Proposed Revisions to the IR Guidance for Evaluating Excessive Variability of Index of Biotic Integrity (IBI) Scores Based on the Magnitude of the Coefficient of Variation (CV)

IR Guidance: Chapter 3, and Appendix D

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Presentation Outline

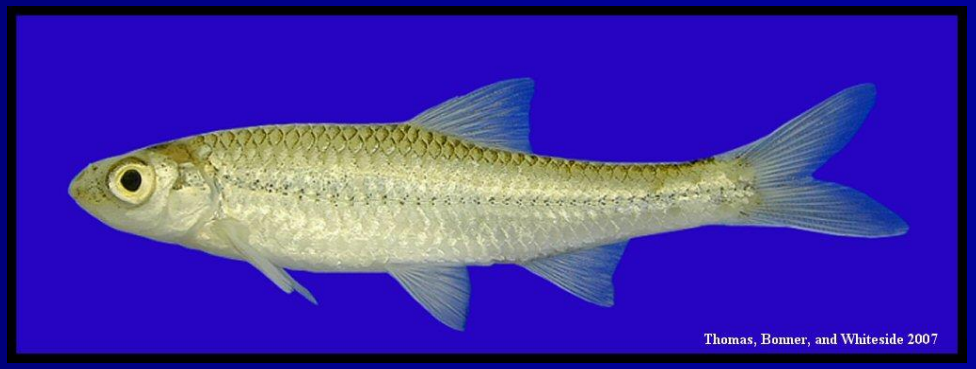
- Background on existing methods for assessing biological data for the IR;
- Define the Issue;
- Supporting Data;
- Proposal for IR guidance revision to address the issue;
- Future plans related to evaluating the variability of IBI scores.

TCEQ/TPWD Interagency Workgroup for Biological Sampling and Data Analysis

- All of these methods were developed based on extensive analysis and discussion in the context of the TCEQ/TPWD interagency workgroup for biological sampling and data analysis;
- Existing IR guidance discussed in this presentation was first implemented in 2010.

Biological Assessments for the IR

Fish



Benthic Macroinvertebrates

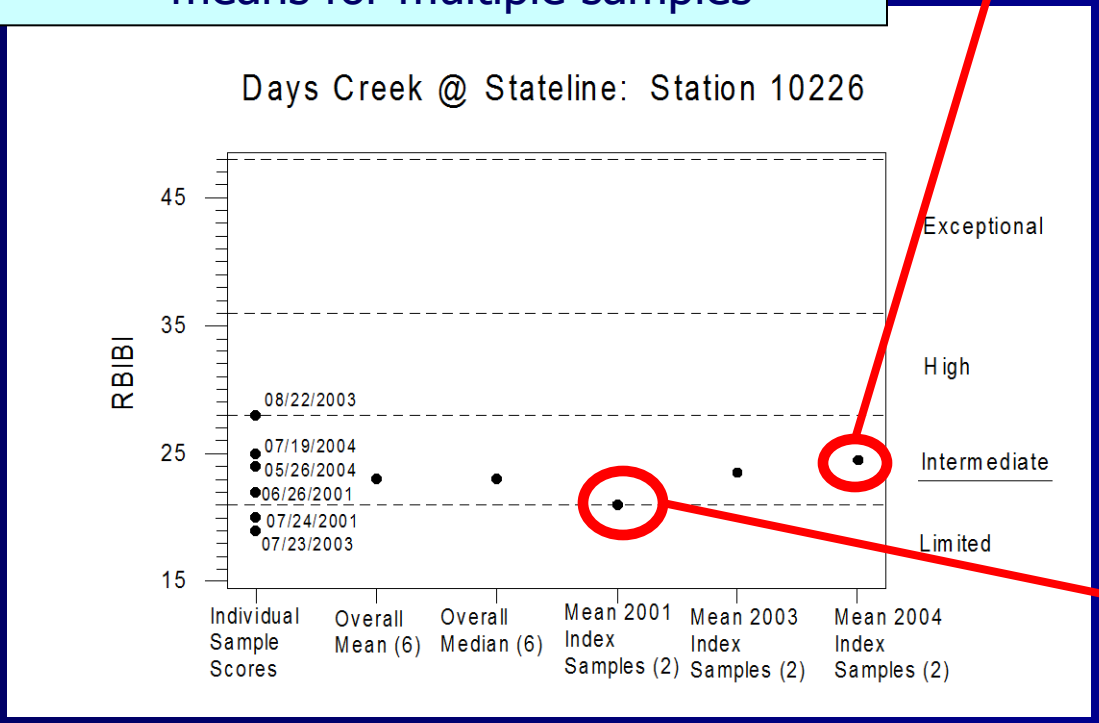
Biological Assessments: Assessing Multiple Samples from the Same Assessment Unit (AU)

