South Florida Water Management District
Regulatory Peer Review Forum
March 23, 2012
9 a.m. – 11:00 a.m.
SUMMARY

Attendees:

Jay Foy	Stormwater J Engineering
Craig Kidwell	Consulting Engineer
Ken Todd	Palm Beach County
Gerry Ward	Gerald M. Ward, P.E.
Howard L. Searcy	Johnathan Ricketts, Inc.
Johnathan Ricketts	Johnathan Ricketts, Inc.
Fred Roth	Schorah & Associates
Marc A. Fermanian	Consultant
Bonnie McLeod	Mathews
John S. Yeenid	John S. Yeenid, P.E.
Ed Weinberg	EW Consultants
Tony Waterhouse	SFWMD – Regulation Division Staff
Damon Meiers	SFWMD – Regulation Division Staff
Laurie Donovan	SFWMD – Regulation Division Staff
Steve Sarley	SFWMD – Regulation Division Staff
Susan Martin	SFWMD – Office of Council
Sharon Trost	SFWMD – Regulation Division Staff
Anita Bain	SFWMD – Regulation Division Staff
Kevin Carter	SFWMD – State Policy and Coordination Unit

1. Opening Remarks – Tony Waterhouse

Mr. Waterhouse opened the meeting at about 9:05 a.m.

2. Numeric Nutrient Criteria Rule (NNC)

Susan Martin led the discussion on the status of the numeric nutrient criteria rule (NNC). Discussion points, including those raised by meeting attendees included the following:

- The DEP adopted its NNC in November 2011.
- The DEP made some amendments and re-issued its NNC in December 2011.

- The DEP NNC was challenged by numerous groups, with estuaries and sampling components the main focus of challenges.
- SFWMD testimony disputed findings on Florida Bay.
- Hearings on the DEP NNC were completed the second week of March 2011.
- The EPA has a proposed NNC. Indications are that the EPA will accept the DEP NNC.
- The DEP NNC is much better for the Florida economy than the EPA NNC.
- The DEP NNC applies to all water bodies.
- The NNC will likely be implemented through the TMDL process.

Tony Waterhouse led continuing discussion on the NNC.

Discussion during this portion of the meeting focused on implementation of the NNC. Discussion points and comments included the following:

- Implementation of the DEP NNC will be through the Basin Management Action Plan (BMAP).
- The DEP NNC will likely be approved by late April 2012.
- There are no changes currently contemplated in the ERP process as a result of the NNC.

Kevin Carter led further discussion on the NNC and provided a PowerPoint Presentation. Discussion points and comments included the following:

- The DEP NNC does not include numeric nutrient criteria for every water body.
- It is not clear how the NNC will assess canals, because there is an understanding that canals differ from streams.
- The current EPA NNC covers lakes, springs and rivers. The DEP NNC includes estuaries.
- The future EPA NNC will include south Florida canals.
- The current DEP NNC is under review by the EPA. Proposed revisions to the DEP NNC are due May 21, 2012.
- The implementation date for the EPA NNC is July 6, 2012.
- The intent of the NNC is to keep water bodies from becoming impaired.
- There is concern about how enforcement will occur if a water body is deemed impaired.

3. <u>Miscellaneous</u>

Handouts were provided, and are attached on:

- Southern Plug Removed at Kissimmee River Restoration Project

- Florida Department of Environmental Protection Technical Support for the Biological Assessment and Numeric Nutrient Standards for Streams, Spring Vents, and Lake

Also attached is the PowerPoint presentation given by Kevin Carter.

4. Next meeting date/other topics/adjournment

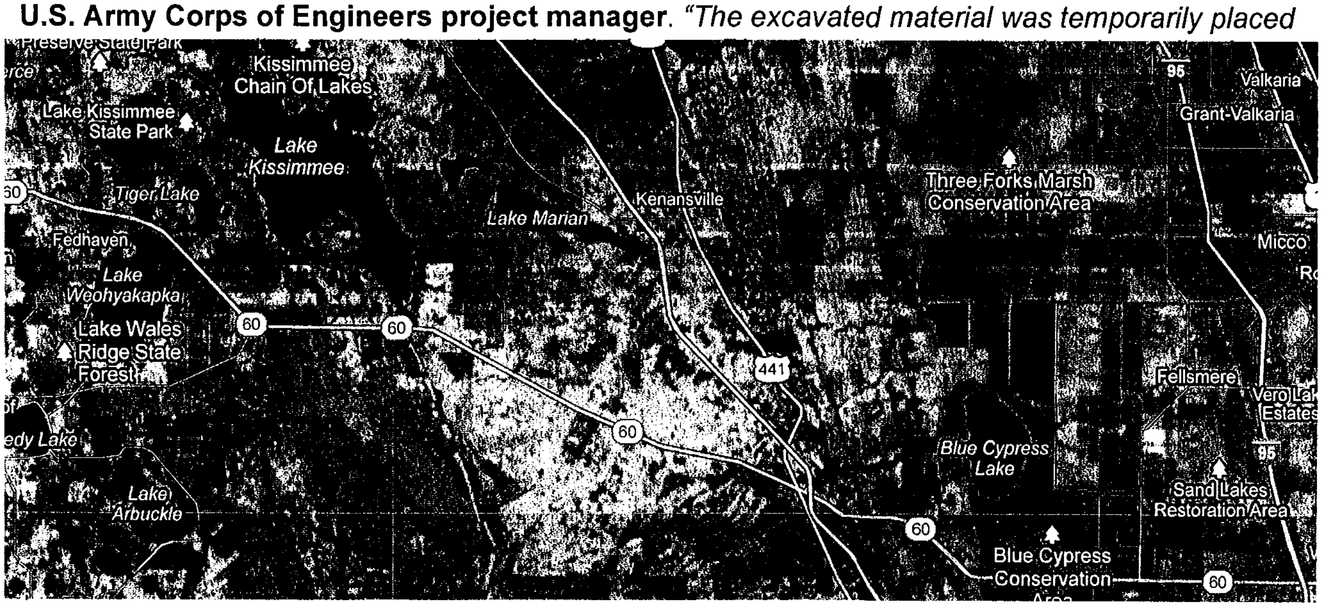
Meeting was adjourned at 11:00am
Next meeting Friday, May 25th

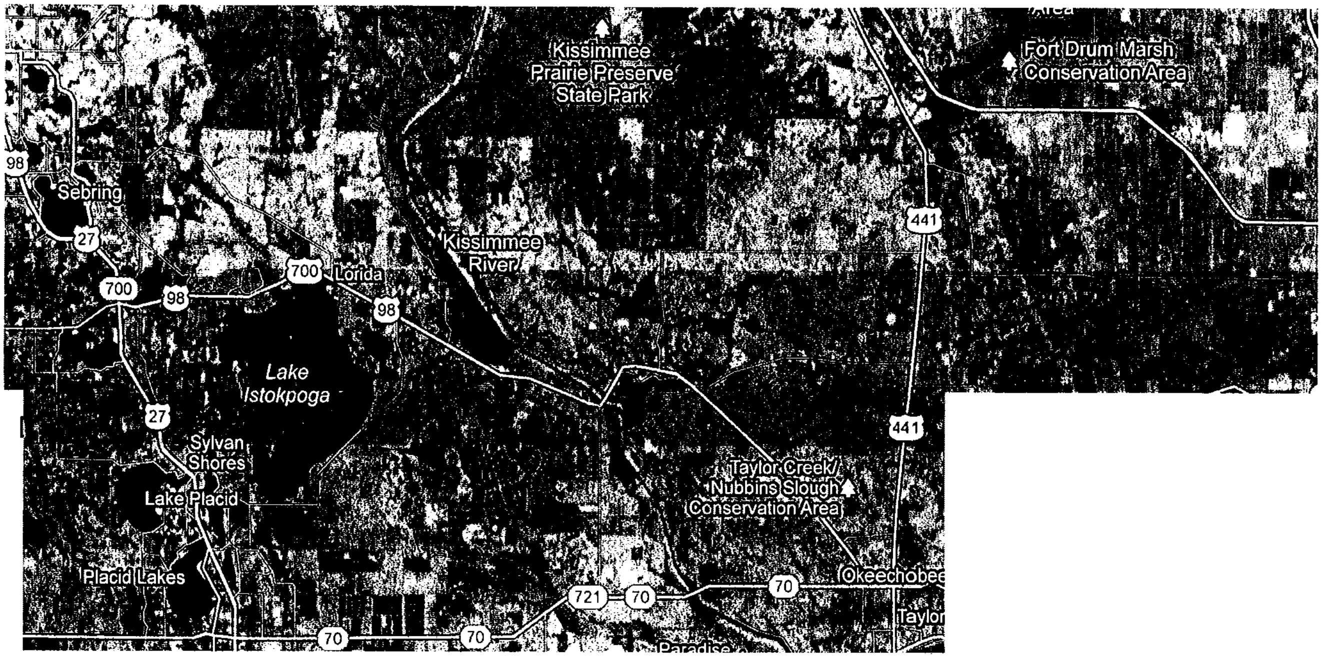
Southern Plug Removed at Kissimmee River Restoration Project (USA)

Posted on Mar 20th, 2012 with tags Americas, Kissimmee, News, Plug, Project, removed, Restoration, river, Southern, USA.

The southern earthen plug located along Reach 3 of the Kissimmee River Restoration project has been removed, connecting a portion of the excavated oxbow to the C-38 Canal, located on the Kissimmee River. The work to remove the plug began March 12, 2012, and was completed March 13, 2012. During this time, over 80 percent of the volume of water flowed into the oxbow.

"*Approximately 7,400 linear feet of material was excavated from this historic oxbow in an effort to duplicate the original meandering pattern, gradient, and cross-sectional area,*" said **Tiphanie Jinks, U.S. Army Corps of Engineers project manager**. "*The excavated material was temporarily placed*




Kissimmee
Prairie Preserve
State Park
Fort Drum Marsh
Conservation Area
98
Sebring
27
441
Kissimmee
River
700
Lorida
700
98
98
Lake
Istokpoga
27
441
Sylvan
Shores
Lake Placid
Taylor Creek/
Nubbins Slough
Conservation Area
Placid Lakes
721
70
70
Okeechobee
70
70

Florida Department of Environmental Protection

Technical Support for the Biological Assessment, and Numeric Nutrient Standards for Streams, Spring Vents, and Lakes

Florida Department of Environmental Protection

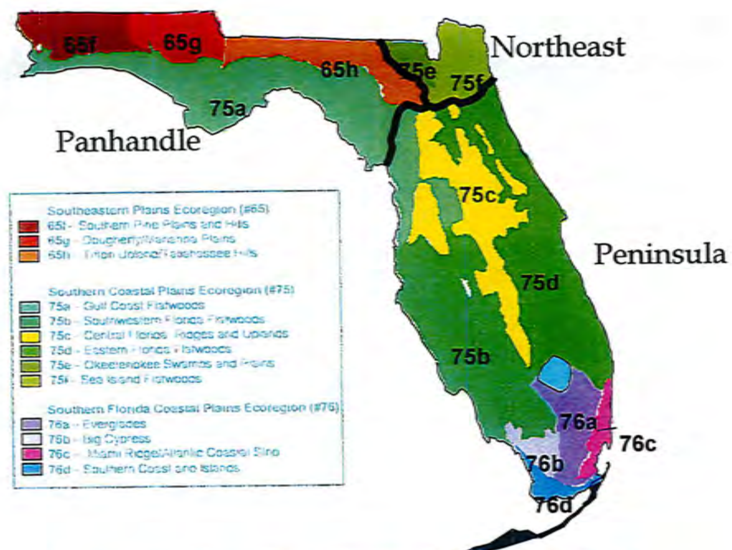
Division of Environmental Assessment and Restoration

History of Bioassessment in Florida

- Beck's Biotic Index, 1950s
- Shannon-Weaver diversity, 1970s
- EPA Rapid Bioassessment multi-metric index, 1992
  - Earlier Iterations of DEP Stream Condition Index, 1996, 2004, 2007
    - Evolving approaches
  - Current SCI calibrated in conjunction with EPA , 2012
    - Human Disturbance Gradient for metric selection
    - Biological Condition Gradient and Reference Site approaches for calibrating Aquatic Life Use Support threshold

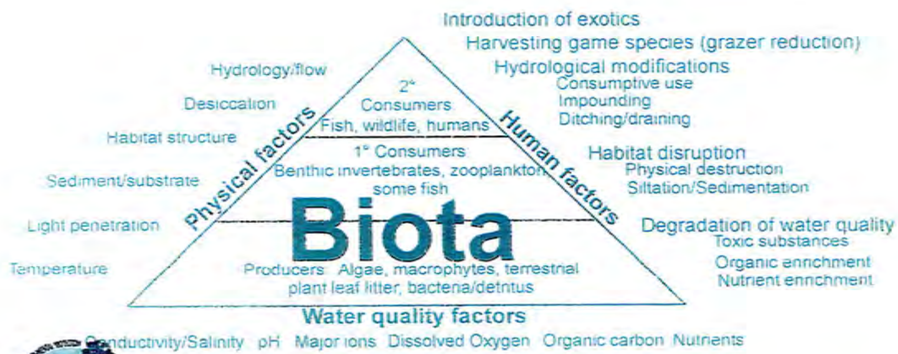
Bioassessment Theory

- Biota respond to a wide variety of cumulative factors, both natural and anthropogenic
- As the organisms integrate these factors over time, a characteristic community structure and function emerges
- When human actions adversely affect a system, the community structure and function will change, leading to an impaired or imbalanced community



.Sub-ecoregions of Florida were aggregated into 3 bioregions, based on multivariate measures of taxonomic similarity.

Human Stressors and Natural Factors Shape Biota



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Adverse Human Factors

- Hydrologic modifications
  - Consumptive use, impounding, ditching/draining
- Habitat disturbance
  - Physical removal, sedimentation, algal smothering
- Degradation of water quality
  - Toxic substances, nutrient and organic enrichment
- Introduction of invasive exotic taxa
  - Displaces natives
- Harvesting biomass
  - Disturbing predator-prey relationships, grazer reduction, etc.

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Interpreting Bioassessment Results

- Measures of ecosystem health that respond predictably to human influence are termed **metrics.**
- Comparing reference sites to "test" sites allows determination of when unacceptable departures from the expected condition occur
- The systems being compared should be similar except for potential human influences
- Natural stressors (*e.g.*, flood vs. drought, natural habitat availability) should be reasonably understood, and controlled for in the sampling design, to more conclusively determine when human actions have caused biological degradation

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Development of SCI Metrics using the Human Disturbance Gradient

Objectively quantified the relative level of human influence based on four factors:

- Landscape disturbance
  - Landscape Development Intensity Index
- Habitat alteration
  - Habitat assessment data
- Hydrologic modification
  - Hydrologic scoring process
- Chemical Pollution
  - Ammonia

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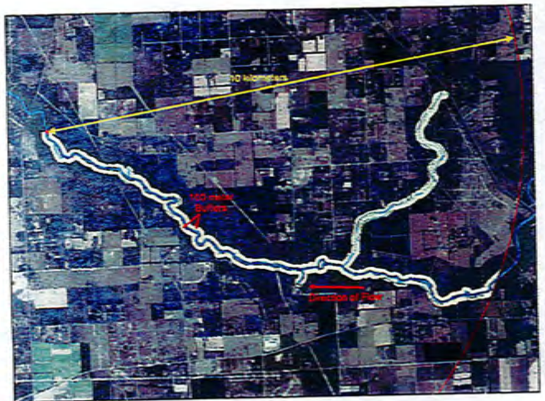
Landscape Development Intensity Index (Brown and Vivas 2004, UF Center for Wetlands)



Specific landuse near a waterbody receives a score from good (1) to bad (10). Based on non-renewable human energy inputs.

