Using the BLM and FMB for Resolving both Spatial and Temporal Variability in Setting Aquatic Life Criteria for Copper

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Copper Alliance

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Overview

- Purpose: Explore application of the fixed monitoring benchmark (FMB) to resolving both spatial and temporal variability in aquatic life criteria derived on the basis of water quality conditions.
- Outline
  - Summarize current uses of freshwater copper Biotic Ligand Model (BLM)
  - Introduction to the FMB
  - Colorado case study: Upper Thompson Sanitation District (UTSD)
  - Implementation challenges
  - Considerations regarding potential updates to the 1985 Guidelines

Where Are We With the Freshwater Copper BLM?

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25 yr → **5 yr** → **6 yr (and counting)**

Research (1970s – 2001)

- FIAM
- Gill studies
- 1996 Pellston
- "BLMs"

Regulatory BLM Development (2002 – 2007)

- 2002 Ghent Workshop
- 2003 1st EPA draft

National AWQC (2007)

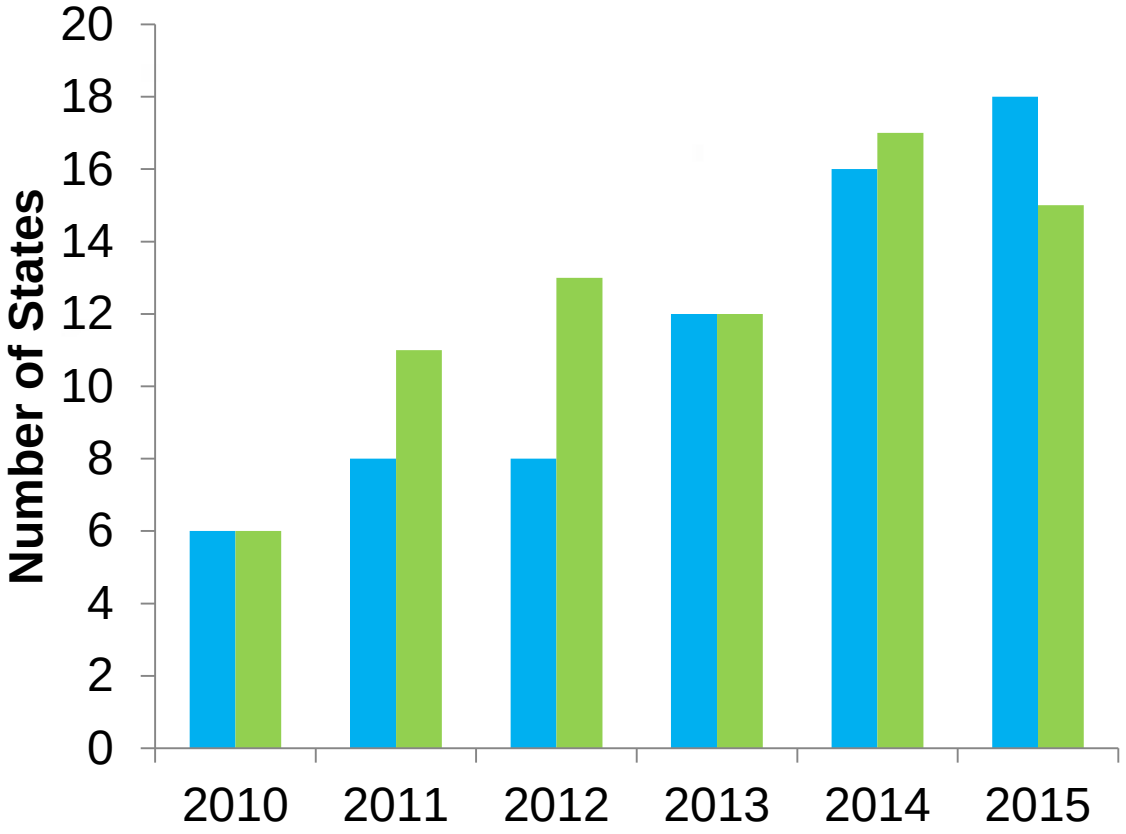
State Application (2008 +)

- Standards
- 303d
- Permits

**** You Are Here***

Next…

U.S. State Implementation



Note: Most as site-specific criteria

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State Implementation Exs.

Delaware: State-wide

Parameter	Fresh Acute Criterion	Fresh Chronic Criterion	Marine Acute Criterion	Marine Chronic Criterion
Copper*	Freshwater criteria calculated using the EPA Biotic Ligand Model	Freshwater criteria calculated using the EPA Biotic Ligand Model	4.8	3.1