- Bioassessments conducted for the IR currently emphasize 2 primary aspects of the distribution of IBI scores for an assessment unit:
  - Central Tendency (Mean IBI Score);
    - A measure of the location of a set of IBI scores relative to ALU category thresholds;
  - Variability of the Scores (Coefficient of Variation);
    - Variability of biotic integrity tends to increase as the disturbance increases in a watershed;
    - CV allows comparison of magnitude of variability across waterbodies with different mean IBI's.

Using the Mean IBI and the "CV Interval" to Assess Attainment of the Designated or Presumed Use for an Assessment Unit

Determining the Appropriate Aquatic Life Use (ALU) Category for the Mean of Multiple IBI Scores from a Single Sample Site or AU

IBI scores at a stream show variability:
- single sample dates
-- means for multiple samples



ALU determination straight forward when average falls mid-range for ALU category

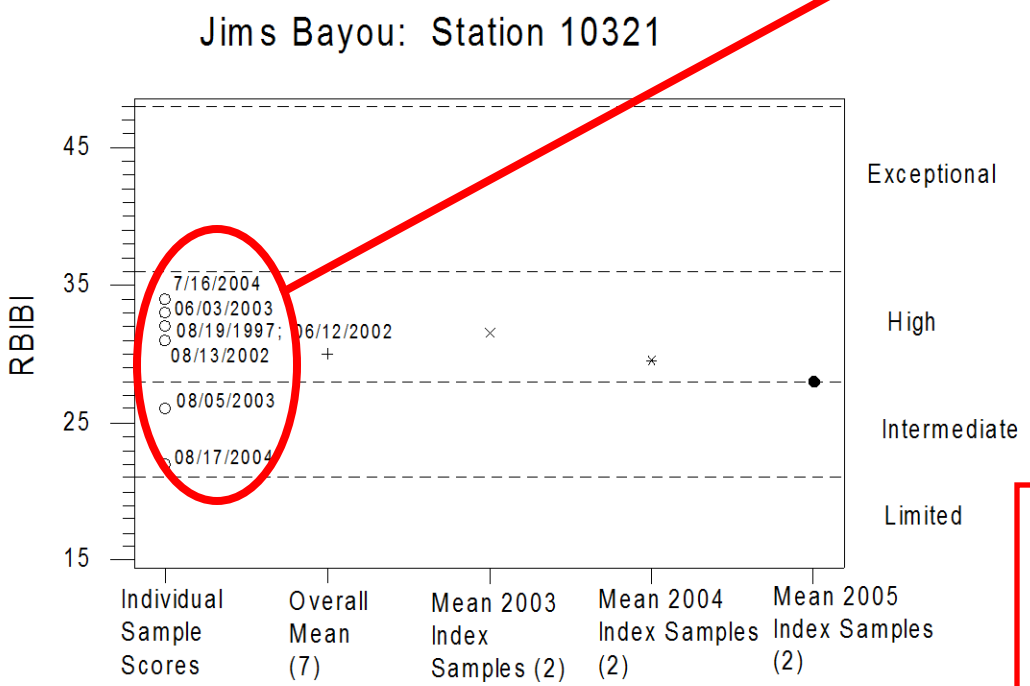
-ALU determination Problematic when the average of multiple IBI scores falls at, or very close to ALU threshold.

