

NUTRIENT CRITERIA AND ASSESSMENT

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PRESENTATION OUTLINE

- Existing water quality standards and assessment procedures for nutrients
- Revising assessment process:
 - To better incorporate narrative nutrient criteria
 - To begin implementing numeric nutrient criteria
- Parameters
- Criteria and thresholds
- Suggested procedure
- Examples
- Other considerations
- Questions

EPA AND NUMERICAL NUTRIENT CRITERIA

- 1998 mandate: Numerical Nutrient Criteria by 2004
- Allowed state development plans and schedules
- Submitted plans to EPA in 2001, 2006, 2014
- Reservoirs, then streams & estuaries
- Convened advisory workgroup
- Separately for each reservoir
- Set on historical conditions

RESERVOIR NUTRIENT CRITERIA

- Assessed as median Chl *a*, ≥ 10 sampling dates
- Assessed at main pool station or comparable
- Option 1: Confirm with TP, Transparency values
 - Calculated same as Chl *a* criteria
- Option 2: Stand-alone Chl *a* criteria
- Adopted: Option 2 for 75 reservoirs in 2010
- EPA approved criteria for 39 of the 75 reservoirs

DATA EVALUATED

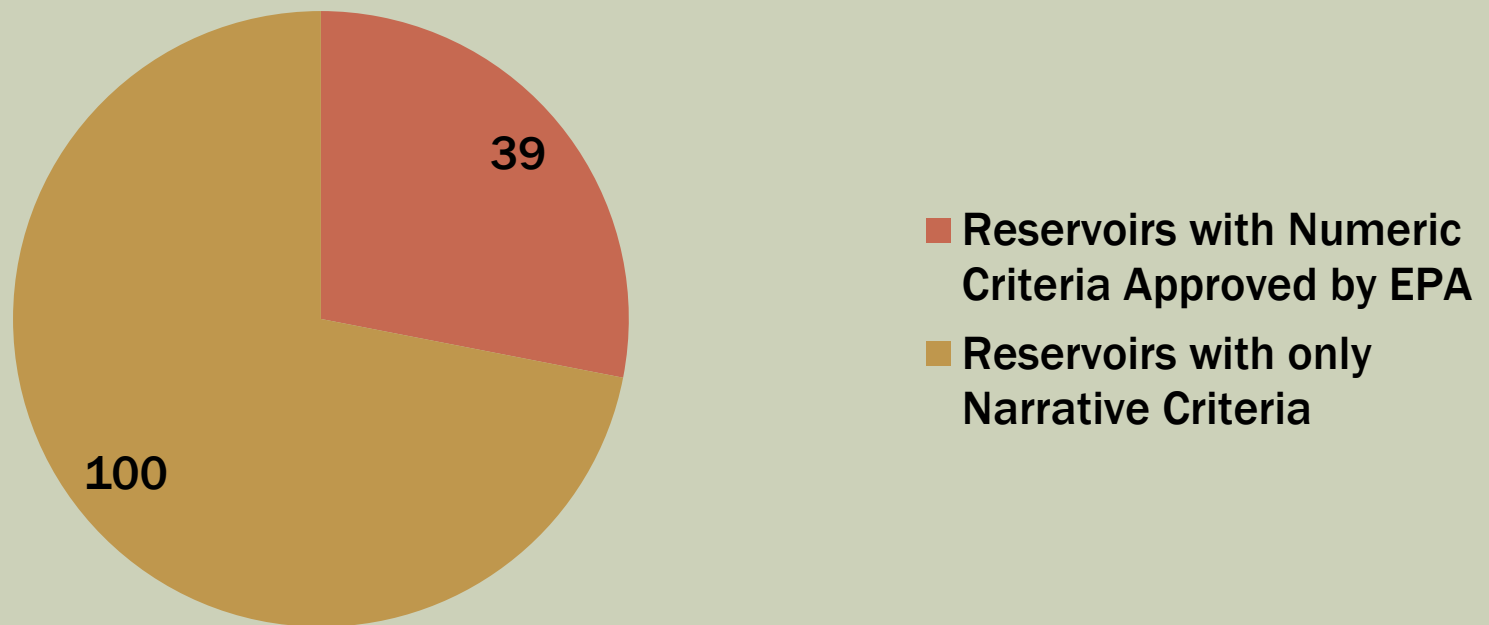
- Historical dataset, 1990-2008
- Minimum of 30 data points required
- Removed outliers => 1.5 interquartile range
- Non-detects were reported as half the detection limit

TYPES OF CRITERIA FOR NUTRIENTS

- When criteria are met, water quality will generally protect the designated use.
- Two Types:
 - Numeric criteria
 - Narrative criteria
- Examples:
 - Numeric criteria: Speed limit = 70 miles per hour on highways
 - Narrative statements: Motorists must not cause accidents due to excessive speeding on highways.