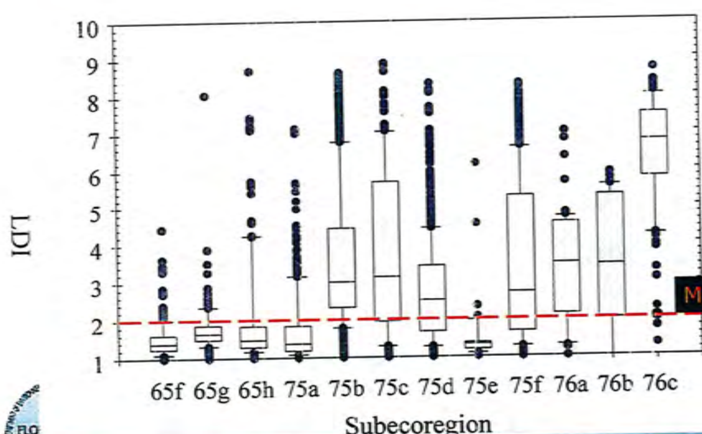
Florida Department of Environmental Protection

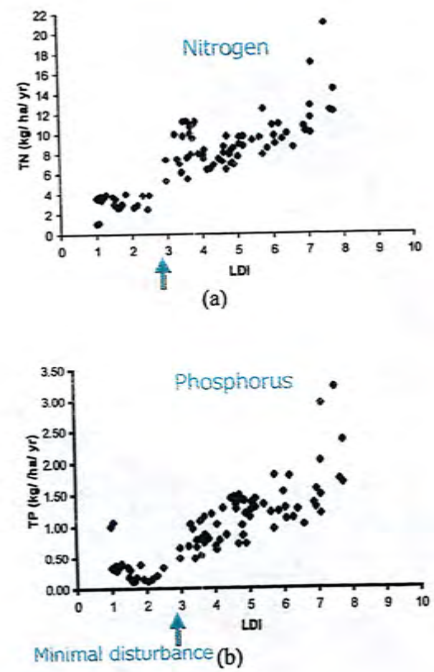
Summary of the Landscape Development Intensity Coefficients

Category	Coefficient
Natural System	1
Pine Plantation	1.6
Pasture	3.4
Row Crops	4.5
Residential (low)	6.8
Residential (high)	7.6
Commercial	8.0
Industrial	8.3
Commercial (high)	9.2
Business District	10.0

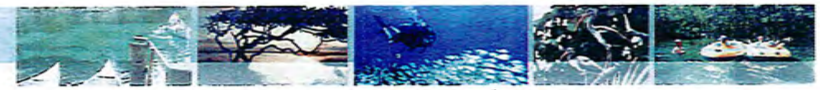
Based on non-renewable Energy inputs, Odom's "Embodied Energy" concept

Summary of Stream LDI (100 m buffer) Results by Ecoregion (n = 5570 stations)





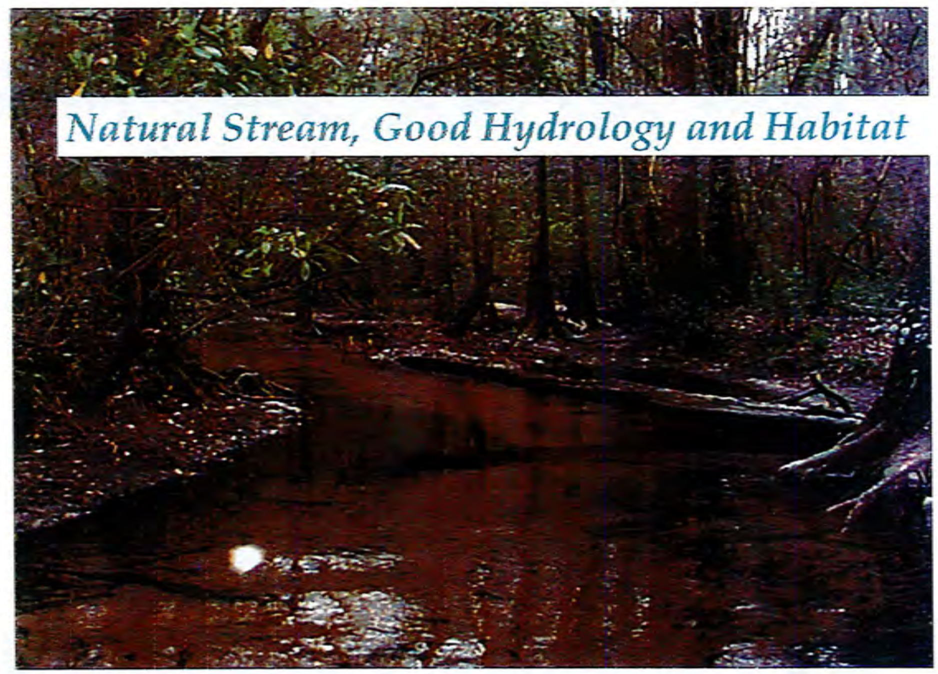
Relationship between LDI and Nutrient Loading (from Brown and Vivas 2005)



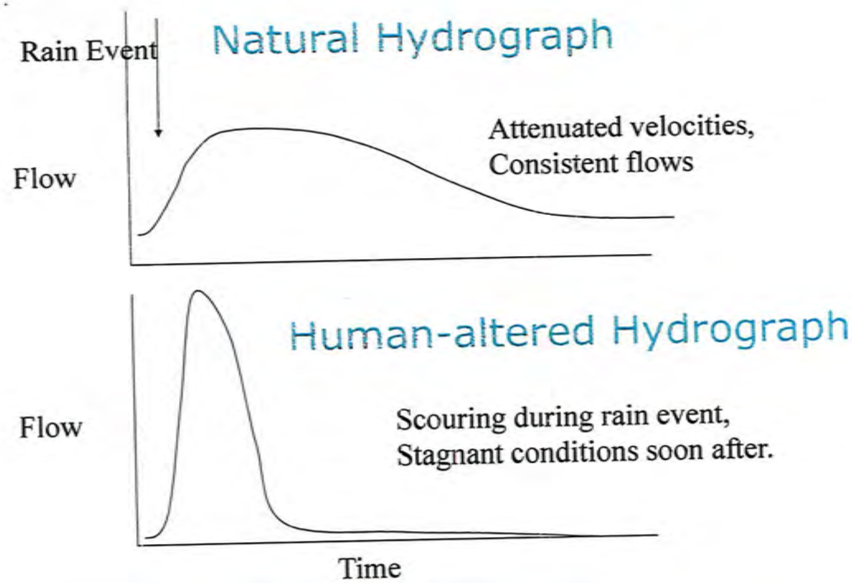
Habitat Assessment Components

- Substrate Types
- Substrate Availability
- Water Velocity
- Artificial Channelization
- Habitat Smothering
- Bank Stability
- Riparian Zone Buffer Width
- Riparian Zone Vegetation Quality

Optimal → Poor
20 points → 1 point



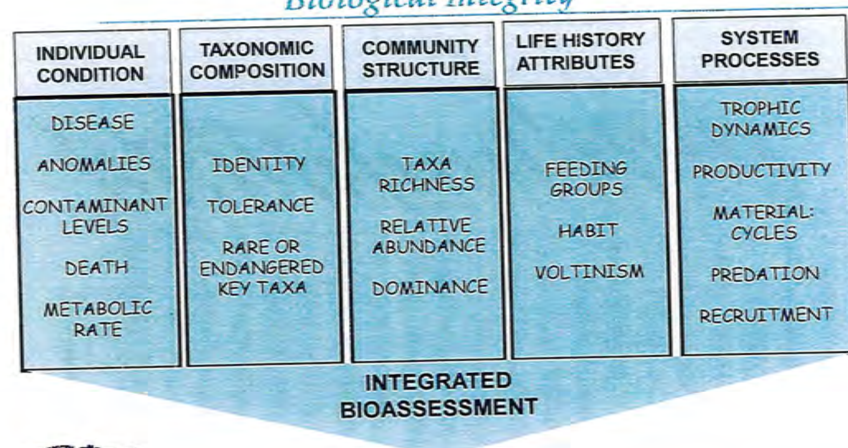
Hydrologically Modified Canal with Limited Habitat



Human Disturbance Gradient as the x- axis

- These components were converted into a dimensionless index, with low values denoting low disturbance, and increasing values associated with more intense human influences
- The index was subsequently used as the x-axis for testing a wide variety of biological attributes associated with the measurement of ecological integrity

Major Attribute Categories for Determining Biological Integrity



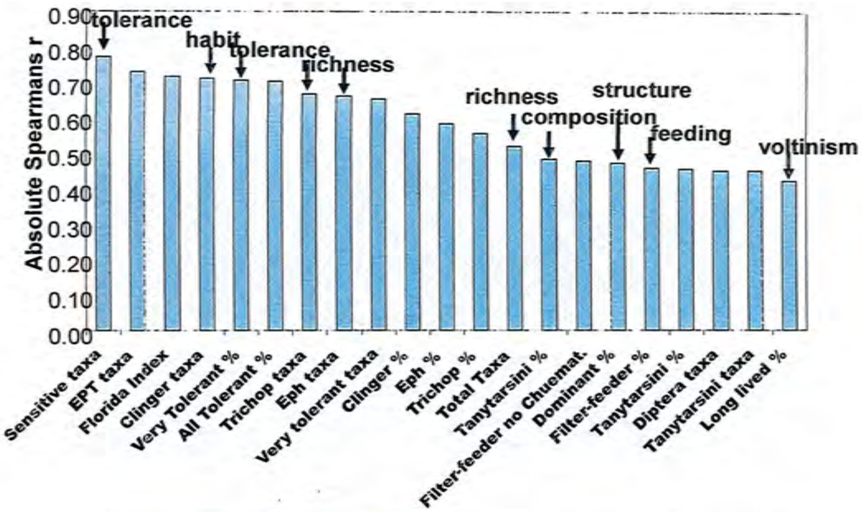
TOXICITY TESTS

INVERTEBRATE SCI

Metric Selection

The 10 selected metrics were chosen to:

- Represent as many attribute categories as possible
- Provide meaningful and predictable assessment of human effects
- Avoid redundancy if several correlated metrics were providing similar information.



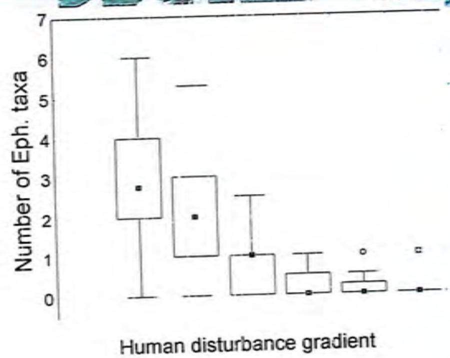
Correlation between various metrics and the Human Disturbance Gradient. Arrows indicated metrics selected for the SCI, and associated attribute group.

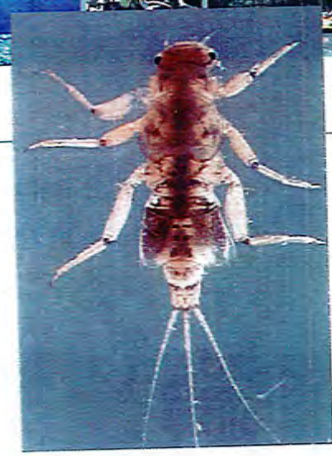
Stream Condition Index Metrics

- Measures invertebrate response to human disturbance, with 10 metrics:
  - Total Taxa,
  - Clinger Taxa,
  - Long Lived Taxa,
  - Percent Suspension Feeders,
  - Sensitive Taxa,
  - Tanytarsini,
  - Very Tolerant (inverse),
  - Ephemeroptera Taxa,
  - Trichoptera Taxa,
  - Percent Dominant (inverse)

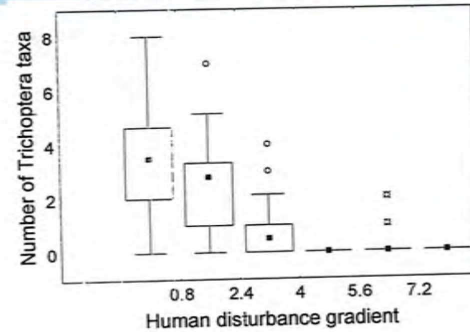
Taxa Richness Metrics

- Total taxa richness (the number of different types of organisms present)
- Trichoptera richness (caddisflies)
- Ephemeroptera richness (mayflies)
- These three measures have historically been shown to decrease with human disturbance
- Three richness metrics were chosen since each one may respond differently, depending on type of disturbance
- Mayflies are more sensitive to metals, certain caddisflies may be more sensitive to flow disruption

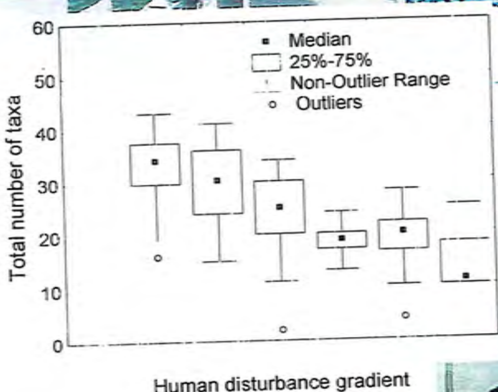




Ephemeroptera Metric. The photo is of Tricorythodes, a sensitive mayfly.



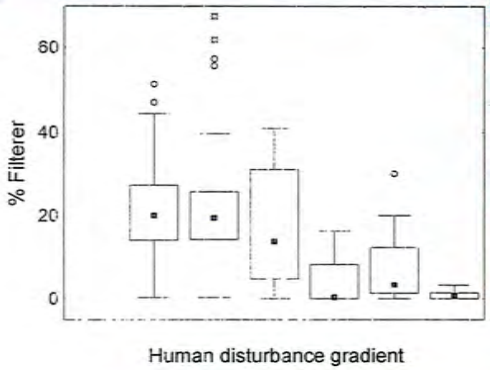
Trichoptera Taxa. The photo is of a caddisfly, Brachycentrus.



Taxa Richness

Feeding Groups Metric

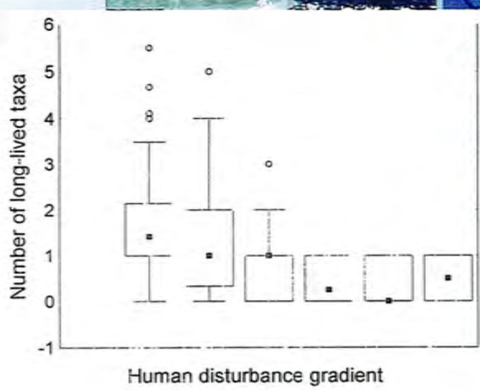
- Disruption of food webs has long been associated with human influence, especially organic pollution
- The relative abundance of filterers (percentage filterer individuals) had the highest correlation and most consistent relationship with the HDG
- Filter feeders extract nutrients by straining food particles from the water column. If the water flow or quality of the organic matter in the water is compromised, a reduction in filter feeders will occur

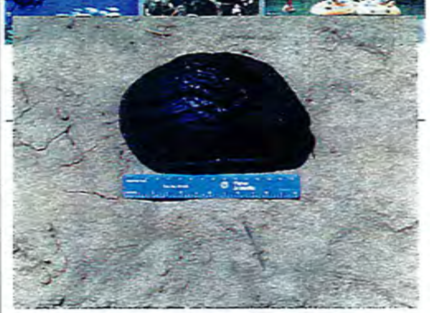


% Filter-feeders Metric. The photo is of a net-spinning caddisfly.

Voltinism Metric

- Voltinism refers to the number of distinct reproductive cycles for a given organism per unit of time
- Long-lived taxa require greater than one year to complete their life cycles
- Long-lived taxa richness would be expected to decrease if a disturbance event (*e.g.*, sporadic illegal dumping, etc.) occurred at a site within a year of sample collection

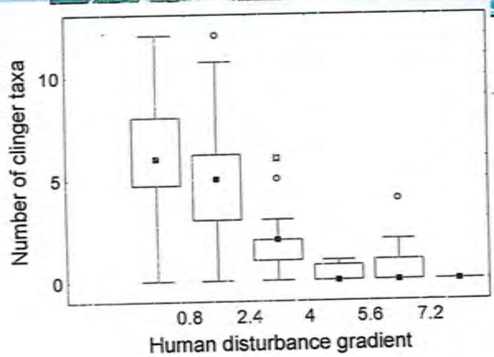




Long-lived Taxa Metric. The photo is of a mollusk, the threatened "purple bank climber".

Organism Habit Metric

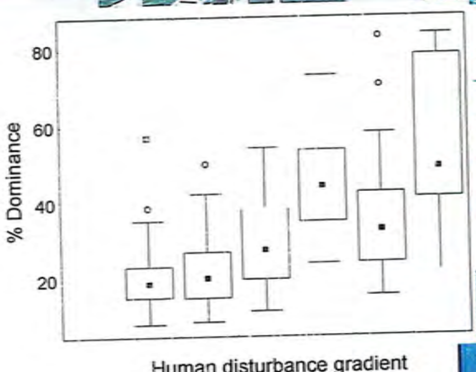
- Clingers are those taxa morphologically adapted to hold onto substrates during routine flow conditions, and would be expected to decline as humans alter a stream's hydrograph, especially during abrasive events caused by high stormwater inputs from impervious surfaces



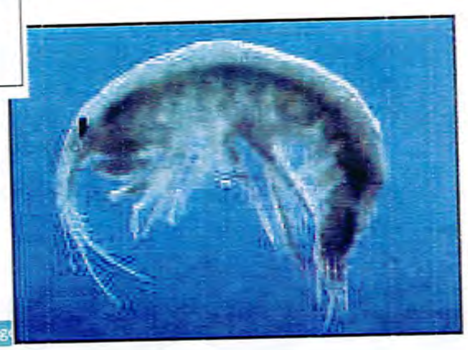
Clinger Taxa Metric. The photo is of a damselfly larvae.

