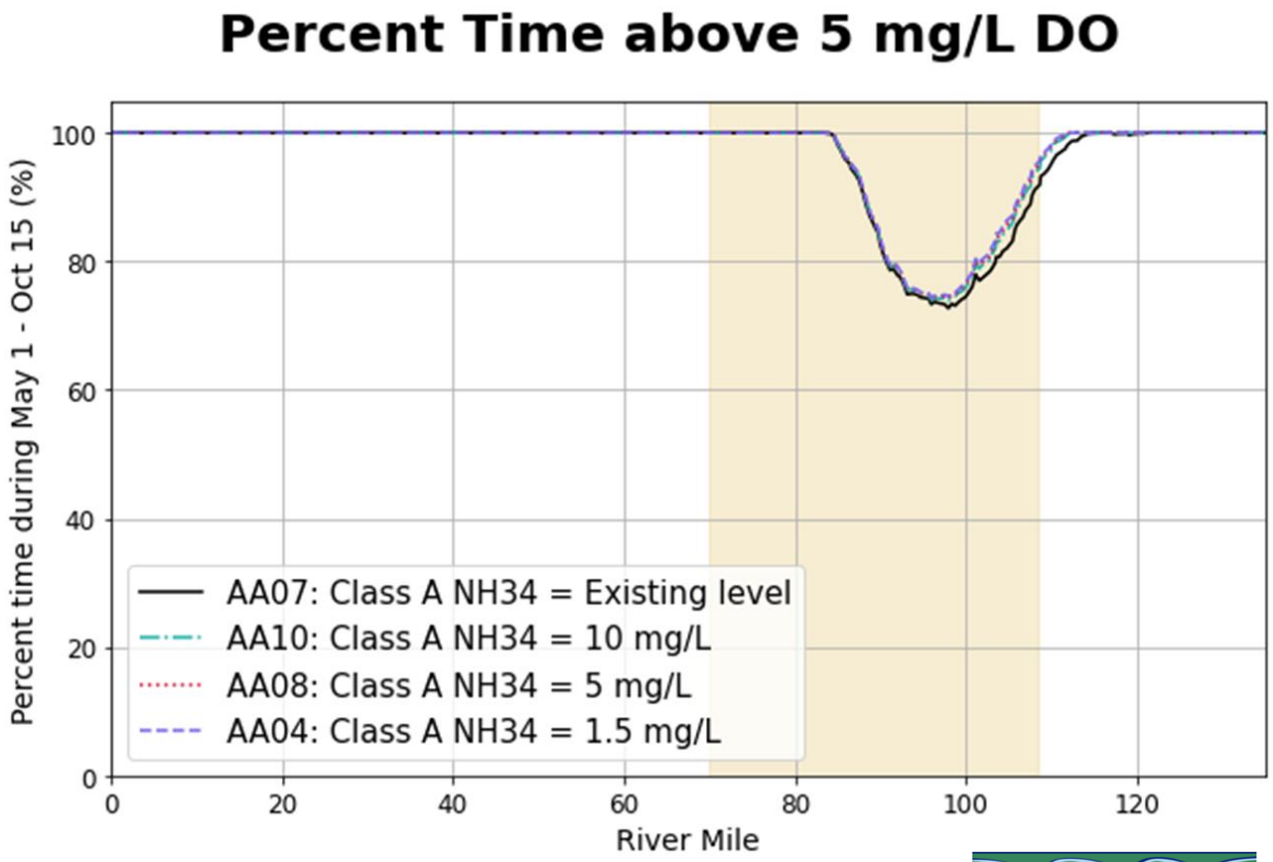
DO is less sensitive to Class A ammonia levels, **but ammonia reduction does have an impact**





