Water Quality Criteria Attainment Patterns

Segment & Designated Use

Water Quality GIT Meeting

October 13, 2015

Mindy Ehrich

Planning effort including: Jeni Keisman, Rebecca Murphy, Gary Shenk, Rich Batiuk, Peter Tango, Richard Tian, & Kyle Hinson

Chesapeake Bay Program

Science. Restoration. Partnership.

Outline

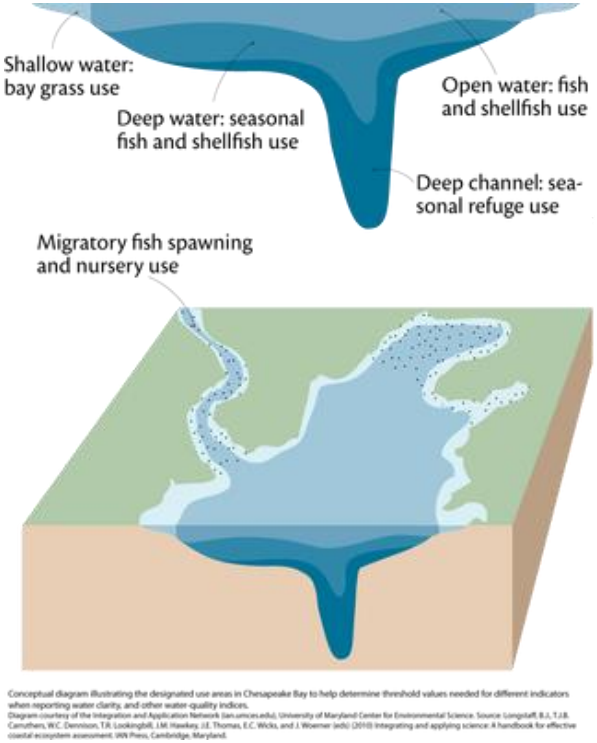
- **Attainment vs. Percent to Attainment**

- **Segment Level & Designated Use Percent to Attainment**

  1. Shallow Water Designated Use
     - Categorization
     - Trends
     - Maps

  2. Dissolved Oxygen Designated Uses
     - Categorization
     - Trends
     - Maps

  3. Chlorophyll Designated Use



Conceptual diagram illustrating the designated use areas in Chesapeake Bay to help determine threshold values needed for different indicators when reporting water clarity, and other water-quality indices.
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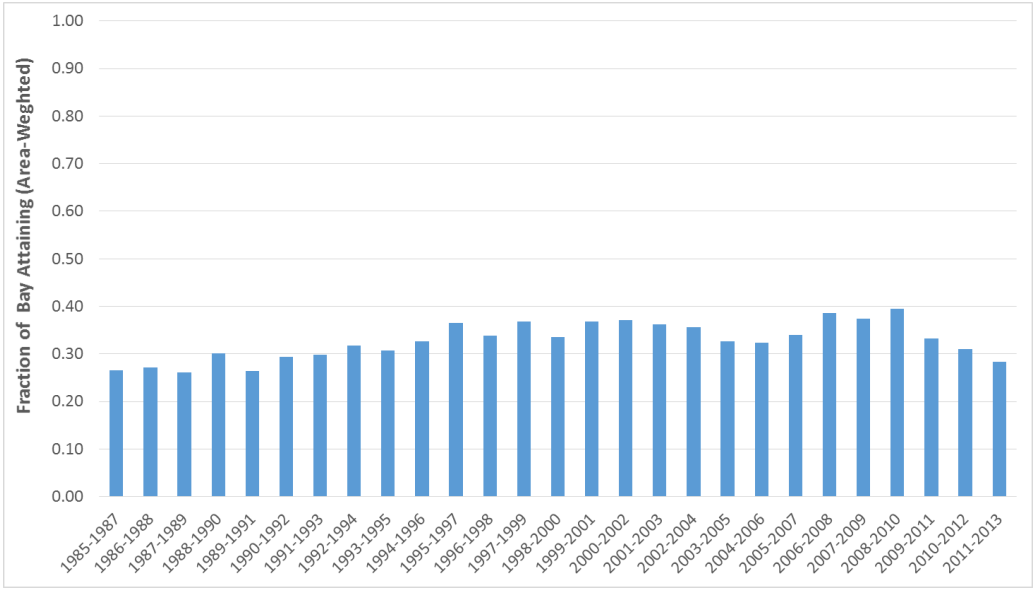
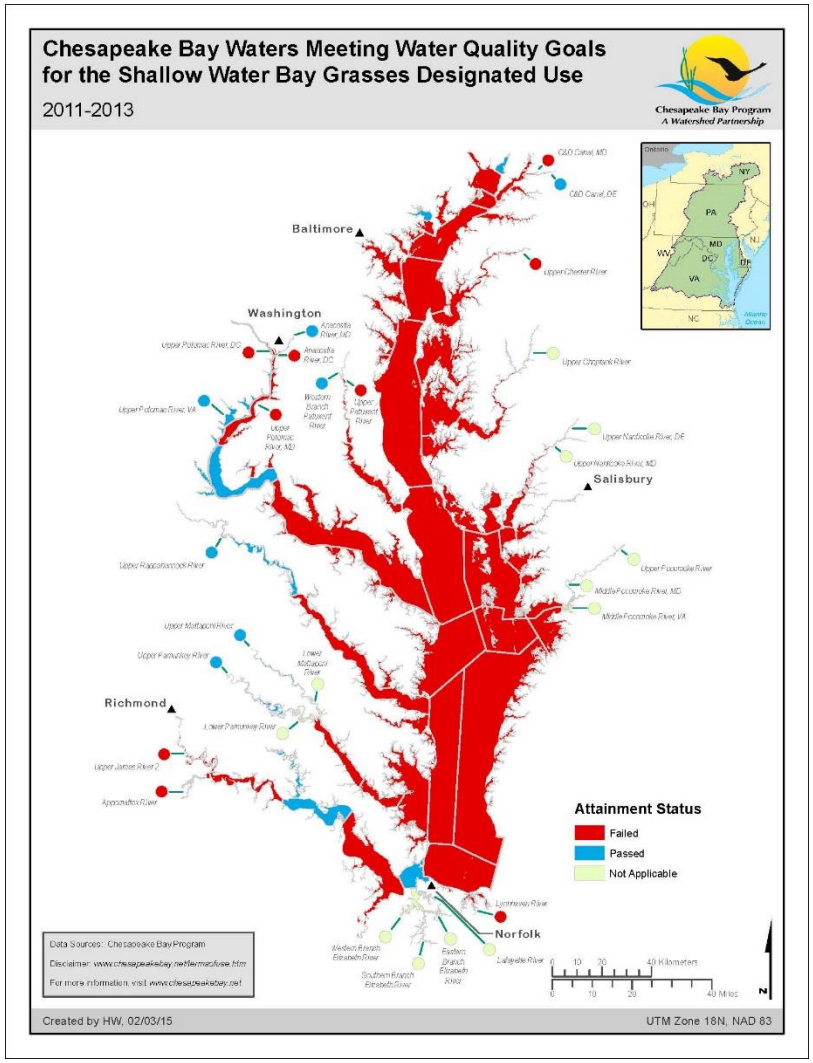
Water Quality Criteria Attainment

Area-Weighted Fraction of Bay In Attainment for Each 3-year Period



Single 3-year Period Pass/Fail for Shallow Water Segments



Attainment vs. Percent to Attainment
Segment and Designated Use

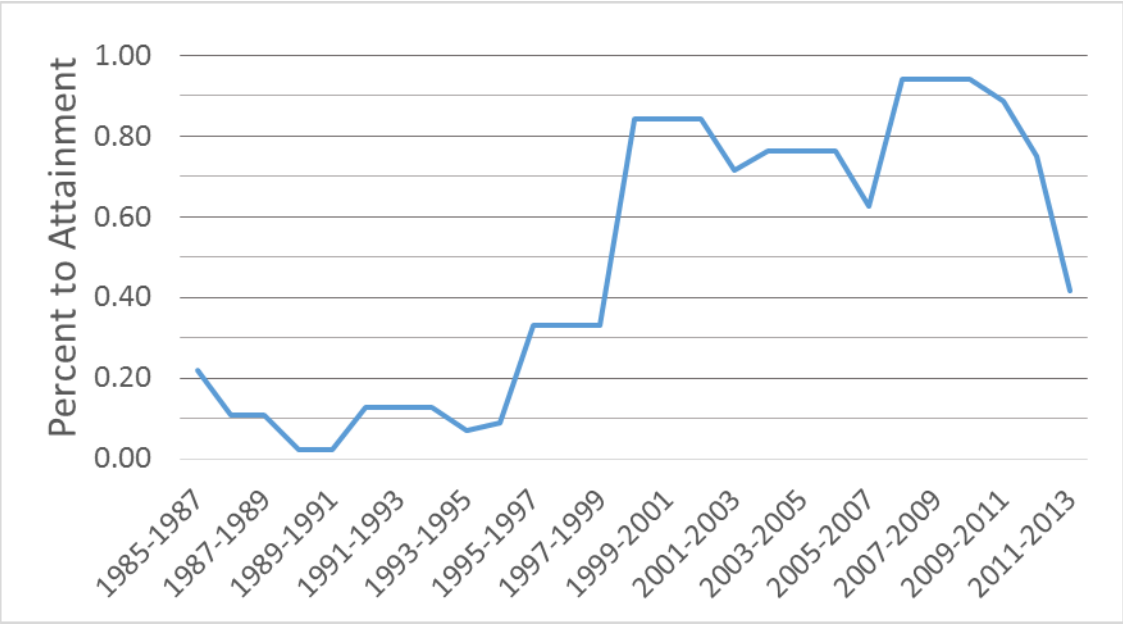
- Single Segment Attainment
  - Is criteria met? Yes/No
  - Either 0 or 1
- Single Segment Percent to Attainment
  - How close is the segment to attainment?
  - Percent to attainment = 100% – percent segment out of attainment (%)
    - For DO and Chlorophyll DUs, this is both spatial and temporal (CFD Curves)
    - SW based on acreage goal

