Wisconsin's Green Fire Analysis

Nitrogen Pollution and The Need to Develop Nitrogen Criteria for Wisconsin's Surface Waters

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Background: Considerable research – both in Wisconsin and across the county – supports the need to control both phosphorus and nitrogen to adequately manage water quality problems in surface waters. In many lakes and streams, both nitrogen and phosphorus contribute to eutrophication and water quality degradation. However, nitrogen itself may be the most important nutrient in certain types of lakes, such as floodplain lakes along rivers across the state. Both nitrogen and phosphorus can be the limiting nutrients causing dense blankets of free-floating plants that cover lake surfaces. The dense free-floating plant blankets not only undermine recreational uses but can literally smother lakes as dissolved oxygen declines to critically low levels without sufficient photosynthesis. Nitrogen, in the form of nitrate, not only threatens human health but has also been shown through research studies to be acutely toxic to young fish, amphibians and early life stages of other aquatic life forms.

Based on monthly sampling at the Wisconsin Department of Natural Resources (WDNR) long term trend site on the Pecatonica River at Martintown and Sugar River at Brodhead, nearly all of the samples dating back to the late 1980s exceeded recommended chronic toxicity level. Where agriculture dominates a surrounding landscape, affected streams often have excessive nitrogen levels along with widespread chronically toxic NO3-N and nitrite nitrogen (NO2-N) concentrations. While no action has been proposed to reduce surface water NO3-N levels in Wisconsin, Minnesota is developing criteria for protection of fish and aquatic life.

Often nitrogen reaches surface waters though groundwater discharges, such as springs and seeps. Rain may infiltrate into the soil and transport nitrogen from fertilizers and manure "laterally" to surface waters. Thus, nutrient management on farms is vital for the quality of Wisconsin lakes, wetlands and streams. However, current management practice standards, such as Natural Resources Conservation Service (NRCS) Nutrient Management Code 590, are insufficient for the level of management needed. The primary goals of the 590 are agronomic and not for water quality protection; the primary reason why nitrate levels across Wisconsin often exceed the Drinking Water Standard.

The Lower Wisconsin State Riverway is a good example where agronomic nutrient management has not protected water quality. The Lower Wisconsin State Riverway was considered by many a model for biodiversity conservation. By as early as 2008 however some oxbow spring lakes (dominated by upland groundwater) were displaying signs of N hypersaturation due to high levels of NO3-N in the sand terrace aquifer. Degradation of other spring lake oxbows in close proximity to the sand terrace followed within just a few years. The degradation of Lower Wisconsin River oxbows took managers by surprise but the vulnerability of the sand terrace to groundwater contamination was widely known for decades.

This paper provides a scientific background on the nature of the nitrogen-related surface water quality problems. But more importantly, it provides a menu of needed water quality standards and management tools for necessary consideration by the WDNR and Wisconsin Department of Trade and Consumer Protection (DATCP).

Recommendations to WDNR

A. **Develop and promulgate site-specific nutrient related criteria for specific oxbow and isolated lakes.**

   These largely overlooked lakes are located in glacial outwash terraces along major Wisconsin rivers, such as the Wisconsin, Chippewa and Black rivers or in isolated locations along the Mississippi River. Some may be viewed as deep-water wetlands.
   These lakes are often impacted by nitrogen (and possibly phosphorus). Many receive nitrogen via groundwater leaching from croplands.

   Exceptional Resource Waters (ERW) Jones Slough, Norton Slough and Bakkens Pond along the Lower Wisconsin River in Sauk County are degraded in the form of severe free-floating plants (duckweeds and metaphyton) due to excessive NO3-N+NO2-N concentrations entering from upland groundwater (Marshall 2013, Marshall et al. 2016, Marshall and Wade 2017).

   Studies of backwater and floodplain lakes on the Mississippi River found hypoxic conditions associated with free floating plants (duckweeds and metaphyton). Researchers identify maximum nitrogen concentrations to alleviate the nuisance conditions (Giblin 2013, Houser et al. 2013, Sullivan and Giblin 2012Sullivan 2008).

B. **Develop and promulgate nitrogen criteria for lakes and backwaters on large floodplain rivers.**

   Wisconsin studies have found nitrogen limited lakes.

   Nitrogen has been identified as having an additive effect to phosphorus on algal related impacts.

Research reviews conducted by water quality agency staff in Minnesota and other states show acute and possibly chronic toxicity impacts from nitrates on early life forms of salmonids and other aquatic related species**As an initial and interim implementation step, adopt 10 mg/L concentration of nitrates at springs and other groundwater inflows.**

Oxbow and other outwash terrace lakes would improve greatly if nitrate concentrations in springs feeding these lakes are lowered to the drinking water enforcement standard. Early life forms of trout may also benefit greatly.

C. As part of the Classification and Listing Methodology (CALM) used for listing impaired waters, adopt and include response-related factors for free floating plants (FFP) which includes duckweeds and filamentous algae.

FFP are very common in Wisconsin lakes, streams and deep-water wetlands and should be included as a response-related factor in listing impaired waters.

A multi-tiered approach is recommended in Table 1 below.

Table 1. Draft nutrient-related water quality impairment criteria for free floating plants (FFP) including metaphyton (filamentous algae) and duckweeds.

Tier	Measurement	Surface Water & Use Class*	Basis
I	FFP cover > 20% & Biomass > 10 g dry wt. m^{-2}	ORW & ERW Waters Rivers, Streams, Lakes and associated waters supporting fish & aquatic life	Protect fish and aquatic life including rare or unique aquatic plant communities
II	FFP cover > 40% & Biomass > 25 g dry wt. m^{-2}	Rivers, Streams, Lakes and associated waters supporting fish & aquatic life	Light shading of SAV Reduced surface re-aeration Recreational use impacts
III	FFP cover > 60% & Biomass > 30 g dry wt. m^{-2}	Deep water marshes supporting seasonal fish & aquatic life use	Light shading of SAV Severe reduction in surface re-aeration

*Water depths > 0.5 m supporting submersed aquatic vegetation (SAV).

ERW – Exceptional Resource Waters

ORW – Outstanding Resource Waters

<u>Additional notes</u>

The 10 g dry wt m^{-2} criteria for FFP biomass is the threshold where surface light is reduced by more than 40%.