TYPES OF NUTRIENT CRITERIA IN RESERVOIRS

**Number of Reservoirs in Draft 2014 Carlson's Trophic
Status Index Report: 139**



CURRENT STANDARDS: NUMERIC NUTRIENT CRITERIA

- Site-Specific Uses and Criteria
 - §307.7(B)(4)(E) Nutrient criteria. Numeric and narrative criteria to preclude excessive growth of aquatic vegetation are intended to protect multiple uses such as **primary, secondary, and noncontact recreation, aquatic life, and public water supplies**. Nutrient numeric criteria for specific reservoirs, expressed as concentrations of chlorophyll *a* in water, are listed in Appendix F of §307.10 of this title.

CURRENT STANDARDS: NARRATIVE NUTRIENT CRITERIA

■ §307.4. General Criteria

- §307.4(e) Nutrients. Nutrients from permitted discharges or other controllable sources must not cause excessive growth of aquatic vegetation that impairs an **existing, designated, presumed, or attainable** use. Site-specific nutrient criteria, nutrient permit limitations, or separate rules to control nutrients in individual watersheds are established where appropriate after notice and opportunity for public participation and proper hearing. Site-specific numeric criteria related to chlorophyll *a* are listed in Appendix F of §307.10 of this title.

CURRENT NUTRIENT ASSESSMENT: RESERVOIRS

- Screening levels for each parameter
 - Ammonia: 0.11 mg/L
 - Nitrate: 0.37 mg/L
 - OP: 0.05 mg/L
 - TP: 0.20 mg/L
 - Chl a: 26.7 ug/L
- Applied to all reservoirs
- 85th percentile (~2006 IR)
- 20% exceedance rate
- Assessed for each AU

WHAT DOES THAT LOOK LIKE?

- Results reported for each parameter assessed per AU



WHY DO WE NEED TO CHANGE THE EXISTING PROCESS?

- **Assessment Needs**
 - Numeric nutrient criteria for 39 reservoirs
 - Narrative nutrient criteria for reservoirs without EPA-approved numeric criteria
- **Stakeholder Input**
 - Stakeholders requested a consistent framework for evaluating all reservoirs
- **Improvement of screening levels**
 - Screening levels do not associate nutrient concentrations with designated uses
 - Potential inconsistencies: Screening levels vs. Numeric criteria

HOW TO INCORPORATE NARRATIVE AND NUMERIC CRITERIA?

- **Weight of Evidence Approach**
 - Ties data evaluation to designated uses included in the TSWQS
 - Allows translation of narrative nutrient criteria using numeric targets
 - Incorporates numeric criteria
 - Provides a more comprehensive assessment than single variable criteria (or screening levels)
 - Decreases uncertainty due to confounding factors that are inherent to water quality data
 - Can incorporate site-specific targets and ecological thresholds in the evaluation

OTHER STATE EXAMPLES

WEIGHT OF EVIDENCE APPROACH

- **New Mexico:**
 - Reservoirs and streams
 - TN, TP, secchi depth, Chl *a*, % cyanobacteria, and DO concentration
- **Arizona:**
 - Lakes and Reservoirs
 - TN, TP, Chl *a*, secchi depth, TKN, cyanobacteria concentration, and DO concentration
- **Arkansas:**
 - Beaver Lake and streams
 - Chl *a* and secchi
 - Reservoir assessment approach still being developed

TRANSLATING NARRATIVE CRITERIA

Nutrients from permitted discharges or other controllable sources must not

CAUSE → **TN and TP**

EXCESSIVE GROWTH OF AQUATIC VEGETATION → **Chlorophyll a**

that impairs an

EXISTING, DESIGNATED, PRESUMED or ATTAINABLE USE.