PAXTF OW DO

Years	Attainment	Percent to Attainment
1985-1987	1	100%
1986-1988	1	100%
1987-1989	1	100%
1988-1990	1	100%
1989-1991	1	100%
1990-1992	1	100%
1991-1993	1	100%
1992-1994	0	97%
1993-1995	0	91%
1994-1996	0	91%

How can we describe what is occurring with Shallow Water/Bay Grasses by Segment?

SW Example:



MIDOH

Shallow Water Criteria:

-% to SAV Acreage Goal

OR

-% to Clarity Acres Goal

- SW has a range from 0% to 100%
- Many significant trends
- Clarity for selected years adds complexity for analysis

Categorization for Shallow Water / Bay Grasses

Segment Behavior

At / Near Attainment

Other / In Between

At 0% / <10% *

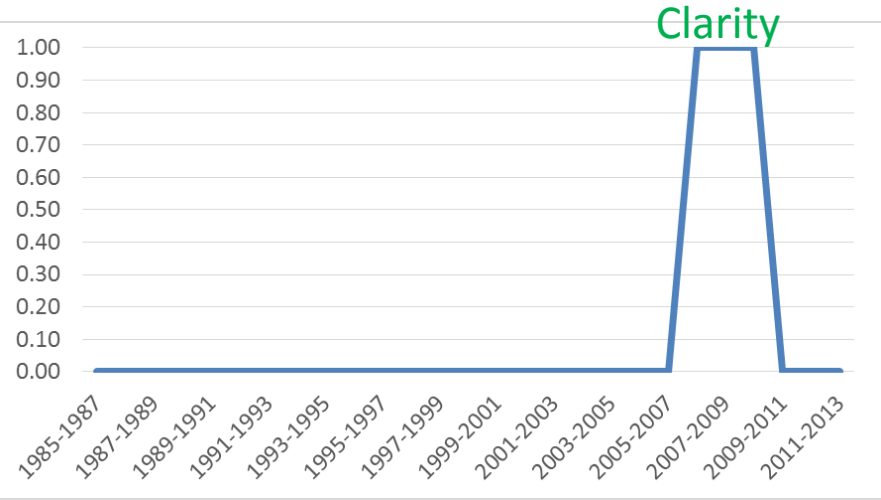
* Ignoring clarity

Trends in % to Attainment

↓ - Decreasing

↑ - Increasing

★ - Increasing Due to Clarity



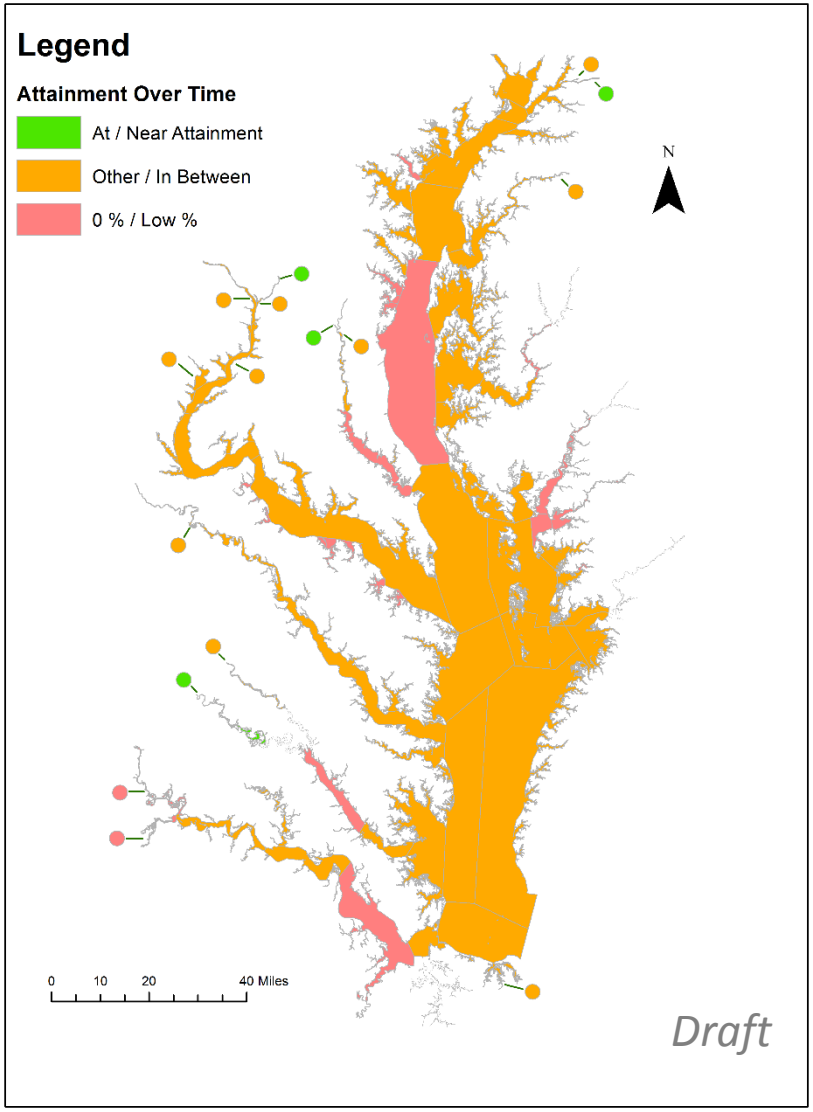
WICMH

← With no clarity, the segment is at 0%. The behavior would be in the category: At 0% / <10%.

← Clarity did **NOT** create a **SIGNIFICANT** upward trend here, so **NO TREND**.

Segment Level Analysis

Percent to attainment: Shallow Water 1985-2013



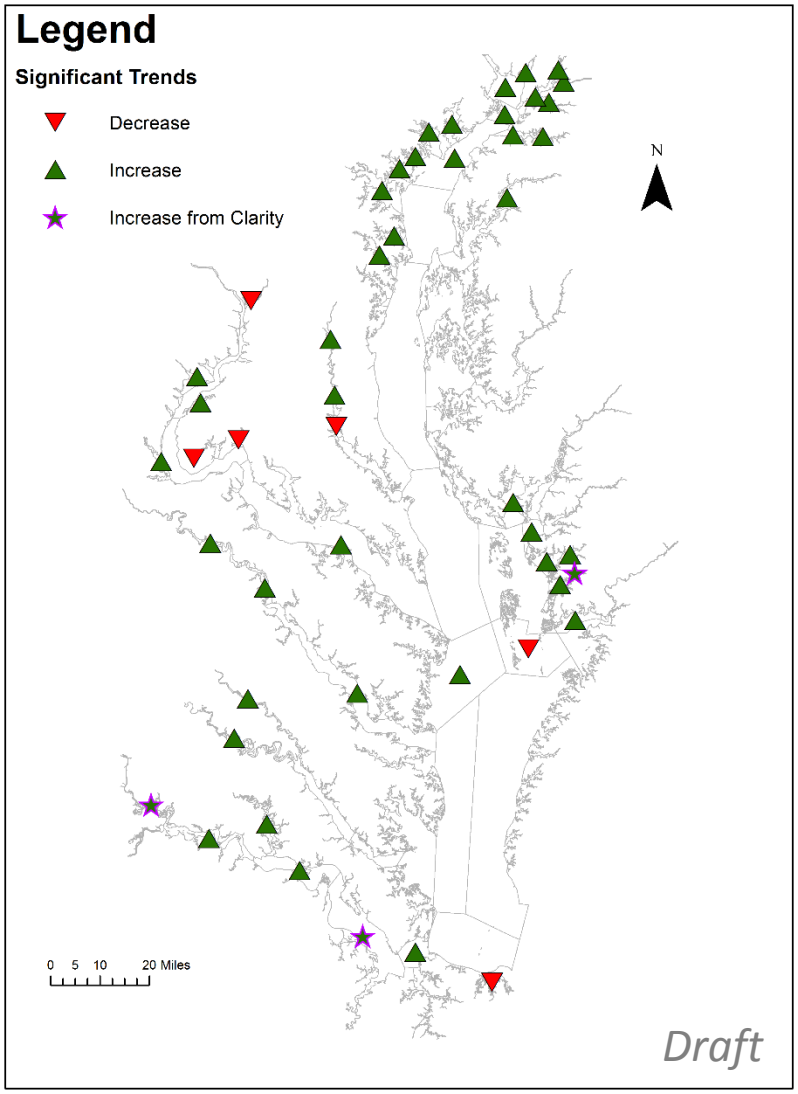
How have the segments been doing?

