TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION

Use of Level IV Ecoregion Reference Stream Data to Develop Regionalized Water Quality Criteria

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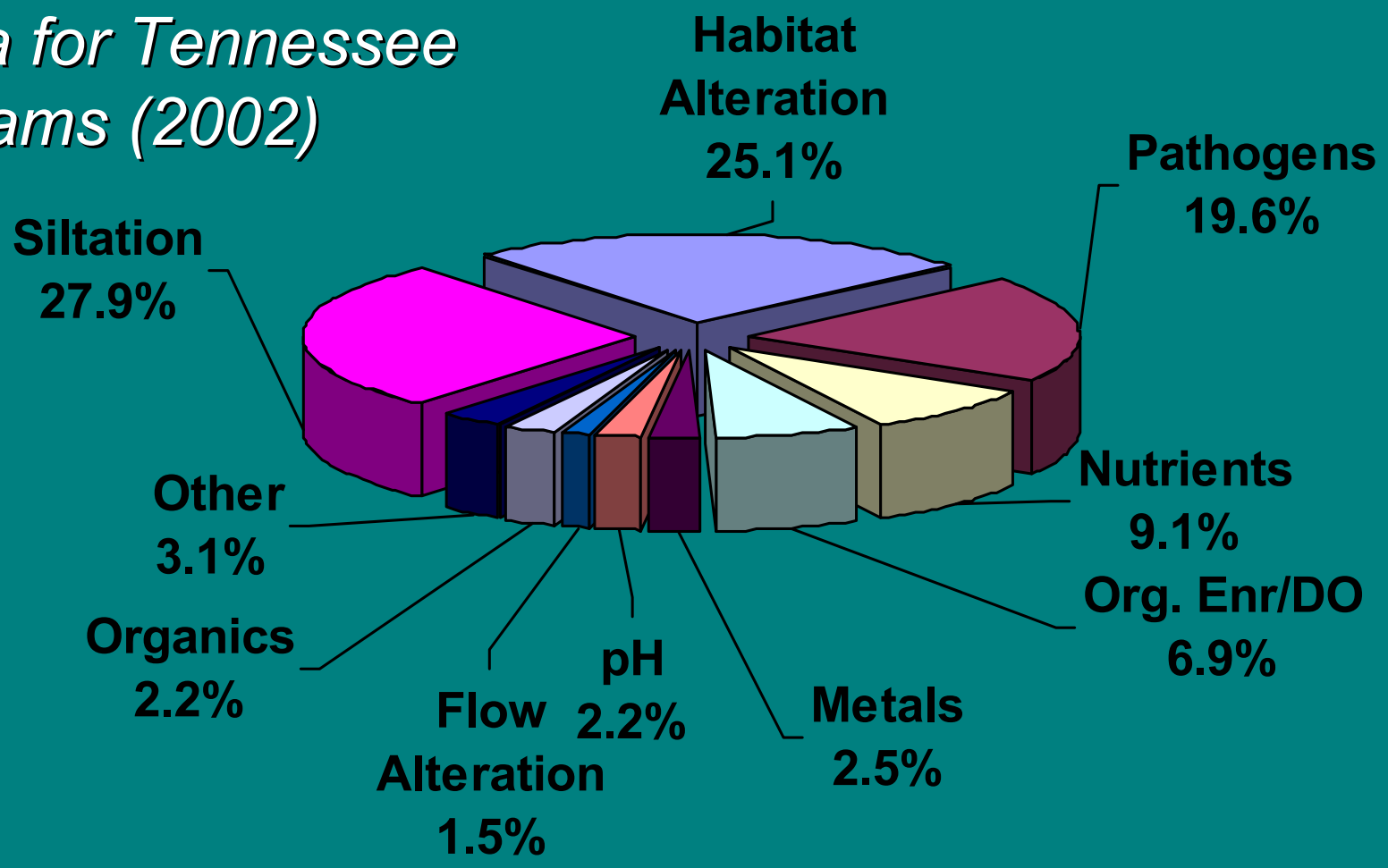
Following the completion of the 1991 triennial review of water quality standards, we decided to take proactive steps to improve water quality standards.

Nutrients, siltation, habitat alteration, and loss of biological integrity are major causes of nonsupport in Tennessee waterbodies:

Data for Tennessee streams (2002)

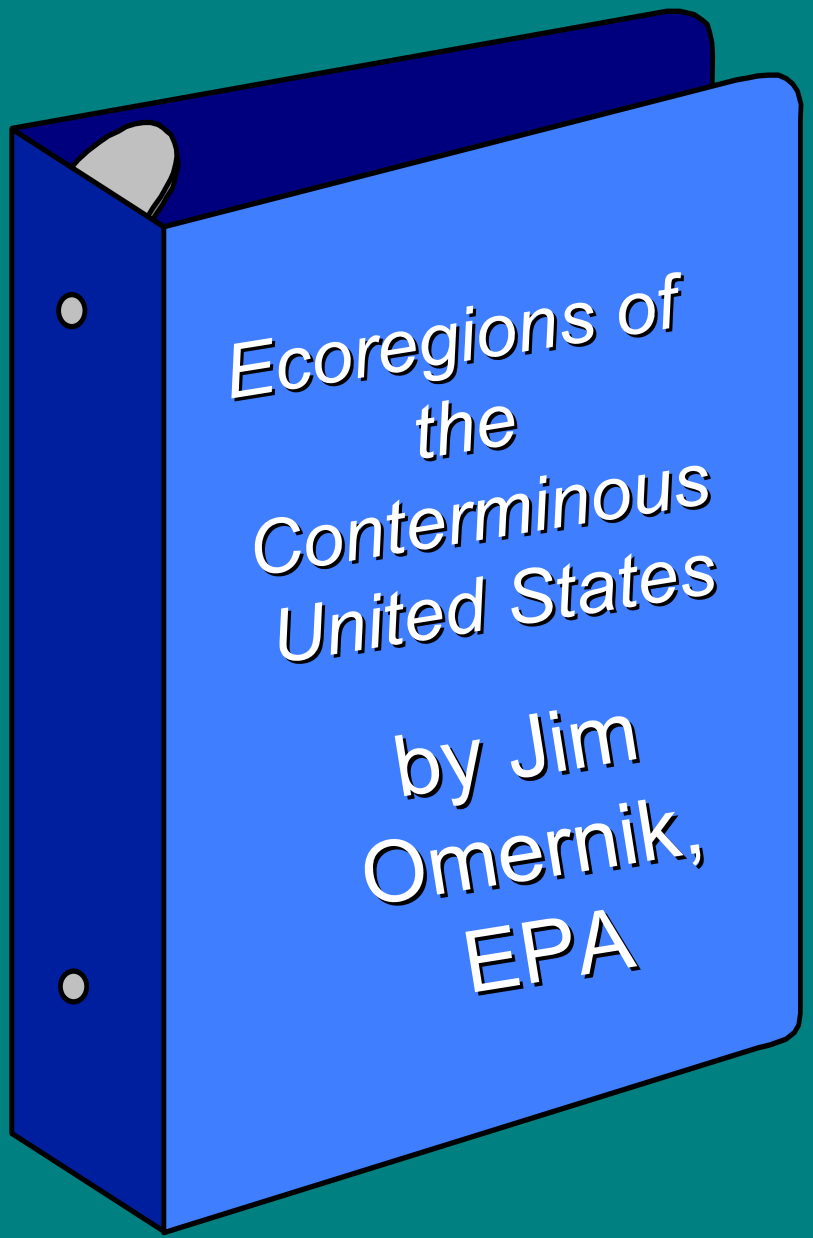


The problem with the two kinds of General Water Quality Criteria:

- *Numeric Criteria - "One Size Fits All". Statewide numeric criteria leave little room for **regional** flexibility.*

- *Narrative Criteria - Need an objective means of **regional** interpretation.*

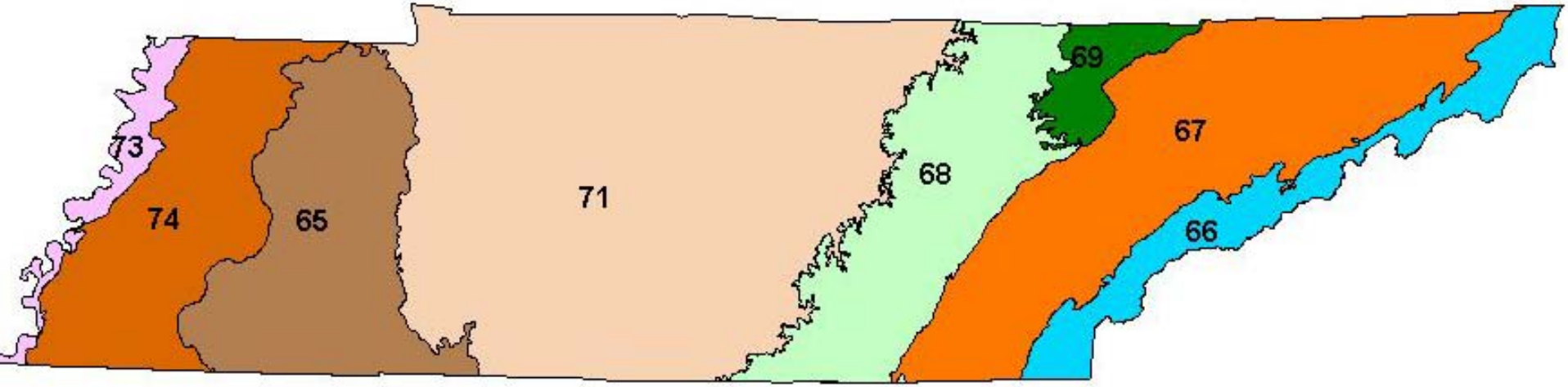
So we need regional criteria. What geographic basis?



We learned about the ecoregions of Tennessee

Ecoregions
are relatively homogenous areas defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.

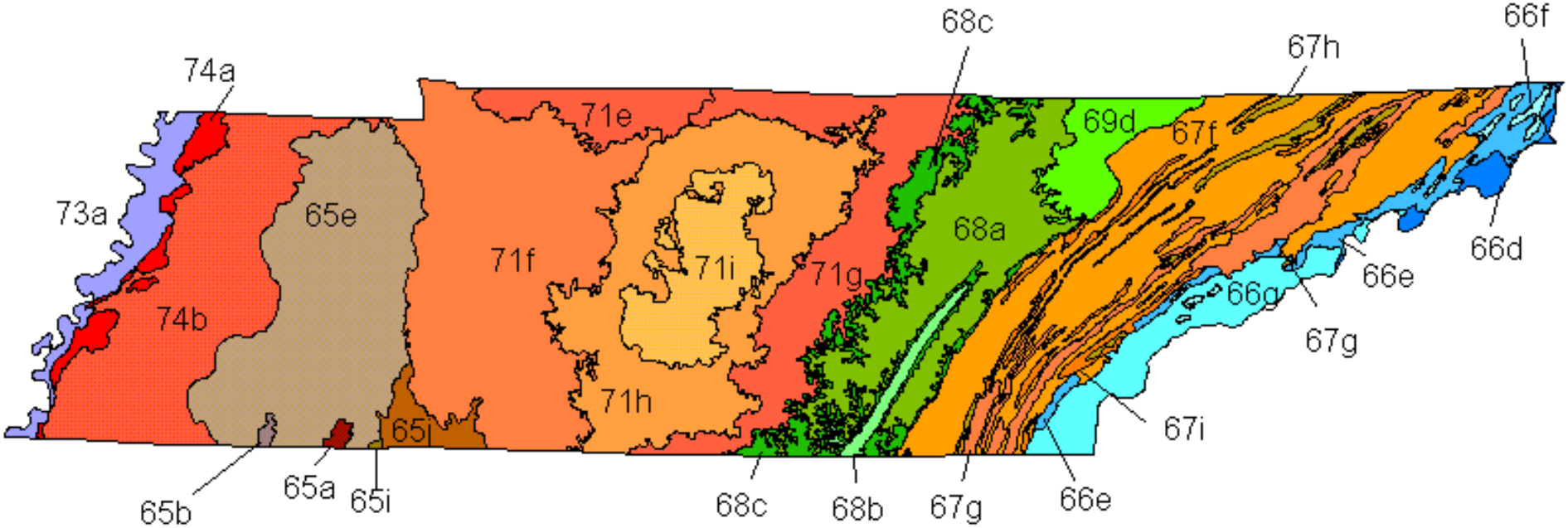
Level III Ecoregions of Tennessee



The Ecoregion Project was envisioned with three phases.

- *Subecoregion Delineation*
- *Reference Stream Selection*
- *Reference Stream Monitoring*