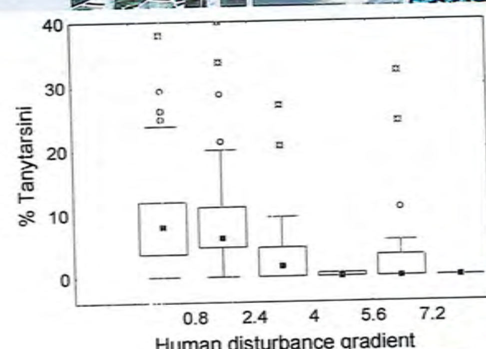
Community Structure Metrics

- Substantial shifts in proportions of major groups of organisms, compared to reference conditions, indicate degradation
- The percent dominant taxon, which increases in conditions where a few pollution tolerant organisms are very abundant, to the exclusion of other taxa, was selected as a metric
- Tanytarsini midges are sensitive to disturbance, including toxic metals, and% Tanytarsini metric was included in the SCI as the best available measure of the chironomid assemblage

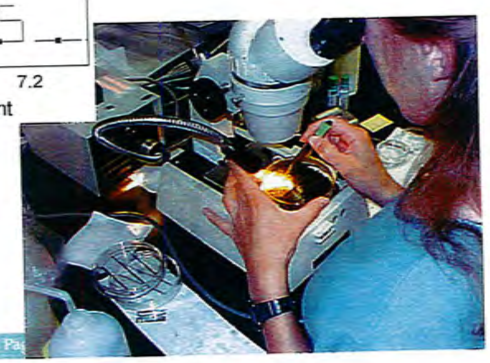


% Dominance Metric. Photo is Hyalla azteca, a tolerant amphipod.



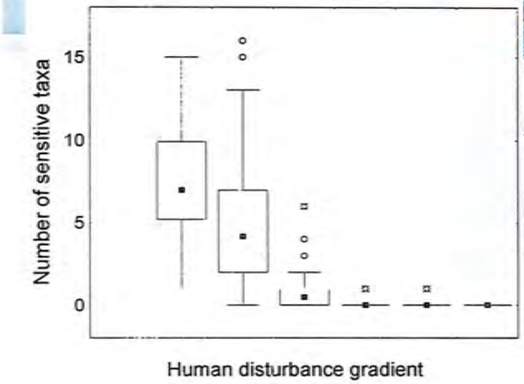


% Tanytarsini (Sensitive midges)

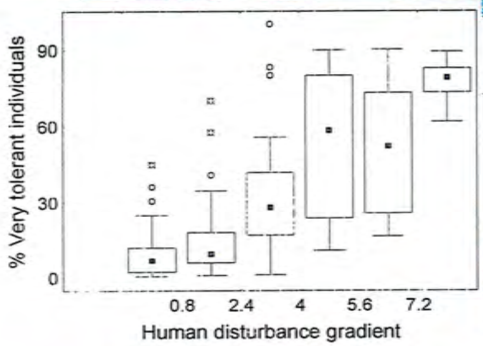


Tolerance Metrics

- A list of sensitive and very tolerant invertebrates were established by analyzing the responses of 1,200 individual species to the HDG
- The number of taxa selected as sensitive equaled around 12% of the taxa tested, and the number of very tolerant taxa was approximately 10% of the taxa tested
- Many sensitive taxa belonged to the Ephemeroptera, Trichoptera or Odonata; several chironomids were also included. All the Plecoptera were included as sensitive taxa
- The number of sensitive taxa and the percent very tolerant taxa were highly correlated with the HDG



Sensitive Taxa Metric. The photos include a plecopteran (stonefly) and odonate (dragonfly).



% Very Tolerant Metric. Photos include lunged snails, tolerant midges, and leeches.

Establishing SCI Thresholds for Aquatic Life Use Support (Calibration)

- Biological Condition Gradient Approach
- Reference Site Approach

The EPA Biological Condition Gradient: Biological Response to Increasing Levels of Stress

Levels of Biological Condition

Natural structural, functional, and taxonomic integrity is preserved.

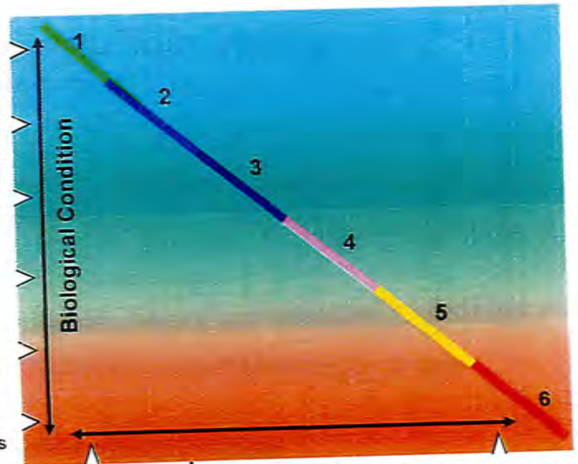
Structure & function similar to natural community with some additional taxa & biomass; ecosystem level functions are fully maintained.

Evident changes in structure due to loss of some rare native taxa; shifts in relative abundance; ecosystem level functions fully maintained.

Moderate changes in structure due to replacement of some sensitive ubiquitous taxa by more tolerant taxa; ecosystem functions largely maintained.

Sensitive taxa markedly diminished; conspicuously unbalanced distribution of major taxonomic groups; ecosystem function shows reduced complexity & redundancy.

Extreme changes in structure and ecosystem function; wholesale changes in taxonomic composition; extreme alterations from normal densities.



Watershed, habitat, flow regime and water chemistry as naturally occurs.

Chemistry, habitat, and/or flow regime severely altered from natural conditions.

10 BCG Attributes Extracted from Site Community Information

- Historically documented, sensitive, long-lived or regionally endemic taxa
- Sensitive and rare taxa
- Sensitive but ubiquitous taxa
- Taxa of intermediate tolerance
- Tolerant taxa
- Non-native taxa
- Organism condition
- Ecosystem functions
- Spatial and temporal extent of detrimental effects
- Ecosystem connectance

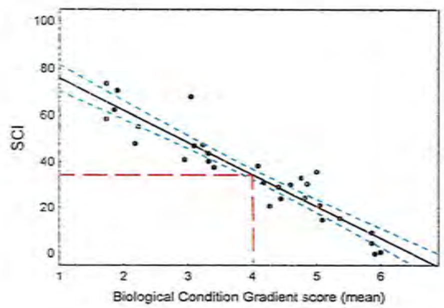
SCI BCG Workshop (October 24, 2006)

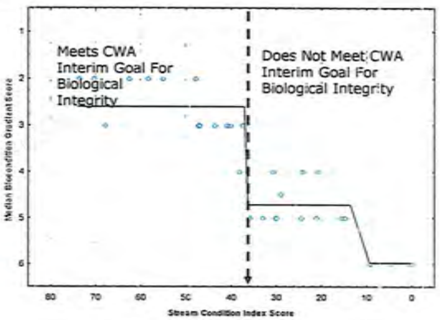
- Experts independently ranked 30 data sets
- Consistency discussions occurred (Delphi Technique)
- Provided expert opinion on where "impairment" line (not meeting interim goal of CWA) existed in rankings
- Later, expert rankings were used to modify the SCI thresholds
  - Regression
  - Change Point Analysis

BCG Experts

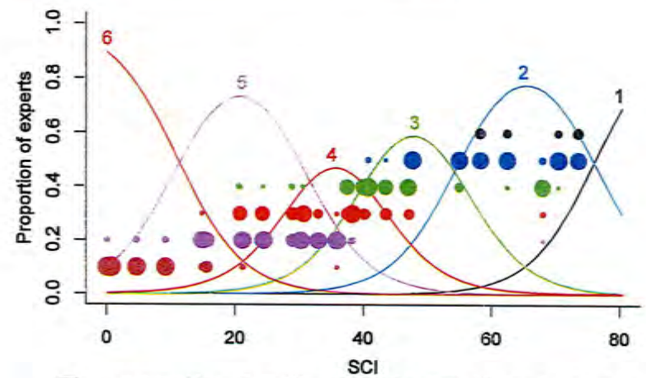
Expert name		Affiliation	Years
Jerrell	Daigle	DSA, Inc.	>20
Dana	Denson	FDEP Central District	10-15
Doug	Durbin	Biological Research Associates	>20
John	Epler	John Epler Consulting	>20
Julie	Espy	FDEP Tallahassee	5-10
David	Evans	Water and Air Research	>20
Michael	Heyn	FDEP Tallahassee	>20
Joy	Jackson	FDEP Tallahassee	10-15
Deron	Lawrence	Biological Research Associates	10-15
Laura	Line	Water and Air Research	10-15
Rob	Mattson	St. Johns River Water Management District	>20
Peggy	Morgan	FDEP Southwest District	>20
Patrick	O'Connor	FDEP Northeast District	>20
Manuel	Pescador	Florida Agricultural and Mechanical University	>20
Marianne	Pluchino	Reedy Creek Improvement District	>20
Eric	Pluchino	FDEP Orlando District	>20
Donald	Ray	FDEP Northwest District	>20
Johnny	Richardson	Leon County	10-15
Gitta	Schmitt	FDEP Southwest District	5-10
Mary	Szafraniec	Southwest Florida Water Management District	5-10
Albert	Walton	FDEP South District	>20
Gary	Warren	Florida Fish and Wildlife Commission	>20

Linear Regression and Change Point Models





Proportional Odds Model



The proportional odds analysis provides assurance that stream communities deemed exceptional (BCG category 2) will not be considered impaired at a threshold of 40.

BCG Process Final Result

- Based on the regression analyses, 35 is the lowest score that achieves the Clean Water Act interim goal
- Scores of 34 and below do not achieve the CWA goal for biological integrity, and are considered impaired
- Must also consider the Reference Site Approach in conjunction with propensity analysis

Reference Site Approach

- Defining reference condition using minimally disturbed sites recognizes that natural stressors can affect the biology of a stream, introducing variability into the reference site data distribution
- Natural drought will cause dry or stagnant flow conditions
- High water, or floods, will limit the effectiveness of the sampling method and potentially result in scouring
- Substrate diversity at some reference sites may be naturally limiting

Reference Selection Criteria

- Landscape Development Intensity Index < 2 (100 m buffer) and < 3 (entire watershed)
- Habitat Assessment Index > 75% of total points
- Ammonia < 0.1 mg/L
- Hydrologic Index ≤ 5
- Exclude sites with average conductivity > 600 umhos/cm (eliminate "tidal" influence)
- Exclude sites receiving NPDES-permitted wastewater treatment facility discharges, based on a review information from the Water Facilities Regulation database
- Use samples with number of individuals identified ranging from 100-175 (inclusive)

Mule Creek @ CR 12

Parameter	Value
Habitat Assessment	132
Hydrologic Score	2
LDI Score	1.31
SCI Score	67 A
Total Phosphorus Geometric Mean (mg/L)	0.033
Total Nitrogen Geometric Mean (mg/L)	0.50

Black Creek @ SR 16

Parameter	Value
Habitat Assessment	133
Hydrologic Score	2
LDI Score	1.21
SCI Score	91 A
Total Phosphorus Geometric Mean (mg/L)	0.116
Total Nitrogen Geometric Mean (mg/L)	0.55

EPA Peer Review Comments on DEP Reference/Benchmark Site Selection

- "I am extremely impressed by the way DEP has gone about choosing reference sites for nutrient criteria. It was a multifaceted approach utilizing LDI, 303(d) list, the proposed nitrate criteria, aerial photos, site visits, statistical analysis, and expert opinion. I can think of nothing that would improve upon their selection process."

EPA Peer Review Comments on DEP Reference/Benchmark Site Selection *(continued)*

- "Considerable effort has been applied to the task of screening benchmark sites. The steps seem reasonable in general. The methods used to identify, screen, cull and eventually select benchmark sites were rigorous and sound."
- "The rigorousness of the benchmark screening process leads me to believe that all nutrient concentrations observed at the benchmarks are fully protective of the use."

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EPA Peer Review Comments on DEP Reference/Benchmark Site Selection *(continued)*

- "An elaborate screening protocol is described for winnowing available sites to benchmark pool. Though some assumptions can be questioned, the overall impression is of a conservative approach, ensuring a valid list of candidate datasets with which to establish minimally impacted benchmark sites."

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Determining Lowest Acceptable Aquatic Life Use Scores Based on Reference Sites

- Simultaneously used statistical "interval test" (what is different) and "equivalence test" (what is similar) to balance Type I and Type II errors, given the variability in reference sites
- Because of high confidence in reference sites, DEP wanted no more than 2.5% of reference sites to fail (by definition)
- The examination of the two most recent SCIs from 55 vetted reference streams showed that the 2.5th percentile of reference data was in the range of 35-44 points
  - The middle of this range was 40 points, which balances Type I and Type II errors

FLORIDA

Interval and Equivalence Tests Conducted on Reference Sites

Average of 2 most recent temporally independent samples, including vetted SCI reference sites and benchmark sites, N = 55

Threshold description	Ref site mean	Threshold (numeric)	Impaired	Undetermined	Reference
2.5th percentile of reference	65	40	< 35	35 – 44	> 44
5th percentile of reference	65	44	< 39	39 – 47	> 47

FLORIDA

Summary of Lowest Acceptable Aquatic Life Use Scores for SCI

- BCG regression approach yielded 35 as lowest acceptable score
- BCG propensity analysis suggested that scores near 40 were midway between Category 2 (exceptional scores) and Category 5 (impaired)
- Reference site approach (using interval and equivalence tests) determined that an average SCI score of 40 (lower 2.5 percentile) balanced Type I and Type II errors

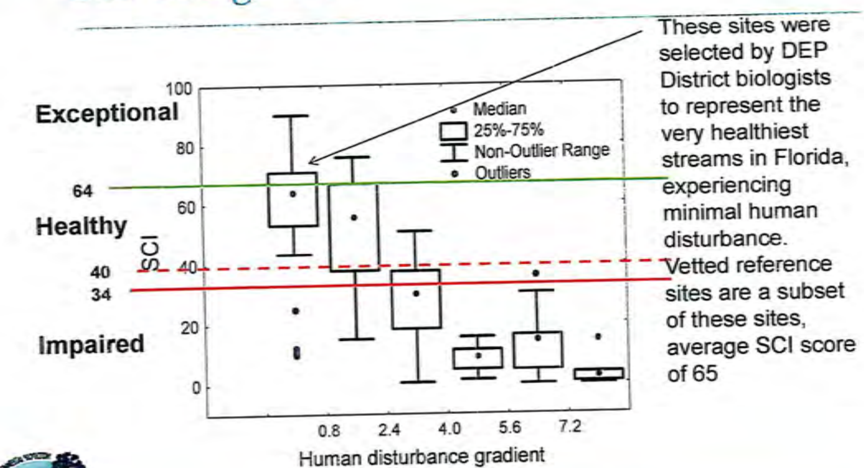
EPA Conclusion on SCI

- "An SCI score > 40 has been determined to be indicative of biologically healthy conditions based on an expert workshop and analyses performed by both FDEP and EPA. Please refer to the EPA's January 2010 proposal and the final TSD accompanying this final rule for more information on the SCI and the selection of the SCI value of 40 as an appropriate threshold to identify biologically healthy sites" (Federal Register /Vol. 75, No. 233 /December 6, 2010 /Rules and Regulations , page 75775)

Use of the BCG to Set the Exceptional Category

- Biological Condition Gradient Approach concluded that SCI scores of 64 and above were similar to natural (minimally disturbed) conditions
- Discussions with EPA suggested this was an appropriate "exceptional" threshold

SCI Categories



Improving the Power of SCI by Reducing Variability

- 2004 SCI document identified laboratory sub-sampling of the SCI samples as contributing to approximately 50% of the measurement error
- DEP began using 2 X 150 subsamples to calculate SCI, which should reduce variability while maintaining scoring within the range used to calibrate the SCI

Lake Vegetation Index Development

Human Disturbance Gradient for LVI

Measure	0	1	2
WQ index (Included TN, TP, conductivity)	< 3.5	3.5-5.9	>= 6
Habitat index	> 65	45-64	< 45
Hydrologic condition	No impound	impound	
LDI	< 2	2-4	> 4

HDG ranged from 0 to 7

Metric Testing Results

- Tested 64 metrics vs. HDG
- 10 were significantly correlated with the HDG
- Most significant metrics in 2 categories: nativity and tolerance/sensitivity
- Metrics calculated as number of taxa and as % of total taxa