Category	Count
At / Near Attainment	6
Other / In Between	66
At 0% or <10%	19

Most segments have not been attaining over the time period.

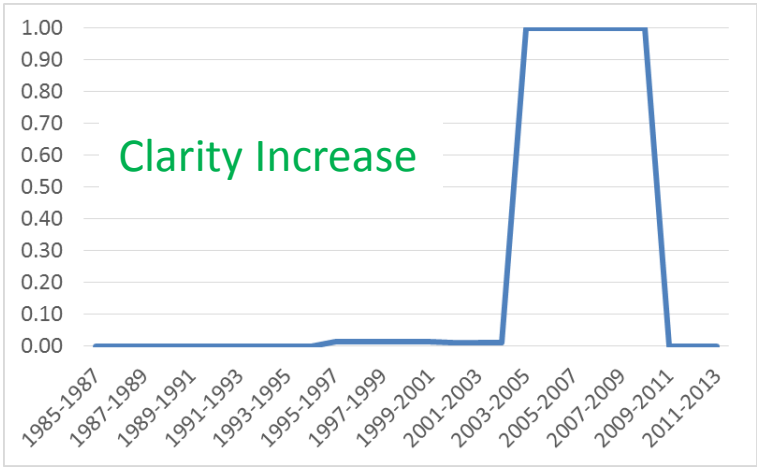
Segment Level Analysis

Percent to attainment: Shallow Water 1985-2013



Are there trends?

Trend	Count
Significant ↑	40 / 43 (clarity)
Significant ↓	6

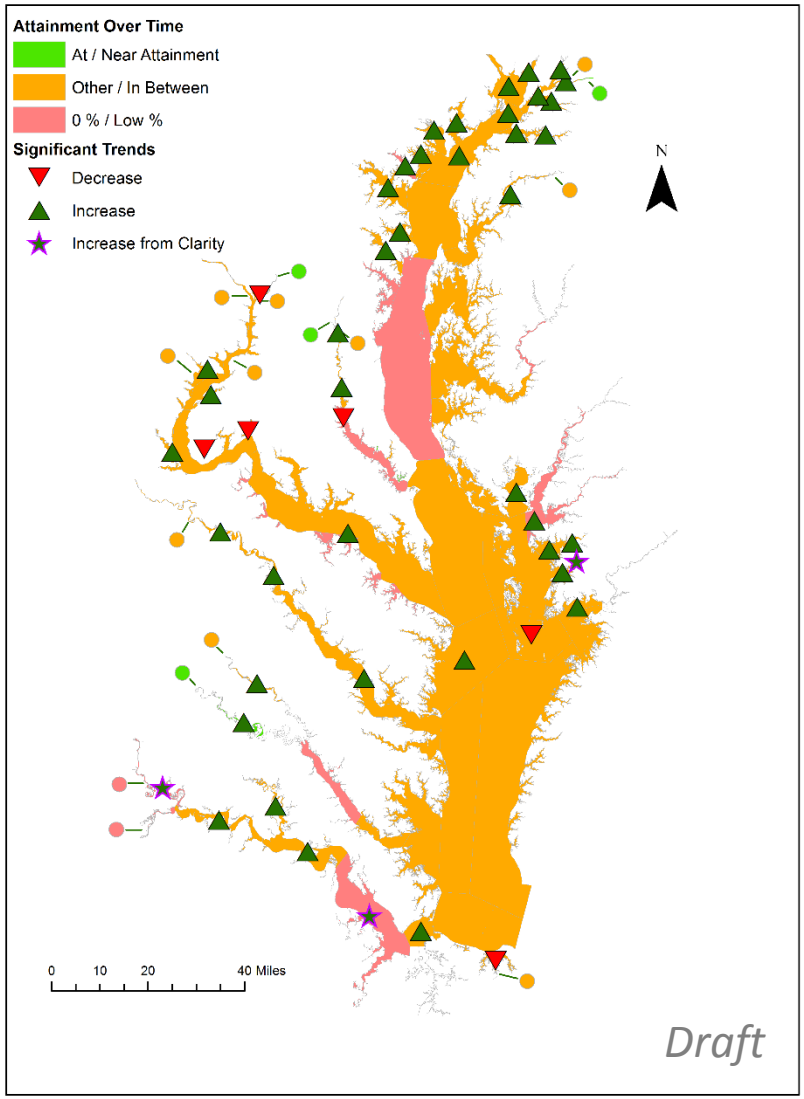


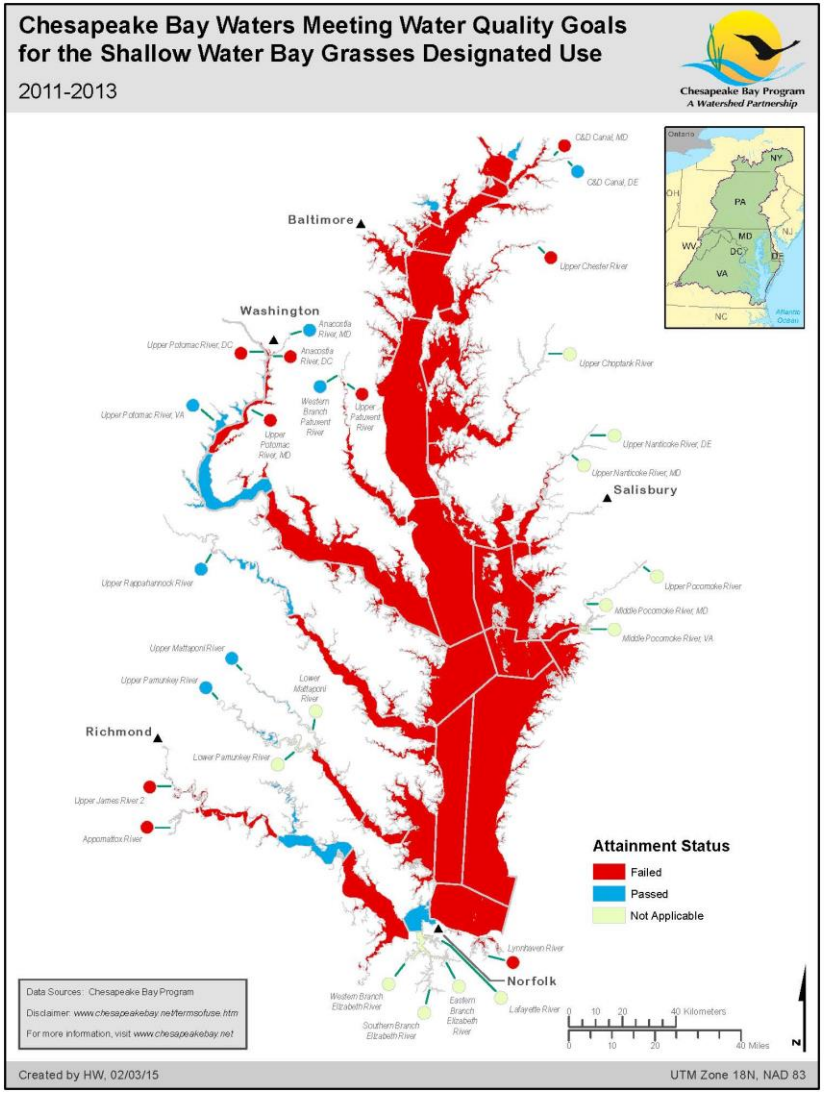
JMSMH

A majority of trends are increasing.