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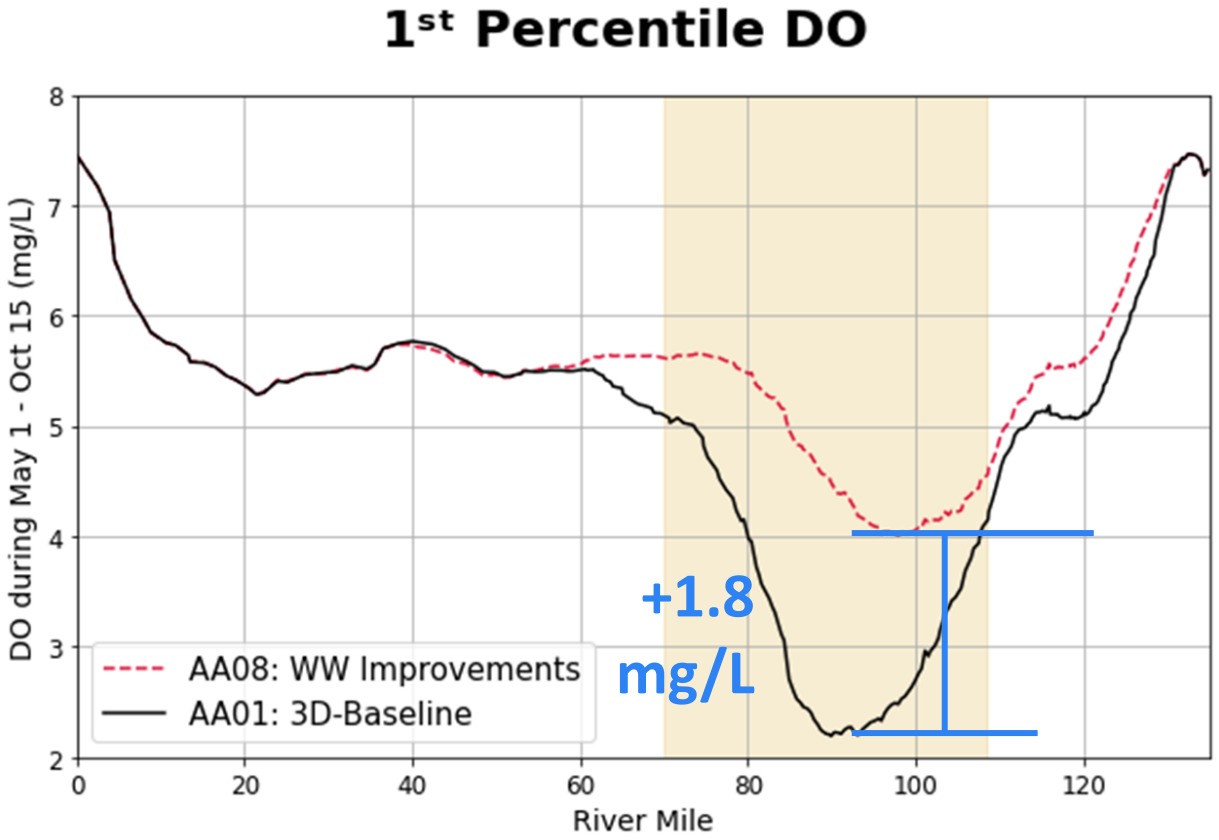