LVI Metrics

- % Native taxa
- % FLEPPC invasive exotic taxa
- % Sensitive (C of C > 7) taxa
- Coefficient of Conservatism of dominant or codominant taxa

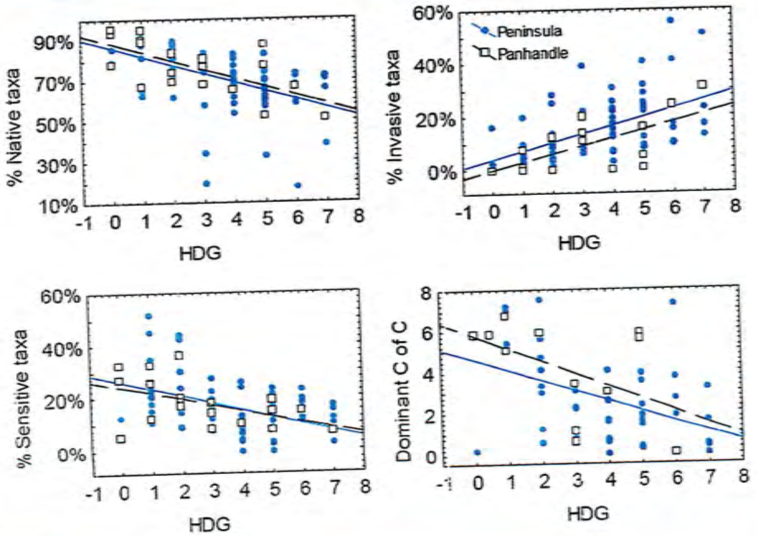


Figure 3

Strong Association Between LVI and HDG, n = 95, r = -0.71

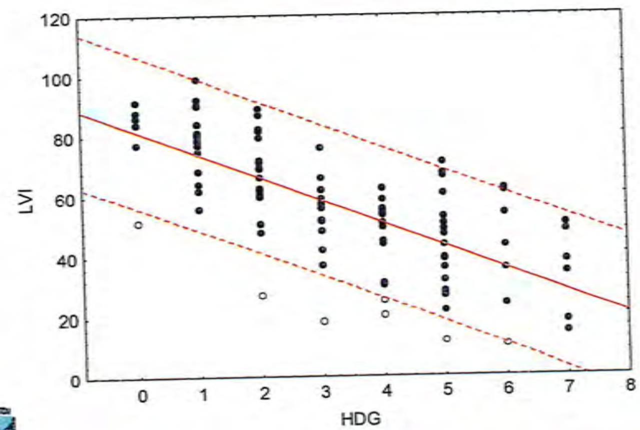
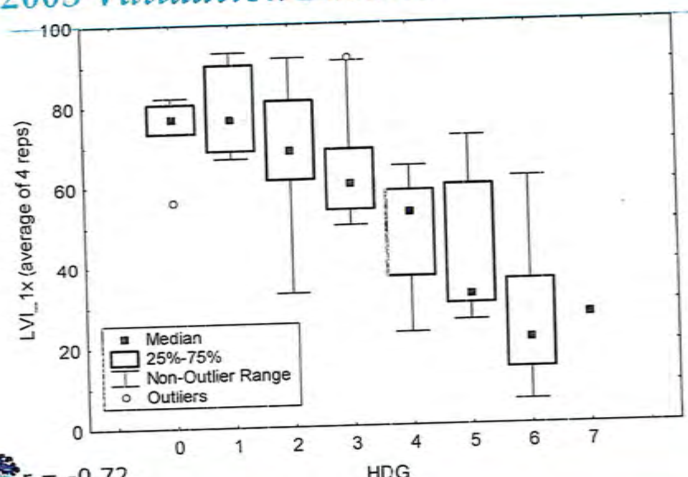


Figure 12

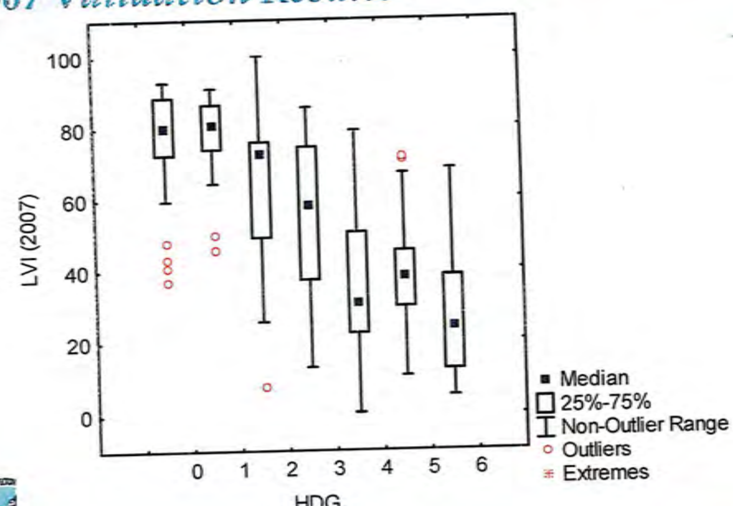
2005 Validation Results



r = -0.72

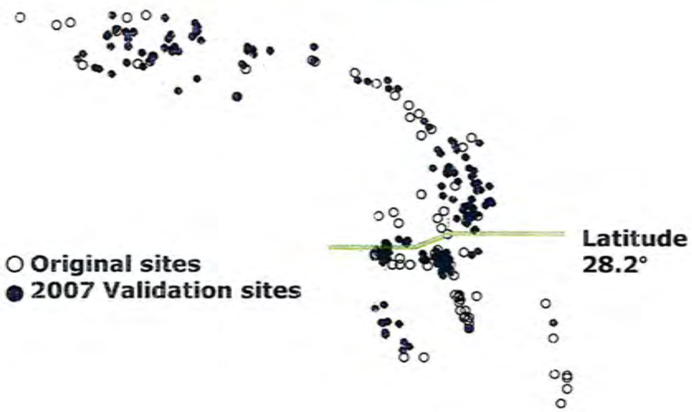
Figure 11

2007 Validation Results



App. Figure 6.4

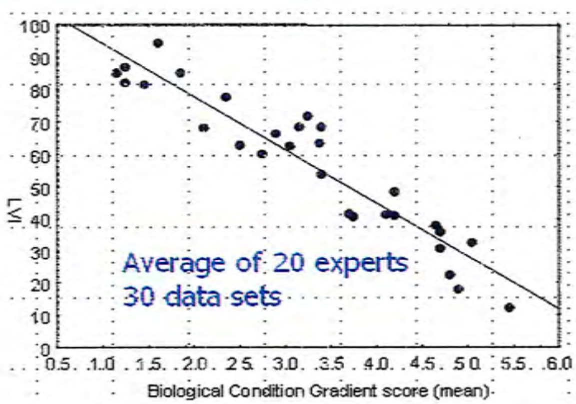
LVI Regions



2007 Variability Estimate

- 90% confidence interval for within-lake between site visits is 24.1 (+/- 12 points) for one sample and 17 for 2 samples

Lake Vegetation Index BCG Results



Reference lakes: Interval and Equivalence Tests

Impairment threshold (description)	Impairment threshold (numeric)	Impaired	Undetermined	Reference
2.5th percentile of reference	46*	<31	31–53	>53
5th percentile of reference	50	<37	37–57	>57

* Subsequently adjusted to 43 based on rescaling of the index to include recent information

2011 LVI Adjustments

- In 2011, adjustments were made to the LVI metrics to:
  - Include the C of C Scores as revised by the 2011 expert panel;
  - Use the Florida Exotic Pest Plant Council (FLEPPC) Category I (only) instead of including both FLEPPC categories; and
  - Scale the percent Sensitive, C of C Dominant/Co-dominant, and percent Native metrics by region

Evaluation of 2011 Scoring

- 227 probabilistically-derived lake samples, collected from 2008-2010, were compared using both old and new calculation methods
  - Very high correlation (r = 0.97) between new and old calculation
- New method resulted in reduction in mean & median of 3.7 points
- LVI scores for the two most recent samples from 30 benchmark lakes were recalculated using the new procedure (20 lakes with duplicates)
  - With the 2011 LVI adjustments, the 2.5th percentile of the reference site distribution shifted from 46 to 43, meaning that a score of **43** is equivalent to the former minimum acceptable threshold (46) for aquatic life use support

Independent Review of DEP Bioassessment Program

- Chris Yoder, Research Director of the Center for Applied Bioassessment and Biocriteria at the Midwest Biodiversity Institute was contracted by EPA to conduct an independent review of DEP's Bioassessment Program in 2009 (Yoder 2009)
- This evaluation consisted of an analysis of the following elements: Index Period, Spatial Coverage, Natural Classification, Criteria for Reference Sites, Reference Conditions, Taxonomic Resolution, Sample Collection, Sample Processing, Data Management, Ecological Attributes, Biological Endpoints and Thresholds, Diagnostic Capability, and Professional Review
- Mr. Yoder awarded the DEP Bioassessment Program full points for almost all review elements, for a final score of 95% (Yoder 2009), which is among the top three scores in the nation (Chris Yoder, personal communication 2009)

Efforts to Develop a Periphyton Index

- Comprehensive studies of stream periphyton were conducted in an attempt to formulate a multi-metric index for assessing human disturbance, including nutrient effects (see Development of a Stream Diatom Index)
- Preliminary analysis indicated that the best potential metrics were percent sensitive diatom cells, percent tolerant diatom cells, percent diatom cells that prefer high oxygen, percent cells that prefer oligotrophic conditions, and van Dam's weighted index for trophic status

Efforts to Develop a Periphyton Index (cont.)

- Metrics were transformed into a dimensionless index, the Stream Diatom Index (SDI)
- Unfortunately, analysis showed that the SDI was most highly correlated with pH.
  - When the data were categorized according to pH, a *relationship between SDI and human disturbance was not observed*
- DEP determined that the SDI is not appropriate for use as biocriteria due to its poor correlation with human disturbance and its strong association with pH, meaning that other methods for assessing stream floral health were needed (e.g., Rapid Periphyton Survey)

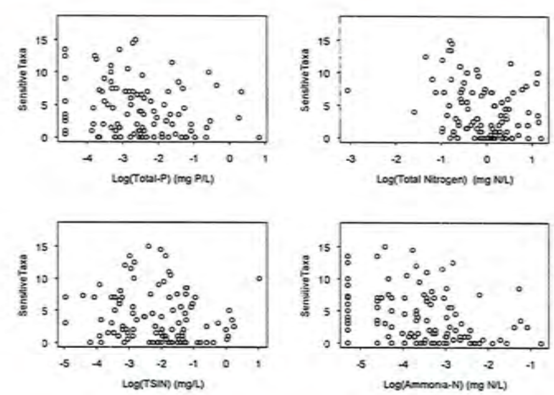
Streams Nutrient Criteria Approach

- Stressor-response relationships
- Benchmark-based criteria
  - Nutrient regions
- Nitrate-nitrate criterion for streams
- Application of stream criteria

Stressor Response Relationships

- Evaluated responses of chlorophyll *a*, taxonomic composition of macroinvertebrate and algal communities, and frequency of occurrence and abundance of algae (Rapid Periphyton Survey)
- Used linear regression, multiple linear regression, non-linear regression, LOESS regression, change point analysis, Classification And Regression Tree analysis, correlation analysis, and paired variable plots

Sensitive Invertebrate Taxa vs. Nutrients



Summary of Diatom Response-Multiple Linear Regression

Table 5-1. Summary of multiple-linear regression analyses conducted for the panhandle nutrient region.

Panhandle Nutrient Region

	Response Variable									
	PollSens	PollTol	%Tol lowDO	%Oligosap	VDTSI	TP Sens Dia	TIN Sens Dia	N Metab	pH Optima	SDI
Data Transformation	None	SQRT	arcsin(sqrt(x))	arcsin(sqrt(x))	None	None	None	Recip	Recip	arcsin(sqrt(x))
1	pH	pH	pH	pH	pH	Cond.L	pH	pH	pH	pH
2	Color.L	Color.L	TN.L	TN.L	Cond.L	pH		TN.L		
3	TN.L	TN.L			TIN.L	TP.L				
4	TP.L	TP.L			TP.L	TIN.L				
5					Color.L					
Adjusted r^2=	0.25	0.10	0.08	0.10	0.27	0.20	0.18	0.11	0.13	0.12

Yellow shading = Pr < 0.05

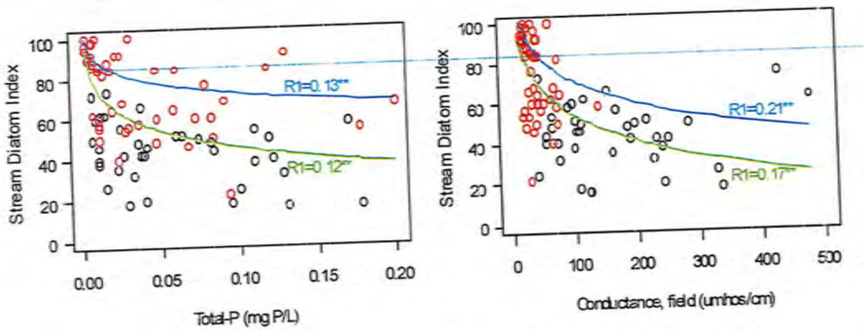
Summary of Diatom Response-Change Point Analyses

Table 5-2. Summary of change-point analyses conducted for the panhandle nutrient region.

	Response Variable									
	PollSens	PollTol	%high DO	%Oligosap	VDTSI	TP Sens Dia	TIN Sens Dia	SDI	N Metab	pH Optima
Data Transformation	None	log	arcsin(sqrt)	arcsin(sqrt)	sqrt	arcsin(sqrt)	None			
Model	SF	NL	SF	SF	SF	SF	SF	SF	SF	SF
1st Change Pt. [confidence interval]	22 ppb [22,88]	10 ppb [8,78]	15 ppb [10,98]	18 ppb [15,131]	22 ppb [22,40]	22 ppb [10,60]	22 ppb [10,67]	22 ppb [22,40]	15 ppb [15,98]	22 ppb [10,36]
2nd Change Pt. [confidence interval]	88 ppb [10,131]	78 ppb [8,94]	90 ppb [18,149]	131 ppb [*]	131 ppb [*]	NA	67 ppb [8,129]	82 ppb [8,131]	131 ppb [*]	NA
2nd Change Pt. Confidence Level	79%	80%	80%	80%	80%	NA	79%	80%	80%	NA

SF=Step Function, NL=Non-Linear, L=Linear, NCP=No Change Point

[*]=Extreme interval outside data range



- Quantile regression showing relationships between the Stream Diatom Index and both total phosphorus and conductivity levels
- Note low coefficient of determination

Stressor-Response Conclusions

- Many of the biological measures evaluated exhibited a response to nutrient enrichment, but the variation in responses explained by nutrients was very low
- Due to confounding factors (e.g., pH, color, conductivity, grazers, etc.), the relationships between the response variables and nutrient levels were insufficiently robust for establishing **thresholds** needed for criteria
- Nitrate-nitrate was an exception, covered later

Plan B: Reference Site Approach

- Due to lack of stressor-response thresholds, DEP and EPA used the nutrient benchmark site approach
- Rationale: Nutrient regime associated with minimally disturbed sites, which are characterized healthy biological communities, is inherently protective of the "healthy, well balanced" designated use
- Limitation: Exceeding the value does not indicate impairment, and need biological data

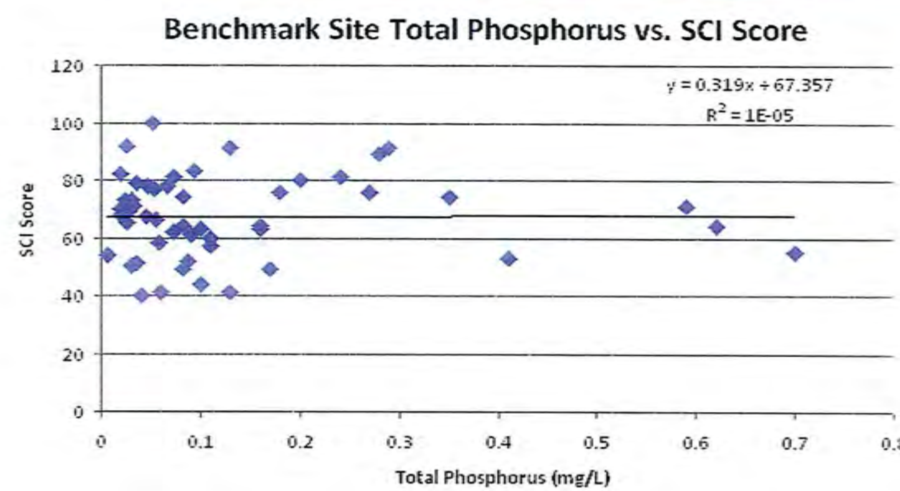
FDEP Reference Site Approach

- FDEP used extensive, multi-step selection process to demonstrate minimally disturbed conditions:
  - Landscape Development Intensity Index (LDI) as initial screening (buffer < 2, watershed <3)
  - Review of Planning and Verified TMDL Lists
  - Screen against springs nitrate threshold (eliminate far field groundwater effects)
  - BPJ Input from District Biologists
  - Examination of recent aerial photos
  - Field Verification, including watershed assessment and application of BPJ at most sites above the nutrient median
  - Demonstration that sites support valued ecologic attributes (healthy SCI and minimal algae growth)