Segment Level Analysis

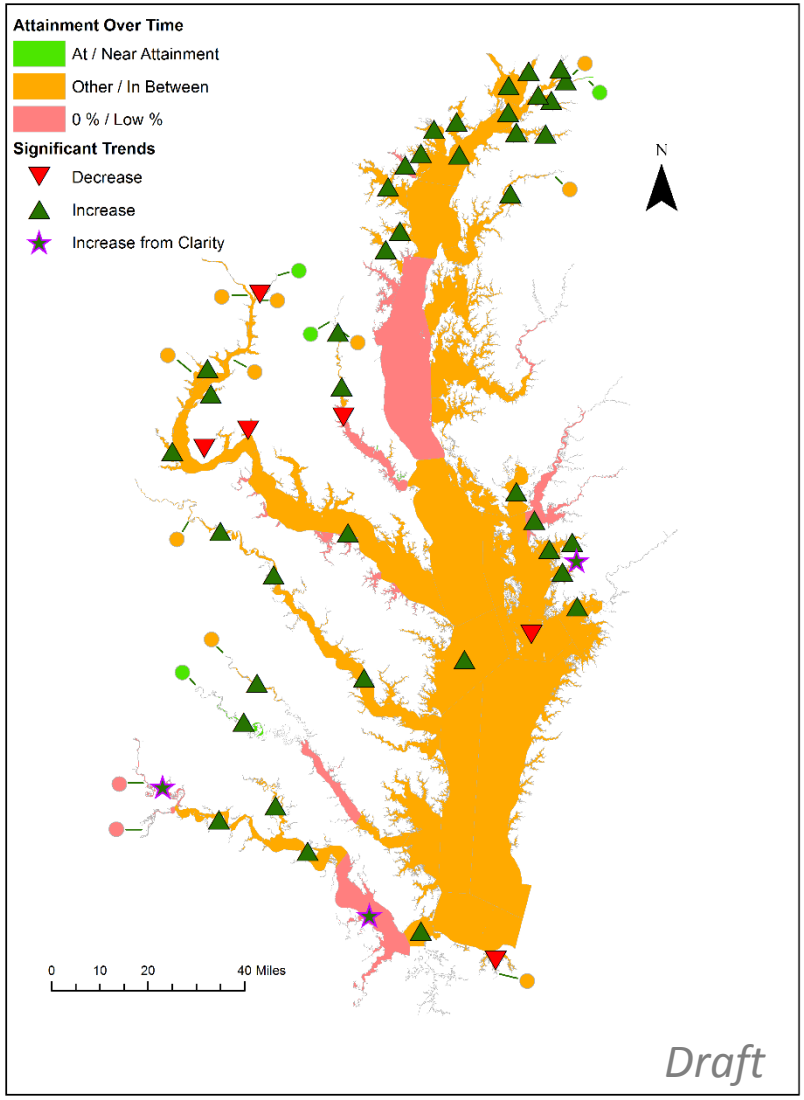
Percent to attainment: Shallow Water 1985-2013





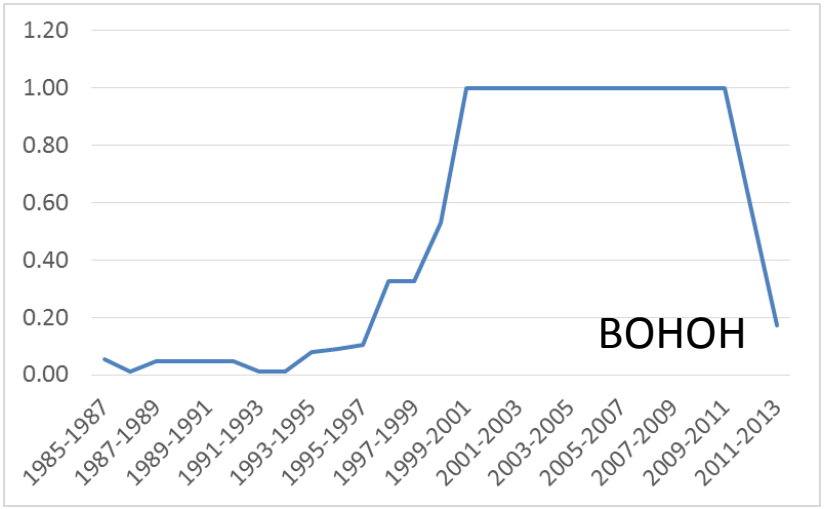
Segment Level Analysis

Percent to attainment: Shallow Water 1985-2013



General Findings:

- High Variability -> Some segments drop from 100% to 0%.
- Many decreases in the last 3 years that are not captured by the trend from 1985-2013.



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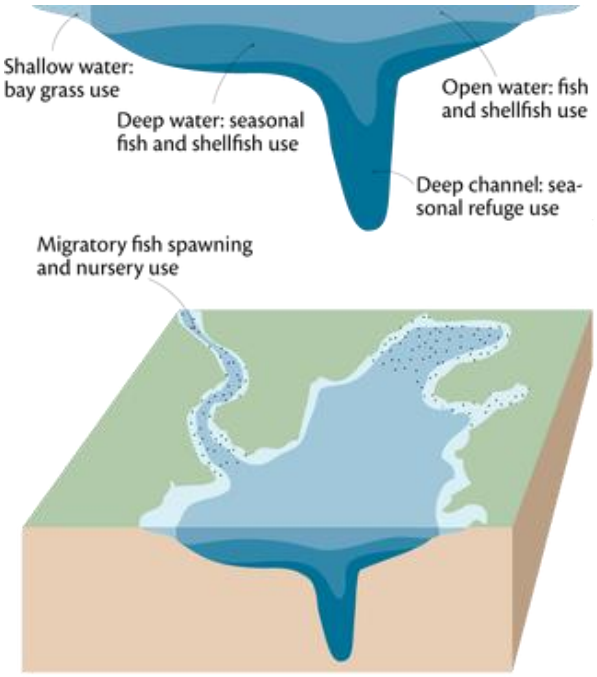

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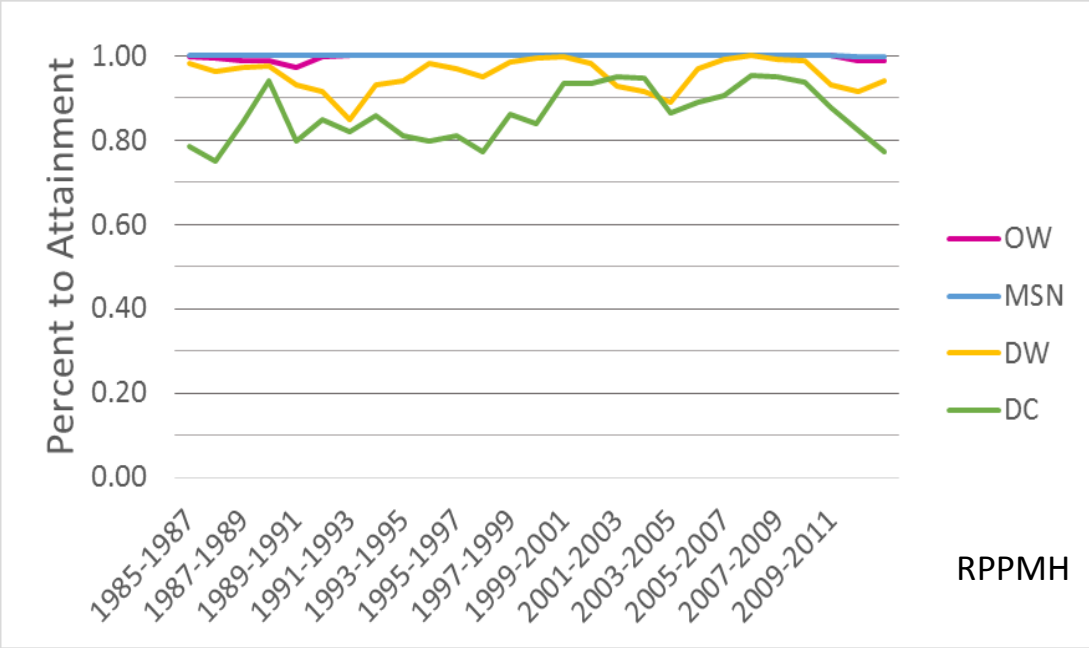
How can we describe what is occurring with DO DUs by Segment?

One Segment Dissolved Oxygen DUs (DC, DW, OW, MSN):



- Not many segments found to have a trend
- Most values were above 75%

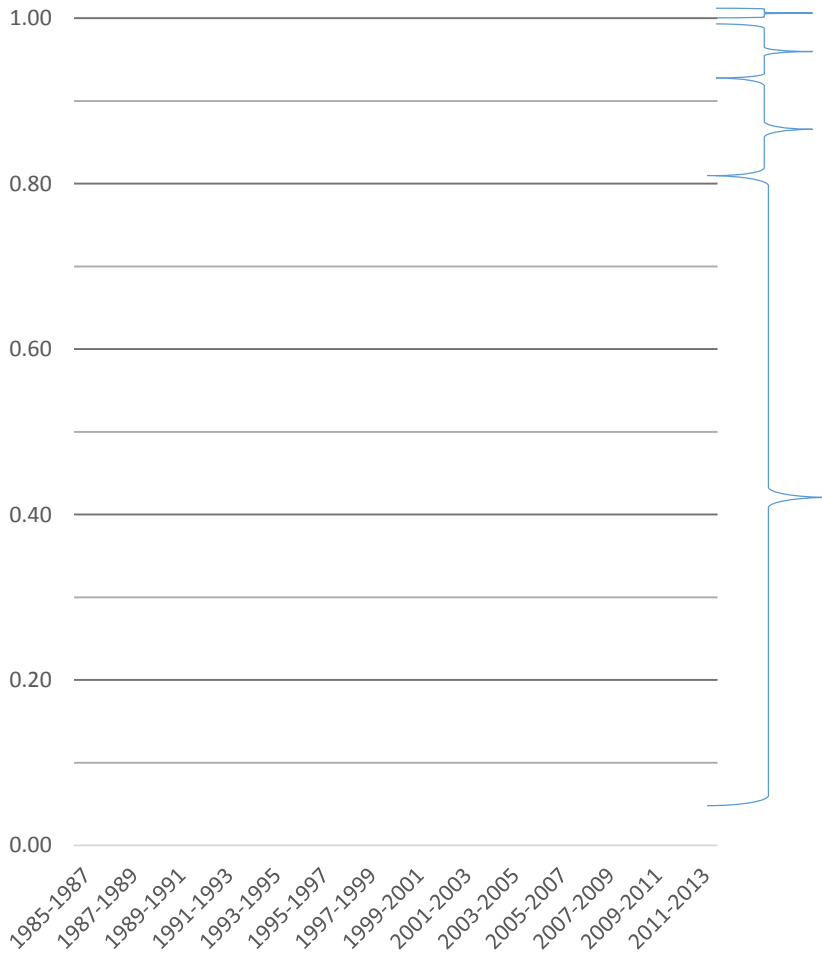
DO DESIGNATED USES

- DC: Deep-channel seasonal refuge use (worms and clams)
- DW: Deep-water seasonal fish and shellfish use
- OW: Open water fish and shellfish use
- MSN: Migratory fish, spawning and nursery use

100% is the minimal needed for sustaining life.