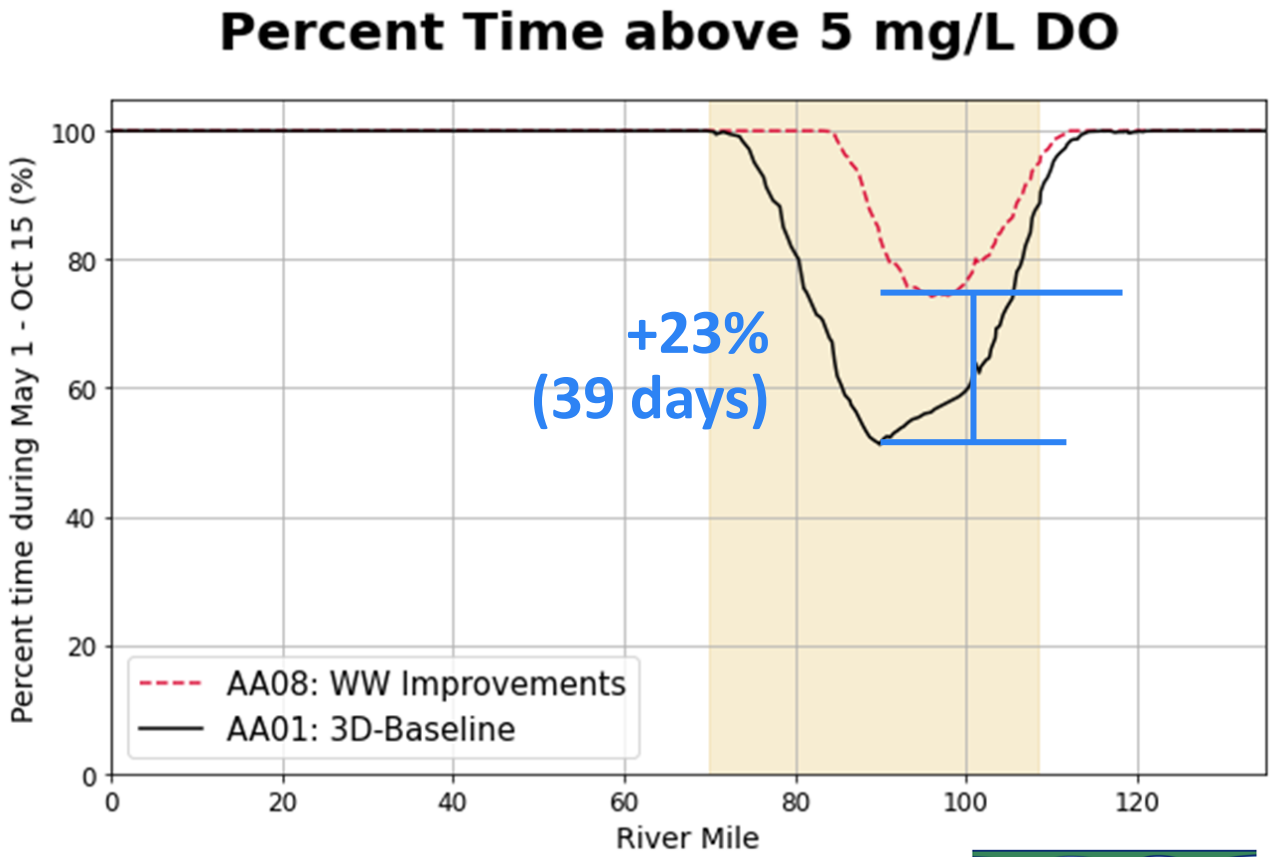
Implementing these improvements **substantially benefits habitat**