Maryland: Site-specific

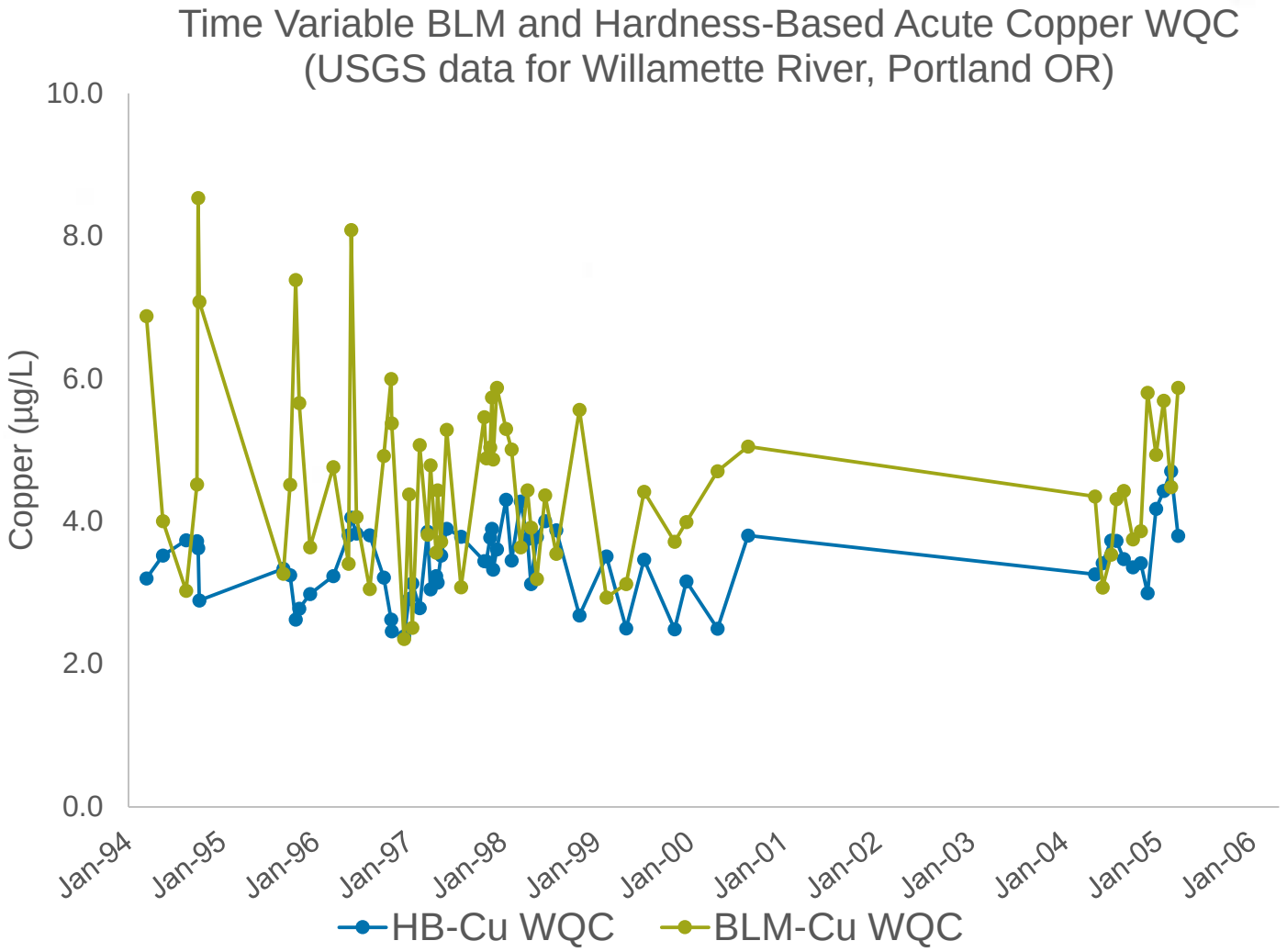
	CAS#	Aquatic Life (µg/L)					
		Fresh Water		Estuarine Water		Salt Water	
		Acute	Chronic	Acute	Chronic	Acute	Chronic
Copper[1]	7440508	13	9	6.1		4.8	3.1

For calculation of site-specific copper criteria, a discharger may use the Biotic Ligand Model in accordance with "Aquatic Life Ambient Freshwater Quality Criteria-Copper 2007 Revision (EPA-822-R-07-001, February 2007)" which is incorporated by reference.

