New Hampshire’s Approach to the 2018 304(a) Aluminum Guidance

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Albuquerque, New Mexico

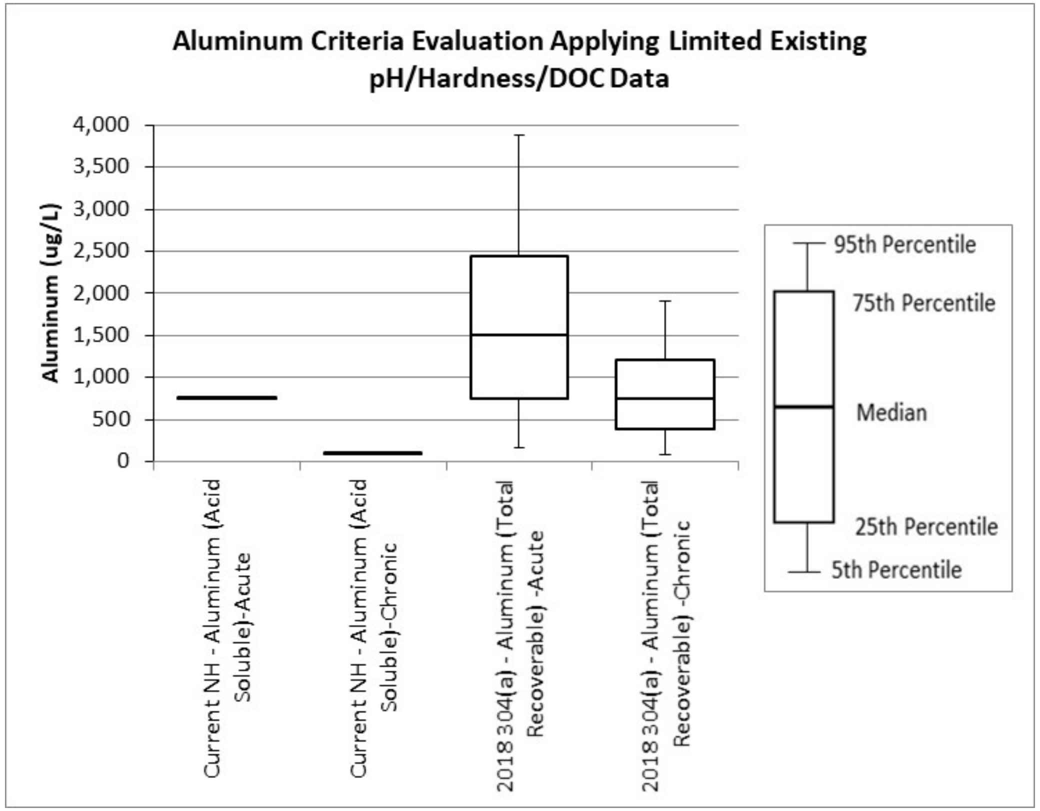
NHDES

Aluminum

- What did we think the 2018 aluminum criteria values might look like.
- What we found the 2018 aluminum criteria values might look like.
- How New Hampshire interrogated our aluminum MLR input variables.
- Where we are headed for NPDES implementation.

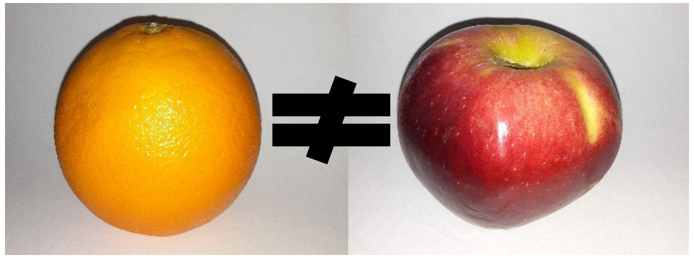
Comparability based on limited data?

(From Jan 14, 2021 Meeting)