Task 1:
Subdelineate Ecoregions in Tennessee



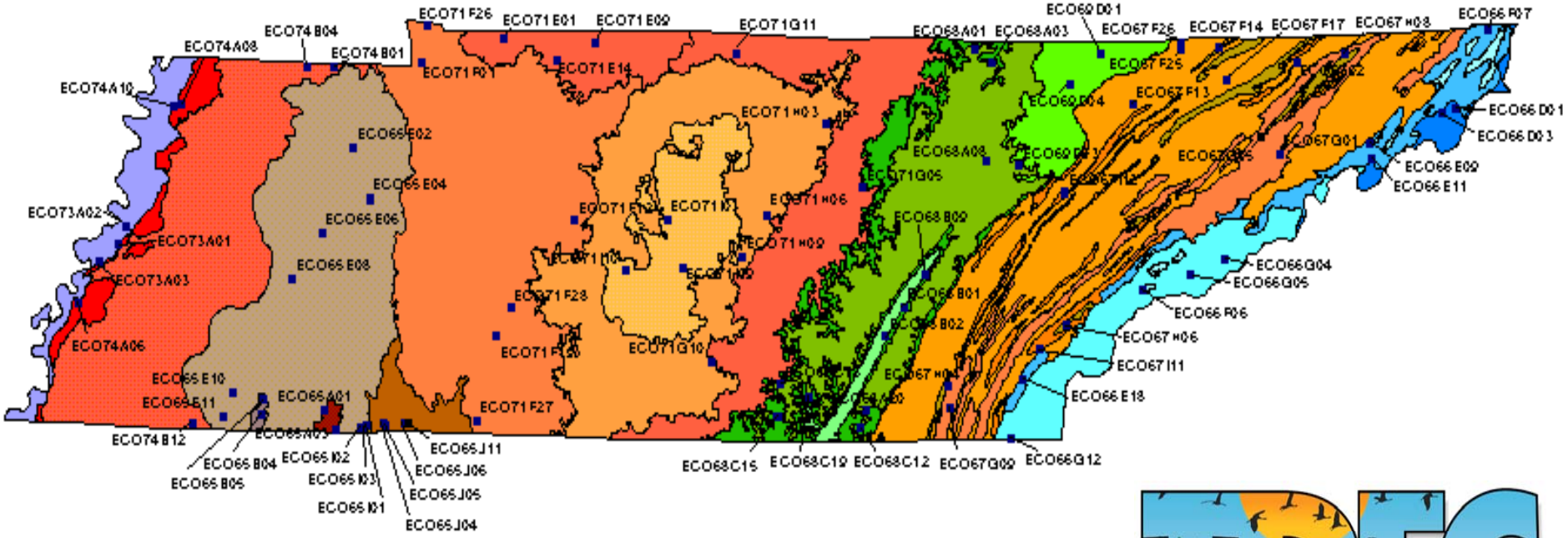
Level IV Ecoregions

Identify and Intensively Monitor Reference Streams

A reference stream

is a least impacted, but representative, waterbody within an ecoregion that can be monitored to establish a baseline to which other waters can be compared. Reference streams are not necessarily pristine or undisturbed by humans.

Reference Stream Locations



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Reference Stream Monitoring

- Over 100 stations sampled semi-annually for biology, quarterly for chemical for 3 + years.
- Generally, 3 streams per sub-ecoregion.
- Modified “clean” techniques used.

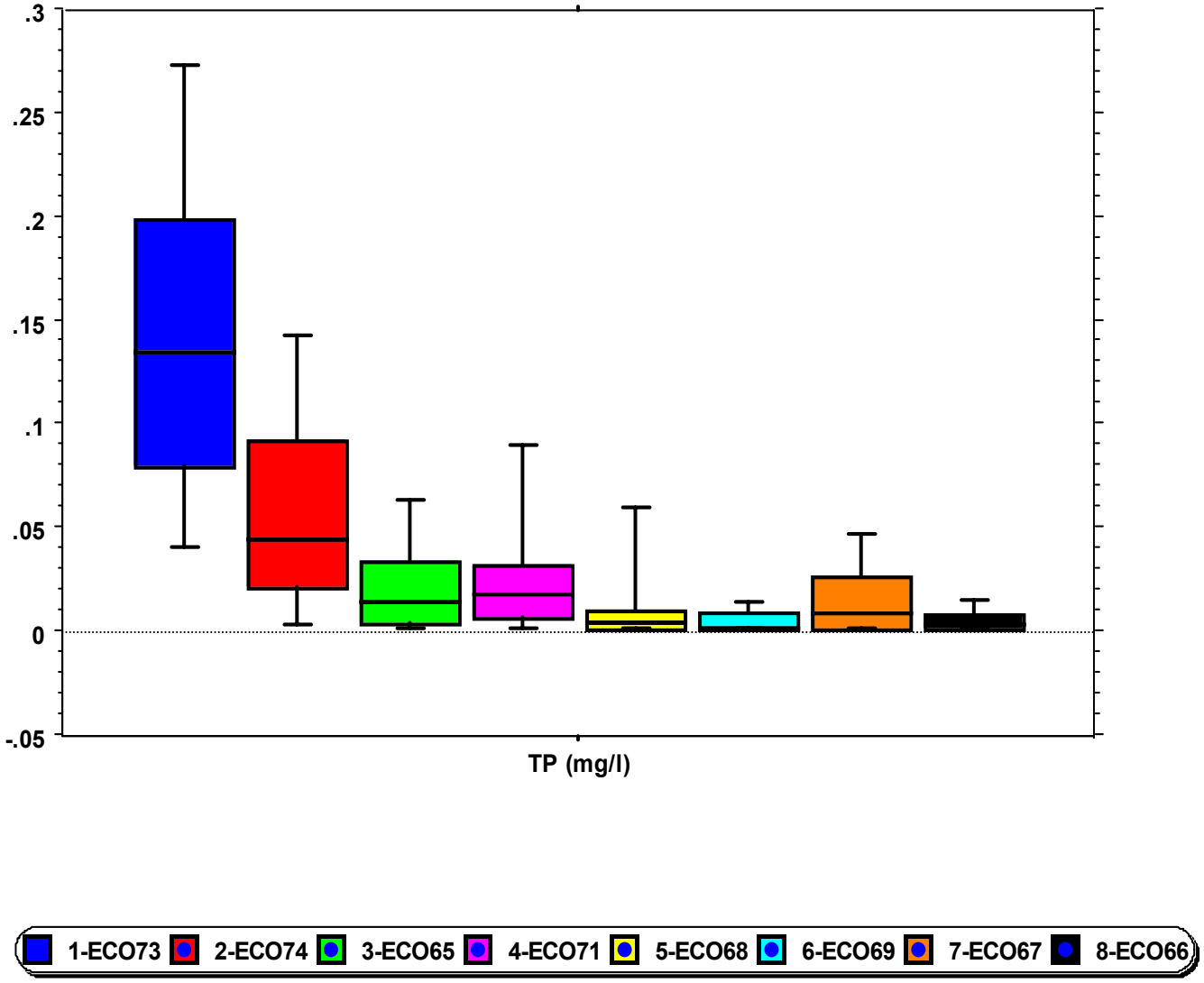
Steps in the Process for Developing Tennessee's Regional Criteria

- *Establish ecoregional data ranges for the various substances or conditions.*
- *Select potential criteria points.*
- *Field test potential criteria levels (explore relationships between levels and biological harm).*
- *Develop final report containing recommended criteria levels, plus an implementation strategy.*
- *Initiate triennial review of water quality standards.*

