

# NUMERIC PHOSPHORUS CRITERIA

Wisconsin's Experience

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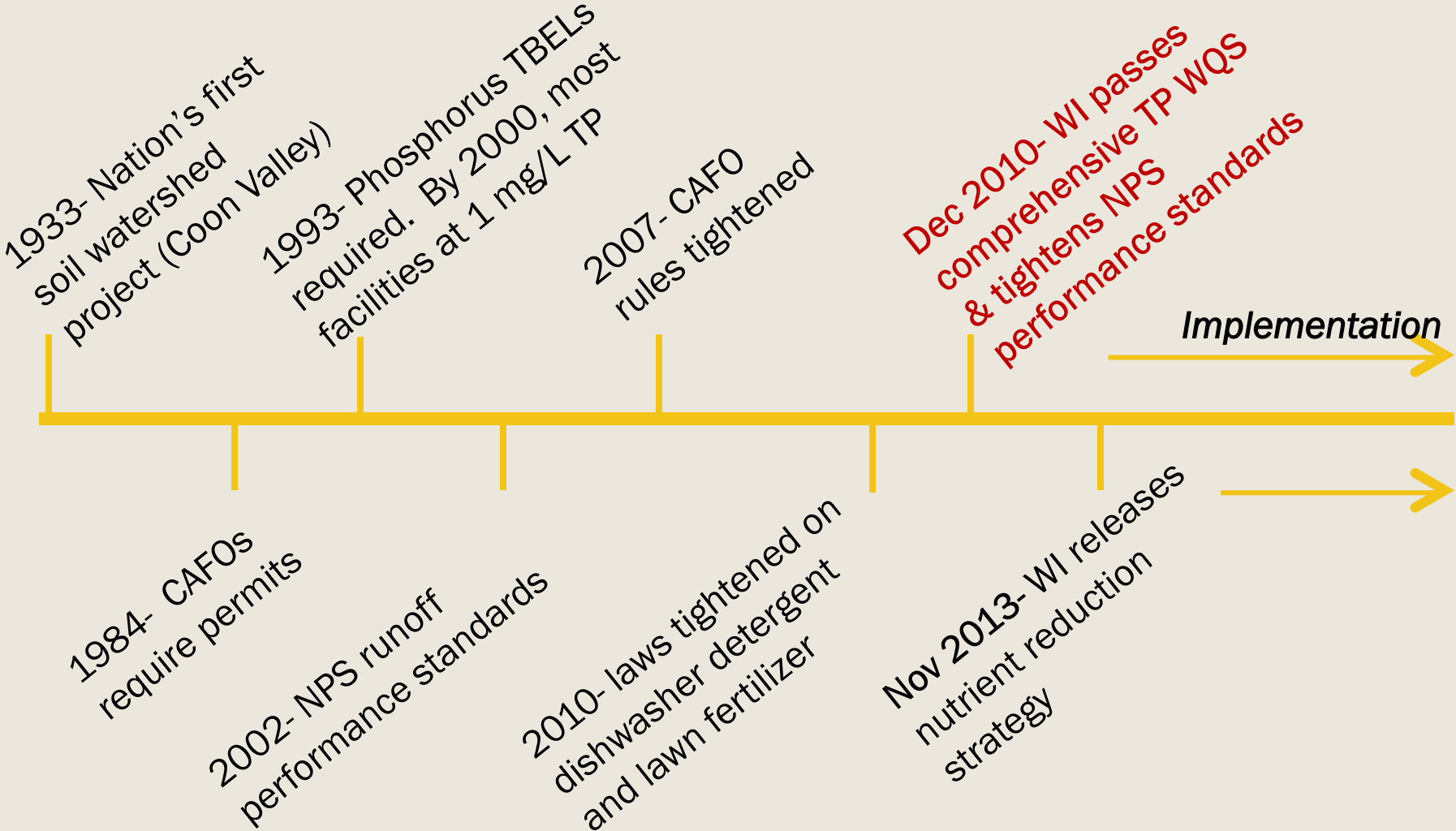


# Content

- History of P Criteria in WI
- Impact on Listing & Delisting
- Impact on TMDLs
- Implementation of P Criteria



# History of Phosphorus Regulations in WI

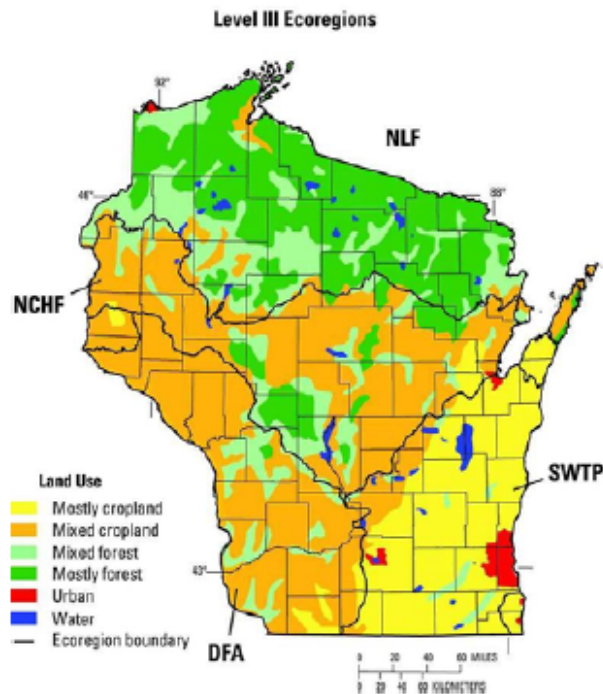




# Development of Numeric Nutrient Criteria

- In 2001, Wisconsin DNR initiates an 8-year study with USGS to evaluate nutrients (both phosphorus and nitrogen) and determine thresholds for potential numeric criteria.
- 2009 Environmental groups notified U.S. EPA of lawsuit over lack of progress in development of numeric criteria in Wisconsin. As part of settlement agreement, numeric criteria must be completed by end of 2010.

In 2000, EPA published supplemental guidance suggesting phosphorus levels for different multi-state eco-regions for Wisconsin as follows:



- Northern lakes and forests (NLF) -- 12 ug/l
- Northcentral hardwood forests (NCHF) – 29 ug/l
- Driftless area (DFA) – 70 ug/l
- Southeastern Wisconsin till plain (SWTP)– 80 ug/l

The eco-regions are generally based on land cover, rather than features, such as soils, stream gradient, etc. So, for example, the values for the northern lakes and forests are based on clayey soils near Lake Superior as well as sandy soils in the northern part of the lower peninsula of the state of Michigan. All values are based on the 25<sup>th</sup> percentile of available data (25 percent of the data has lower values and 75 percent has higher values).

EPA Eco-regions for Wisconsin (Source USGS)

# Development of Numeric Nutrient Criteria

- Re-formation of technical advisory committees. Implementation of numeric phosphorus criteria becomes the major discussion point and results in the development of extended compliance schedules and alternative compliance schedules. Nitrogen criteria not pursued.
- November 2010 phosphorus rules adopted.
- December 2010 approved by U.S. EPA, rules become effective.
  - See *“Wisconsin Phosphorus Water Quality Standards Criteria: Technical Support Document”*, Department of Natural Resources, December 2010.

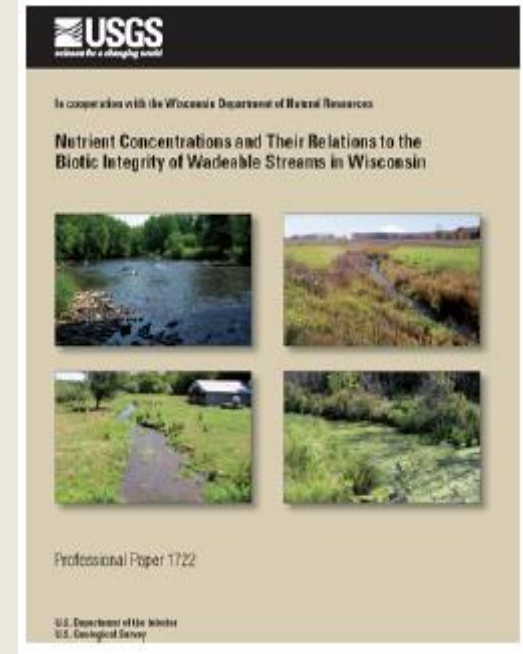
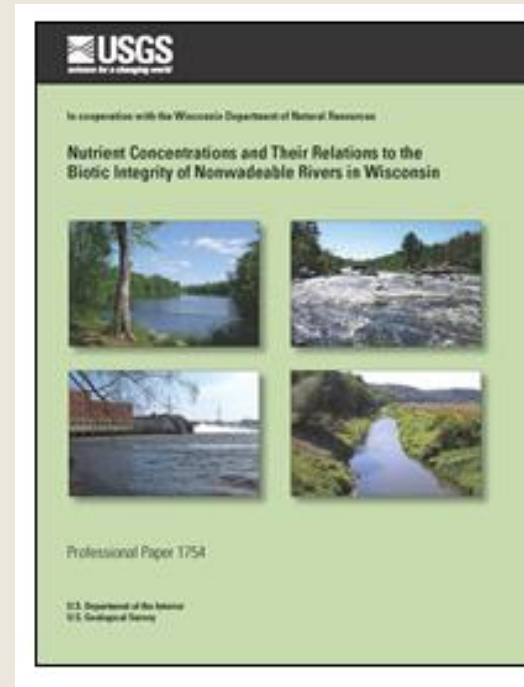
# Nutrient Criteria for Wadeable and Nonwadeable Streams and Rivers

Wisconsin DNR and USGS sampled 240 wadeable and 34 nonwadeable streams across Wisconsin for different forms of phosphorus and nitrogen, and assemblages of macroinvertebrates and fish to:

(1) examine how macroinvertebrate and fish measures correlated with the nutrients;

(2) quantify relationships between key biological measures and nutrient forms to identify potential threshold levels of nutrients to support nutrient criteria development; and

(3) evaluate the importance of nutrients in influencing biological assemblages relative to other physicochemical factors at different spatial scales.