The 25 g dry wt m^{-2} criteria for FFP biomass is the threshold where surface light is reduced by more than 80%. Duckweed cover >60% is associated with mid-day dissolved oxygen <5mg/l.

The 30 g dry wt m^{-2} criteria for FFP biomass is the threshold where surface light is reduced by more than 90%. Duckweed cover >60% is associated with mid-day dissolved oxygen <3mg/l.

Additional Considerations

1 WDNR should adopt most recent NRCS 590 into all applicable regulations and statues, then use that standard only as a minimum since more sensitive regions, such as the Central Sands, Northeast Karst and Lower Wisconsin State Riverway require additional protections. Previously, the late Dr. Byron Shaw made a strong case that the early version of the 590 agronomic model did not protect groundwater or water quality. In fact, under IV. Federal, State and Local Laws: *Users of this standard are responsible for compliance with applicable federal, state, and local laws, rules, or regulations governing nutrient management systems. This standard does not contain the text of federal, state, or local laws. Implementation of this standard may not eliminate nutrient losses that could result in a violation of law*. Application of the revised Nutrient Management Code 590 in many geological settings can result in Drinking Water Standard violations and Clean Water Act violations. Groundwater monitoring, both at CAFO production areas and land spreading fields, should be required where groundwater contamination susceptibility is high.

2 WDNR should enforce the Drinking Water Standard via WPDES permitting and other regulatory vehicles. For example, even with no other management, reducing groundwater nitrate concentrations below 10 mg/l would not only protect public health but also significantly reduce nitrate loading to many waterbodies. Surface water pollution has been severe where NO3-N concentrations in groundwater exceed the Drinking Water Standard by 2X-3X, Marshall et al. (2015).

3 WDNR CAFO permitting should accept the science demonstrating that 590 Nutrient Management Standards do not protect groundwater from nitrogen loading and recognize the link between contaminated groundwater and the effects on water quality. This reality also must recognize contaminated groundwater can violated antidegradation rules and water quality standards.

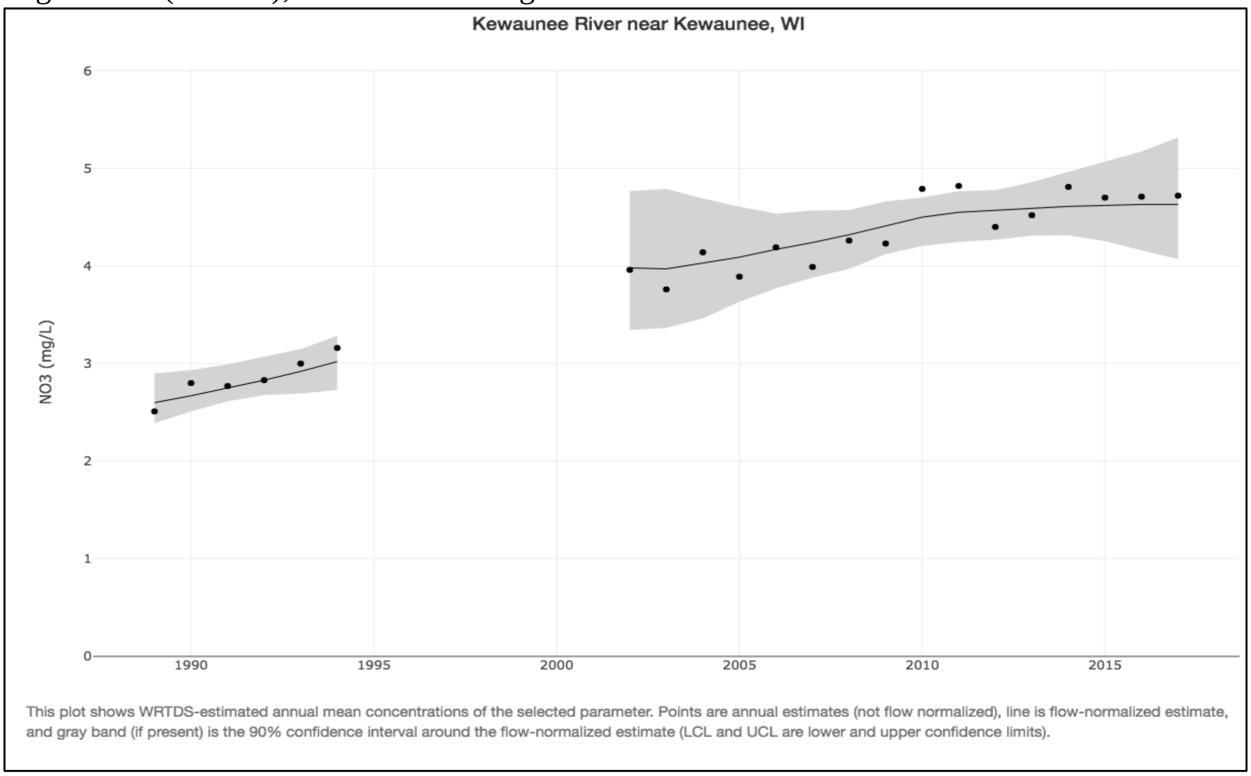
4 Stanley and Maxted (2008) demonstrated the need to sample NO2-N separately from standard NO3-N+NO2-N samples on a more routine basis.