Existing New Hampshire Env-Wq 1700 Criteria

Acid Soluble

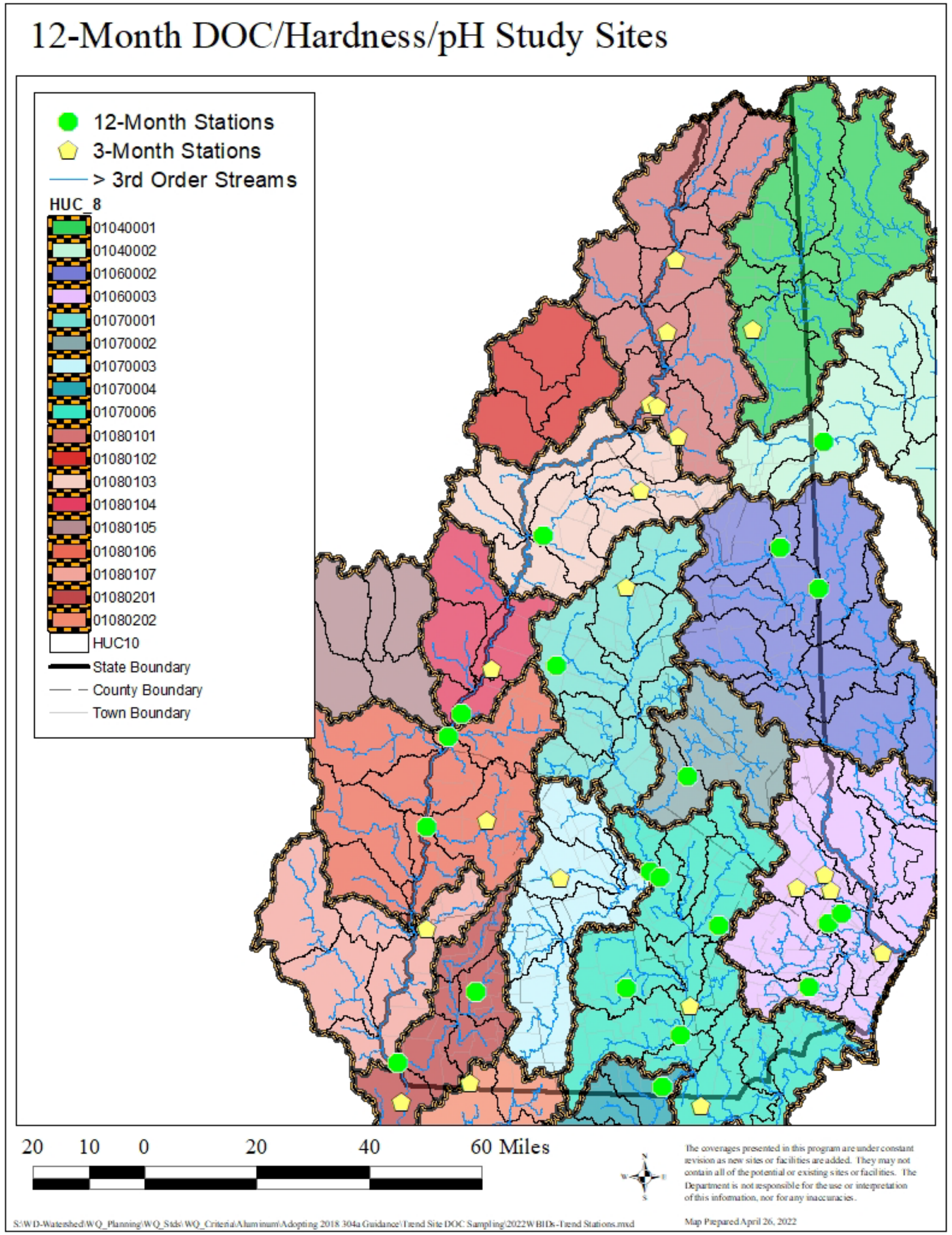


2018 304(a) Recommendations

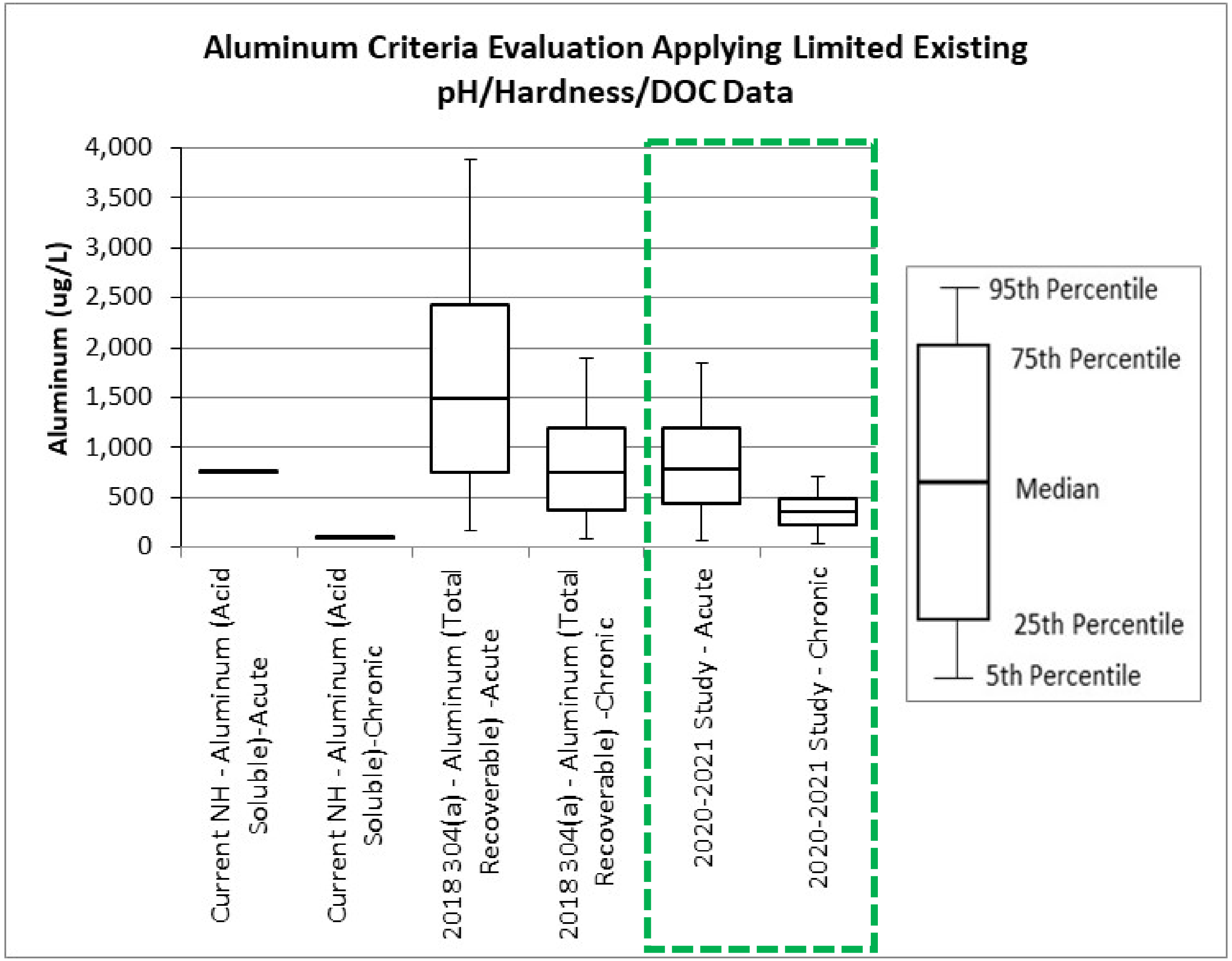
Total Recoverable Aluminum

Nov-2020 to Oct-2021

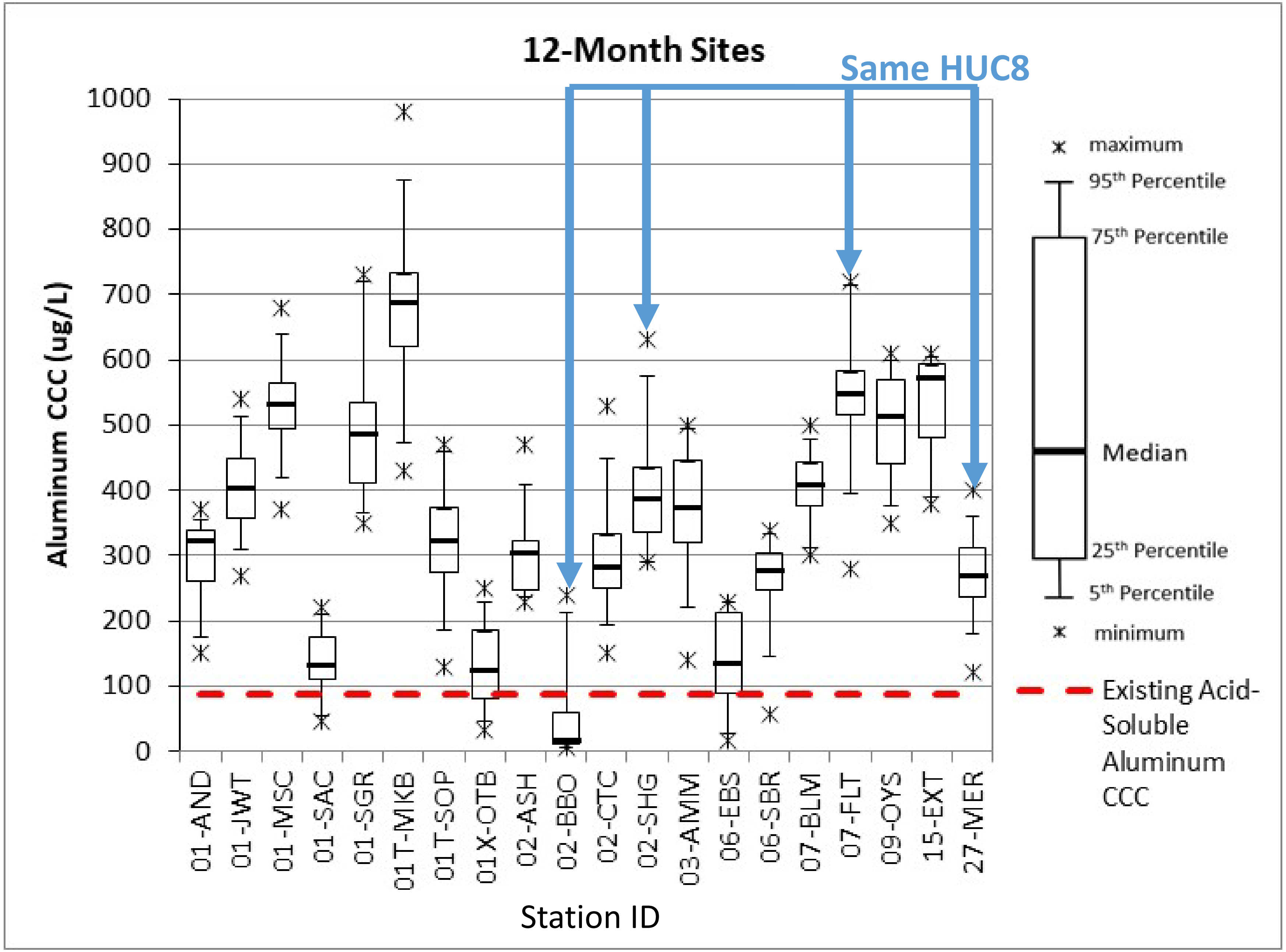
- Dissolved Organic Carbon
- Hardness
- pH
- Total Aluminum
- Color
- Specific Conductance
- Chloride
- Turbidity
- Temperature
- Dissolved Oxygen



Adding the 2020-2021 Study data



- Similar, but overall lower criteria predicted for the trend monitoring network sites.
- More representative of state flowing water diversity.