Nutrient Concentrations and Their Relations to the Biotic Integrity of Nonwadeable Rivers in Wisconsin; 2008; PP; 1754; Robertson, Dale M.; Weigel, Brian M.; Graczyk, David J.

Nutrient concentrations and their relations to the biotic integrity of wadeable streams in Wisconsin; 2006; PP; 1722; Robertson, Dale M.; Graczyk, David J.; Garrison, Paul J.; Wang, Lizhu; LaLiberte, Gina; Bannerman, Roger



# Rivers in NR 102

- Specific rivers are identified in NR 102.



**Rivers**

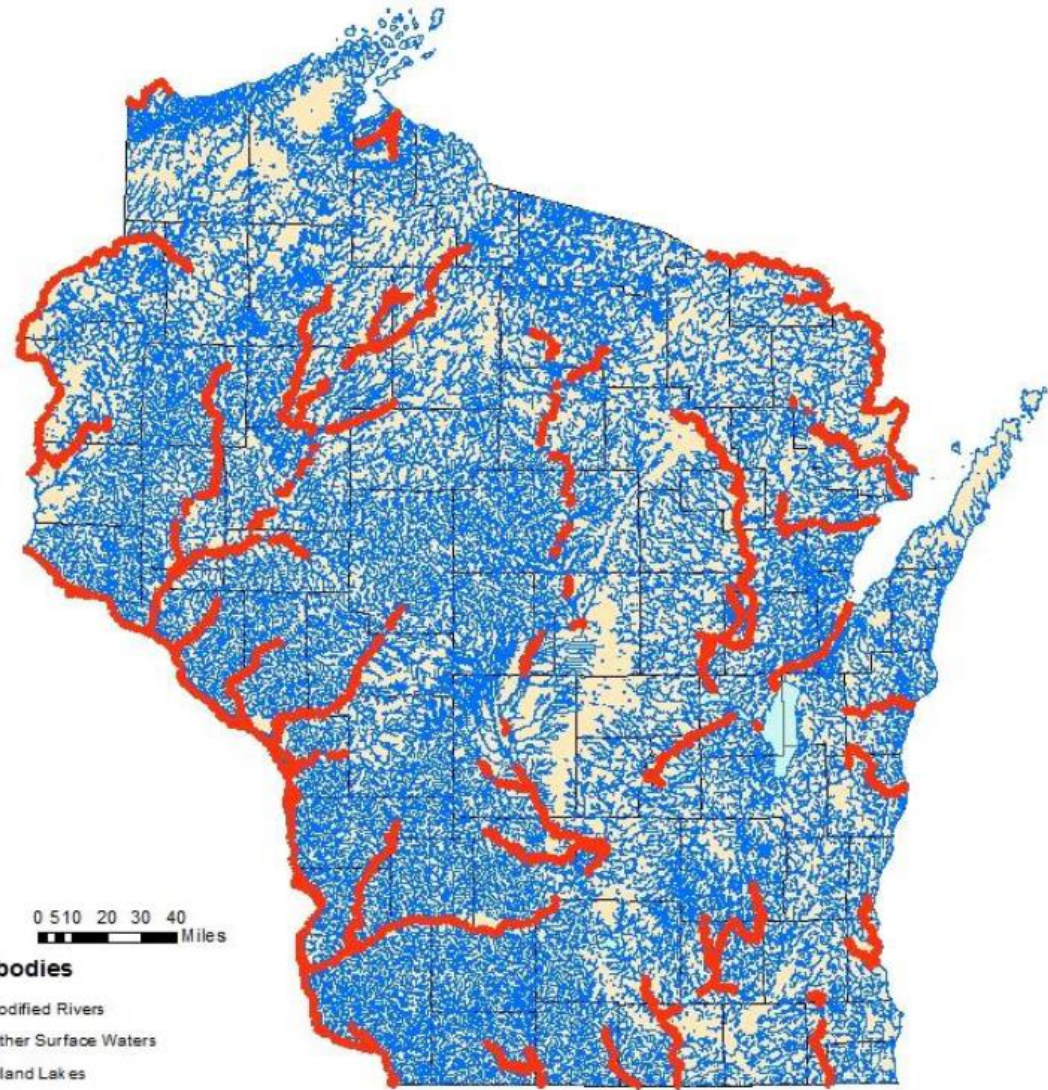
100 µg/L



**Streams**<sup>1</sup>

75 µg/L

Waterbodies Codified as Rivers in NR 102  
September 2013



- Waterbodies**
- Codified Rivers
  - Other Surface Waters
  - Inland Lakes
  - County Boundary

Date: 09/03/2013  
Cartographer: Amanda Minks, Bureau of Water Quality



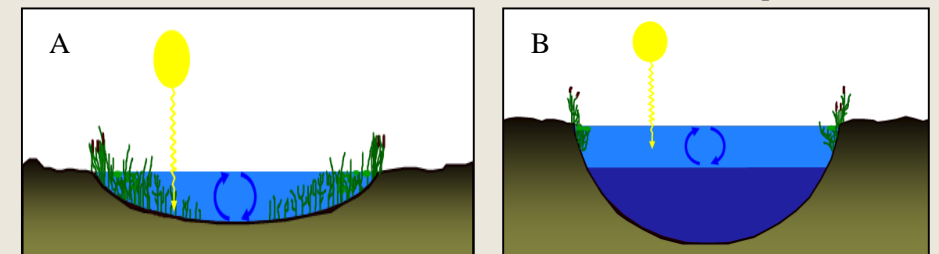
<sup>1</sup>All unidirectional flowing waters not in NR 102.06(3)(a). Excludes Ephemeral Streams.

# Lake Phosphorus Criteria

- Lake P Criteria considers hydrology of the waterbody.
- Derived to:
  - Minimize frequency of nuisance algal conditions;
  - Minimize shifts in aquatic plant communities (macrophyte to planktonic);
  - Sustain fish communities.

Stratification	Lake Natural Community	Total Phosphorus Criteria ( $\mu\text{g/L}$ )
Unstratified (Shallow)	Headwater Drainage	40
	Lowland Drainage	
	Seepage	
Stratified (Deep)	Headwater Drainage	30
	Lowland Drainage	
	Seepage	20
	Two-Story Fishery	15

**Figure 4.** Illustrations of (A) a shallow, mixed lake and (B) a deep, stratified lake.





# Impact on Listing & Delisting



- Wisconsin Consolidated Assessment and Listing Methodology (WisCALM)
  - Minimum data requirements
  - Seasonal range and frequency
  - Data quality
  - Confidence Intervals
  - Listing & delisting protocols
- Automated Assessment Package