The lowest DO value in the Estuary **increases** and **moves upstream**

~~**50**~~ **28 miles** experience DO less than 5 mg/L

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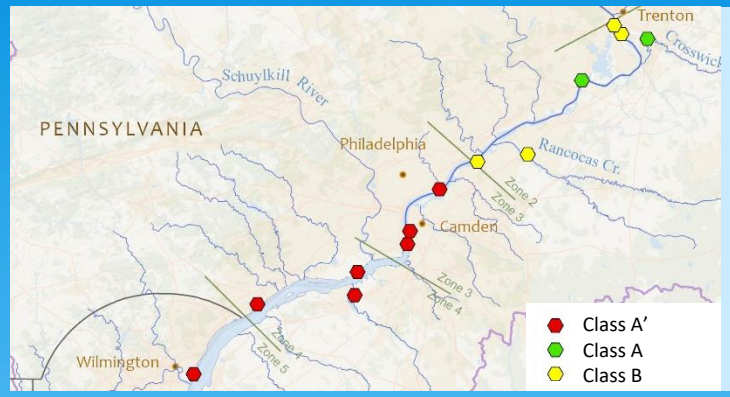

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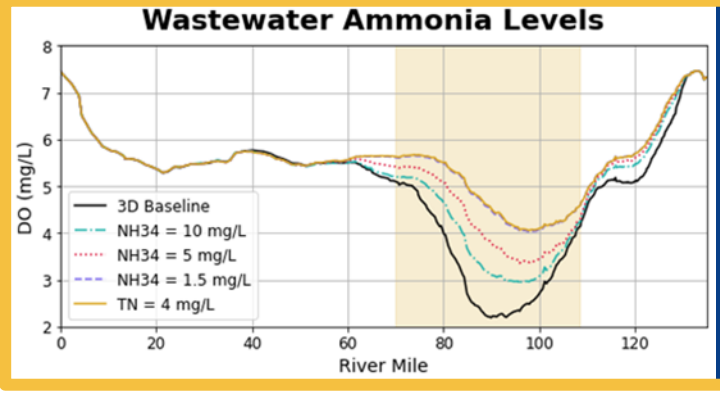
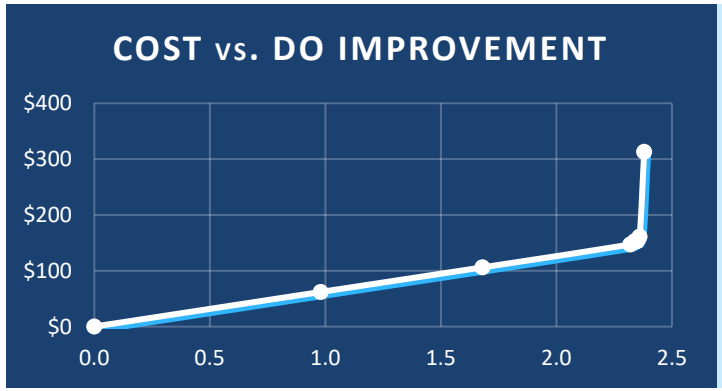


Reducing effluent ammonia to **1.5** mg/L (Class A') and **5** mg/L (Class A) **improves habitat** in the urban estuary



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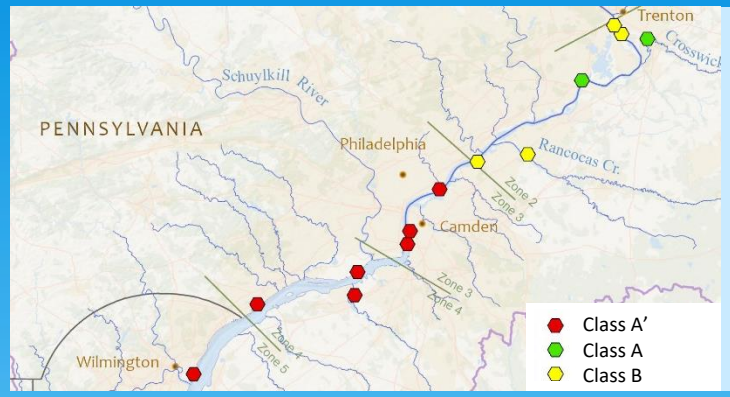

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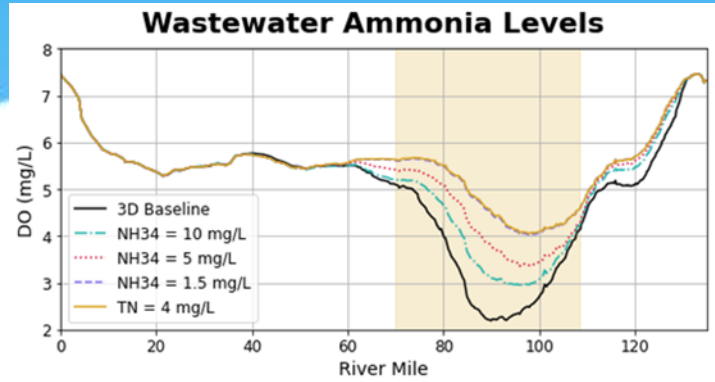

