ATTACHMENT 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

JUN 30 2010

REPLY TO THE ATTENTION OF:
WN-16J

Al Keller, Manager
Permit Section, Division of Water Pollution Control
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276

Re: November 2009 Draft Permits for the Metropolitan Water Reclamation District of Greater Chicago (MWRD) Calumet, Stickney, and Northside Plants

Dear Mr. Keller:

The U.S. Environmental Protection Agency Region 5 previously reviewed and commented on the above-referenced public notice draft permits. There were a number of significant public comments raised on those draft permits, including comments raising concerns about the draft permits' provisions (or lack thereof) pertaining to mercury, polychlorinated biphenyls (PCBs), and nutrients. In light of those significant public comments, we offer the following additional recommendations pertaining to the permit, reflecting information that EPA has obtained subsequent to the date of our previous comments.

The review revealed that several water bodies impacted by discharges from the three relevant wastewater treatment plants are impaired and that these wastewater plants' effluent may contain contributing pollutants. In further evaluating the issues raised by the significant public comments, we sent a letter to MWRD requesting effluent and ambient data including flow, temperature, dissolved oxygen, mercury, PCBs, nitrite-nitrogen, nitrate-nitrogen, total Kjeldahl nitrogen, total nitrogen, and total phosphorus parameters. EPA received the requested data from MWRD. For your convenience, we have enclosed the MWRD response letter and a CD containing the data. We also completed a reasonable potential analysis for PCBs and mercury at all plants. Please see the enclosure. We are currently analyzing the nutrient data.

The Little Calumet River, North Branch of the Chicago River, North Shore Channel, Chicago Sanitary and Ship Canal (CSSC) and the Des Plaines River are all included on the State of Illinois' list of impaired waters under Section 303(d) of the Clean Water Act, with impairments being caused by a number of pollutants including mercury, PCBs, and total phosphorus. The Secondary Contact waterways of the Little Calumet River, the North Branch of the Chicago River and the CSSC are upstream of and flow

into the General Use waters of the Des Plaines River. EPA's analysis indicates that mercury discharges may have reasonable potential to cause or contribute to excursions beyond the human health criterion in the downstream General Use waters. EPA's analysis was based on conservative assumptions including no mass loss of mercury in downstream waters and no additional inflows or outflows.

We recommend that the Illinois Environmental Protection Agency (Illinois EPA) conduct its own reasonable potential analyses for mercury and nutrients for the Calumet, Stickney, and Northside plants prior to finalizing the permits for those plants, and include in the final permits appropriate water quality based effluent limitations where reasonable potential exists. We also recommend that Illinois EPA include in the finalized permits provisions requiring that the permittee use test methods 1631E for mercury and 1668 for PCBs. While EPA has not promulgated method 1668 as a 40 CFR part 136 method, we note that 40 CFR § 122.21(j)(4)(viii) allows use of an alternative in a permit application when the alternative is specified in the (prior) permit. It is appropriate for Illinois EPA to require methods 1631E and 1668 so the State can determine whether effluent limits for mercury or PCBs are required in future permits under 40 CFR § 122.44(d). Finally, we recommend that a meeting or telephone conference between Region 5 and Illinois EPA be scheduled to discuss the outcome of Illinois EPA's reasonable potential analysis. We are available to assist Illinois EPA throughout this process.

It is our expectation that Illinois EPA will appropriately address the issues raised by this letter before it finalizes the three referenced permits. Nevertheless, in light of the significant public comments on these and other issues, we have determined that the State must submit the permits that it proposes to finally issue (*i.e.*, the "proposed permit" as defined at 40 CFR § 122.2) to EPA in accordance with 40 CFR § 123.44(j), for EPA review in accordance with 40 CFR § 123.44.

If you should have any questions regarding this letter feel free to contact Janet Pellegrini of my staff at (312) 886-4298. For questions pertaining to the reasonable potential analysis please contact Rob Pepin at (312) 886-1505.

Sincerely,

Kevin M. Pierard, Chief
NPDES Programs Branch

Enclosures

cc: Amy Dragovich, Illinois EPA
Rob Sulski, Illinois EPA

U. S. Environmental Protection Agency
Region 5 NPDES Branch
Reasonable Potential Analysis
Robert Pepin
June 2010

EPA conducted a reasonable potential analysis for mercury and PCBs. Effluent and ambient waterway data for the years 2005-2009 were provided by the MWRD for the three main treatment plants (Northside, Stickney, and Calumet) and for the receiving waterways in the Chicago River system. EPA used the methodology described in the March 1991 EPA/505/2-90-001 PB91-127415 Technical Support Document for Water Quality-based Toxics Control, assuming a log-normal distribution of the effluent data. The chemicals were considered conservative after discharge; no loss assumed, and no additional inputs of dilution water. Where data were below detection a concentration of 0 was assumed. The results of the analyses are summarized below.

PCBs

USEPA conducted a reasonable potential analysis for PCBs. However, the outcome of the analysis is not meaningful because all effluent and ambient data were below the reporting level (300 to 500 ng/L) and the reporting level is well above the human health National Recommended Water Quality Criteria (0.064 ng/L); at http://epa.gov/waterscience/criteria/wqctable/). EPA method 1668 has an estimated minimum level of 0.050 to 1 ng/L dependent on the congener to be measured. While these levels are above the National Recommended Criterion, method 1668 is much more sensitive than the method that MWRD currently employs. The State should require MWRD to use method 1668.

Mercury

A reasonable potential analysis was conducted for mercury for all three plants. The analysis considered both the Secondary Contact Use criterion of 500 ng/L and the General Use criterion of 12 ng/L. The results indicate no reasonable potential for all three plants to cause or contribute to an exceedence of the Secondary Contact Use criterion, but all three were determined to have reasonable potential to cause or contribute to exceedences of the General Use criterion. Based on this analysis, water quality-based effluent limits for mercury should be established for all three facilities. Further, the reporting level provided by the MWRD ranged from 9-50 ng/L. The EPA approved method 1631E has a minimum level of 0.5 ng/L. Because of the sensitivity of method 1631E in relation to the General Use criterion for mercury, the State should require this method to be used by the MWRD.

Attachment

		Mercury WQC (ug/L)		Flows[1]	
		Secondary Contact	General Use		
		302.407	302.208(f)	Statistic	Mixing (35 IAC 302.102)
USE	Acute		2.6	7Q10	25%
	Chronic		1.3	7Q10	25%
	Human 1	0.5	0.012	7Q10	25%
	Human 2				
	Ind/Agric				
	Other				

	Statistic	Northside	Stickney	Calumet
Effluent Flow		515	1857	548
Background Flow		0	311	20
n		260	260	261
n (<RL)		226	217	250
Max		0.320	0.260	0.100
Mean		0.0076	0.0106	0.0022
CoV		3.6580	2.9617	5.3076
α		0.95	0.95	0.95
Multiplier		0.3575	0.3863	0.3135
PEQ		0.1144	0.0964	0.0311
RP?		YES*	YES*	YES*
		General Use		

[1] A dilution flow is not provided for the Calumet plant since the Little Calumet River is impaired for mercury.

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago
100 East Erie Street Chicago, Illinois 60611-3154 f: 312.751.7926 312.751.7900

Richard Lanyon
Executive Director
richard.lanyon@mwrd.org

April 14, 2010

Mr. Kevin M. Pierard
Chief of NPDES Programs Branch
United States Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3590

Dear Mr. Pierard:

SUBJECT: Response to File WN-16J, USEPA Region 5: Request for Monitoring Data from the Metropolitan Water Reclamation District of Greater Chicago

In response to your April 8, 2010 letter requesting monitoring data and information we have compiled the following for your use:

1. USEPA Region 5 Data Request 2005-2009 Effluent Data Large Plants.xls. This workbook contains worksheet tabs by plant and by year. Information contained includes: flow (millions of gallons per day), dissolved oxygen (DO) mg/L, total Kjeldahl nitrogen (TKN) mg/L, NO_2-N+NO_3-N mg/L, total nitrogen (Total N) (calculated) mg/L, phosphorus mg/L, temperature and mercury µg/L.

2. USEPA Region 5 Data Request 2005-2009 Waterways.xls. This workbook contains worksheet tabs by year. Each year is sorted by waterway location. The first worksheet tab is a description of each waterway sample location. Information contained includes DO, temperature, NO_2+NO_3-N, TKN, Total N, phosphorous and mercury.

3. USEPA Region 5 Data Request PCBs 2005-2009 Waterways and Large Plants.xls. This workbook contains three worksheet tabs 1) Waterway Locations 2) Waterway PCBs µg/L and 3) Plant Effluent PCBs. **Note**: All sample results for PCBs were non-detects.

4. CDOMReqData 12M04Y10.xls: This workbook contains continuous DO monitoring data for years 2005-2009, sorted by location and includes hourly

SUBJECT: Response to File WN-16J, USEPA Region 5: Request for Monitoring Data from the Metropolitan Water Reclamation District of Greater Chicago

readings. There is a worksheet tab which lists the monitoring stations and 16 tabs, one for each location.

5. 2007 AWQA Program Quality Assurance Plan (QAPP).pdf. Included within this file is the requested information such as sampling frequency, sampling locations, sample depth, latitude & longitude as well as test methods utilized. **Note**: All test methods used are approved methods contained in 40 CFR Part 136.

The data are in Excel format and the files are on the attached CD.

If you have any further questions or require more information please contact Mr. Louis Kollias, Director of Monitoring and Research, at (312) 751-5190 or Louis.Kollias@mwrd.org.

Very truly yours,

R Lanyon

Richard Lanyon
Executive Director

LK:TG:bk
Attachments
cc: L. Kollias
F. Feldman
O. Jamjun

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

APR - 8 2010

REPLY TO THE ATTENTION OF:
WN-16J

Richard Lanyon, General Superintendent
Metropolitan Water Reclamation
District of Greater Chicago
100 East Erie Street
Chicago, Illinois 60611-3154

Re: Information Request - Metropolitan Water Reclamation District of Greater Chicago's (MWRD);
November 9, 2009, permit for the Calumet Water Reclamation Plant (WRP), IL0028061
November 11, 2009 permit for the Stickney Water Reclamation Plant, IL0028053, and
November 12, 2009 permit for the Northside Water Reclamation Plant, IL0028088

Dear Mr. Lanyon:

The U.S. Environmental Protection Agency, Region 5, reviewed the above-referenced public notice permits for the Calumet, Stickney and Northside Water Reclamation Plants (WRPs). That review revealed various use impairments for each of the receiving water bodies with potential contributing pollutants that may be contained in the effluent from these WRPs. In order to complete our permit review for these WRPs we are requesting data of the MWRD.

Please provide the following information electronically and in a tab delimited formation with column names as headings: Sampling information that contains the most recent 5 years of data regarding mercury, polychlorinated biphenyls and nutrients (total nitrogen including nitrite and nitrate, and phosphorus) including (1) all ambient water samples; (2) Calumet, Stickney and Northside WRPs effluent water samples and (3) associated dissolved oxygen, percent saturation, temperature and effluent flow (when applicable). Include for all ambient, effluent and associated parameter samples, the sampling frequency, sampling location, sample dates, sample depths, latitude, longitude and if available, easting/northing projection information. Additionally, specify test methods utilized and test results with units for each parameter.

Please provide this information within seven days of receipt of this letter. If you have any questions or require additional information concerning this matter you may contact me or Janet Pellegrini of my staff at (312) 886-4448 or (312) 886-4298 respectively.

Sincerely,

Kevin M. Pierard, Chief
NPDES Programs Branch

cc: Al Keller Illinois EPA,
Rob Sulski, Illinois EPA, Des Plaines Office

ATTACHMENT 2

Wis. Admin. Code s NR 102.06

C
Wisconsin Administrative Code Currentness
Department of Natural Resources
Chapter NR 102. Water Quality Standards for Wisconsin Surface Waters
Subchapter I. General (Refs & Annos)
➡ **NR 102.06 Phosphorus.**

(1)GENERAL. This section identifies the water quality criteria for total phosphorus that shall be met in surface waters.

(2)DEFINITIONS. In this section:

(a) "Drainage lake" means a lake with an outlet stream that continually flows under average summer conditions based on the past 30 years.

(b) "Ephemeral stream" means a channel or stream that only carries water for a few days during and after a rainfall or snowmelt event and does not exhibit a flow during other periods, and includes, but is not limited to, grassed waterways, grassed swales, and areas of channelized flow as defined in s. NR 243.03 (7).

(c) "Mean water residence time" means the amount of time that a volume of water entering a waterbody will reside in that waterbody.

(d) "Nearshore waters" means all waters of Lake Michigan or Lake Superior within the jurisdiction of the State of Wisconsin in the zone extending from the shore to a depth of 10 meters, based on the long-term mean elevation for Lake Superior of 183.4 meters (601.7 feet) and for Lake Michigan of 176.5 meters (579.0 feet).

(e) "Open waters" mean all waters of Lake Michigan or Lake Superior within the jurisdiction of the State of Wisconsin with depths greater than nearshore waters.

(f) "Reservoir" means a waterbody with a constructed outlet structure intended to impound water and raise the depth of the water by more than two times relative to the conditions prior to construction of the dam, and that has a mean water residence time of 14 days or more under summer mean flow conditions using information collected over or derived for a 30 year period.

(fm) "Seepage lake" means a lake that does not have an outlet stream that continually flows under average summer conditions based on the past 30 years.

(g) "Stratified lake or reservoir" means a lake or reservoir where either of the following equations results in a value of greater than 3.8:

Maximum Depth (meters) -- 0.1

Log_{10}Lake Area (hectares)

Maximum Depth (feet)* 0.305 -- 0.1

Log_{10}Lake Area (acres) * 0.405

(i) “Stratified two-story fishery lake” means a stratified lake which has supported a cold water fishery in its lower depths within the last 50 years.

(j) “Total phosphorus” means all of the phosphorus in a water sample analyzed using the methods identified under the provisions of s. NR 219.04 (1).

(3)STREAMS AND RIVERS. To protect the fish and aquatic life uses established in s. NR 102.04 (3) on rivers and streams that generally exhibit unidirectional flow, total phosphorus criteria are established as follows:

(a) A total phosphorus criterion of 100 ug/L is established for the following rivers or other unidirectional flowing waters:

1. Apple River from the outlet of the Apple River Flowage in Amery to the St. Croix River, excluding Black Brook Flowage.

2. Bad River from confluence with the Marengo River within the Bad River Indian Reservation downstream to Lake Superior.

3. Baraboo River from highway 58 in La Valle to the Wisconsin River.

4. Bark River from confluence with Scuppernong River near Hebron to the Rock River.

5. Black River from confluence with Cunningham Creek near Neillsville to Mississippi River, excluding Lake Arbutus.

6. Brule River from state highway 55 in Forest County downstream to Menominee River.

7. Buffalo River from confluence with Harvey Creek near Mondovi to Mississippi River.

8. Chippewa River from Lake Chippewa in Sawyer County to Mississippi River, excluding Holcombe Flowage, Cornell Flowage, Old Abe Lake, Lake Wissota and Dells Pond.

9. Crawfish River from confluence with Beaver Dam River to Rock River.

10. East Branch Pecatonica River from confluence with Apple Branch Creek near Argyle to Pecatonica River.

11. Eau Claire River from confluence with Bridge Creek near Augusta to Chippewa River, excluding Altoona Lake.

12. Embarrass River from confluence with Pigeon River near Clintonville to Wolf River.

13. Flambeau River from outlet of Turtle-Flambeau Flowage in Iron County to Chippewa River, excluding Pixley Flowage, Crowley Flowage and Dairyland Flowage.

14. Fox River from outlet of Lake Puckaway near Princeton to Green Bay, excluding Lake Butte des Morts and Lake Winnebago.

15. Fox River from confluence with Mukwonago River near Mukwonago to state line, excluding Tichigan Lake.

16. Grant River from confluence with Rattlesnake Creek near Beetown to Mississippi River.

17. Jump River from confluence with the North Fork and the South Fork of the Jump rivers in Price County to Holcombe Flowage.

18. Kickapoo River from confluence with Weister Creek near La Farge to Wisconsin River.

19. Kinnickinnic River from confluence with Wilson Park Creek in Milwaukee to Milwaukee River.

20. La Crosse River from confluence with Fish Creek near Bangor to Mississippi River, excluding Neshonoc Lake.

21. Lemonweir River from outlet of New Lisbon Lake in New Lisbon to Wisconsin River, excluding Decorah Lake.

22. Little Wolf River from confluence with South Branch Little Wolf River near Royalton to Wolf River.

23. Manitowoc River from confluence of North Branch and South Branch Manitowoc rivers to the opening at the end of the piers at Lake Michigan.