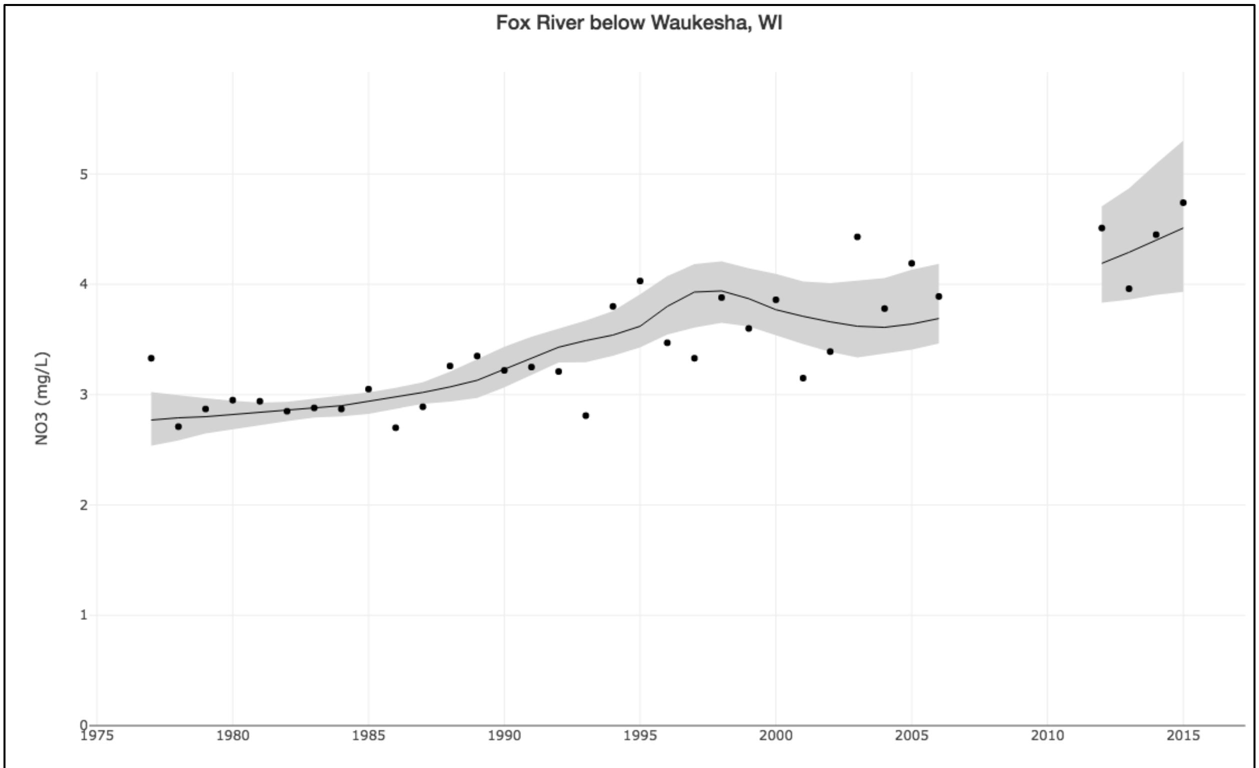
5 Across the Southwest Grassland Bird and Stream Conservation Area trout streams responded positively to extensive Conservation Reserve Program (CRP) protections (Marshall et al. 2008). WDNR should work with the US Department of Agriculture in a similar fashion to expand CRP and grassland grazing as alternatives to nutrient intensive agriculture where groundwater contamination is evident.

6 Specific to the Lower Wisconsin State Riverway, WDNR should join partners (Lower Wisconsin State Riverway Board and Friends of the Lower Wisconsin Riverway – FLOW) in their efforts to restore the pre-1994 Stewardship funds established as part of Act 30 that

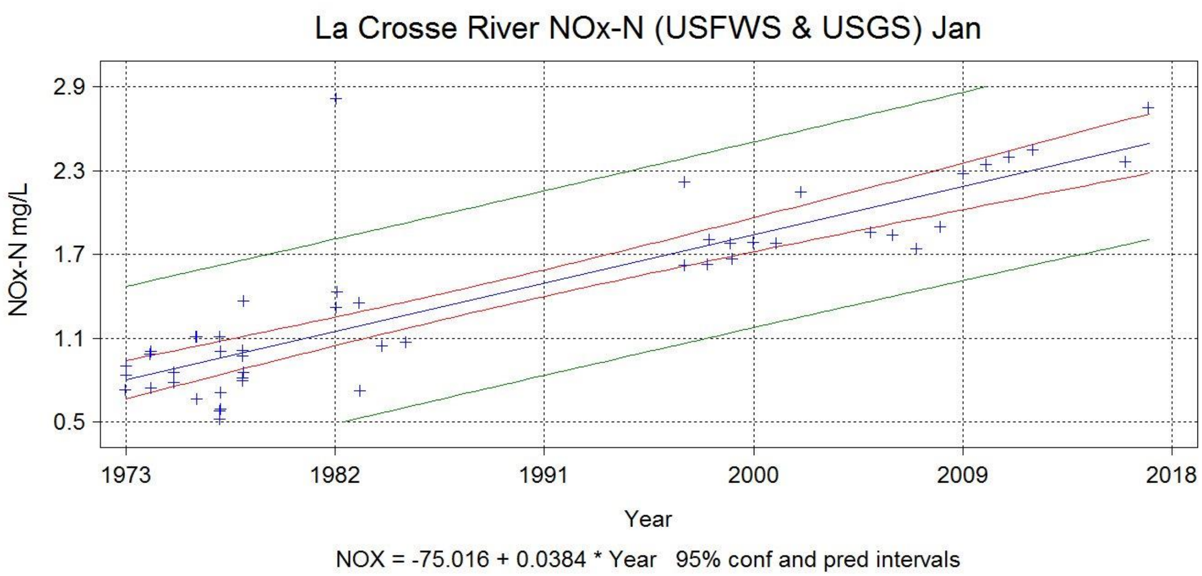
created the State Riverway. The funds were discontinued in 1994 under the premature assumption that conservation goals were met for the State Riverway but could be used to purchase conservation easements and fee title public lands acquisition given the dearth of buffers around the large river ecosystem.