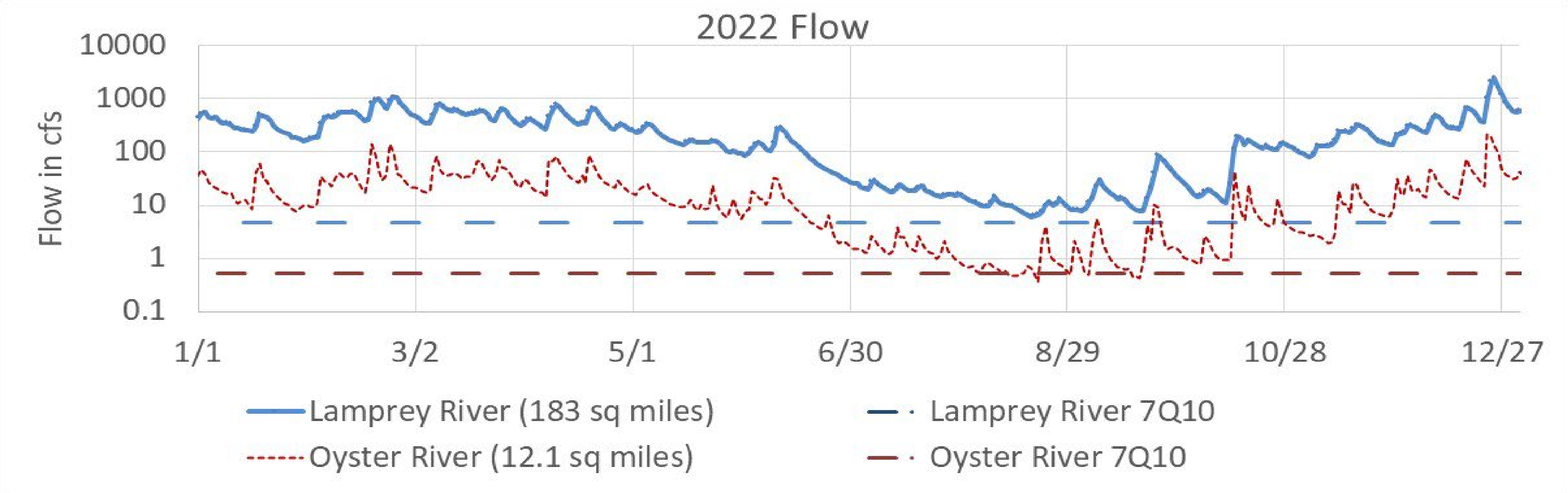
- CCC = criterion continuous concentration = chronic criterion.
- Large variability within and between stations.
- Some stations see extremely low criterion at times.
- High within HUC8 variability.

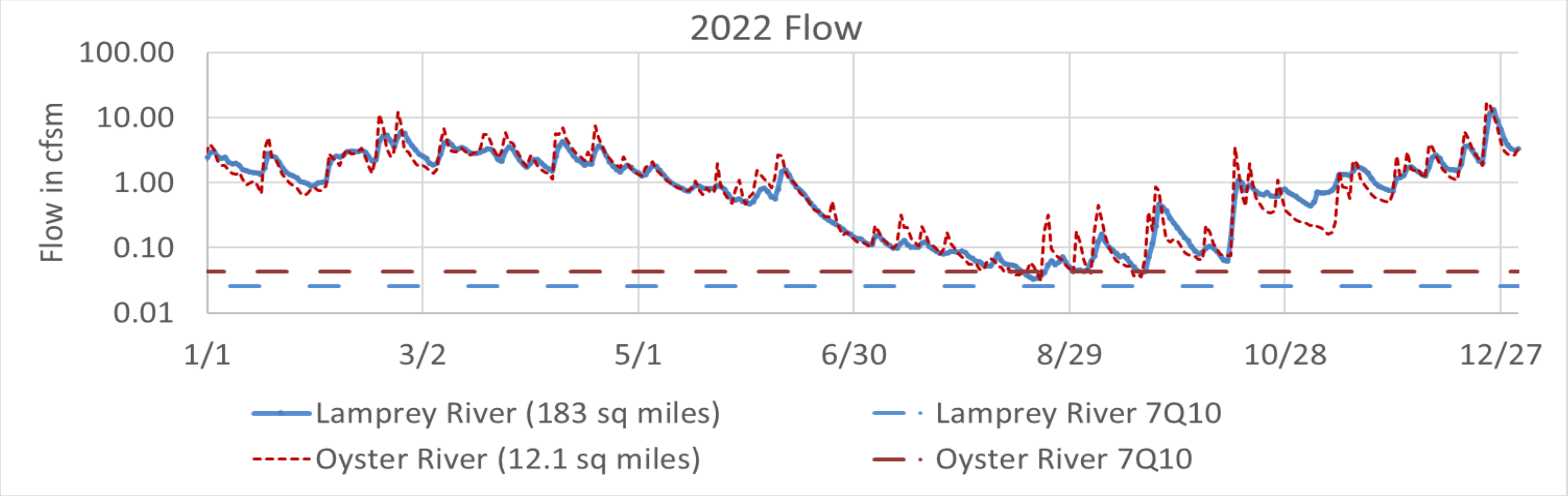
Data dive for 2018 Aluminum 304(a) criteria patterns