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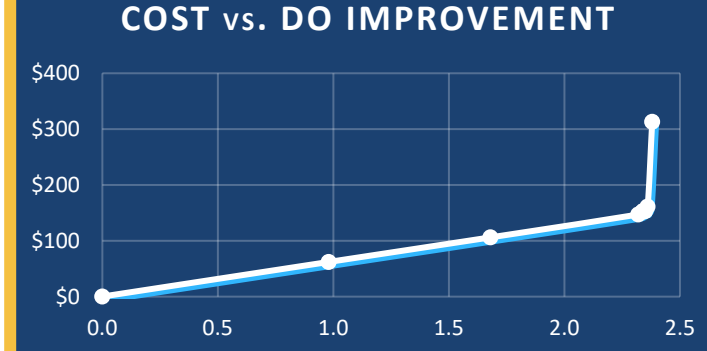
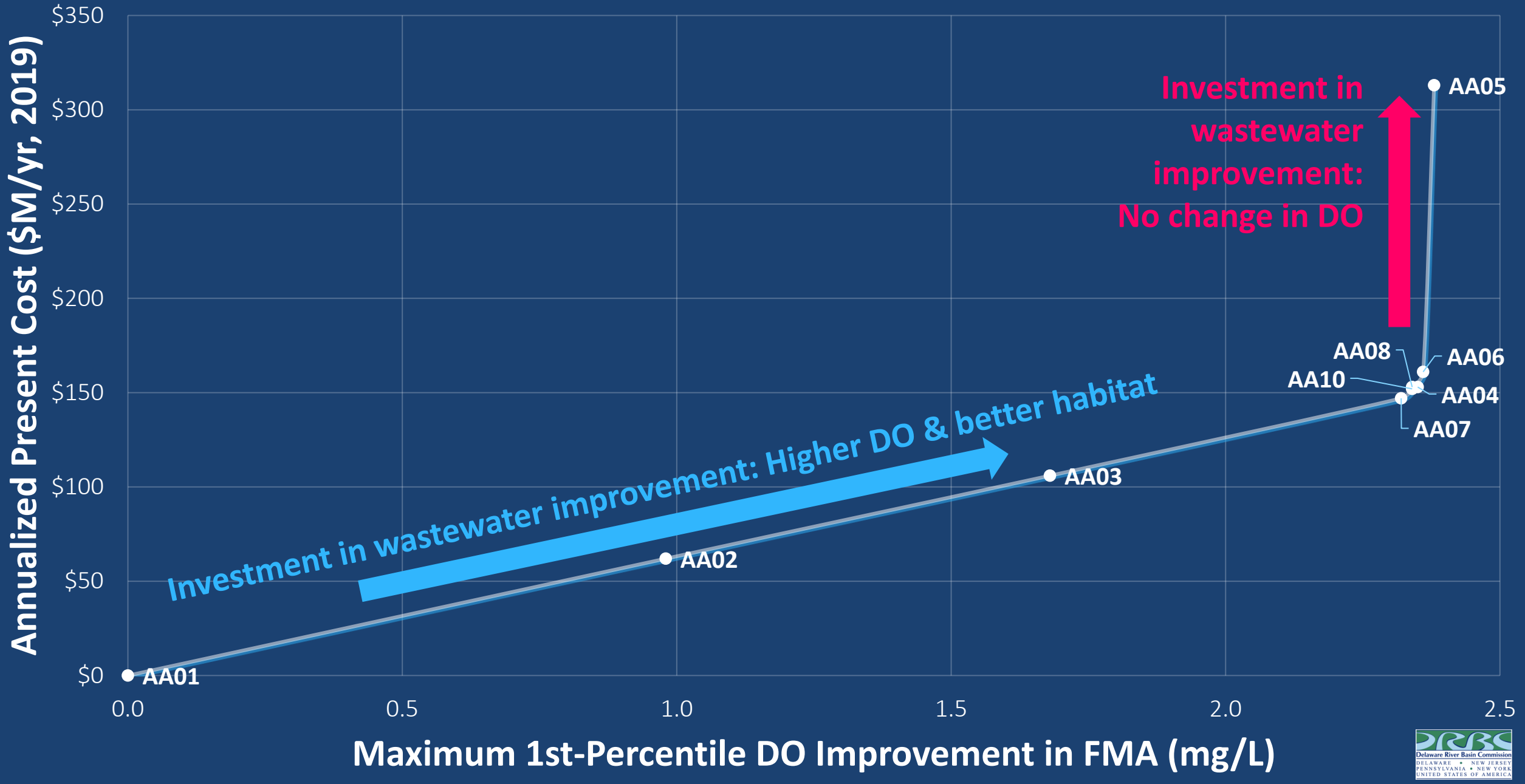


