



Linked nutrient and biological criteria for the protection of designated uses for Vermont Lakes and Streams.

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How has Vermont participated in the EPA national strategy on nutrient criteria?

- Contributed to EPA technical guidance
- Participated in Region 1 Technical Advisory Group
- Received grants from EPA for data collection and analysis.
- Submitted draft technical document to EPA for peer review in April 2007.
- Prepared revised draft report incorporating EPA comments and further analyses, Dec. 2008.
- Developed proposed language for WQS August, 2009.



Scope of nutrient criteria analysis



- EPA guidance encourages nutrients and response variables in WQS packages
- We broke this into four analyses.

Use→ WB type↓	Aesthetics	Aquatic Biota
Lakes	User Survey Dataset	VT Lake IBI
Wadeable Streams	Stream Periphyton Assessment using Pebble Count	VT Stream Trophic IBI



Vermont Water Quality Standards



Class/ Water Mgmt Type	Use	Management Objective or Criterion
A(1)	<u>Aesthetic</u>	<u>Natural condition</u>
A(2), B(1)		Consistently <u>excellent</u> aesthetic value
B(2)		Consistently <u>very good</u> aesthetic value
B(3)		Variability allowed provided <u>good</u> aesthetic value is achieved
B (untyped)		Consistently <u>good</u> aesthetic value
A(1)	<u>Aquatic Life</u>	Within the range of the <u>natural condition</u>
B(1)		No more than <u>minor change</u> from reference condition
A(2), B(2), B(3)		No more than <u>moderate change</u> from reference condition
B (other)		No change from reference condition that would have an undue adverse effect



Process used to derive criteria for lakes and wadeable streams aesthetics and aquatic life uses

1. Use reference distribution approach for Class A(1)
2. Use Conditional Probability Analysis for other WMT's
 - Use conditional probability plots to find possible change-points.
 - Examine original data to verify or adjust change-points.
 - Apply knowledge of Vermont lakes and professional judgment.
3. Verify high probability of use attainment.