Categorization for Dissolved Oxygen DUs

How close to attainment is the segment?



At/Near Attainment -> Mostly/All 1.0

95-100 %-> Numerous in the 0.95-1.00 Range

80-95%-> Most values between 0.80-0.95 / High variability of values crossing multiple categories

<80%-> Numerous values less than 80%

Is there any significant trend?

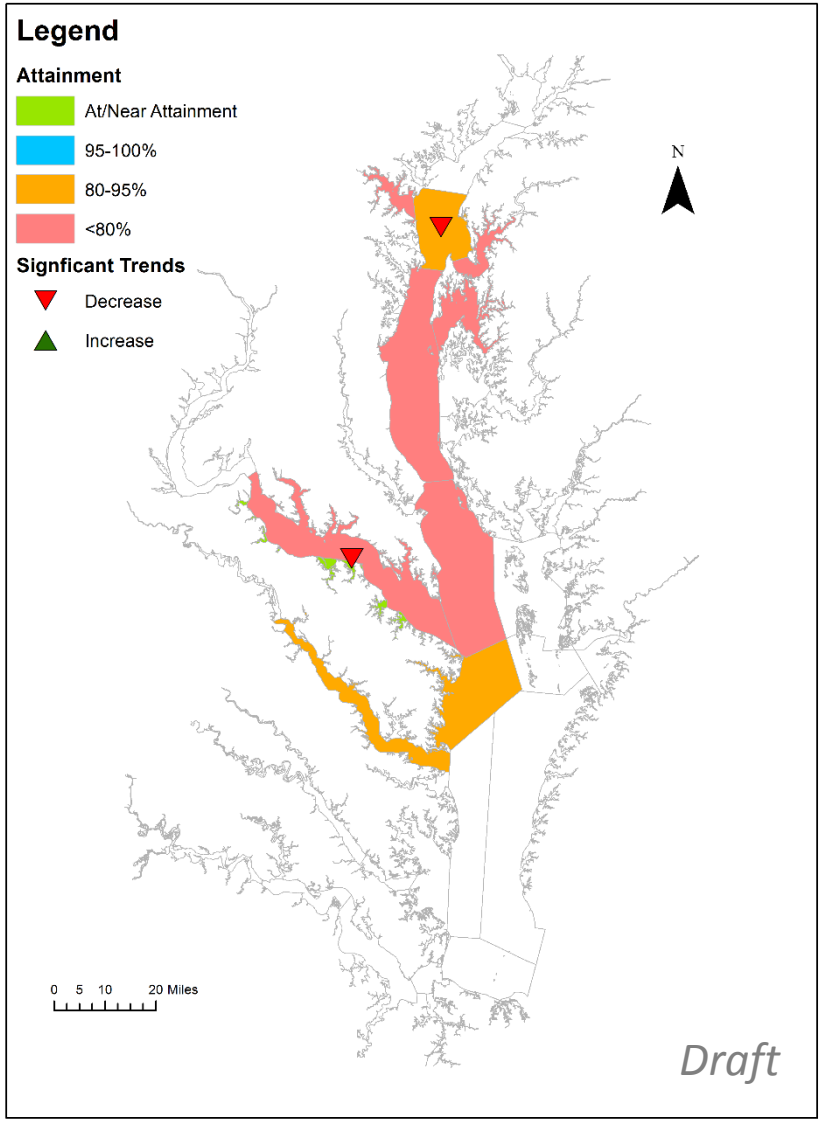
↑ - Increasing

↓ - Decreasing

Note: The percent change is slight.

Segment Level Analysis

Percent to attainment: Deep Channel DO 1985-2013



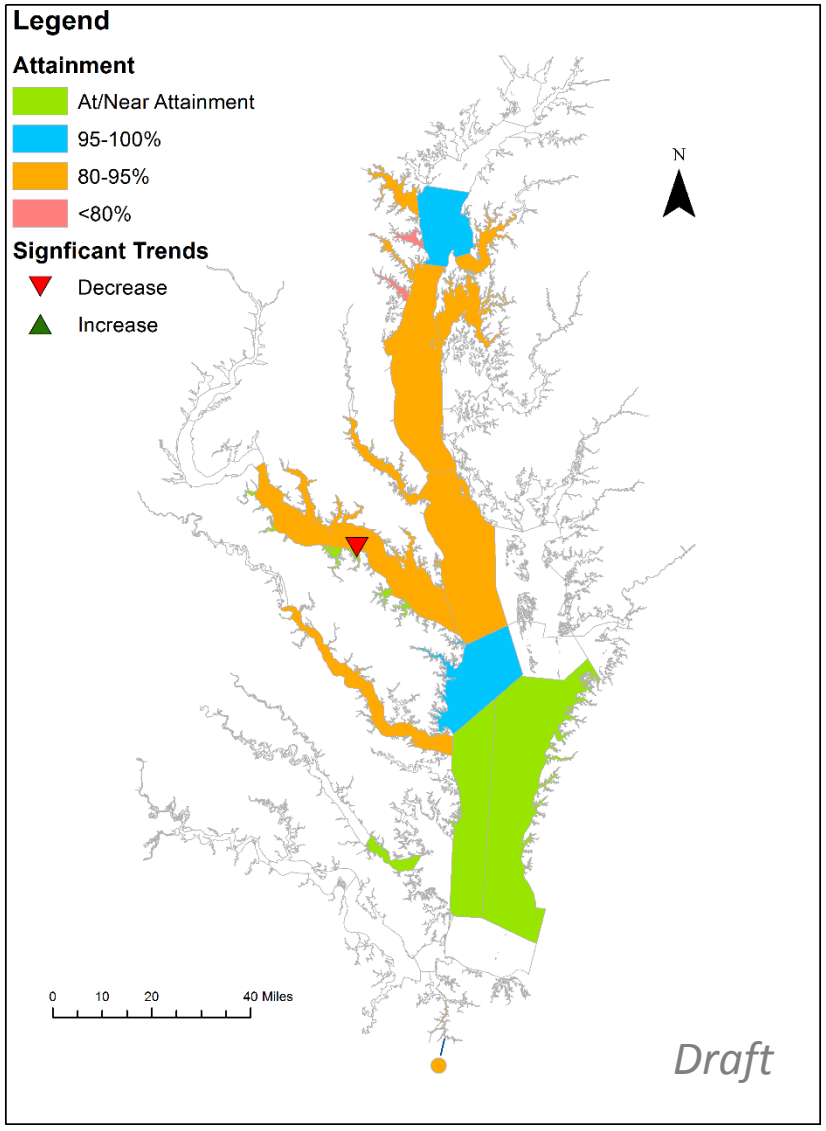
Category	Count	Category	Count
At/Near Attainment	1	80-95%	3
95-100%	0	<80%	6

Trends	
Significant ↑	0
Significant ↓	2

Most Deep Channel segments have not been near attainment over the time series.

