

CBF Concerns regarding proposed revisions to James River Chlorophyll Standards

16 Jun 2016



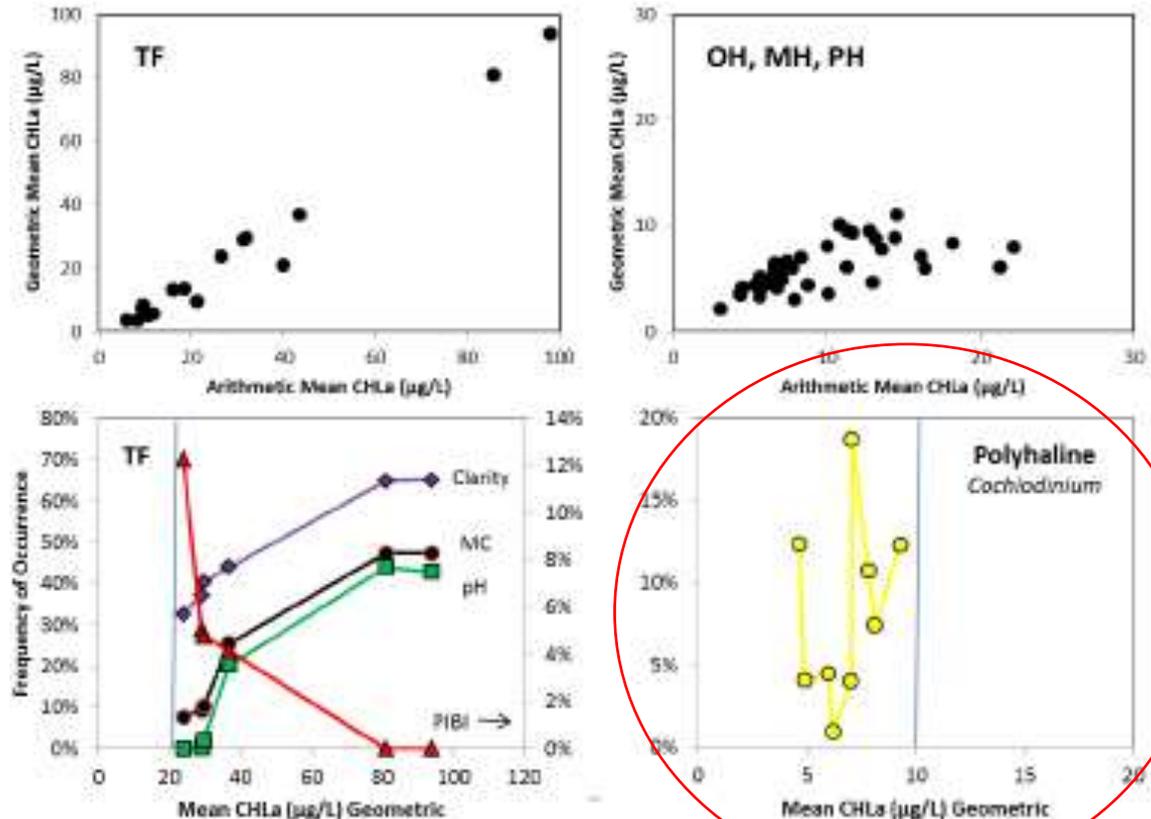
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Virginia Staff Scientist

Concern #1: The method to assess and the method to establish criteria needs to be consistent

Empirical Relations Report Supplemental Information (pg. 42):