-- IR Guidance prior to implementing the CV Interval, would interpret this as Limited ALU.

Assessing Attainment of the Designated or Presumed ALU Category Using IBI Scores for Multiple Aquatic Life Monitoring Events in a Single Assessment Unit (AU)

- In the early 2000's the TCEQ and TPWD interagency workgroup on biological monitoring undertook an analysis of the variability of IBI scores;
- Approximately 290 fish and benthic macroinvertebrate sample sets were evaluated;
- Analysis restricted to sample sets with multiple paired samples (benthic macroinvertebrates and fishes) at a single site;
- The coefficient of variation (CV) was calculated for each sample set at each site.

Addressing Variability of IBI Scores: Incorporating the CV Interval



Mean = 30
Std. Dev. = 4.36

Coefficient of Variation:
Std. Dev./Mean = 0.14

These statistics were calculated for each of the 290 sample sets from least disturbed ecoregion reference streams.

TCEQ

Existing Guidance for Fish Ecoregion ALU Specific CV

Ecoregion/ALU category specific coefficients of variation (CV) for use with **fish** samples. Each CV represents the average of all ecoregion/ALU category specific pairwise comparisons used to derive the CV's.

Aquatic Life Use	Ecoregion 24	25,26	27,29,32	30	33,35	34
Exceptional	2.22% (2)	-	6.28% (6)	4.41% (9)	3.87% (6)	-
High	6.13% (46)	-	6.95% (118)	5.14% (144)	5.61% (245)	6.04% (9)
Intermediate	7.6% (25)	4.1% (5)	6.4% (165)	7.92% (36)	5.86% (211)	3.3% (6)
Limited	8.25% (42)	14.29% (1)	12.82% (75)	-	6.66% (86)	3.85% (1)

The number of pairwise comparisons used to calculate the average is given in parentheses.

Existing Guidance for Benthic Macroinvertebrate Ecoregion ALU Specific CV

Ecoregion/ALU category specific coefficients of variation (CV) for use with **benthic macroinvertebrate** samples. Each CV represents the average of all ecoregion/ALU category specific pairwise comparisons used to derive the CV's.

Aquatic Life Use	Ecoregion				
	27,29,32	30	31	33,35	34
Exceptional	-	6.47% (6)	-	4.45% (6)	-
High	5.22% (24)	5.95% (40)	6.90% (1)	6.28% (56)	5.09% (9)
Intermediate	6.06% (23)	6.43% (13)	8.76% (2)	8.98% (76)	6.31% (7)
Limited	9.78% (5)	-	-	7.42% (12)	-

The number of pairwise comparisons used to calculate the average is given in parentheses.

Existing IR Guidance for Assessing Multiple Aquatic Life Monitoring Events: Using the Mean and the "CV Interval" to Assess Attainment