Segment Level Analysis

Percent to attainment: Deep Water DO 1985-2013



Category	Count	Category	Count
At/Near Attainment	4	80-95%	10
95-100%	2	<80%	2

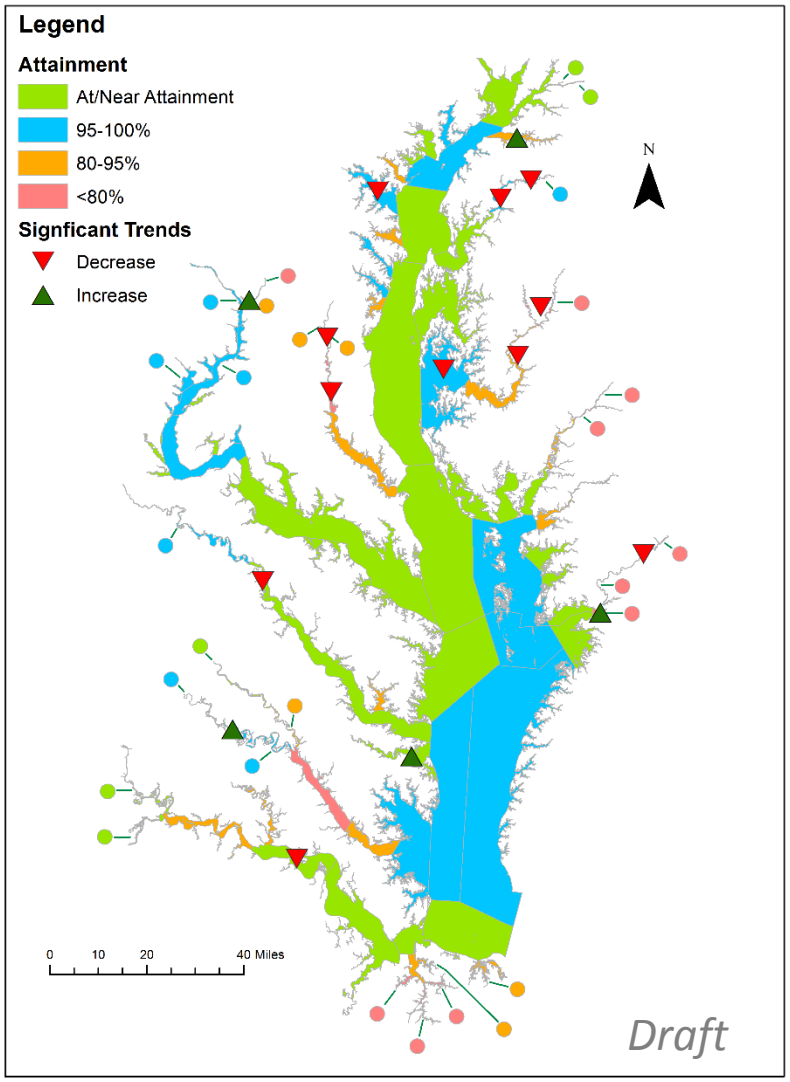
Trends	
Significant ↑	0
Significant ↓	1

The Lower Bay is doing well.

Mid Bay is not doing well, and the Lower Potomac River has been degrading.

Segment Level Analysis

Percent to attainment: Open Water DO 1985-2013



Category	Count	Category	Count
At/Near Attainment	36	80-95%	21
95-100%	23	<80%	12

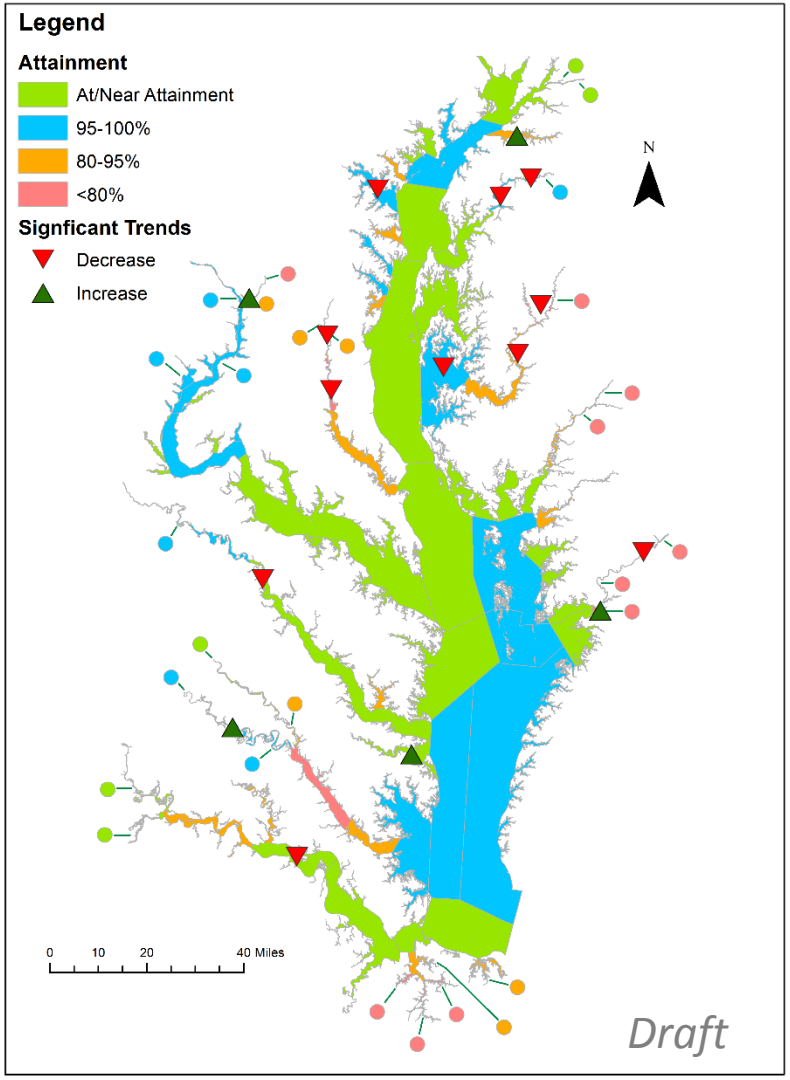
Trends	
Significant ↑	6
Significant ↓	11

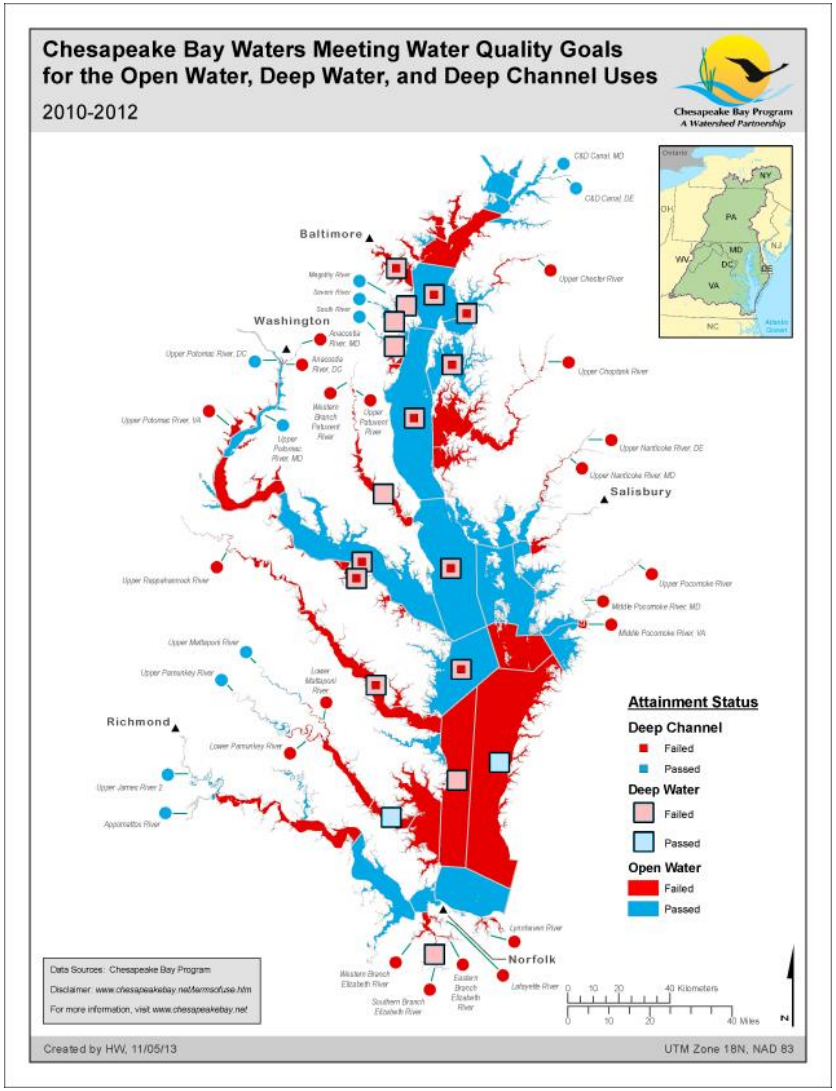
Mainstem segments have been doing well.

Many smaller segments are in the “red” and show decreasing trends.