Cubic feet per second

-verses-

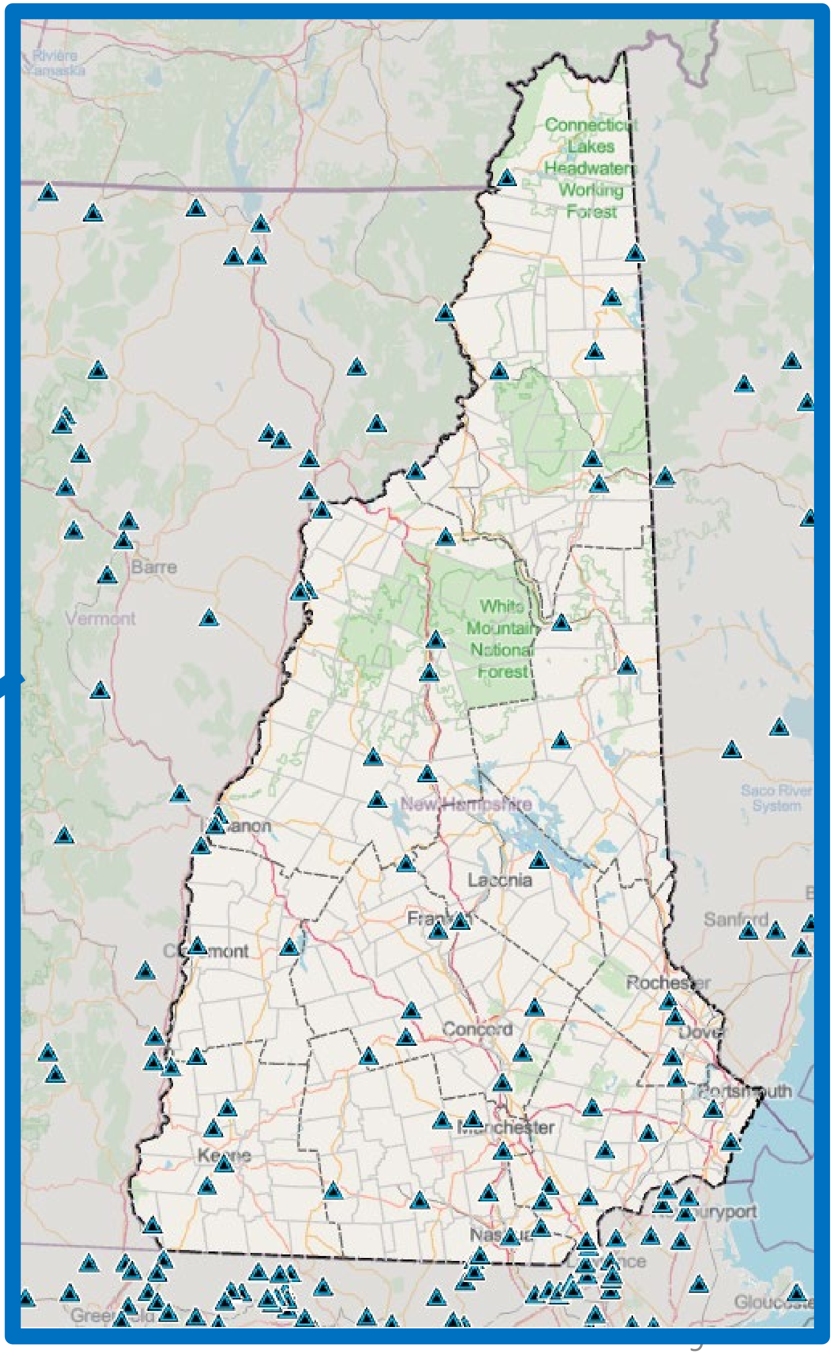
Cubic feet per second per square miles



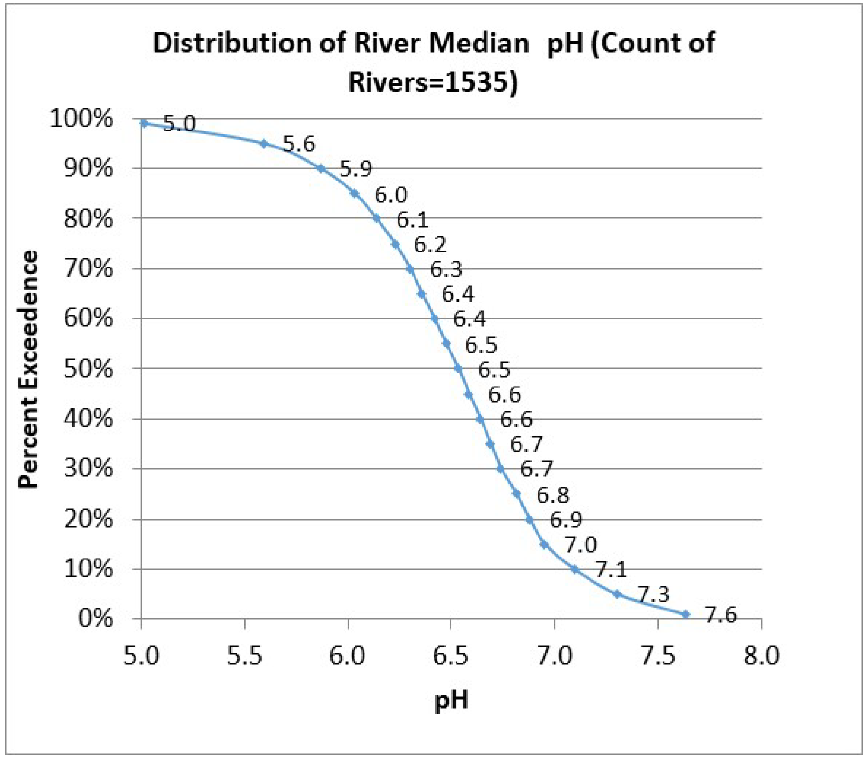


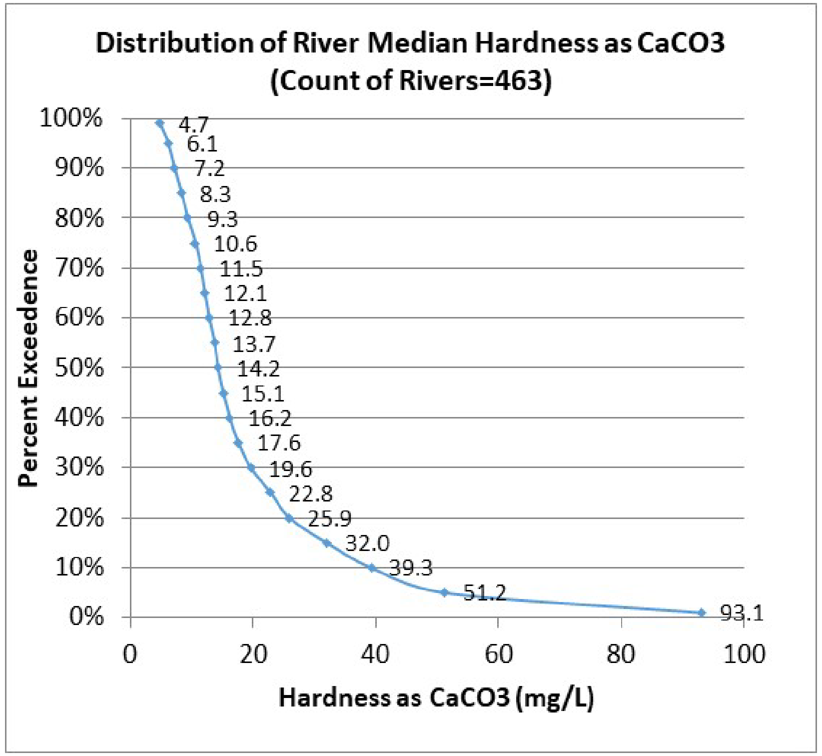
On the majority of days, the cfsm values from the two locations are interchangeable.

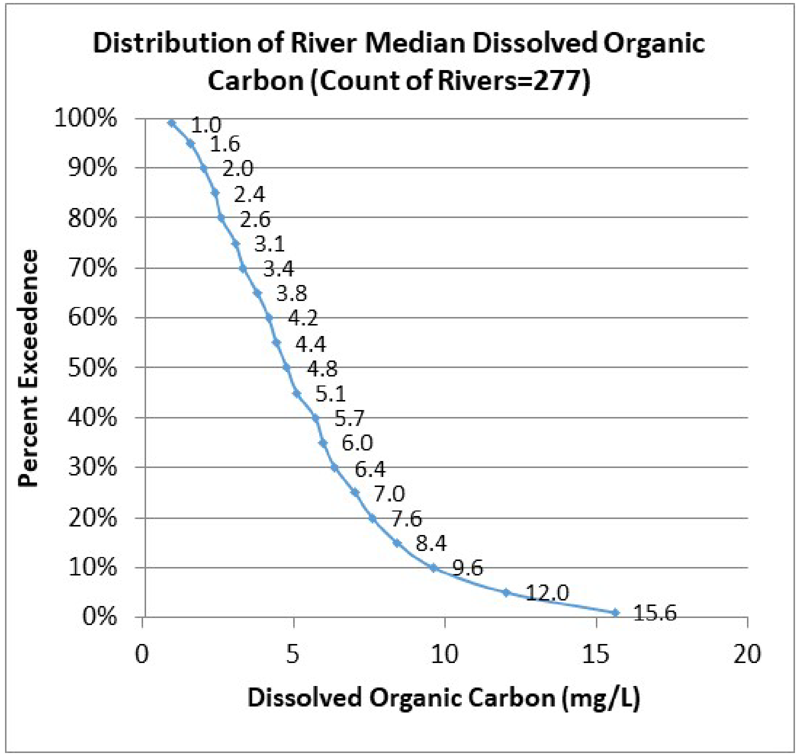
Relationship between every sampling station and the most representative USGS gage