Nutrients

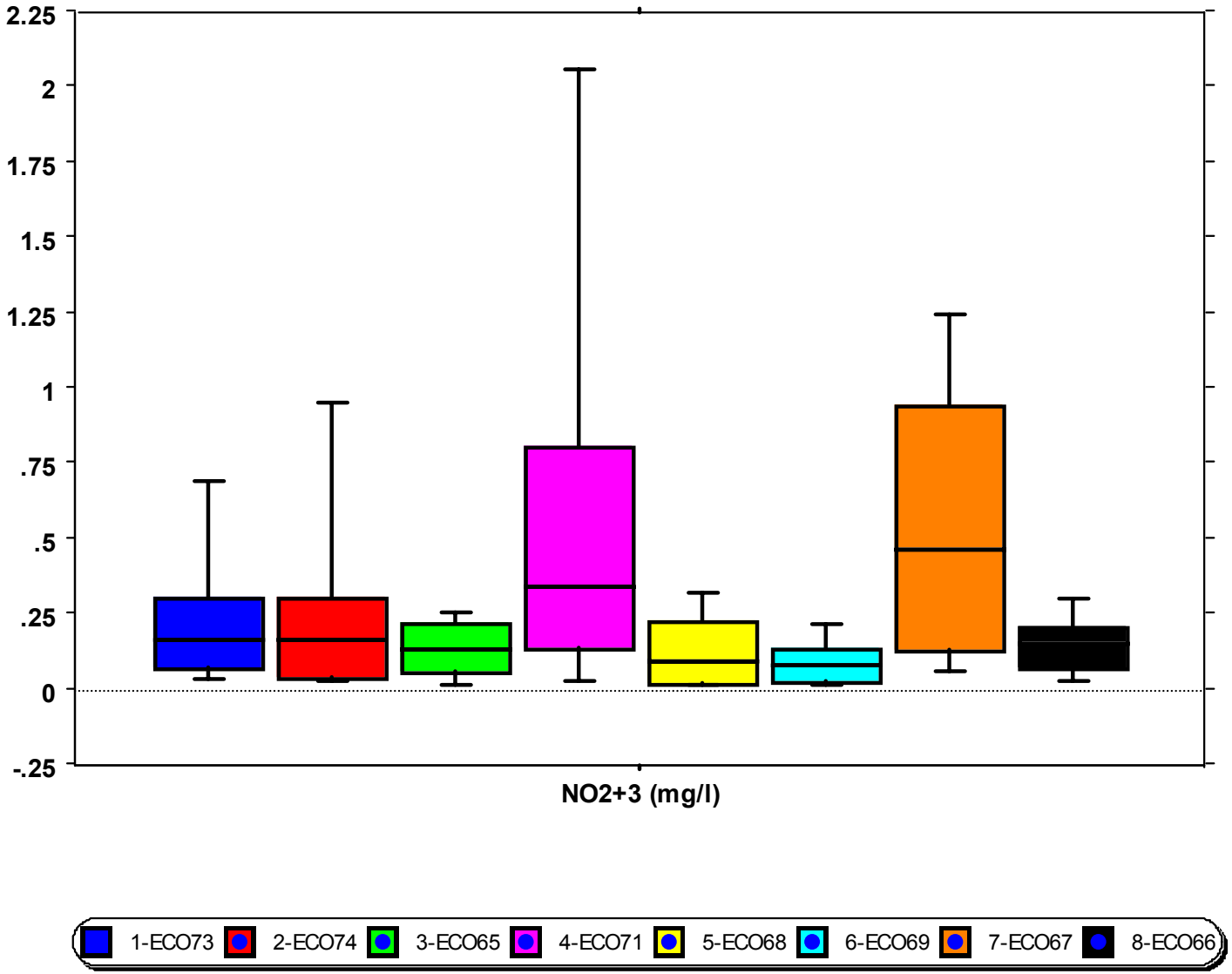
Total Phosphorus Concentrations

Level III Ecoregions

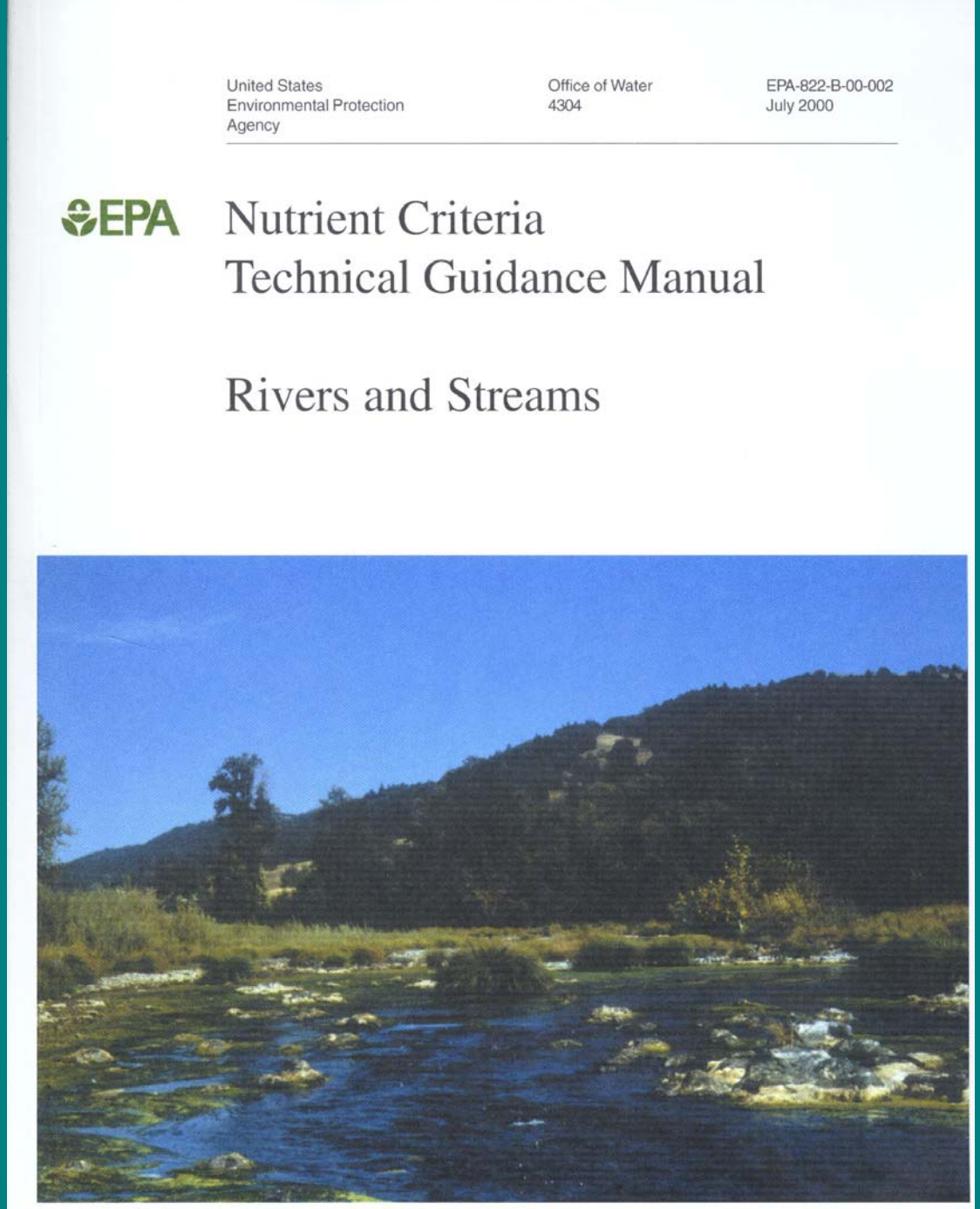


Nitrite + Nitrate Concentrations

Level III Ecoregions



We tested the 75th and 90th percentiles of the data ranges as potential criteria levels.