24. Menominee River from confluence with Brule River to the opening at the end of the piers at Green Bay.

25. Menomonee River from confluence with Little Menomonee River to Milwaukee River.

26. Milwaukee River from confluence with Cedar Creek downstream to the openings of the breakwaters at Lake Michigan.

27. Mississippi River main channels and side channels.

28. Namekagon River from outlet of Trego Lake near Trego to St. Croix River.

29. Oconto River from confluence with Peshtigo Brook to the opening at the end of the piers at Green Bay.

30. Pecatonica River from confluence with Vinegar Branch near Darlington to state line.

31. Pelican River from confluence with Slaughterhouse Creek near Rhinelander to Wisconsin River.

32. Peshtigo River from confluence with Brandywine Creek downstream to Green Bay, excluding Cauldron Falls Flowage and High Falls Flowage.

33. Pine River from confluence with Popple River in Florence County to Menominee River, excluding Pine River Flowage.

34. Red Cedar River from confluence with Brill River to Chippewa River, excluding Rice Lake, Tainter Lake and Lake Menomin.

35. Rock River from outlet of Sinissippi Lake downstream to the state line, excluding Lake Koshkonong.

36. St. Croix River from confluence with Namekagon River downstream to Mississippi River, excluding Lake St. Croix near Hudson.

37. St. Louis River from state line to the opening between Minnesota Point and Wisconsin Point at Lake Superior.

38. Sheboygan River from outlet of Sheboygan Marsh to the opening at the end of the piers at Lake Michigan.

39. South Fork of Flambeau River from state highway 13 near Fifield to Flambeau River.

40. Sugar River from outlet of Albany Lake to state line, excluding Decatur Lake.

41. Tomahawk River from outlet of Willow Reservoir to Lake Nokomis.

42. Trempealeau River from confluence with Pigeon Creek near Whitehall to Mississippi River.

43. White River from outlet of White River Flowage in Ashland County to Bad River.

44. Wisconsin River from the Rhinelander Dam to Mississippi River, excluding Lake Alice, Lake Mohawksin, Alexander Lake, Lake Wausau, Mosinee Flowage, Lake Dubay, Wisconsin River Flowage, Biron Flowage, Petenwell Flowage, Castle Rock Flowage and Lake Wisconsin.

45. Wolf River from confluence with Hunting Creek in Langlade County to Lake Poygan.

46. Yahara River from outlet of Lake Kegonsa to Rock River.

(b) Except as provided in subs. (6) and (7), all other surface waters generally exhibiting unidirectional flow that are not listed in par. (a) are considered streams and shall meet a total phosphorus criterion of 75 ug/L.

(4)RESERVOIRS AND LAKES. Except as provided in sub. (1), to protect fish and aquatic life uses established in s. NR 102.04 (3) and recreational uses established in s. NR 102.04 (5), total phosphorus criteria are established for reservoirs and lakes, as follows:

(a) For stratified reservoirs, total phosphorus criterion is 30 ug/L. For reservoirs that are not stratified, total phosphorus criterion is 40 ug/L.

(b) For the following lakes that do not exhibit unidirectional flow, the following total phosphorus criteria are established:

1. For stratified, two-story fishery lakes, 15 ug/L.

2. For lakes that are both drainage and stratified lakes, 30 ug/L.

3. For lakes that are drainage lakes, but are not stratified lakes, 40 ug/L.

4. For lakes that are both seepage and stratified lakes, 20 ug/L.

5. For lakes that are seepage lakes, but are not stratified lakes, 40 ug/L.

(c) Waters impounded on rivers or streams that don't meet the definition of reservoir in this section shall meet the river and stream criterion in sub. (3) that applies to the primary stream or river entering the impounded water.

(5)GREAT LAKES. To protect fish and aquatic life uses established in s. NR 102.04 (3) and recreational uses established in s. NR 102.04 (5) on the Great Lakes, total phosphorus criteria are established as follows:

(a) For both open and nearshore waters of Lake Superior, 5 ug/L.

(b) For both open and nearshore waters of Lake Michigan, excluding waters identified in par. (c), 7 ug/L.

(c) For the portion of Green Bay from the mouth of the Fox River to a line from Long Tail Point to Point au Sable, the water clarity and other phosphorus-related conditions that are suitable for support of a diverse biological community, including a robust and sustainable area of submersed aquatic vegetation in shallow water areas.

(6)EXCLUSIONS. The following waters are excluded from subs. (3) (b), (4) and (5):

(a) Ephemeral streams.

(b) Lakes and reservoirs of less than 5 acres in surface area.

(c) Wetlands, including bogs.

(d) Waters identified as limited aquatic life waters in ch. NR 104. Limited aquatic life waters are those subject to the criteria in s. NR 104.02 (3) (b) (2).

(7)SITE-SPECIFIC CRITERIA. A criterion contained within this section may be modified by rule for a specific surface water segment or waterbody. A site-specific criterion may be adopted in place of the generally applicable criteria in this section 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.

Note: Reservoirs, two-story fishery lakes and water bodies with high natural background phosphorus concentrations are the most appropriate water bodies for site-specific criteria.

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.”

Wis. Admin. Code s NR 102.06

History: Cr. Register, July, 1975, No. 235, eff. 8-1-75; am. Register, October, 1986, No. 370, eff. 11-1-86; renum. from NR 102.04, Register, February, 1989, No. 398, eff. 3-1-89; am. Register, November, 1992, No. 443, eff. 12-1-92; **CR 10-035: r. and recr. Register November 2010 No. 659, eff. 12-1-10; renumbering of (2) (fm) made under s. 13.92 (4)(b)1., Stats., Register November 2010 No. 659.**

Wis. Adm. Code s NR 102.06, WI ADC s NR 102.06

Current through Register 659, November 2010 Update

END OF DOCUMENT

ATTACHMENT 3

Form 1100-001
(R 12/09)

NATURAL RESOURCES BOARD AGENDA ITEM

Item No. 3.A.5

SUBJECT: Request authorization for hearing Board Order #WT-25-08, revisions to NR 102 and NR 217 related to phosphorus water quality standards criteria and WPDES permit provisions for phosphorus.

FOR: MARCH 2010 **BOARD MEETING**

TO BE PRESENTED BY: Russ Rasmussen, Director Bureau of Watershed Management

SUMMARY:

The proposed administrative rule changes include phosphorus water quality standards criteria for streams, inland lakes and Great Lakes, as required by the U.S. Environmental Protection Agency. These criteria are also in response to identified phosphorus-related water quality in many Wisconsin waters including nuisance algae blooms in lakes, "toxic algae", algal mats along Lake Michigan beaches and low dissolved oxygen in streams and rivers. The criteria will be used to determine whether or not waters are impaired, serve as "targets" for total maximum daily load allocations, used to determine water quality based effluent limits for WPDES permits and used as the basis for water quality based nonpoint source performance standards. The proposed administrative rules changes also include new procedures for developing and implementing Wisconsin Pollutant Discharge Elimination System permit water quality based effluent limits for phosphorus. The affordability of meeting projected effluent limits is a concern for many municipal and industrial wastewater dischargers.

RECOMMENDATION:

LIST OF ATTACHED MATERIALS:

No	☐	Fiscal Estimate Required	Yes	☑	Attached
No	☑	Environmental Assessment or Impact Statement Required	Yes	☐	Attached
No	☐	Background Memo	Yes	☑	Attached

APPROVED:

Russell Rasmussen — 3/1/10
Bureau Director, — Date

[signature] — 3/5/10
Administrator, — Date

Matt Frank — 3-5-10
Secretary, Matt Frank — Date

cc: Laurie J. Ross - AD/8 Julia Riley -- WT/3 Robin Nyffeler - LS/8
Russ Rasmussen -- WT/3

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: March 5, 2010 FILE REF: 3200

TO: Natural Resources Board Members

FROM: Matt Frank, Secretary

SUBJECT: Request Authorization for Public Hearing Authorization for Board Order WT-25-08, Pertaining to the Revision of chs. NR 102 and 217, Wis. Adm. Code, Incorporating Phosphorus Water Quality Standards Criteria for Lakes, Streams and Wisconsin Pollutant Discharge Elimination System Permit Water Quality Based Effluent Standards and Limitations for Phosphorus

Why is this rule being proposed?

This rule is being proposed to set numeric phosphorus water quality standards criteria for lakes, reservoirs, streams and rivers per s. 281.15, Wis. Stats, (refines existing narrative criteria) and to establish provisions for developing and implementing Wisconsin Pollutant Discharge Elimination System (WPDES) permit provisions based on the phosphorus criteria per ss. 283.11, 283.13(5), 283.31, 283.55 and 283.84, Wis. Stats.

What event or action triggered the proposal?

The revision is in response to phosphorus related problems in many Wisconsin lakes and streams. Although these water quality problems have been known for some time, results of studies published in 2006 and 2008 have now provided information sufficient to establish statewide phosphorus water quality standards to assure protection of designated uses of Wisconsin's waters. Federal law also requires the adoption of nutrient criteria.

Phosphorus related water quality problems across the state include algal mats on Lake Michigan beaches, nuisance algae conditions in many Wisconsin lakes, low dissolved oxygen in many Wisconsin streams, and "toxic" blue-green algae in a number of lakes. Presently, 172 lakes and streams are included on Wisconsin's impaired waters list for phosphorus.

In late 2000, US EPA, under the authority of s. 304(a) of the Clean Water Act, published two guidance documents for use by states in setting water quality standards nutrient criteria. Once EPA publishes such guidance documents, states are required within a reasonable number of years to adopt water quality criteria that are protective of designated uses. Under s. 303(c)(4)(B) of the Clean Water Act, US EPA may determine, in the absence of state adopted criteria, that a new or revised standard is needed to meet Clean Water Act requirements and purse federal adoption of the criteria for the state. On November 23, 2009, seven groups notified EPA of their intent to sue over the EPA's failure to promulgate phosphorus and nitrogen criteria for Wisconsin.

In 2001, the Department in concert with the US Geological Survey, initiated stream and river studies to determine the cause and effect relations between phosphorus and nitrogen and stream biotic indices. The results of the stream study were published in 2006 and the results of the river study in 2008. Based on those studies and related studies both in Wisconsin and elsewhere, the Department developed proposed

phosphorus criteria for streams and rivers. In addition, using a wealth of field data and established lake management procedures, the Department proposed phosphorus criteria for lakes and reservoirs. The Department is not proposing nitrogen criteria at this time and will need to develop such criteria in the future.

Summary of the Rules

The proposed rule has two parts. The first is a set of phosphorus water quality standards criteria for rivers, streams, various types of lakes, reservoirs and Great Lakes. The second is procedures for determining and incorporating phosphorus water quality based effluent limitations into Wisconsin Discharge Pollutant Elimination System (WPDES) permits under chapter 283, Stats. Pursuant to 40 CFR 131.11, states are required to adopt water quality standards criteria that are protective of the designated uses of surface waters. Pursuant to section 303(c)(4) of the Clean Water Act, EPA may step in and promulgate the criteria for the state, if the state does not. Development of point source permit procedures is required as part of the state's point source permit delegation agreement. EPA approval of state water quality criteria is required under 40 CFR ss. 131.5, 131.6 and 131.21.

The proposed criterion for listed rivers is 100 ug/l and the proposed criterion for all other streams, unless exempted, is 75 ug/l. The criteria are set at levels intended to prevent in-stream algae and plant growth to the extent that is detrimental to fish and aquatic life as determined by intensive field studies. For example, extensive algae or aquatic plant growth consumes so much dissolved oxygen during the night that too little is left for certain fish species and aquatic insects that are the basis of the food chain. For lakes and reservoirs, a series of phosphorus concentrations are proposed ranging from 15 ug/l for lakes supporting a cold water fishery in lower portions of the lake to 40 ug/l for shallow lakes and reservoirs. For small impoundments, the criteria are the same as the inflowing streams or river. The lake criteria are intended to protect both fish and aquatic life and recreational uses. For Lake Michigan and Lake Superior, the proposed criteria are based on the analyses of the Great Lakes Water Quality Agreement. Provisions are also proposed for future incorporation of site-specific criteria.

The proposed rule establishes a process for implementing the numeric criteria through effluent limits for point source discharge permits. The procedures are in a new subchapter of ch. NR 217. The new provisions will apply to publicly and privately owned wastewater dischargers discharging phosphorus; to a limited extent to concentrated animal feeding operations when phosphorus is being discharged though a treatment system (non-storm water related) discharge; and to municipal storm water discharges when the Department determines that the existing requirements contained in chapters NR 151 and NR 216 are not sufficient to attain and maintain the applicable phosphorus criteria. The proposed rule includes procedures for: determining when a point source has "reasonable potential" to cause or contribute to exceeding water quality standards; calculating water quality based effluent limits; maximum limits; use of total maximum daily load wasteload allocations in lieu of, or in addition to, water quality based effluent limits; compliance schedules and a variance procedure for stabilization pond and lagoon systems. The proposed provisions for compliance schedules and variances include procedures for interim measures and interim effluent limits. Technology-based effluent standards and limitations for phosphorus currently in NR 217 will remain in place for other discharges.

How does this proposal affect existing policy?

In general, the proposed numeric criteria refine the existing narrative criteria in ch. NR 102.06. The proposed criteria fill gaps in our suite of numeric water quality standards criteria. The criteria will also be

used in identifying impaired waters and will be the water quality basis for establishing total maximum daily load allocations for phosphorus. The proposed numeric phosphorus criteria for streams, rivers, lakes, reservoirs and Great Lakes are similar to and are applied in concert with existing numeric criteria for dissolved oxygen and other parameters.

The proposed WPDES phosphorus water quality based effluent limitations are in addition to the existing technology-based phosphorus effluent limitations in ch. NR 217. The existing technology-based effluent limitations apply to municipal discharges of more than 150 pounds of phosphorus per month and industrial discharges of more than 90 pounds per month; regardless of the water quality conditions in the receiving water. The existing technology-based effluent limitations are set at 1 mg/l for phosphorus or an alternate limitation.

Has the Board dealt with these issues before? If so, when and why?

Since the enactment of the federal Clean Water Act in 1972 and corresponding state laws, the Board has dealt with promulgation of a number of water quality standards criteria. The Board dealt with creation of the technology-based phosphorus effluent limitations in 1992. Presently, the Board is dealing with changes to the performance standards and prohibitions in ch. NR 151 that include use of a phosphorus index for agricultural nonpoint source management as well as other performance standards that will reduce the amount of phosphorus carried in runoff from nonpoint sources to lakes and streams.

Who will be impacted by the proposed rule? How will they be impacted?

Ultimately, state residents and tourists will have improved healthy and sustained use and enjoyment of Wisconsin's surface waters for fishing, swimming, scenic enjoyment and water supply.

For point sources, the proposed rule will affect many, but not all municipal and industrial wastewater permitted facilities that directly discharge phosphorus to lakes and streams. Since the rule deals with water quality based effluent limitations, the effect will vary for each discharge from no additional limitations for waters with assimilative capacity to relatively stringent limitations for those waters with little or no assimilative capacity. For those facilities receiving relatively stringent limits, compliance would likely require installation of additional treatment processes, such as filtrations, at a substantial capital costs with increased operation and maintenance costs. Whether or not these additional costs are affordable to the community depends on a number of factors, such as size of the facility and current service fees.

The phosphorus criteria will also be used to identify and list impaired lakes and streams on the states 303(d) list. For those impaired waters, the phosphorus water quality criteria will be used to establish TMDLs that apply to both point and nonpoint sources.

Information on environmental analysis.

This is considered as a Type III action since it does not have adverse environmental impacts or involve conflicts in use of waters.

Small business analysis.

Based on an analysis of food processing facilities, there are few, if any, small businesses that directly discharge wastewater containing phosphorus to lakes or streams. Many small cheese factories land apply their wastes and do not discharge wastewater containing phosphorus. If there is an effect on small businesses, it would likely be an indirect affect. Some small businesses discharge their wastes to a municipal wastewater treatment facility. If the municipal wastewater treatment plant is required to further remove phosphorus, it is possible that the service fee may increase or the municipality may require some level of pretreatment.

Wisconsin Department of Administration
Division of Executive Budget and Finance
DOA-2048 (R10/2000)

Fiscal Estimate — 2009 Session

		LRB Number	Amendment Number if Applicable
☒ Original	☐ Updated		
☐ Corrected	☐ Supplemental	Bill Number	Administrative Rule Number WT-25-08

Subject

Phosphorus Water Quality Standards and Effluent Standards and Limitations

Fiscal Effect

State: ☐ No State Fiscal Effect

Check columns below only if bill makes a direct appropriation or affects a sum sufficient appropriation.

