Maryland
Department of
the Environment

MD's Enhanced Monitoring Fishing Bay Case Study Updates

CAP Workgroup 8/13/2024

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Watershed Protection, Restoration, and Planning Program

Fishing Bay Case Study Updates

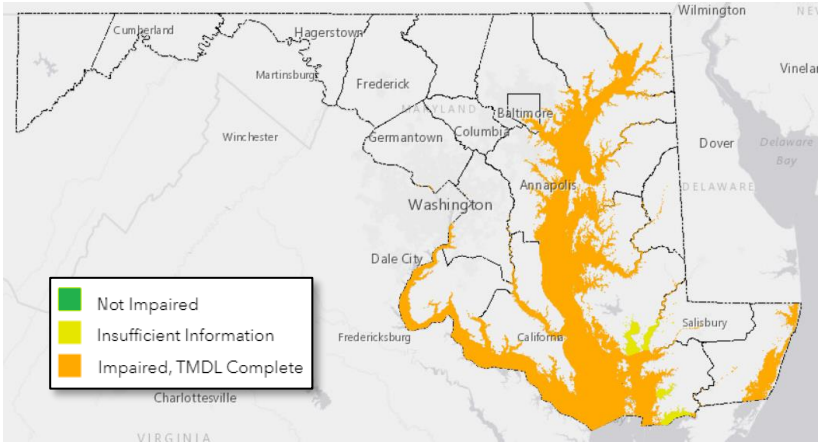
Background

Maryland's Effort to Fully Assess Fishing Bay

Why is this important?

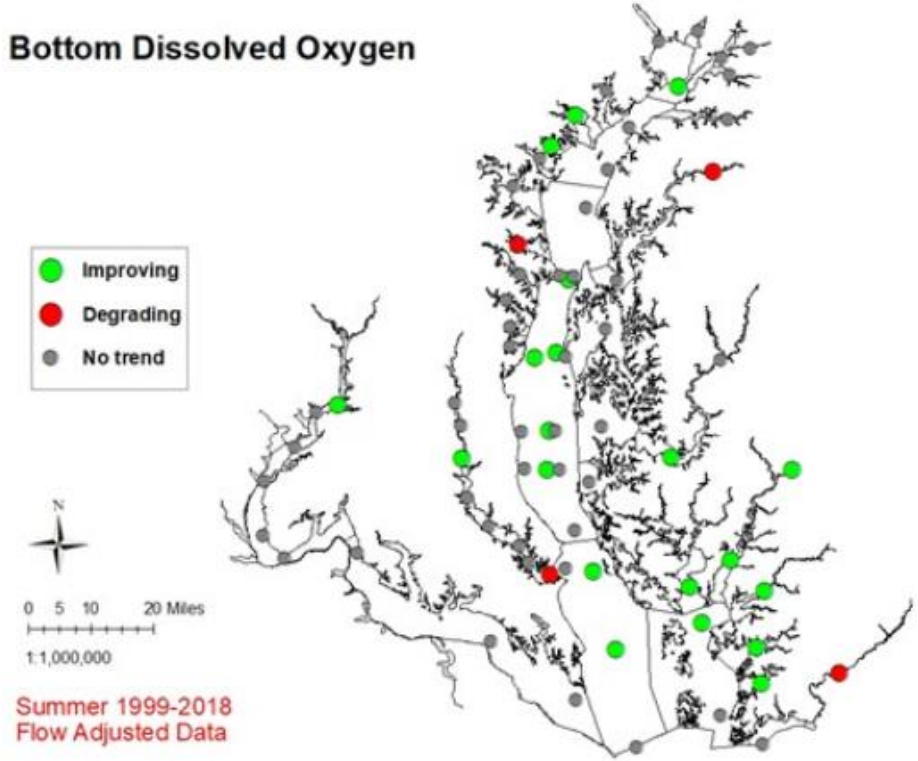
- Maryland has invested billions in bay restoration
  - The 2025 Bay TMDL deadline is close
  - N, P & DO are improving

- It has never been more important to show results and yet ….



All of our tidal waters are either listed as impaired or shown as having insufficient information to assess for DO

We suspect that not every segment is impaired…



https://storymaps.arcgis.com/stories/234759335b7249d88442a7bff53a8784

Pilot Project- Goals and Steps

- Goals of the Pilot Project-
  - **Develop a process to monitor and assess all DO criteria for all uses within a Bay segment.**
  - Demonstrate restoration success story or at least show a segment in good health
  - Apply these lessons in the future segments
- General Steps-
  - Pick candidate segments
  - Develop a 3 year monitoring plan
  - Execute the monitoring plan
  - Assess the data using all available tools

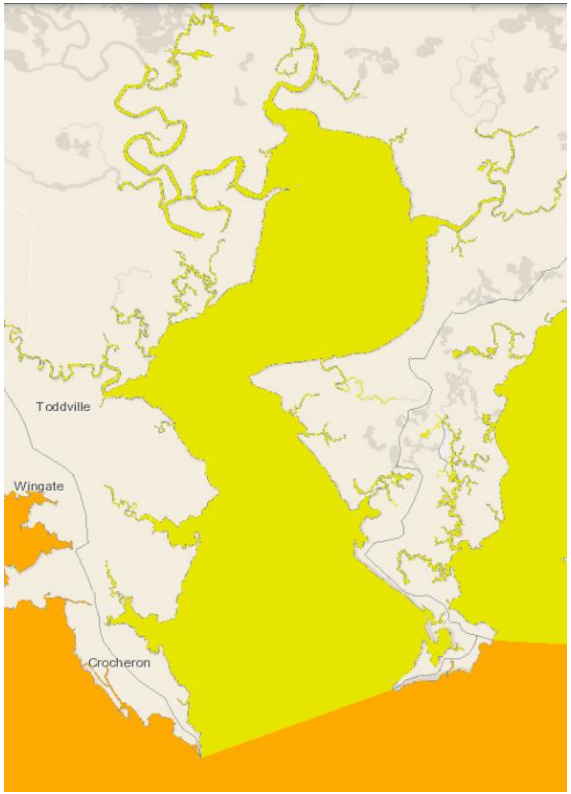
Table II-1. Chesapeake Bay dissolved oxygen water quality criteria.

Designated Use	Criteria Concentration/Duration	Protection Provided	Temporal Application
Migratory fish spawning and nursery use	7-day mean ≥ 6 mg/L (tidal habitats with 0-0.5 salinity)	Survival/growth of larval/juvenile tidal-fresh resident fish; protective of threatened/endangered species	February 1-May 31
	Instantaneous minimum ≥ 5 mg/L	Survival and growth of larval/juvenile migratory fish; protective of threatened/endangered species	
	Open-water fish and shellfish designated use criteria apply		June 1-January 31
Shallow - water bay grass use	Open-water fish and shellfish designated criteria apply		Year-round
Open-water fish and shellfish use[1]	30-day mean ≥ 5.5 mg/L (tidal habitats with ≤0.5 salinity)	Growth of tidal-fresh juvenile and adult fish; protective of threatened/endangered species	Year-round
	30-day mean ≥ 5 mg/L (tidal habitats with >0.5 salinity)	Growth of larval, juvenile and adult fish and shellfish; protective of threatened/endangered species	
	7-day mean ≥ 4 mg/L	Survival of open-water fish larvae	
	Instantaneous minimum ≥ 3.2 mg/L	Survival of threatened/endangered sturgeon species[1]	
Deep-water seasonal fish and shellfish use	30-day mean ≥ 3 mg/L	Survival and recruitment of bay anchovy eggs and larvae	June 1-September 30
	1-day mean ≥ 2.3 mg/L	Survival of open-water juvenile and adult fish	
	Instantaneous minimum ≥ 1.7 mg/L	Survival of bay anchovy eggs and larvae	
	Open-water fish and shellfish designated-use criteria apply		October 1-May 31
Deep channel seasonal refuge use	Instantaneous minimum ≥ 1 mg/L	Survival of bottom-dwelling worms and clams	June 1-September 30
	Open-water fish and shellfish designated use criteria apply		October 1-May 31

1. When water column temperatures are greater than 29 °C, an open water dissolved oxygen criterion for the instantaneous minimum of 4.3 mg/L is applied to protect habitat for survival of shortnose sturgeon.