United States Environmental Protection Agency

Office of Water 4304

EPA-822-B-00-002 July 2000

EPA

Nutrient Criteria Technical Guidance Manual

Rivers and Streams

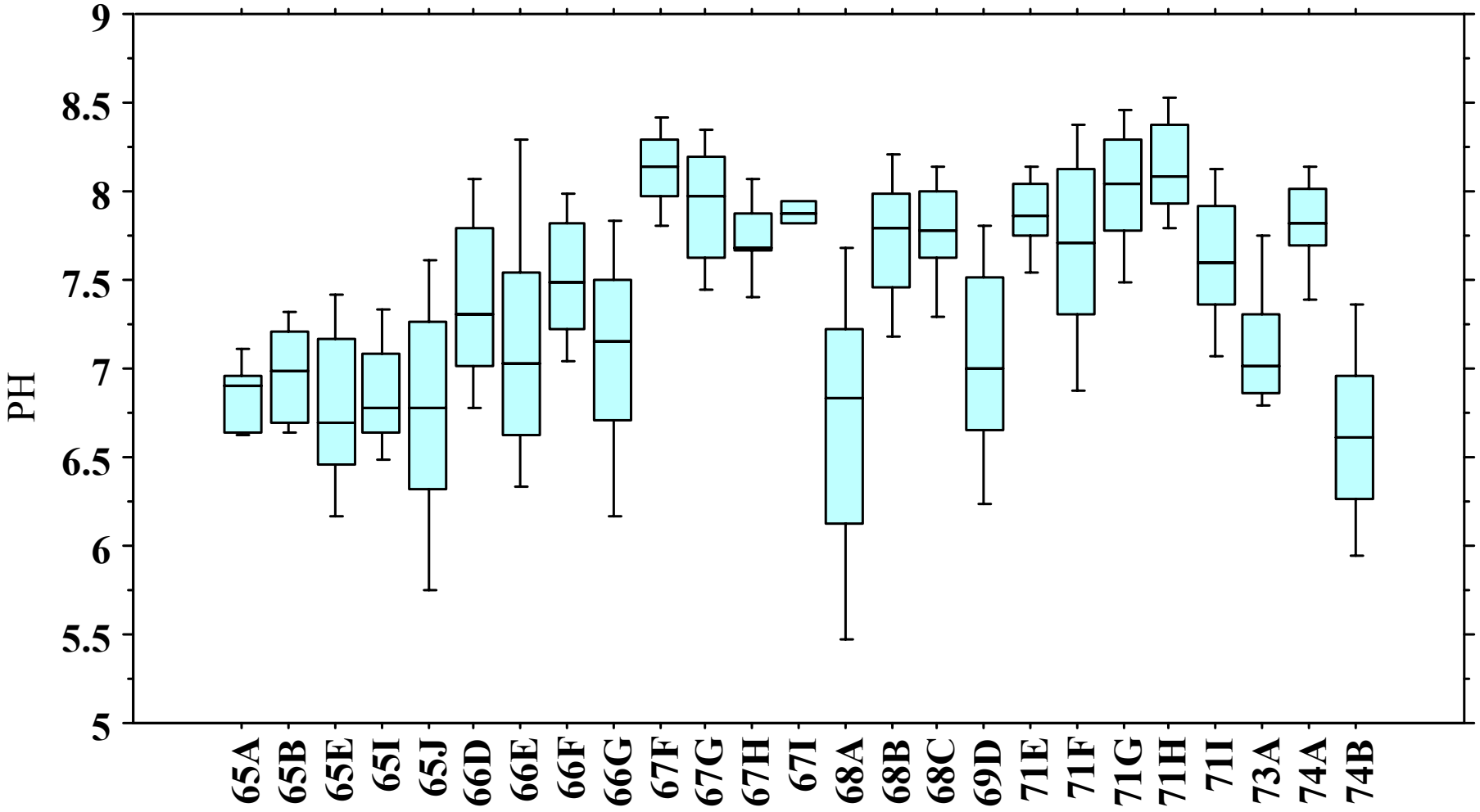
We wrote a Case Study for EPA's "Nutrient Criteria Technical Guidance Manual" for rivers and streams.

Nutrient Criteria Report

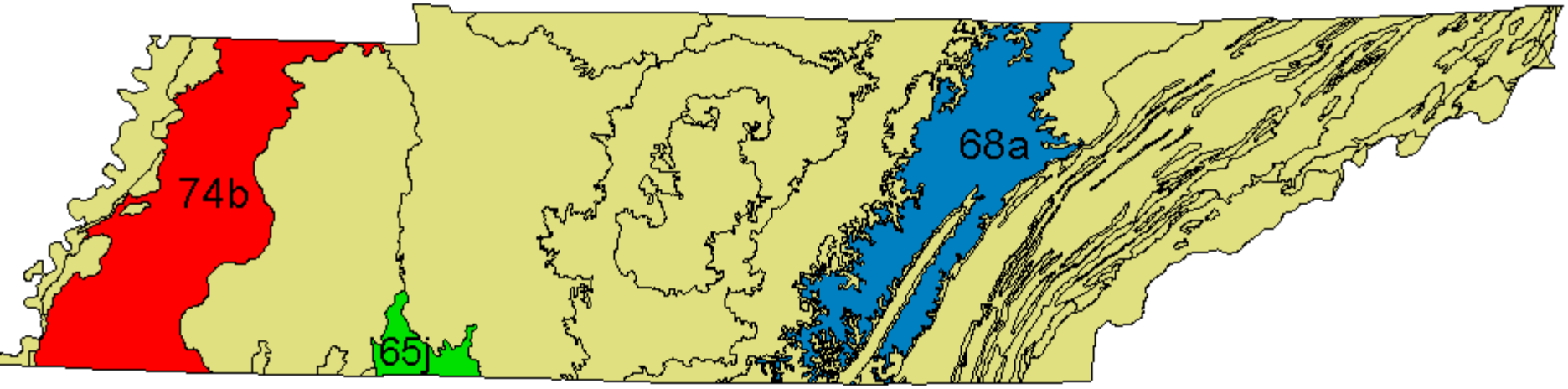
- *Draft report peer reviewed by members of Region IV RTAG Group. Final report published in August, 2001.*
- *Documented the reference condition for nitrate + nitrite and total phosphorus in each of the 25 subecoregions.*
- *Proposed the 90th percentile of the reference condition as a regional interpretation of the narrative criteria.*