☐ Increase Existing Appropriation ☐ Increase Existing Revenues
☐ Decrease Existing Appropriation ☐ Decrease Existing Revenues
☐ Create New Appropriation

☒ Increase Costs — May be possible to absorb within agency's budget.
☒ Yes ☐ No

☐ Decrease Costs

Local: ☐ No Local Government Costs

1. ☒ Increase Costs
   ☐ Permissive ☒ Mandatory
2. ☐ Decrease Costs
   ☐ Permissive ☐ Mandatory
3. ☐ Increase Revenues
   ☐ Permissive ☐ Mandatory
4. ☐ Decrease Revenues
   ☐ Permissive ☐ Mandatory
5. Types of Local Governmental Units Affected:
   ☒ Towns ☒ Villages ☒ Cities
   ☐ Counties ☒ Others Sanitary districts
   ☐ School Districts ☐ WTCS Districts

Fund Sources Affected

☒ GPR ☐ FED ☐ PRO ☐ PRS ☐ SEG ☐ SEG-S

Affected Chapter 20 Appropriations

20.370 (4) (ma)

Assumptions Used in Arriving at Fiscal Estimate

I. RULE SUMMARY

The rule package proposes to implement numeric phosphorus water quality standards criteria for lakes and streams, as required by EPA. If the Department does not adopt phosphorus criteria, EPA has the authority to do so for Wisconsin. On November 23, 2009, EPA received a notice of intent to sue over a lack of numeric criteria for Wisconsin waters.

The rule package also includes procedures for using the phosphorus criteria to develop water quality based effluent limitations for publicly and privately owned wastewater treatment facilities, and implementing those limitations through Wisconsin Pollutant Discharge Elimination System (WPDES) permits. Various options included in these permit procedures are limitations derived from total maximum daily load (TMDL) plans, compliance schedules, interim limitations and variances.

II. STATE FISCAL IMPACT

This rule package has no impact on state revenues; however, the Department would incur costs associated with WPDES permits to implement the provisions of the rule package. An ongoing workload equivalent to about 2.0 FTE statewide is projected for at least five to ten years. Wastewater engineer positions will develop effluent limitations, including consideration of TMDL wasteload allocations, review of variance requests, development of compliance schedules, etc. The workload estimate is based on 100 permits per year at about 40 hours per permit with five years to complete an initial cycle of permit reissuances. Salary and fringe costs are estimated at $220,000 per year (4,000 hours x $35/hour salary + 48.59% fringe + travel and supplies).

Long-Range Fiscal Implications

The fiscal impact on local governments and industries will likely be spread over a 10 to 20 year period with less costly interim limitations being imposed in the initial five to ten years and the more stringent limits being phased in primarily in the 10 to 20 year period.

Prepared By:	Telephone No.	Agency
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Authorized Signature	Telephone No.	Date (mm/dd/ccyy)
[signature]	266-2794	03-01-10

Fiscal Estimate — 2009 Session

Page 2 Assumptions Narrative Continued

LRB Number	Amendment Number if Applicable
Bill Number	Administrative Rule Number

Assumptions Used in Arriving at Fiscal Estimate – Continued

III. LOCAL FISCAL IMPACT

The proposed rule package will result in compliance costs for a number of municipal and other publicly owned wastewater treatment facilities. These costs may be in the form of capital expenditures, increased operation and maintenance costs, or both, and will vary considerably by municipality or sanitary district. For some facilities, no additional costs will be needed since they discharge to streams and rivers and already meet the phosphorus criteria. For up to an estimated 163 facilities, the addition of filtrations processes may be needed and a substantial cost could be incurred. The Department estimates that municipalities and sanitary districts will incur costs of between $300 million $1.13 billion to comply with the provisions in the rule package. Costs per unit of phosphorus removed are much lower for larger facilities than for smaller facilities. Furthermore, it should be noted that the estimated cost range does not take into account the possibility that some municipalities and sanitary districts may need to acquire land for locating additional wastewater treatment facilities, and thus incur the corresponding land acquisition costs.

There are a number of factors that could push the costs toward the low end of the range, or even lower. These mitigating factors include nonpoint source control that lessen the need for point source control of phosphorus either in general or through implementation of TMDLs. Other factors include economic variances that limit the degree of control to affordable levels, emerging technology that may lower costs, and pollutant trading. The low end of the range may also be overstated to the extent that facilities have already upgraded their treatment plants and/or treatment processes and have thus already incurred some of the costs.

IV. PRIVATE SECTOR FISCAL IMPACT

The proposed rule package will result in compliance costs for a number of industrial wastewater facilities. These costs may be in the form of capital expenditures, increased operation and maintenance costs, or both. The paper industry and the food processing industry would be most affected. The Department estimates that up to 35 facilities could have stringent effluent limitations. Those discharging wastes to municipal wastewater treatment plants may also face increased service fees. Similar to local governmental entities, there is a great degree of variability in the costs that would be incurred. The Department estimates the cost range to be between $80 million and $440 million.

The same mitigating factors described above for local governmental entities will push costs toward the lower end of the range for private sector facilities.

Wisconsin Department of Administration
Division of Executive Budget and Finance
DOA-2047 (R10/2000)

Fiscal Estimate Worksheet — 2009 Session

Detailed Estimate of Annual Fiscal Effect

		LRB Number	Amendment Number if Applicable
☐ Original	☐ Updated		
☐ Corrected	☐ Supplemental	Bill Number	Administrative Rule Number WT-25-08

Subject
Phosphorus Water Quality Standards and Effluent Standards and Limitations

One-time Costs or Revenue Impacts for State and/or Local Government (do not include in annualized fiscal effect):

Annualized Costs:	Annualized Fiscal Impact on State Funds from:	
A. State Costs by Category	Increased Costs	Decreased Costs
State Operations — Salaries and Fringes	$ 208,000	$ - 0
(FTE Position Changes)	(2.00 FTE)	(- 0.00 FTE)
State Operations — Other Costs	12,000	- 0
Local Assistance	0	- 0
Aids to Individuals or Organizations	0	- 0
Total State Costs by Category	$ 220,000	$ - 0
B. State Costs by Source of Funds	Increased Costs	Decreased Costs
GPR	$ 220,000	$ - 0
FED	0	- 0
PRO/PRS	0	- 0
SEG/SEG-S	0	- 0
State Revenues — Complete this only when proposal will increase or decrease state revenues (e.g., tax increase, decrease in license fee, etc.)	Increased Revenue	Decreased Revenue
GPR Taxes	$	$ -
GPR Earned		-
FED		-
PRO/PRS		-
SEG/SEG-S		-
Total State Revenues	$	$ -

Net Annualized Fiscal Impact

	State	Local
Net Change in Costs	$ 220,000	$ see narrative
Net Change in Revenues	$ 0	$

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Joe Polasek	266-2794	Department of Natural Resources
Authorized Signature	Telephone No.	Date (mm/dd/ccyy)
[signature]	266-2794	03-01-10

ORDER OF THE STATE OF WISCONSIN NATURAL RESOURCES BOARD
AMENDING, REPEALING AND RECREATING AND CREATING RULES

The Wisconsin Natural Resources Board proposes an order to **amend** ch. NR 217 (title), NR 217.01, 217.02 and 217.03; to **repeal and recreate** NR 102.06; and to **create** NR 217 subchs. I (title), II (title), and III (title), NR 217.10, 217.11, 217.12, 217.13, 217.14, 217.15, 217.16, 217.17, 217.18 and 217.19 relating to phosphorus water quality standards criteria and limitations and effluent standards.

WT-25-08

Analysis Prepared by Department of Natural Resources

1. Statutes Interpreted: Sections 281.15, 283.11, 283.13(5), 283.31, 283.55, 283.84

2. Statutory Authority: Sections 227.11(2)(a), 281.15, 283.001(2), 283.13(5), 283.15, 283.31, 283.35, 283.37

3. Explanation of agency authority: Section 227.11(2)(a), Stats., expressly confers rulemaking authority on the department to promulgate rules interpreting any statute enforced or administered by it, if the agency considers it necessary to effectuate the purpose of the statute. The department considers the proposed rules necessary to implement the pollution abatement permit program established in chapter 283, Stats. The phosphorus water quality standard included in the proposed rules is required pursuant to s. 281.15, Stats., which directs the department to promulgate water quality standards for state waters. Section 283.13 (5), Stats., gives the department the authority to establish water quality based effluent limitations based on applicable water quality standards and to require compliance with those limitations consistent with a schedule of compliance or state or federal law. Section 283.15, Stats., provides authority to establish rules for variances to water quality standards, s. 283.31, Stats., provides authority to establish permit terms and conditions for water pollutant discharge elimination system permits, and s. 283.37, Stats., gives the department authority to require the submittal of information as part of a permit application.

4. Related statute or rule: s. 283.11(3)(am), chapters NR 106 and 200

5. Plain language analysis:

The proposed rule has two parts. The first is a set of phosphorus water quality standards criteria for rivers, streams, various types of lakes, reservoirs and Great Lakes. The second is procedures for determining and incorporating phosphorus water quality based effluent limitations into Wisconsin Discharge Pollutant Elimination System (WPDES) permits under chapter 283, Stats. Pursuant to 40 CFR 131.11, states are required to adopt water quality standards criteria that are protective of the designated uses of surface waters. Pursuant to section 303(c)(4) of the Clean Water Act, EPA may step in and promulgate the criteria for the state, if the state does not. Development of point source permit procedures is required as part of the state's point source permit delegation agreement. EPA approval of state water quality criteria is required under 40 CFR ss. 131.5, 131.6 and 131.21.

Phosphorus Water Quality Standards Criteria

The proposed rule establishes phosphorus water quality criteria of 100 ug/l (parts per billion) for rivers specifically identified in the rule and of 75 ug/l for smaller streams and rivers. No criteria are proposed at this time for ephemeral streams or streams identified in ch. NR 104, Wis. Adm. Code as limited aquatic life waters. Both of the criteria are intended to prevent in-stream algae and other plant growth to the extent that is detrimental to fish and aquatic life. For example, extensive algae or macrophyte (large plants growing on the beds of streams) consume oxygen during the night to the extent that may leave too little oxygen for certain fish species and for certain aquatic insects. About half of Wisconsin's rivers and streams meet the proposed criteria.

For lakes and reservoirs, the proposed rule has a suite of criteria for five different types of lake ranging from 15 ug/l for lakes supporting a coldwater fishery, such as lake trout or cisco in its bottom waters, to 40 ug/l for shallow drainage lakes and reservoirs. The criteria are intended to prevent or minimize nuisance algal blooms; prevent shifts in plant species in shallow lakes; maintain adequate dissolved oxygen in the bottom of "two-story" lakes with a warmwater fishery in top waters and coldwater fisheries in bottom waters; and to maintain fisheries. "Toxic" algae concerns may also be addressed. For millponds and similar impoundments, the upstream river or stream criteria would apply. More than half of Wisconsin's lakes meet the proposed criteria with the percent varying by lake type. No criteria are proposed at this time for marsh lakes and other wetlands since they will be part of future wetlands nutrient criteria adoption.

For the Great Lakes, phosphorus criteria are proposed for the open waters of Lake Superior (5 ug/l), the open waters of Lake Michigan (7 ug/l) and the nearshore waters of Lake Michigan (7 ug/l). Presently, for the open waters both Lake Michigan and Lake Superior are meeting the criteria. For the nearshore waters of Lake Michigan, the zone from the beaches to a depth of 10 meters, where there are concerns with the Cladophora algal mats forming on beaches, the criteria may be exceeded in some locations.

Below is a table showing the proposed phosphorus water quality standards criteria by type of water body. The specific water body types are defined in the proposed rules, and there are some exclusions based on size or flow conditions.

Proposed Phosphorus Criteria by Type of Water Body	Total Phosphorus in ug/l
Listed rivers	100
All other streams	75
Stratified reservoirs	30
Non-stratified reservoirs	40
Stratified "two-story" fishery lakes	15
Stratified drainage lakes	30
Non-stratified (shallow) drainage lakes	40
Stratified seepage lakes	20
Non-stratified (shallow) lakes	40
Impoundments	Same as inflowing river or stream
Lake Michigan open and nearshore waters	7
Lake Superior open and nearshore waters	5

WPDES Effluent Standards and Limitations

The current regulations for phosphorus establish specific procedures for including technology based limitations and standards in WPDES permits (existing chapter NR 217). There is also an existing rule (s. NR 102.06) that generally states the department may establish water quality based limits for phosphorus in permits on a case-by-case basis using an evaluation of phosphorus sources in a watershed, but this rule is being repealed and replaced with a proposed new subchapter in chapter NR 217 that includes detailed procedures for establishing water quality effluent limitations for phosphorus.

Specifically, there are provisions for determining when a water quality based effluent limitation is needed in a WPDES permit; equations and procedures for calculating effluent limits based on different types of waters and stream flow assumptions; and provisions for expressing permit compliance averaging periods, such as a monthly average. The rule requires concentration limits, as commonly used in permits. However, it also specifies where and how mass limits are required, such as for discharges to impaired waters, where there is a downstream lake and where there is a downstream outstanding or exceptional resource water. The rule also addresses the relationship and procedures for including a various types of phosphorus limits in permits such as a phosphorus limit based on a total maximum daily load, a technology based phosphorus limit and a water quality based phosphorus limit calculated under the new procedures in chapter NR 217.

The proposed rule allows the department to include compliance schedules in permits. The compliance schedule provisions specify factors the department may consider when establishing the length of a compliance schedule. One of the options for a compliance schedule provision for discharges to nonpoint source dominated waters includes an adaptive management option where interim limits may be phased in, if phosphorus concentrations improve in the receiving water.

There are also provisions for a streamlined approach for processing variances for stabilization pond and lagoon systems that mimic the procedures for ammonia variances in ch. NR 106. These special provisions are based on the knowledge that presently there are few means to control phosphorus being discharged from these systems and that the construction of a mechanical plant is not affordable for smaller municipalities. The inclusion of streamlined procedures for stabilization pond and lagoon systems should not be interpreted to mean that these are the only systems that may obtain a variance, where appropriate. There are standard procedures for variances in statutory language and other administrative codes.

6. Summary of, and comparison with, existing or proposed federal regulation:

The proposed phosphorus criteria for streams of 75 ug/l and rivers of 100 ug/l are similar to EPA's guidance values for the southern half of Wisconsin. EPA recommended 70 ug/l of phosphorus for both rivers and streams in the southwestern driftless area of the state and 80 ug/l of phosphorus for both rivers and streams in the remainder of the southern half of the state. EPA, did however, recommend a criterion of 29 ug/l for a band or area stretching west to east though the middle of the state and 10 ug/l for the forested northern part of the state. All of the EPA guidance numbers are based on the 25th percentile of available data from a number of states and do not represent a cause-

effect situation. We could not find concentrations as low at 10 ug/l even for pristine conditions in most of the forested northern portion of Wisconsin.

For lakes, the proposed criteria that range from 15 to 40 ug/l based on the type of lake are different than EPA's guidance values that range from 9.7 ug/l for northern lakes to 36 ug/l for driftless area lakes. EPA's guidance values are based on data from multiple states and represent the 25th percentile of available data. They do not differentiate based on the type of lake.

The proposed criteria for Lake Michigan and Lake Superior are the same as the values derived for the federal Great Lakes Water Quality Agreement.

The proposed WPDES permit procedures, including water quality based effluent limitations, are based on general EPA regulations and guidelines.

7. Comparison with similar rules in adjacent states:

All states, including adjacent states, are required by EPA to promulgate nutrient water quality standards criteria under EPA's Clean Water Act authority. In addition, all states delegated National Pollutant Discharge Elimination System permit authority by EPA, including all adjacent states, are required to issue point source permits that will meet water quality standards.

To date, Minnesota has promulgated phosphorus criteria for lakes which are very similar to what is proposed in this rule. Minnesota is now in the process of developing proposed criteria for rivers and streams. Illinois has had phosphorus criteria for lakes and Lake Michigan in its water quality standards for some years, but is in the process of developing phosphorus criteria for streams and rivers. Michigan and Iowa are developing criteria, but to date have not publicly proposed criteria. None of the adjacent states or Wisconsin has proposed criteria for nitrogen, except for ammonia.

All adjacent states have provisions for developing water quality based effluent limits, but none to date have proposed rules that specifically deal with the issues uniquely related to phosphorus.

8. Summary of factual data and analytical methodologies used and how any related findings support the regulatory approach chosen:

The proposed water quality standards phosphorus criteria for streams and rivers are based on results of a number of Wisconsin studies aimed at determining when biotic effects occur and how these effects relate to protection of desiguated uses. The primary studies were jointly conducted by department and USGS staff and their results are reported in "Nutrient Concentrations and Their Relations to the Biotic Integrity of Wadeable Streams in Wisconsin", USGS Professional Paper 1722, by Robertson, Graczyk, Garrison, Wang, LaLiberte and Bannerman, 2006; and "Nutrient Concentrations and Their Relations to the Biotic Integrity of Nonwadeable Rivers in Wisconsin", USGS Professional Paper 1754, by Robertson, Weigel and Graczyk, 2008. These studies identified a suite of breakpoints or thresholds for effects of phosphorus on algae, aquatic insects and fish. Based on discussions involving a number of experts in the scientific field, the department used an averaging method of the suite of breakpoints to derive the proposed criteria. These proposed criteria were compared to Department studies of trout streams in southwestern Wisconsin, the early

1980's Department study of phosphorus in streams and studies cited in EPA's "Nutrient Criteria Technical Guidance Manual: Rivers and Streams", EPA-822-B-00-002, 2000.