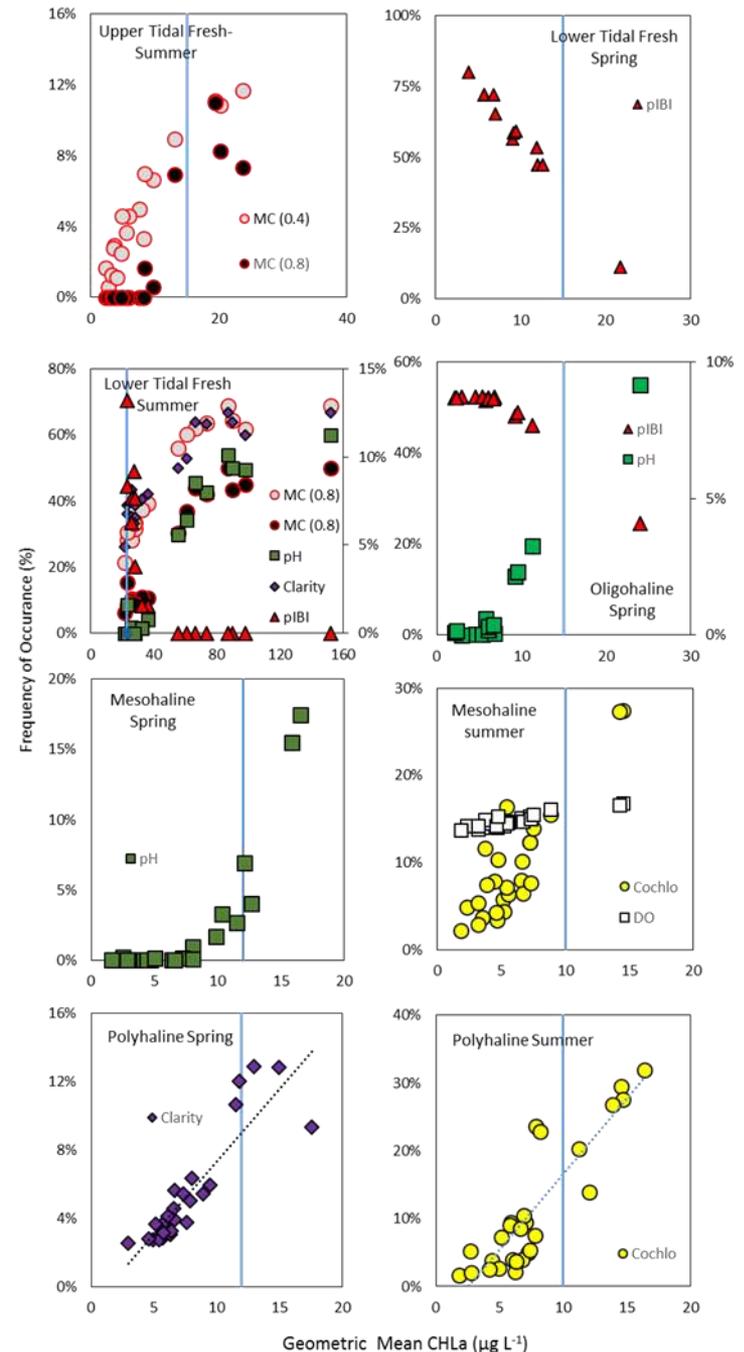
Arithmetic means
chosen to improve
correlation
between CHLa &
threshold
exceedances
(especially in the
lower James)

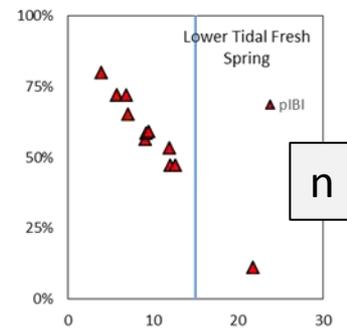
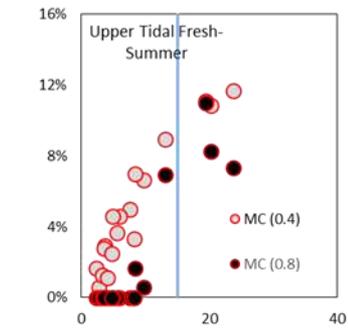
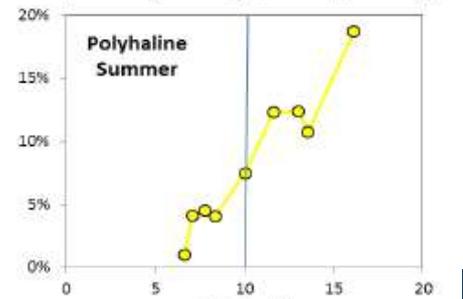
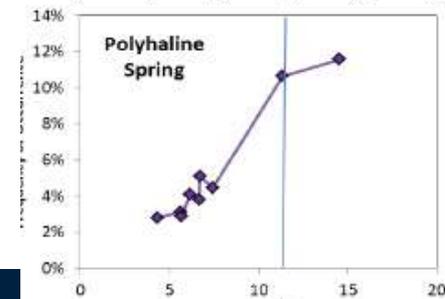
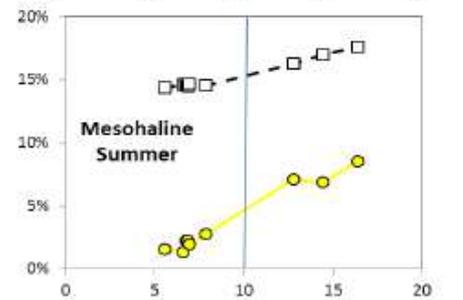
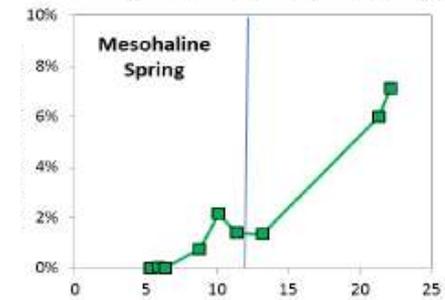
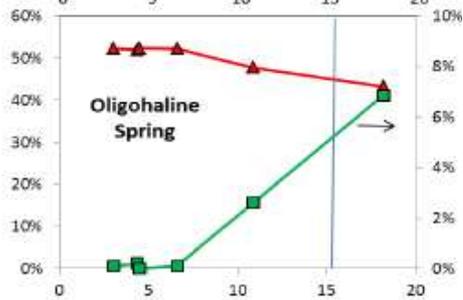
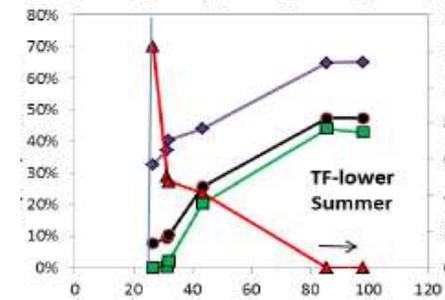
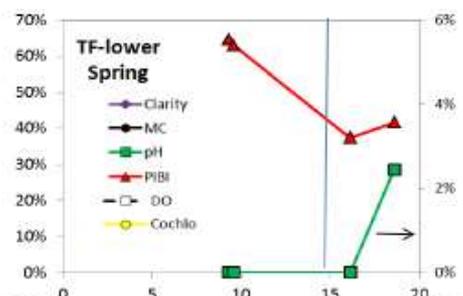
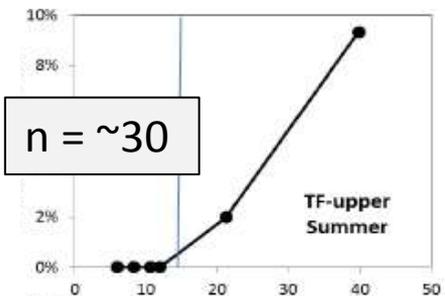