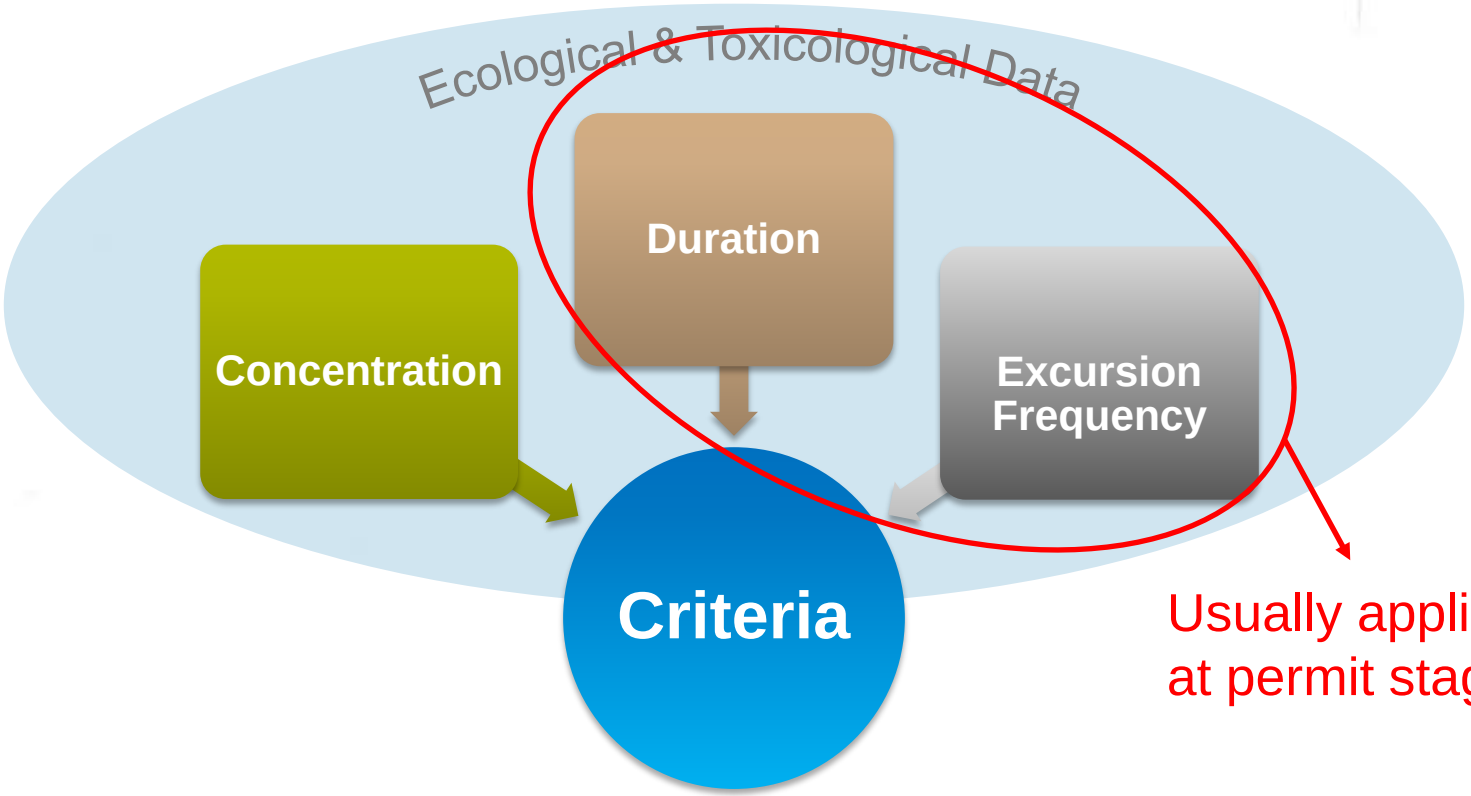
Applying the BLM

- Need to be able to apply BLM to individual sites and not just for deriving site-specific criteria
  - Site-specific criteria often require rulemaking
    - Costs time and money
    - May trigger additional ESA consultation
- *Can we use BLM just like existing hardness-based criteria?*