pH

Reference pH by Subecoregion



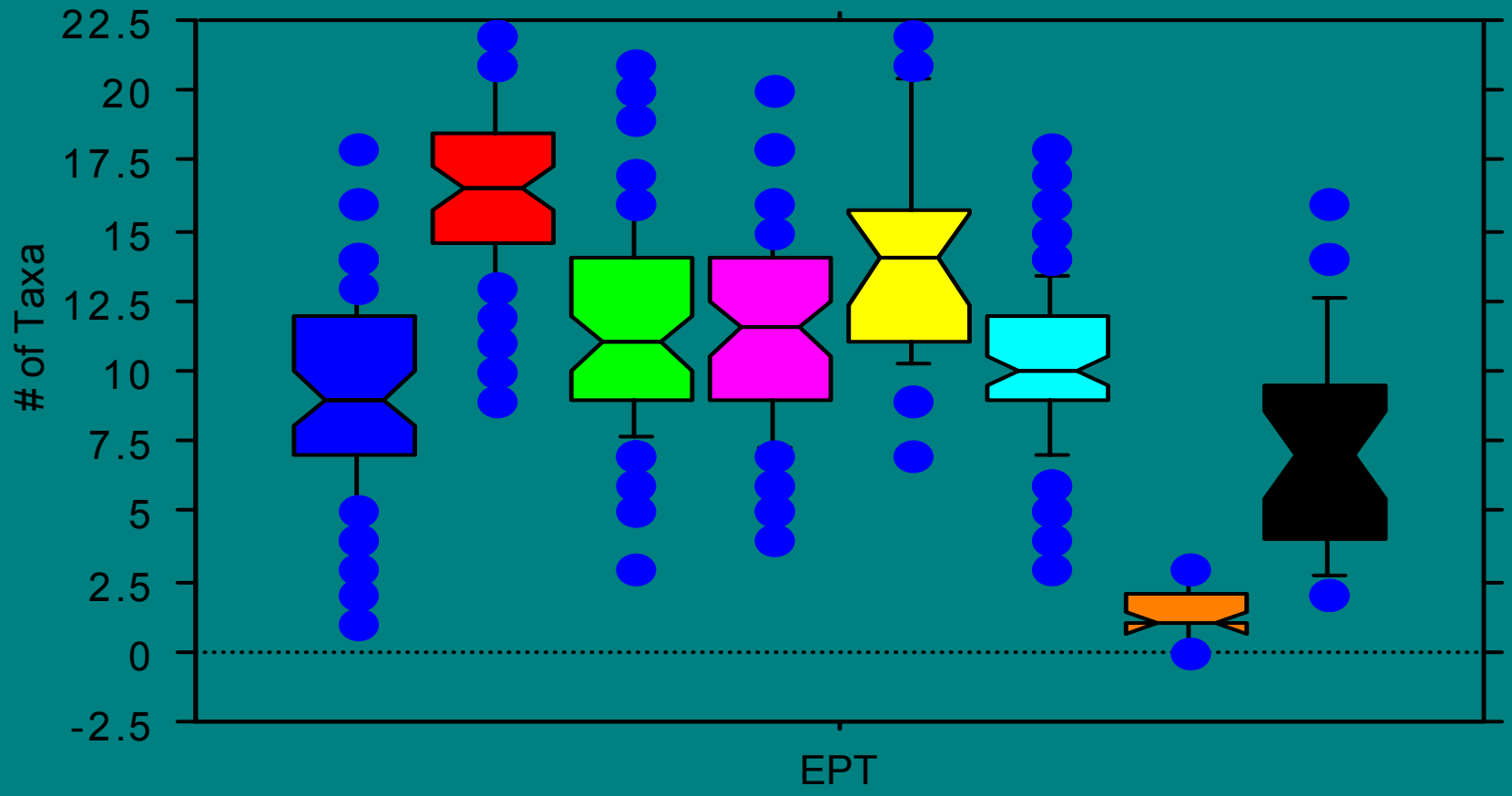
Proposed Regional pH Criteria



- 6.0-9.0
- 5.5 - 8.5
- 5.5-8.5 (1st & 2nd order) and 6.0-9.0 (3rd order+)
- 5.5-8.0 (1st, 2nd, & 3rd order) and 6.0-9.0 (4th order+)

Biological Integrity.....

EPT Richness by Ecoregion



65 66 67 68 69 71 73 74

FINAL METRIC SELECTION

TAXA RICHNESS (TR)

EPT RICHNESS (EPT)

EPT ABUNDANCE (% EPT)

OLIGOCHAETE & CHIRONOMID ABUNDANCE (%0C)

NORTH CAROLINA BIOTIC INDEX (NCBI)

PERCENT DOMINANT ORGANISM (% DOM)

PERCENT CLINGERS (% CLING)

Subregion 71e (Western Pennyroyal Karst)