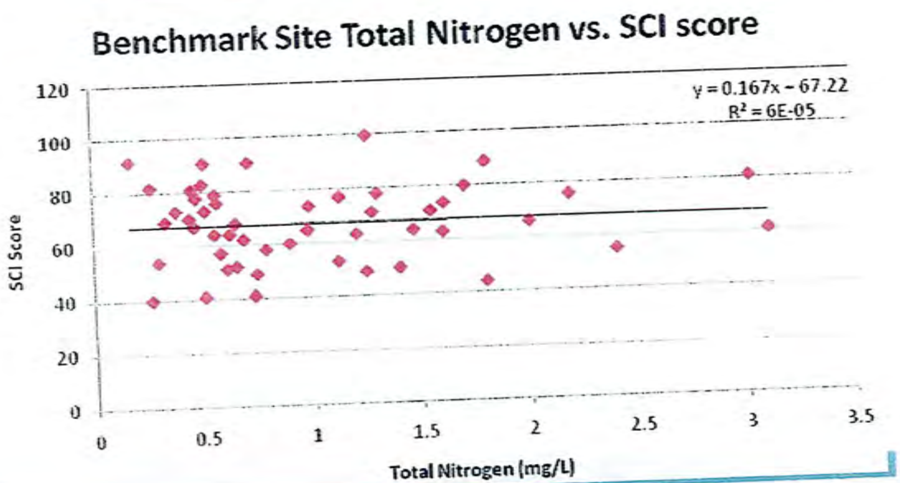
Documenting Results of Reference Site Evaluation Study

Documented that reference/benchmark sites with nutrients above the median truly represented minimally disturbed conditions, including site photos, aerial photos, and key physical, biological and water quality data. EPA Peer Reviewers supported DEP approach.

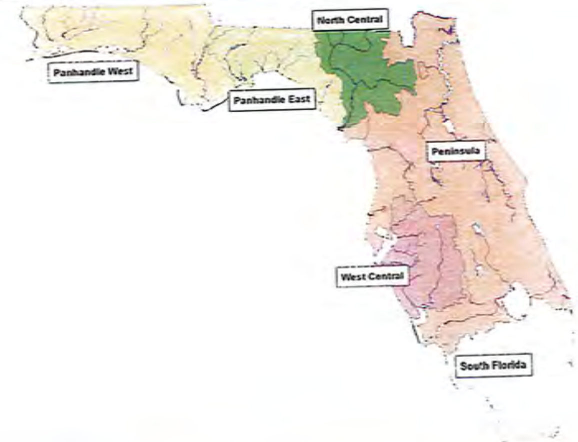
Biological Community Health in Benchmark (Reference Sites)



Biological Community Health in Benchmark (Reference Sites)



Nutrient Regions for Streams



Thresholds Based on Stream Reference Site Approach

Nutrient Region	Total Phosphorus Threshold	Total Nitrogen Threshold
Panhandle West	0.06 mg/L	0.67 mg/L
Panhandle East	0.18 mg/L	1.03 mg/L
North Central	0.30 mg/L	1.87 mg/L
Peninsula	0.12 mg/L	1.54 mg/L
West Central	0.49 mg/L	1.65 mg/L
South Florida	No numeric nutrient threshold. The narrative criterion in paragraph 62-302.530(47)(b), F.A.C., applies.	

Peninsula Benchmark TP and TN Thresholds and the Effect of Number of Samples per Year

Parameter	Minimum Number of Samples per WBID-Year					
	≥ 1	≥ 2	≥ 3	≥ 4	≥ 6	≥ 10
90th Percentile of Annual WBID Geometric Mean TP Concentrations (µg/L)	131	119	115	113	112	111
TP WBID-Years (n) {WBIDs}	232 {70}	168 {42}	127 {36}	116 {30}	97 {23}	59 {14}
90th Percentile of Annual WBID Geometric Mean TN Concentrations (mg/L)	2.0	1.7	1.7	1.7	1.6	1.6
TN WBID-Years (n) {WBIDs}	237 {85}	168 {52}	140 {42}	127 {35}	97 {26}	59 {17}

Use of Geometric Mean

- The geometric mean is the mean of the logarithms, transformed back to the original data
- For positively skewed data, the geometric mean is typically very close to the median
- For distributions that are positively skewed and vary over orders of magnitude (such as nutrients or bacteria counts), the geometric mean is a more accurate indicator of the central tendency than the arithmetic mean (Sanders et al. 2003)
- DEP has historically used a geometric mean and log-normal statistics to describe nutrient distributions and calculate upper percentiles

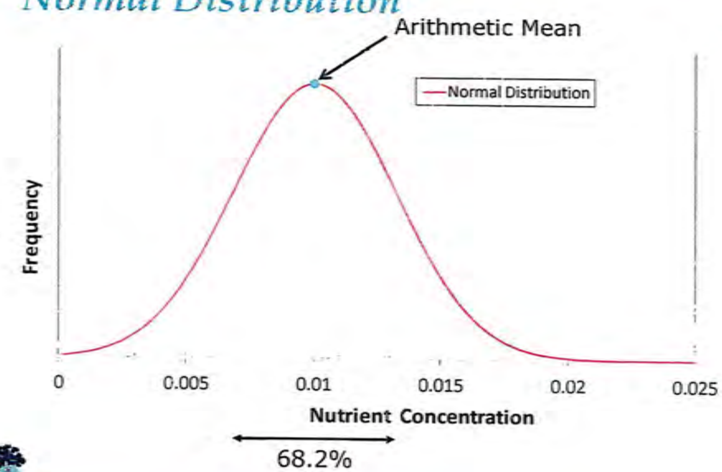
Use of Geometric Mean *(continued)*

- Geometric used for Everglades Phosphorus Criterion
- Geometric means are used in EPA-approved NNC in Hawaii and Oklahoma
- EPA (2011) demonstrated that Florida Stream TP and TN data do not follow a normal distribution, and are skewed to the right and more closely follow a log-normal distribution
- EPA further demonstrated that lake TP, TN and chlorophyll a were log-normal distributed; that is, the natural log transformed data approximated a normal distribution
- Thus, the use of geometric mean is statistically and scientifically defensible

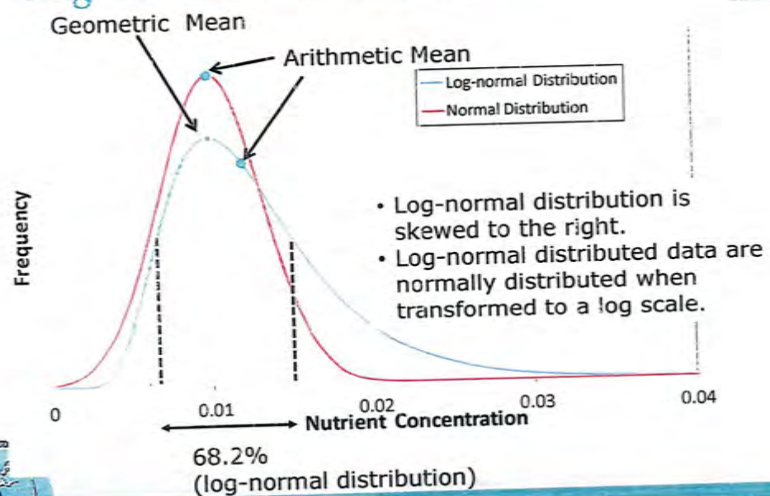
Log-normal Distribution (from Dr. Niu, FSU)

- Nutrient data typically approximate a lognormal distribution (can only be verified with large data sets ~200 data points)
- It is acceptable to assume a lognormal distribution, even if deviations occur at the tails, as long as the fit is very good at the 75th percentile
- Finding the best approximation of the distribution is an acceptable practice

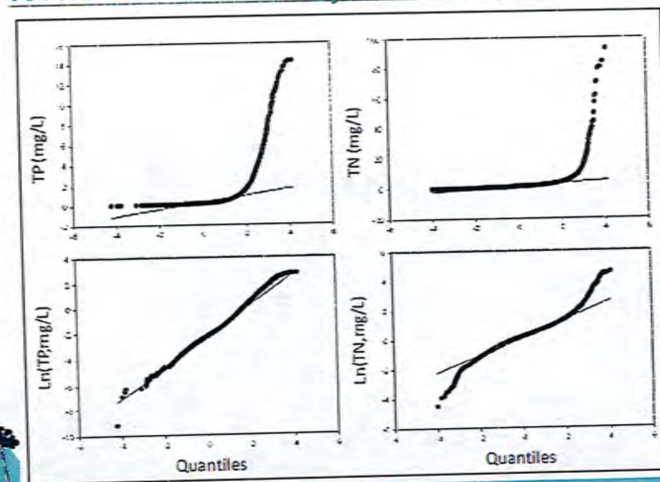
Normal Distribution



Log-normal Distribution

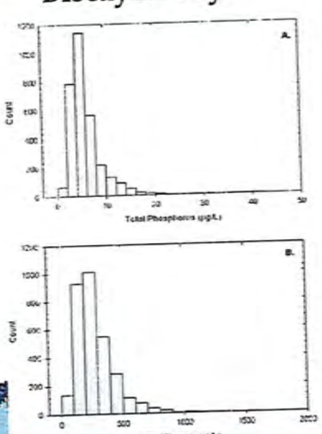


Quantile plots of TP, Ln(TP), TN, and Ln(TN) for Florida stream data, from EPA (2011)

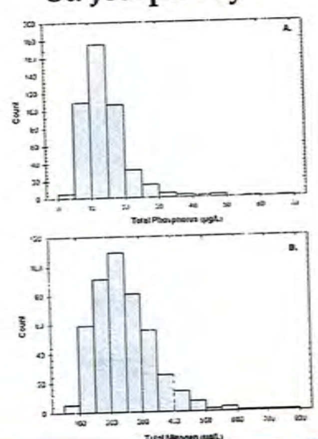


Right Skewed Distributions Estuary Examples

Biscayne Bay



St. Joseph Bay



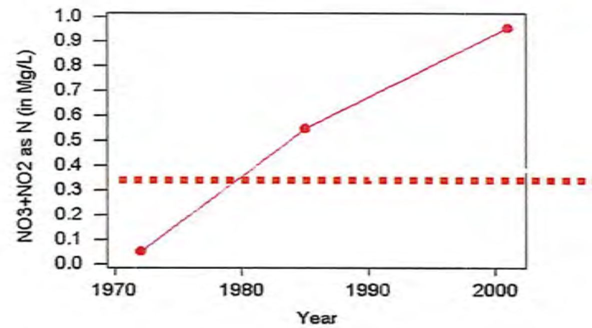
One in Three-Year Exceedance Frequency

- The exceedance frequency (no more than once in a three year period) was based on EPA's Technical Support Document for Water Quality-Based Toxics Control, March 1991 (EPA number: 505290001), which when applied to non-toxic substances, such as nutrients, is inherently protective

Streams
One in Three-Year Exceedance Frequency

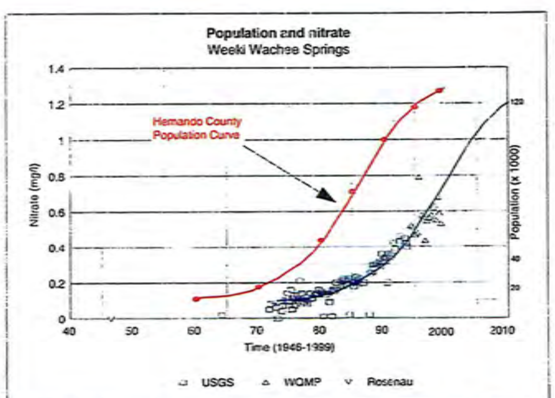
- Conservative approach for streams
  - Streams criteria were developed based on data distribution of minimally disturbed reference sites that had healthy biology
  - Reference streams at the numeric nutrient standard (i.e., 90th percentile streams) will exceed the standard in 50% of the years, which is greater than 1 in 3-years (33.3%)
  - Long-term geometric mean concentrations will need to be below the numeric standard to consistently achieve it

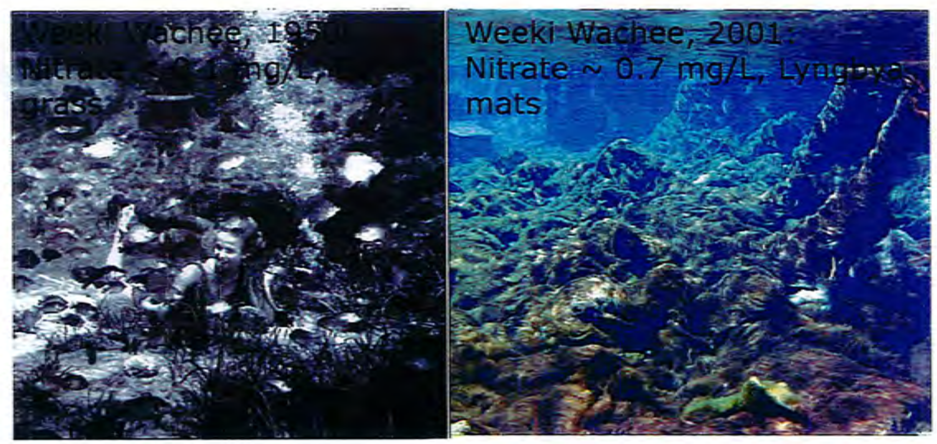
Springs Nitrate: Increasing Trend in Most Florida Springs



Alexander, Chassahowitzka Main, Fanning, Ichetucknee Main, Jackson Blue, Madison Blue, Manatee, Rainbow Group composite, Silver Main, Silver Glen, Volusia Blue, Wakulla, and Wacissa #2 Springs. Taken from Scott et al., 2004.