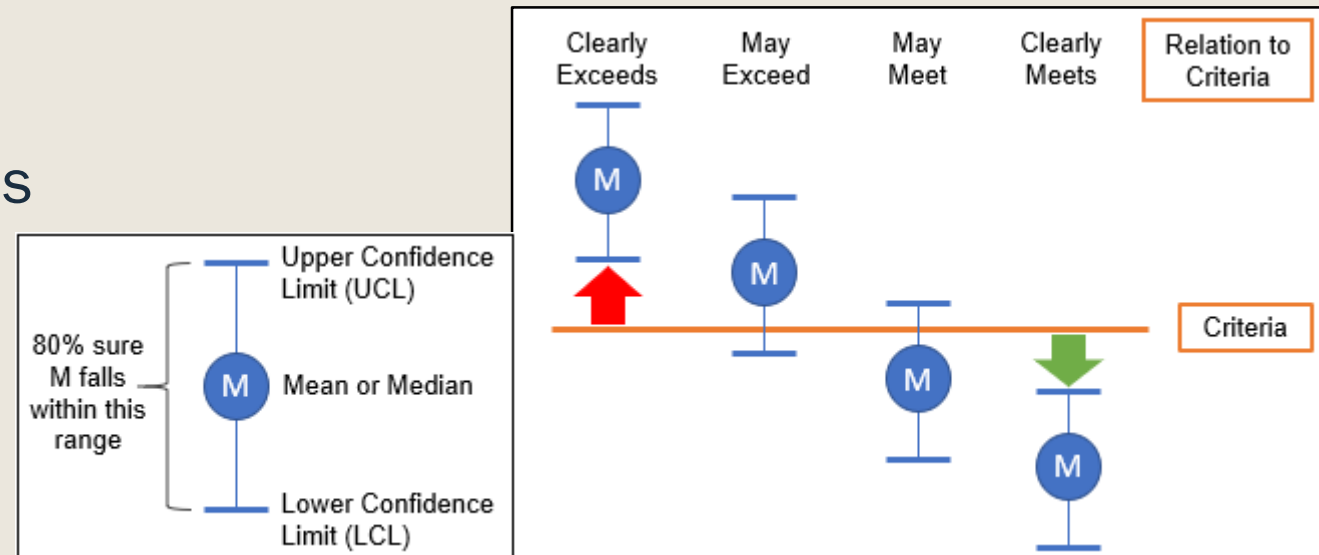


Figure 13. Comparison of the Upper and Lower Confidence Limit values and Mean/Median (M) to the criteria.

# Impact on Listing & Delisting



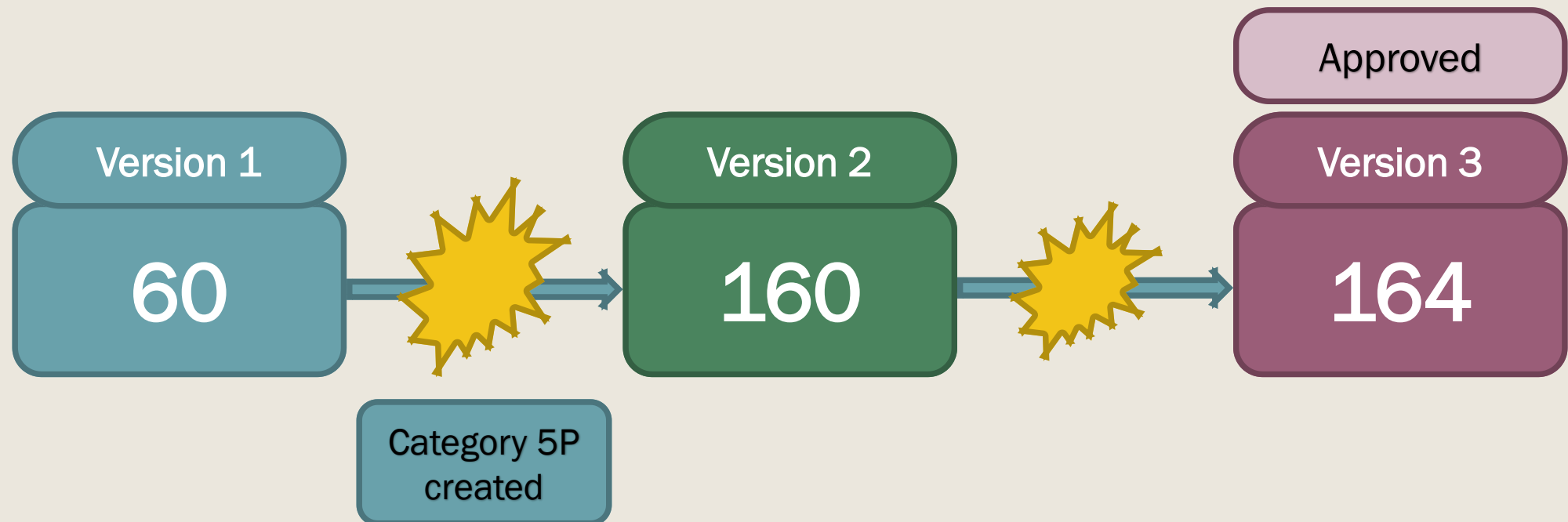
## ■ Rule language clarity

**Note:** When placing a water body on the 303 (d) list as impaired for phosphorus, the department considers factors such as frequency and duration of criterion exceedances, the time of year of the exceedance and the magnitude of each exceedance above the applicable criterion. The department may also choose to consider other factors such as the concentration of suspended algae and floating plants; density of benthic algae; macrophyte density; minimum and daily change in dissolved oxygen levels due to diurnal swings; water clarity; and natural background phosphorus concentrations. The 303 (d) list is a list of impaired waters established by the department and approved by US EPA pursuant to [33 USC 1313 \(d\) \(1\) \(A\)](#) and [40 CFR 130.7](#). Information on frequency and duration is contained in the department's impaired waters listing guidance, "Wisconsin Consolidated Assessment and Listing Methodology."

# Impact on Listing & Delisting



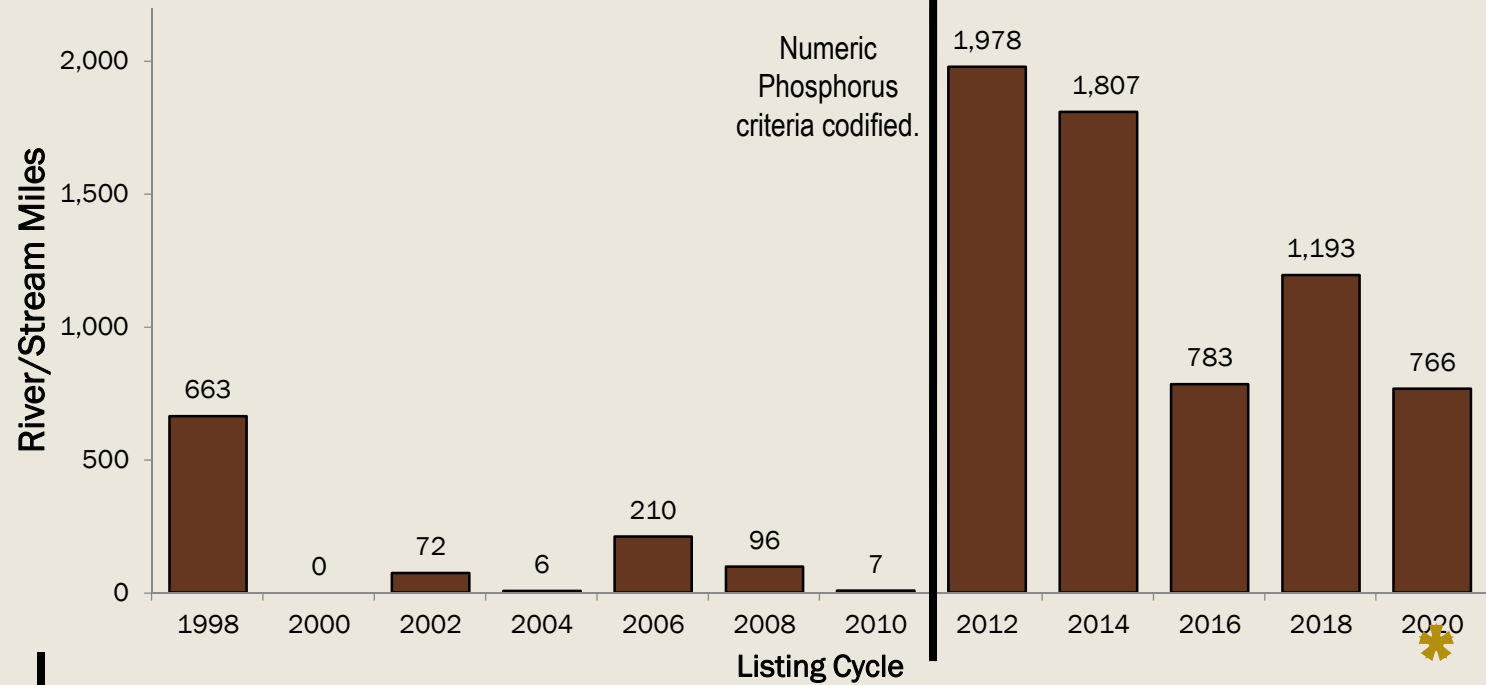
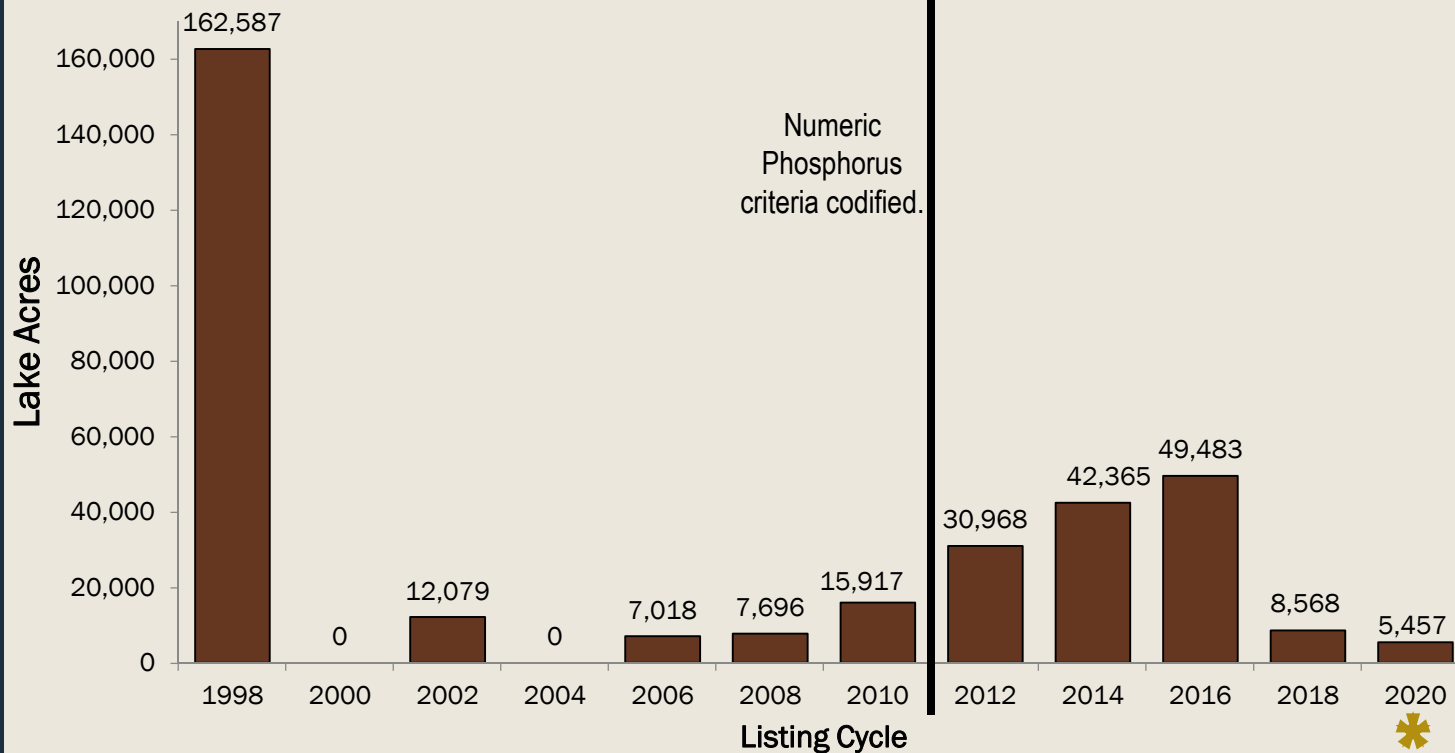
- Rule language clarity – following the letter of the law.
- 2012 Impaired Waters Listing Cycle, first use of criteria:



# Phosphorus Listings by Cycle

Amount (by size) listed each cycle (not cumulative).

■ Listed





# Impact on Listing & Delisting



## ■ Optics

*“Wisconsin’s waters are all dirty and unusable!”*

*“Our waters are getting worse!”*

*“Tourists won’t want to use an impaired lake!”*

**Green Bay Press Gazette.** HOME NEWS BUSINESS JOBS USA TODAY 53° M

## Number of polluted waters in state, counties continue to rise

CT Feb. 24, 2016

## Wisconsin DNR adds more than 200 lakes and rivers to impaired waters list

List includes nearly 1,300 bodies of

BY CHUCK QUIRMBACH, WISCONSIN PUBLIC RADIO

DOOR COUNTY PULSE | THE WATER HEADLINES NATURE OUTDOOR

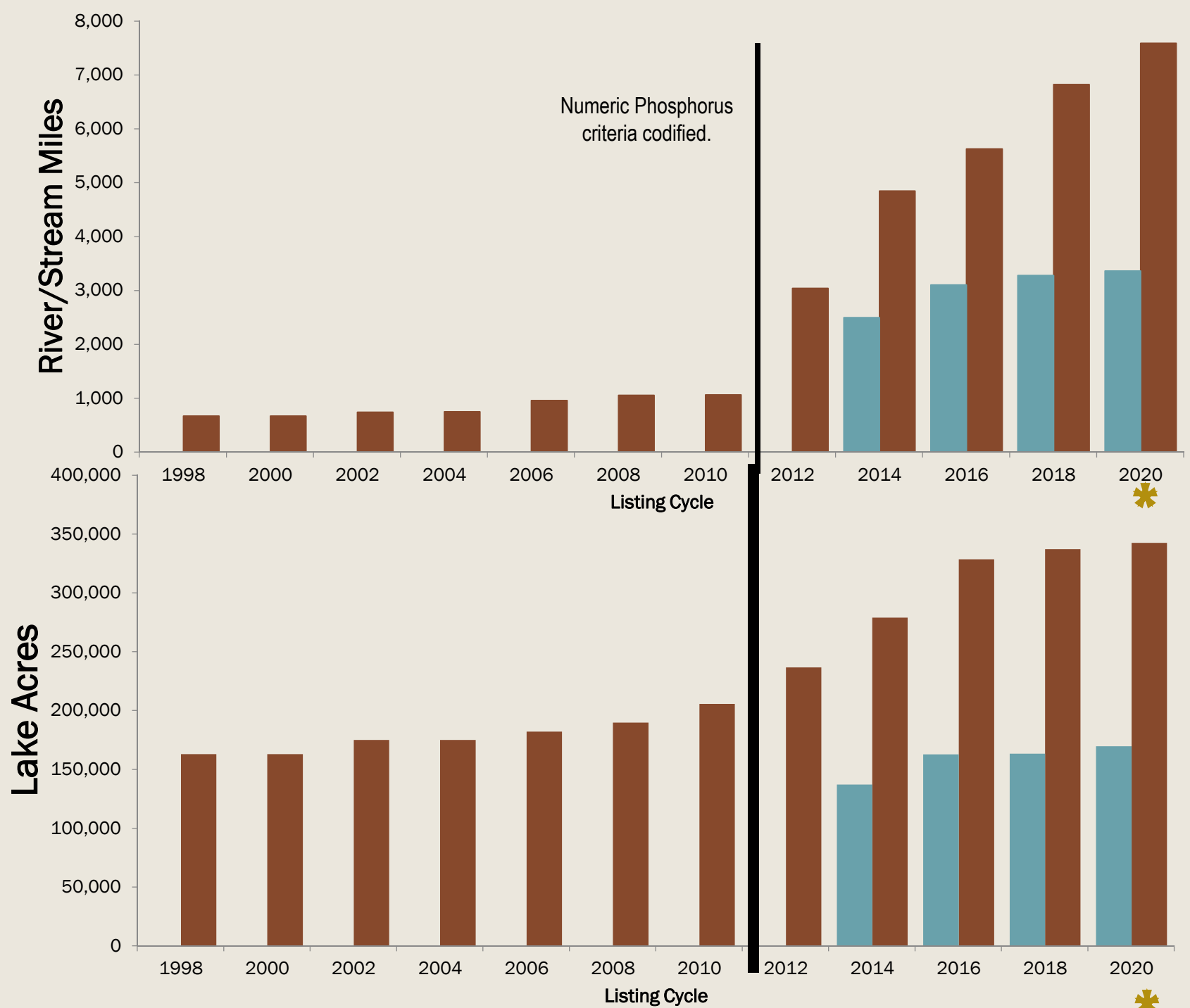
## Wisconsin Finds 240 More Impaired Waterways