Source: U.S. EPA 2003a

Select a Candidate Segment



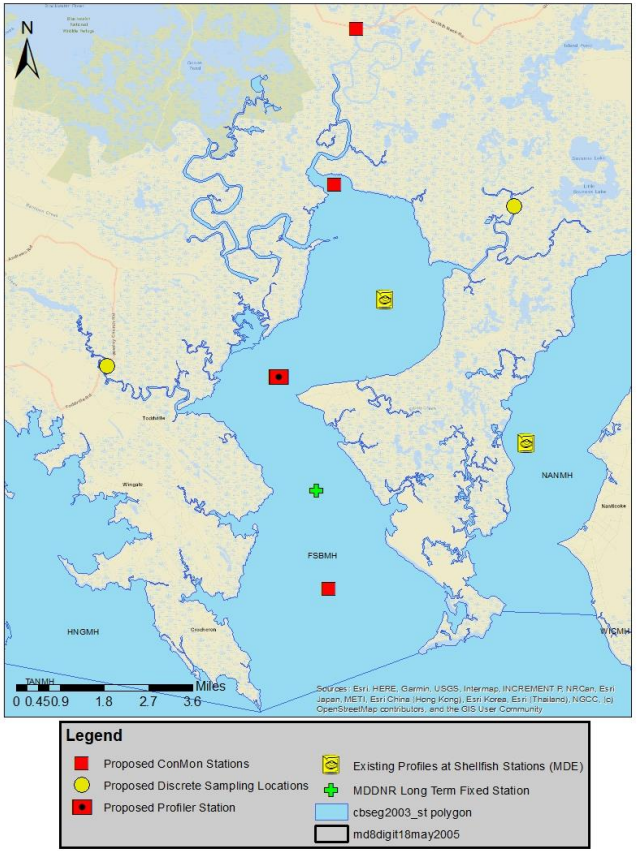
- **Fishing Bay Mesohaline (FSBMH)** was selected for the pilot because:
  - Met OW DO Criteria for Summer and non-Summer
  - Nutrient Indicator trends are improving (TP, TN, TSS, and DO)
  - Met it's SAV restoration goal
  - No major logistical barriers**
  - Simple Pilot- Only designated uses present: OW and MSN
  - Smaller and shallower in depth
  - Currently not assessed as impaired

Develop a 3 Year Monitoring Plan

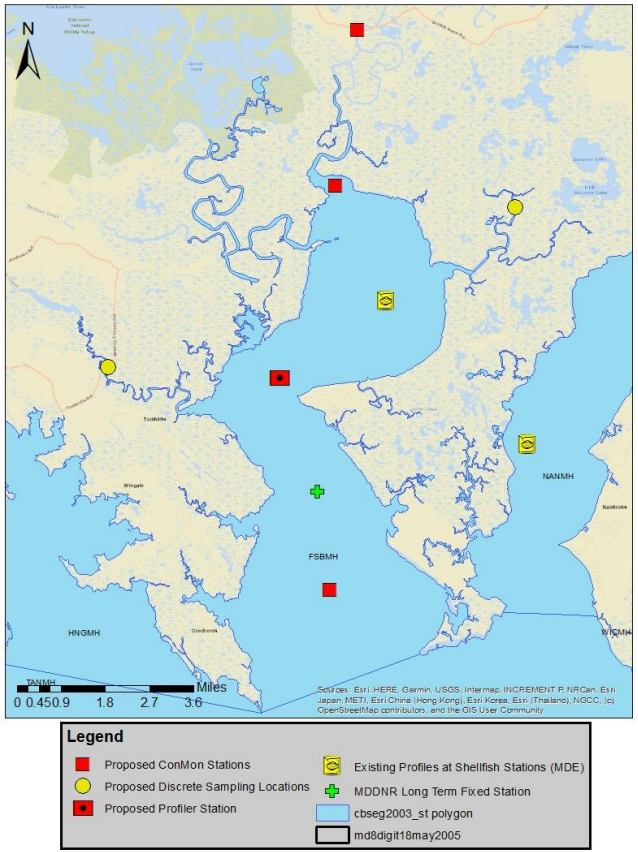
Partnership with MDE and DNR

- What types of sampling can be used to assess each criterion within each zone and where is there overlap?
- Who/What/Where/When?
- Discrete, ConMon, Profiler

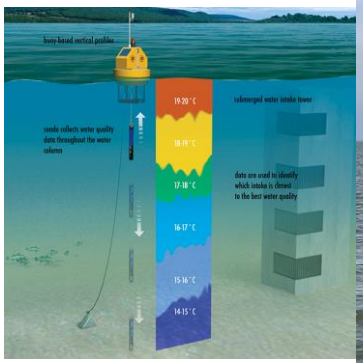
Temporal Components		Geospatial Component		
		Subsegment of Bay Segment		
Designated Use	DO - Duration Criterion	Zone 1: Open water	Zone 2: Shallow water	Zone 3: Isolated waters aka: Tributary of a Tributary
Open Water	30 day Mean	Fixed Station	ConMon	Discrete sampling OR ConMon
	7 day Mean	Fixed Station/Conditional Attainment OR Profiler ConMon	ConMon	Discrete sampling OR ConMon
	Instantaneous Minimum	Covered by assessments of Zone 2 and 3	ConMon	Discrete sampling OR ConMon
Migratory Fish Spawning and Nursery	7 day Mean	N/A	ConMon	Discrete sampling OR ConMon
	Instantaneous Minimum	N/A	ConMon	Discrete sampling OR ConMon
Deep Water	30 day Mean	Fixed Station	N/A	N/A
	1 day Mean	Addressed by Fixed Station Conditional Attainment	N/A	N/A
	Instantaneous Minimum	Addressed by Fixed Station Conditional Attainment	N/A	N/A
Deep Channel	Instantaneous Minimum	Fixed Station	N/A	N/A



Develop a 3 Year Monitoring Plan- Stations



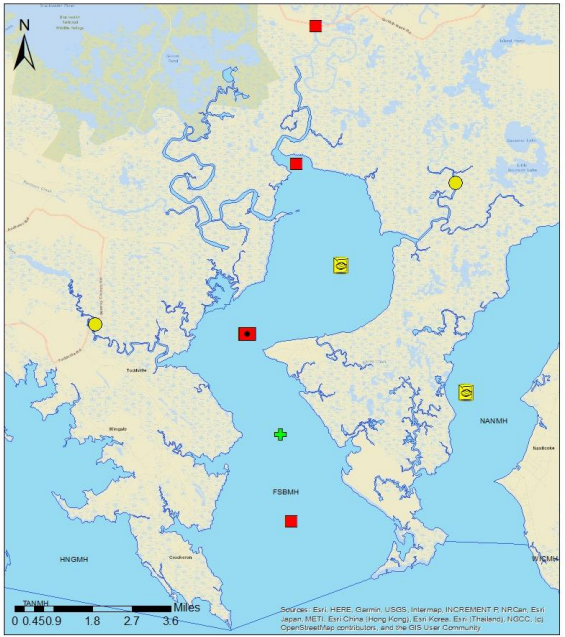
- Combination of discrete and continuous
- Covered all zones and uses