What are the associated costs?

TOTAL COST vs. DISSOLVED OXYGEN IMPROVEMENT



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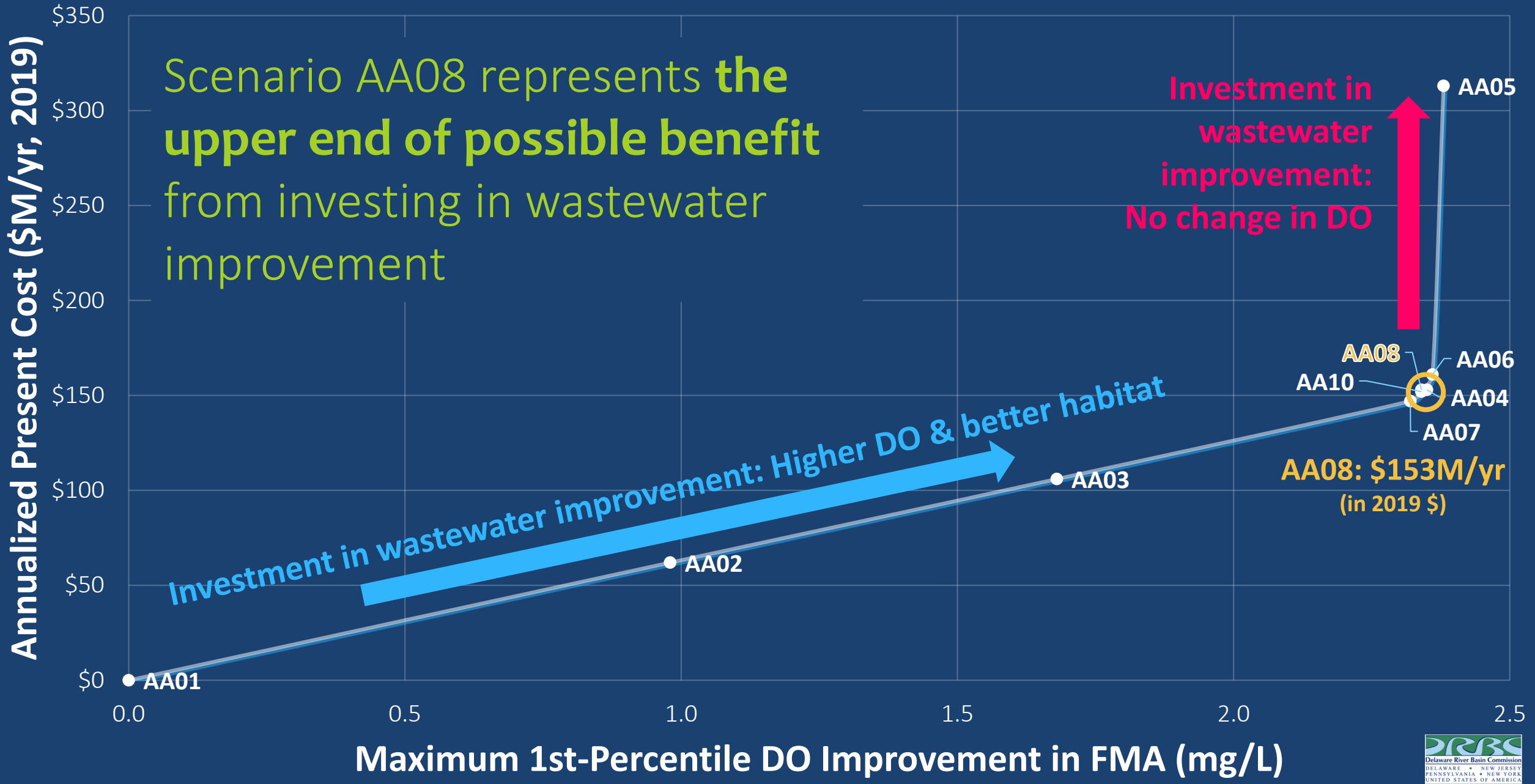