Proposed Solution for Concern 1:

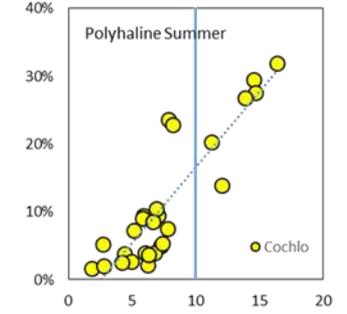
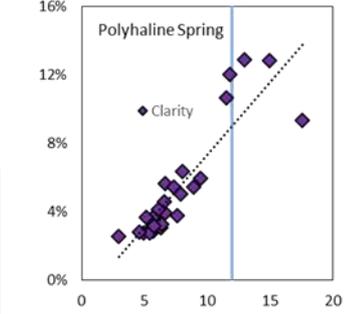
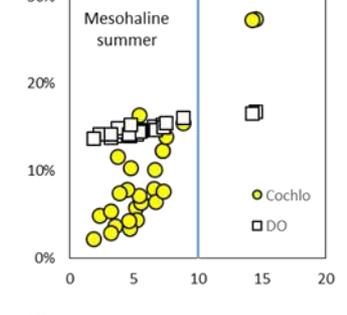
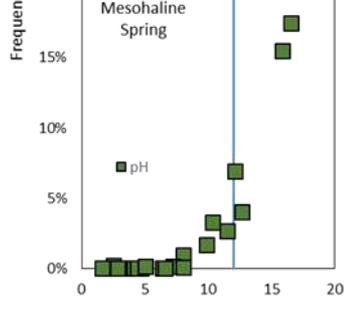
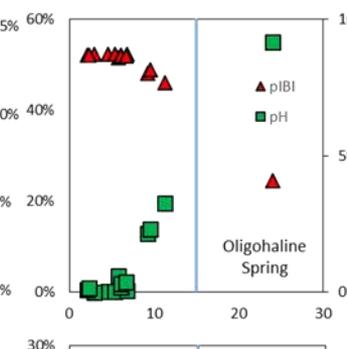
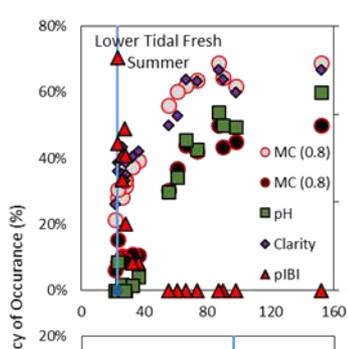
- A. Use the same approach with plots from geometric monthly means (rather than seasonal)