Target Index Score (Feb-June) = 32

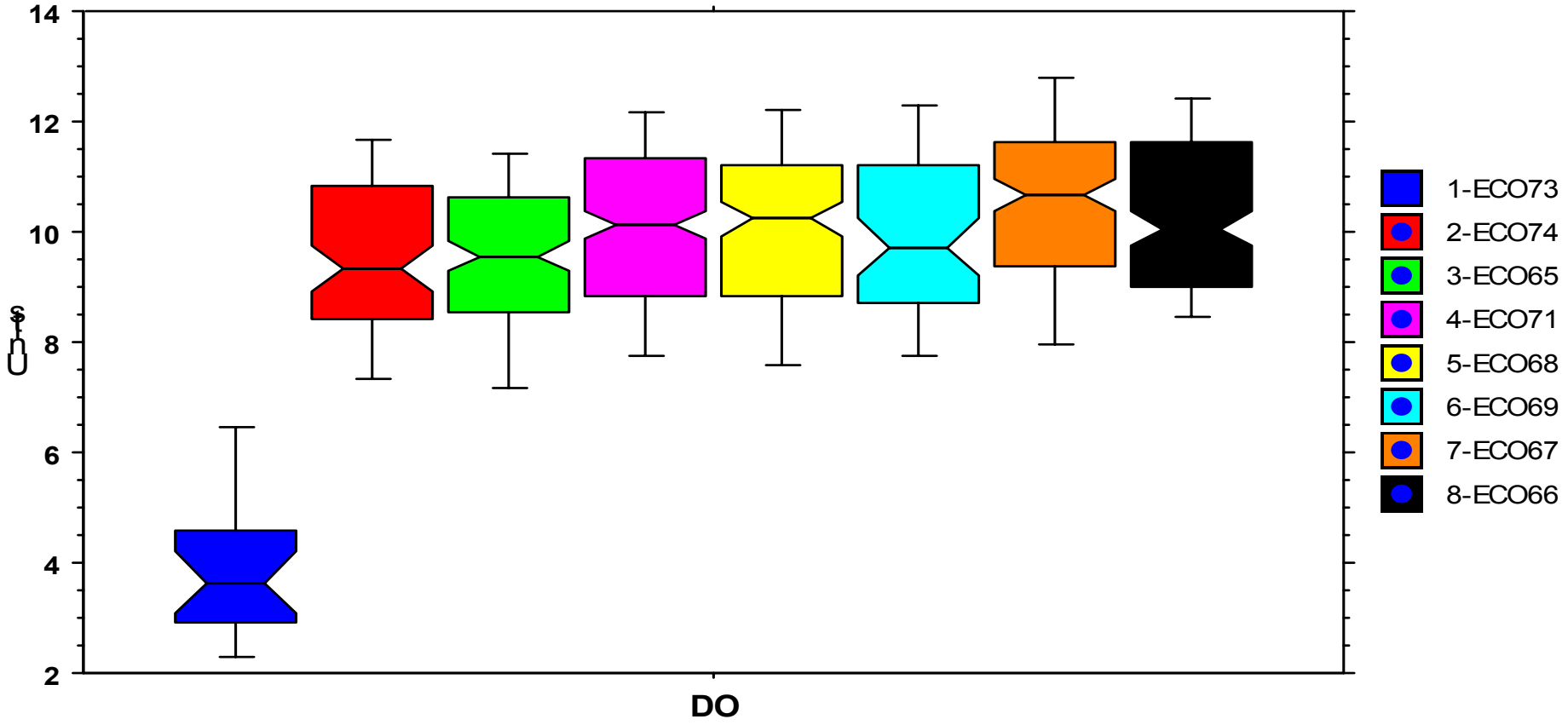
Target Index Score (July-Nov) = 28

Method: SQKICK

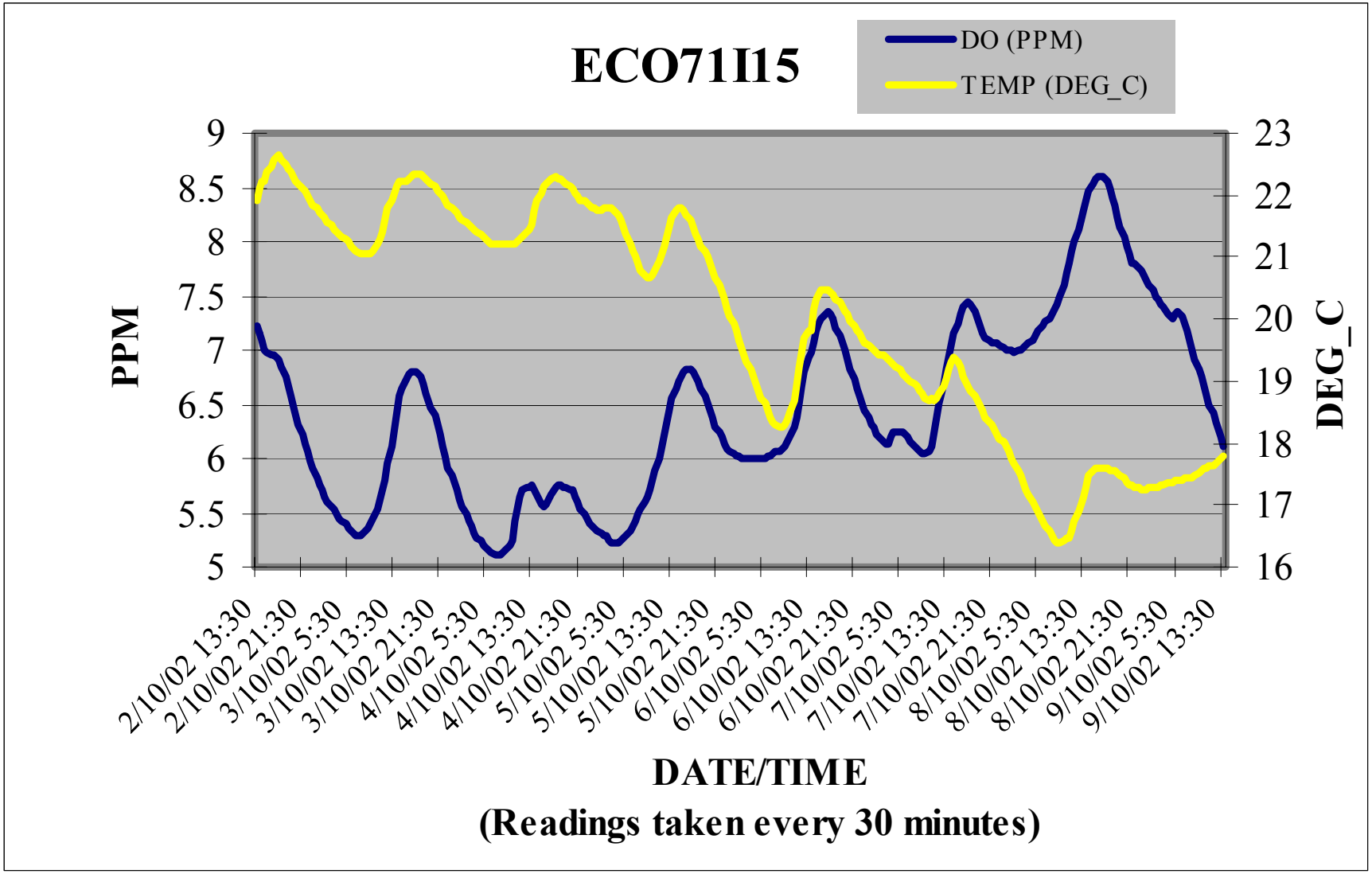
Metric	6	4	2	0
TR	> 23	16 – 23	8 – 15	< 8
EPT	> 7	5 – 7	3 – 4	< 3
%EPT	> 48.9	32.7–48.9	16.4-32.6	< 16.4
%OC	< 26.7	26.7-51.1	51.2-75.6	> 75.6
NCBI	< 5.05	5.05-6.69	6.70-8.34	> 8.34
%Dominant	< 35.1	35.1-56.6	56.7-78.2	> 78.2
% Clingers	> 59.8	40.0-59.8	20.1-39.9	< 20.1

Dissolved oxygen…

Dissolved Oxygen Levels in Level III Reference Streams



Diurnal Dissolved Oxygen Levels at Harpeth River Reference Site

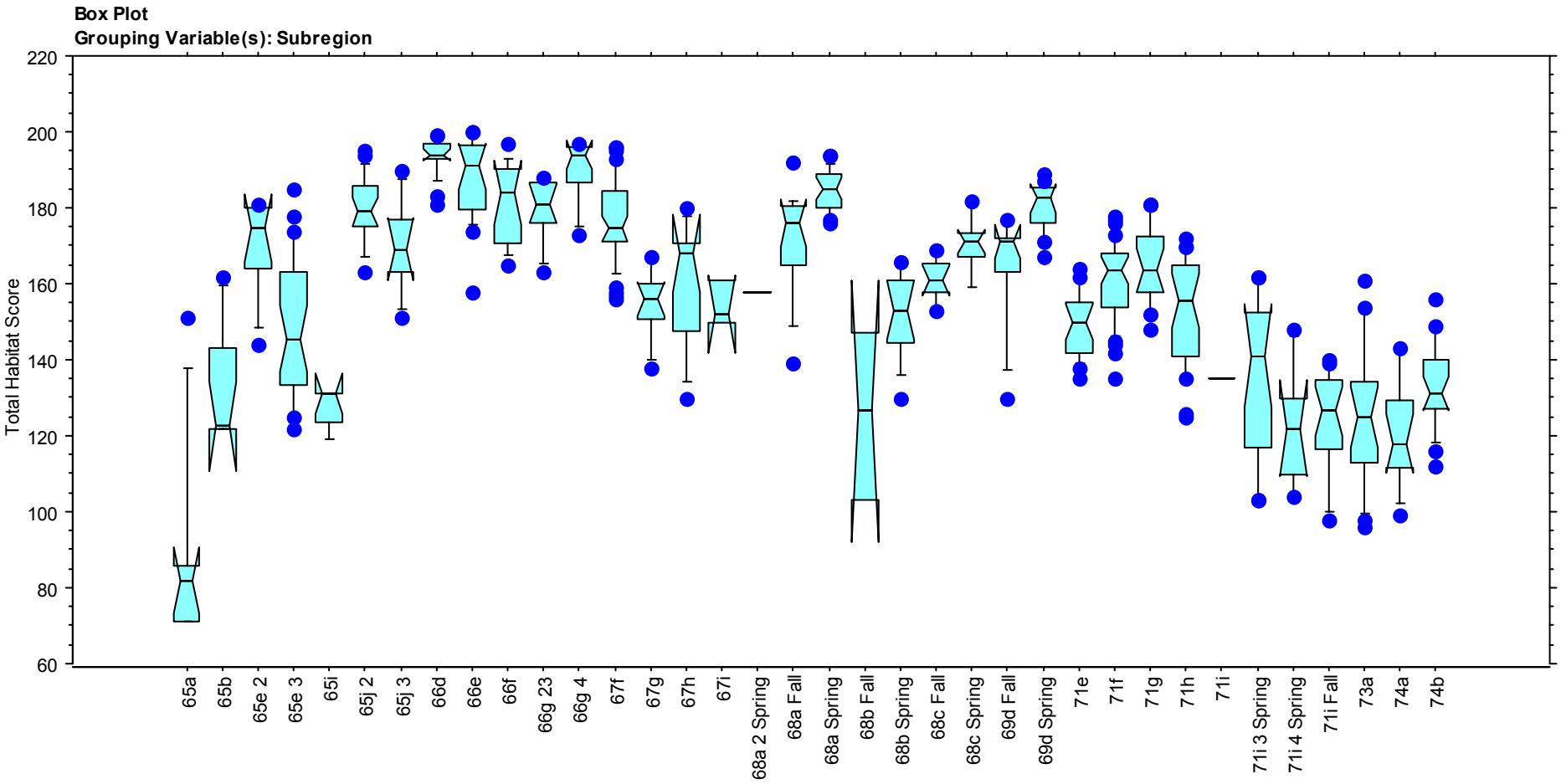


DO Proposal (most stringent criteria in southeastern U.S.)