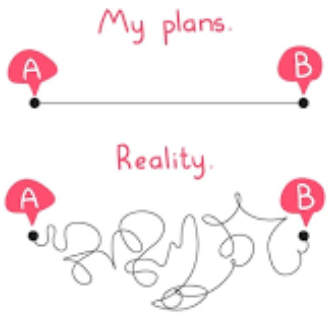


Photos from DNR
Graphic from YSI.com

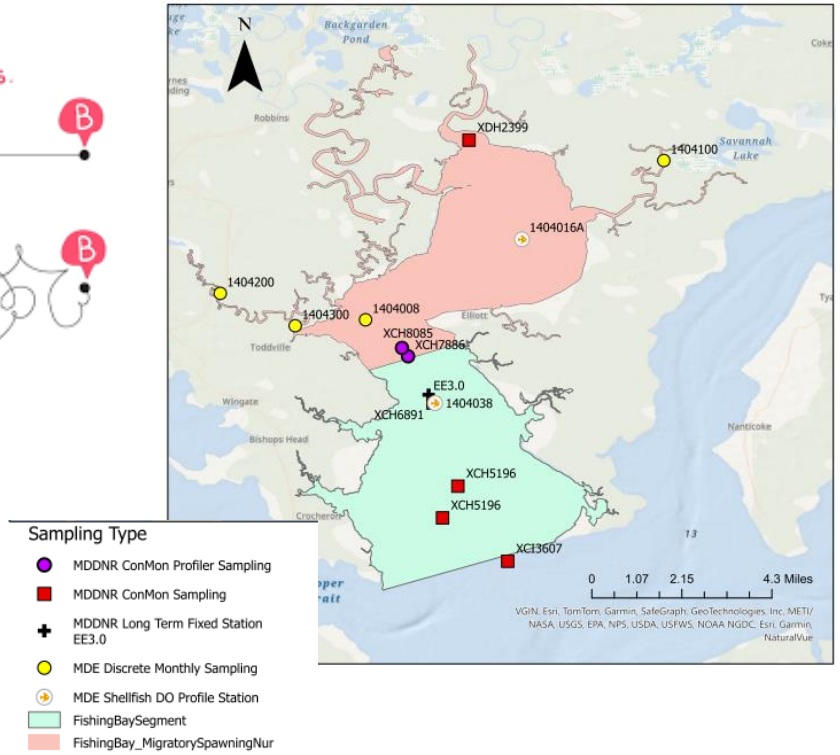
Execute the Monitoring Plan- In Progress

Proposed Monitoring

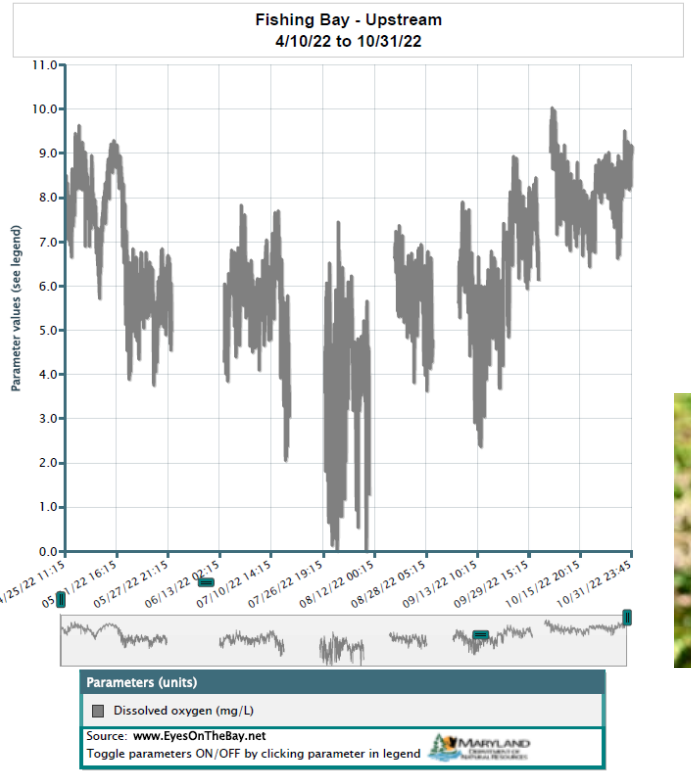




Current Monitoring



Execution- Lessons Learned- Equipment

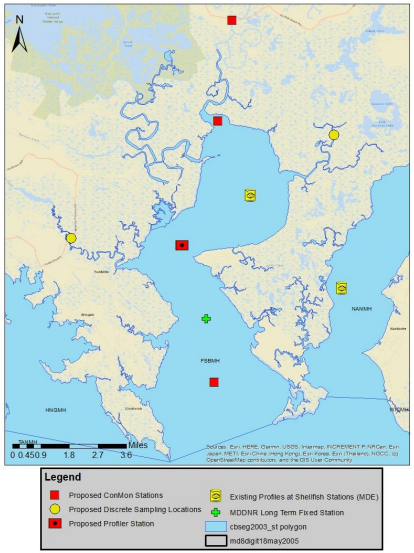


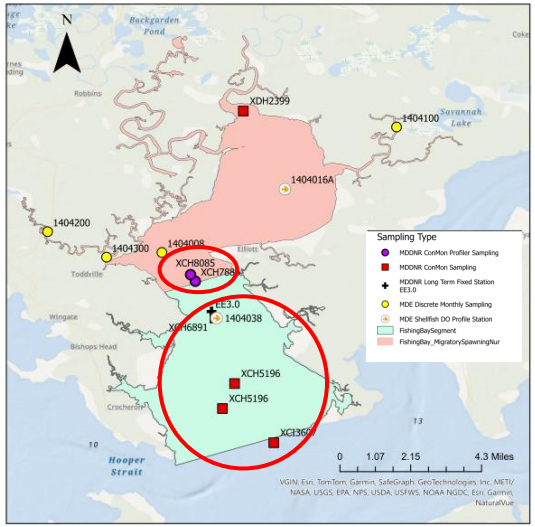
- Biofouling of the ConMon sensors
- MDE purchased 2 additional sondes with a central wiper- new probes
- Profiler not working/maintenance
- Data Drift- CAP WG discussion?