Segment	Season	Metric type	Metric Value	Geometric Mean			
				Slope \pm 95% CI	β_0	R^2	p
UTF	Spring	None	-	-	-	-	-
UTF	Summer	Microcystin	$0.8 \mu\text{g L}^{-1}$	0.0051 ± 0.001	-0.02	0.83	<0.001
LTF	Spring	<i>pIBI</i> *	-	-	-	-	-
LTF	Summer	Microcystin	$0.8 \mu\text{g L}^{-1}$	0.0043 ± 0.001	0.02	0.81	<0.001
OH	Spring	pH	90th %tile > 9	0.0044 ± 0.001	-0.02	0.94	<0.001
OH	Summer	None	-	-	-	-	-
MH	Spring	pH	90th %tile > 9	0.0088 ± 0.002	-0.04	0.70	<0.001
MH	Summer	<i>Cochlodinium</i>	1000 cells mL ⁻¹	0.0192 ± 0.004	-0.02	0.79	<0.001
PH	Spring	Clarity	Algae > 20% TSS	0.011 ± 0.002	-0.02	0.78	<0.001
PH	Summer	<i>Cochlodinium</i>	1000 cells mL ⁻¹	0.0223 ± 0.005	-0.06	0.78	<0.001





$n = \sim 10$



Seasonal Arithmetic Mean CHLa

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Monthly Geometric Mean CHLa

Proposed Solution B for Concern 1:

- B. Utilize Peter Tango's geometric ~ arithmetic relationships in order to translate criteria.

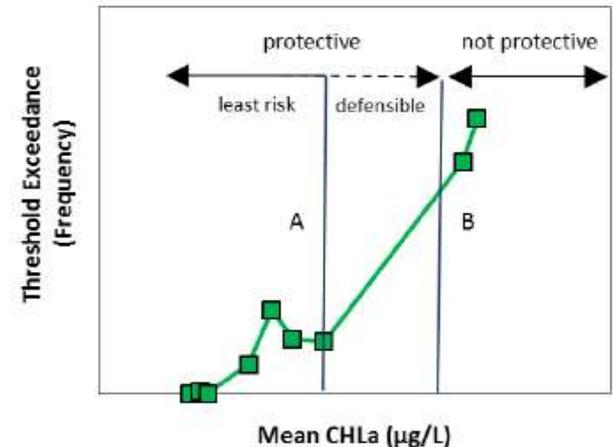
Segment	Season (Geometric mean criterion)	Metric	SAP report Range - arithmetic means	SAP report protection assessment	Translated SAP range to geometric mean	Updated assessment for protection of an existing criterion
TF – up	Spring (10)	None	NA	No change	NA	No change
	Summer (15)	Microcystin	12-21	Defensible	10.1 to 17.6	Defensible
TF-low	Spring (15)	pH	10-16	Defensible	7.4 to 12	Underprotective
		PIBI	10-16	Defensible	7.4-12	Underprotective
	Summer (23)	PIBI	27-31	Overprotective	22.5-25.9	Defensible
		Clarity	32-43	Overprotective	26.7-35.8	Overprotective
		pH	32-43	Overprotective	26.7-35.8	Overprotective
Microcystin	32-43	Overprotective	26.7-35.8	Overprotective		
OH	Spring (15)	pH	7-18	Defensible	5-13.5	Underprotective
		PIBI	7-18	Defensible	5-13.5	Underprotective
	Summer (22)	None	NA	No change	NA	No change
MH	Spring 12	pH	13-21	Overprotective	9.7-15.8	Defensible
	Summer (10)	DO	8-13	Defensible	6.8-10.9	Defensible
		Cochlodinium	8-13	Defensible	6.8-10.9	Defensible
PH	Spring (12)	Clarity	7-11	Underprotective	5-8.1	Underprotective
	Summer (10)	Cochlodinium	8-12	Defensible	6.8-10.9	Defensible



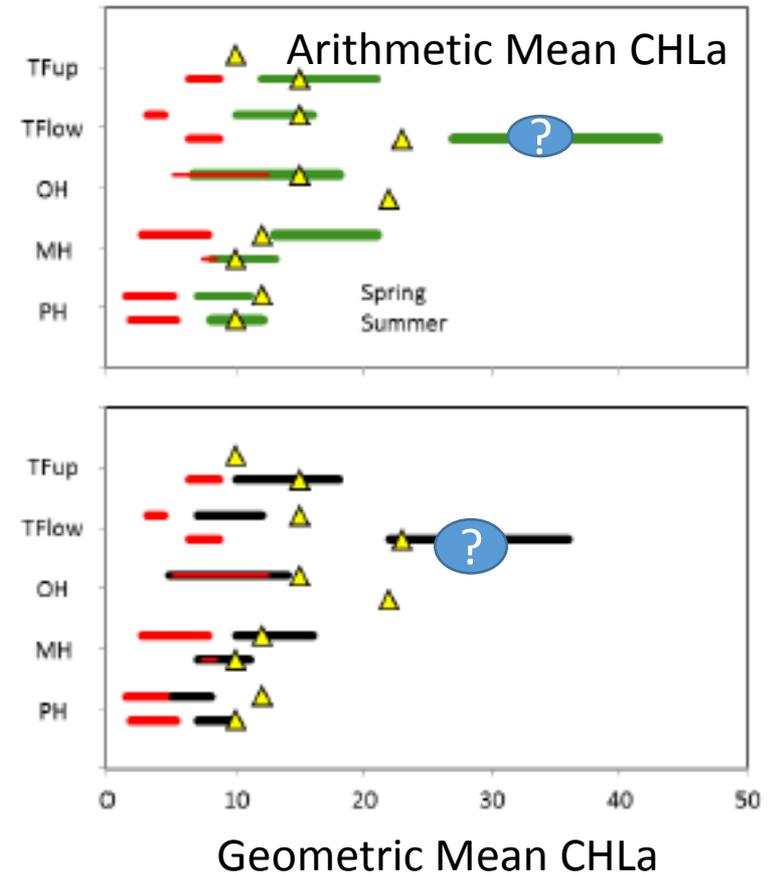
Concern #2 The approach outlined cannot be easily reproduced independently