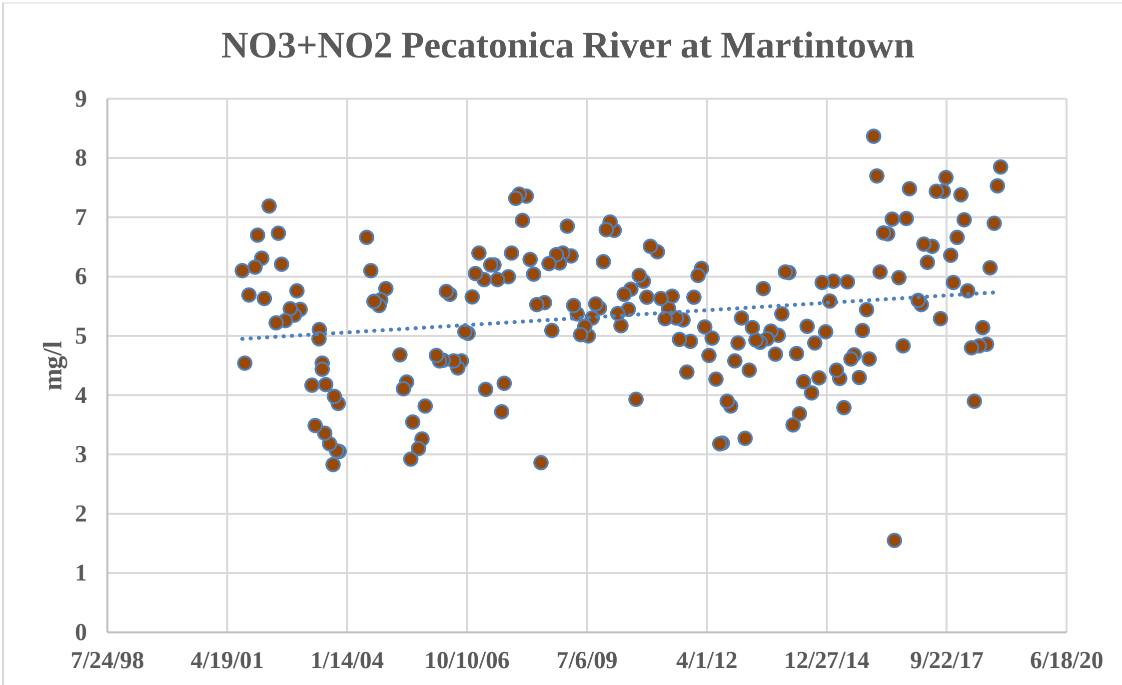
Figure 1: Long Term Trend NO3-N+NO2-N Data for the Kewaunee River (WDNR), Illinois Fox River (WDNR), La Cross River (USFWS and USGS), Pecatonica River (WDNR) and Sugar River (WDNR); NOx-N increasing in all five rivers.





This plot shows WRTDS-estimated annual mean concentrations of the selected parameter. Points are annual estimates (not flow normalized), line is flow-normalized estimate, and gray band (if present) is the 90% confidence interval around the flow-normalized estimate (LCL and UCL are lower and upper confidence limits).




NO3+NO2 Pecatonica River at Martintown
mg/l
0
1
2
3
4
5
6
7
8
9
7/24/98
4/19/01
1/14/04
10/10/06
7/6/09
4/1/12
12/27/14
9/22/17
6/18/20

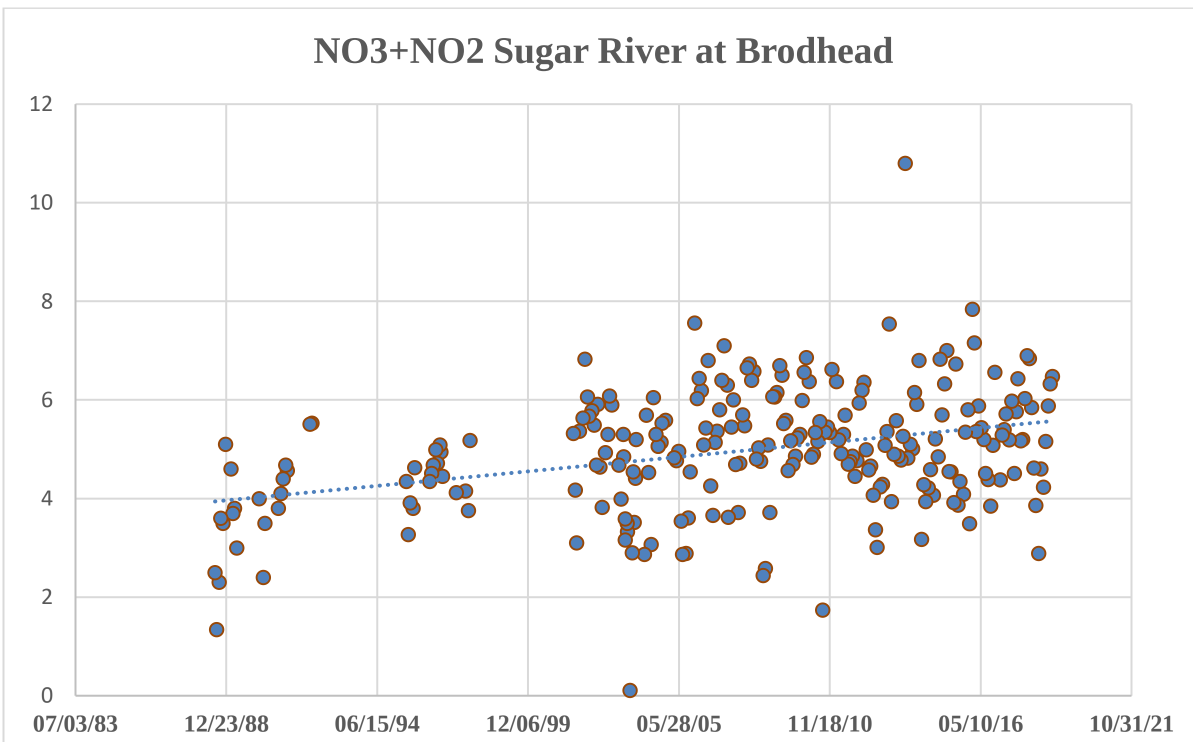

NO3+NO2 Sugar River at Brodhead
0
2
4
6
8
10
12
07/03/83
12/23/88
06/15/94
12/06/99
05/28/05
11/18/10
05/10/16
10/31/21

Figure 2: Exceptional Resource Water (ERW) Jones Slough along the Lower Wisconsin River, Sauk County. Excessive nitrate loading resulted in severe free-floating plant cover and water quality degradation that violates the Clean Water Act antidegradation rule.