Picture from YSI website

Photos from DNR

Execution- Lessons Learned- *Helpers*

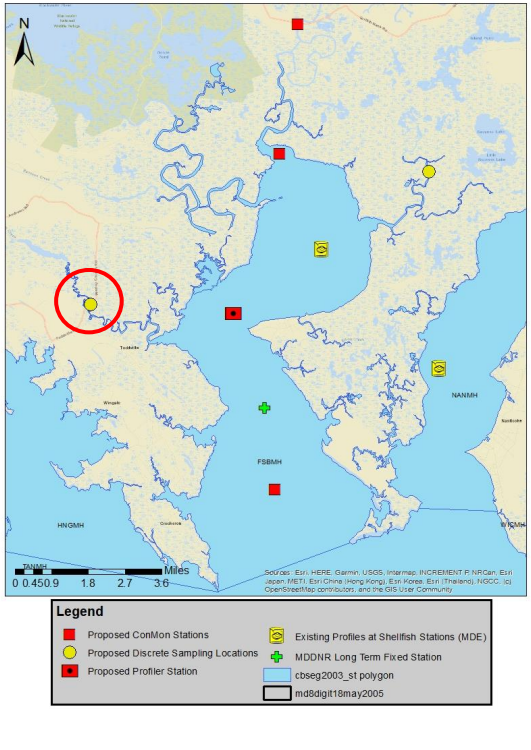


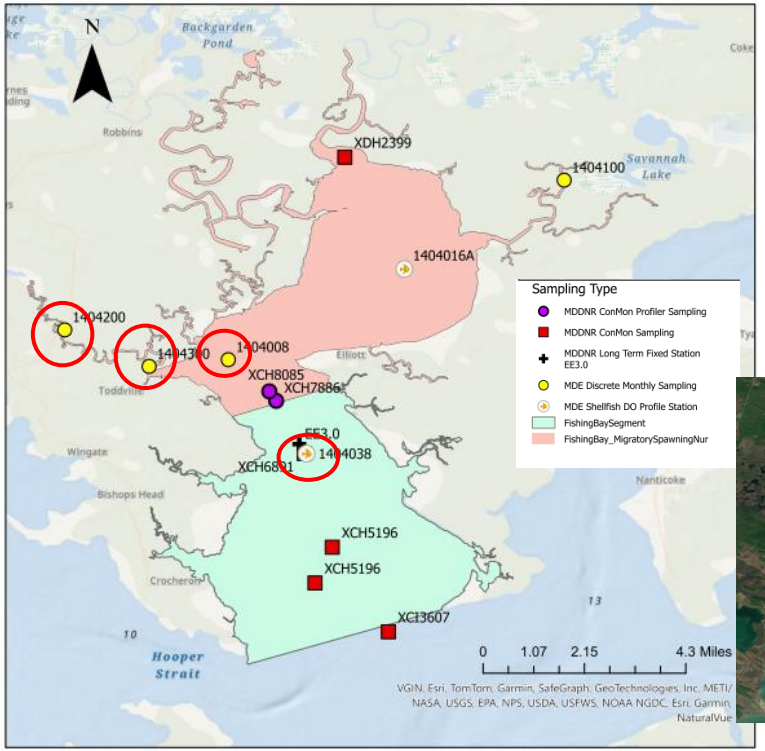


- We had some unwanted *help* in moving our stations
- DNR connected with the watermen

Images from DNR

Execution- Lessons Learned- Preliminary Assessment





- 1404200 Showing lowest DO
- Natural or not?
- Added stations and pH- maybe DOC or BOD?

Assess Data Using All Available Tools

What are the available tools? Which ones should we use? How do they compare to each other?

- Proposed Assessment Methodology for Virginia's Chesapeake Bay Dissolved Oxygen Criteria?
- 10% rule?
  - By station
  - By segment
  - By use
- Discrete vs. Profiler vs. ConMon
- Interpolator?
- Special Considerations for ConMon?

From 2017 Technical Addendum: Recommended Methods DO Criteria Attainment

Zone	Zone Description	Applicable Criteria Assessment Procedures
1	Open, well-mixed mainstem Bay and tidal tributary waters	• CFD-based assessment of the 30-day mean • CFD-based assessment of the 7-day mean with enhanced temporal frequency of monitoring • Conditional attainment assessment of the 7-day mean • Continuous monitoring-based assessment of the instantaneous minimum
2	Shallow-water waters	• Continuous monitoring-based assessment of the instantaneous minimum
3	Tributaries of tributaries off of the mainstem Chesapeake Bay and its tidal tributaries	• Discrete sampling-based assessment of the instantaneous minimum

CBSEG_92	SPLIT SEGS	MSN	MSN ATTAINMENT	DO OWsum	Owsum ATTAINMENT	DO OW Other	OW OTHER ATTAINMENT	DO DW	DW ATTAINMENT	DO DC	DC ATTAINMENT	SW BAY GRASSES	ATTAINMENT	CHLA-spring	CHLA-summer	CHLA ATTAINMENT
CB1TF				0.00%	1	0.00%	1									
	CB1TF1											y	1			
	CB1TF2											n	0			
CB2OH				0.00%	0	0.00%	1					y	1			
CB3MH				0.00%	1	0.00%	1	3.89%	0	11.57%	0	n	0			
CB4MH				0.00%	1	1.52%	0	17.14%	0	45.48%	0	n	0			
CB5MH_MD				0.00%	1	0.00%	1	6.23%	0	13.56%	0	n	0			
CB5MH_VA				0.022%	0	0.000%	1	0.28%	0	2.68%	0	n	0			
CB6PH				0.02%	0	0.00%	1	0.00%	1			n	0			
CB7PH				2.40%	0	0.00%	1	0.00%	1			n	0			
CB8PH				0.00%	1	0.00%	1					y	1			
CHKOH				19.75%	0	0.00%	1					y	1			
CHOMH1				1.59%	0	0.00%	1					y	1			
CHOMH2				7.31%	0	0.00%	1					n	0			
CHOOH				17.64%	0	0.00%	1					n	0			
CHOTF				26.35%	0	0.96%	0					NGZ				
CHSMH				4.24%	0	0.00%	1	9.98%	0	19.89%	0	n	0			
CHSOH				8.39%	0	0.00%	1					y	1			
CHSTF				17.88%	0	0.00%	1					y	1			
CRRMH				15.08%	0	0.05%	0					n	0			
EASMH				0.00%	1	0.00%	1	5.27%	0	24.82%	0	n	0			
EBEMH				54.78%	0	0.00%	1					NGZ				
ELIPH				0.00%	1	0.00%	1	0.00%	1	0.00%	1	NGZ				
ELKOH				0.00%	1	0.00%	1									
	ELKOH1											y	1			
	ELKOH2											n	0			
FSBMH				0.00%	1	0.00%	1					y	1			
GUNOH				0.00%	1	0.00%	1									
	GUNOH1											n	0			
	GUNOH2											y	1			
HNGMH				1.79%	0	0.00%	1					n	0			

Image from Tish Robertson's Dissolved Oxygen Criteria Assessment at Virginia's Chesapeake Bay Continuous Monitoring Stations presentation- 1/22/20

Fishing Bay Case Study Updates

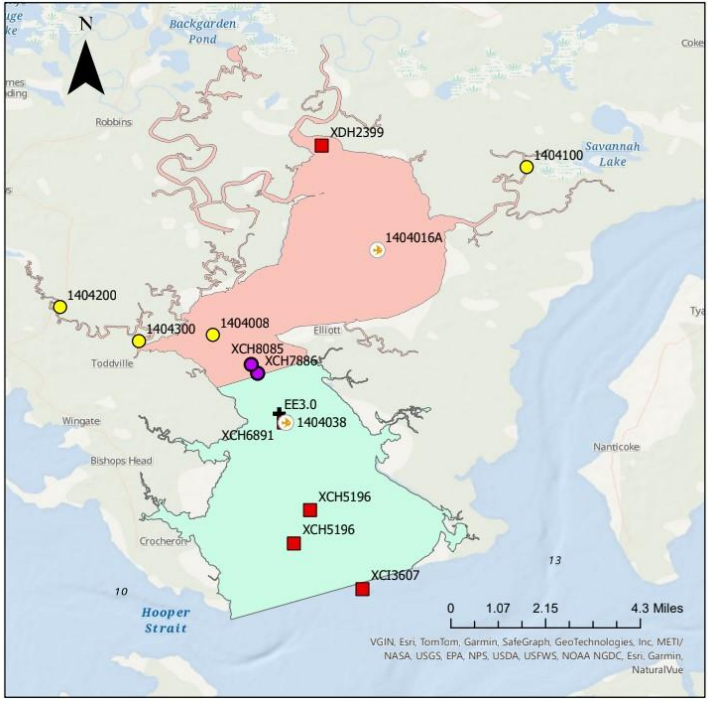
Preliminary Assessment

Assessment Overview

- Modified R scripts shared by VA
  - No rounding
  - Assessed all applicable samples against IM criteria regardless of sample layer
  - Assessed profiler stations at max depth
  - Required at least 75% monitored days to calculate 7-day and 30-day means
- Station by station assessment