The proposed water quality standards phosphorus criteria for lakes and reservoirs are based on methods commonly used for decades in lake management in Wisconsin and adjacent states. Specifically, for most types of lakes, the proposed criteria are based on limiting the risk of nuisance algae conditions (20 ug/l chlorophyll a) to no more than 5 percent of the time (e.g. less than one week per year from June though September) using work by Walmsley (Journal of Environmental Quality, 13:97-104, 1988) and Heiskary and Wilson ("Minnesota Lake Water Quality Assessment Report: Developing Nutrient Criteria", Minnesota Pollution Control Agency, September 2005). These concentrations were also determined to be sufficient to protect sport fisheries in lakes again using information from Heiskary and Wilson ("Minnesota Lake Water Quality Assessment Report: Developing Nutrient Criteria", Minnesota Pollution Control Agency, September 2005). For the relatively few lakes that support a cold water fishery in the lower waters, the department's objective was to maintain 6 mg/l for dissolved oxygen in the lower waters. To determine the appropriate phosphorus concentrations, the Department examined sediment cores and current water concentrations to determine undisturbed conditions. The proposed criteria were compared to literature information summarized in EPA's "Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs", EPA-822-B-00-001, 2000.

For development of the water quality based effluent limitation procedures for permits, the department reviewed existing state and federal regulations and guidance for the point source discharge permit programs, consulted with EPA representatives, and received input from a technical advisory committee that met several times in 2008 through 2009. The technical advisory committee was comprised of representatives of municipal and industrial wastewater dischargers, municipal storm water dischargers, agricultural interests, water user groups and environmental groups. Staff from EPA and USGS also attended committee meetings as advisories to the committee and the Department.

9. Analysis and supporting documents used to determine effect on small business

The Department initially identified cheese and other dairy operations that discharge wastewater containing phosphorus to lakes and streams as small businesses potentially impacted by the proposed rules. With the assistance of the Wisconsin Cheese Makers, 11 businesses were identified for analysis. All 11 are likely to have more than $5 million in annual revenue, but may have less than 25 employees. Of the 11, six apply wastes to the land through a variety of methods. Some may discharge non-contact cooling water without adding additives, which would not come under this rule. The other six discharge their wastes to municipal wastewater treatment plants.

Based on this analysis, the Department concluded that there are few, if any, small businesses that directly discharge of wastewater containing phosphorus to lakes or streams. If there is an effect, it would likely be an indirect affect on those small businesses that discharge their wastes to a municipal wastewater treatment facility. If the municipal wastewater treatment plant is required to further remove phosphorus, it is possible that the service fee may increase or the municipality may require some level of pretreatment.

10. Effect on small business:

The department has determined the rule will not have a significant impact on small businesses. Most of the fiscal impacts from the proposed rules will affect municipalities and industries (with phosphorus discharges to surface waters) that aren't considered small businesses. The rule may have an effect on a few small businesses, but it is very difficult to estimate. As mentioned above, small cheese factories may be the best example. For those meeting the definition of a small business, many of the facilities land apply all or the majority of their wastewater, and therefore will not be impacted by these rules. If there are any businesses that discharge wastes directly to surface waters that meet the definition of a small business, they may apply for a variance if compliance with water quality based effluent limits for phosphorus would cause significant economic hardship. The proposed rules do not provide for less stringent reporting, longer compliance schedules or completed exemptions for small businesses with phosphorus discharges to surface waters because it would not be allowed under federal regulations or state statutes. There is, however, a variance procedure which is allowed under both state and federal law for all point sources that qualify. Reporting and record keeping requirements are established through permit terms and conditions.

11. Agency contact person:

Jim Baumann, P.O. Box 7921, Madison, WI 53707; telephone number 608/266-9277; e-mail address: james.baumann@wisconsin.gov.

12. Place where comments are to be submitted and deadline for submission:

Written comments may be submitted at the public hearings, by regular mail, fax or e-mail to:

Jim Baumann
Department of Natural Resources
Bureau of Watershed Management
PO Box 7921
Madison, WI 53707
Fax: 608/267-2800
james.baumann@wisconsin.gov.

Written comments may also be submitted to the Department using the Wisconsin Administrative Rules Internet Web site at http://adminrules.wisconsin.gov

Hearing dates and submission deadline are to be determined.

SECTION 1. NR 102.06 is repealed and recreated to read:

NR 102.06 Phosphorus. (1) GENERAL. This section identifies the water quality criteria for total phosphorus that shall be met in surface waters.

(2) DEFINITIONS. The following definitions are established for purposes of this section:

(a) "Ephemeral stream" means a channel or stream that only carries water for a few days during and after a rainfall or snowmelt event and does not exhibit a flow during other periods.

(b) "Drainage lake" means a lake with an outlet stream that continually flows under average summer conditions based on the past 30 years.

(c) "Hydraulic residence time" means the amount of time that a volume of water entering a waterbody will reside in that waterbody"

(d) "Nearshore waters" means all waters of Lake Michigan or Lake Superior within the jurisdiction of the State of Wisconsin in the zone extending from the shore to a depth of 10 meters, based on the long-term mean elevation for Lake Superior of 183.4 meters (601.7 feet) and for Lake Michigan of 176.5 meters (579.0 feet).

(e) "Open waters" mean all waters of Lake Michigan or Lake Superior within the jurisdiction of the State of Wisconsin with depths greater than nearshore waters.

(f) "Reservoir" means a waterbody with a constructed outlet structure intended to impound water and raise the depth of the water by more than two times, and that has a mean water residence time of 14 days or more.

(g) "Stratified lake or reservoir" means a lake or reservoir where either of the following equations results in a value of greater than 3.8:

$$\frac{\text{Maximum Depth (in meters)} - 0.1}{\text{Log}_{10}\text{Lake Area (in hectares)}}$$

$$\frac{\text{Maximum Depth} * 0.305 \text{ (in feet)} - 0.1}{\text{Log}_{10}\text{Lake Area} * 0.405 \text{ (in acres)}}$$

(h) "Seepage lake" means a lake that does not have an outlet stream that continually flows under average summer conditions based on the past 30 years.

(i) "Stratified two-story fishery lake" means a stratified lake which has supported a cold water fishery in its lower depths within the last 50 years.

(j) "Total phosphorus" means all of the phosphorus in a water sample analyzed using the methods identified under the provisions of s. NR 219.04(1).

(3) STREAMS AND RIVERS. To protect the fish and aquatic life uses established in s. NR 102.04(3) on rivers and streams that generally exhibit unidirectional flow, total phosphorus criteria are established as follows:

(a) A total phosphorus criterion of 100 ug/L is established for the following rivers or other unidirectional flowing waters:

1. Apple River from the outlet of the Apple River Flowage in Amery to the St. Croix River, excluding Black Brook Flowage.

2. Bad River from confluence with the Marengo River within the Bad River Indian Reservation downstream to Lake Superior.

3. Baraboo River from highway 58 in La Valle to the Wisconsin River.

4. Bark River from confluence with Scuppernong River near Hebron to the Rock River.

5. Black River from confluence with Cunningham Creek near Neillsville to Mississippi River, excluding Lake Arbutus.

6. Brule River from state highway 55 in Forest County downstream to Menominee River.

7. Buffalo River from confluence with Harvey Creek near Mondovi to Mississippi River.

8. Chippewa River from Lake Chippewa in Sawyer County to Mississippi River, excluding Holcombe Flowage, Cornell Flowage, Old Abe Lake, Lake Wissota and Dells Pond.

9. Crawfish River from confluence with Beaver Dam River to Rock River.

10. East Branch Pecatonica River from confluence with Apple Branch Creek near Argyle to Pecatonica River.

11. Eau Claire River from confluence with Bridge Creek near Augusta to Chippewa River, excluding Altoona Lake.

12. Embarrass River from confluence with Pigeon River near Clintonville to Wolf River.

13. Flambeau River from outlet of Turtle-Flambeau Flowage in Iron County to Chippewa River, excluding Pixley Flowage, Crowley Flowage and Dairyland Flowage.

14. Fox River from outlet of Lake Puckaway near Princeton to Green Bay, excluding Lake Butte des Morts and Lake Winnebago.

15. Fox River from confluence with Mukwonago River near Mukwonago to state line, excluding Tichigan Lake.

16. Grant River from confluence with Rattlesnake Creek near Beetown to Mississippi River.

17. Jump River from confluence with the North Fork and the South Fork of the Jump River in Price County to Holcombe Flowage.

18. Kickapoo River from confluence with Weister Creek near La Farge to Wisconsin River.

19. Kinnickinnic River from confluence with Wilson Park Creek in Milwaukee to Milwaukee River.

20. La Crosse River from confluence with Fish Creek near Bangor to Mississippi River, excluding Neshonoc Lake.

21. Lemonweir River from outlet of New Lisbon Lake in New Lisbon to Wisconsin River, excluding Decorah Lake.

22. Little Wolf River from confluence with South Branch Little Wolf River near Royalton to Wolf River.

23. Manitowoc River from confluence of North Branch and South Branch Manitowoc River to the opening at the end of the piers at Lake Michigan.

24. Menominee River from confluence with Brule River to the opening at the end of the piers at Green Bay.

25. Menomonee River from confluence with Little Menomonee River to Milwaukee River.

26. Milwaukee River from confluence with Cedar Creek downstream to the openings of the breakwaters at Lake Michigan.

27. Mississippi River main channels and side channels.

28. Namekagon River from outlet of Trego Lake near Trego to St. Croix River.

29. Oconto River from confluence with Peshtigo Brook to the opening at the end of the piers at Green Bay.

30. Pecatonica River from confluence with Vinegar Branch near Darlington to state line.

31. Pelican River from confluence with Slaughterhouse Creek near Rhinelander to Wisconsin River.

32. Peshtigo River from confluence with Brandywine Creek downstream to Green Bay, excluding Cauldron Falls Flowage and High Falls Flowage.

33. Pine River from confluence with Popple River in Florence County to Menominee River, excluding Pine River Flowage.

34. Red Cedar River from confluence with Brill River to Chippewa River, excluding Rice Lake, Tainter Lake and Lake Menomin.

35. Rock River from outlet of Sinissippi Lake downstream to the state line, excluding Lake Koshkonong.

36. St. Croix River from confluence with Namekagon River downstream to Mississippi River, excluding Lake St. Croix near Hudson.

37. St. Louis River from state line to the opening between Minnesota Point and Wisconsin Point at Lake Superior.

38. Sheboygan River from outlet of Sheboygan Marsh to the opening at the end of the piers at Lake Michigan.

39. South Fork of Flambeau River from state highway 13 near Fifield to Flambeau River.

40. Sugar River from outlet of Albany Lake to state line, excluding Decatur Lake.

41. Tomahawk River from outlet of Willow Reservoir to Lake Nokomis.

42. Trempealeau River from confluence with Pigeon Creek near Whitehall to Mississippi River.

43. White River from outlet of White River Flowage in Ashland County to Bad River.

44. Wisconsin River from confluence with Pelican River near Rhinelander to Mississippi River, excluding Lake Alice, Lake Mohawksin, Alexander Lake, Lake Wausau, Mosinee Flowage, Lake Dubay, Wisconsin River Flowage, Biron Flowage, Petenwell Flowage, Castle Rock Flowage and Lake Wisconsin.

45. Wolf River from confluence with Hunting Creek in Langlade County to Lake Poygan.

46. Yahara River from outlet of Lake Kegonsa to Rock River.

(b) Except as provided in sub. (7), all other surface waters generally exhibiting unidirectional flow that are not listed in par. (a) sub. (4) are considered streams and shall meet a total phosphorus criterion of 75 ug/L.

(4) RESERVOIRS AND LAKES. To protect fish and aquatic life uses established in s. NR 102.04(3) and recreational uses established in s. NR 102.04(5) total phosphorus criteria are established for reservoirs and lakes, as follows:

(a) For stratified reservoirs, total phosphorus criterion is 30 ug/l. For reservoirs that are not stratified, total phosphorus criterion is 40 ug/l.

(b) All lakes and other surface waters that do not exhibit unidirectional flow shall meet the following water quality criteria:

1. For stratified, two-story fishery lakes, 15 ug/l

2. For lakes that are both drainage and stratified lakes, 30 ug/l.

3. For lakes that are drainage lakes, but are not stratified lakes, 40 ug/l.

4. For lakes that are both seepage and stratified lakes, 20 ug/l.

5. For lakes that are seepage lakes, but are not stratified lakes, 40 ug/l.

(c) Waters impounded on rivers or streams with a mean annual hydraulic residence time of less than 14 days based on the previous 30 years shall meet the river and stream criterion in sub (3) that applies to the primary stream or river entering the impounded water.

(5) GREAT LAKES. To protect fish and aquatic life uses established in s. NR 102.04(3) and recreational uses established in s. NR 102.04(5) on the Great Lakes, total phosphorus criteria are established as follows:

(a) For both open and nearshore waters of Lake Superior, 5 ug/l.

(b) For both open and nearshore waters of Lake Michigan, excluding waters identified in par. (c), 7 ug/l.

(c) For the portion of Green Bay from the mouth of the Fox River to a line from Long Tail Point to Point au Sable, the water clarity and other phosphorus-related conditions are suitable for support of a diverse biological community, including a robust and sustainable area of submersed aquatic vegetation in shallow water areas.

(6) EXCLUSIONS. The following waters are excluded from subs. (3)(b), (4) and (5):

(a) Ephemeral streams.

(b) Lakes and reservoirs of less than 5 acres in surface area.

(c) Wetlands, including bogs.

(d) Waters identified as limited aquatic life waters in ch. NR 104. Limited aquatic life waters are those subject to the criteria in s. NR 104.02(3)(b)(2).

(7) SITE-SPECIFIC CRITERIA. (a) *General.* A criterion contained within this section may be modified by rule for a particular surface water segment or body. A criterion may be modified if specific information is provided which shows that the data used to derive the criterion do not apply and if additional information is provided to derive a site–specific criterion. Site–specific criteria are intended to be applicable to a specific surface water segment. Criteria shall be modified for site–specific considerations in accordance with the procedure identified in s. NR 105.02(1).

Note: Reservoirs, two-story fishery lakes and water bodies with high natural background phosphorus concentrations are the most appropriate water bodies for site-specific criteria.

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. When deciding whether to include a water body on the 303(d) list, the Department may also choose to consider other factors such as concentration of suspended algae and floating plants, density of benthic algae, macrophyte density; minimum and daily change in dissolved oxygen levels; water clarity and natural background phosphorus concentrations.

SECTION 2. Chapter NR 217 (title) is amended to read:

CHAPTER NR 217

EFFLUENT STANDARDS AND LIMITATIONS FOR PHOSPHORUS

SECTION 3. NR 217 Subchapter I title to precede s. NR 217.01 is created to read:

SUBCHAPTER I - GENERAL

SECTION 4. NR 217.01 is amended to read:

NR 217.01 Purpose. The purpose of this chapter is to reduce the amount of phosphorus ~~pollutants~~ discharged to surface waters by establishing effluent standards and limitations, including water quality based effluent limitations, for phosphorus ~~pollutants~~ in effluent discharged to surface waters of the state. Effluent standards and limitations are developed ~~adopted~~ pursuant to ch. 283, Stats.

SECTION 5. NR 217 Subchapter II (title) to follow s. NR 217.01 is created to read:

SUBCHAPTER II - PHOSPHORUS EFFLUENT STANDARD AND LIMITATIONS

SECTION 6. NR 217.02 is amended to read:

NR 217.02 Applicability. This ~~chapter~~ subchapter is applicable to point sources which discharge ~~wastewater~~ phosphorus to the surface waters of the state.

SECTION 7. NR 217.03 is amended to read:

NR 217.03 Definitions. Definitions of terms and the meaning of abbreviations used in this ~~chapter~~ subchapter are as defined in chs. NR 102, 106, 205, 210 and 243. In addition: "effluent standard" means any requirement for ~~a specific pollutant applicable to a category or class of point sources which are more stringent than the requirements under s. 283.13 (1) to (4), Stats.~~ phosphorus established pursuant to s. 283.11(3), Stats., and this subchapter.