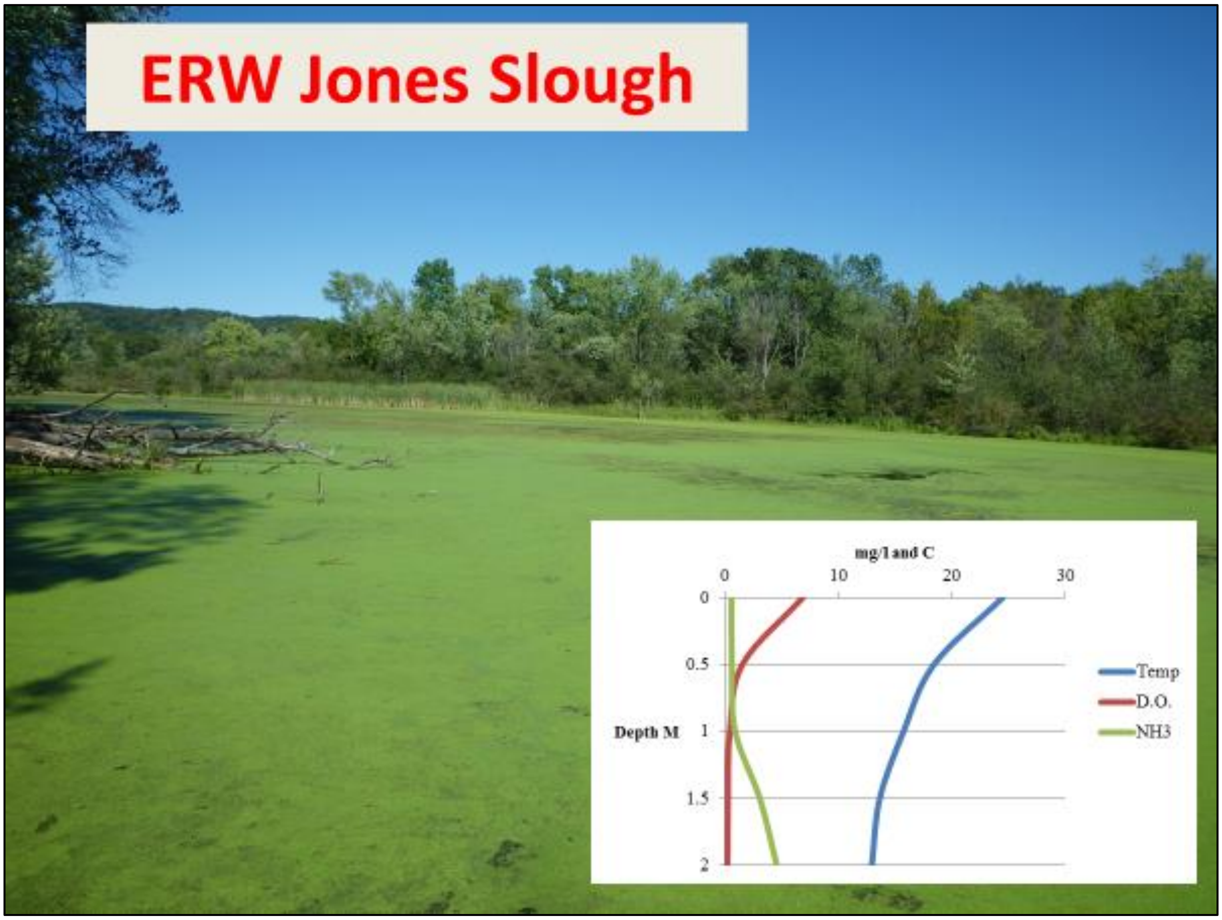


Figure 3: Mean NO3-N+NO2-N and total phosphorus and N:P ratios in nested wells along the banks of four ERW spring lake oxbows demonstrated that nitrogen is the primary cause for eutrophication and water quality degradation of ERW Lower Wisconsin State Riverway oxbow lakes.

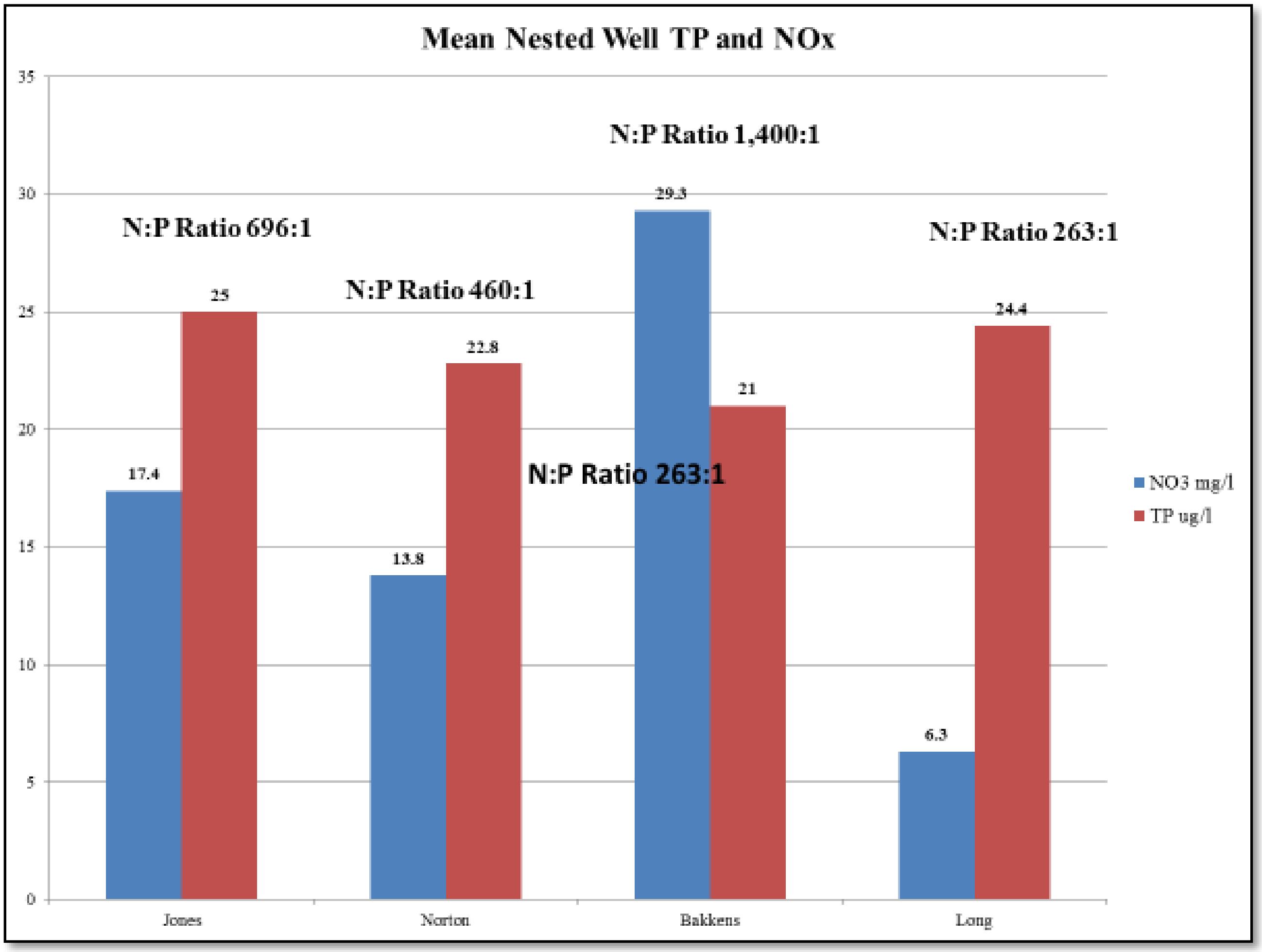


Figure 4: Groundwater Contamination Susceptibility (UW Extension and WDNR 1989) usually coincides with surface water quality degradation.