    - Replace the old model (hardness) with the new model (BLM)

What's the Right Number?



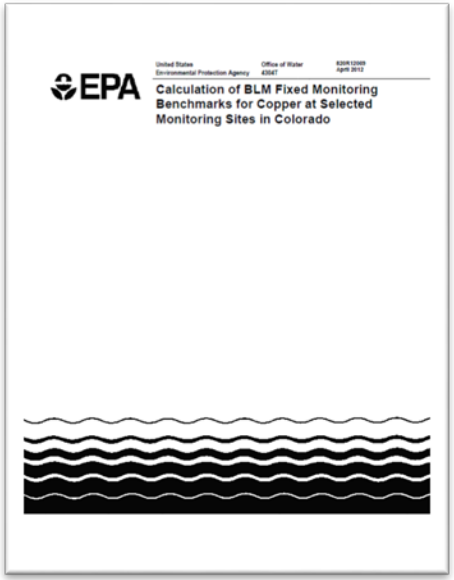
Elements of the Criteria



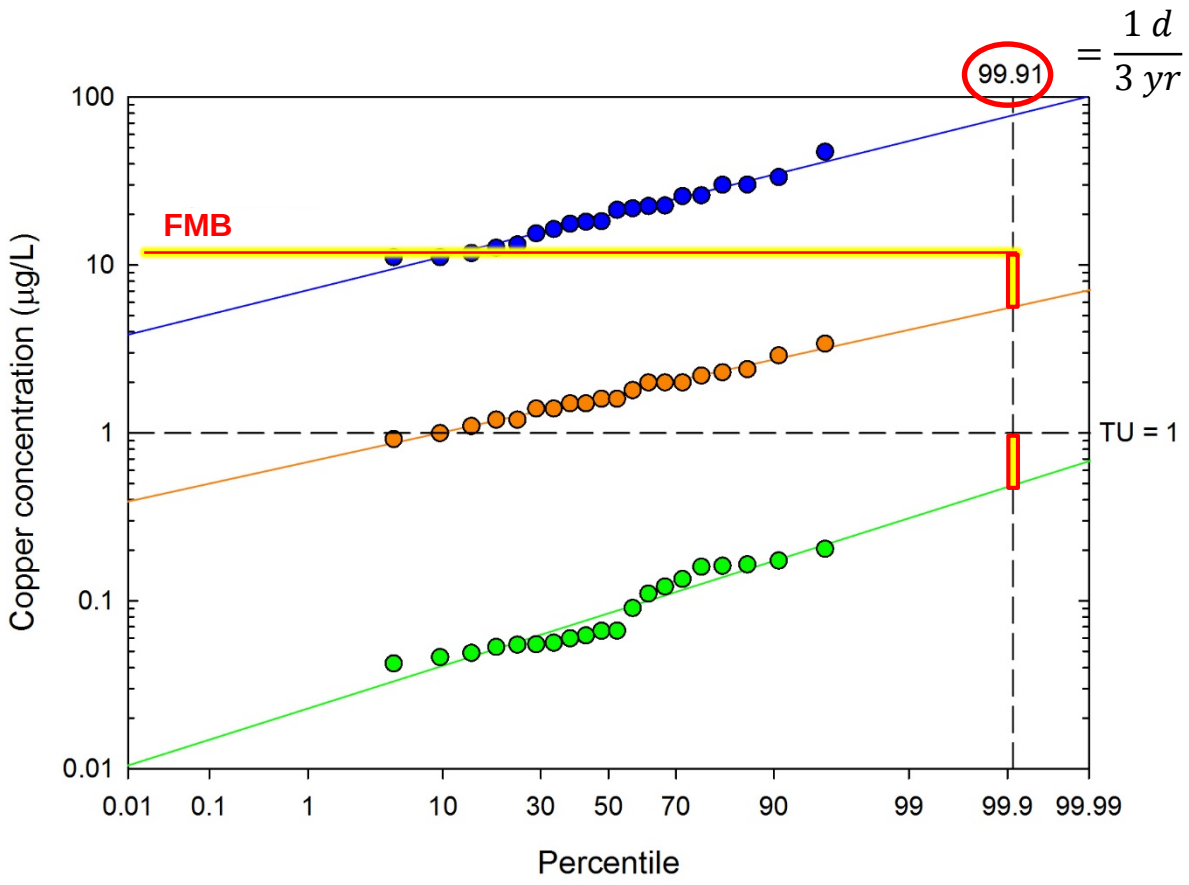
More explicit probabilistic tools exist to incorporate these elements into a single number