Nitrate in Weeki Wachee and Population of Hernando County





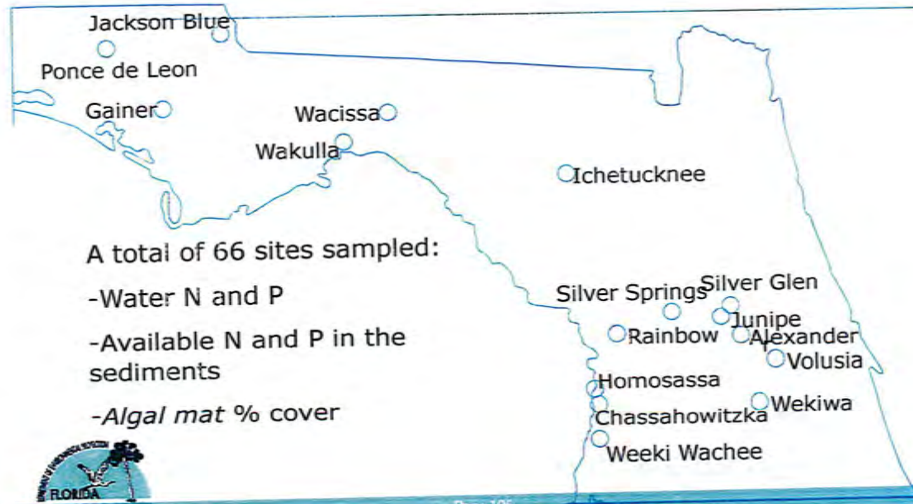
Anecdotal Observations Show Significant Increases in Nuisance Algal Mats Over Time

(credits: Florida Archives; Agnieszka Pinowska)

Studies Applicable to Springs Criterion Development

- Jan Stevenson Study
  - Field studies to determine the nature and extent of nuisance algal problems in springs
  - Lab experiments to determine cause-effect relationships between nutrients and nuisance algal growth
- Suwannee River Periphyton Study
  - Periphytometers deployed at spring dominated rivers
  - More than 15 years of data

Stevenson Field Studies: Spring Site locations



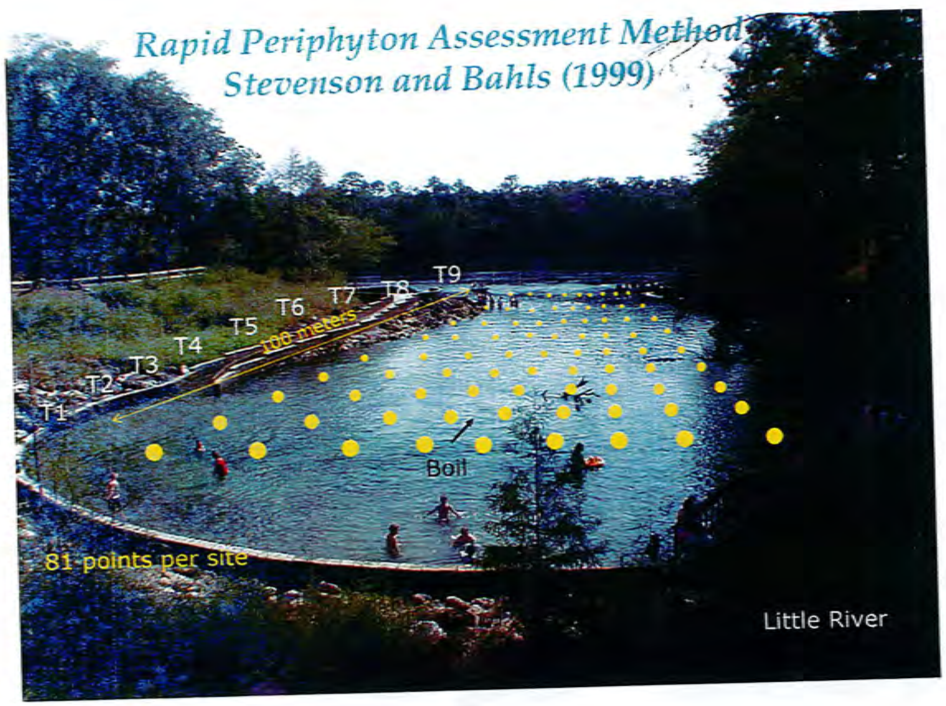
A total of 66 sites sampled:

-Water N and P

-Available N and P in the sediments

-*Algal mat* % cover

Rapid Periphyton Assessment Method
Stevenson and Bahls (1999)



24 Main Taxa of Macroalgae in Springs

Cyanophyta:
Lyngbya wollei 32%
Oscillatoria sp. 8%
Lyngbya aestuarii
Aphanothece sp. balls
Phormidium sp.

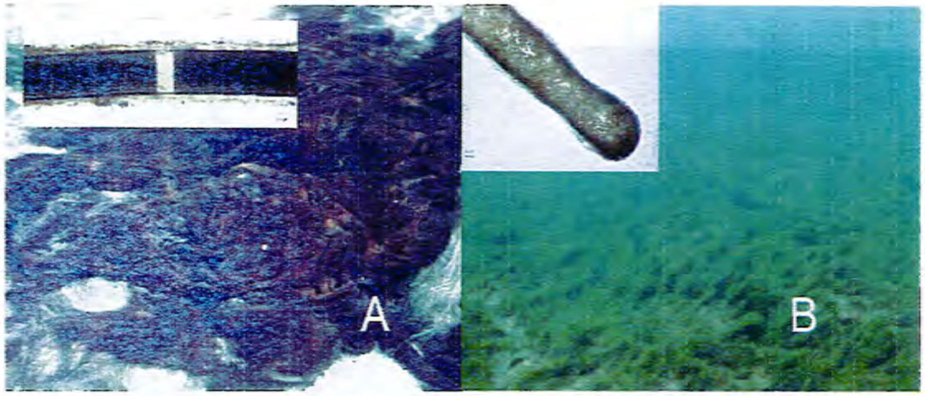
Rhodophyta:
Polysiphonia subtilissima
Caloglossa sp.
Campsopogon sp.
Audouionella sp.
Batrachospermum sp.

Bacillariophyta:
Pleurosira leavis
Terpsinoe musica 2%
Aulacosira sp.

Xanthophyceae:
Vaucheria sp. 26%

Chlorophyta:
Spirogyra sp. 10%
Cladophora cf glomerata 7%
Rhizoclonium hieroglyphicum 2%
Dichotomosiphon sp. 1.5%
Hydrodiction sp. 3%
Enteromorpha sp.
Chaetomorpha sp. 2%
Stigeoclonium sp.
Oedogonium sp.
Schizomeris sp.

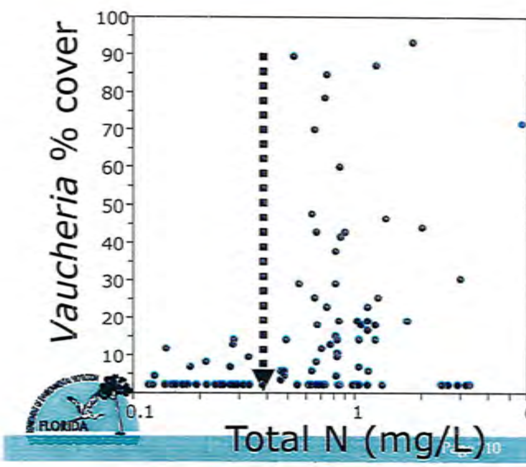
% of points macroalga was dominant



Lyngbya wollei *Vaucheria*

The two dominant nuisance algae in Florida springs (Stevenson 2007)

Field Studies: Vaucheria % Cover was Significantly Related to Nitrate



Excessive growth and cover of *Vaucheria* was found at sites with nitrate-nitrite concentrations at or above **0.454 mg/L.** No such relationship was found with *Lyngbya wollei*

Stevenson Field Study Conclusion

- Nuisance accumulations of *Vaucheria* occurred at nitrate-nitrite concentrations at or above 0.454 mg/L
- There was no field relationship between *Lyngbya wollei* and nitrate
  - *Lyngbya* found in many pristine springs with natural background nitrate, including Silver Glen, Alexander, and Juniper
  - Alternate explanation includes natural low DO, grazer exclusion, and N fixation

Stevenson Laboratory Experiments

- Advantages
  - Strict control on nutrient concentration
  - Demonstrate cause and effect
- Limitations
  - Totality of real world conditions not represented
  - Lack of grazing pressure
  - Light limitation not a factor
  - Temperature fluctuations controlled for
  - Single strand or very small tufts used (larger mats would need higher concentrations due to diffusion issues)

Results from *Lyngbya wollei* Microcosms

Day 1

Day 12

Growth measurement:

Length (mm)

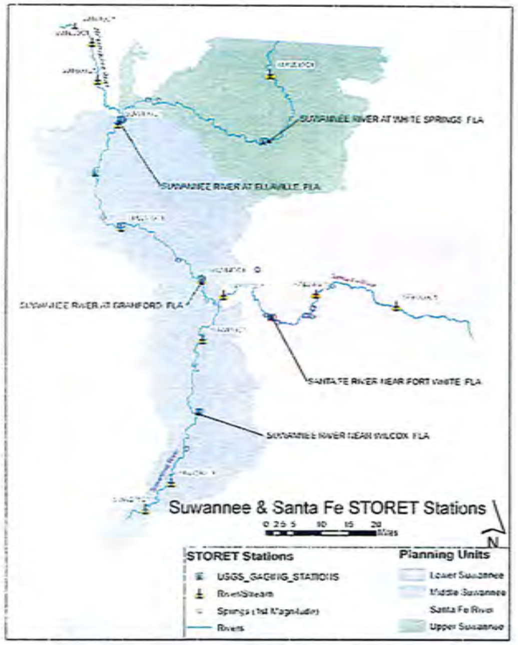
Stevenson: Experimental (21 day) Algae Mesocosms

Effect of Experimental Scale on Growth

- Microcosms (single strand): *Lyngbya* growth between 0.034 - 0.230 mg/L nitrate
- Donut mesocosms (0.01 g of algae): *Lyngbya* growth between 0.327 – 0.821 mg/L nitrate, no *Vaucheria* response
- Raceway mesocosms (small tufts): No *Lyngbya* growth up to 5 mg/L nitrate

Experimental Conclusions

- Stevenson *et al.* (2007) recommended using the ED90 (nitrate-nitrite concentration that produces 90 percent of the maximum growth) in microcentrifuge experiments as a benchmark for a nitrate criterion
  - The most conservative estimate for the nitrate ED90s determined from the laboratory experiments was 230 µg N/L for *Lyngbya wollei* and 261 µg N/L for *Vaucheria sp.*

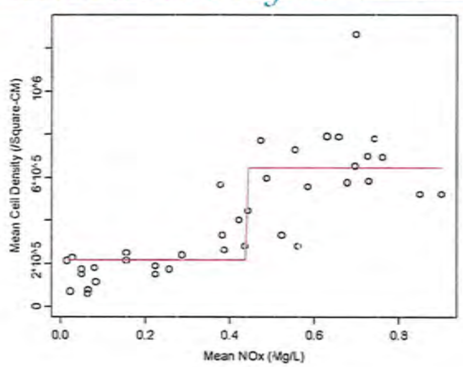


Locations of Suwannee System Periphyton Stations

Change Point Analysis

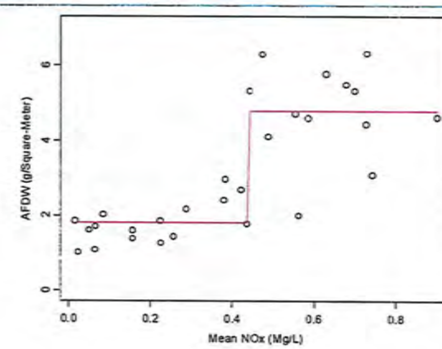
- Nui et al.(2000) introduced a type of regression analyses involving an iterative procedure for detecting and modeling level-shift change points in environmental data
- This procedure was used extensively in development of the Everglades TP criterion
- The change point indicates where shifts occur, meaning a margin of safety below the change must incorporated into criteria

Suwannee Periphytometer Change Point Analysis: Cell Density



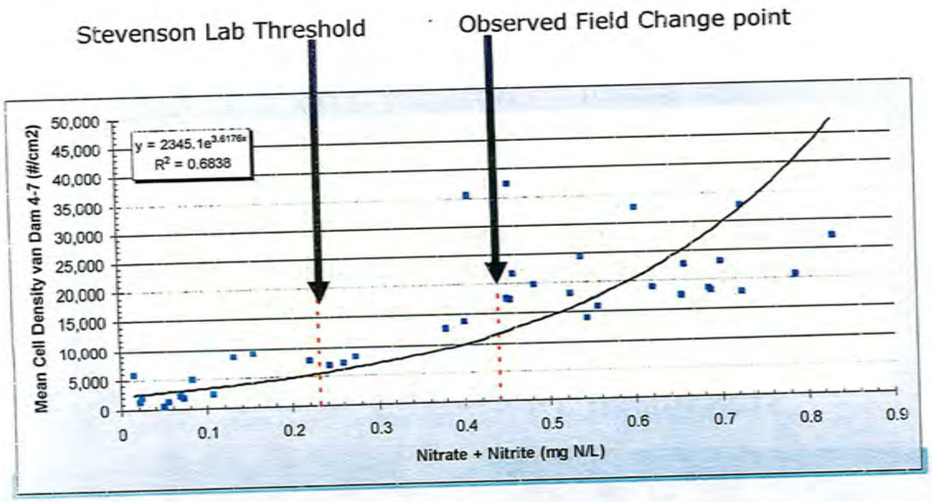
Change Point at **0.441 mg/L Nitrate-nitrite**, R2 = 0.62. The 95% confidence interval for the change point based on 1000 bootstrapping samples is 0.378 to 0.629.

Change Point Analysis: Biomass (AFDW)



Change Point at **0.441 mg/L Nitrate-nitrite**. R2 = 0.74. The 95% confidence interval for the change point based on 1000 Bootstrapping samples is 0.441 to 0.584 µg N/L.

Suwannee Community Composition Shift: Increase in Van Dam Eutrophic Indicators



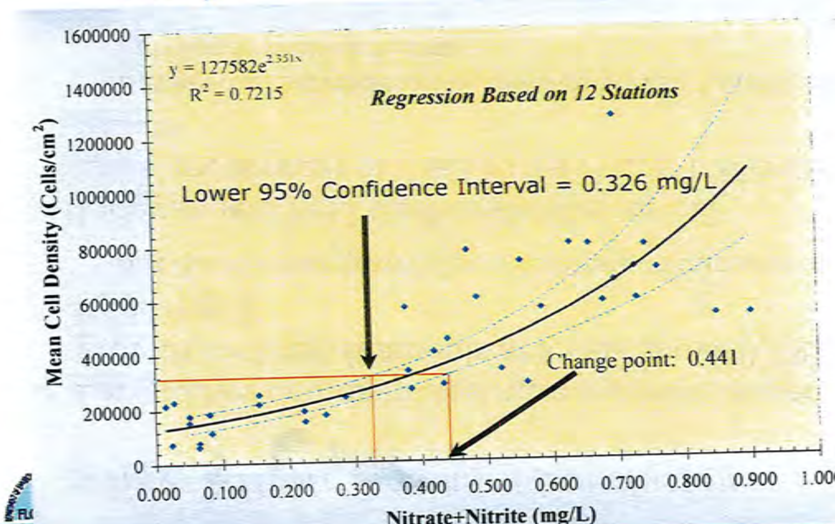
Suwannee Periphyton Conclusions

- Significant algal cell density and biomass increases occurred at 0.441 mg/L nitrate-nitrite
- This, coupled with the substantial increase in Van Dam eutrophic indicator taxa, constitute an imbalance of aquatic flora

Setting the Nitrate-nitrite Criterion

- The most conservative lab experiments showed growth thresholds from 0.230 to 0.261 mg/L nitrate
- Stevenson field studies showed *Vaucheria* imbalances at 0.454 mg/L nitrate
- Suwannee study showed algal imbalances at 0.441 mg/L nitrate based on 3-year averages (considered the strongest evidence)
- Appropriate criterion (neither under- nor over-protective) should include a margin of safety to sustain environmental conditions below the imbalance point

Use of Lower 95% Confidence Interval



Calculating the Margin of Safety

- Full confidence interval procedure = 0.33 mg/L
- Using upper half of confidence interval method = 0.38 mg/L
- Averaging these complimentary methods = 0.35 mg/L

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Springs Nitrate Summary Conclusions

- Lab studies demonstrated nitrate-nitrite caused growth in single filaments at levels above 0.230 to 0.263 mg/L
  - But don't know growth level resulting in impairment
- Independent field studies showed actual imbalances occur at 0.441 to 0.454 mg/L nitrate-nitrate
  - But need to set criterion below these levels to prevent imbalance from occurring

FLORIDA

Springs Nitrate Summary Conclusions

- The springs nitrate criterion (0.35 mg/L, as an annual geometric mean) combines both lines of evidence and provides a margin of safety below levels demonstrating imbalance
- Establishing a 1 in 3 year exceedance frequency (based on EPA guidance for toxins) is an additional conservative measure, resulting in maintenance of long term nitrate near 0.27 mg/L (due to variability of springs nitrate data)

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Application of Stream Numeric Nutrient Thresholds

- **Section 2.7 of the SCI Primer (adopted by reference) describes a weight-of-evidence evaluation to assess whether a stream attains the narrative nutrient criterion in Rule 62-302.530(47)(b), F.A.C., pursuant to the provisions in Rule 62-302.531(2)(c), F.A.C.**
- **This approach evaluates water chemistry, biological (flora and fauna) data and physical information from the waterbody to determine if nutrient concentrations are causing an imbalance in flora or fauna in a given stream**

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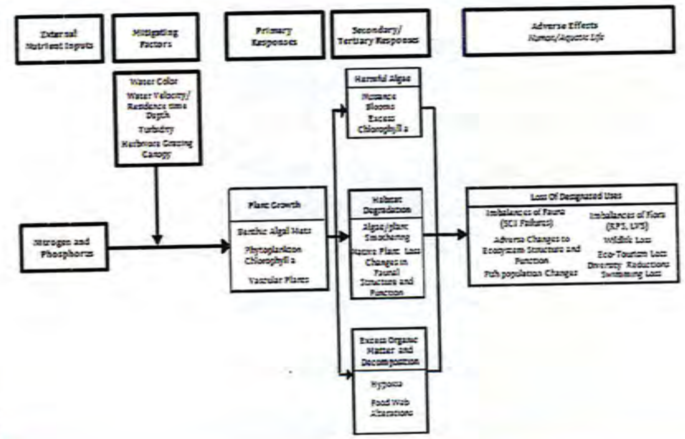
Application of Stream Numeric Nutrient Thresholds

(cont.)