SECTION 8. NR 217 Subchapter III (title) to follow s. NR 217.04 is created to read:

SUBCHAPTER III - WATER QUALITY BASED EFFLUENT LIMITATIONS FOR PHOSPHORUS

SECTION 9. NR 217.10 is created to read:

NR 217.10 Applicability. This subchapter applies to discharges of phosphorus to surface waters of the state from the following point sources:

(1) Publicly and privately owned wastewater facilities or treatment works;

(2) Noncontact cooling water discharges which contain phosphorus unless 100 percent of the phosphorus in the discharge originates from the receiving water;

(3) Concentrated animal feeding operations that discharge manure or process wastewater from the production area through alternative treatment facilities under s. NR 243.13; and

(4) A facility or site that is regulated under ch. NR 216 only where the department has determined that compliance with the standards in ch. 151 and 216 are not sufficient to meet phosphorus criteria in s. NR 102.06.

SECTION 10. NR 217.11 is created to read:

NR 217.11 Definitions. Definitions of terms and the meaning of abbreviations used in this subchapter are as defined in chs. NR 102, 106, 205, 210 and 243. In addition, for purposes of this subchapter, the following definitions apply:

(1) "303(d) list" means a list of waters established by the department and approved by EPA pursuant to 33 USC 1313(d)(1)(A) and 40 CFR 130.7.

(2) "New Source" means a point source which was not authorized by a WPDES permit as of the effective date of this rule {revisor insert date}. A new source includes a relocation of an outfall to a different receiving water.

(3) "Phosphorus impaired water" means a surface water listed on the 303(d) list that is impaired for phosphorus, nutrients or dissolved oxygen.

Note: A surface water may be impaired and placed on the 303(d) list for a reason other than phosphorus, nutrients or dissolved oxygen (e.g. mercury), however the procedures in this subchapter only apply to impairments related to phosphorus, nutrients or dissolved oxygen.

(4) "Technology based limitation" means an effluent limitation for phosphorus established pursuant to s. 283.11(3), Stats., and subch. II or s. 283.13(2) or (4), Stats.

(5) "Total Maximum Daily Load" or "TMDL" means the amount of pollutants specified as a function of one or more water quality parameters that can be discharged into a water quality limited segment and still ensure attainment of the applicable water quality standard in a watershed.

SECTION 11. NR 217.12 is created to read:

NR 217.12 General. (1) Water quality based effluent limitations for phosphorus shall be included in a permit whenever the department determines:

(a) The discharge from a point source contains phosphorus at concentrations or loadings which will exceed the criteria in s. NR 102.06 in either the receiving water or downstream waters; and

(b) The technology based effluent limitation or the alternative treatment technology limitation calculated under s. NR 243.13 is less stringent than necessary to achieve the applicable water quality standard for phosphorus in s. NR 102.06.

(2) If the technology based limitation expressed as a concentration is more stringent than the water quality based effluent limitation expressed as a concentration under ss. NR 217.13, then the technology based limit shall be included in the permit, along with any mass limitations calculated under this subchapter as required under ss. NR 217.14(1) and (3).

SECTION 12. NR 217.13 is created to read:

NR 217.13 Calculation of water quality based effluent limitations for phosphorus. (1) BASIS FOR LIMITATIONS. (a) The department shall calculate potential water quality based effluent limitations for point source dischargers of phosphorus using the procedures in this section.

(b) Water quality based effluent limitations for phosphorus shall be calculated based on the applicable phosphorus criteria in s. NR 102.06 at the point of discharge except the Department may calculate the limitation based on more stringent downstream water quality criteria in s. NR102.06 if the Department determines the discharge will affect the downstream water. To determine whether a discharge will affect a downstream water, the Department shall consider all relevant information available, including the following factors:

1. Distance of the outfall to the downstream water;

2. Amount of phosphorus discharged compared to the flow of the receiving water;

3. Presence of an impoundment or other natural or artificial feature which would impede the movement of phosphorus downstream; and

4. Presence of floodplains, wetlands and similar physical features where phosphorus may be retained.

(2) DISCHARGES TO STREAMS AND RIVERS. (a) *Limitation calculation.* For discharges of phosphorus to flowing streams and rivers, the water quality based effluent limitation shall be calculated using the following conservation of mass equation:

$$\text{Limitation} = [(WQC)\,(Qs+(1\text{-}f)Qe) - (Qs - fQ_e)\,(Cs)]/Qe$$

Where:

Limitation	=	Water quality based effluent limitation (in units of mass per unit of volume),
WQC	=	The water quality criterion concentration (in units of mass per unit volume) from ss. NR 102.06
Qs	=	Receiving water design flow (in units of volume per unit time) as specified in par. (b)
Qe	=	Effluent flow (in units of volume per unit time) as specified in par. (c)
f	=	Fraction of the effluent flow that is withdrawn from the receiving water, and
Cs	=	Upstream concentration (in units of mass per unit volume) as specified in par. (d).

(b) *Receiving water design flow (Qs).* Based on the availability of information and the professional judgment of the department, the value of Q_s to be used in calculating the effluent limitation for discharges to flowing waters shall be determined using one of the following:

1. The average minimum 7-day flow which occurs once every 2 years (7-day Q_2) as determined by the U. S. Geological Survey using data from a gauging station with a period of record of at least 10 years.

2. If provided by the permittee and approved by the department, the average low 30-day flow which occurs once every 3 years (30-day Q_3) as determined by the U. S. Geological Survey using data from a gauging station with a period of record of at least 10 years.

3. Other flow deemed more representative flow conditions and approved by the department.

(c) *Effluent flows (Q_e).* 1. For dischargers subject to ch. NR 210 and which discharge for 24 hours per day on a year-round basis, Q_e shall equal the maximum effluent flow, expressed as a daily average, that is anticipated to occur for 12 continuous months during the design life of the treatment facility unless it is demonstrated to the department that this design flow rate is not representative of projected flows at the facility.

2. For other dischargers not subject to ch. NR 210, Q_e shall equal one of the following based on the best professional judgment of the department:

a. The maximum effluent flow, expressed as a 365 day rolling average of daily discharges, that has occurred for 12 continuous months and represents normal operations.

b. The maximum effluent flow, expressed as a 30 day rolling average, which has occurred for 30 continuous days and represents normal operations.

3. For seasonal discharges, discharges proportional to stream flow, or other non-continuous discharge situations, Q_e shall be determined on a case by case basis.

(d) *Upstream concentrations (C_s).* The representative upstream concentration of phosphorus shall be used in specific water quality based effluent limit calculations. At a minimum, the representative upstream concentration shall be either a concentration derived by the department based on data from the specific stream or from a similar location. Where data is collected on the specific upstream location, the concentration used shall equal the median of at least four samples collected throughout the period of May through October. All samples collected during a 28-day period shall be considered as a single sample and

the average of the concentrations used. Where data is available from more than one year in the last five years, the department may use all of the years of data in the calculation of the upstream concentration. Upstream concentrations may not be measured at a location within the direct influence of a point source discharge. The determination of upstream concentrations shall be evaluated at each permit reissuance.

Note: The department has guidance on collection methods for ambient water sampling and may develop guidance of the evaluation of representative data. These methods should be followed.

(3) DISCHARGES TO INLAND LAKES AND RESERVOIRS. For discharges of phosphorus to inland lakes, reservoirs and other receiving waters which do not exhibit a unidirectional flow at the point of discharge, the department will set the effluent limit equal to the criterion for the receiving water or the downstream water.

Note: As described in s. NR 217.16, effluent limitations for discharges to lakes may also be based on the wasteload allocation of a total maximum daily load, where the total maximum daily load has been approved by US EPA.

(4) DISCHARGES DIRECTLY TO GREAT LAKES. For discharges directly to the Great Lakes, the department shall set effluent limits consistent with nearshore or whole lake model results approved by the department. Prior to the availability of such model results, the department may set interim effluent limits based on the best readily available phosphorus removal technology commonly used in Wisconsin.

(5) OTHER METHODS OF LIMIT CALCULATION. The department may use other models and equations for calculating a water quality based effluent limitation if, in the best professional judgment of the department, the model provides a more accurate representation of the conditions.

(6) MULTIPLE DISCHARGES. (a) Except as provided in par. (b), whenever the department determines that more than one discharge may be affecting the water quality of the same receiving water, the resultant combined allowable load shall be divided among the various discharges using an allocation method based on site-specific considerations. Whenever the department makes a determination under this section, the department shall notify all permittees who may be affecting the water quality of the same

receiving water of the determination and any limitations developed under this section. Permittees shall be given the opportunity to comment to the department on any determination made under this section.

(b) This subsection does not apply if there is an EPA approved TMDL for phosphorus for the receiving water. If there is an EPA approved TMDL, the combined allowable load shall be divided in accordance with the approved TMDL.

(7) MINIMUM EFFLUENT LIMITATIONS. If the water quality based effluent limitation calculated pursuant to the procedures in this section is less than the phosphorus criterion specified in s. NR 102.06 for the water body, the effluent limit will be set to be equal to the criterion.

(8) NEW SOURCES. If a new source is proposing a discharge of phosphorus to a receiving or downstream water that a phosphorus impaired water, the new source may not discharge phosphorus except as follows:

(a) The new source discharge of phosphorus is allocated part of the reserve capacity in an EPA approved TMDL;

(b) The new source can demonstrate the new discharge of phosphorus will improve water quality in the phosphorus impaired segment; or

(c) The new source can demonstrate that the new phosphorus load will be offset through a phosphorus trade or other means with another discharge of phosphorus to the 303(d) listed water. The offset must be approved by the Department and must be implemented prior to discharge.

Note: S. 283.84, Stats., establishes requirements for pollutant trades.

SECTION 13. NR 217.14 is created to read:

NR 217.14 Expression of limitations. (1) GENERAL. (a) Water quality based effluent limitations, when required pursuant to s. NR 217.15 shall be expressed in a discharge permit as a concentration. A mass limit shall also be included in a permit for discharges of phosphorus to any of the following receiving or downstream waters:

1. A lake or reservoir;

2. An outstanding or exceptional resource water, as designated in ss. NR 102.10 and 102.11;

3. A phosphorus impaired water; or

4. A surface water that has an approved TMDL for phosphorus.

(b) The department may establish mass limitations in permits for any other discharges of phosphorus if a concentration limit for phosphorus is included in the permit, and where an increase in phosphorus load is likely to result in adverse effects on water quality in the receiving water or downstream water.

(c) For discharges to lakes, the Department shall also include an annual mass limit for phosphorus in the permit.

(d) If there is an EPA approved TMDL for the receiving water, the Department shall include a mass limit expressed in the manner consistent with the requirements of the TMDL. As provided in s. NR 217.16, this TMDL based mass limit may be included in the permit in addition to, or in lieu of the mass limit in par. (a).

Note: In accordance with s. 283.84, Wis. Stats., the Department may approve the use of phosphorus trading as a means for a point source to achieve compliance with the water quality based effluent limitation, including a TMDL based limitation. The trade shall be incorporated into the terms of the WPDES permit for the point source and must be approved by the Department prior to implementation. Any trade should consider a trading ratio, a margin of safety and must result in a water quality improvement. A trade may occur between two point sources or a point source and a nonpoint source or a combination thereof.

(2) CONCENTRATION BASED LIMITATIONS. Concentration effluent limitations calculated under s. NR 217.13 shall be expressed as 30-day rolling averages in permits.

(3) MASS BASED LIMITATIONS. Concentration effluent limitations as calculated under s. NR 217.13 shall be converted into mass effluent limitations using the effluent flow identified in s. NR 217.13 and an appropriate conversion factor, and expressed as a 30 day rolling average in the permit.

SECTION 14. NR 217.15 is created to read:

NR 217.15 Determination of necessity for water quality based effluent limitations for phosphorus. (1) (a) *General.* The department shall include a water quality based effluent limitation for phosphorus in a permit whenever the discharge from a point source contains phosphorus at concentrations or loadings which will exceed the water quality standards in ch. NR 102 in either the receiving water or downstream waters. The department shall use the procedures in this section to make this determination.

(b) *Permittees with existing phosphorus limitations.* If a permittee has a technology based phosphorus limitation in a permit that is less restrictive than a water quality based effluent limitation for phosphorus calculated pursuant s. NR 217.13, then the Department shall include the water quality based effluent limitation in the permit..

(c) *Permittees without existing phosphorus limitations.* If a permittee discharges phosphorus, but does not have a technology based limitation for phosphorus in its permit, the Department shall use the procedures in this paragraph to determine whether a discharge has the reasonable potential to cause or contribute to an exceedance of the phosphorus water quality criterion in s. NR 102.06 in the receiving or downstream waters, and whether to include a water quality based effluent limit for phosphorus in the WPDES permit.

1. Using at least 11 daily discharge concentrations of phosphorus, if the upper 99^{th} percentile of the 30 day average discharge concentration of phosphorus exceeds the potential phosphorus limitation calculated under s. NR 217.13, then the water quality based effluent limitation for phosphorus shall be included in the WPDES permit. If the upper 99^{th} percentile of the 30 day average discharge concentration of phosphorus is less than_the potential phosphorus limitation calculated under s. NR 217.13, then a water quality based effluent limitation for phosphorus is not required in the WPDES permit. The upper 99^{th} percentile of available discharge concentrations shall be calculated pursuant to s. NR 106.04(5).

2. If 11 daily discharge concentrations of phosphorus are not available for a permittee, then a water quality based effluent limitation for phosphorus shall be included in the permit when the mean of available effluent concentrations is greater than one-fifth of the limit.

(d) *Sampling.* Prior to permit reissuance, a permittee discharging any phosphorus shall collect effluent samples of phosphorus at a frequency specified by the Department in the permit application for reissuance.

(e) New sources. The Department shall include a water quality based phosphorus limitation in a permit for a new source if the Department determines the new source will discharge phosphorus at concentrations or loadings which may cause or contribute to exceedances of the water quality criteria in s. NR 102.06 in either the receiving water or downstream waters. To estimate the amount of phosphorus discharged by a new source, the Department may consider projected discharge information from the permit applicant and phosphorus discharge information from similar sources.

(2) If the Department determines a water quality based effluent limitation is not necessary in a permit based on the procedures in this section, the Department may still require monitoring for phosphorus discharges.

SECTION 15. NR 217.16 is created to read:

NR 217.16 Relationship of WQBELs and TMDL based limitations.

(1) In addition to a WQBEL calculated pursuant to s. NR 217.13, the department may calculate a water quality based effluent limitation for phosphorus based on an EPA approved TMDL. This TMDL based limitation may be included in a permit in addition to, or in lieu of, the water quality based limitation calculated under s. NR 217.13. When deciding whether to use a TMDL based limit as a substitute for the limitation calculated under s. NR 217.13, the department shall consider the following factors:

(a) The degree to which nonpoint sources contribute phosphorus to the impaired water;

(b) Whether waters upstream of the impaired waters are meeting the phosphorus criteria; and

(c) Whether waters downstream of the impaired water are meeting the phosphorus criteria.

(2) If the phosphorus limitation based on an approved TMDL is less stringent than the water quality based effluent limitation calculated in s. NR 217.13 and the department includes the TMDL based limitation for phosphorus in the WPDES permit in lieu of the limit calculated in s. NR 217.13, the TMDL

based limit may remain in the permit for up to two permit terms to allow time for implementation of the TMDL, or the implementation period specified in the TMDL, whichever is less. The department may include a schedule of compliance to achieve a TMDL based limit if the department determines a schedule of compliance is necessary. If after two permit terms, the department determines the nonpoint source load allocation has not been substantially reduced, the department may impose the more stringent water quality based effluent limitation calculated under s. NR 217.13, or may include the TMDL based limitation for an additional permit term if the department determines there will be significant nonpoint source load reductions within the upcoming permit term. If the department decides to remove a TMDL based phosphorus limit from a permit and instead include a more stringent water quality based phosphorus limit in the permit calculated under s. NR 217.13, the department may provide a schedule of compliance for the more stringent limit if the department determines additional time is needed for the permittee to comply with the revised limit. Such schedules must require compliance as soon as possible, but in no case no more than 5 years from the date that the permit is reissued or modified to include the revised effluent limitations.

Note: The TMDL based limitation may be less stringent than the water quality based effluent limitation calculated under s. NR 217.13 in cases where nonpoint sources are the significant phosphorus sources responsible for the impairment.

(2) If the phosphorus limitation based on an approved TMDL is more stringent that the water quality based effluent limitation calculated under ss. NR 217.13, the department shall include the more stringent TMDL based limitation in the WPDES permit.

SECTION 16. NR 217.17 is created to read:

NR 217.17 Schedules of Compliance. (1) GENERAL. (a) Except as provided in sub. (5), the department may provide a schedule of compliance for a water quality based phosphorus limitation in a WPDES permit, where based on available information the department finds that:

1. The schedule of compliance will lead to compliance with the water quality based effluent limitation as soon as possible; and

2. The schedule of compliance is appropriate and necessary because the permittee cannot immediately achieve compliance with the water quality based effluent limitation based on existing operation of its treatment system.

(b) In determining whether a compliance schedule is appropriate and determining the length of the compliance schedule, the department shall consider all of the following factors:

1. Whether there is any need for modifications to the treatment facilities, operations or measures to meet the water quality based effluent limitation, and if so, how long it will take to implement the modifications. If the department determines that a permittee only needs to make operational changes to achieve compliance with a limitation, the compliance schedule should be as brief as possible and only allow time for operational start-up adjustments.