Fixed Monitoring Benchmark

- Developed for Colorado in 2008
  - 2012 draft under peer review
- Designed to generate a single number (benchmark/criteria) from water quality data that vary over time



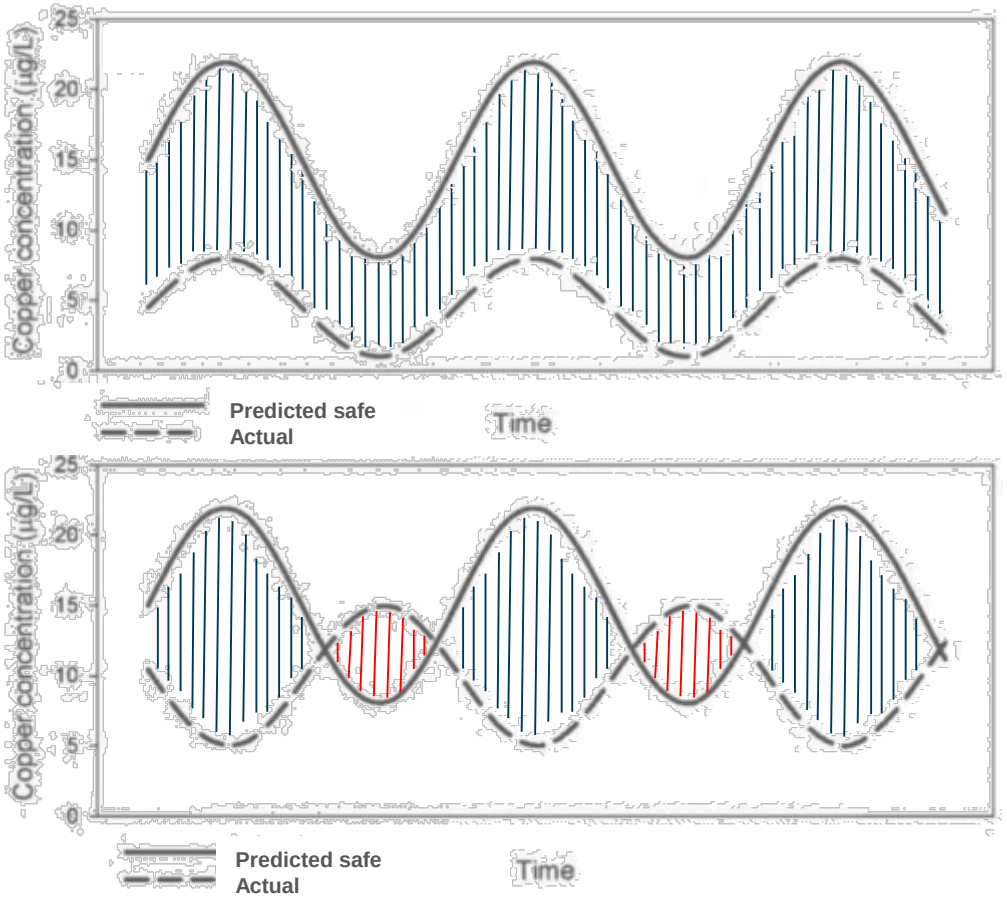
FMB Calculation



Predicted Safe Cu
Actual Cu
Toxic Units

$$TU = Toxic\ Unit = \frac{\text{Actual Cu}}{\text{Predicted Safe Cu}}$$

FMB: Temporal Trends Important



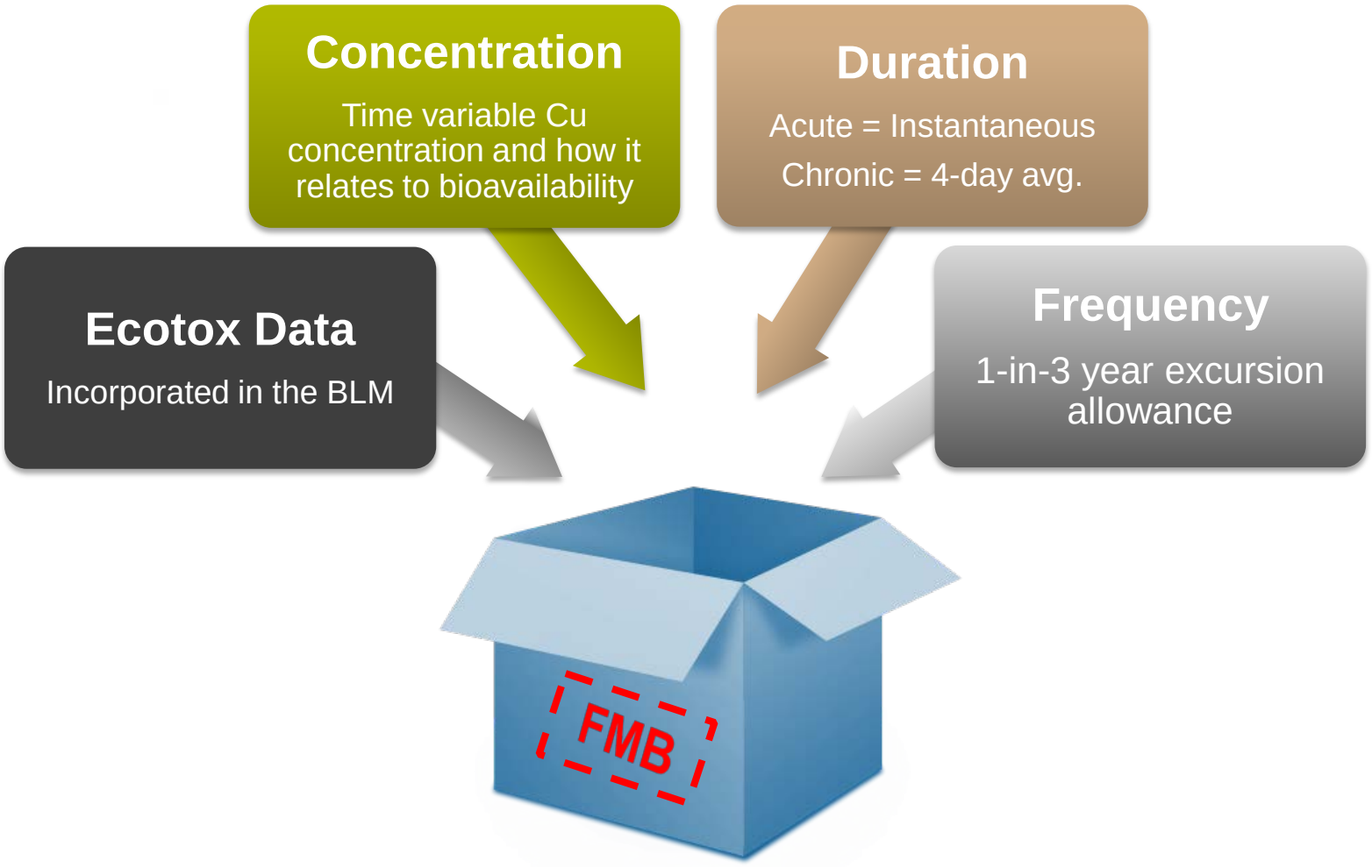
Lower probability of actual copper > predicted safe copper: ↑ **FMB**

Higher probability of actual copper > predicted safe copper: ↓ **FMB**

BLM Application Challenges

- Criteria don't live in a bubble
  - Criteria guidelines and tools need to set the stage for criteria implementation
  - Have to be adopted by states, incorporated into permits
  - Needed for 303(d) assessments
- FMB can assist with this
  - *Is this something that should be incorporated into the national criteria?*

What's Built into the FMB



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FMBs Are Robust

- Incorporates all the major elements of the criteria
- FMB has the flexibility needed for national criteria
- Not an explicit number but rather a method for deriving that number depending on real water quality data from a “site” which vary over time and space

What is a “Site”?

- Criteria are based on data from a “site”
- Does this refer to…
  - A single location (e.g., single outfall)?
  - A water body segment (made of many sampling locations)?
    - SSWQC and 303(d) often done on segments
- Greatly affects how criteria are derived and how the FMB is applied

Upper Thompson Sanitation District

- Wastewater utility in Estes Park, CO
- Facing a compliance schedule based on the hardness-based standard
- Initiated an investigation into whether the BLM and FMB could resolve this issue
  - 7 sampling locations
  - ~ 10 years of data