By Jackson Parr, Peninsula Pulse – November 22nd, 2017

# Phosphorus Listings by Cycle

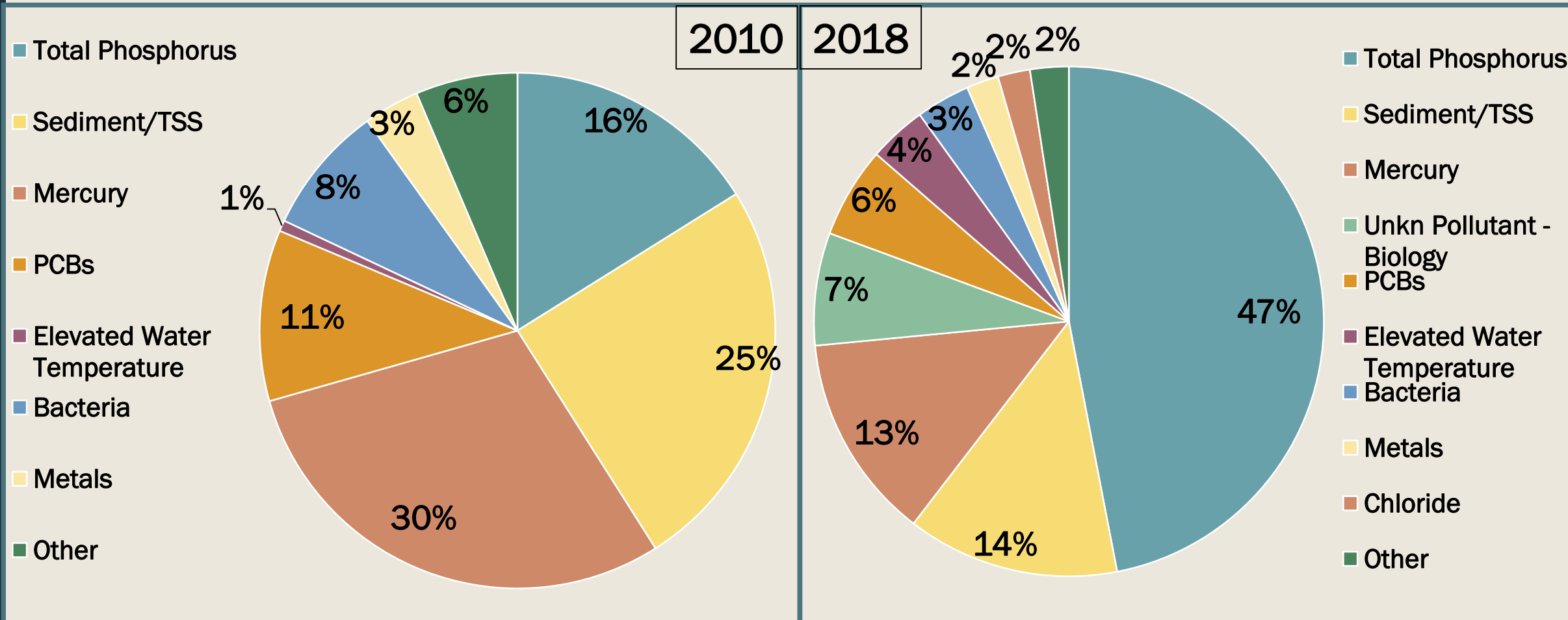
Amount (by size) listed each cycle (cumulative).

- Listed
- Supporting Use(s)



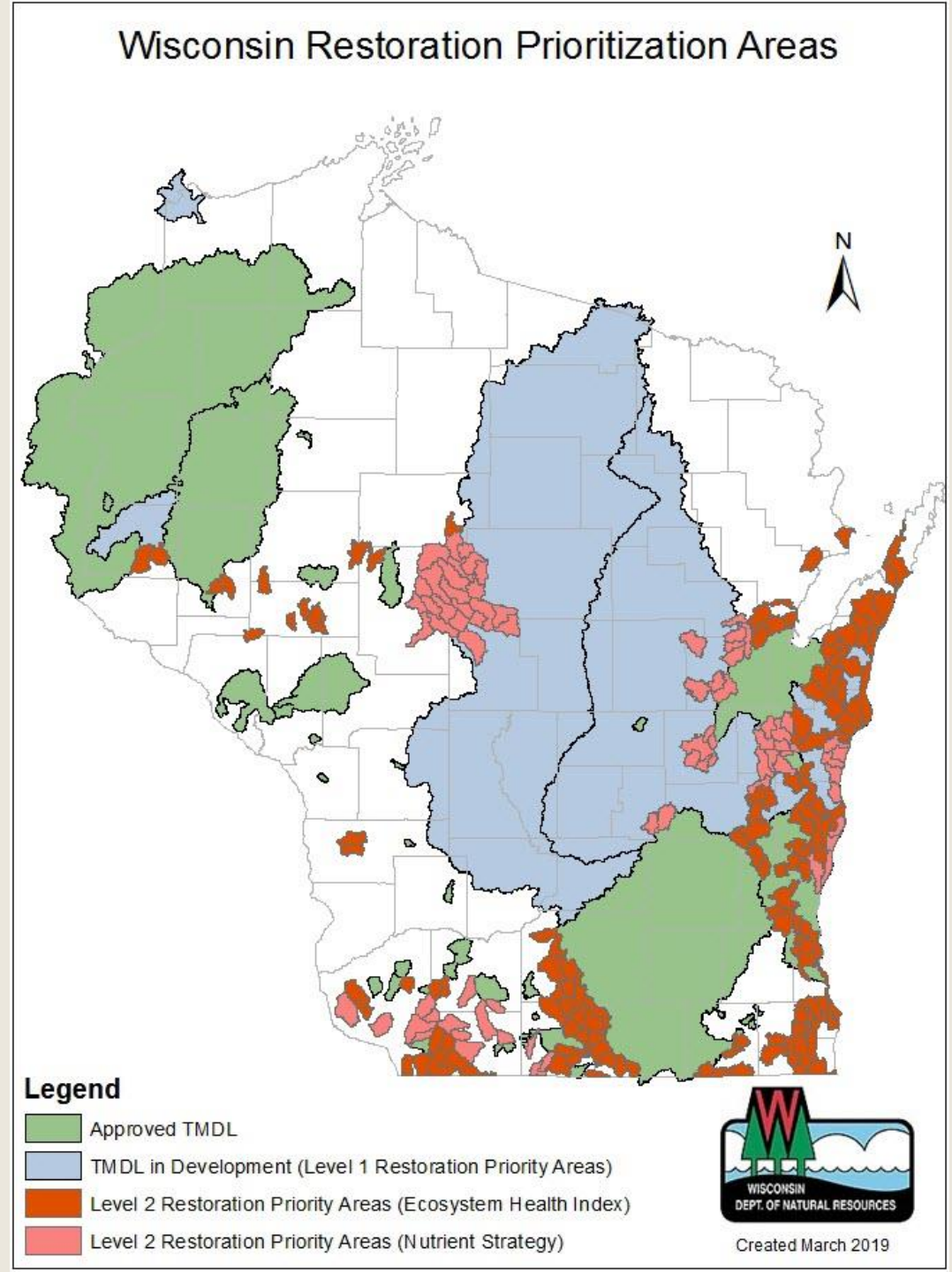
# Impact on Listing & Delisting

■ Shifted most-listed pollutant from Mercury to Phosphorus.



# Impact on Listing & Delisting

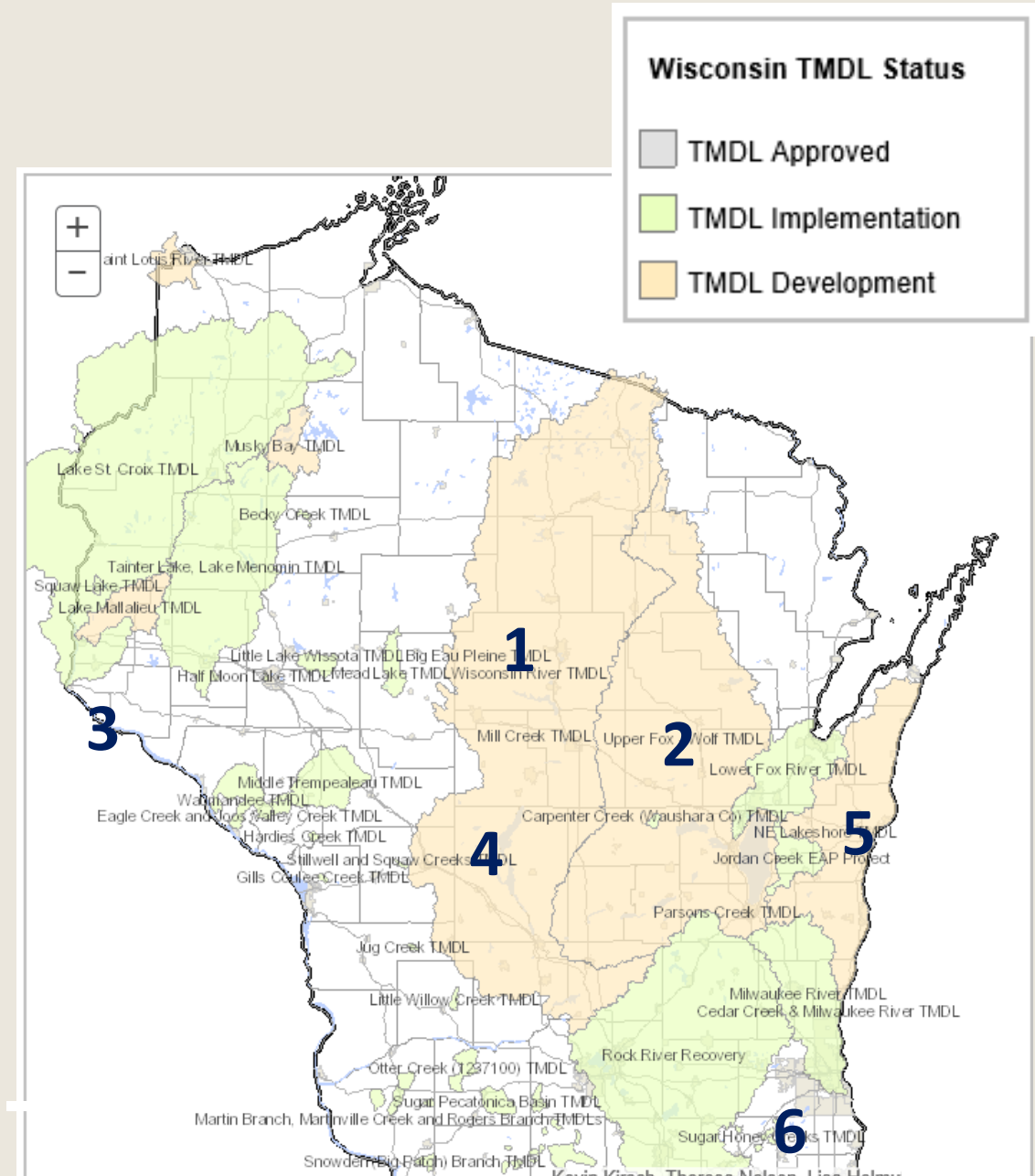
- Shift in TMDL priority to Total Phosphorus & TSS listings.
- 2015 Wisconsin Restoration Prioritization Plan