2. How much time the discharger has already had to meet the water quality based effluent limitation or TMDL based limit under prior permits.

3. The extent to which discharger has made good faith efforts to comply with the water quality based effluent limitation and other requirements in prior permits, if applicable.

4. The extent to which the phosphorus removal process technologies have been developed and proven to be effective.

(c) In determining whether a compliance schedule is appropriate and determining the length of the compliance schedule, the department may also consider any of the following factors:

1. Whether there is a need to acquire a substantial amount of property to accommodate the needed modifications;

2. Whether there is a need to develop an extensive financing plan and obtain financing of that plan; and

3. The likelihood that a TMDL will be developed and approved within the permit term and whether the wasteload allocation for the facility will likely be less stringent than a water quality based effluent limit calculated under s. NR 217.13.

Note: A compliance schedule may be provided for both a water quality based effluent limit for phosphorus calculated under s. NR 217.13 or a TMDL based limit for phosphorus.

(2) MAXIMUM COMPLIANCE SCHEDULE PERIOD. Except for situations where filtration or a similar phosphorus removal process is required or if the department includes a compliance schedule pursuant to sub. (4), any compliance schedule established by the department under sub. (1) may not exceed 7 years from the date a permit was first modified or reissued to include a water quality based phosphorus limit calculated under s. NR 217.13. Where compliance with the water quality based phosphorus limit requires the construction of filtration or a similar phosphorus removal process, the department may grant a schedule of compliance not to exceed 9 years from the date that the permit is first reissued or modified to include effluent limitations developed under provisions of this subchapter. In cases where a compliance schedule extends beyond 5 years, the department may revise the schedule at reissuance or pursuant to a permit modification.

(3) INTERIM LIMITATIONS. When granting a schedule of compliance, the department shall include, as conditions of the permit, interim limitations that will lead to the compliance with the water quality based effluent limitation. Interim limitations may include a sequence of actions or operations as well as interim numerical effluent limitations. The sequence of actions or operations may include, as appropriate, but are not limited to:

(a) Development and implementation of a phosphorus discharge optimization plan for the current operation.

(b) Implementation of an upstream and downstream receiving water phosphorus monitoring plan sufficient to better develop water quality based effluent limitations.

(c) Development and implementation of a local pollutant trading program that applies to the receiving water, if proposed by the permittee.

(d) Interim effluent limitations representing good management and operation for similar treatment processes based on performance of wastewater treatment facilities.

(4) ADAPTIVE MANAGEMENT OPTION. (a) If requested by the permittee in the permit application for reissuance, the department may provide a schedule of compliance using adaptive management approaches as interim limits in a compliance schedule where the department finds all of the following:

1. The exceedance of the phosphorus criterion in s. NR 102.06 is caused by pollutant contributions from both point sources and nonpoint sources and that the nonpoint source contribution is at least 50 percent.

2. Without further control of phosphorus from nonpoint sources, the permittee would need to install and operate expensive technology to meet the effluent limitations and that, with the additional nonpoint source control, the expensive technology would not likely be needed.

3. The department determines that the phosphorus criterion in s. NR 102. 06 for the receiving water is not likely to be met without the control of phosphorus from nonpoint sources.

(b) In making a finding under par. (a), the department may use information provided by the permittee or any other relevant information.

(c) The schedule of compliance under this option shall include all of the following:

1. A requirement to monitor the receiving water at locations and at times established in the permit.

2. Development and implementation of a plan to optimize the treatment system to control phosphorus.

3. Installation and operation of treatment equipment that is readily affordable.

4. Interim numerical effluent limitations as follows:

a. A phosphorus limit under s. NR 217.04 shall be included in the permit and shall require a monthly average compliance periods as required under subchap.II. In addition, an initial interim limitation of no higher than 0.6 mg/l of total phosphorus expressed as a seasonal average over the period

of May 1st through October 31st, shall be included in the permit. The department may allow the permittee a compliance schedule, not to exceed 5 years to meet this limitation, if necessary.

b. In the next permit term, a more stringent interim limitation of no higher than 0.5 mg/l shall be established where the monitoring data of the receiving water has shown that the phosphorus water quality criterion in s. NR 102.06 has not been met by the end of the term of prior permit.

c. In the third permit term, the department may impose a phosphorus limitation calculated under ss. NR 217.13 and allow a maximum compliance schedule of 5 years to achieve that limitation, if the monitoring data collected for the receiving water shows the criterion has not been achieved.

(5) NEW SOURCES. Any new source may not receive a compliance schedule to achieve compliance with a phosphorus water quality based effluent limitation.

SECTION 17. NR 217.18 is created to read:

NR 217.18 Variances for stabilization ponds and lagoon systems. (1) GENERAL.

(a) *Applicability.* Based on the findings in par. (b), an owner or operator of a permitted wastewater treatment system that consists primarily of a permitted stabilization pond system or a lagoon system may apply for a variance to the phosphorus water quality based effluent limitations using the procedures in this section. The department may only grant a variance under this section to phosphorus water quality based effluent limitations for stabilization pond and lagoon systems regulated under ch. NR 210.

Note: The variance procedures in this section are not applicable to industrial facilities.

(b) *Findings.* As of [insert effective date of this rule], the department finds all of the following:

1. Stabilization ponds and lagoons subject to ch. NR 210 are operated primarily by communities that serve a population of 2000 or less.

2. Most stabilization pond and lagoon facilities cannot meet the water quality based effluent limitations for phosphorus derived under this subchapter.

3. In many cases, under currently available technology, it will be necessary for owners of the systems in subd. 1. to construct a new wastewater treatment plant to comply with phosphorus effluent limitations. Construction of new wastewater treatment facilities for these permittees will result in substantial and widespread adverse social and economic impacts in the area served by the existing stabilization pond and lagoon system.

(c) *Initial variance.* The procedures in this section may be used when a water quality based phosphorus limit is required under this subchapter for this first time in a WPDES permit reissued or modified after [revisor insert effective date].

(d) *New sources.* A new source may not receive approval for a variance under this section or pursuant to any other variance procedure.

(2) APPLICATION FOR A VARIANCE. (a) The application for a variance under this section shall be submitted with the WPDES permit application for reissuance, or within 30 days after the permittee receives written notification of the proposed phosphorus limits, if the notification occurs later. The application shall be submitted on the form available from the department.

(b) The application shall, at a minimum, include the following information:

1. Information required by s. NR 200.22 (1) (a), (b) and (d).

2. Any phosphorus monitoring data for the applicant's system collected during the permit term in effect at the time the application is filed. The permittee shall specify the sample location, sample types and dates, analysis dates, lab name and certification number.

3. A statement that the permittee is seeking a variance pursuant to this section.

4. Information on the number of lagoon or pond treatment cells, treatment process, discharge periods, retention times, population served, influent flow, and available capacity for holding wastewater.

5. Other information requested by the department that is relevant to the review conducted under sub. (3).

Note: It is recommended that the permittee ask for calculation of potential phosphorus water quality based limits at least 12 months prior to permit expiration. This information will help the permittee complete their variance request portion of the permit application which is due 180 days prior to permit expiration.

(3) DEPARTMENT REVIEW. (a) The department shall review the submitted application for the variance and determine whether the permittee's system can meet the phosphorus effluent limitations calculated pursuant to s. NR 217. 13. To make this determination, the department shall compare the calculated phosphorus effluent limitations to the phosphorus effluent data submitted under sub. (2). If the applicant does not have phosphorus discharge data for its system, the department shall use effluent data from a similar lagoon or pond system in the state to make the comparison. Any valid, representative effluent data which exceeds a calculated limitation may be grounds for the department to determine that the existing system cannot meet the calculated phosphorus limitations. The department may apply statistical methodologies to make its determination on the ability of the system to meet phosphorus limitations.

(b) The department's decision to approve or deny a variance under this section shall be made on or before the date of the s. 283.53 (3) (d), Stats., public notice for the proposed permit reissuance and shall be made in accordance with the following:

1. If the department determines that the permittee's system cannot meet a phosphorus effluent limitation, the department shall approve the variance. If the variance is approved, the department shall specify in the permit that the variance has been granted for phosphorus, and the requirements in sub. (4) shall also be included in the permit.

2. If the department determines that the applicant's existing system can meet the phosphorus effluent limitations or that effluent limitations are not necessary as determined by s. NR 217.15, the department shall deny the variance and notify the applicant of this determination in writing.

(c) A permittee with a lagoon and stabilization pond that is denied a variance under the procedures of this section may not be granted a variance for phosphorus based on the criteria in s. 283.15(4)(a)1.f., Stats., and using the procedures in ch. NR 200 and s. 283.15, Stats.

(d) A permittee may seek a variance from a phosphorus limit in a reissued WPDES permit based on the criteria in s. 283.15(4)(a)1.a. to e., Stats, and using the procedures and requirements in s. 283.15, Stats., and ch. NR 200.

(4) PERMIT TERMS IF VARIANCE IS APPROVED. If the department approves a variance to the phosphorus effluent limitations under this section, the following requirements shall be included in the reissued permit:

(a) The permittee shall conduct weekly monitoring of phosphorus during discharge periods.

(b) The permittee shall, to the extent practicable, identify and minimize the non-domestic sources of phosphorus to the system and operate the treatment system to minimize exceedances of the calculated limits.

(c) Within 36 months following permit reissuance, the permittee shall submit an operational evaluation report that evaluates the ability of the existing system to meet the phosphorus effluent limitations calculated under s. NR 217.13. The report shall evaluate the results of efforts to reduce non-domestic sources of phosphorus under par. (b) as well as the holding capacity of the system and the results of operational changes and other minor system modifications that are designed to reduce phosphorus discharges levels. Based on the information in the operational evaluation report, the department shall make one of the following determinations:

1. If the department determines the system can consistently meet the phosphorus effluent limitations calculated under s. NR 217.13 with operational adjustments, these phosphorus effluent limitations shall become effective within 30 days of the department's determination, and the permittee is not required to submit a facilities plan under subd. 3. When making this determination, the department shall consider weather conditions and wastewater loading during the operational evaluation period, relationship of current to design conditions and other pertinent site-specific factors.

2. If the department determines the system cannot consistently meet the phosphorus effluent limitations calculated under s. NR 217.13 with operational changes, the department shall renew the

variance for the remaining term of the permit, and the permittee shall submit a facilities plan in accordance with the schedule in subd. 3.

3. If required by subd. 2., the permittee shall, within 48 months of permit reissuance, submit a facilities plan that evaluates alternatives for meeting the phosphorus effluent limitations calculated under s. NR 217.13. The facilities plan shall satisfy the requirements in ss. NR 110.08 and 110.09.

(5) CONTINUED VARIANCES. (a) If a permittee received approval for a variance to the phosphorus standard under this section in a reissued permit, the permittee may request a continued variance from the phosphorus standard in a subsequent reissued permit pursuant to the procedures in ch. NR 200 and s. 283.15 (4), Stats.

(b) If a permittee requests a continued variance in a subsequent reissuance because attaining the water quality based phosphorus effluent limitations is not feasible and would cause substantial and widespread adverse social and economic impacts in the area where the permittee is located as provided under s. 283.15 (4) (a) 1. f., Stats., all of the following information shall be submitted and considered by the department in its decision on this variance request:

1. Information in s. NR 200.22 (1).

2. The date the major components of the stabilization pond or lagoon system were constructed, or most recently substantially modified.

3. The projected design life of the stabilization pond or lagoon system as stated in the approved facilities plan at the time the system was constructed.

4. In addition to the information in s. NR 200.22 (1) (p), information on the remaining debt service associated with the construction of the existing stabilization pond or lagoon system and household income in the service area.

5. An assessment of the current system as reflected by the information submitted to the department under the compliance maintenance annual reporting requirements of ch. NR 208.

6. Any other water quality standards variances previously granted to the permittee.

SECTION 18. EFFECTIVE DATE. This rule shall take effect on the first day of the month following publication in the Wisconsin administrative register as provided in s. 227.22(2), Stats.

SECTION 19. BOARD ADOPTION. The forgoing rule was approved and adopted by the State of Wisconsin Natural Resources Board on ______________________________.

Dated at Madison, Wisconsin ______________________________________.

STATE OF WISCONSIN

DEPARTMENT OF NATURAL RESOURCES

By ________________________________.

Matthew J. Frank, Secretary

(SEAL)

ATTACHMENT 4

IMPACTS OF CHICAGO METROPOLITAN AREA POINT SOURCES ON WATER QUALITY IN THE UPPER ILLINOIS WATERWAY

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WATERWAY HISTORY

Since 1900, the additional flows and wastewater loadings from the Chicago metropolitan area have had a profound impact in the Illinois River. The Des Plaines River and the Illinois River suffered through the early part of the 20th Century so that Lake Michigan could be spared from the adverse effects of wastewater if Chicago's wastewater were to go back to the lake. The additional flows and waste loads imposed on the Illinois River caused increased flooding and water quality degradation. Even though it was scientifically demonstrated that bacterial contamination did not effect the Illinois River at Peoria and down-river reaches, the organic demand and increased solids took their toll. From 1900 to 1930, the Sanitary District of Chicago (now the Metropolitan Water Reclamation District of Greater Chicago, or MWRD) was able to follow the statutory requirement for dilution, 3.33 cubic feet per second (cfs) per 1,000 population, often violating the limits in federal permits issued by the Secretary of War. This large increase in flow swept downstream, increasing the capacity of the Illinois River to assimilate the wastewater load. However, the industrial load did not figure into the dilution rate, so its impact was not compensated for.

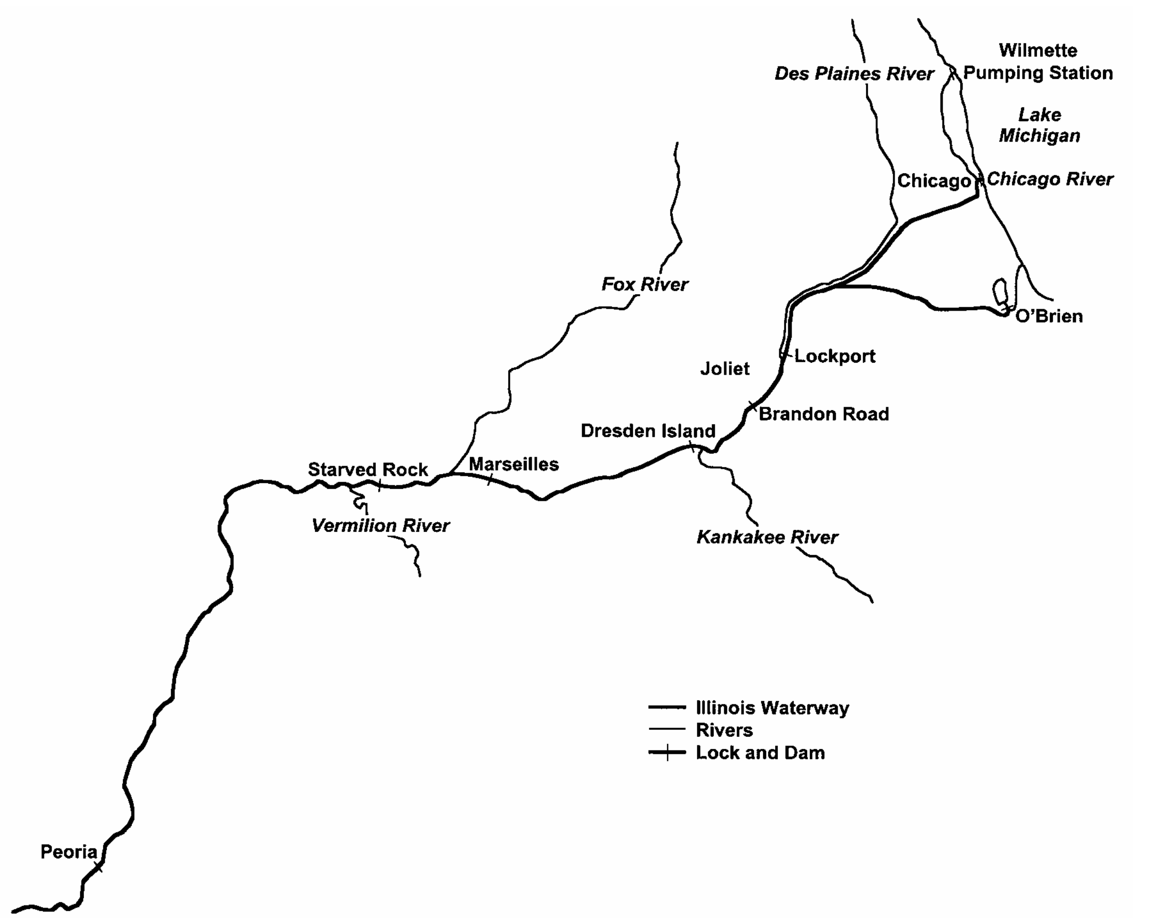
In 1930, the U.S. Supreme Court Decree went into effect, gradually reducing the amount of dilution over the 1930 through 1939 period. While this reduction was being accomplished, MWRD was supposed to be building intercepting sewers and sewage treatment facilities to compensate for the loss in dilution. These were somewhat delayed due to the Great Depression, but, remarkably, were completed by the early 1940s, despite the shift to a wartime economy. However, sewage treatment being what it was in those years, much of the wastewater load was not removed, but simply passed downstream. With the loss of dilution, flows in the Illinois River became sluggish. Another development during the 1930s also adversely impacted the Illinois River. The long-sought state of Illinois dream of a navigable waterway was completed with the U.S. Army Corps of Engineers given a congressional mandate to take over and complete a state project. Illinois had simply run out of funds and could not afford to complete the construction of lock and dam structures, channel walls and channel dredging. Channelizing the Des Plaines and Illinois Rivers and creating several impoundments changed the hydraulic characteristics and adversely affected aquatic habitat conditions. These two rivers, now imposed with wastewater flows from the Chicago area and converted to a series of navigation pools, became the federalized Illinois Waterway (IW). The middle of the century was probably the bleakest period for water quality in the Illinois River.