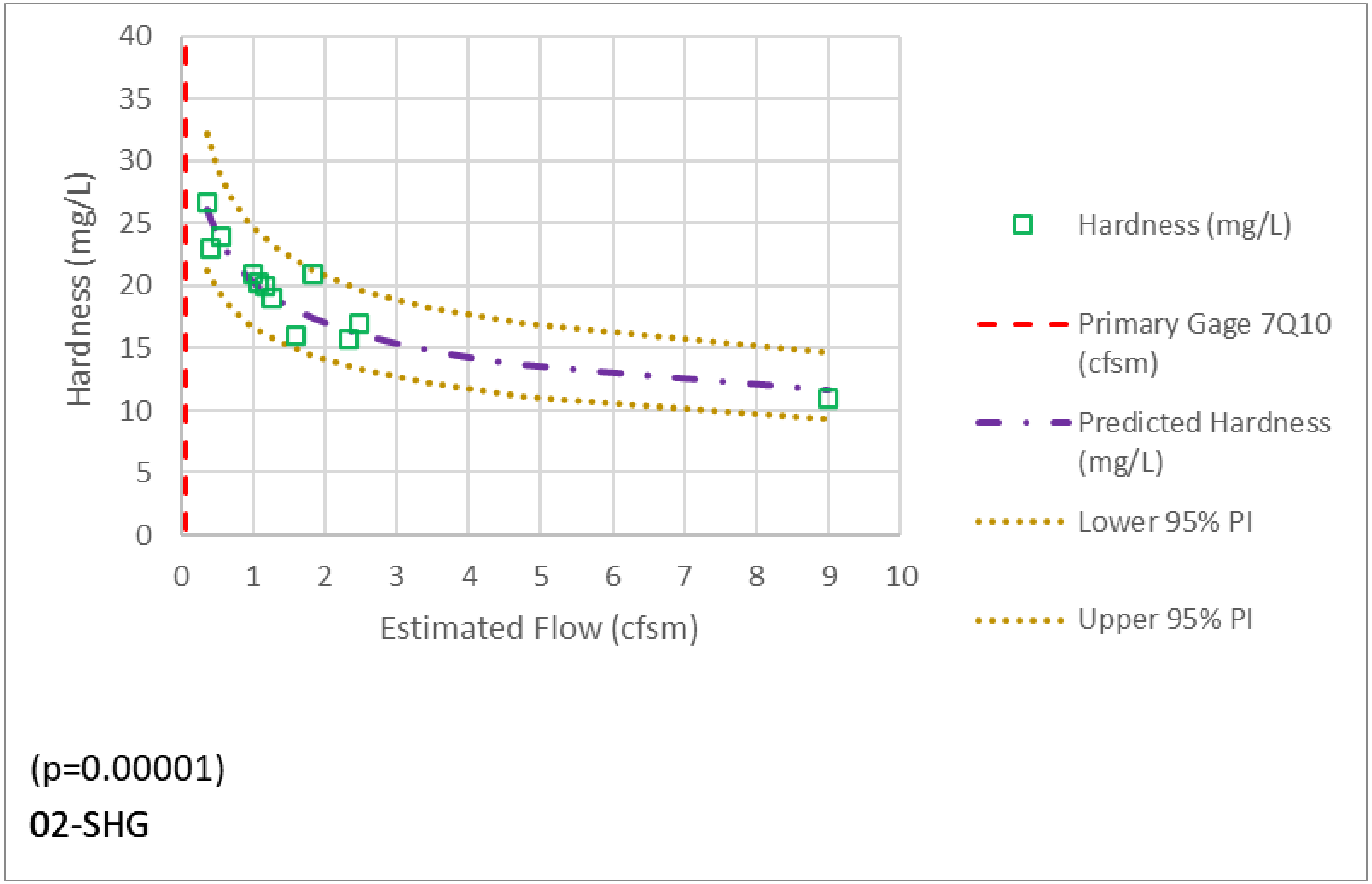
Distributions of pH, hardness, DOC







Hardness – vs – Flow
Souhegan River Example from 12-Month study



- Hardness is strongly predicted by flow.
- Hardness is highest at low flows.

Ratio of Sampled Concentration to Station Median – Site Example: 27-MER, hardness

Month-Year	Hardness (mg/L)
Nov-20	14
Dec-20	11
Jan-21	12
Feb-21	15
Mar-21	12
Apr-21	8.8
May-21	10.6
Jun-21	16.1
Jul-21	11
Aug-21	13
Sep-21	14
Oct-21	12.6

Hardness median across dates = 12.3 mg/L

Month-Year	Station Sample:Station Median [Hardness Ratio]
Nov-20	1.14
Dec-20	0.89
Jan-21	0.98
Feb-21	1.22
Mar-21	0.98
Apr-21	0.72
May-21	0.86
Jun-21	1.31
Jul-21	0.89
Aug-21	1.06
Sep-21	1.14
Oct-21	1.02

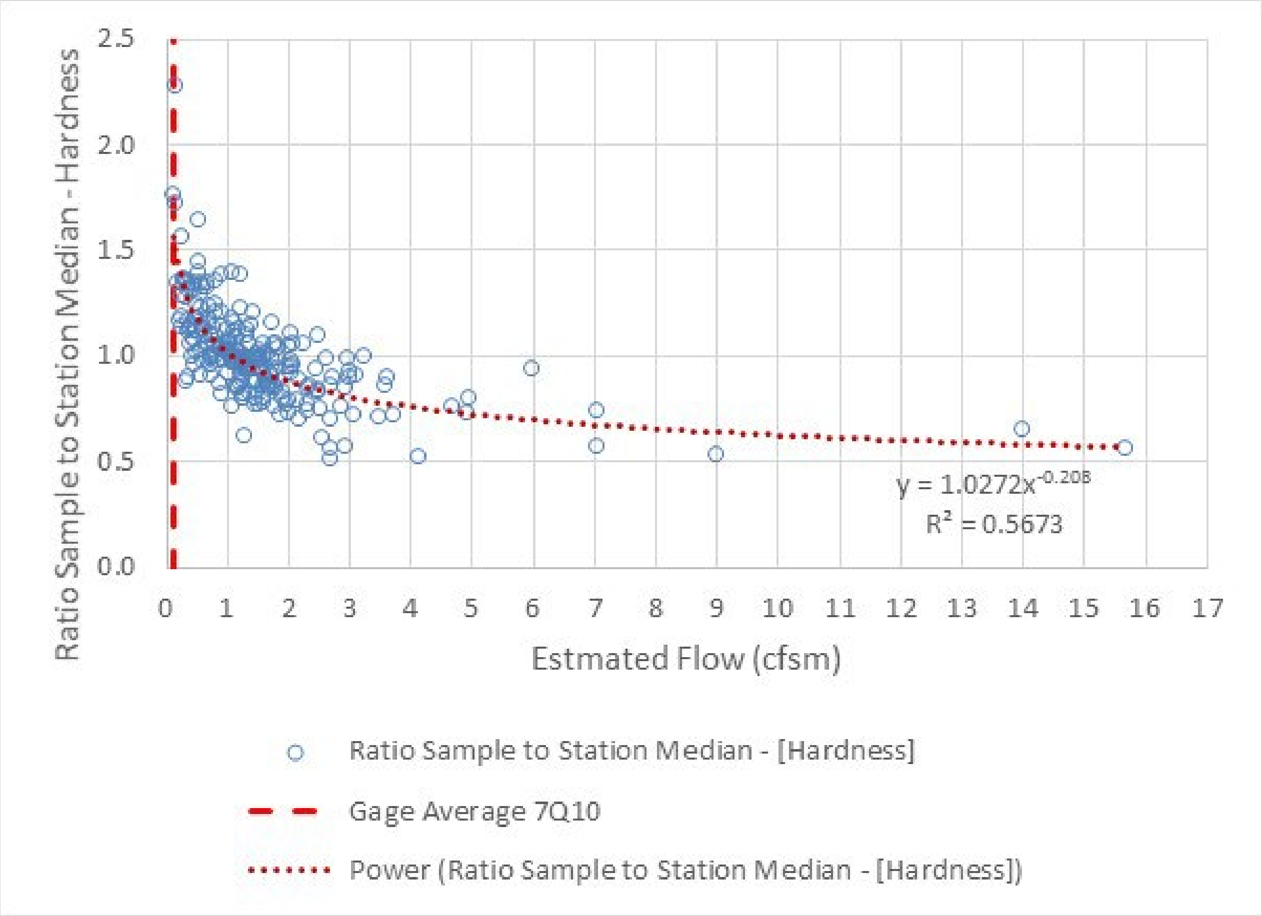
>1 → Sample is over the site median

=1 → Sample equals site median

<1 → Sample is below site median

Hardness – vs – Flow
Based on the 12-Month Sites

- 20 of 20, Hardness increases with decreasing flow
  - 17 of 20, significant at p<0.05
  - 2 of 20, p>0.5 & <0.10
  - 1 of 20, p>0.10