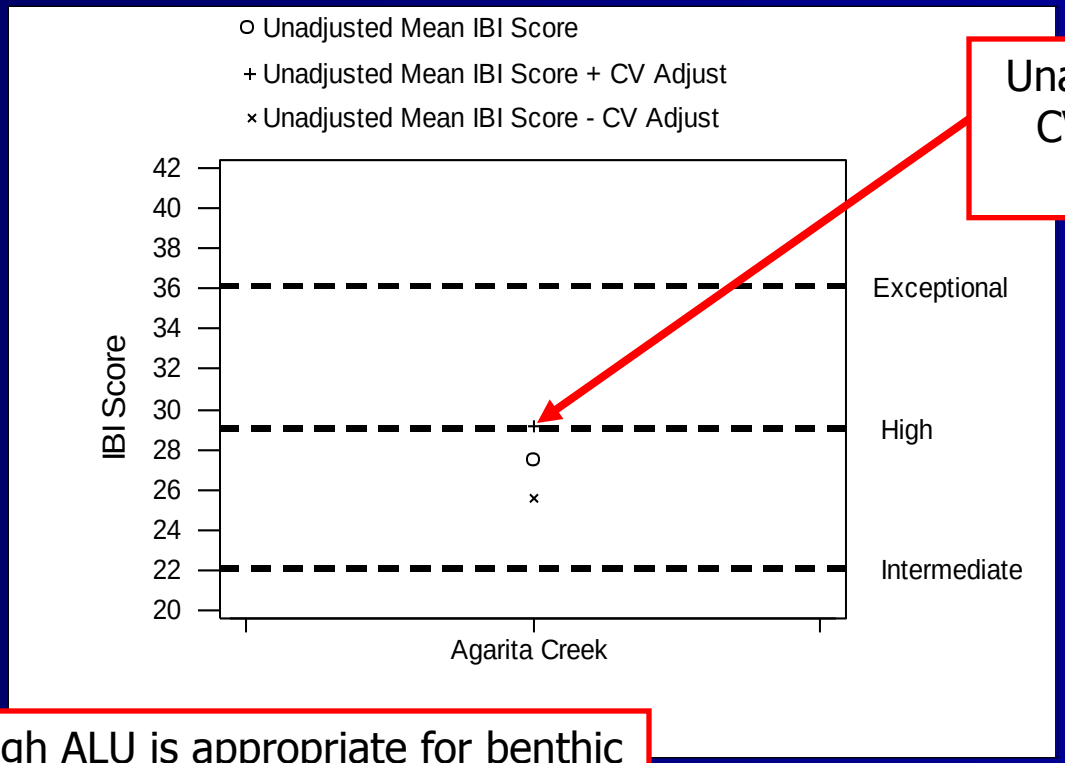
- **IR Guidance, Appendix D:**
  - To assess attainment of the ALU category for an assessment unit, the mean of a minimum of two samples collected from each of one or more representative sites within the AU will be calculated;
  - The ecoregion Coefficient of Variation will be used to establish an interval about the mean;
  - The highest ALU category included in the interval will be used to determine attainment.

Existing Guidance: Example of the Analysis of Multiple ALM samples; Using the CV to Establish an Interval about the Mean.

	Fish IBI	Benthic IBI
Non-Critical Period Sample	34	16
Critical Period Sample	41	22
Average	37.5	19
ER Ref. CV	0.0586	0.0742
(ER Ref CV)*AVG	2.1975	1.4098
AVG + (ER Ref CV*AVG)	39.7 (Upper bound of interval for AVG Fish IBI)	20.4 (Upper bound of interval for AVG Benthic IBI)
AVG – (ER Ref CV*AVG)	35.3 (Lower bound of interval for AVG Fish IBI)	17.59 (Lower bound of interval for AVG Benthic IBI)

Existing Guidance: Example for "Agarita Creek"

Agarita Creek with Unadjusted Mean IBI Score—Intermediate ALU



Unadjusted mean + CV adjust falls in High ALU

Indicates High ALU is appropriate for benthic macroinvertebrates in Agarita Creek, designated High ALU supported.

Use of the Sample CV to Evaluate the Magnitude of Variability of IBI Scores Relative to that Observed in Least Disturbed Reference Streams

Existing Guidance for Assessing Variability of Multiple IBI Scores from the same AU (Proposed and Accepted for 2010 IR)

- **IR Guidance, Appendix D:**
  - If separate samples from an assessment unit fall in different aquatic life use categories and the CV for the samples is greater than twice the ecoregion CV for the ALU category containing the mean, then the water body will be identified as a concern, and additional data collection will be scheduled;
  - Identification of the water body as a concern will occur even if the mean and interval indicate support of the designated use;
  - An attempt will be made to determine the source of the observed "excessive variability" (Sample CV >2X ER Ref. CV).