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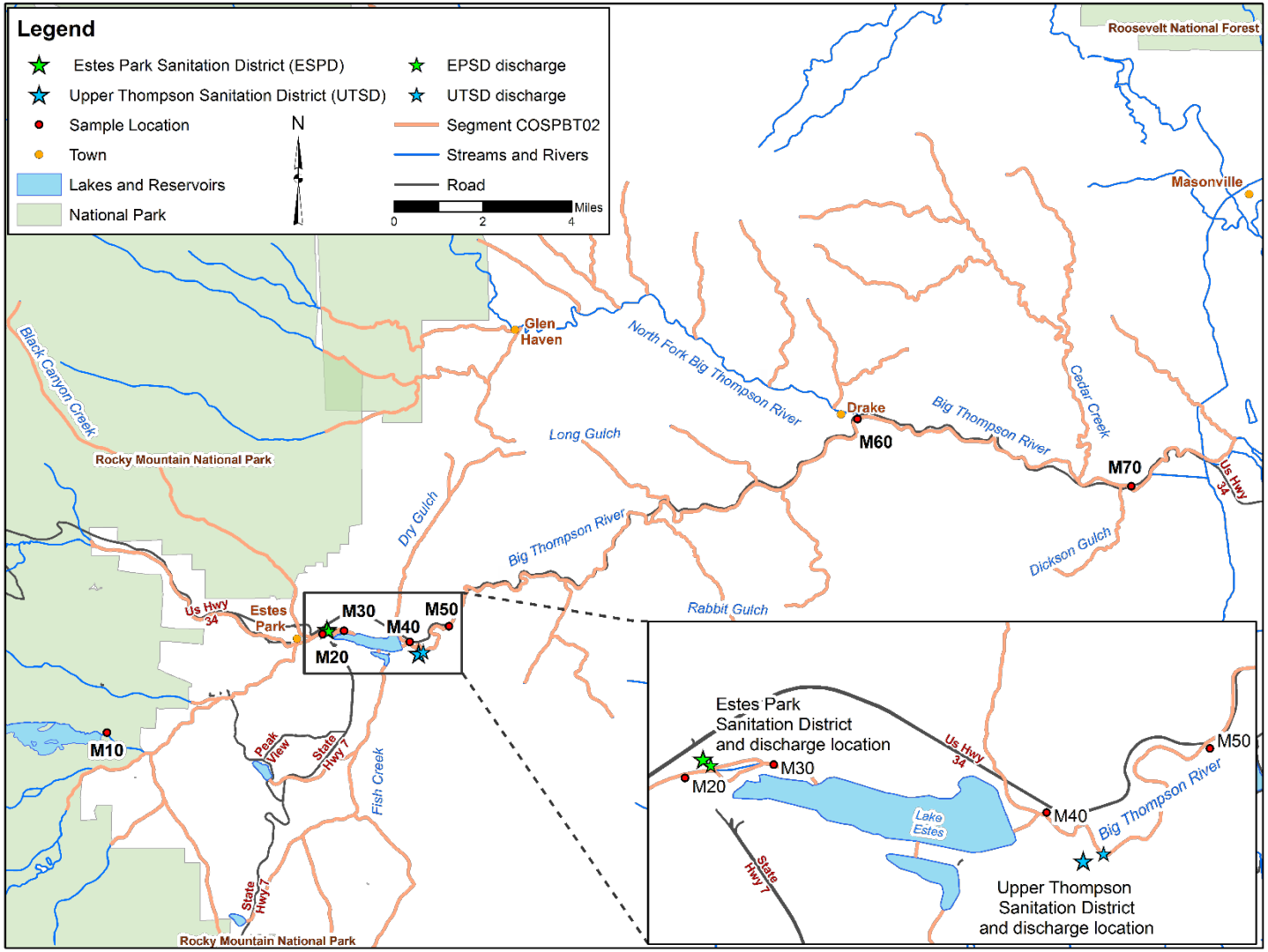

Site	Dates	n
M10	01/08 - 05/14	70
M20	01/04 - 11/13	113
M30	01/04 - 11/13	116
M40	01/04 - 11/13	115
M50	01/04 - 11/13	115
M60	01/04 - 11/13	115
M70	01/04 - 09/13	112

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Criteria Calculations

Individual Sites				Acute (µg Cu/L)		Chronic (µg Cu/L)	
Location	**n**	**Dates**	**% Cu Detected**	**FMBa**	**Hardness-based**	**FMBc**	**Hardness-based**
M10	70	01/08 - 05/14	97	3.0	1.3	2.1	1
M20	113	01/04 - 11/13	98	5.4	2.0	3.6	1.6
M30	116	01/04 - 11/13	97	6.1	2.2	4.1	1.7
M40	115	01/04 - 11/13	98	11.1	2.8	7.2	2.1
M50	115	01/04 - 11/13	99	12.7	2.9	8.4	2.2
M60	115	01/04 - 11/13	98	16.6	3.1	10.8	2.4
M70	112	01/04 - 09/13	99	14.0	2.9	9.1	2.2

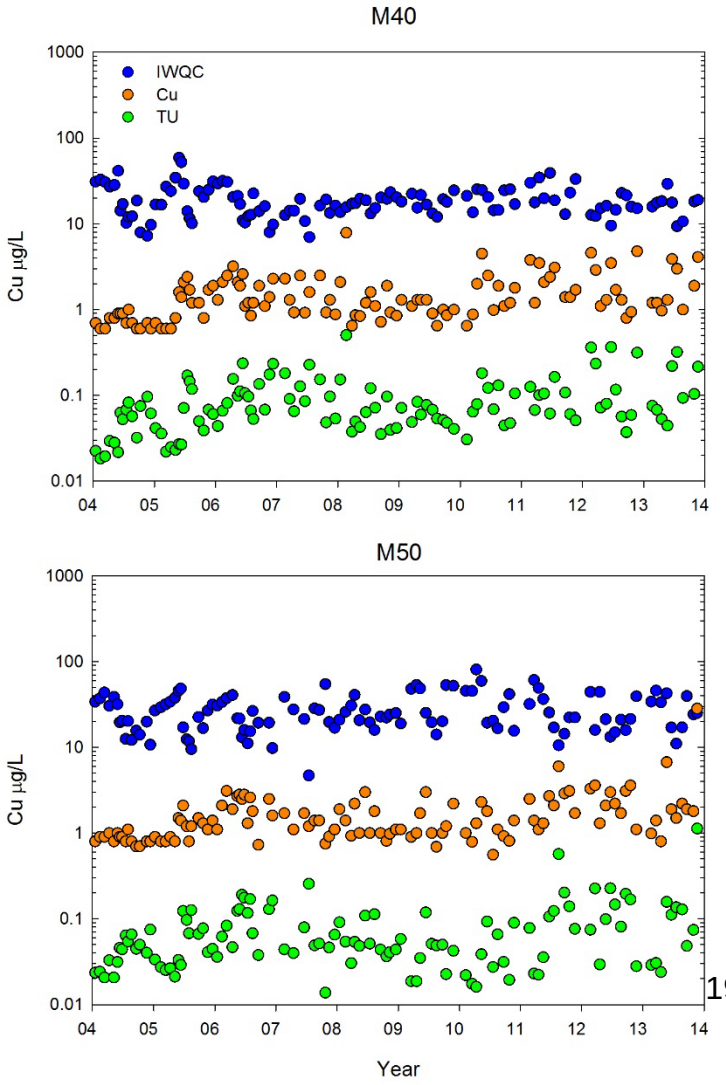
Sites upgradient of UTSD discharge indicated with shading