Segment Level Analysis

Percent to attainment: Open Water DO 1985-2013

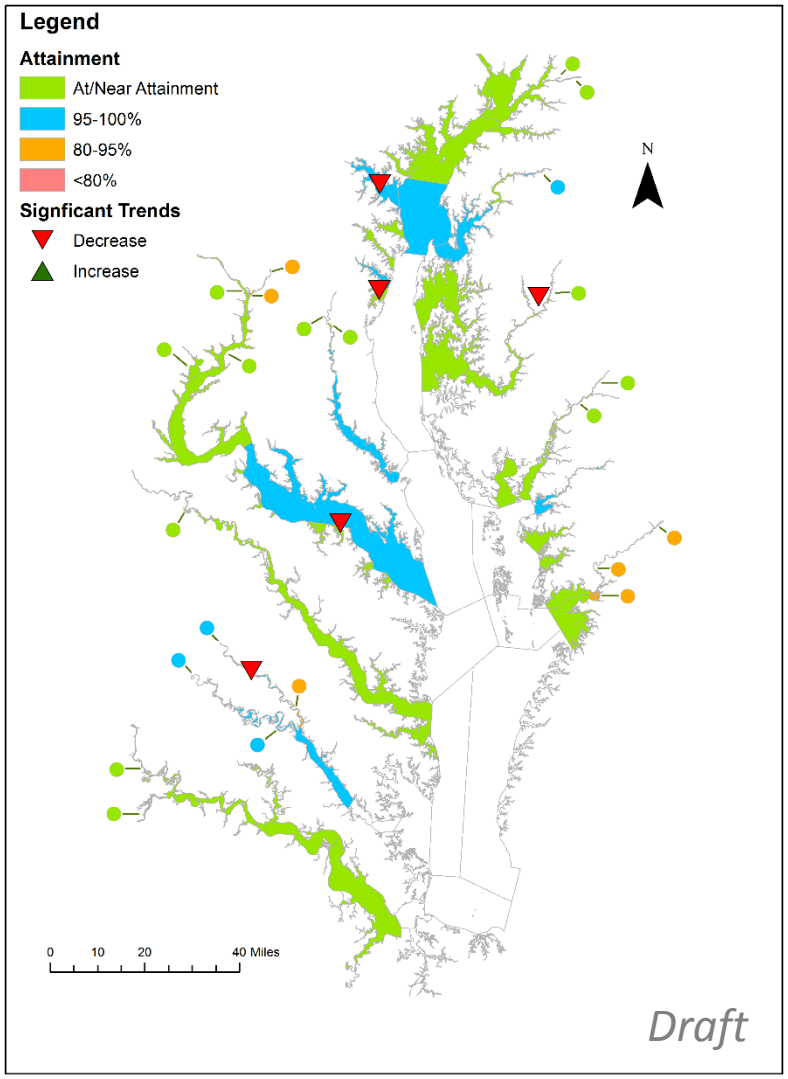




Segment Level Analysis

Percent to attainment:

Migratory Fish, Spawning, and Nursery Use DO 1985-2013



Category	Count	Category	Count
At/Near Attainment	54	80-95%	6
95-100%	13	<80%	0

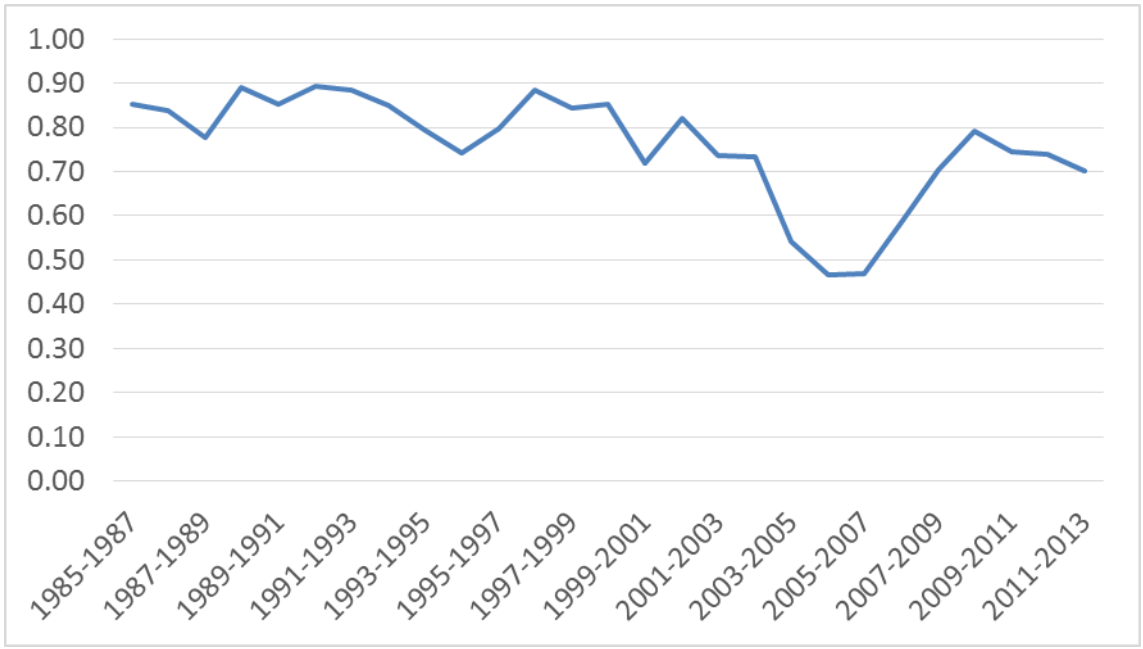
Trends	
Significant ↑	0
Significant ↓	5

Majority of segments are doing well.

The trends that exist are decreasing.

Findings: Long Term & Short Term Patterns Are Often Different

Short Term and Long Term Analysis Can Tell Different Stories



PAXOH OW

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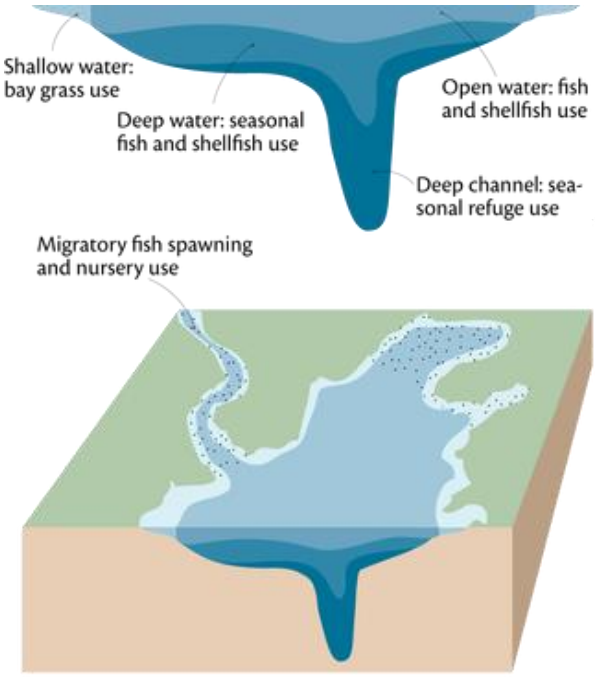

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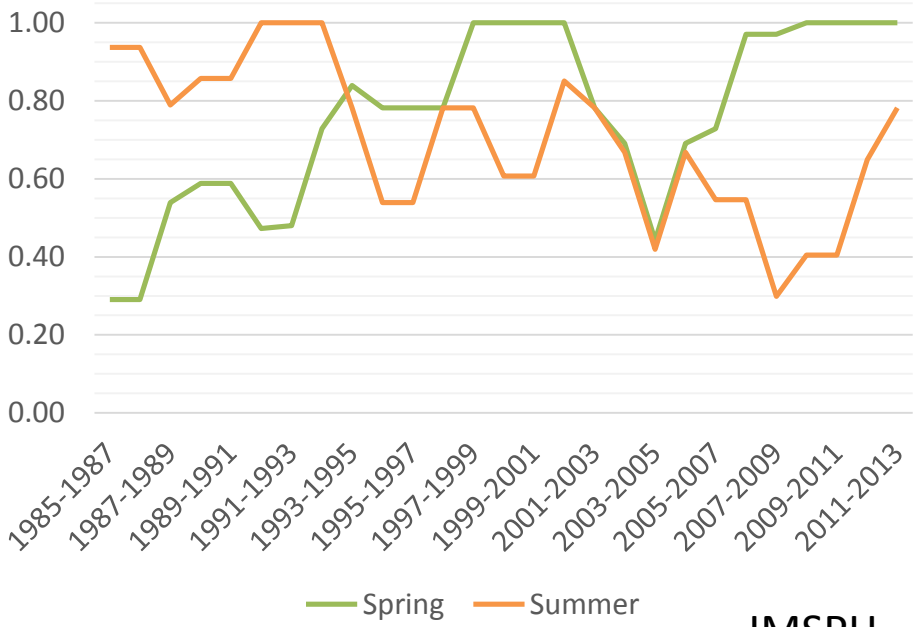
Segment Level Analysis
Percent to Attainment: Chlorophyll 1985-2013

How often does the segment attain?
- Always (A)
- Sometimes (S)
- Never (N)



JMSPH

	Spring		Summer	
Segment	Attainment (A/S/N)	Trend	Attainment (A/S/N)	Trend
ANATF_DC			N	
POTTF_DC			S	
JMSTF2	N	↑	S	
JMSTF1	N	↑	S	
JMSOH	S		S	↑
JMSMH	S		S	↓
JMSPH	S	↑	S	↓

Mostly increasing trends.

Summary

Overall Findings on a Bay-wide Level (1985-2013):

SW/Bay Grasses

- Most segments have NOT been attaining.
- Increasing trends are prevalent.

Dissolved Oxygen

- DC -> Most segments have consistently been <80% to attainment.
- DW -> Lower Bay has been attaining, while other parts have not been meeting the criteria.
- OW -> Larger segments are doing well and have been close to attainment.
- MSN-> Most segments have had a high % to attainment.