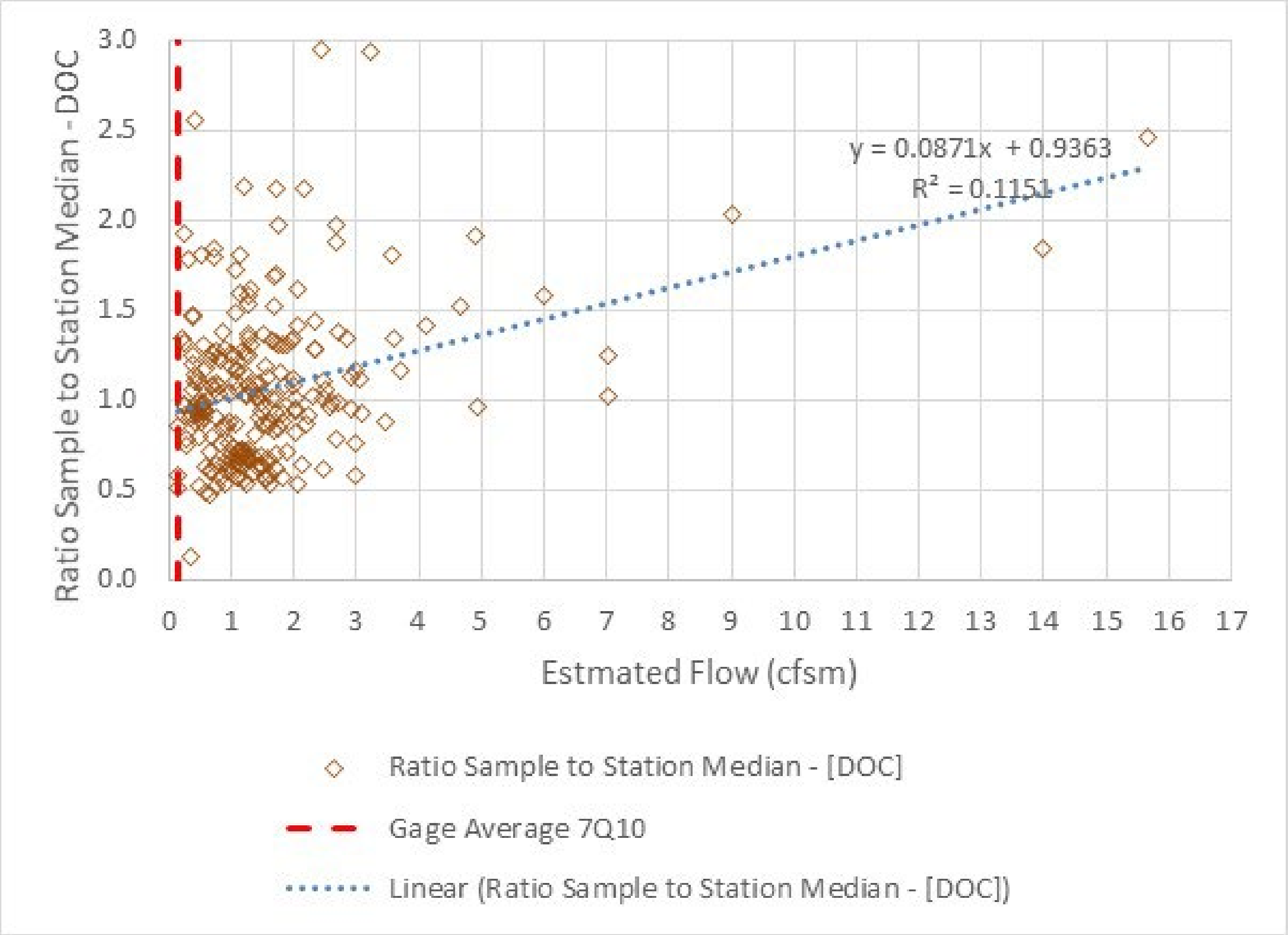
Hardness – vs – Flow
Statewide Relationships?

- Start with the 514 river stations that have hardness data
  - 95 Stations where;
    - Sampled at flow < 1 cfsm
    - Sampled at flow range > 2cfsm
    - At least 5 samples (median n = 13)
- 67 significant relationships ($p<0.05$):
  - 67 Hardness increases with decreasing flow
  - 0 Hardness decreases with decreasing flow
- 28 insignificant relationships:
  - 24 Hardness increases with decreasing flow
  - 4 Hardness decreases with decreasing flow

Based on hardness patterns - MLR based aluminum criteria will be highest at low flows.

DOC – vs – Flow
Based on the 12-Month Sites

- 2 of 20, DOC increases with decreasing flow
  - 2, $p>0.30$
- 18 of 20, DOC decreases with decreasing flow
  - 1, $p<0.05$
  - 17, $p>0.15$

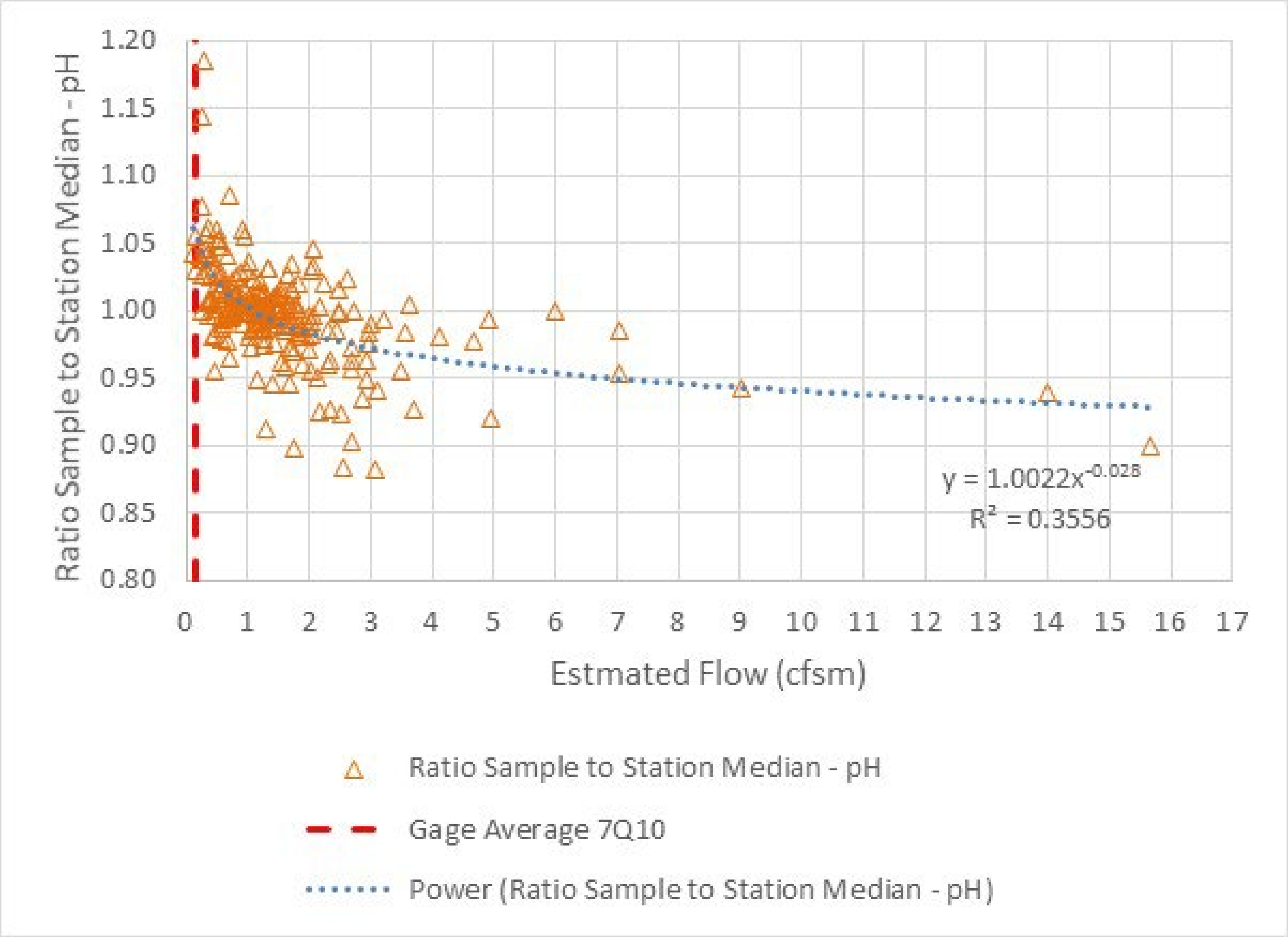


DOC – vs – Flow
Statewide Relationships?

- ??? – Not enough data to explore.

pH – vs – Flow
Based on the 12-Month Sites

- 19 of 20, pH increases with decreasing flow
    - 15, significant at $p<0.05$
    - 4, $p>0.10$
- 1 of 20, pH decreases with decreasing flow
    - 1, $p>0.30$