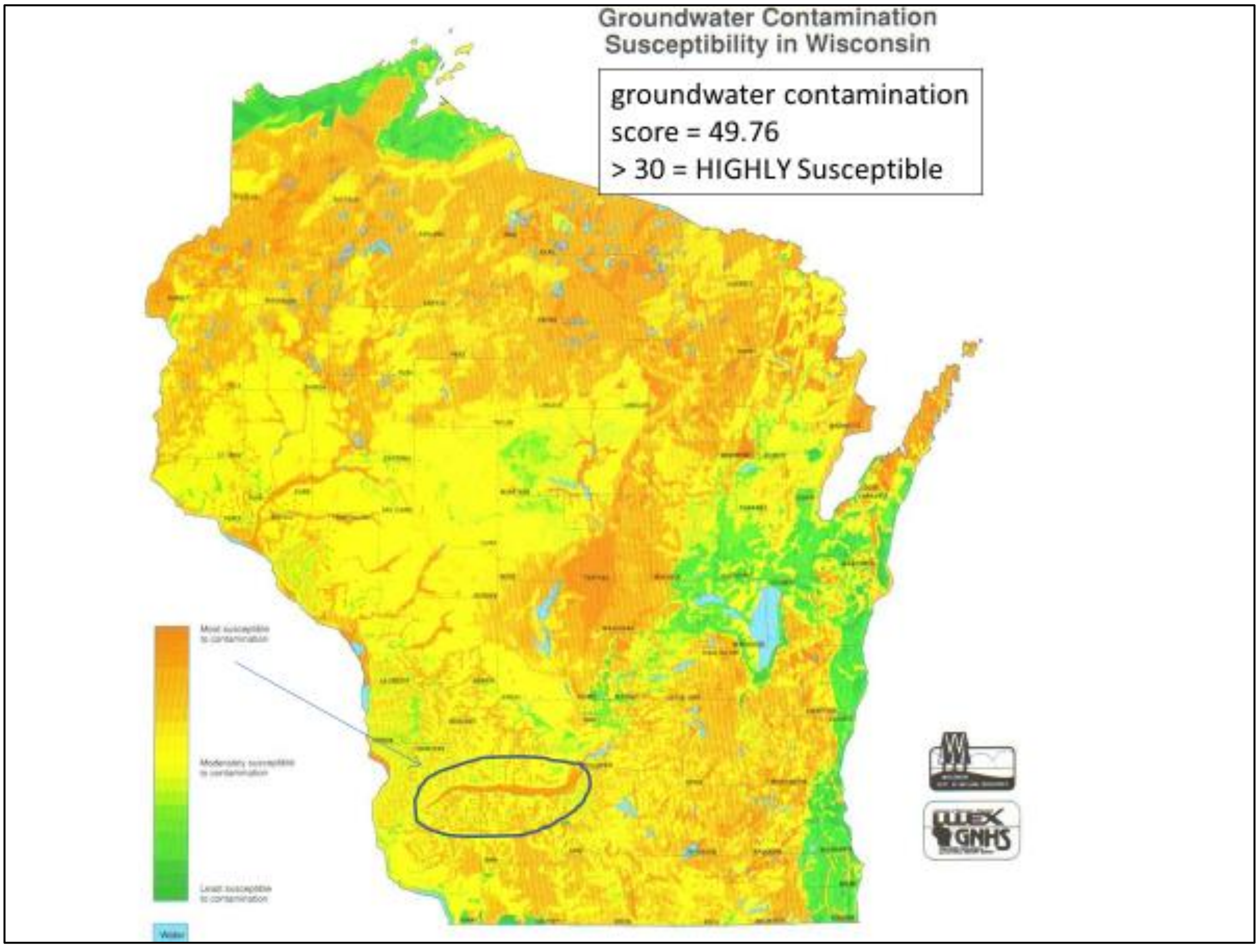


Figure 5: Photo of liquid manure transported in large semi-trailers produced significant distances from the Lower Wisconsin River sand terrace where it is field spread. The practice demonstrates the failure of approved agronomic nutrient management since excessive amounts pollute both groundwater and surface water.

Background on Scientific Literature and Data

The US Environmental Protection Agency (USEPA) (2000) recommends that states and tribes adopt water quality criteria for both phosphorus and nitrogen. The need for criteria development is in part based on widespread state and tribal reports that identify excessive nutrient levels as a major reason why nearly half of the surface waters in the U.S. do not meet water quality objectives. Development of phosphorus criteria and control of phosphorus sources is seen across North America and Europe, while nitrogen regulations lag and nitrogen pollution increases (Howarth 2008). The focus on phosphorus is largely a response to the groundbreaking nutrient manipulations at Lake 227 in the Experimental Lakes Area, Canada (Schindler 1973), along with additional evidence/arguments that phosphorus is the primary limiting nutrient in lakes (Carpenter 2008, Schindler et al. 2008).

Recent research has demonstrated that controlling both nitrogen and phosphorus is required to reduce eutrophication and is more in line with USEPA recommended nutrient control strategies (Conley et al. 2009, Lewis et al. 2011). Phosphorus controls may be more critical for managing stratified glacial lakes and impoundments, but shallow lakes and estuaries can be adversely affected by elevated nitrogen (Sondergaard et al. 2017, Howarth 2008). In coastal estuaries, nitrogen is more often the limiting nutrient and primary cause of eutrophication (Howarth and Marino 2006). Even in some stratified eutrophic lakes, anthropogenic nitrogen has been linked to toxic non-diazotrophic (non-nitrogen fixing) Cyanobacteria blooms (Gobler et al 2016). In Lake Mendota, where the long-term nutrient management has primarily focused on phosphorus control, toxic non-diazotrophic algal blooms have also occurred in response to elevated nitrate nitrogen (NO3-N) concentrations (Beversdorf et al. 2015).