Station Characterization

Station	Designated Use	Data Type	Assessment Date Range
EE3.0	OW	Discrete	04/2022 - 12/2023
1404100	MFSN	Discrete	04/2022 - 02/2024
1404200	MFSN	Discrete	04/2022 - 02/2024
1404016A	MFSN	Discrete	04/2022 - 03/2024
XCH8085	MFSN	ConMon - Profiler	05/2022 - 12/2022
XCH7886	MFSN	ConMon - Profiler	04/2023 - 05/2024
FBD_XCH5196	OW	ConMon	04/2022 - 09/2022
FBM_XCH6891	OW	ConMon	11/2022 - 05/2023
FBL_XCI3607	OW	ConMon	05/2023 - 04/2024
FBU_XDH2399	MFSN	ConMon	04/2022 - 04/2024



Applicable Criteria

Table II-1. Chesapeake Bay dissolved oxygen water quality criteria.

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	Instantaneous minimum ≥ 5 mg/L	Survival and growth of larval/juvenile migratory fish; protective of threatened/endangered species	
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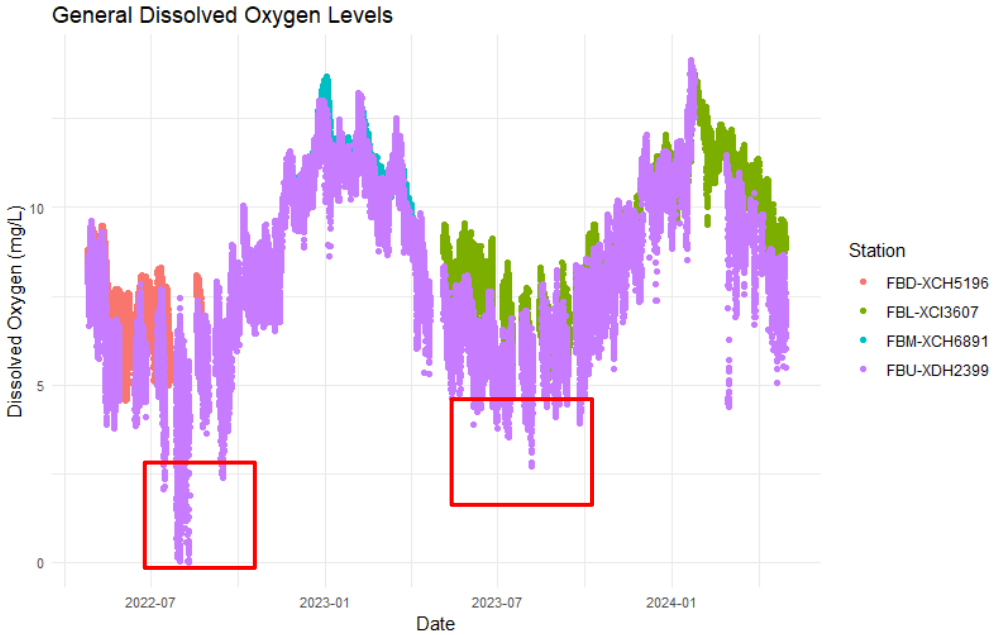
Open-water fish and shellfish use[1]	30-day mean ≥ 5.5 mg/L (tidal habitats with ≤0.5 salinity)	Growth of tidal-fresh juvenile and adult fish; protective of threatened/endangered species	Year-round
	30-day mean ≥ 5 mg/L (tidal habitats with >0.5 salinity)	Growth of larval, juvenile and adult fish and shellfish; protective of threatened/endangered species	
	7-day mean ≥ 4 mg/L	Survival of open-water fish larvae	
	Instantaneous minimum ≥ 3.2 mg/L	Survival of threatened/endangered sturgeon species[1]	