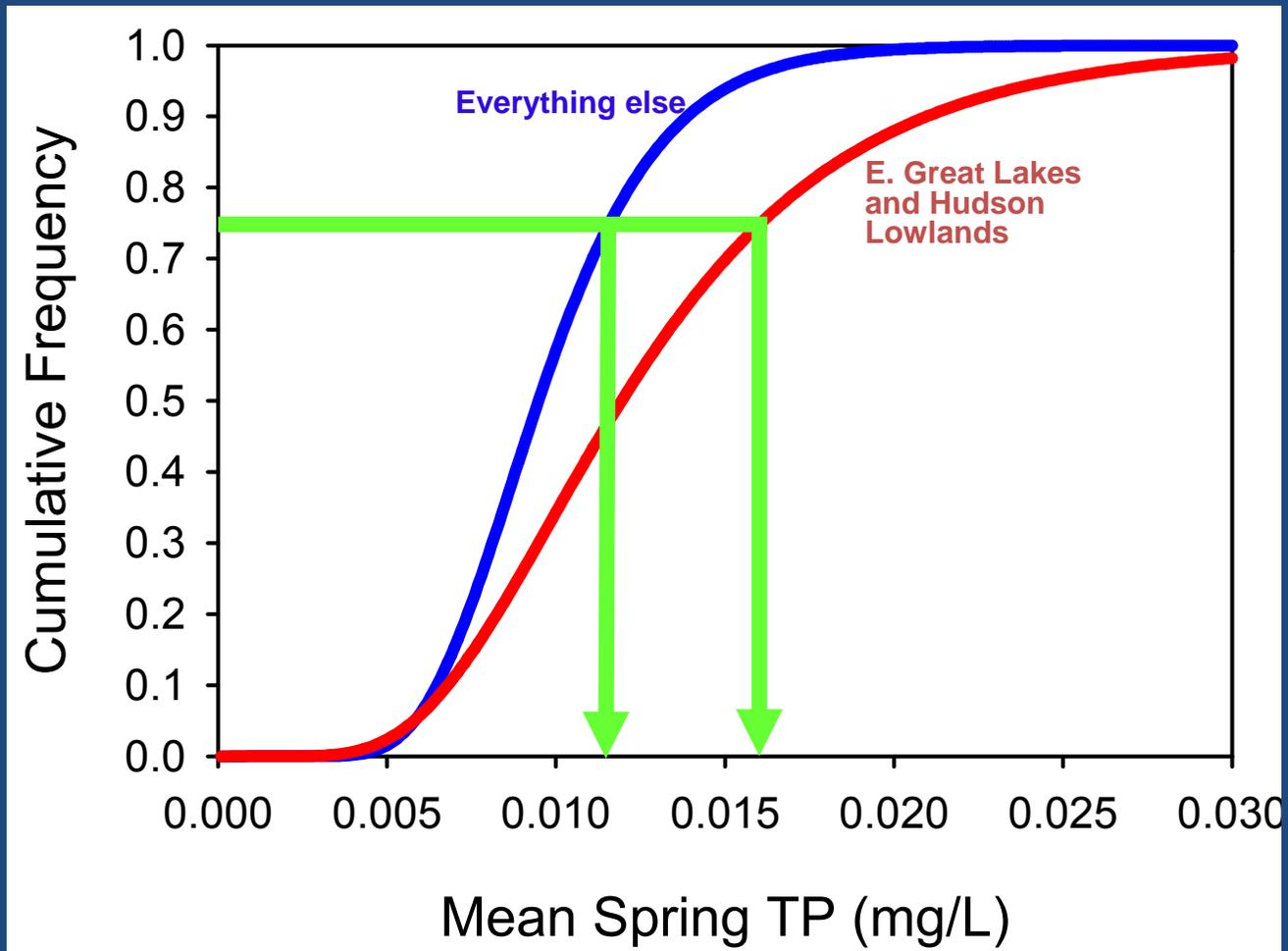


Lakes





Spring TP distributions for lakes with minimally developed watersheds



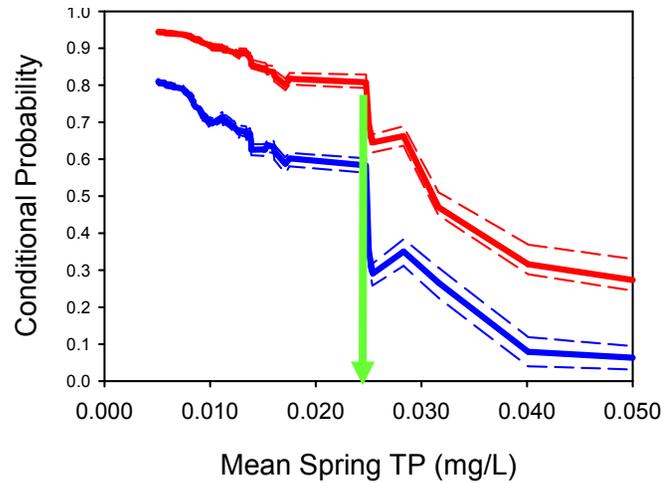


Lakes

Conditional Probability Analysis

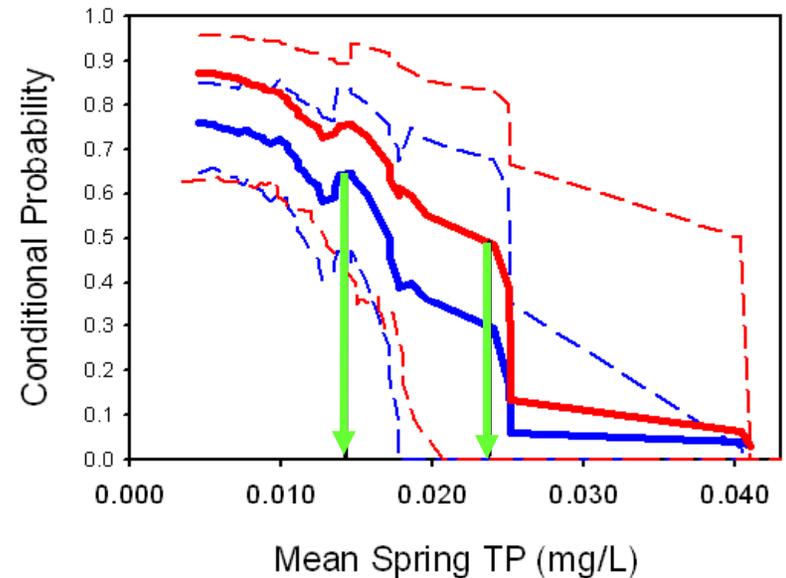
Lakes -Aesthetics

- No worse than excellent with very minor problems (A2, B1)
- No worse than slight impairment (B, B2, B3)