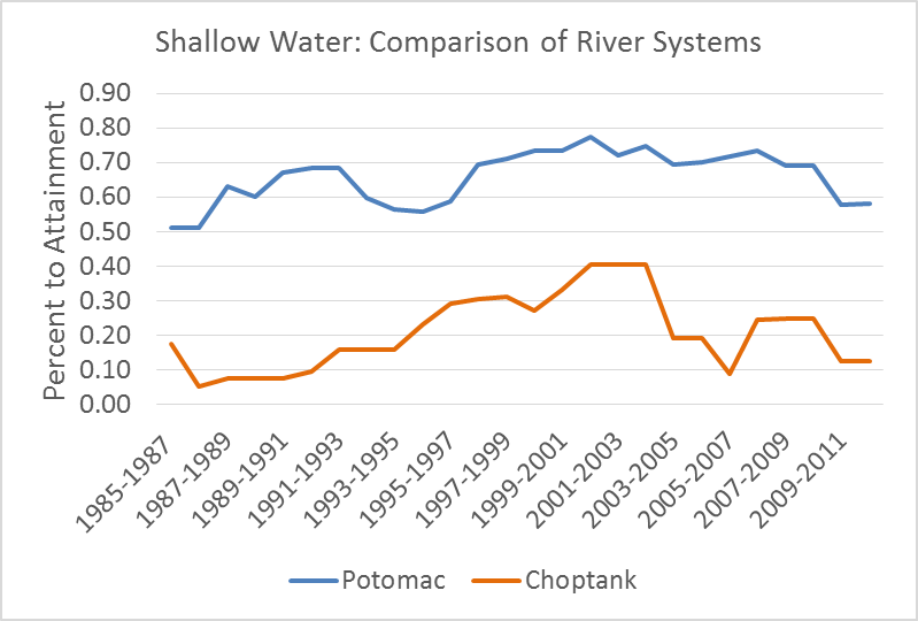
Chlorophyll

- Some segments show increasing trends, but high variability occurs.

Discussion

Potential Next Steps:

- Segment Behaviors by Groupings (Salinity, Watersheds, Regions)
- Further breakdown of SW Other/In Between
- Short-Term Trend Analysis
- Correlations Between Segments



Each segment is equally weighted.

Additional Analysis:

What is driving the patterns found? (R. Murphy and R. Tian)

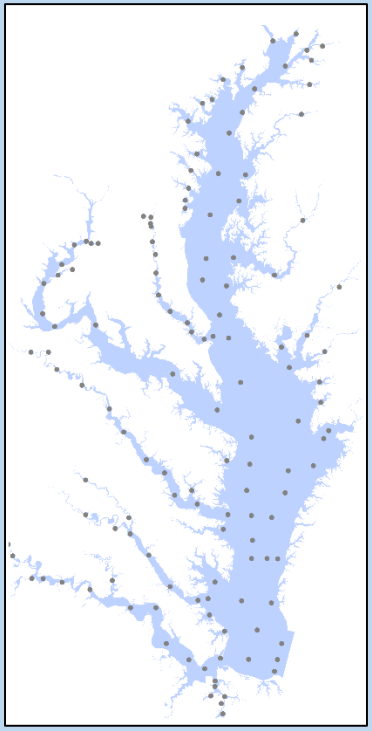
Suggestions? Needs?

Individual Segment Graphs (Drafts):

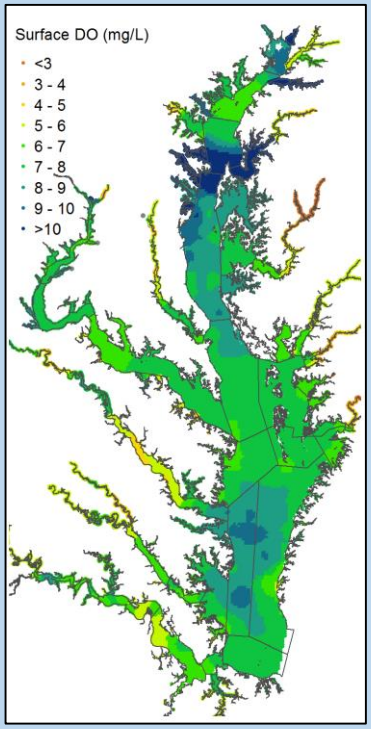
https://public.tableau.com/profile/melinda.ehrich#!/

Incremental Computations

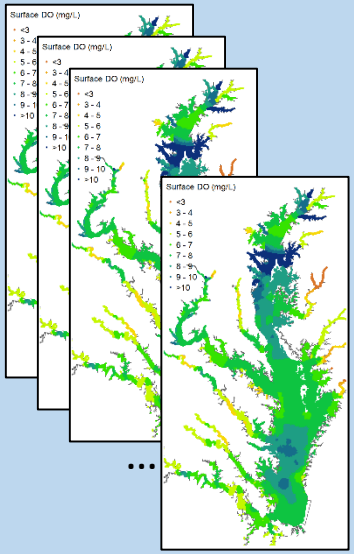
Bi-weekly observations



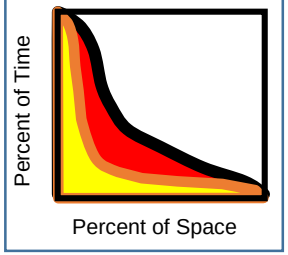
Monthly interpolations

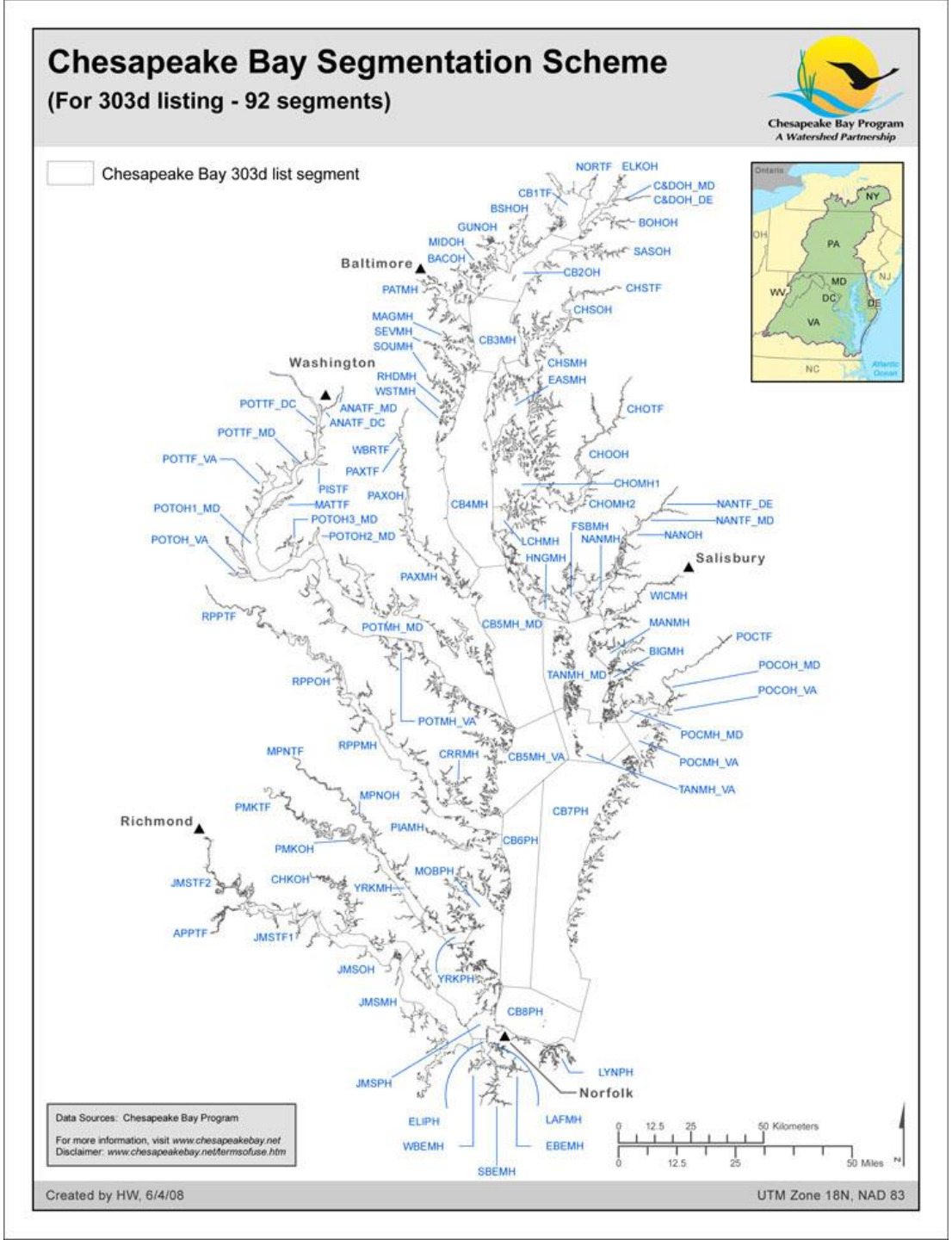


Combine interpolations for each summer month, over 3-year period



Construct CFD



Yes/no each segment in this 3-year period

Extra: Segment map