In the 1970s, with the Clean Water Act construction grants program, the MWRD made great strides in expansion and improvement of its treatment plants and the construction of the Tunnel and Reservoir Plan (TARP) to reduce combined sewer overflows. The first to benefit were the Calumet and Chicago River systems. More gradually, the benefit has reached downstream. About this same time, MWRD began to monitor improvements in water quality in local and down-river waters. The first Lockport to Peoria sampling run by boat was conducted in 1977. Since the mid-1980s, these sample collection runs have occurred each year, except in 1998.

WATERWAY DESCRIPTION

The 327-mile IW extends from the mouth of the Illinois River at Grafton, Illinois, to Lake Michigan at Chicago following the course of the Illinois River, Des Plaines River and Chicago Sanitary and Ship Canal (CSSC). Near Chicago the IW branches, with one branch following the CSSC, South Branch and Chicago River to Chicago Harbor and the other branch following the Calumet-Sag Channel, Little Calumet River and Calumet River to Calumet Harbor. Most commercial navigation traffic follows the latter branch. The IW consists of eight navigation pools formed by lock and dam (L&D) structures that lower the water level 156.2 feet from Lake Michigan to the Mississippi River.

Upper Illinois Waterway Chicago to Peoria



There are three distinctly different river regimes along the IW. The three downstream pools (Peoria, La Grange and Alton) follow a north to south course and cover a distance of 231 miles, dropping 22 feet. Near the upstream end of the Peoria Pool, the Illinois River executes a sharp bend, marking the division between two regimes. Downstream of the bend near Hennepin, Illinois, the valley of the river is broad and the gradient is flat. The three intermediate pools (Dresden Island, Marseilles and Starved Rock) follow an east to west course and cover a distance of 55 miles, dropping 65 feet. The valley of the Illinois River is narrow and the gradient is mild. The two upstream pools (Lockport and Brandon Road) generally follow a northeast to southwest course and cover a distance of 40 miles, dropping 71.2 feet. Over part of this distance, the valley of the Des

Plaines River is narrow as it drops steeply over the face of the Niagran escarpment between Willow Springs and Joliet, Illinois. Upstream of the escarpment, the Chicago River, South Branch, CSSC and Des Plaines River flow across the flat Chicago Lake Plain. The following table illustrates these regimes.

Regime	Length miles	Drop feet	Gradient feet per mile
Downstream	231	22	0.095
Intermediate	55	65	1.18
Upstream	40	71.2	1.78

The conversion of the Illinois and Des Plaines Rivers into the channelized and navigable IW has significantly altered the hydraulic behavior of these rivers. Without floodplains, flood peaks are not attenuated and the navigation channel confines the flow in a deeper and narrower channel than what it would be under natural conditions. Except for flood periods, the water level in each pool is held constant for navigable depths, depriving the river channel and aquatic habitat of the annual low-water season. It is likely that the gradients imposed by the IW L&D structures conveys flow and constituents through the upstream and intermediate regime pools and allows more deposition in the downstream regime pools.

PRINCIPAL POINT SOURCES

Treated wastewater effluent from the Chicago metropolitan area is a significant source of flow and constituent loads to the IW. Principal among these are the three large water reclamation plants (WRPs) owned and operated by the MWRD, namely the Calumet, North Side and Stickney WRPs. The combined design capacity of the WRPs is nearly 1,900 million gallons per day (mgd) and the average flow for 2002 is 1,170 mgd, or 1,800 cfs. In addition to the WRPs, the MWRD operates the Tunnel and Reservoir Plan project to capture and treat combined sewer overflows (CSOs) from the 360 square-mile area of combined sewers in the metropolitan area. Captured CSO is treated at the Calumet and Stickney WRPs, both of which discharge directly to the branches of the IW in the Chicago area. The North Side WRP discharges to the North Shore Channel, which is tributary to the IW in downtown Chicago. Reduction of the frequency and volume of CSO has improved water quality in the CSSC and the IW.

The MWRD has installed several supplemental aeration stations in the receiving waterways downstream of the WRPs. This has helped to meet the dissolved oxygen water quality standard. In 1984, the IPCB eliminated the bacterial standard from the Secondary Contact standards and the requirement for point sources to practice effluent disinfection. The three WRPs mentioned above were able to discontinue disinfection and although the concentration of fecal coliform in the CSSC and the Calumet-Sag Channel increased significantly, little increase was noted in the CSSC at Lockport because of the die-off of these organisms in the waterway. The removal of residual chlorine resulted in a resurgent fish population.

Although the CSSC is the principal tributary of the Des Plaines River, there are numerous municipal treatment plants throughout the watershed in Cook, DuPage, Lake and Will Counties. This accounts for treated effluents being the dominant flow at the mouth of the Des Plaines River where it joins with the Kankakee River to form the Illinois River. Proceeding in the downstream direction, other rivers, such as the Fox, Mazon and Vermillion, yield significant quantities of agricultural nonpoint drainage and stormwater flow that lessen the impact of pollutants from Chicago area point sources on water quality in the IW near Peoria.

WATER AND SEDIMENT QUALITY MONITORING

The IW has been the subject of numerous investigations by several federal and state agencies. Of recent note are the two National Water Quality Assessment Program study unit investigations conducted by the U.S. Geological Survey for the Upper Illinois River Basin (UIRB) and the Lower IRB (LIRB). These comprehensive and intensive investigations are of short-term duration, but are repeated on a nine-year cycle. Despite these and investigations by others, the MWRD has conducted its own on-going monitoring program of the IW upstream of Peoria to gather information on the impact of MWRD point sources on the downstream reaches of the Des Plaines and Illinois Rivers.

The MWRD began a regular program of monitoring the 133-mile reach of the Upper IW between Lockport and Peoria in 1983 and, with the exception of 1998, has continued the program through to the present. There are 49 sampling stations distributed as shown in the following table:

Navigation Pool	**Number of Sampling Locations in Pool for**	
	Water Quality	**Sediment Quality**
Lockport	1[1]	1[1]
Brandon Road	3	1
Dresden Island	7	2
Marseilles	9	2
Starved Rock	7	1
Peoria	22	7

1. The single sampling location is located immediately upstream of the Lockport Lock & Dam.

Samples are collected by boat during the months of May, August and October. In each month the MWRD's boat and crew collect samples on the downstream run, beginning at Lockport on Monday and finishing in Peoria on Thursday. In the following week, samples are collected on the upstream run, beginning on Monday in Peoria and finishing in Lockport on Thursday. Each location is sampled for water column quality for a total of six times per year. For sediment quality, 14 of the locations are sampled once per year in October on the downstream boat run. Water quality samples are collected 3 feet below the surface in the center of the navigation channel using a submersible pump. The sampling locations were carefully chosen where the river channel is well mixed so that a single sample could be considered representative.

All water samples were filtered in the field, properly preserved and packed in ice in insulated chests. The samples for each day's collection were transported back to the MWRD laboratory in Chicago where analysis began the following day. Bacterial samples were collected and packed separately and transported to a contract laboratory in Peoria at the end of each day so that analysis could begin within the required time. Sediment samples were collected with a 6x6 inch Ponar grab sampler from the bottom of the center of the navigation channel, transferred to a wide-mouth bottle, properly preserved and prepared for transport the same as the water samples. All analyses were performed according to protocols in *Standard Methods for the Examination of Water and Wastewater* in laboratories that are either accredited for wastewater chemical analysis by the IEPA or certified for drinking water analysis by the IDPH. Water quality samples were analyzed for 15 constituents, including nutrients and oxygen-demanding substances, and for 11 dissolved metals and total metals. Sediment samples were analyzed for most of the same constituents, but only the total metals.

WATER QUALITY TRENDS

Downstream of the I-55 Bridge southwest of Joliet, the IW is designated as General Use Waters by the IPCB. Upstream of this Bridge, the designation is for Secondary Contact and Indigenous Aquatic Life Species. However, for purposes of comparison, only the General Use

standards will be used. Also for purposes of comparison, the Peoria Pool is divided into Upper and Lower portions, where the Lower portion is the reach downstream of Chillicothe where the pool widens into Lake Peoria. Spatial trends in water quality in 2002 are shown in the following table, using the mean concentration of all samples collected in each pool. Due to space limitations, only five constituents are shown, four of which have water quality standards. It is noted that water quality standards are generally met for all constituents, including those that are not shown.

Navigation Pool	Temperature Degrees Centigrade	Dissolved Oxygen mg/L	pH Units	Fecal Coliform[1] cfu/100 ml	Total Suspended Solids mg/L
Lockport	24.4	4.7	7.2	39	21
Brandon Road	23.5	5.6	7.2	82	22
Dresden Island	23.5	7.9	7.5	59	27
Marseilles	22.0	8.5	7.8	18	41
Starved Rock	21.0	9.1	8.0	16	46
Upper Peoria	20.2	9.0	8.1	21	53
Lower Peoria	19.6	8.2	8.2	19	60
General Use Standards	32/16	6.0/5.0	6.5-9.0	400/200	Ns[2]

1. Geometric mean.
2. No standard.

Nutrients are of particular interest because the IEPA is currently developing proposed standards for submittal to the IPCB. The following table shows the two nutrients, two response variables and total suspended solid together with the criteria published by the USEPA in January 2001. As can be seen, both total nitrogen and total phosphorus decrease in the downstream direction, but are significantly above the criteria. Groschen, 2000, corroborates the decrease of total nitrogen and total phosphorus concentrations in the downstream direction.

Navigation Pool	Total Nitrogen mg/L	Total Phosphorus mg/L	Turbidity NTU	Chlorophyl a µg/L
Lockport	6.58	1.05	18.0	6.00
Brandon Road	5.95	0.87	22.0	9.00
Dresden Island	5.81	0.90	33.7	13.3
Marseilles	5.62	0.75	60.0	18.2
Starved Rock	5.40	0.66	70.0	44.2
Upper Peoria	5.50	0.62	77.0	40.9
Lower Peoria	5.28	0.54	82.0	55.6
EPA Criteria	2.2	0.076	9.9	7.3

This report found that substantial differences among nutrient concentrations in small agricultural basins and lower nutrient concentrations in large rivers indicate that hydrological and biochemical processes reduce the nutrient concentrations as nutrients moves through the LIRB.

Both turbidity and chlorophyll a increase significantly in the downstream direction. Although the response variables, turbidity and chlorophyll a, are regarded by USEPA to be indicators of eutrophication, the relationship between these two constituents and total nitrogen and total phosphorus is not well understood. Ammonia is not shown in the table because this toxic pollutant has been effectively controlled for the last decade through nitrification at municipal wastewater treatment plants.

In the two tables above it is noted that both total suspended solids and turbidity increase in the downstream direction. Sullivan, 2000, corroborates this trend wherein it is found that suspended solids were higher from agricultural areas in the Iroquois River Basin, a tributary of the Kankakee River, and the Fox River Basin. The increase in total suspended solids and turbidity to Peoria is probably due to the influx of other tributaries from agricultural areas in central Illinois. Sullivan also makes these observations regarding nutrients in the UIRB:

- Nutrient concentrations, with the exception of nitrate, were highest in urban area streams in the Des Plaines River Basin.

- Nitrate concentrations were higher in streams in agricultural areas.

- Nutrient concentrations in streams in agricultural areas show strong seasonal variability, whereas in urban areas, seasonal variations are less pronounced.

- Industrial and municipal sources were responsible for the higher concentrations of ammonia and phosphorus in the Des Plaines River Basin.

- Suspended solids concentrations were highest in the summer and lowest in the winter, reflecting higher stream flow in summer from stormwater runoff and increased phytoplankton growth.

- The CSSC was the major contributor of ammonia, total nitrogen and total phosphorus in the Des Plaines River Basin.

- Significant downward trends in ammonia concentrations and correlative upward trends in nitrate concentrations occur in the period, most likely the result of nitrification at municipal wastewater treatment plants.

Since 1984, constituent concentrations have varied somewhat, but are similar to the concentrations shown in the above tables for 2002. Temporal trends in water quality are not apparent in the monitoring conducted by the MWRD since 1984, but other researchers have tracked water quality trends over longer periods. Larson, 2001, compiled water quality records from a number of sources from the early 1970s through 1995 at several locations between Chicago and Peoria. In the CSSC near Lockport, upward trends were found for dissolved oxygen, nitrate plus nitrite, total phosphorus and sulfate. Downward trends were found for ammonia and total Kjeldahl nitrogen. In the Illinois River at Marseilles, downward trends were found for ammonia, total phosphorus and total suspended solids. At Peoria, the Illinois River showed upward trends for dissolved oxygen and turbidity and downward trends for ammonia, phosphate and total suspended solids. It was noted that the Illinois River at Peoria now consistently meets the water quality standard of 5.0 mg/L. A summary of these findings is shown in the following table.

Water Quality Parameter	**CSSC Lockport**	**Illinois River**	
		Marseilles	**Peoria**
Dissolved Oxygen	↑	--	↑
Total Suspended Solids	--	↓	↓
Turbidity	--	--	↑
Total Kjeldahl Nitrogen	↓	--	--
Ammonia	↓	↓	↓

Nitrate$_3$ + Nitrite$_2$	↑	--	--
Total P	↑	↓	--
Phosphate	--	--	↓

↑ Upward trend.
↓ Downward trend.
-- No significant trend.

SEDIMENT QUALITY

Sediment quality in rivers can have a significant effect on the overlying water quality and other elements of freshwater ecosystems. However, sediment quality can vary significantly across the river cross-section and will change more slowly over time in response to temporal changes in water quality and other environmental influences.

Sediment quality at 11 locations between Lockport and Peoria showed considerable variations in 2002. Generally, sediment quality concentrations decreased in the downstream direction with some constituent concentrations increasing in the Upper and Lower Peoria Pools. Representative general chemistry concentrations are shown in the following table.

	Dry Weight Concentration in mg/kg			
Navigation Pool and Station Number	**Ammonia Nitrogen**	**Total Kjeldahl Nitrogen**	**Total Phosphorus**	**Total Volatile Solids percent**
Lockport				
1	254	2,690	4,510	13
Brandon Road				
2	2	33	190	15
Dresden Island				
5	17	3,320	5,680	6
8	2	100	530	10
Marseilles				
12	5	400	1,460	5
18	2	95	88	1
Starved Rock				
23	27	1,120	1,670	3
Upper Peoria				
32	2	36	153	2
38	35	1,510	1,170	7
Lower Peoria				
44	27	1,900	1,280	9
48	19	1,200	751	6

Representative concentrations of metals in the sediment are shown in the following table.

	Dry Weight Concentration in mg/kg			
Navigation Pool and Station Number	**Chromium**	**Copper**	**Lead**	**Zinc**
Lockport				
1	173	157	225	820
Brandon Road				

2	180	161	214	719
Dresden Island				
5	27	10	99	86
8	50	38	47	219
Marseilles				
12	18	6	15	68
18	17	4	8	34
Starved Rock				
23	16	6	27	48
Upper Peoria				
32	15	3	6	56
38	28	21	27	134
Lower Peoria				
44	48	37	37	198
48	37	21	20	105

Based on a comparison of 2002 concentrations with results in earlier years, there does not appear to be any significant changes in sediment quality over the past two decades.