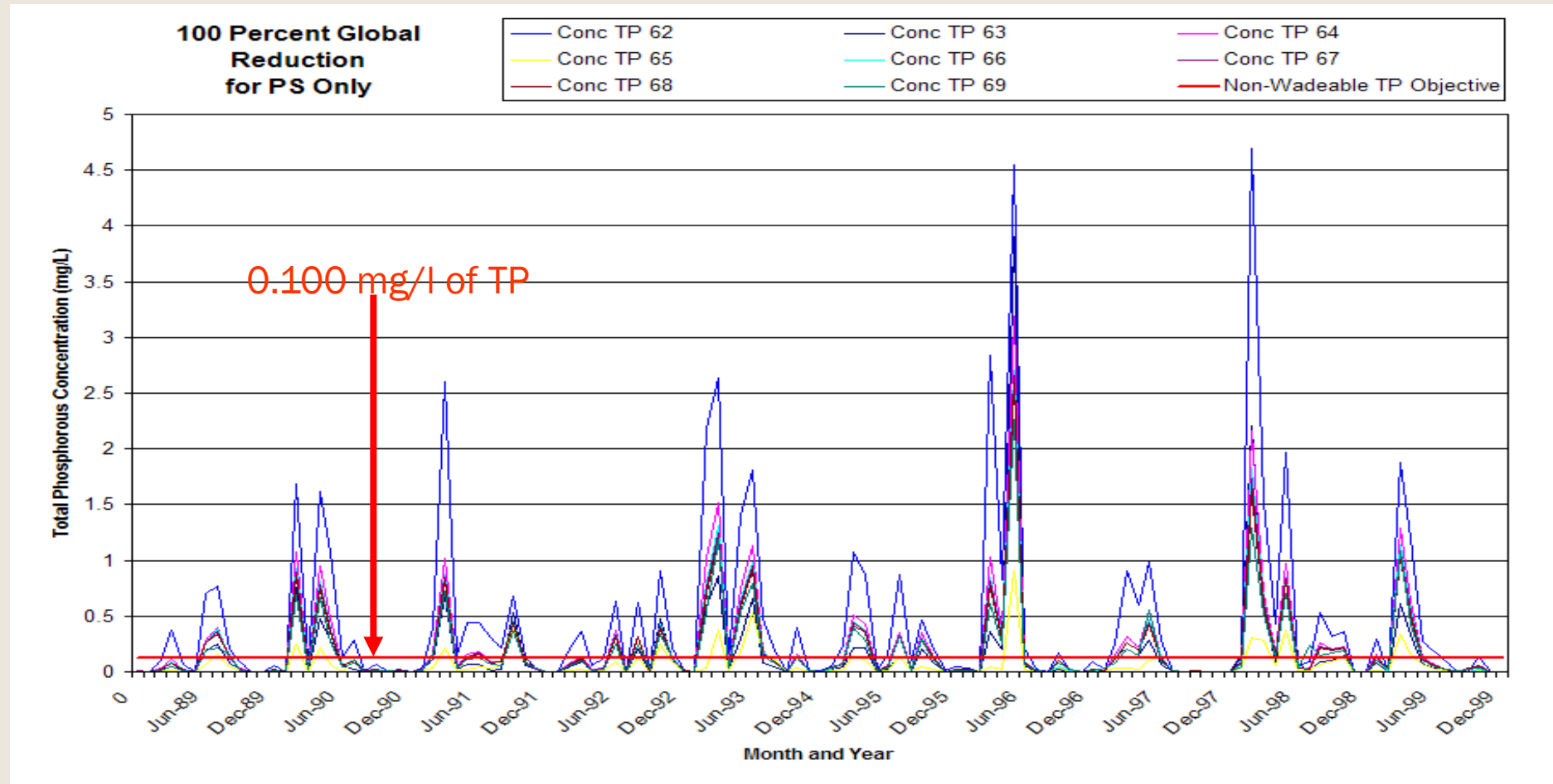
# Impact on TMDLs: Phosphorus Dominated

1. Wisconsin River Basin - TP  
Approved April 2019.
2. Upper Fox-Wolf Basin – TP & TSS  
DNR reviewing and responding to public hearing comments.
3. Lake Pepin (Led by MN) - TP and TSS
4. Wisconsin River Basin – BOD  
Collecting low flow DO and BOD samples
5. NE Lakeshore TMDL – TP and TSS  
*Requested by State Legislature. Currently collecting monitoring and modeling data. EPA contractor support for watershed modeling.*
6. Fox-Illinois Basin – TP and TSS  
*Currently scoping project and examining what additional monitoring data needs to be*



# Expression of Nutrient Criteria in TMDLs

- The numeric criteria specific in code lack frequency and duration. This led to the first draft TMDL utilizing the criteria to have allocations set to meet the criteria 100% of the time.



# Expression of Nutrient Criteria in TMDLs

- To determine whether ambient water quality conditions meet the phosphorus criteria, the DNR recommends use of the median concentration of samples collected between May and October.
- By definition, the median allows individual samples to be above and below the actual numeric criteria. DNR desired a high probability of meeting water quality criteria and set an upper bound on the exceedance rate for the TMDL. To select an exceedance rate, DNR relied on existing EPA guidelines that recommend a 10% exceedance threshold for conventional (nontoxic) pollutants such as phosphorus and sediment.

*“For conventional pollutants, the 305(b) guidelines indicated that whenever more than 10% of the water quality samples collected exceed the criterion threshold, the WQS is not attained (U.S. EPA 1997).”*

Source: Consolidated Assessment and Listing Methodology–Toward a Compendium of Best Practices

- By following EPA guidelines, the TMDL was developed with the intention that the median of samples collected between May and October meet the water quality criteria greater than 90% of the time on an annual basis.

# Expression of WLAs in WPDES Permits

Limit Type	Industrial Facilities		Municipal POTW's	
	Total P	TSS	Total P	TSS
Daily (max)		X		
Weekly Avg				X
Monthly Avg	X	X	X	X

\* Mass limits expressed in (lbs/day)

XYZ Municipal WWTP - Annual Average Design Flow 2.5 MGD

Total Phosphorus WLA's			
Month	Monthly WLA (lbs/month)	# of days per month	Monthly Avg Total P Effluent Limit (lbs/day)
Jan	91.29	31	2.94
Feb	95.53	28	3.41
Mar	87.07	31	2.81
Apr	88.55	30	2.95
May	96.38	31	3.11
Jun	96.49	30	3.22
Jul	86.83	31	2.80
Aug	84.04	31	2.71
Sep	86.50	30	2.88
Oct	72.21	31	2.33
Nov	88.49	30	2.95
Dec	82.55	31	2.66