WQS 307.7(B)(4)(E)



Aquatic Life Use → **DO**

Public Water Supply → **Secchi, Chlorophyll a, and TN (Human Health Criteria for NO₃)**

Recreational Use → **Secchi**

PARAMETERS SUGGESTED FOR REVISED RESERVOIR NUTRIENT ASSESSMENT

■ Causal Parameters

- Total Phosphorus
 - Site specific
- Total Nitrogen
 - 0.58 mg/L

■ Response Parameters

- Chl *a*
 - Site specific
- Secchi depth
 - Site specific
- Dissolved Oxygen
 - IR assessment outcome

DATA QUALITY OBJECTIVES

CHLOROPHYLL A

■ Chlorophyll a

- Fluorometric, PC 70953, LOQ = 0.2 ug/L (TCEQ) or 2.0 ug/L (LCRA)
 - EPA method 445.0. Low-level determination of chl a using fluorescence detection.
 - Unpreserved - no acid
- Spectrophotometric, PC 32211, LOQ = 2.0 ug/L
 - EPA method 446.0. Determination of chl a using visible spectrophotometry.
 - Unpreserved - no acid
- Both methods were used to develop criteria
- Lowest Criteria or threshold is 5.0 ug/L
- Sample collection and preservation per *SWQM Procedures Vol. 1*

DATA QUALITY OBJECTIVES

TOTAL NITROGEN

■ Total Nitrogen

■ TN = TKN + Nitrate + Nitrite

■ TKN, PC 00625, LOQ = 0.2 mg/L

- TKN is the sum of organic nitrogen and ammonia (NH₃)
- EPA method 351.2. The procedure converts nitrogen components of biological origin such as amino acids, proteins and peptides to ammonia. The digested sample is measured colorimetrically.
- Acid preserved

■ Nitrate+Nitrite, PC 00630, LOQ 0.02 mg/L

- EPA 353.2 with cadmium reduction. Nitrate is reduced to nitrite by passage through a copperized cadmium column, which is then measured colorimetrically.
- Acid preserved

■ Nitrate, PC 00620, LOQ = 0.02 mg/L

- EPA 353.2 with cadmium reduction. See above.
- Unpreserved - no acid

■ Nitrite, PC 00615, LOQ = 0.02 mg/L

- EPA 353.2. Nitrite can be determined individually on an unpreserved sample by removing the cadmium column
- Unpreserved - no acid

■ Lowest threshold for consideration is 0.58 mg/L

■ Sample collection and preservation per *SWQM Procedures Vol. 1*

DATA QUALITY OBJECTIVES

TOTAL PHOSPHORUS

■ Total Phosphorus

- PC 00665, LOQ = 0.02 mg/L
 - Total phosphorus is the sum of inorganic and organic forms of phosphorus.
 - EPA method 00665. The procedure converts phosphorus components to orthophosphate. The digested sample is measured colorimetrically.
 - Acid preserved
- Lowest threshold is 0.01 mg/L
- Sample collection and preservation per *SWQM Procedures Vol. 1*

ADDITIONAL WORK NEEDED

■ Parameter hierarchy

- Establish preferred parameters for assessment use
- Evaluate other methods in the database, but not in SWQM QAPP
 - Determine comparability
- Make use of all available data:
 - When only certain constituents are reported,
 - When multiple constituents are reported on the same day.

■ Example:

Nitrate	00620	1
Nitrate	00630	2
Nitrate	00593	3
Nitrate	00631	4
Nitrate	00618	5

■ Incorporating directly measured Total Nitrogen

- PC 00600 - ?
- PC 00601 - USGS method being evaluated

CRITERIA

- Chlorophyll a (Appendix F of 2014 TSWQS)
 - Site-specific
 - 39 reservoirs
 - 5.00 ug/L to 19.77 ug/L
- Dissolved oxygen - Reservoirs
 - Site-specific (Appendices A and D of TSWQS)
 - High 5/3 mg/L
 - Exceptional 6/4 mg/L
 - Presumed (§307.4(h)(3), General Criteria)
 - High

SITE-SPECIFIC THRESHOLDS

■ Chlorophyll *a*

■ Options

- Site-specific criteria adopted in 2010 but not approved by EPA
 - 99th confidence level
 - N = 28
 - 11.21 - 28.15 ug/L
- Site-specific criteria proposed in 2010 with TP and Secchi, but not adopted by TCEQ
 - 95th confidence level
 - N = 30
 - 9.93 - 29.73 ug/L
- Cap site-specific values at 30 ug/L
- Include additional level of protection for reservoirs with observed medians > 40 ug/L