- Available procedures for evaluating the floral community in the stream, include chlorophyll *a* levels, periphyton abundance and species dominance (as measured using the Rapid Periphyton Survey [RPS]), and macrophyte distribution (as measured using the Linear Stream Vegetation Survey [LVS])
- Examples of a weight-of-evidence approach for determining achievement of nutrient criteria are presented

Simplified nutrient enrichment conceptual model used to assess potential adverse effects of nutrients in streams. Relationships between nutrients and biological responses are highly influenced by site-specific and mitigating factors



Interpreting the Narrative Criterion in Streams

- The narrative nutrient criterion in paragraph 62-302.530(47)(b), F.A.C., shall be interpreted as being achieved in a stream segment if:
  - Information on chlorophyll *a* levels, algal mats or blooms, nuisance macrophyte growth, and changes in algal species composition do not indicate an imbalance in flora or fauna; AND EITHER
  - The average score of at least two temporally independent SCIs performed at representative locations and times is 40 or higher, with neither of the two most recent SCI scores less than 35 (*i.e.*, no faunal imbalances), OR
  - The Nutrient Thresholds (expressed as annual geometric means) are not exceeded more than once in a three year period.

Use of Rapid Periphyton Survey

- **99 measurements of algal presence/thickness in 100 m stretch**
- **RPS data available from 467 sites, including benchmark sites**
  - **RPS rank 4-6 coverage (> 6 mm) at Benchmark streams averaged 6% with a 90th percentile value of 25%**
  - **RPS rank 4-6 coverage at all biologically healthy sites (SCI scores > 40), averaged 8% with a 90th percentile value of 32%**
- **Persistence and autecology also considered**

Use of Chlorophyll a

- Annual geometric mean chlorophyll a at the 94 Benchmark streams averaged 2.0 ug/L, with a 90th percentile value of 3.2 ug/L
- Annual geometric mean chlorophyll a at 274 biologically healthy sites (SCI scores > 40), averaged 2.1 ug/L, with a 90th percentile value of 3.5 ug/L

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Use of Chlorophyll a (cont.)

- Streams with annual geometric mean chlorophyll *a* values that exceed 20 ug/L, are considered to exhibit imbalances of flora
- Streams with annual average chlorophyll values between 3.5 ug/L and 20 ug/L are evaluated on a site specific basis (consider water residence time, climate, system size, etc.)

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Use of Chlorophyll a (cont.)

- Chlorophyll *a* is also evaluated using Mann's one-sided, upper-tail test for trend, (95% confidence interval)
- The observation of a statistically significant increase in chlorophyll *a* in a stream is another line of evidence used by DEP to determine floral imbalances

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Use of Linear Vegetation Survey

- 10 taxa lists generated in 100 m stretch
- Requires 2 m^2 of plant coverage
- Based on data from 58 reference sites, if a stream exhibits a mean Coefficient of Conservatism score $\geq$ 2.5 and the frequency of occurrence of Category I exotic plants listed by Florida Exotic Pest Plant Council is $\leq$ 25% of the total plant occurrences, would be considered an indication of no imbalance of flora

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Numeric Interpretation for Lakes

- Cause and Effect based
- Annual geometric mean of chlorophyll a measurements is the primary indicator of balance of Flora and Fauna
  - Protect Oligotrophic Lakes (Chl *a* < 6 ug/L)
  - Protect Mesotrophic Lakes (Chl *a* < 20 ug/L)
- Color (PCU) & Alkalinity
  - Used to categorize background nutrient expectations
    - Increased color indicates increased TP & TN from wetlands and runoff
    - Increased Alkalinity indicates increased TP from soils

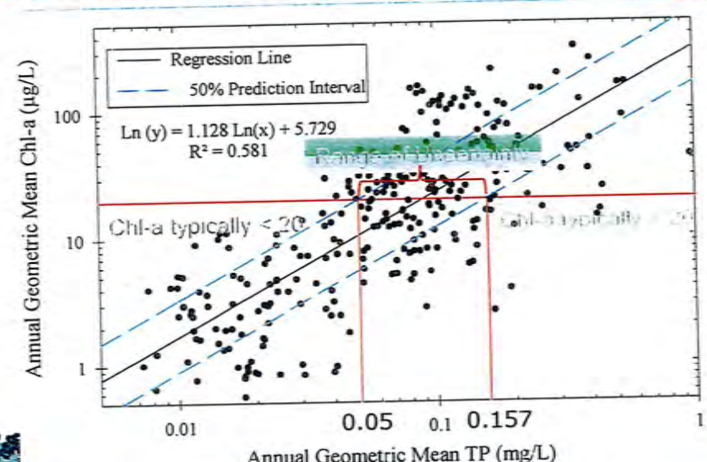
Lake Chlorophyll a Thresholds

- In conjunction with EPA and NNC TAC, and based on multiple lines of evidence, annual geometric mean chlorophyll *a* of **20** µg/L in colored lakes (>40 PCU) or clear lakes with high alkalinity (>20 mg/L) is protective of designated uses
  - Protect against shift from mesotrophic to eutrophic conditions
  - Low probability of harmful algal blooms (HABs)
- Annual geometric mean chlorophyll *a* of **6** µg/L in clear (≤40 PCU) lakes with low alkalinity (≤20 mg/L)
  - Protects against shift from oligotrophic to mesotrophic conditions, very low probability of HABs

Lines of Evidence Supporting Protective Chlorophyll a Thresholds

Line of Evidence	Chlorophyll *a* target	State
Paleolimnological studies	14 to 20 µg/L and higher for some lakes (Average condition)	Florida
Expert opinion	20-33 µg/L (Annual or summertime averages)	Virginia, Iowa, West Virginia, Maryland
Fisheries responses (warmwater)	35-60 µg/L (Summer average)	Virginia
Lake user perceptions	20-25, up to 30 µg/L in colored lakes (Instantaneous)	Texas and Florida
Existing levels approach	5-27 µg/L (Average condition)	Alabama
Reference lake approach	9-18 µg/L in colored lakes (Average condition)	Florida, using 75th percentile

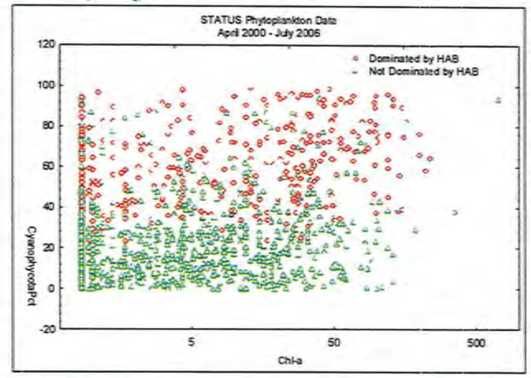
Colored Lake Chl-a Response to Total Phosphorus



Chlorophyll and HABs

- World Health Organization guidance indicates that chlorophyll of 50 µg/L, when dominated by cyanobacteria, represents a moderate risk for recreation
- DEP analysis predicts that an annual geometric mean chlorophyll *a* of 20 µg/L could be associated with instantaneous chlorophyll a concentrations of 50 µg/L approximately 4 percent of the time, but there is no correlation with HABs

Lack of Relationship Between Chlorophyll and HABs



No relationship between chlorophyll *a* concentrations (note the log scale) and the percent cyanobacteria in 1,364 lake samples collected for Florida's statewide probabilistic monitoring program

Chlorophyll and Microcystin

- UF conducted a survey of microcystin concentrations at 187 lakes in Florida throughout 2006 (Bigham et al. 2009)
- Results suggested that lake with a chlorophyll *a* concentration of 20 µg/L is associated with an approximately 5% probability of microcystin detection above the WHO drinking water guideline of 1 µg/L

Chlorophyll and Microcystin

- Microcystin concentrations did not exceed the WHO recreational guideline of 20 µg/L until chlorophyll *a* exceeded 130 µg/L
- Based on this dataset, a chlorophyll *a* limit of 20 µg/L would have been protective of drinking water in 95% of those systems and recreational uses in all systems
- Mesotrophic lakes would be naturally expected to sometimes have microcystin above drinking water guidelines and water treatment facilities have technology to deal with those times (filtration, activated carbon)

Nutrients and Potable Water Supply

- Insufficient information to base numeric interpretations of the narrative criterion on impacts to potable water supply, but both water quality standards (Chapter 62-302, F.A.C.) and the Impaired Waters Rule (Chapter 62-303, F.A.C.) contain several provisions that protect waters against problematic algal blooms
- Waters with algal blooms or mats in sufficient quantities to pose a nuisance or hinder reproduction of threatened or endangered species are listed as impaired

  Rules 62-303.350[1], 62-303.351[3], 62-303.352[2], 62-303.353[3], 62-303.354[2], 62-303.450, F.A.C.

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Nutrients and Potable Water Supply

- A waterbody can be listed for the occurrence of HABs even if the annual geometric mean is less than the applicable chlorophyll a criterion for the waterbody
- The IWR also includes a provision (Rule 62-303(1)(b), F.A.C.) that lists a water on the planning list if a public water system demonstrates that either
  - a) treatment costs to meet applicable drinking water criteria have increased by at least 25% to treat blue-green algae or other nuisance algae in the source water, or
  - b) the system has changed to an alternative supply because of additional costs that would be required to treat their surface water source

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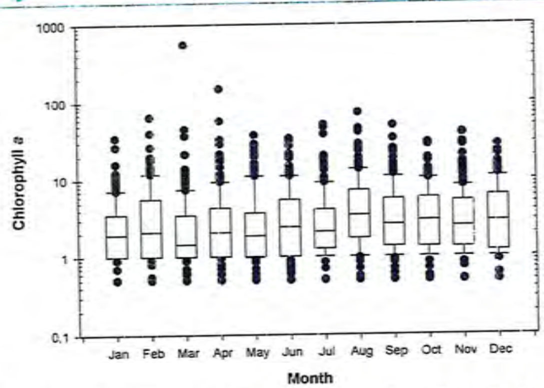
Lack of Seasonal Chlorophyll Response



Boxplot of chlorophyll *a* concentrations in low alkalinity clear Florida lakes by month. Note that high concentrations (blooms) can and do occur during any month of the year with approximately equivalent frequencies.

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Lake Nutrient Criteria

Annual Geometric Mean Thresholds, No more than 1 in 3 year exceedance

Long Term Geometric Mean Lake Color and Alkalinity	Annual Geometric Mean Chlorophyll *a*	Minimum calculated numeric interpretation		Maximum calculated numeric interpretation	
		Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen	Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen
> 40 Platinum Cobalt Units	20 µg/L	0.05 mg/L	1.27 mg/L	0.16 mg/L[1]	2.23 mg/L
≤ 40 Platinum Cobalt Units and > 20 mg/L $CaCO_3$	20 µg/L	0.03 mg/L	1.05 mg/L	0.09 mg/L[1]	1.91 mg/L
≤ 40 Platinum Cobalt Units and ≤ 20 mg/L $CaCO_3$	6 µg/L	0.01 mg/L	0.51 mg/L	0.03 mg/L[1]	0.93 mg/L

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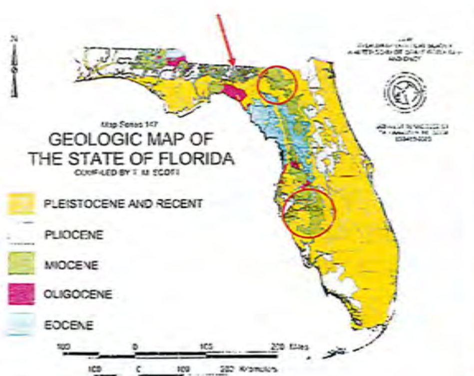
1 in 3 Year Exceedance Frequency for Lakes

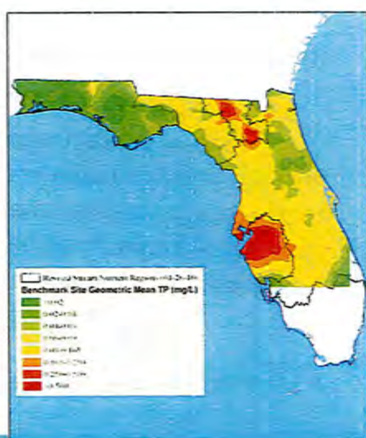
- Chlorophyll criteria were established as a annual geometeric means because that produced the strongest relationship with nutrients
- Generally, half of values are above and half are below a geometric mean

1 in 3 Year Exceedance Frequency

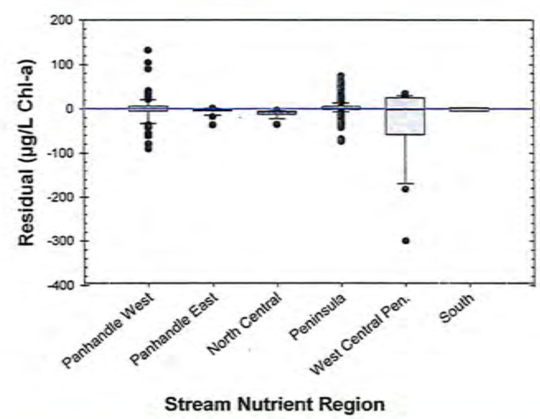
- As an added conservative measure, DEP added a 1 in 3 year exceedance frequency (based on EPA guidance for toxics)
- Based on inter-annual variability in lake chlorophyll *a* levels, the <u>long-term</u> geometric chlorophyll *a* concentration in a lake would need to be between 12.8 and 15.5 µg/L to be consistently found in compliance with the chlorophyll *a* standard of 20 µg/L

Stream Nutrient Regions were based on Geologic Formations and Reference Stream TP Levels



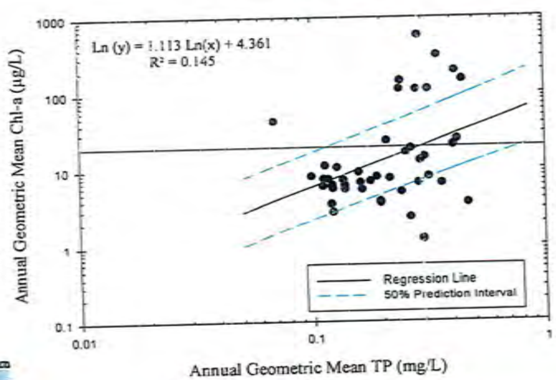


Residuals Analysis of the Lakes TP/Chl-a Regressions by DEP Stream Nutrient Region (Data from IWR Run 43)



Relationship Between Annual Average (Ln transformed) Nutrients and Chl-a in Bone Valley Lakes consistent with other Regions except for TP in Colored Lakes

Colored Lake TP



Added footnote allowing TP max limit to increase to 0.49 mg/L.