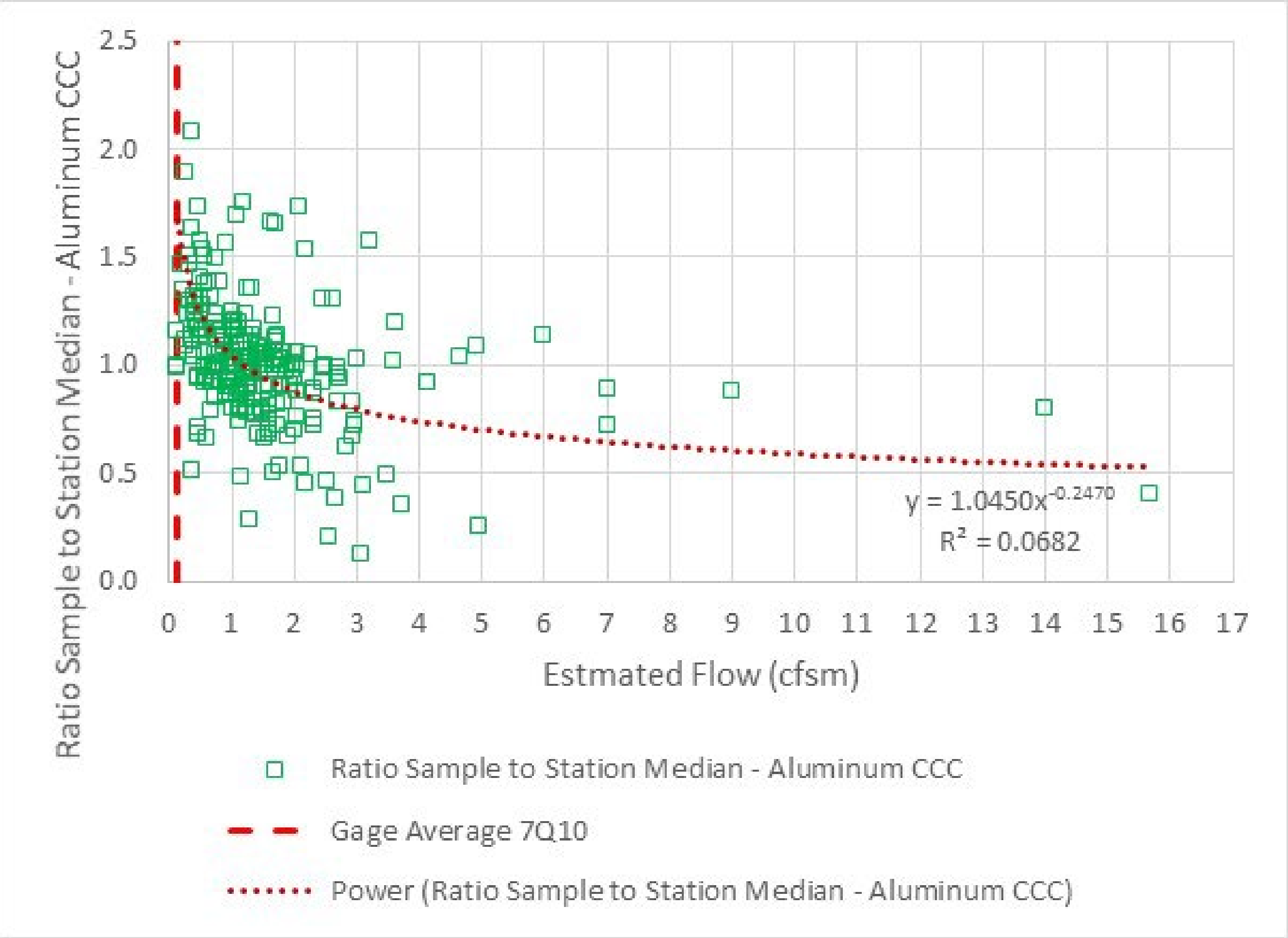
pH – vs – Flow
Statewide Relationships?

- Start with the 2446 river stations that have pH data.
  - 880 stations where;
    - Sampled at flow < 1 cfsm
    - Sampled at flow range > 2cfsm
    - At least 20 samples (median n = 49)
- 544 significant relationships (p<0.05):
  - 525 pH increases with decreasing flow
  - 19 pH decreases with decreasing flow
- 336 insignificant relationships:
  - 244 pH increases with decreasing flow
  - 92 pH decreases with decreasing flow

Based on pH patterns - MLR based aluminum criteria will be highest at low flows.

2018 Aluminum 304(a) – vs – Flow Based on the 12-Month Sites

- 19 of 20, Aluminum CCC increases with decreasing flow
  - 8, significant at p<0.05
  - 4, p>0.5 & <0.10
  - 7, p>0.10
- 1 of 20, Aluminum CCC decreases with decreasing flow
  - 1, p>0.25



2018 Aluminum 304(a) criteria patterns.

- Large spatial variability.
- At times, a larger temporal variability at a given site.
- In our datasets, the new criteria are inversely related to flow. That is, aluminum is predicted to be more toxic as flows increase.
- There is generally the lowest toxicity during the warmest, most biologically active, lowest flow periods.

Bottom line - MLR based aluminum criteria will be highest at low flows.

Draft Env-Wq 1700 Aluminum Criteria

CAS Number	Chemical Name	Protection of Aquatic Life Concentration in micrograms per liter (µg/~~l~~L)[v]				Protection of Human Health Units per Liter	
		Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water & Fish Ingestion	Fish Consumption Only
7429-90-5	Aluminum	750 [s]	87 [s]	--	--	--	--

(s) The letter "s" shall indicate that ~~this value is expressed as acid-soluble aluminum~~ ***there are two methods to evaluate the aluminum criteria and*** ~~t~~***the appropriate method shall be determined as follows:***

(1) The values in Table 1703-1 are expressed as acid-soluble-aluminum and shall be used subject to (2) below.

(2) Where waterbody specific pH, dissolved organic carbon and hardness are available, sample specific total aluminum criteria shall be determined using the procedures described in the EPA publication "Final Aquatic Life Ambient Water Quality Criteria for Aluminum", EPA-822-R-18-001, dated December 2018, available as noted in Appendix B, provided that for aluminum, either of the following references may be used to calculate the site-specific criteria:

a. The "Aluminum Criteria Calculator V2.0 (Excel)(xlsm)", dated December 2018; or

b. The "Aluminum Criteria Calculator R Code and Data V2.0(R)", dated November 15, 2019.

NPDES Implementation

Water Quality Data Requirements

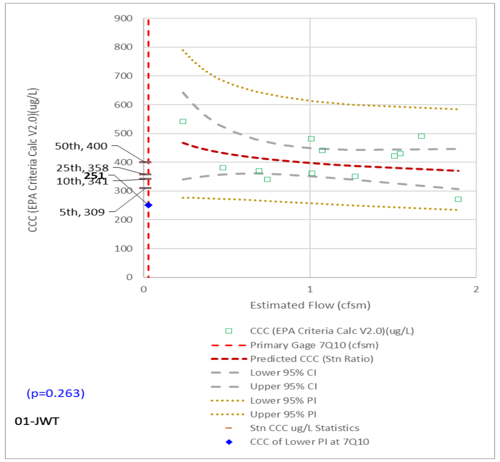
- NPDES permit reasonable potential analysis needs to be based on site level data.
- Five years of quarterly sampling of DOC *(TOC),* pH, hardness, and total aluminum.
  - 20 samples would be a complete dataset. 17 samples would be adequately representative (85%).
- Alternatively,
  - Monthly sampling for 2-years (n=24, 21 samples would be adequately representative (85%))
  - Bi-monthly sampling for one year (n=24, 21 samples would be adequately representative (85%))
  - ….other
- Collections are to be distributed over the year and flow range.

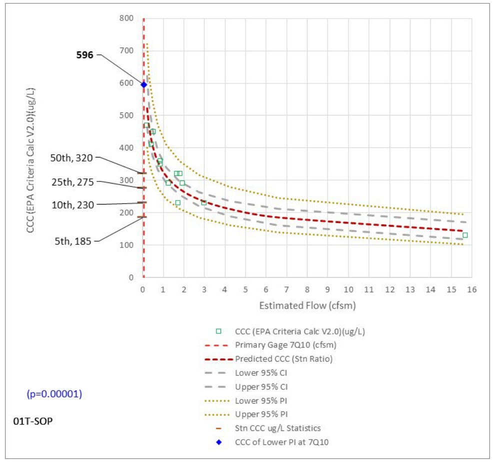
NPDES Implementation (cont.)

Calculations

1. Determine if **threatened or endangered species** are present, or habitat has been declared.
2. Calculate the **aluminum instantaneous criteria values (ICVs).**
3. Perform a power regression of flow (cfsm) verses aluminum CCC and determine the **95th percentile lower prediction interval**.
4. Calculate the **7Q10** for the representative gage(s) or the more site representative synthetic hydrograph depending upon the method used to generate the flow data for the power regression.
5. Calculate the **5th, 10th and 50th percentile CCC from the ICVs** for the site data (CCC-5, CCC-10, CCC-50).
6. Calculate the **CCC of the 95th percentile lower prediction interval at 7Q10** (CCC-L95-PI).

NPDES Implementation (cont.)