SITE-SPECIFIC THRESHOLDS

Reservoirs with Numeric Criteria

- Secchi Depth
 - 0.19 – 3.13 meters
- TP
 - 0.01 – 0.20 mg/L

Reservoirs with only Narrative Criteria

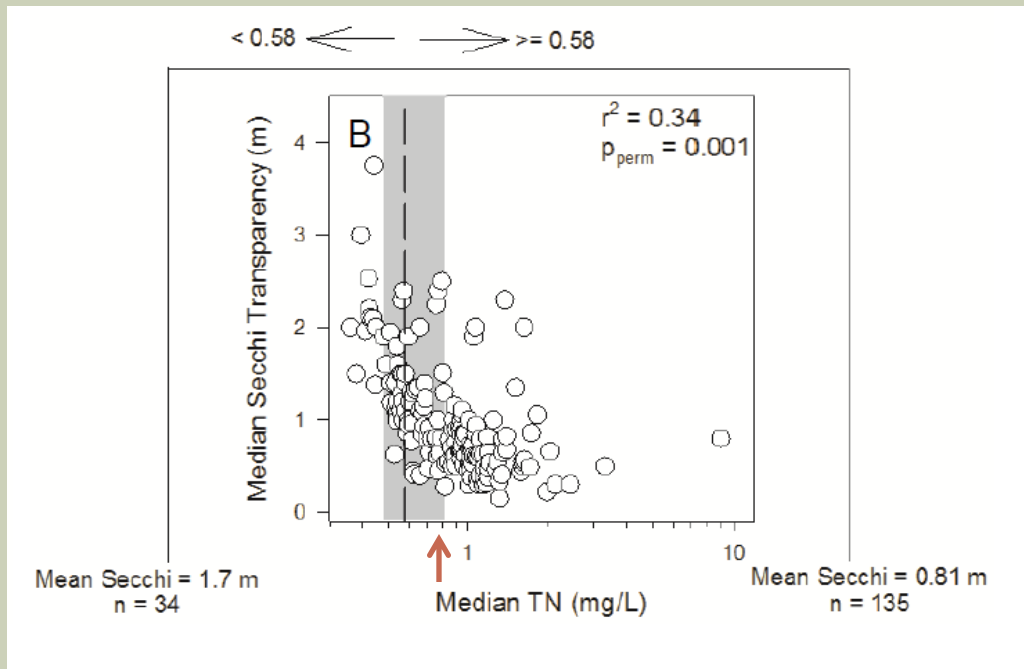
- Secchi Depth
 - 0.12 – 1.46 meters
- TP
 - 0.03 – 1.23 mg/L

WHY SITE-SPECIFIC?

- Water quality conditions vary considerably throughout the state
- Thresholds indicative of local water quality help address confounding factors
 - In naturally turbid waters, phosphorus is bound to suspended particles in the water column
- Appreciation for aesthetic enjoyment is largely based on existing water quality (TWCA, 2006)

TOTAL NITROGEN STATEWIDE THRESHOLD

- Derived from stressor/response model using water quality observations from Texas' reservoirs
- Threshold at which TN concentrations maximize changes in magnitude and/or variability in Secchi depth