Page 12, Empirical Relationships Report, Methods: *“Protectiveness was judged on the basis of anticipated improvements in water quality with decreasing mean CHLa, as indicated by **lower rates of threshold exceedance**. Existing criteria were judged to be ‘not protective’ if falling within the CHLa range where **elevated threshold exceedance values were observed** (e.g., criteria above Line B in Figure 4). Criteria were considered ‘protective’ if they fell within the CHLa range below the **elevated exceedance values**. Within the protective range, we further distinguished a range of ‘**least risk**’ for which attainment would result in expected exceedance rates at the **low end** of their observed distribution (e.g., criteria falling at or below line A in Figure 4). In the region between A and B, there is greater uncertainty. However, criteria in this range were considered ‘defensible’ in that they occupy a CHLa range below that where **elevated exceedance values** were observed. By this method, we established **least risk**, **defensible**, and **non-protective** ranges for each metric, which served as the basis for assessing the protectiveness of existing criteria. In the following section we present the empirical relationships used to determine the expected rates of threshold exceedance for each of the metrics by season and segment.”*

BUT lower & elevated are not defined in the report so the reader cannot reproduce these results...



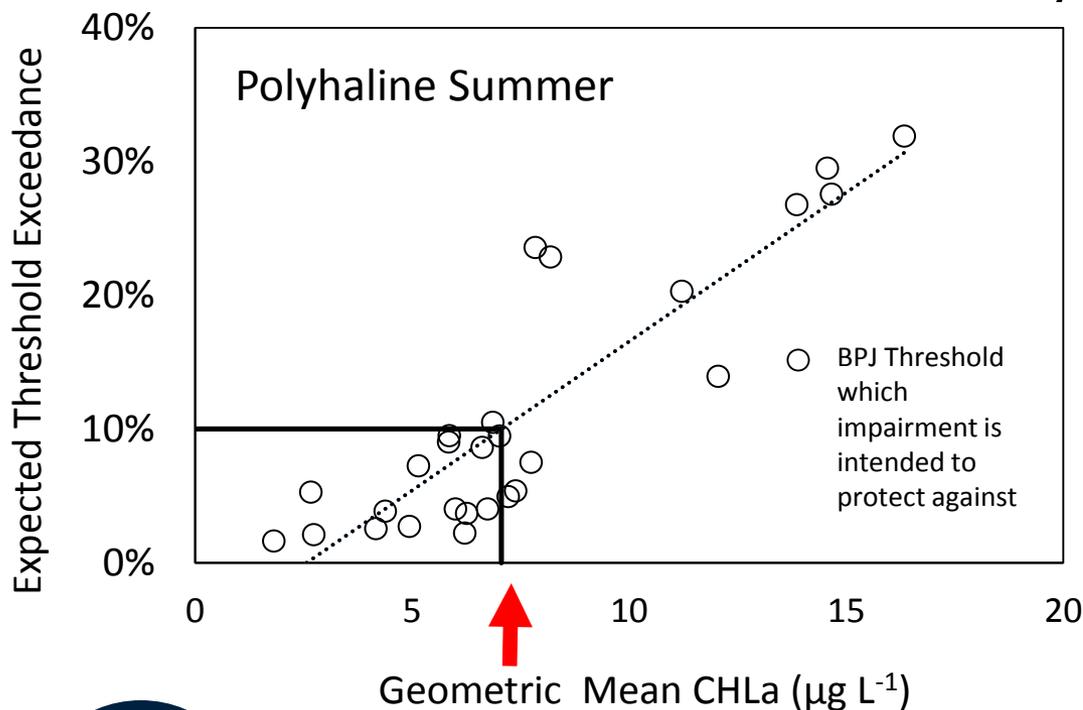
Concern/question #3:
There is currently no
identified mechanism
to select criteria
within the ranges
which are outlined



Proposed Solution for Concern #2/3:

Establish specific absolute risk goals based upon specific threshold exceedances (using BPJ)- HOW?