Regarding river systems, there appears to be less debate regarding the dual role of phosphorus and nitrogen effects on water quality, although manifested in different ways. Robertson et al. (2006) reported significant negative biotic responses in wadeable streams to modest increases in both phosphorus and nitrogen concentrations. Rivers are also conduits for nitrogen loading to the Gulf of Mexico and resulting hypoxia zone (Goolsby et al. 1999). At long term river monitoring sites in Wisconsin, trends in nitrogen concentrations were highly variable due to temporal and spatial factors. It is uncertain if floodplain denitrification may be attenuating main channel N concentrations.

In addition to eutrophication effects, NO3-N also poses toxicity issues for many Wisconsin streams. In Figure 1, NO3-N concentrations in the Kewaunee River and Illinois Fox River were often higher than Total Kjeldahl Nitrogen (TKN) and are increasing. In both rivers NO3-N concentrations consistently exceed chronic toxicity levels (2.5 mg/l NO3-N) established by Camargo et al. (2005). US Fish and Wildlife Service and US Geological Survey (USGS) monitoring demonstrated that NO3-N+NO2-N has been increasing in the La Crosse River since 1973 and more recently concentrations exceed recommended 2.5 mg/l chronic criteria. Based on monthly sampling at the WDNR long term trend site on the Pecatonica River at Martintown and Sugar River at Brodhead, nearly all of the samples dating back to the late 1980s exceeded recommended chronic toxicity level. Where agriculture dominates a surrounding landscape, affected streams often reflect a state of "N hypersaturation" with widespread chronically toxic NO3-N and nitrite nitrogen (NO2-N) concentrations (Stanley and Maxted 2008). Robertson et al. (2006) describe the threshold or breakpoint for macroinvertebrate and fish communities, as indicated by Biotic Index and Index of Biotic Integrity metrics, at about 3.5 mg/l NO3-N. While no action has been proposed to reduce surface water NO3-N levels in Wisconsin, Minnesota is developing criteria for protection of fish and aquatic life. The draft proposed criteria include 3.1 mg/l NO3-N for cool cold aquatic communities and 4.9 mg/l NO3-N for cool/warm aquatic communities (MPCA 2010). There are numerous examples in Wisconsin where NO3-N concentrations exceed both the Camargo et al. (2005) toxicity level and Minnesota proposed criteria (examples in Table 1 and Table 2).

Table 2: Some examples of southcentral Wisconsin surface waters containing very high NO3-N concentrations exceeding chronic NO3-N toxicity levels.

Dates	County	Surface Water	NO3-N + NO2-N mg/l	Source
Nov. 21, 2006 Jan. 12, 2007	Rock	Trib. to ERW Norwegian Creek	205 51	CAFO tiled field, drain tile outlet
Oct. 27, 2015 Aug. 1, 2016 Sept. 9, 2017	Sauk	ERW Jones Slough Oxbow spring lake	16.9 21.4 21.1	Sand terrace nutrient management
March 30, 2015 June 29, 2016 Oct. 10, 2017	Sauk	ERW SNA Bakkens Pond Oxbow spring lake	15.6 9.1 10.7	Sand terrace nutrient management
May 30, 2016	Dane	Kittleson Valley Cr. Trout stream	13.0	Contaminated g.w.
Aug. 11, 2014 June 11, 2018	Dane	Frederick Spring on Pheasant Br. Cr.	14.8 14.0	Contaminated g.w.
Aug. 13, 2014	Dane	Spring on Token Cr. Trout stream	12.1	Contaminated g.w.
Aug. 11, 2014 May 17, 2015	Dane	Spring on Mt. Vernon Cr. Trout stream - ERW	5.8 5.4	Contaminated g.w

Table 3: Estimated NOx-N loads from major tributaries of the Upper Mississippi River in Wisconsin. P data from Wisconsin's Long Term Trends network 2001-2005. Annual average discharge data from nearby USGS gage. Ranked by NOx yield (highest to lowest). J. Sullivan WDNR-LaCrosse.

River	Location	Median NOx-N mg/l	Discharge cfs	Load Lbs/year	Area Sq. miles	Yield Lbs/a/Yr.
Pecatonica	Martintown	5.58	723	7,942,849	1,034	12.00
Sugar	Brodhead	5.14	372	3,764,522	523	11.25
Trempealeau	Dodge	2.03	514	2,054,296	643	4.99
Rock	Afton	1.90	2,156	8,065,033	3,340	3.77
La Crosse	La Crosse	1.19	346	810,638	471	2.69
Chippewa	Durand	0.73	8,451	12,146,042	9,010	2.11
Black	Galesville	0.74	1,788	2,604,972	2,080	1.96
Wisconsin	Muscoda	0.66	8,551	11,111,294	10,400	1.67
St. Croix	Prescott	0.12	5,994	1,416,060	7,650	0.29

Table 4: Potential Nutrient Related Water Quality Criteria for Total Nitrogen for Rivers, Lakes, Backwaters and Wetlands based on USEPA Guidance and Wisconsin DNR Studies.

Document Source	Waterbody Type	Location	Criteria Basis	TN mg/l	Comments
USEPA 2000a	Rivers and Streams	Ecoregion 7	25th Percentile[a]	0.54	Reported TN
		Sub-basin 52	25th Percentile[a]	1.51/1.88	Reported TN/ Calculated TN[b]
		SWTP-53		1.59/1.30	Reported TN Calculated TN[b]
USEPA 2000b	Lakes and Reservoirs	Ecoregion 7	25th Percentile[a]	0.57/0.66	Reported TN Calculated TN[b]
		Sub-basin 52	25th Percentile[a]	1.18	Calculated TN[b]
Sullivan 2008	Backwaters, Floodplain lakes and Wetlands	Upper Mississippi River	Metaphyton (free floating plants) and Duckweeds	0.95	Diverse aquatic plant community protection
				1.23	Midsummer D.O. 3.0 mg/l and Metaphyton biomass <25 g/m^2
Sullivan and Giblin 2012	Backwaters and Floodplain Lakes	Upper Mississippi River	Duckweeds	0.46/0.67	Duckweeds limited by N&P Median TP 0.044-0.079
Giblin et al. 2014	Backwaters and Floodplain Lakes	Upper Mississippi River	Metaphyton and Duckweeds	<0.81[c]	Min. concentration to sustain metaphyton/duckweed biomass

[a] This is calculated from the 25th percentile of all nutrient data available for this region.
[b] Calculated from Total Kjeldahl Nitrogen + NO3-N+NO2-N data.
[c] Minimum threshold not established due to the absence of data below this concentration.