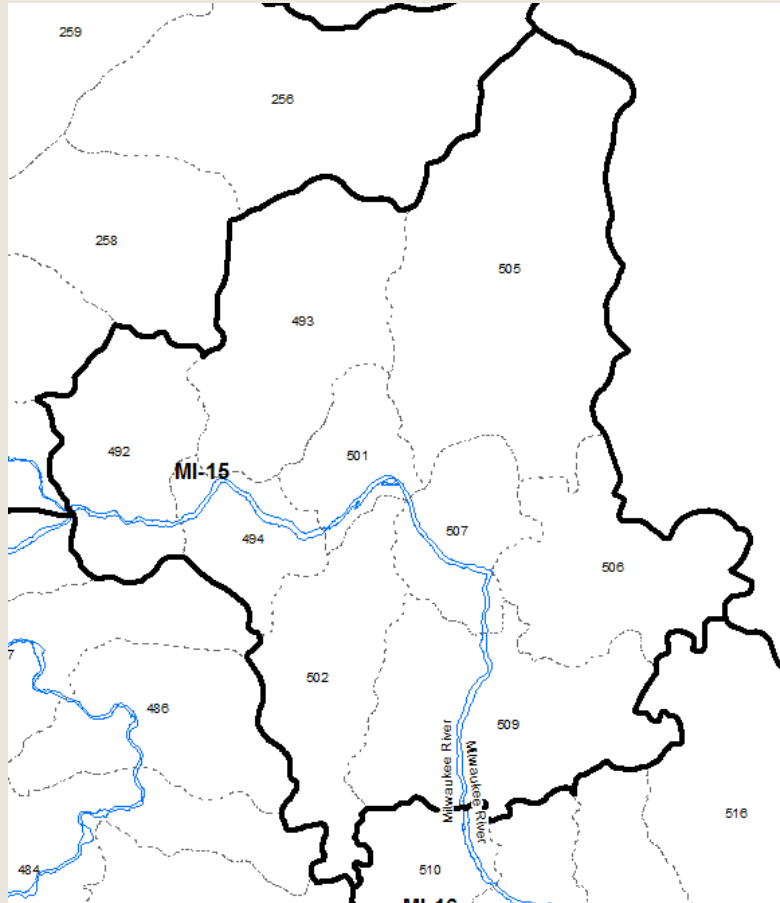


# Expression of WLAs in WPDES Permits

- Mass allocations presented also as concentrations at various flows to help permittees better understand their mass allocations.
- Monthly allocations to ensure that the median of monthly samples meets the water quality criteria.

Month	Monthly Total P WLA (lbs/month)	equivalent total P concentration limit (mg/L) at facility design flow	equivalent total P concentration limit (mg/L) at 60% of facility design flow
Jan	91.29	0.141	0.235
Feb	95.53	0.164	0.273
Mar	87.07	0.135	0.225
Apr	88.55	0.142	0.236
May	96.38	0.149	0.249
Jun	96.49	0.154	0.257
Jul	86.83	0.134	0.224
Aug	84.04	0.130	0.217
Sep	86.50	0.138	0.230
Oct	72.21	0.112	0.186
Nov	88.49	0.141	0.236
Dec	82.55	0.128	0.213

# Determine Loading Capacity for Both Impaired and Unimpaired Waters



- *303(d) list extents*
- *Water quality standard changes*
- *Point source locations*
- *Major flow changes*
- *Changes in land use*
- *Sized to allow flexibility for implementation*

# Impact to TMDLs: Ohio Supreme Court Decides Ohio EPA TMDLs Must be Promulgated As Rules

- [Fairfield County v. Nally](#) Ohio did not have promulgated numeric criteria and had developed water quality “targets” for their TMDLs which were used to set allocations. The Ohio Supreme Court determined that the TMDL needed to be promulgated as a rule before allocations could be enforced through permits.
- This state decision does not apply to WI because we base our TMDLs on promulgated water quality standards and criteria per Wis. Stat. s. 281.15; however, we continue to get comments that we must promulgate our TMDLs.
- The Ohio ruling and Wisconsin’s promulgated criteria impacts the use site specific criteria (SSC) in that it must be first promulgated before allocations based on SSC can be approved and used in permits.

# Site-Specific Total Phosphorus Criteria for Petenwell Flowage, Castle Rock Flowage, and Lake Wisconsin

- Wisconsin Administrative Code NR 102.06(7) allows SSC for total phosphorus (TP) to be adopted where site-specific data and analysis using scientifically defensible methods and sound scientific rationale demonstrate a different criterion is protective of the designated use of the specific surface water segment or waterbody.

Reservoir	Existing TP Criterion (µg/L)	Recommended Site-Specific TP Criterion (µg/L)
Petenwell Flowage	40	53
Castle Rock Flowage	40	55
Lake Wisconsin	100	47

Source: Wisconsin River Basin TMDL



# Two sets of allocations: Current Criteria and Recommended Site Specific Criteria

- To address the need to promulgate SSC, two sets of allocations were calculated so that the TMDL did not need to be redone.

## Appendix J – Allocations based on Current Criteria

Table J-1. Annual Total Phosphorus Allocations by Reach for Current Criteria.

Reach	Loading Capacity (lbs./year)	Reserve Capacity (lbs./year)	Load Allocation (lbs./year)	Background (lbs./year)	Agricultural Nonpoint (lbs./year)	Non-Permitted Urban (lbs./year)	Wasteload Allocation (lbs./year)	General Permits (lbs./year)	Permitted MS4 (lbs./year)	Individual WW Permits (lbs./year)
1	5,618	241	5,208	626	2,896	1,686	169	169	0	0
2	4,096	179	3,896	486	3,230	180	20	20	0	0
3	2,487	98	2,351	489	1,485	378	38	38	0	0
4	2,424	111	2,160	168	1,711	281	153	28	0	125
5	3,398	157	2,732	209	1,980	543	509	54	455	0
6	5,641	216	5,382	1,273	3,885	224	43	43	0	0
7	3,766	144	3,584	849	2,639	95	39	39	0	0
8	1,804	75	1,696	278	1,282	136	33	33	0	0

## Appendix K – Allocations based on Recommended SSC

Table K-1. Annual Total Phosphorus Allocations by Reach for Proposed Site-Specific Criteria.

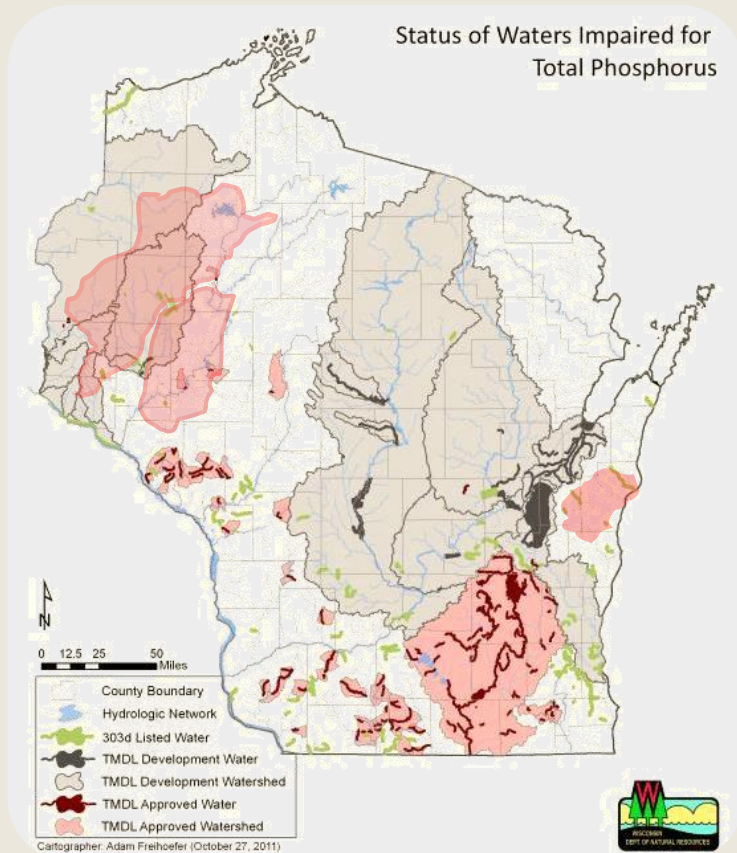
Reach	Loading Capacity (lbs./year)	Reserve Capacity (lbs./year)	Load Allocation (lbs./year)	Background (lbs./year)	Agricultural Nonpoint (lbs./year)	Non-Permitted Urban (lbs./year)	Wasteload Allocation (lbs./year)	General Permits (lbs./year)	Permitted MS4 (lbs./year)	Individual WW Permits (lbs./year)
1	2,561	88	2,304	626	1,060	617	169	169	0	0
2	2,000	75	1,904	486	1,344	75	20	20	0	0
3	1,245	36	1,171	489	544	138	38	38	0	0
4	1,012	41	897	168	626	103	74	28	0	46
5	1,411	57	1,133	209	725	199	221	54	167	0
6	4,331	151	4,138	1,273	2,709	156	43	43	0	0

# Calculation of WQBELs in NR 217 (Point Source Implementation Rule):

- Created during December 2010 rulemaking
- Data Needed:
  - *In-stream P concentration*
  - *Effluent P concentration*
  - *Effluent and stream flow*
- Uses a very conservative mass balance equation to calculate a WQBEL (NR 217.13) using low flow conditions and assuming no other sources:

$$\text{Limit} = [\text{WQC} * (\text{Q}_s + (1-f) \text{Q}_e) - (\text{Q}_s - f \text{Q}_e) * \text{C}_s] / \text{Q}_e$$