Lakes – Aquatic Life

- No more than minor change from reference (B1)
- No more than moderate change from reference (A2, B, B2, B3)





Proposed Effective Criteria for Lakes

	A(1)	A(2)	B	B(1)	B(2)	B(3)
Spring TP (mg/L)	0.012 ^a 0.016 ^b	0.014 ^a 0.016 ^b	0.024	0.014 ^a 0.016 ^b	0.024	0.024
Spring TN (mg/L)	0.36	0.40	0.48	0.40	0.48	0.48
Summer TP (mg/L)	0.014	0.014	0.024	0.014	0.024	0.024
Summer Secchi (m)	3.8	3.8	2.4	3.8	2.4	2.4
Summer Chl (mg/L)	0.005	0.009	0.016	0.009	0.016	0.016

^aNortheastern Highlands; ^bEastern Great Lakes and Hudson Lowlands



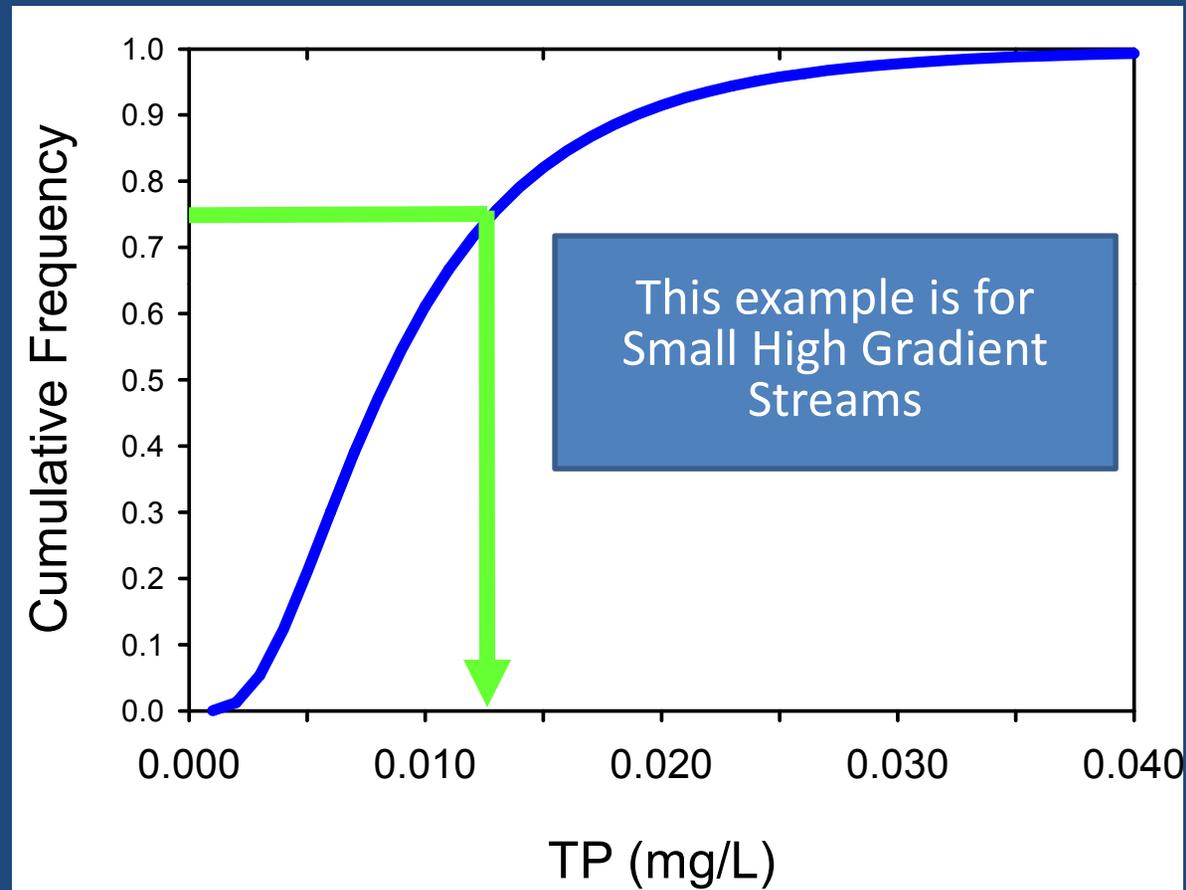
Streams



- Three stream types assessed
 - Small High Gradient
 - Medium High Gradient
 - Warm Water Medium Gradient