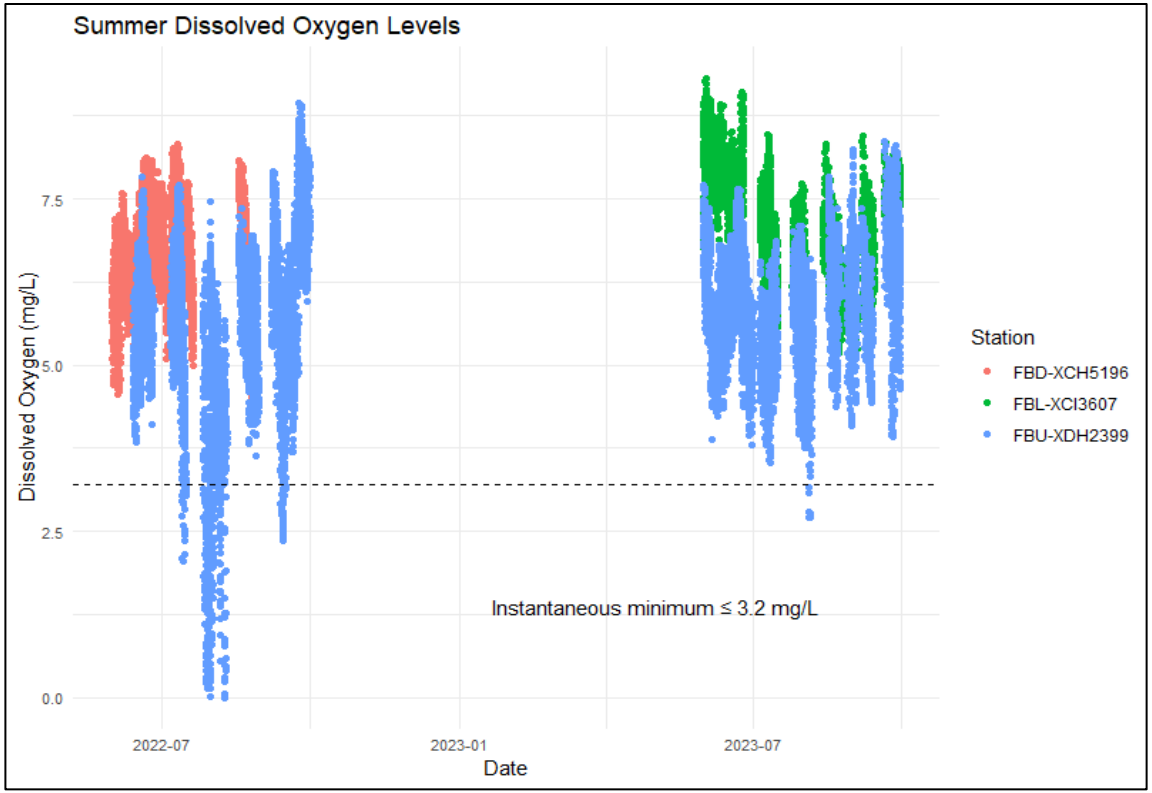
Source: U.S. EPA 2003a

ConMon Stations

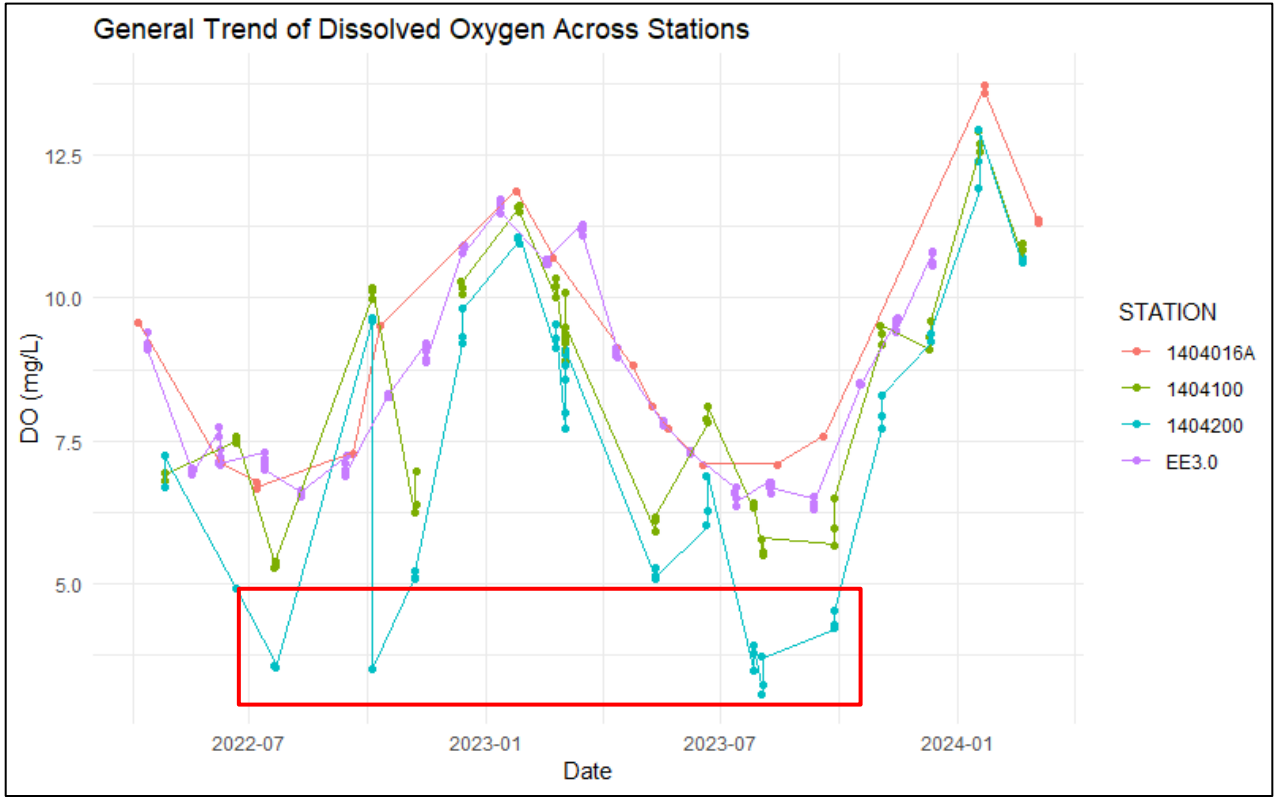


Station	OW_30D Year-round	OW_7D Year-round	OW_IM Year-round	MFSN_IM	MFSN_30D ROY	MFSN_7D ROY	MFSN_IM ROY	OW_IM SUMMER	OW_7D SUMMER	OW_30D SUMMER
FBU_XDH2399	0.0%	0.0%	1.4%	1.2%	0.0%	2.2%	2.1%	5.1%	5.9%	0.0%