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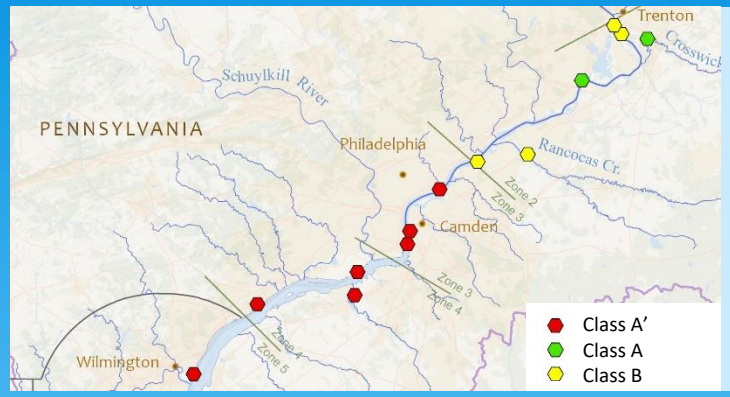
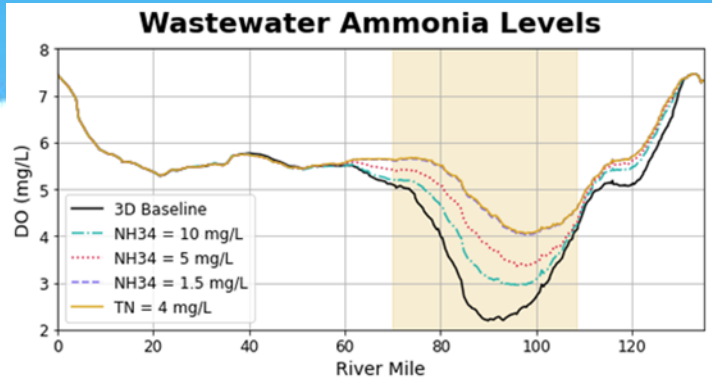
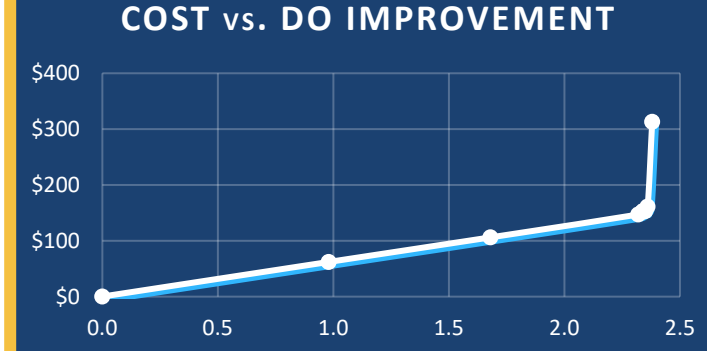