- No less than 5.0 mg/L, except as follows:
- In 71i & 73a, daily ave. DO 5.0, minimum 4.0
- Designated trout streams, 6.0 mg/L
- Any wadeable stream in Blue Ridge Mountains ecoregion (66), 7 mg/L
- Naturally reproducing trout streams (incl. any stream in GSMNP), 8 mg/L.

Habitat…

Habitat Scores By Subecoregion



Habitat Proposal:

- *Guidance only.*
- *Based on 75 percent of the median reference scores for each subecoregion.*
- *Narrative criteria.*

So What Did We Do About Siltation?

Suspended Solids?

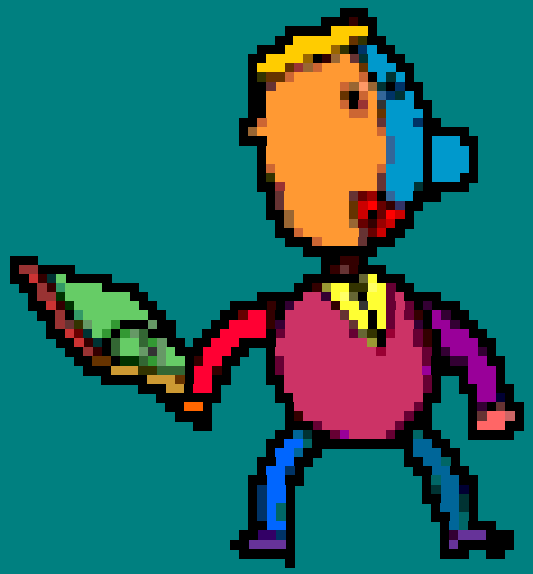
Turbidity?

Habitat Assessments

2001 Triennial Review of Water Quality Standards Summary

- Nutrients: proposed new numeric criteria.
- Biological Integrity: proposed numeric biocriteria.
- Habitat: created guidance for interpreting narrative criteria
- pH: proposed regional revisions to statewide numeric criteria.
- Dissolved oxygen: proposed regional revisions to statewide numeric criteria.

Success?



Nope…

Triennial Review Issues Raised:

- *Criticism of reference approach*
- *Implementation questions about numeric nutrient criteria*
- *Good science/ bad science*
- *Regulated community/ environmental group opposition to biocriteria.*
- *Agriculture concerns*

The Better Part of Valor: Our Fallback Position

- *Nutrients: new narrative criteria that recognizes methodology.*
- *Biological Integrity: revised narrative criteria that recognizes methodology.*
- *pH and dissolved oxygen: stuck to our position.*

EPA Response: Stay Tuned

All of our criteria development reports can be downloaded from our Webpage:

www.state.tn.us/environment/wpc/publications

My Office
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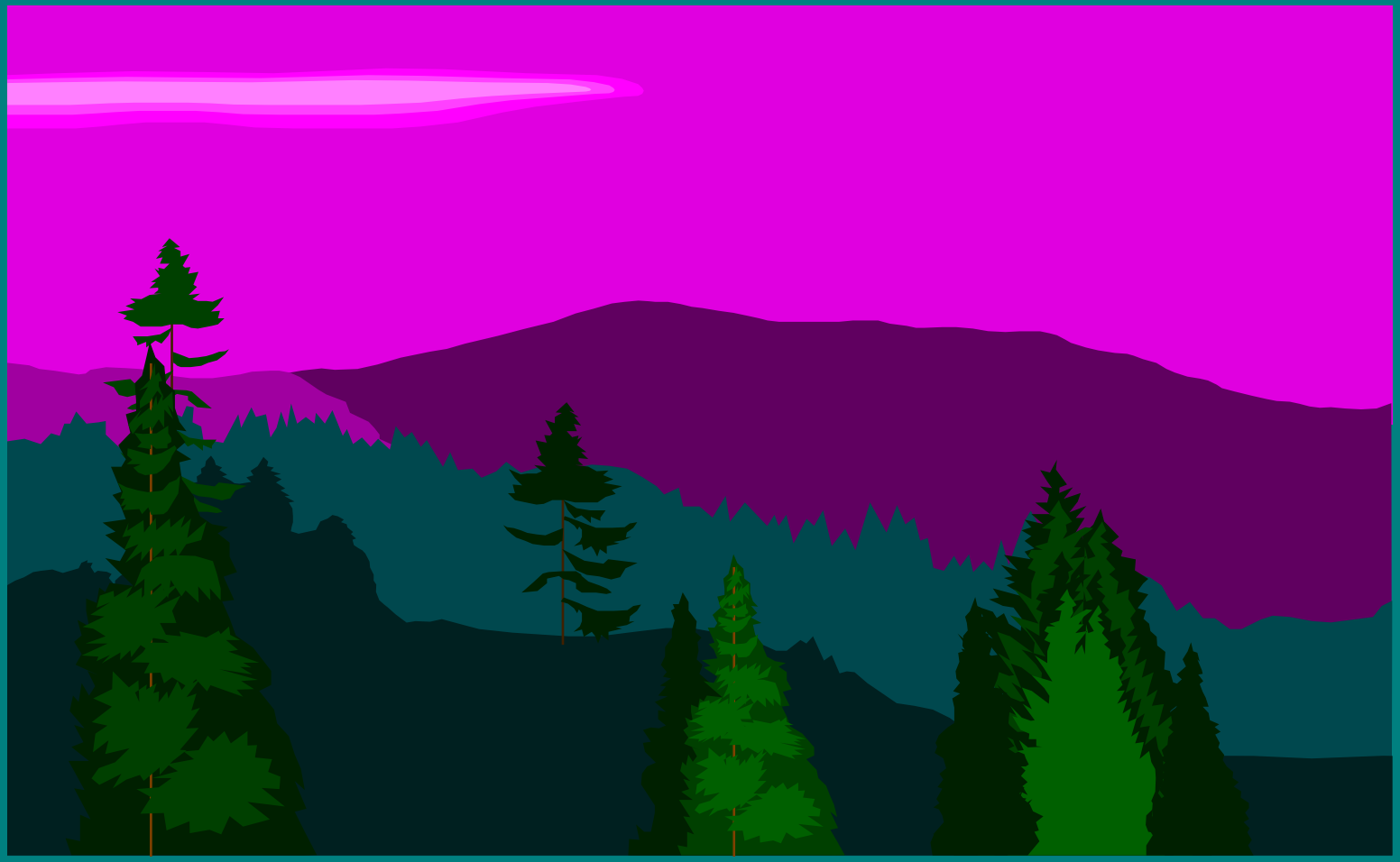
The End



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