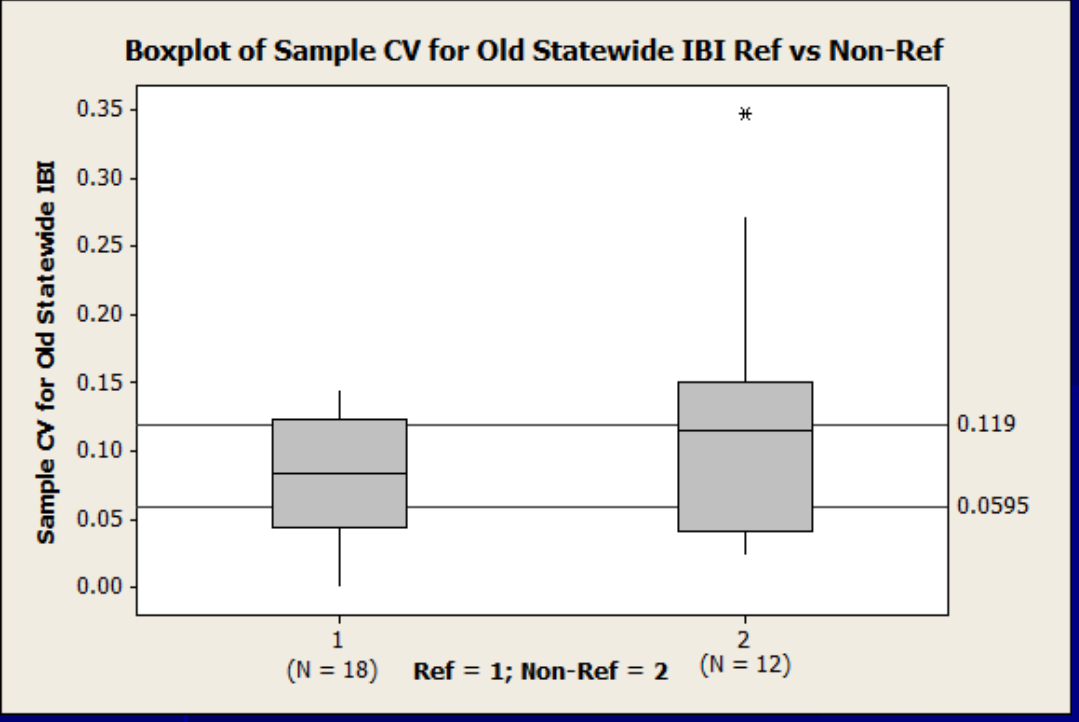
Example: Analysis of multiple ALM samples, magnitude of the sample CV vs the ER Reference CV

	Fish IBI	Benthic IBI
Non-critical Period Sample	34	16
Critical Period Sample	41	22
Average	37.5	19
ER Ref. CV	0.0586	0.0742
CV*AVG	2.1975	1.4098
Sample std. Dev.	4.9497	4.2426
2X ER Reference CV	0.1172	0.1484
Sample CV	0.132 (>2X Ref. CV)	0.2233 (>2X Ref. CV)

Since the sample CV for both the Fish IBI and the Benthic IBI greater than 2X the ER Reference CV a Concern for Screening Level (CS) would be identified for this water body according to the existing guidance.