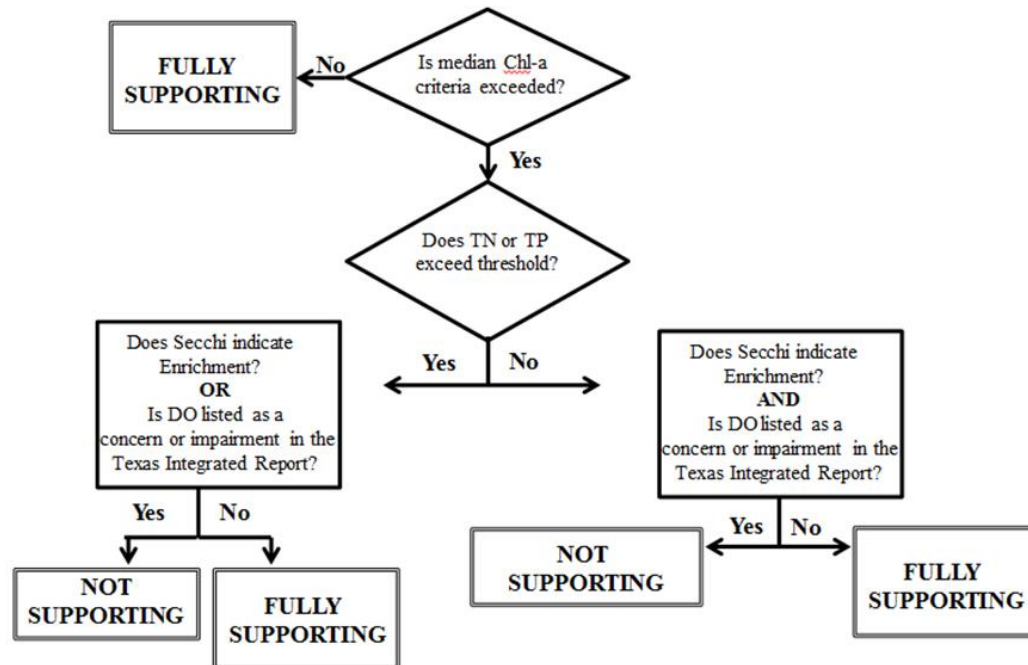


REQUIREMENTS

- Calculate TN = TKN + Nitrate + Nitrite
- Minimum sample size
 - 10 samples for each parameter
- Sample locations per Appendix F in 2010 TSWQS
- Medians of Chlorophyll *a*, TP, TN and Secchi
- DO impairments or concerns from any portion of reservoir incorporated
- Outcomes
 - Reported for entire reservoir, not AU based
 - Numeric criteria: FS, NS, or Not assessed
 - Narrative criteria: CS, NC, or Not assessed

IMPLEMENTING NUMERIC CRITERIA

Reservoirs with Chlorophyll *a*
Criteria approved by EPA



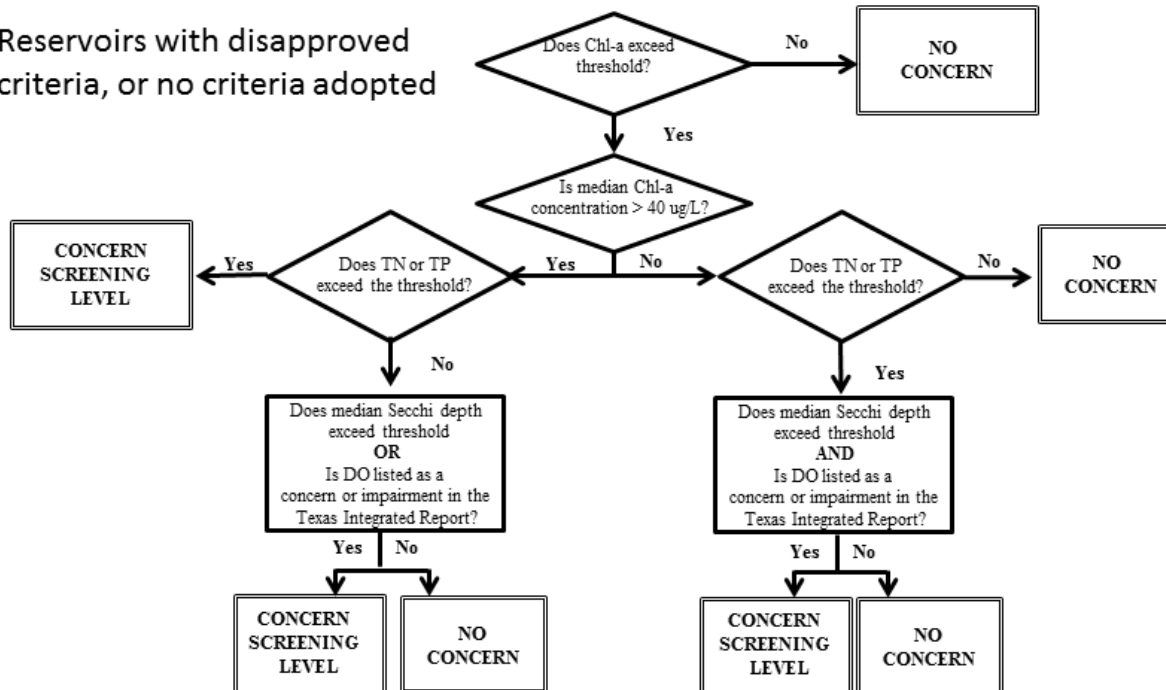
Not Assessed: < 10 samples for any variable

Support: adequate data (>= 10 samples for all variables)

The process for reservoirs with EPA approved chlorophyll *a* criteria begins with evaluation of chlorophyll *a*, then uses a weight of evidence approach to evaluate association with elevated nutrients (TN and TP) and observed ecosystem response (DO and Secchi).