TP distribution for streams with minimally developed watersheds

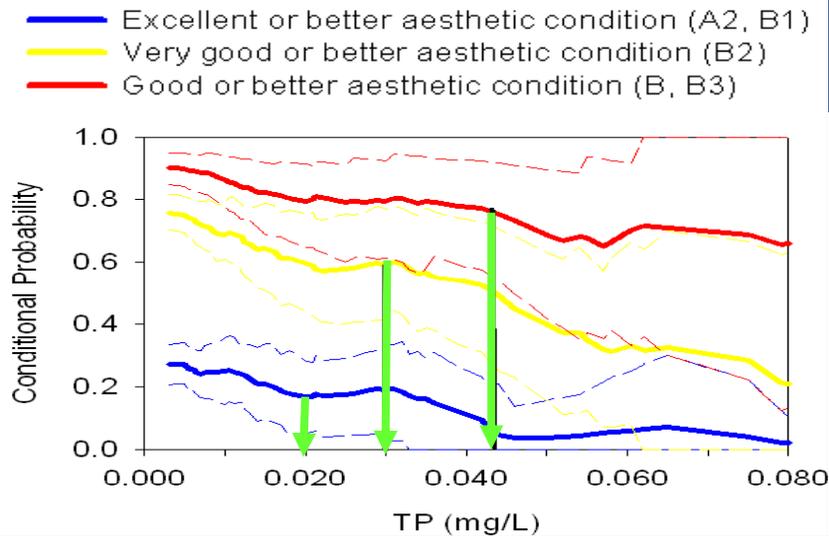


Note: Existing WQ Criteria for A(1) streams >2,500ft MSL were retained since they are more protective, except for WWMG stream types.

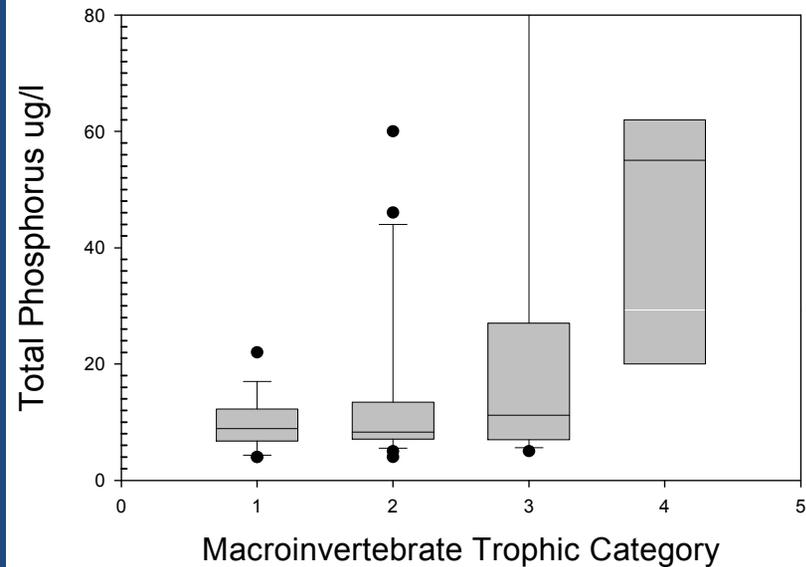


Streams Analysis

Stream Aesthetic Condition



Medium High Gradient Streams



- Aesthetic condition determined as fixed proportions of macroalgae from pebble count
- Biological condition assessed using VT IBI, using the subset of metrics that respond to trophic enrichment