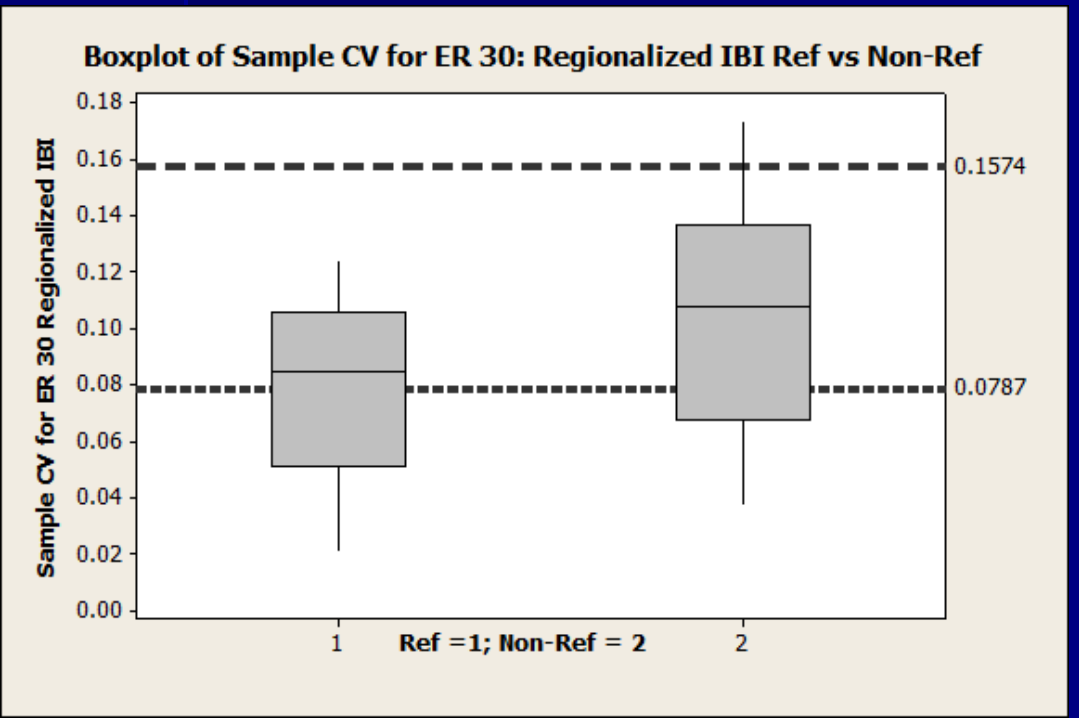
Statement of the Issue

- Based on additional sampling in least disturbed streams for the Texas Aquatic Ecoregion Project it appears that identifying concerns based on a sample coefficient of variation (CV) that is greater than 2X the ecoregion reference CV needs further analysis;
  - Higher CV's than those available in 2010 at Least disturbed sites have been observed;
  - Recently completed draft regionalized IBI's for benthic macroinvertebrates necessitates rescoring and re-development of ER reference CV's;
  - Continued use of current guidance may result in concerns identified for excessive variability when it is actually comparable to that observed at reference streams.



Comparison of the Distribution of Sample CV Scores for Reference vs Non-Reference Streams Relative to Existing ER Reference CV and 2X Existing Reference CV Based on the Existing Statewide Benthic Macroinvertebrate IBI

- >25% of ref. stream sample CV's >2X ER CV
- Concern for almost 50% of non-ref. sample CV's



Comparison of the Distribution of Sample CV Scores for Reference vs Non-Reference Streams Relative to Average ER Reference CV and 2X Reference CV Based on the Draft Regionalized Benthic Macroinvertebrate IBI for ER 30

- No ref. stream sample CV's >2X ER CV
- Concern for much less than 25% of non-ref. Samples

Summary of Results For the 2012 IR: Concerns for 2X CV

	Fish	Benthics	Total
# of AU's Assessed	146	125	271
# Concerns for 2X CV	28	43	71
% Concerns for 2X CV	19%	34%	26

Proposed 2016 IR Guidance Revision

- Suspend the use of evaluation of the magnitude of the sample CV to identify concerns to allow further analysis of this issue in the TCEQ/TPWD interagency workgroup;

- Remove existing concerns for waterbodies that have sample CV greater than 2X the Ecoregion Reference CV.

Future Plans

- **Variability is an important and meaningful inherent aspect of biotic assemblages in aquatic systems;**
  - **The TCEQ/TPWD interagency workgroup for bioassessments will continue with the analysis of the variability of the IBI using additional benthic macroinvertebrate and fish samples collected for the Texas Aquatic Ecoregion Project;**
  - **The draft regionalized benthic macroinvertebrate IBI will be used, in addition to the old statewide IBI, to develop revised ER reference CV's;**
  - **Present results of the analysis to 2018 GAWG, and revisit the IR methodology for identifying concerns.**


Questions?