Surface Water Highly Vulnerable to NO3-N Loading

The common feature of the waters listed in Table 1 is nitrate rich groundwater often occurs in agricultural intensive areas that have an inordinate effect on the surface water quality; such as headwater streams, springs, trout streams, spring lakes, calcareous spring ponds and oxbow lakes/sloughs. NO3-N (and likely NO2-N) toxicity can change biotic communities in headwater streams, springs and some trout streams (Robertson et al. 2006). The Mt. Vernon Creek example listed above is Classified an ERW Class 1 trout stream.

Both toxicity and eutrophication can significantly degrade ponds, oxbows/sloughs and spring lakes. Over the past decade state and federal agencies have focused on the threats of free-floating plants (FFP - primarily filamentous green algae and duckweeds) that have created severe nuisances and ecological disturbances in Mississippi River sloughs and backwaters. Both elevated nitrogen and phosphorus concentrations contribute to this problem with seasonal changes from phosphorus to nitrogen limiting conditions. Restoring these important floodplain habitats will require reducing both phosphorus and nitrogen with proposed criteria in Table 3 (Giblin 2013, Houser et al. 2013, Sullivan and Giblin 2012, and Sullivan 2008). Water column anoxia is often a water quality response with severe impacts to fish and aquatic life. Restoring these waterbodies can be a challenge since anthropogenic nitrogen and phosphorus can sustain an FFP alternative stable state (Scheffer et al. 2003).

The Lower Wisconsin River is the heart of the Lower Wisconsin State Riverway and one of the most biologically diverse large river ecosystems in the Upper Midwest (Lyons 2005). As recently as 2006, the WDNR Land Legacy Report described the Lower Wisconsin River as lacking significant threats and therefore required only limited protection. The report was printed about the time significant changes in nutrient management had occurred across the sand terrace and elsewhere. The Lower Wisconsin State Riverway was considered by many a model for biodiversity conservation (Marshall and Lyons 2008). By as early as 2008 however some oxbow spring lakes were displaying signs of N hypersaturation due to high levels of NO3-N in the sand terrace aquifer (Marshall 2012, Marshall 2013. Degradation of other spring lake oxbows in close proximity to the sand terrace followed within just a few years.

The peripheral floodplain nitrate pollution has not had a dramatic effect on the main river channel water quality. However, the pollution is a concern since floodplain processes are extremely important for diverse large river ecosystems. Denitrification is one important ecological service provided by large river floodplains (Forshay and Stanley 2005, Pfeiffer et al. 2005). Along the Lower Wisconsin State Riverway, some of the denitrification and NO3-N uptake is occurring within Exceptional Resource Waters (ERW) oxbow spring lakes that receive as much as 20 mg/l NO3-N entering from the groundwater (Marshall et al. 2016, Marshall and Wade 2017). ERW is the abbreviation for Exceptional Resource Waters defined in NR 102.11 as: "Surface waters which provide valuable fisheries, hydrologically or geologically unique features, outstanding recreational opportunities, unique environmental settings, and which are not significantly impacted by human activities may be classified as exceptional resource waters." Excessive nitrogen input and plant uptake of NO3-N has resulted in severe FFP growths in the oxbows.

The water quality degradation in oxbow lakes can have cascading effects across the entire large river ecosystem. Oxbows, sloughs and other floodplain waterbodies provide important habitats for lateral fish migrations and as nurseries (Kwak 2013, Slipke et al. 2005, Killgore and Miller 1995, Amoros and Bornette 2002).

The nitrate pollution of ERW oxbow lakes along the Lower Wisconsin River is a statewide issue since it has been described as one of the least impacted floodplains in Wisconsin (Lyons 2005) and is a proposed RAMSAR wetland of international importance. Elsewhere human accelerated floodplain aggradation (Knox 2006) has resulted in widespread degradation and loss of oxbow lakes and lateral fish migrations. Oxbow lakes are now described as the most threatened class of lakes in Wisconsin (Marshall 2012. As recently as the early 2000's, Lower Wisconsin State Riverway oxbow lakes were considered some of the most pristine in Wisconsin. Degradation now threatens the largest population of State Endangered starhead topminnows (*Fundulus dispar*). A rescue effort, that includes conservation aquaculture, is now underway to establish a new population out of harm's way.

Figure 2 demonstrates the ecological disturbance in Exceptional Resource Water (ERW) Jones Slough, a Lower Wisconsin River spring lake oxbow. The smothering effect of dense free-floating plants has resulted in frequent periods of anoxia. Figure 3 demonstrates that in spring lakes where the aquifer dominates the overall hydrology, phosphorus is a minor component of groundwater nutrient loading compared with NO3-N. P concentrations in groundwater typically represent mesotrophic levels. The degradation of Lower Wisconsin River oxbows took managers by surprise but the vulnerability of the sand terrace to groundwater contamination was widely known for decades (Figure 4). The sand terrace is often used for liquid manure disposal. In some cases the liquid manure is a waste product transported many miles from the sand terrace and the USDA 590 Nutrient Management Standards and WPDES allows this practice despite the groundwater contamination and impacts to surrounding oxbow spring lakes (Figure 5).

Conclusion

Considerable research no longer supports the sole focus on phosphorus for controlling eutrophication but rather the dual role of both nitrogen and phosphorus in the eutrophication process. Inorganic NO3-N and NO2-N also pose toxicity problems in many waterbodies and the impacts of N Hypersaturation are evident from the northeast karst region across the southeast glacial plains, Central Sands, Lower Wisconsin River sand terrace and the rest of the Driftless Area where landscapes include intensive agriculture.

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For more information on this analysis contact Wisconsin's Green Fire at info@wigreenfire.org

Wisconsin's Green Fire: Voices for Conservation is a statewide organization dedicated to supporting our conservation legacy by promoting science-based management of natural resources. Our members include career natural resource professionals and scientists from a variety of disciplines throughout Wisconsin.