- Method 1: Combined Probability Approach:

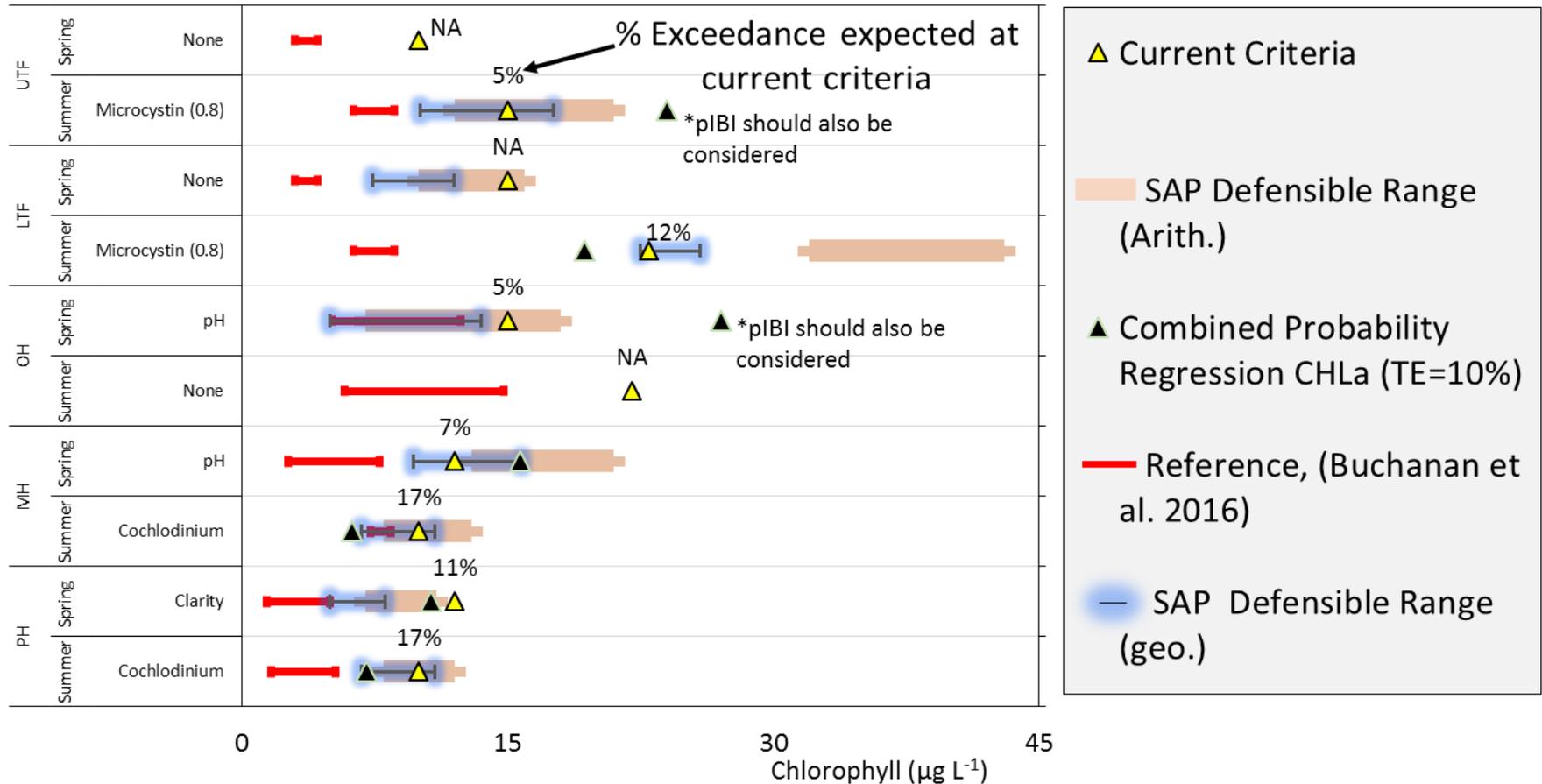


Metric	Acceptable use?
pH	Yes
Microcystin	Yes
Cochlodinium	Yes
pIBI	Variable
Clarity	Variable
DO	No

Available for 5-7 of the 8 evaluated segments



Results of proposed analysis:

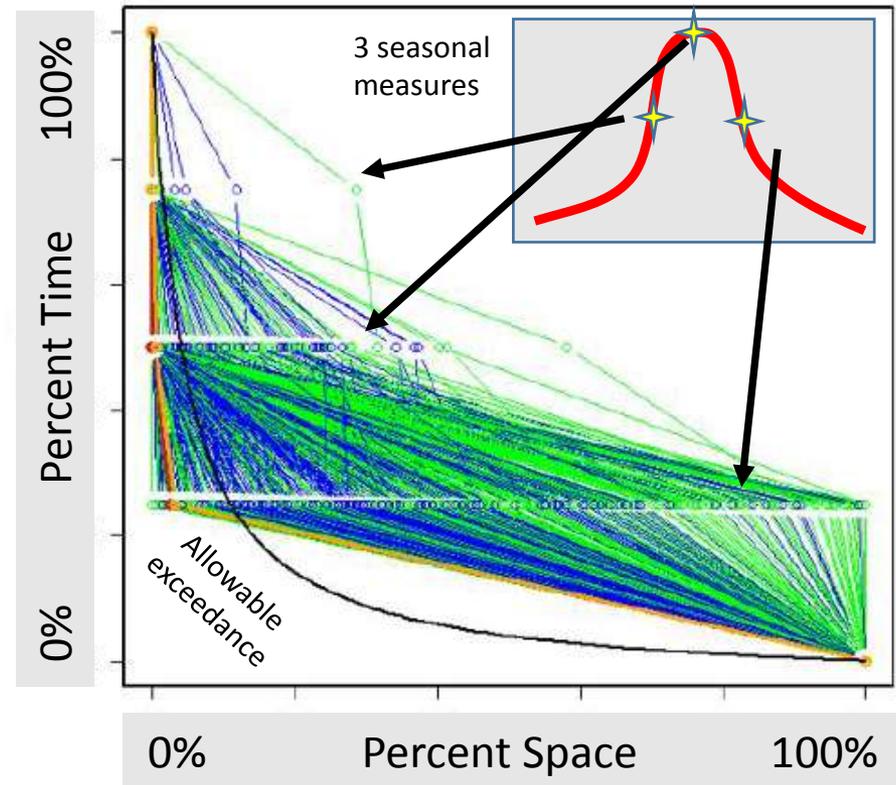


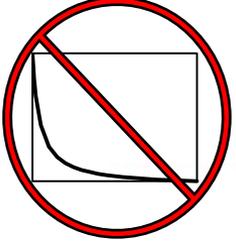
Concerns with the proposed Assessment protocol

- *“This analysis shows that the variability of the CFD based on this limited sampling plan is very high. When the true condition of the estuary is either passing or failing, the sample CFD has a high probability of reaching the wrong conclusion.”*
- *“The cursory validation examples presented indicate the simulated data does mimic the spatial and temporal dependence that is present in the observed DataFlow and ConMon data”*

-E. Perry 2015

“Though VADEQ anticipates that the Bay Program-funded fixed stations will continue to be the primary source of data for much of the estuary, **it also believes that the characterization of chlorophyll is significantly enhanced when datasets such as Dataflow are brought into the analysis.**” DEQ Assessment Proposal





FIXED STATION SAMPLES

Sampling Date	Station A	Station B	Station C	Station D	Spatial Median*
1-Jul	10	12	43		12
30-Jul				30	30
1-Aug	10	8	30		10
1-Sep	9	5	56		9
30-Sep				50	50

Segment seasonal geometric mean
(value to be compared to the criterion)

= 17

Must be below criteria in 4/6 years to achieve attainment:

*The true median is justified but given only 3 data points, high levels of variability (associated with uncertainty) should also be considered.



Concern #4 Single station monitoring insufficient to categorize spatial variability

Erroneous Assessment Rate

(How often do dataflow and CBP produce same result?)

Segment	CBP	CBP + 1
UTF	55%	18%
LTF	0%	0%
OH	0%	17%
MH	40%	27%
PH	13%	13%

Quotes from DEQ Assessment Proposal:

“The ability to accurately characterize a system using a small number of samples diminishes when segments are not homogenous.”

“a sampling design that fails to appreciate a segment’s non-uniformity can result in uneven protection of designated use(s)”

Average Percent Difference (ABS):

How different are the values between Dataflow and CBP?

Segment	CBP vs. Dataflow	CBP +1 vs. dataflow
JMSTFU	69%	13%
JMSTFL	8%	15%
JMSOH	53%	27%
JMSMH	85%	65%
JMSPH	14%	11%