Sites upgradient of Lake Estes indicated in bold

Site Grouping				Acute (µg Cu/L)		Chronic (µg Cu/L)	
Location	**n**	**Dates**	**% Cu Detected**	**FMBa**	**Hardness-based**	**FMBc**	**Hardness-based**
Downstream of lake	457	01/04 - 11/13	99	12.7	2.9	8.3	2.3

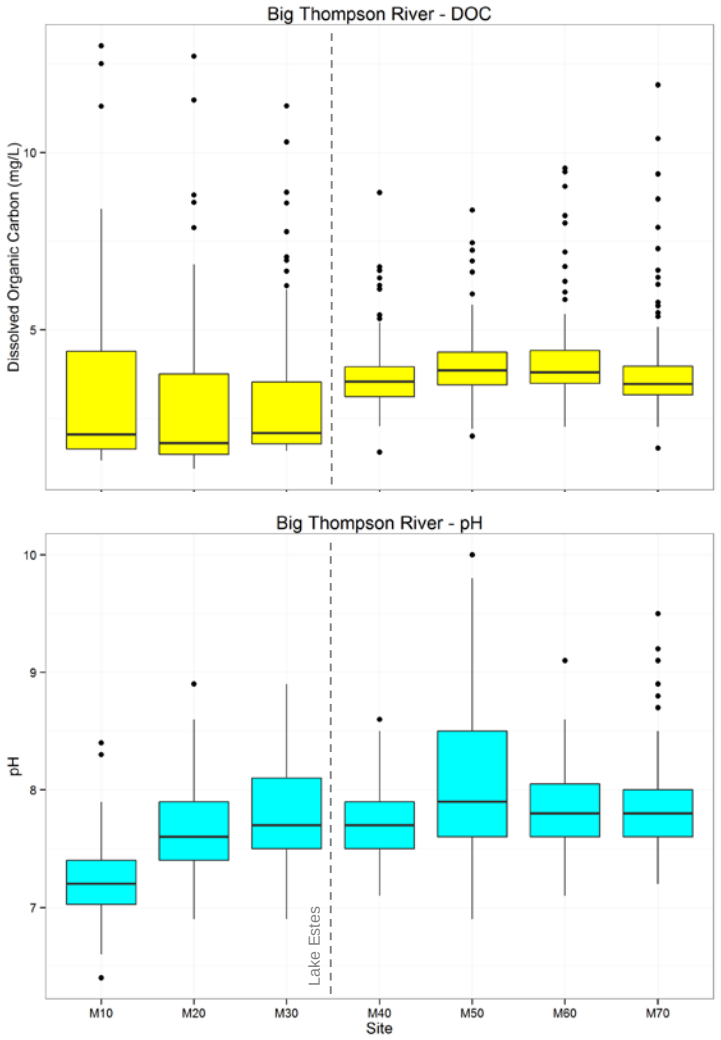
Temporal Variability

- Similar temporal trends in instantaneous water quality criteria (IWQC) above and below UTSD discharge
  - *Should upgradient data be included in the derivation of the standard used for a discharger?*



Spatial Variability

- Important to evaluate how parameters vary between sites to explain differences in IWQC
  - Particularly for sensitive parameters (e.g., DOC, pH)
  - *Caution:* differences in a single parameter between sites does not necessarily mean that the sites as a whole are different