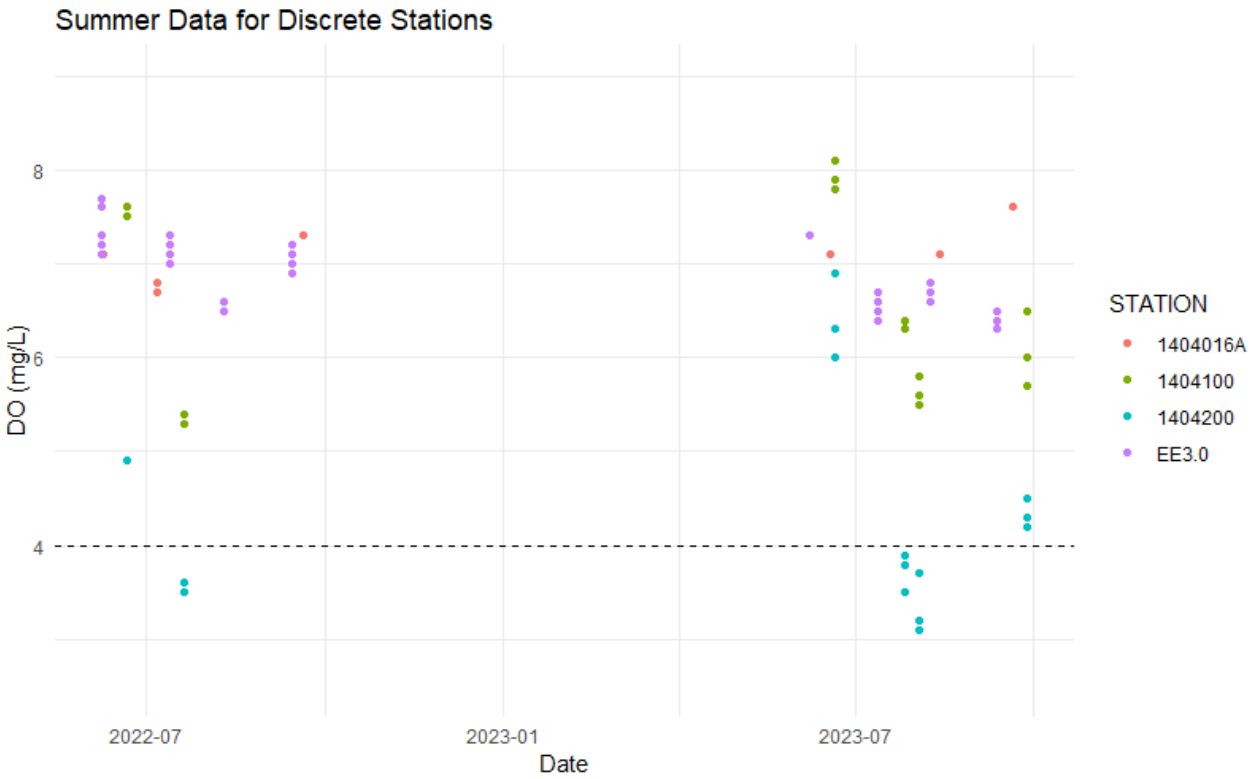
ConMon Stations - Summer



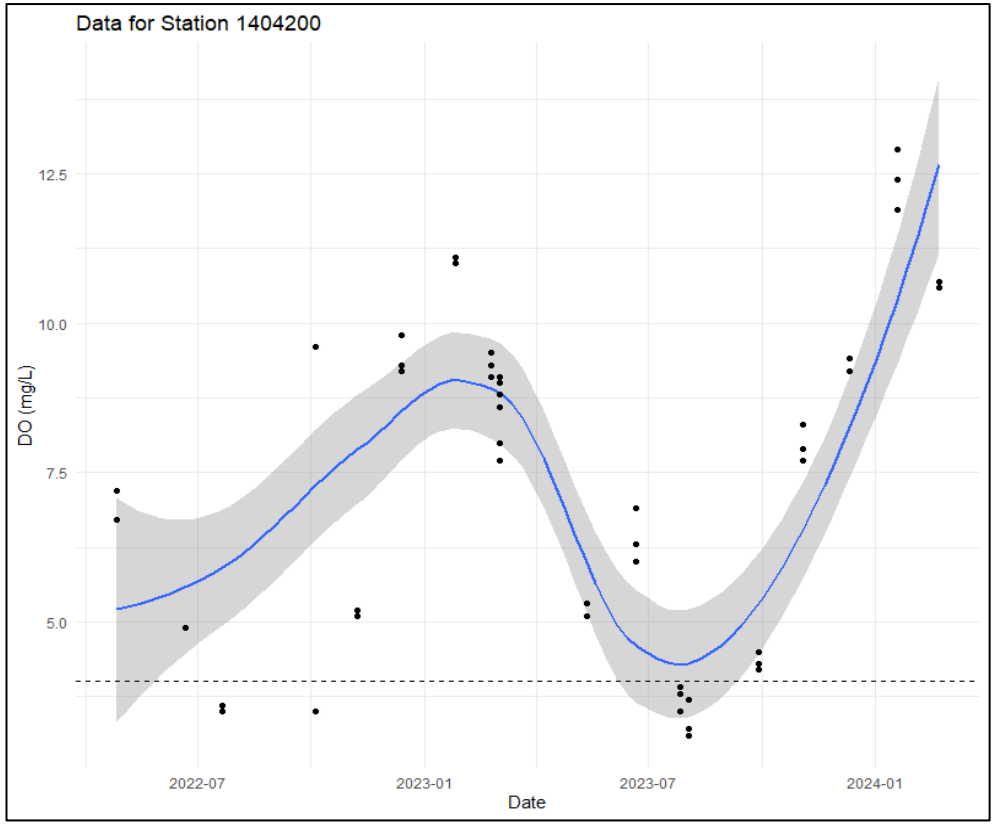
Discrete Stations



Discrete Stations - Summer



Discrete Stations - 1404200



Discrete Stations - 1404200

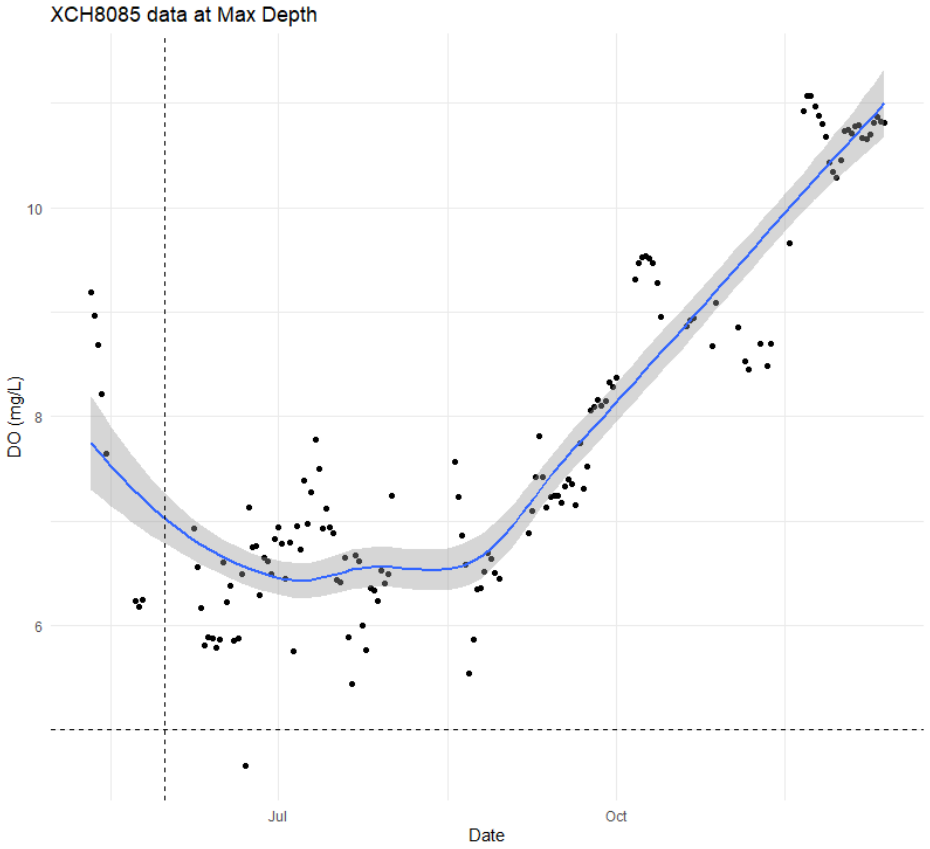
Open Water Criteria (June 1 to Jan 31)

	DEPTH_CAT	Count	Exceedances_7day	Exceedances_30day	IM_Exceedances	Exceedance_Rate_7day	Exceedance_Rate_30day	IM_Exceedance_Rate
1	0.5-0.9	13	3	5	2	0.2307692	0.3846154	0.1538462
2	1-1.1	13	3	5	2	0.2307692	0.3846154	0.1538462
3	1.2+	11	3	5	0	0.2727273	0.4545455	0.0000000

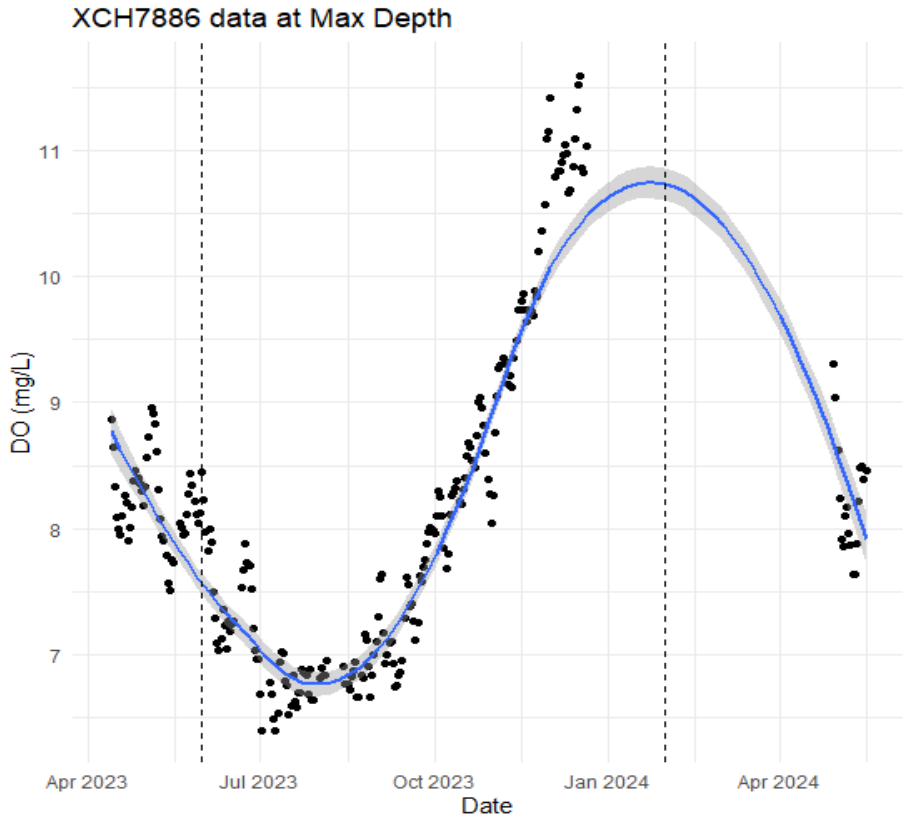
MFSN Criteria (Feb 1 to May 31)

	DEPTH_CAT	Count	IM_Exceedances	IM_Exceedance_Rate
1	0.5-0.9	7	0	0
2	1-1.1	5	0	0
3	1.2+	5	0	0