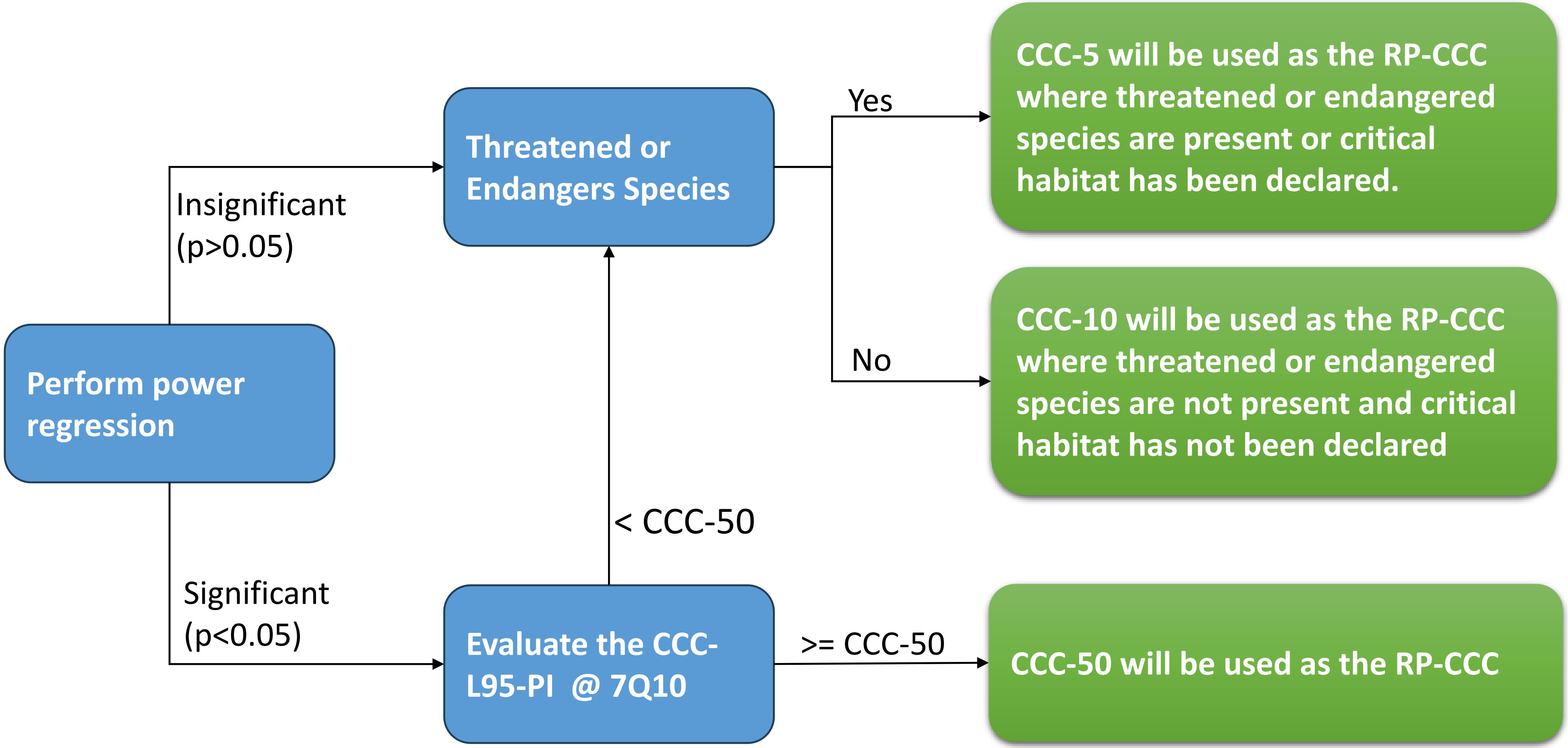


Application of the Analysis Output

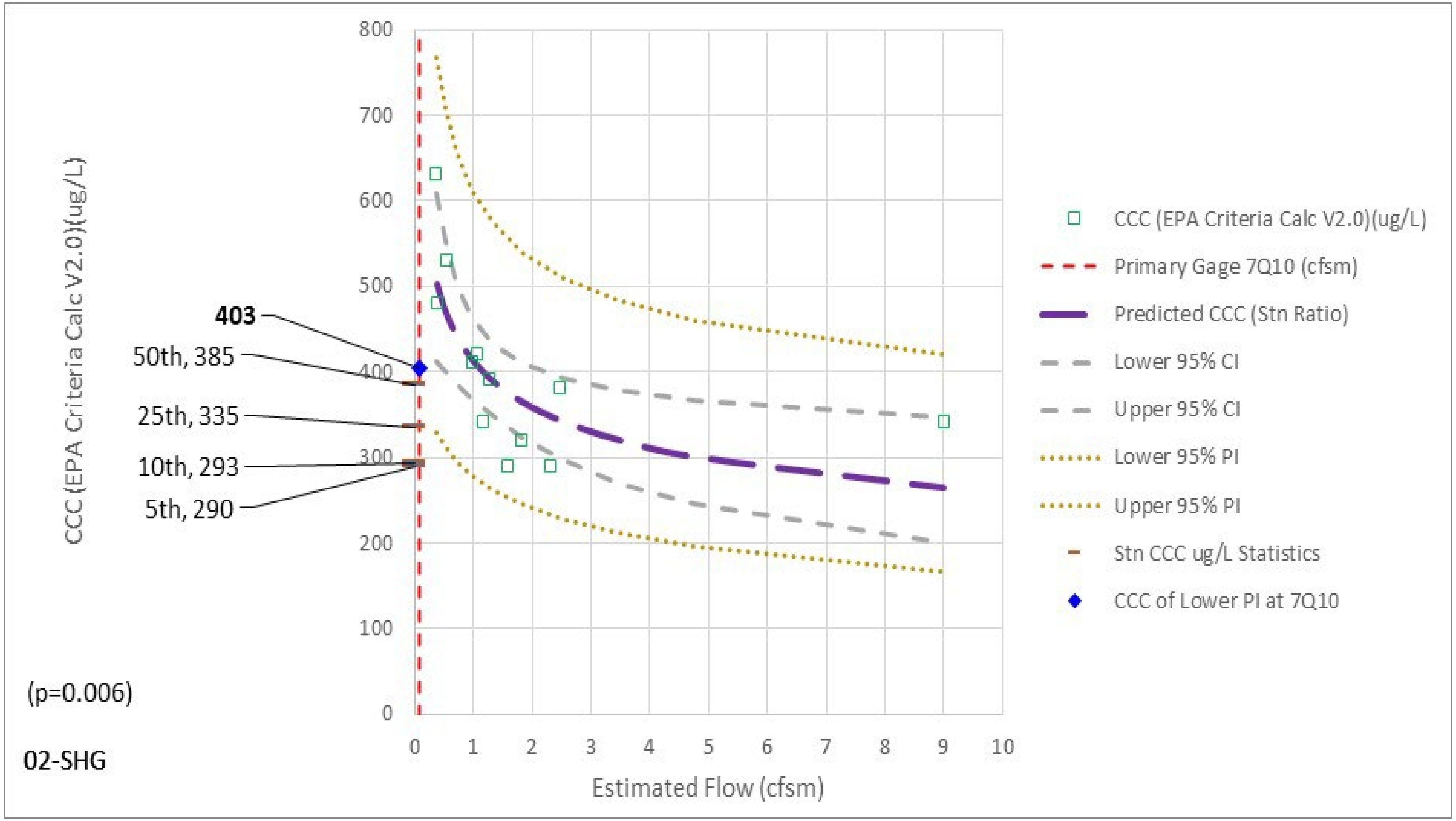
- If the power regression is insignificant (p>0.05),
  - CCC-5 where threatened or endangered species are present, or habitat has been declared.
  - CCC-10 where threatened or endangered species are not present, and habitat has not been declared.

- If the power regression is significant (p<=0.05),
  - If CCC-L95-PI > CCC-50 → CCC-50
  - If CCC-L95-PI < CCC-50 →
    - CCC-5 where threatened or endangered species are present, or habitat has been declared.
    - CCC-10 where threatened or endangered species are not present, and habitat has not been declared.

NPDES Implementation (cont.)



Souhegan River (02-SHG) Example



- At this site, reasonable potential would be based on 385 ug/L as the permitting chronic criterion.
- Rate of increased dilution exceeds the decrease in the ICV.

Thoughts/Discussion/Questions?

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