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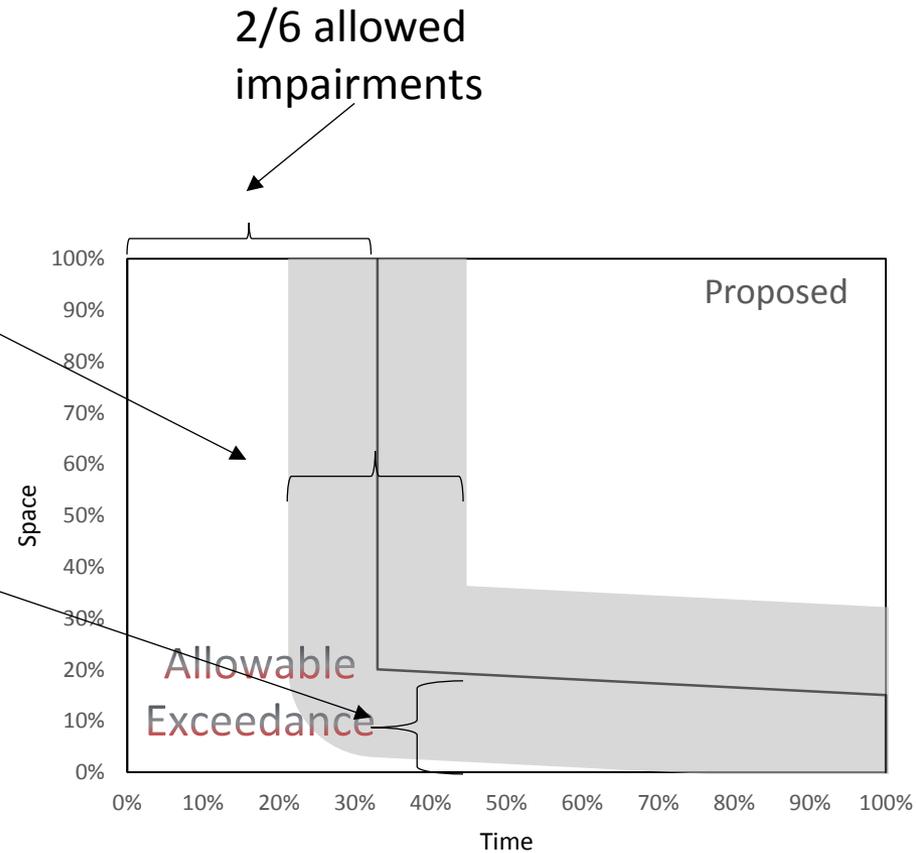
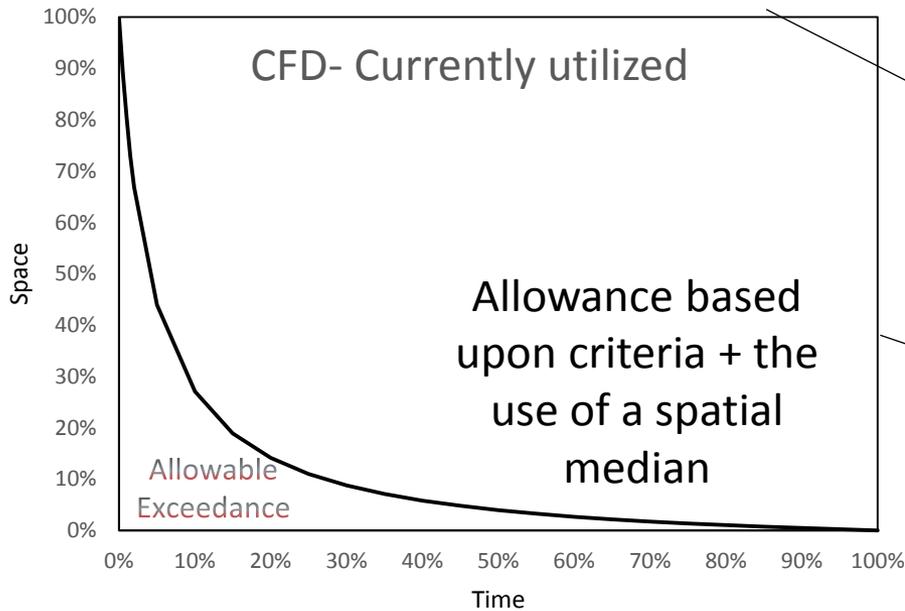
Concern #5 2/6 years (or 33% time, 100% space) represents a considerable increase to the allowable exceedance rate (previously 10% space, 10% time)

- The currently used CFD is built upon the underlying idea that exceeding impairments more than 10% of space & time is unacceptable. We acknowledge problems with using the CFD (Perry 2014)
- HOWEVER → This should not be addressed by revising how we define an impaired waterway. Even an allowance of 1/6 would be an expansion over 10% space~time.



Theoretical depiction of assessment proposal

Uncertainty associated with 3-4 station monitoring (11-65%)



Proposed Solution

- A. Secure a dataflow monitoring program to capture spatial variability (at a minimum for OH, MH & PH with monthly sampling)
- B. If dataflow is absolutely not feasible, confidence intervals should be used to take into account uncertainty associated with monitoring data.

Necessary to determine attainment (or non attainment) with statistical significance