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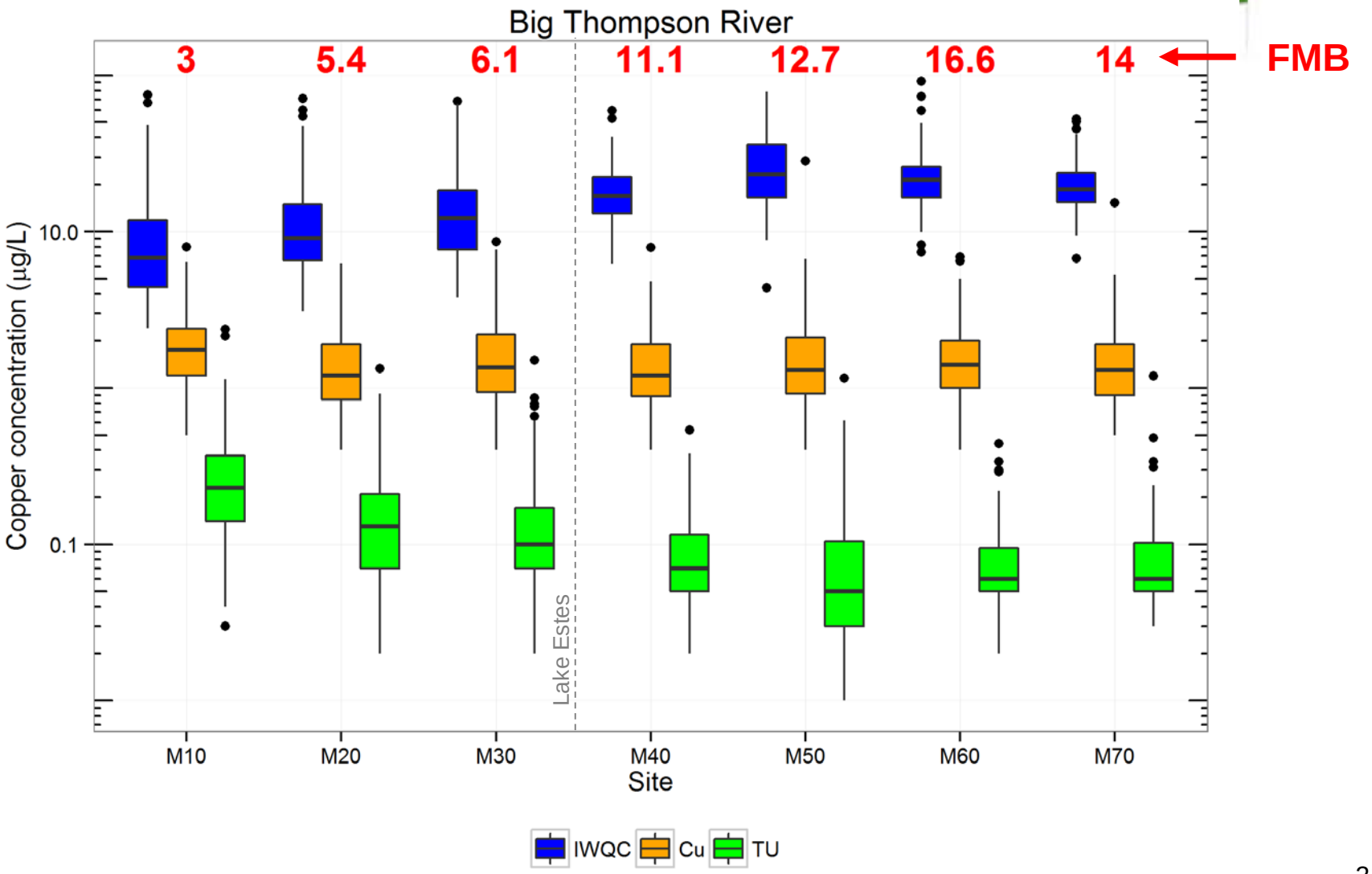
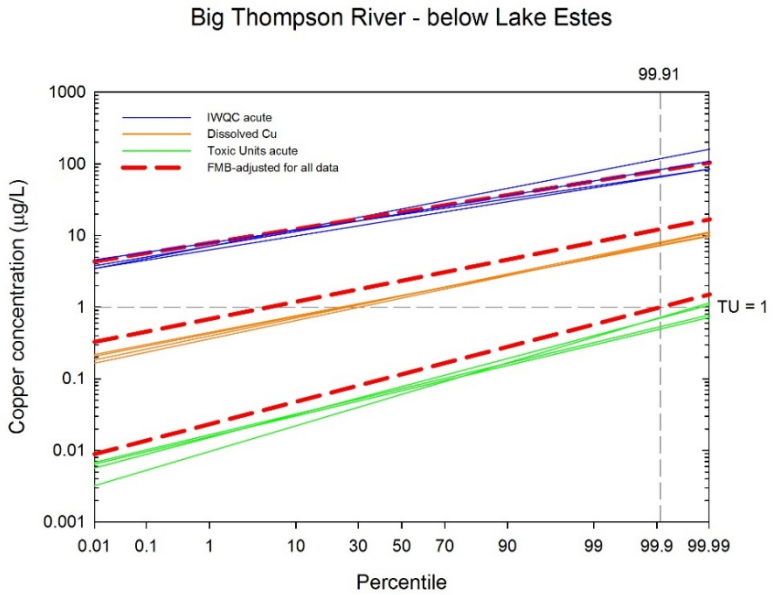


How Was the FMB Implemented?

- GEI recommended combining data *downstream of the lake* to derive an FMB
  - Agencies not yet comfortable with this concept
  - Compromised instead by using the lowest FMB from a single site *downstream of discharge*



Combining Data

- How do we evaluate a dataset to determine whether data should be combined?
- Are FMBs derived using combined data protective of aquatic life at each individual site?
- Does each site matter since waters are regulated on coarse spatial scales (e.g., “segments”)?

FMB and BLM – Next Steps

- FMB isn't BLM-specific, just a probabilistic tool for any criterion derived on basis of WQ
- But for use with the Cu BLM, need additional guidance on:
  - Minimum data collection/ data requirements etc…
  - Do's and Don'ts for using the FMB
  - *Is the FMB really a "not to exceed" number?*
    - Can it be used as a criterion?
      - » Colorado using for SSWQC, Oregon considering
    - And what might this mean for standards, permits, and 303d assessment?

Updates to 1985 Guidance

- Need explicit and consistent process on how to select a single regulatory number from variable water quality data
  - Probabilistic methods, such as the FMB, are powerful tools for resolving variability issues
  - Additional guidance for its use with the BLM would be helpful
- Lots of confusion; wide range of solutions being considered
  - Is this desirable or appropriate?
- Many states waiting on issues with copper to be resolved before pursuing BLMs for other metals

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Questions?

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