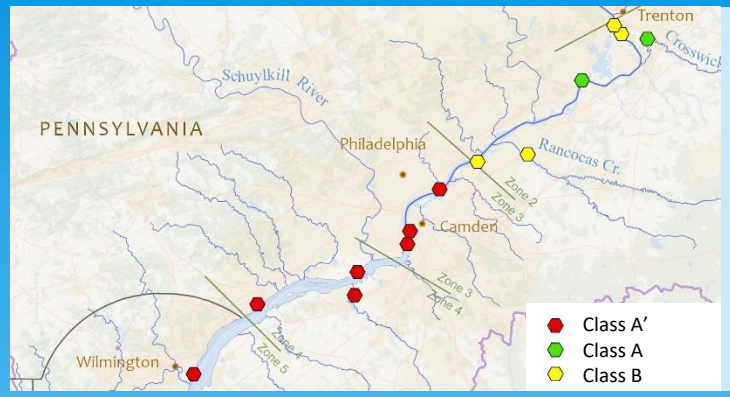
Nine wastewater discharges have great potential to **improve DO in the FMA**



Reducing effluent ammonia to **1.5** mg/L (Class A') and **5** mg/L (Class A) **improves habitat** in the urban estuary



Cost (**$153M/yr** in 2019) was considered, but selected scenario **driven by maximum achievable DO improvement**



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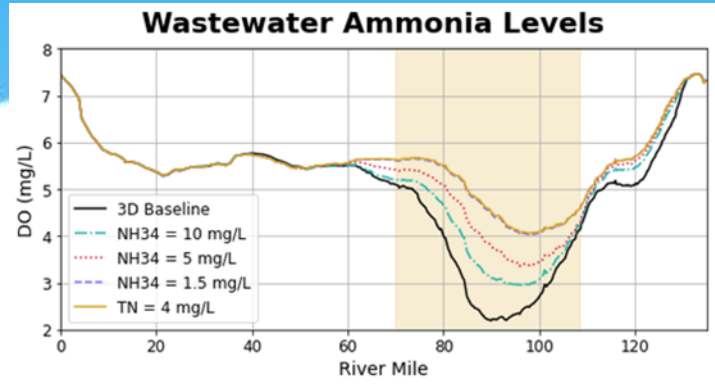

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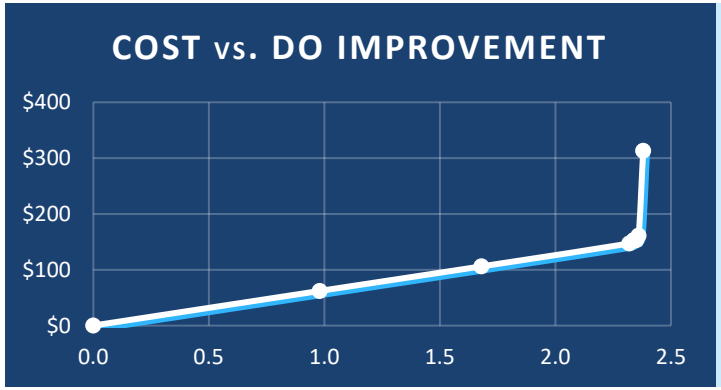

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Improving Dissolved Oxygen and Aquatic Life Uses in the Delaware River Estuary

Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

Topic	Presenter
Why are we here?	Steve Tambini
How did DRBC address low dissolved oxygen in the Delaware Estuary - then and now?	Namsoo Suk
Where do ammonia and other nutrients in the Delaware Estuary originate, and how do we know?	John Yagecic
What is this estuary-wide eutrophication model and why do we need it?	Li Zheng
What matters and what doesn't with regard to low dissolved oxygen events in the Delaware Estuary?	Fanghui Chen
What combination of wastewater improvements will achieve the best dissolved oxygen outcome in the Delaware Estuary?	Sarah Beganskas
What is the highest attainable dissolved oxygen condition in the Delaware Estuary, and what will it mean for aquatic life uses?	**Thomas Amidon**
Q&A Panel: Enhancing support for aquatic life uses in the Delaware Estuary	**All**