Spatial Expression

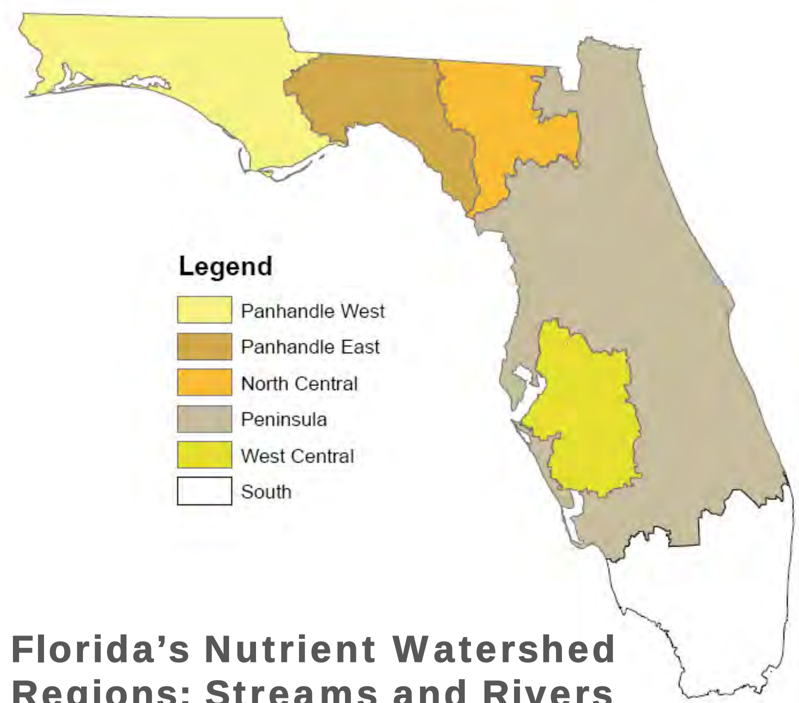
- Attainment of the narrative criterion should be assessed as a spatial average for the waterbody consistent with derivation
  - For SSACs and TMDLs, spatial component is as defined in the TMDL or SSAC document
  - If based on cause-effect relationship, stated in a manner consistent with the <u>derivation of the criterion</u>
    - Lake Criteria were based on lake averages
    - Streams thresholds based on homogeneous units

Waters with Insufficient Information

- Narrative will continue to apply in aquatic systems where insufficient information currently exists to accurately interpret the narrative nutrient criteria, such as
  - Class III wetlands, Class III flowing waters in South Florida, and Class III intermittent streams
- The Department will numerically interpret the narrative criteria as the information is developed

3 'Structural Components' of Numeric Nutrient Criteria Rules

- **Current EPA rule:**
  - Freshwater Lakes, Springs, Rivers Streams, and Downstream Protection Values (DPVs)
- **Current DEP rule:**
  - Freshwaters Lakes, Springs, Rivers and Streams, and some Estuaries:
    - Narrative rule for some waters
    - Current TMDLs become NNC
- **Future EPA Rulemaking:**
  - All Estuaries, Offshore Waters, Downstream Protection Values and South Florida Canals



Florida's Nutrient Watershed Regions: Streams and Rivers

Numeric Nutrient Criteria and the Winds of Change

- Many future dates in this presentation are subject to change

Numeric Nutrient Criteria: Legal Challenge on Current EPA rule

- Jan. 9th: **Federal Court Hearing** on current **EPA** rule for lakes, springs, rivers and streams, and DPVs
- Feb. 22nd: Federal Judge Hinkle's Final Order **upheld** the following in the current **EPA** rule:
  - 2009 EPA Determination Letter, Lakes and Springs criteria
  - DPVs for flowing waters into impaired lakes
- Feb. 22nd: Federal Judge Hinkle's Final Order **struck** the following in the current **EPA** rule:
  - Rivers and Streams Criteria
  - DPVs for flowing waters to non-impaired lakes

Numeric Nutrient Criteria: Future Federal Timelines

- May 21st: **Proposed revisions due** for struck components of current **EPA** rule
  - Rivers and Streams, DPVs into non-impaired lakes
- May 21st: **EPA's future rulemaking**
  - Proposed criteria due for estuaries, offshore waters, South Florida canals, and DPVs (for flowing waters into estuaries)
- Jul. 6th: **EPA's** current rule **Implementation Date**
- Jan. 6th (2013): **EPA's future rulemaking**
  - Final criteria due for estuaries, offshore waters, South Florida canals, and DPVs (for flowing waters into estuaries)

Additional Federal NNC News

- Mar. 6th: National Research Council Panel's Prepublication **Review of Economic Cost** Analysis of **EPA** Current rule:
  - For a number of different "sectors" (e.g., industry, agriculture, septic tanks…) had the following statement:

"the costs of complying with the NNC rule in those watersheds determined by EPA to be incrementally impaired are likely to be higher than EPA estimates"

Additional Federal NNC News (cont.)

- Jan. 30th: **'The State Waters Partnership Act'** bill announced by U.S. Rep. Steve Southerland, II:
  - U.S. Senator Marco Rubio companion bill introduced Feb. 16th

- Feb. – Mar.: Letters from Congressional Delegation to EPA Administrator Jackson
  - Request prompt review and approval of **DEP Rule**

DEP's Current Rule: Major Concepts

- Hierarchy of Site Specific Numeric Interpretation of Current Narrative Nutrient Criterion:
  - 1. Nutrient Site Specific Analyses (e.g., Current TMDLs)

    ↓

  - 2. Cause and Effect Relationships (e.g., FW Lakes & Springs)

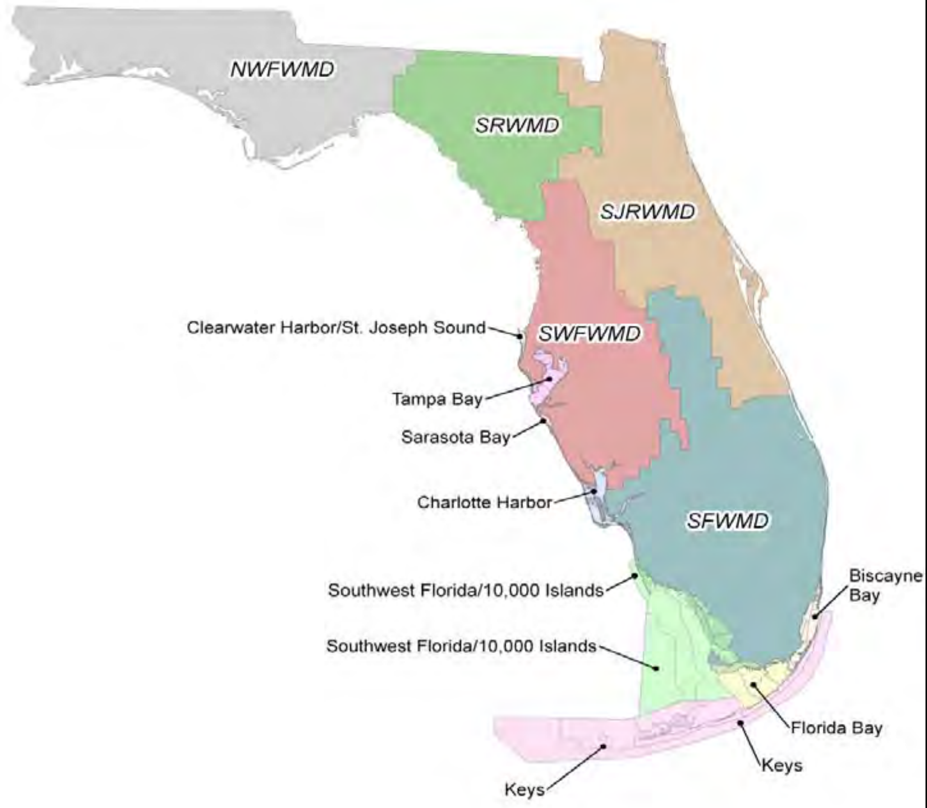
    ↓

  - 3. Reference-based Thresholds Combined with Biological Data to Evaluate Attainment (e.g., Rivers and Streams)

    ↓

  - 4. Narrative standard continues where numeric interpretation is unavailable (e.g., Wetlands, Canals, and Intermittent Streams)

DEP's Current Rule: Estuaries



Florida Estuaries with NNC in current DEP Rule

- Current TMDLs
  - e.g., St. Lucie Estuary
- National Estuary Programs
  - e.g., Charlotte Harbor
- Southern Estuaries
  - e.g., Florida Bay
- Set Future NNC Development Schedule
  - e.g., Lake Worth Lagoon deadline is June 2015

Numeric Nutrient Criteria: DEP Rulemaking Update

- Dec. 2011: **DEP rule** passes the Environmental Regulation Commission
  - Subsequently challenged by 5 petitioners
- Jan. through Feb. 2012: **DEP rule** passes Legislature for an exemption to ratification process and signed by Governor Rick Scott
- Feb. 20th: **DEP rule** submitted to EPA for provisional review while being challenged
- Feb. 27th through Mar. 2nd: Division of Administrative Hearings (DOAH) Proceedings on **DEP rule** challenge

Summary of NNC Future Milestones in next 4 months

- **DEP Rule:** Await the DOAH Judge's Ruling (Late April into mid May?)
- If **DEP Rule** upheld by DOAH, clears path for final EPA decision on whether to accept DEP's NNC
- How will EPA address DEP rule and their own rulemaking process?:
  - May 21st: **Proposed revisions due** for struck components of current **EPA** rule and **EPA's future rulemaking** for estuaries, offshore waters, South Florida canals, and DPVs
  - Jul. 6th: **EPA's** current rule **Implementation Date**

Discussion on Path Forward

Here is the ppt from Drew's Senate Committee on Environmental Preservation and Conservation. I thought there may have been some different info here than I remembered but it must have been more in the questions and answers that you might find interesting. Slide 5 is a good summation of difference in EPA and DEP. If interested the video is at http://www.flsenate.gov/Committees/Show/EP

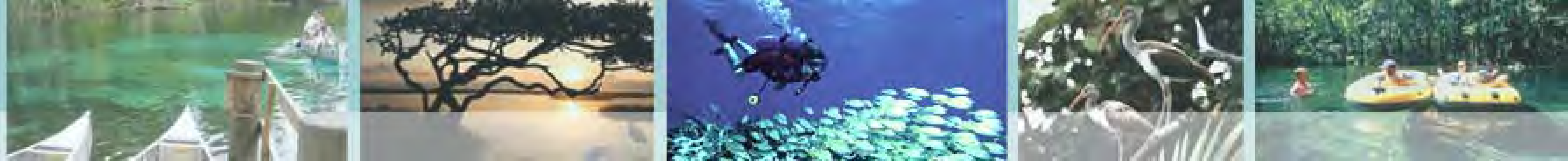
Florida Department of
Environmental Protection

Numeric Nutrient Criteria

Discussion of Department's Rulemaking Efforts

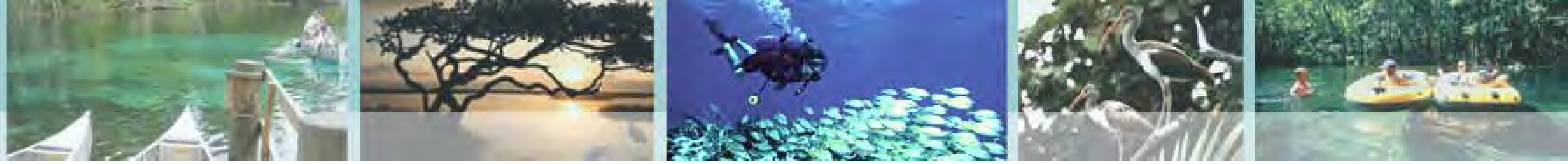
By: Florida Department of Environmental Protection
Drew Bartlett, Director
Division of Environmental Assessment and Restoration

Prepared for: *Senate Environmental Preservation and Conservation Committee*
January 24, 2012
Chair: *Senator Charlie Dean, Sr.*



Clean Water Act: Its Role in the Nutrient Issue

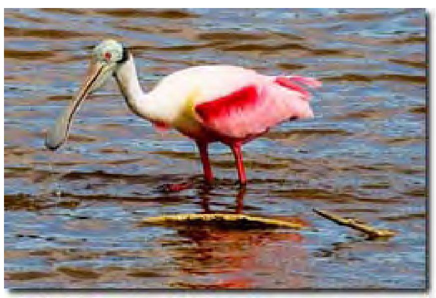
- 303 (a-c) – **Water Quality Standards**
  - Requires each state to assign **designated uses** to all waterbodies in the state, as well as the **criteria** that will maintain or be used to attain the designated use.
    - **Designated Uses/Goals**
      - Recreation, Fish and Wildlife, Drinking Water
    - **Criteria**
      - Water quality limits necessary to protect designated use
      - Can be Numeric or Narrative
    - **Impaired Waterbody**
      - One that does not meet water quality standards.



FDEP Filed Petition with EPA *(April 22, 2011)*

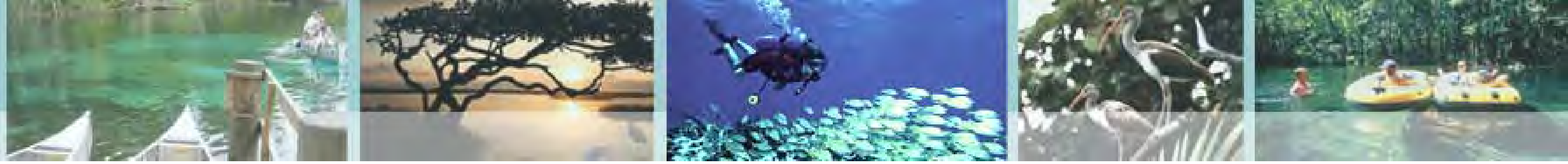
- FDEP Petitioned EPA based on Florida's performance of the eight key elements identified in an EPA Memo.

- Petition included initiation of rule development for state standards, and requested that EPA:

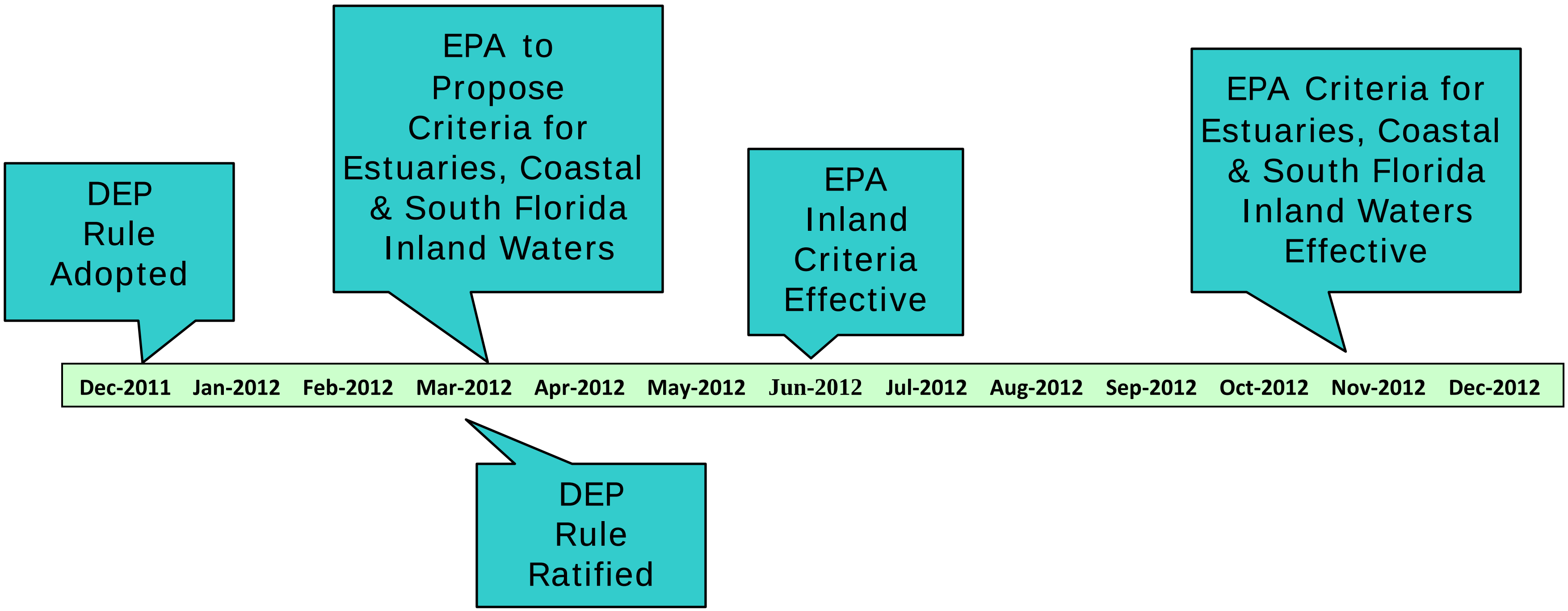


  - Rescind the Determination to Promulgate Numeric Nutrient Criteria in Florida
  - Rescind Promulgated Criteria

- EPA's initial response (May 22, 2011) did not grant or deny.



Timeline: Numeric Nutrient Criteria



Three Differences of FDEP's Draft Rule

Give preference to nutrient Site Specific Science.

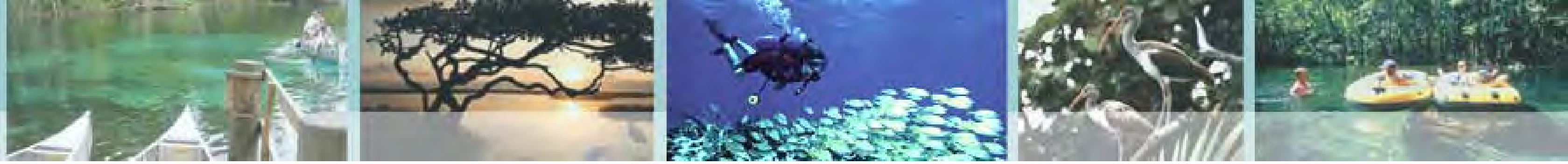
EPA's do not

Only create nutrient reduction expectations where necessary to protect Florida waterbodies.

EPA's do regardless of waterbody health

Eliminate unnecessary procedures that do not add to waterbody protection and restoration.

EPA's use federal procedures to overcome Illogical outcomes



Financial Impact of EPA's Rule

- EPA estimates annual costs of $135.5 to $206.1 million.
  - National Academy of Sciences is performing an independent review of EPA's analysis – due out in February 2012.
- Cardno ENTRIX estimates a range of costs between $298 million to $4.7 billion.
  - This wide range is due to the uncertainty over how the rule would be implemented.
- FSU estimates cost of DEP rule to be between $51 million to $150 million.

Questions?

For more information, please contact:

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