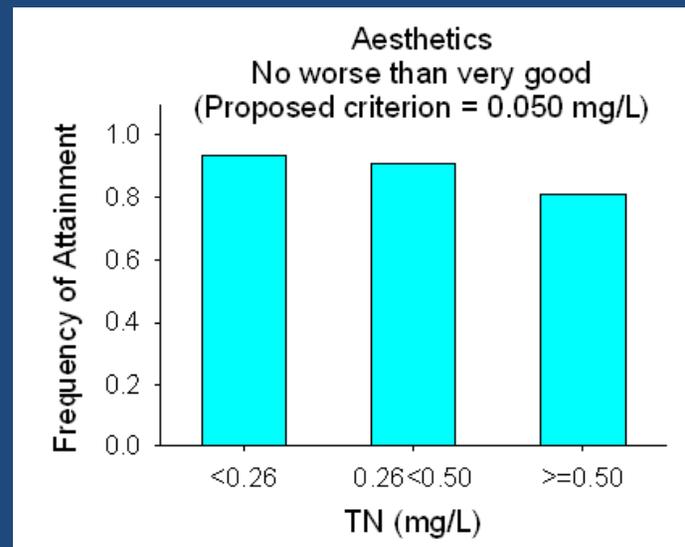
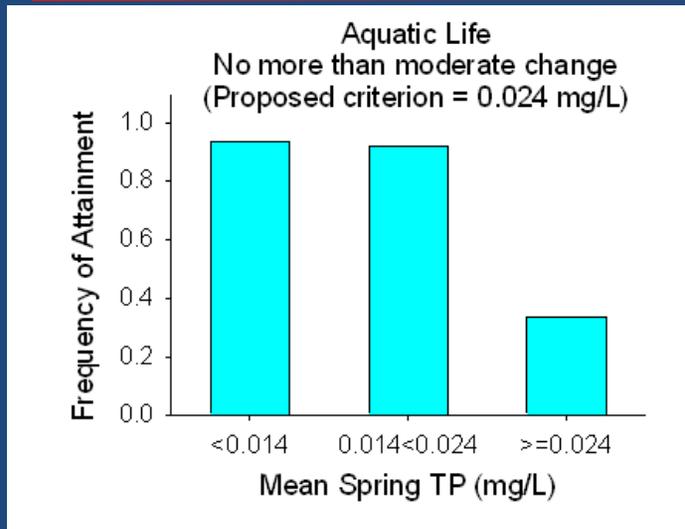
Proposed Effective Criteria for Streams

		A(1)	A(2)	B	B(1)	B(2)	B(3)
TP	SHG	0.010	0.020	0.035	0.020	0.030	0.035
TP	MHG	0.010	0.020	0.035	0.020	0.030	0.035
TP	WWMG	0.020	0.020	0.044	0.020	0.030	0.044
TN	SHG	0.30	0.75	0.75	0.50	0.50	0.75
TN	MHG	0.30	0.75	0.75	0.50	0.50	0.75
TN	WWMG	0.30	0.75	0.75	0.75	0.50	0.75

Numbers in WHITE derived from aesthetic thresholds; numbers in YELLOW from aquatic life thresholds.



Verifying protectiveness



- Analysis split range of nutrient parameter into three bins
- Evaluated proportion of sites attaining condition within each bin
- Note high attainment percentage even in the range of nutrients nearest the criterion.



Translating technical recommendations into Water Quality Standards rule language





One number is not enough.

- Response to nutrient enrichment is incremental, without sharp thresholds.
- Response to nutrient enrichment is highly variable among different waterbodies.
- These factors lead to high rates of “false positive” and “false negative” impairment determinations.



Hierarchy of Criteria

Nutrient criteria (TP, TN) met?	Biological response criteria met?	Compliance Determination
Yes	Yes	Meets WQS
No	Yes	Meets WQS
Yes	No	Does not meet WQS*
No	No	Does not meet WQS
Yes	Indeterminate	Presumed to meet WQS
No	Indeterminate	Does not meet WQS

* Impairment may or may not relate to nutrients. This is determined through biological analyses.



Current status

- Draft rules currently in front of VT Water Resources Panel
- Received EPA pre-rulemaking comments recently
 - Need to develop site specific numeric values where base value is exceeded, but response indicates attainment
 - Address protection of downstream uses
- VT is considering options at this point.