IMPLEMENTING NARRATIVE CRITERIA

Reservoirs with disapproved criteria, or no criteria adopted



Not Assessed: < 10 samples for any variable

Adequate Data: >= 10 samples for all variables

The process for reservoirs without EPA approved chlorophyll *a* criteria begins with evaluations for TN and TP, since it is a translation of TCEQ's narrative criteria for nutrients. Narrative criteria §307.4(f): Nutrients from permitted discharges or other controllable sources must not cause excessive growth of aquatic vegetation that impairs an existing, designated, presumed, or attainable use.

EXAMPLES

Lake A (Numeric Criteria)

Chl-a (ug/L)		TN (mg/L)		TP (mg/L)		DO (mg/L)		Secchi (m)	
Criteria	Median	Threshold	Median	Threshold	Median	Criteria	LOS	Threshold	Median
5.6	3.16	0.58	0.36	0.03	0.03	5	FS	1.34	2

Lake A (Numeric Criteria)

Chl-a (ug/L)		TN (mg/L)		TP (mg/L)		DO (mg/L)		Secchi (m)	
Criteria	Median	Threshold	Median	Threshold	Median	Criteria	LOS	Threshold	Median
5.6	3.16	0.58	0.36	0.03	0.03	5	FS	1.34	2

FULLY SUPPORTING

EXAMPLES

Lake B (Numeric Criteria)

Chl-a (ug/L)		TN (mg/L)		TP (mg/L)		DO (mg/L)		Secchi (m)	
Criteria	Median	Threshold	Median	Threshold	Median	Criteria	LOS	Threshold	Median
5.32	6	0.58	0.535	0.06	0.038	5	FS	1.01	1.5

Lake B (Numeric Criteria)

Chl-a (ug/L)		TN (mg/L)		TP (mg/L)		DO (mg/L)		Secchi (m)	
Criteria	Median	Threshold	Median	Threshold	Median	Criteria	LOS	Threshold	Median
5.32	6	0.58	0.535	0.06	0.038	5	FS	1.01	1.5

FULLY SUPPORTING

EXAMPLES

Lake C (Numeric Criteria)

Chl-a (ug/L)		TN (mg/L)		TP (mg/L)		DO (mg/L)		Secchi (m)	
Criteria	Median	Threshold	Median	Threshold	Median	Criteria	LOS	Threshold	Median
13.85	14.1	0.58	0.97	0.06	.055	5	FS	0.42	0.375

Lake C (Numeric Criteria)

Chl-a (ug/L)		TN (mg/L)		TP (mg/L)		DO (mg/L)		Secchi (m)	
Criteria	Median	Threshold	Median	Threshold	Median	Criteria	LOS	Threshold	Median
13.85	14.1	0.58	0.97	0.06	.055	5	FS	0.42	0.375

NOT SUPPORTING

EXAMPLES

Lake D (Narrative Criteria)

Chl-a (ug/L)		TN (mg/L)		TP (mg/L)		DO (mg/L)		Secchi (m)	
Criteria	Median	Threshold	Median	Threshold	Median	Criteria	LOS	Thresold	Median
30	48.1	0.58	1.27	0.09	0.08	5	FS	0.63	0.595

Lake D (Narrative Criteria)

Chl-a (ug/L)		TN (mg/L)		TP (mg/L)		DO (mg/L)		Secchi (m)	
Criteria	Median	Threshold	Median	Threshold	Median	Criteria	LOS	Threshold	Median
30	48.1	0.58	1.27	0.09	0.08	5	FS	0.63	0.595

CONCERN SCREENING LEVEL

OTHER FACTORS

- Other reservoirs?
 - Can develop site-specific thresholds as data are available
 - N = 30
- De- Listing
 - Attainment determined using flow chart
 - Improved chl *a* is most direct way to be de-listed
- Addressing Spurious Impairments
 - 4c, particularly when Carlson's Trophic Status Index or TSS indicates reduced transparency is not related to chl *a*
 - Drought impacts
 - Consider criteria revision

HOW TO UPDATE INFORMATION

- **Site-specific criteria revisions (Chl *a*)**
 - Same procedure as other site-specific standards
 - Through triennial standards review process
 - Spurious impairments, stakeholder request and data availability
- **Thresholds for TP, Secchi and Chl *a***
 - Same procedure as other Integrated Report-related info.
 - Will be published in the Assessment Guidance
 - Every two years
 - Spurious impairments, stakeholder request and data availability
- **Stations**
 - §307.9(e)(7) – “The data for the assessment must be collected at the sampling stations used for calculating the criteria..., **or from comparable stations in the main pool of the reservoir**”.

QUESTIONS AND OTHER CONSIDERATIONS?