ConMon Profiler Stations - XCH 8085



ConMon Profiler Stations - XCH 7886



Summary

- Minimal exceedances in main segment
- Collecting additional data around Station 1404200
- Next step: develop discrete + continuous monitoring assessment methodology

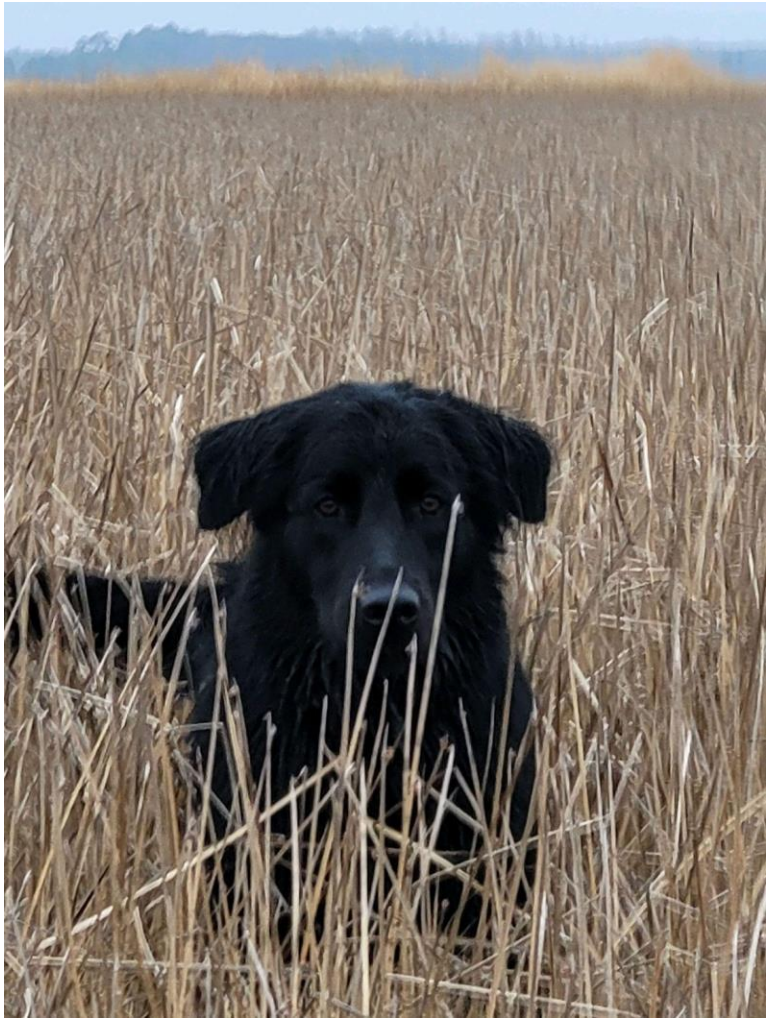
**Request for CBP Assistance: Is the CBP willing to run this data through the 3-D and 4-D interpolator and assist with comparisons of assessment methodologies?

Questions/Concerns

- Blackwater conditions and potential parallel with POCOH/POCTF
- How to assess space represented by one low DO station?
- How to include profiler data in the assessment?
- What should be the frequency of exceedance for IM and 7-day mean?
- Should we assess each station individually rather than aggregated by monitoring frequency?
- Should we continue data collection based on current results or other factors?

Possible Lessons to be Learned

- Can we achieve similar results with less stations?
- Are the assessment methods comparable with assessments from the interpolator?
  - What does this mean for the interpolator?
  - Do we still need a model to assess this data, or is continuous monitoring giving us the spatial and temporal variability that models were originally trying to produce?
  - If we do still need a model, what do we need it to do and why?
  - Who will run it?
  - Can we (States) understand it and explain it to the public?



Contact Information:

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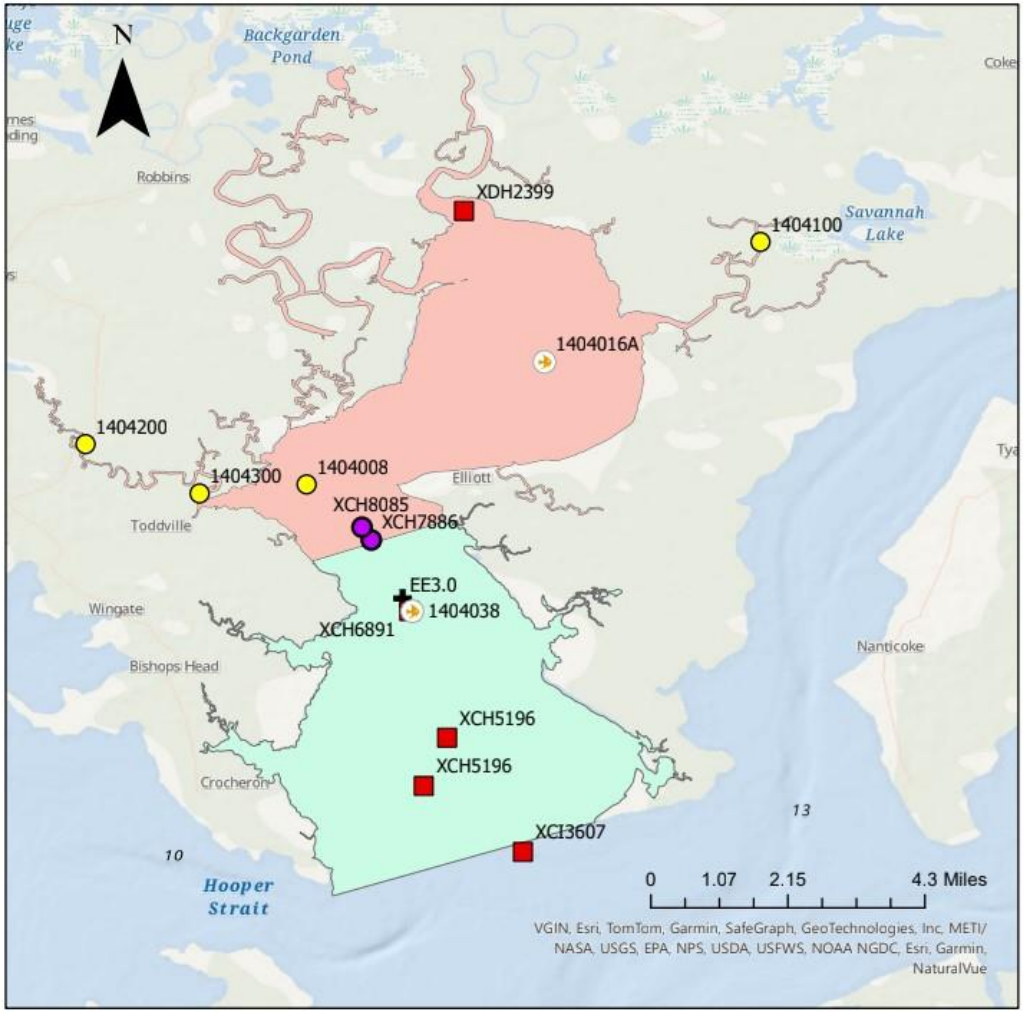
Watershed Protection, Restoration, and Planning Program

Maryland
Department of the Environment



Sampling Type

- MDDNR ConMon Profiler Sampling
- MDDNR ConMon Sampling
- MDDNR Long Term Fixed Station EE3.0
- MDE Discrete Monthly Sampling
- MDE Shellfish DO Profile Station
- FishingBaySegment
- FishingBay_MigratorySpawningNur