# TMDL Derived Limits vs NR 217.13 Limits:



- Typically less stringent than NR 217.13 calculated WQBEL because of allocations to other sources and more realistic flows.
- TMDL-derived limits are mass limits
  - *Limit will be expressed consistent with the TMDL WLA*
- TMDL-derived limits can be included in a WPDES permit in lieu of or in addition to a WQBEL
- *If nonpoint reductions do not occur, then the TMDL derived WQBEL can be replaced with the more stringent NR 217.13 derived limit.*

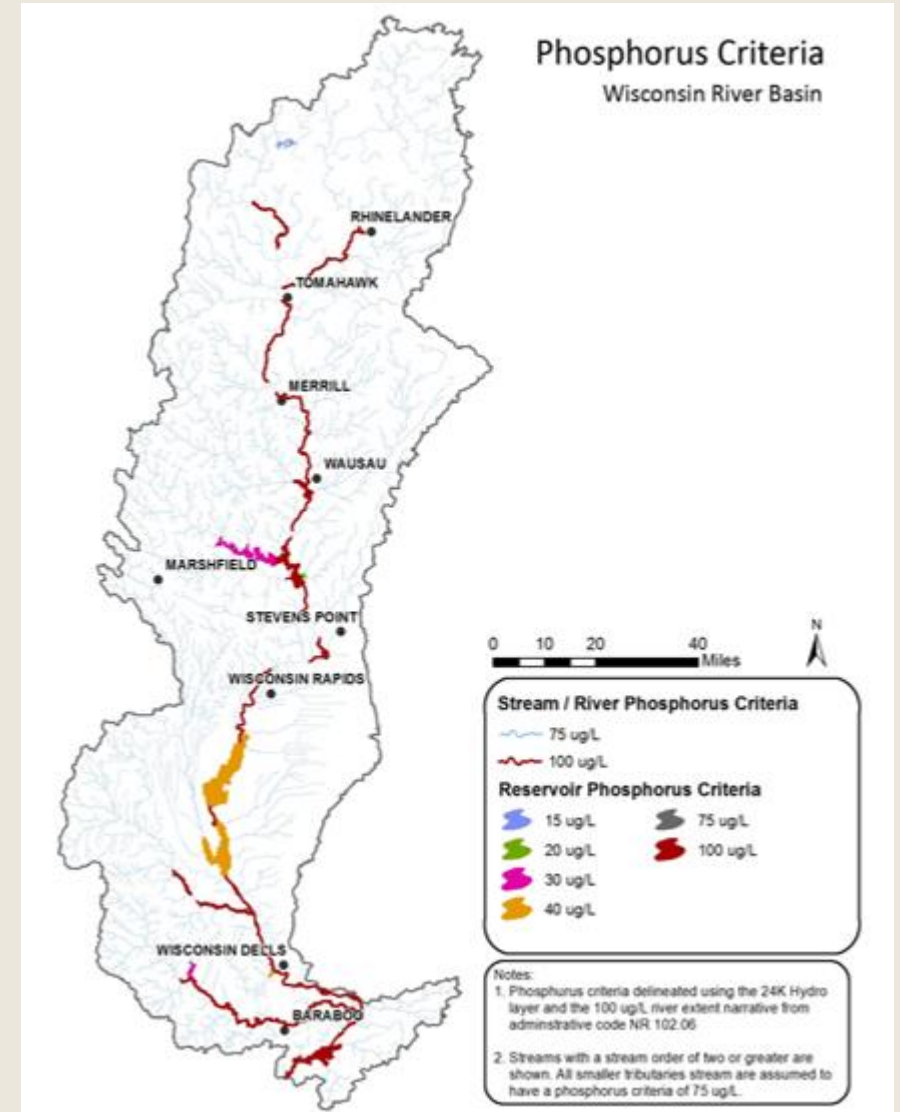
# Considering Downstream Protection

- Easy to require
  - “will cause, has the reasonable potential to cause or contribute to an exceedance ... in either the receiving water or downstream water”.
- At times, hard to implement
- Generally applies to situations where the downstream water has a lower criterion.



# Considering Downstream Protection

- The department shall include a TP WQBELs in a permit whenever the discharge has the potential to exceed TP water quality standards in either the receiving water or downstream waters
  - *What happens when a PS is a very small contributor of the downstream impairments?*
  - *Conflicting court decisions*
- This is best accomplished through the use of a TMDL; however, it can get complicated.





# Considering Downstream Protection

## Breakout of Allocations

## Downstream waterbody

**Table O-1. Allocations and Reach Phosphorus Targets by Permitted Point Source Based on Current Phosphorus Criteria.**

Facility Name	Permit Number	TMDL Reach	TP Wasteload Allocation (lbs./year)	Local Wasteload Allocation (lbs./year)	Max Downstream Credits (lbs./year)	Downstream Reservoir	Adaptive Management Target (mg/L)
ABBOTSFORD WASTEWATER TREATMENT FACILITY	0023141	323	160	162	2	Big Eau Pleine	0.074
ABBYLAND FOODS INC ABBOTSFORD PLANT	0057436	323	198	201	3	Big Eau Pleine	0.074
ADAMS WASTEWATER TREATMENT FACILITY	0023159	202	1,328	1,328	0	-	0.041
ANTIGO CITY OF	0022144	216	1,051	4,121	3,070	Petenwell	0.022
ARPIN WASTEWATER TREATMENT FACILITY	0031267	314	42	42	0	-	0.075
ATHENS WASTEWATER TREATMENT FACILITY	0022365	215	117	304	187	Petenwell	0.029
AUBURNDALE WASTEWATER TREATMENT FACILITY	0022411	211	108	112	4	Petenwell	0.073
BARABOO WASTEWATER TREATMENT FACILITY	0020605	179	6,793	6,793	0	-	0.094
BLENKER SHERRY SANITARY DISTRICT WWTF	0031950	207	18	85	67	Petenwell	0.049

**Table O-2. Allocations and Reach Phosphorus Targets by Permitted Point Source Based on Proposed Site-Specific Phosphorus Criteria.**

Facility Name	Permit Number	TMDL Reach	TP Wasteload Allocation SSC (lbs./year)	Local Wasteload Allocation SSC (lbs./year)	Max Downstream Credits (lbs./year)	Downstream Reservoir	Adaptive Management Target (mg/L)
ABBOTSFORD WASTEWATER TREATMENT FACILITY	0023141	323	160	162	2	Big Eau Pleine	0.074
ABBYLAND FOODS INC ABBOTSFORD PLANT	0057436	323	198	201	3	Big Eau Pleine	0.074
ADAMS WASTEWATER TREATMENT FACILITY	0023159	202	486	1,328	842	Lake Wisconsin	0.021
ANTIGO CITY OF	0022144	216	1,874	4,121	2,247	Lake Wisconsin	0.036
ARPIN WASTEWATER TREATMENT FACILITY	0031267	314	42	42	0	-	0.075
ATHENS WASTEWATER TREATMENT FACILITY	0022365	215	209	304	95	Lake Wisconsin	0.045
AUBURNDALE WASTEWATER TREATMENT FACILITY	0022411	211	112	112	0	-	0.075

Source: Appendix O: Wisconsin River TMDL



# Expression of TP Limits

- 122.45 (d)- All permit limitations, including those necessary to achieve water quality standards, shall unless **impracticable** be stated as:
  - *Maximum daily and average monthly discharge limitations for all dischargers other than publicly owned treatment works; and*
  - *Average weekly and average monthly discharge limitations for POTWs.*
- Impracticability demonstration approved 4/30/2012
  - *Allows 6-month average limits and monthly average limitations in limits < 0.3 mg/L*
  - *Annual limitations can be given if received water residence time > 1 year*
- WQBELs (TMDL/WLA) Consistent with Wasteload Allocation

# Phosphorus Compliance Schedules and Options

- Successfully negotiated extending compliance schedules beyond the permit term; typically 7 to 9 years.
- Provides additional time to consider compliance options including adaptive management and water quality trading.

Number of Facilities	Status on Addressing Phosphorus Effluent Limits
105	Currently no phosphorus effluent limit.
174	Effluent limit achieved through optimization of treatment system.
195	The facility is still in the planning phase and evaluating options.
95	The planning phase has been conducted and a report is pending to the department outlining the selected option.
85	The facility has opted for the Multi-discharger Variance.
30	The facility has pursued an individual variance.
18	The facility has engaged in Adaptive Management.
40	The facility has employed Water Quality Trading.

# Direct Discharge to the Great Lakes

- For discharges directly to the Great Lakes, the DNR shall set effluent limits consistent with nearshore or whole lake model results.
- No model has yet to be approved.
- Tetra Tech hired by U.S. EPA. Contract completed with no model available. Discussions with U.S. EPA ongoing.



# Questions?