LOADS

Loads of total suspended solids and nutrients for the UIRB were reported in Sullivan, 2000, for the 1978 through 1997 period. The CSSC was the major contributor of total nitrogen and total phosphorus in the Des Plaines River Basin, resulting from the effluent discharge of the three large MWRD WRPs. The Kankakee River was the major contributor of total suspended solids. Total nitrogen, total phosphorus and total suspended solids loads at Ottawa, the outlet of the UIRB, were 91,800, 5,400 and 1,290,000 tons per year (tpy), respectively for the 1978 through 1997 period. However, recent results from the 1999 through 2001 UIRB NAWQA study unit investigation indicates somewhat less loadings for these three parameters than the above. Further, according to Sullivan, 2000, loads in the CSSC at Lockport are approximately 43, 80 and 10 percent of the loads at Ottawa for total nitrogen, total phosphorus and total suspended solids, respectively. Thus, total nitrogen and total phosphorus in the CSSC at Lockport constitute a large part of the nutrient load leaving the UIRB at Ottawa, whereas, total suspended solids in the CSSC at Lockport is a small part of the total suspended solids load at Ottawa.

Groschen, 2000, found that the UIRB contributes roughly the same amount of nutrients as does the LIRB. From this it can be concluded that the total nitrogen and total phosphorus loads in the CSSC at Lockport are approximately 22 and 40 percent of the total nitrogen and total phosphorus load being discharged from the LIRB to the Mississippi River. The total suspended solids load in the CSSC is again a small portion of the total suspended solids load reaching the Mississippi River.

Loads for total nitrogen, total phosphorus and total suspended solids from the three large MWRD WRPs and for the CSSC at Lockport have been determined by the MWRD for the years 1985, 1989, 1993, 1999 and 2002. The average loads at Lockport for these five years varies from the average loads in Sullivan, 2000, as follows:

Constituent	Source	Ottawa tpy	Lockport tpy	Three WRPs tpy
Total Nitrogen	Sullivan, 2000	91,800	38,500	--
	MWRD	--	22,300	15,000

Total Phosphorus	Sullivan, 2000	5,400	4,300	--
	MWRD	--	3,000	2,600
Total Suspended Solids	Sullivan, 2000	1,290,000	132,000	--
	MWRD	--	67,000	14,800

The differences at Lockport are significant and may be partly due to the different periods. It is noted that the MWRD loads are for five increments over an 18-year period, whereas the average loads in Sullivan, 2000, is based on annual determinations over a slightly earlier 20-year period. Regardless of the differences, this shows that total nitrogen and total phosphorus in the effluent of the three MWRD WRPs are a major part of the load of these constituents in the CSSC at Lockport. Total suspended solids in the effluent are a much smaller part of the CSSC load.

CONCLUSION

Through expanded treatment capacity and improved process performance at the MWRD WRPs and the capture and treatment of CSOs, most pollutant concentrations and loadings in the Upper IW have been reduced. The large load of total suspended solids in the Illinois River at Ottawa and at Peoria derive mostly from agricultural areas in the watershed and not from municipal wastewater treatment plants. However, the MWRD along with other municipal wastewater treatment authorities operate facilities that are significant sources of nutrients and nutrients will continue to be a matter of concern until the IEPA can complete its work on the development of nutrient standards. Until then, it will not be known with certainty if nutrients are serious impairments in Illinois rivers and streams.

However, nitrogen is also known to contribute to the condition of hypoxia in the Gulf of Mexico. A federal task force has yet to define the limits that will be imposed on states in the Mississippi River Basin to reduce nitrogen. If it comes to the need for standards, sources of nutrients, both point and nonpoint will have to find affordable and effective means to remove the nutrient loads. Municipal wastewater authorities have treatment technologies that can be employed for point sources and these can be regulated through the NPDES permit program. There is no comparable regulatory program for the discharge of nutrients and total suspended solids from agricultural nonpoint sources and effective control technologies are yet to be found. The management of nutrients and total suspended solids must be addressed on a watershed scale to effectively address both point and nonpoint sources.

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ATTACHMENT 5

BEFORE THE POLLUTION CONTROL BOARD
OF THE STATE OF ILLINOIS (R04-026)

PRE-FILED TESTIMONY OF Michael J. Lemke

Testimony of Michael J. Lemke, Ph.D.

My name is Michael J. Lemke. I am a professor of biology at the University of Illinois at Springfield where I have held the position of Assistant Professor (1999-2003) and Associate Professor (2003-present). My position includes education of graduate and undergraduate students and continuing research.

Introduction

Eutrophication is the most widespread water quality problem in the U.S. (Carpenter et al. 1998) and accounts for over one-half of impaired river reaches in the US (US EPA 1996a). On the basis of my experience as a biologist who has worked in Illinois aquatic ecosystems, I think that it is important that Illinois strictly limit increased discharges of phosphorus going into Illinois rivers and streams. I would like to stress three major points in this introduction, which I discuss in greater detail in the body of my testimony.

- First, it is important that rivers and streams be protected from unnatural levels of phosphorus just as it is important that lakes be protected from such pollution. While early research described the relationship between excessive phosphorus and harmful environmental effects in lakes, it is now well known that excess phosphorus harms riverine systems. Both extensive research documented in the scientific literature and my own experience working in Illinois rivers and streams support this observation.

- Second, addition of unnaturally high amounts of phosphorus to a river or lake almost always has some environmental effect. In Illinois, phosphorus is most often the nutrient that limits algal and bacterial growth, and where phosphorus is limiting, further additions of phosphorus will lead to unnatural growth of algae and bacteria. Phosphorus-enriched systems often support algal and bacterial growth at levels that are considered offensive and harmful to the environment. Further, even when unnatural phosphorus loadings do not immediately affect the stream segment they initially entered, they may affect downstream waters.

- Finally, while excessive levels of phosphorus in any form can be a problem, inorganic soluble phosphorus is immediately biologically available as a nutrient for algae and bacteria growth. Other factors, such as suspended particles, amount of sunlight, and flow rate are all factors affecting the particulars of the outcome of phosphorus-enrichment. Even phosphorus that is in particulate, seemingly unavailable form can be subsequently released in the benthos and

affect the water in which it was stored or contribute to problems downstream. These factors must be considered in development of the management plan.

Qualifications

My qualifications to comment on the issue at hand, evaluation of the environmental benefits of limiting new loadings of phosphorus to Illinois lakes and streams are based on my experience in researching nutrient impacts in aquatic ecosystems, including rivers and streams. This experience includes:

- current research on and evaluation of nutrient levels in the LaGrange Reach of the Illinois River
- publications exploring organic phosphate uptake in microbial communities
- dissertation (Michigan Technological University) focused on decomposition processes & nutrient cycling
- numerous peer-reviewed journal articles in the field of aquatic ecology
- funded research specific to nutrient dynamics in central Illinois for the past four years

I do not claim to be an expert on Illinois regulation or regulatory matters and will not be testifying on any of the details of the Agency proposal.

The Ecology of Phosphorus in Streams

It has been known as early as the mid-1800's that the yield of plants can be limited by the nutrient found in least quantity in the environment (i.e., limiting nutrient) relative to the demand of plants for growth (Liebig's Law of the Minimum; von Liebig, 1855). Inorganic nitrogen and phosphorus are the primary nutrients that limit growth, not only of terrestrial plants, but of freshwater aquatic algae and vascular plants (Smith et al.1999, Vollenweider 1968). However, for some time, a viewpoint existed that many rivers are insensitive to nutrient input because they are "nutrient saturated" (Smith et al. 1999). This belief was based on assumptions that physical (e.g., light, suspended solids; flow), chemical (i.e., nutrients), and biological (e.g., invertebrate grazing) factors of rivers potentially restrict the effects of algal growth. However, findings from numerous studies (some as early as Huntsman 1948, Correll 1958) completed in a variety of diverse habitats showed a relationship between river and stream conditions and their sensitivity to inputs of nitrogen and phosphorus that can result in increased algal biomass (attached and free-floating), increased rates of decomposition (and thus higher benthic respiration), and changes in aquatic invertebrate community composition (Elwood et al. 1981).

Processes. Familiarity with the fundamental processes of phosphorus in flowing waters is essential to discussions defining its input to flowing waters. Phosphorus exists in inorganic and organic forms (e.g., DNA, ATP, etc.). The most significant form of phosphorus in natural waters is inorganic soluble phosphorus (orthophosphate written as PO_4^{3-}). The other common way of measuring ecologically significant amounts of phosphorus is as total phosphorus, or the total concentration of phosphorus in unfiltered water that represents particulate and dissolved forms. Generally, more than 90% of organic phosphate is in particulate form being either incorporated into organism biomass or absorbed to particles, particularly to particulate organic matter. Phosphate can also complex with inorganic particles, such as clay or precipitate with carbonates. Dissolved phosphate exists as orthophosphate, polyphosphates and/or organic colloids.

Total phosphorus (TP) concentration of most uncontaminated surface waters is between 0.01 to 0.05 ppm P. Orthophosphate (also called soluble reactive phosphate (SRP) which is the filterable inorganic soluble form that can be directly taken up by plant and algal cells) is 0.025 ppm on average in unpolluted rivers (Wetzel 2001). A factor often found misleading in water quality monitoring is that even in the height of an algal bloom, the phosphorus measured in filtered water is low. One must appreciate that the SRP is low because the phosphorus (phosphate) has been assimilated by algal and bacterial growth and thus temporarily removed from the water and incorporated into biomass.

Ecological and Biogeochemical Relationships. Several crucial relationships describe the cycling of phosphorus in aquatic ecosystems. There is a reciprocal relationship between oxygen and phosphate concentrations in the water column. In oxygenated waters (as in many streams most of the time but not necessarily in larger streams and rivers), iron, manganese, and aluminum can complex with phosphate, making it largely unavailable to organisms for growth. Often, these complexes can become large enough in particle size to precipitate from the water column and collect in the sediment. Three prevalent pathways for the precipitation of phosphate include complexation with calcium to form hydroxyapetite, co-precipitation with calcium carbonate (often due to increased algae growth subsequently increasing pH and creating a carbonate shift) (Wetzel 2001) and adsorption of organic and inorganic P to sediments (Meyer 1979).

But in these streams where the phosphorus has complexed and collected in the sediment, if oxygen levels decrease to anoxia (i.e., reducing conditions [E_7] < +200 mV; Mortimer 1971) phosphate complexed to ferrous iron (Fe^{2+}) or mangonous (Mn++) becomes "uncoupled" and increases in solubility and thus is made available to the system. In streams, complexation with these cations is especially important at high levels of P (0.025-0.100 ppm, Strumm and Morgan 1981). In Illinois, high levels of non-point source nitrogen typically make water bodies phosphate-limited. High amount of subsequent organic load (i.e., death of algal blooms and aquatic vascular plants) contribute to a high level of decomposition that can create anoxic conditions due to high levels of heterotrophic bacteria respiration. The anoxic conditions, along with nutrient release from decomposition itself, create conditions of soluble phosphate release. Thus, a "sink" of phosphorus (P-complex) can become a "source" of phosphorus.

Phosphorus, production, and trophic status of natural waters. Phosphorus is the least abundant element of the major nutrients required for algal growth in the majority (~ 75%) of fresh waters (Wetzel 2001). The most important form of phosphorus for plant nutrition is ionized inorganic phosphate (PO_4^{3-}). The rate of uptake differs among specific algal groups.

The relationship between TP and lake productivity is well documented for lakes (Table 1) (Vollenweider 1968) and has similar implications for streams given the degree of light exposure. In shaded, headwater streams, suspended algae blooms may not be supported as much as benthic (bottom) algae. As is the case in many of the agriculturally disturbed streams, rivers, drainage ditches, and flowages in Illinois, light can be abundant. Abundant light, along with abundant nutrients makes abundant plant and algal growth.

Table 1. Levels of total phosphate (TP) associated with classification terms given for levels of productivity.

General Level of Lake Productivity	TP (mg/L)
ultra-oligotrophic	<0.005
oligo-mesotrophic	0.005 - 0.01
meso-eutrophic	0.01 - 0.03
eutrophic	0.03 - 0.1
hypereutrophic	>0.1

The term "eutrophication" means increased growth of the biota and that the rate of increasing productivity accelerates compared to conditions that occur in the absence of perturbations (increased nutrient input) to the system (Wetzel 2001). Phosphorus and nitrogen have been recognized for decades as critical nutrients for plant growth and productivity in agriculture. The concentration of phosphate not only affects the amount and rate of growth, but alters composition of the algae community (Table 2).

Table 2. An example phosphate levels associated with grouped freshwater algae (Chu 1943, Rodhe, 1949)

	optimal growth	upper tolerance	example
group 1	below 20 ug PO_4-P/L	below 20 ug PO_4-P/L	Uroglena
group 2	below 20 ug PO_4-P/L	well above 20 ug PO_4-P/L	*Asterionella* & other diatoms
group 3	above 20 ug PO_4-P/L	above 20 ug PO_4-P/L	*Scenedesmus, Ankistrodesmus* & many others

Bacteria, as well as algae, have a phosphate requirement. In fact, the requirement is higher than for unattached algae (phytoplankton), and bacteria will consume 4-10X phosphate per unit biomass than algae. Typically, bacteria can out-compete algae for phosphorus. This can introduce a different set of problems that include support of pathogen growth, increased decomposition rates, and anoxia.

The effects of eutrophication on stream ecosystems are many and serious. A summary list includes the following categories of impacts to flowing waters (after Quinn 1991; cited in US EPA 1996b):

1) increased biomass and changes in algae and periphyton species composition
2) reduced water clarity
3) taste and odor problems
4) blockage of intake screens and filters
5) fouling of submerged lines and nets
6) disruption of flocculation and chlorination processes at water treatment plants
7) restriction of swimming and other water-based recreation
8) diel fluctuations in pH and in dissolved oxygen concentrations that can be harmful to aquatic life and cause fish kills
9) dense algal mats that reduce habitat quality for macroinvertebrates and fish spawning

The concept of limiting nutrients and the Redfield ratio. Essential elements for production of biomass include carbon, nitrogen, and phosphorus. These exist in biomass, especially algal biomass, at a remarkably specific ratio which has come to be known as the Redfield ratio (Redfield et al. 1963). The molar ratio is C:N:P of 106:16:1 or 41:7.2:1 by weight. This means that if there was a wet weight of 500 and one of the three elements was limiting and the other two existed in excess, phosphorus could generate 500X its weight in living algae, nitrogen 69X (i.e. 500/7.2) and 12X for carbon. Because carbon (as carbon dioxide) generally only will become limiting during a serious algal bloom and biologically-available nitrogen is supplied to freshwaters (i.e., through runoff, fixation from the atmosphere, nitrification of ammonia) more readily than phosphorus sources, external sources of phosphorus are less available. The problem, therefore, is that a little bit of phosphorus can have a much larger, multiplicative effect on the growing plant and algae biomass in an aquatic system.

Should excess P be introduced to the system, as can be the case through point-source pollution and non-point runoff, P will cease to be the limiting nutrient and N becomes the limiting nutrient. Unlike the case with phosphorus, where the aquatic habitat is dependent on a supplemental phosphate source to alter growth, nitrogen-limited aquatic systems contain microorganisms (i.e., cyanobacteria a.k.a. blue-green bacteria often called “blue-green algae”) that can acquire nitrogen from air. Thus, the algal community can be shifted in its composition from green algae and diatoms to blue-green cynaobacteria. Some species of cyanobacteria are known from their thick green mats, contribution to foul-tasting water, and dominance in the water. Some cyanobacteria

create toxins that can sicken or kill aquatic and terrestrial life that comes into contact with them (Dodds 2002).

When aquatic systems (both lakes and riverine) are presented with high amounts of phosphorus (pulsed), the response is a rapid increase in algal productivity (Vollenweider 1968, Correll 1998). A common way of measuring algae production is by extraction of the photosynthetic pigment, chlorophyll a (chl a). In streams, chl a of benthic (bottom) algae is highly correlated to total phosphorus and total nitrogen. Calculations of phosphorus budgets in many aquatic systems show a direct relationship between phosphate concentration and chl a concentration, such as [avg chl a] = 0.55 $\{[P]_i/(1+\sqrt{\tau_w})\}^{0.76}$ where τ_w = avg. residence time of water and $[P]_I$ = avg. inflow conc. of TP. An additional benefit to be appreciated from this mathematical relationship is that the key factors are also identified and can be entered into management strategies. These are knowledge of the phosphate added as well as the concentration of P exported (in both organic and inorganic forms).

My students and I have documented the relationship between phosphate concentrations, chl a, and bacteria abundance (total and coliform) in the Illinois River and adjoining shallow floodplain lakes that are seasonally connected to the river. High average SRP and TP levels were recorded in spring and summer 2002 and in summer 2003 (note scale difference) (Figure 1).

During the times of high dissolved phosphate and high total phosphorus concentration, high chl a levels are seen (Figures 1 and 2) consistent with the correlation between the two factors. Phosphate concentrations for the South Big Lake spike are in Table 3. It should be emphasized that nutrient discharge to a river is not always direct. As seen in North and South Big Lakes, seasonal pulsing of river water into backwater areas can drastically alter water conditions.

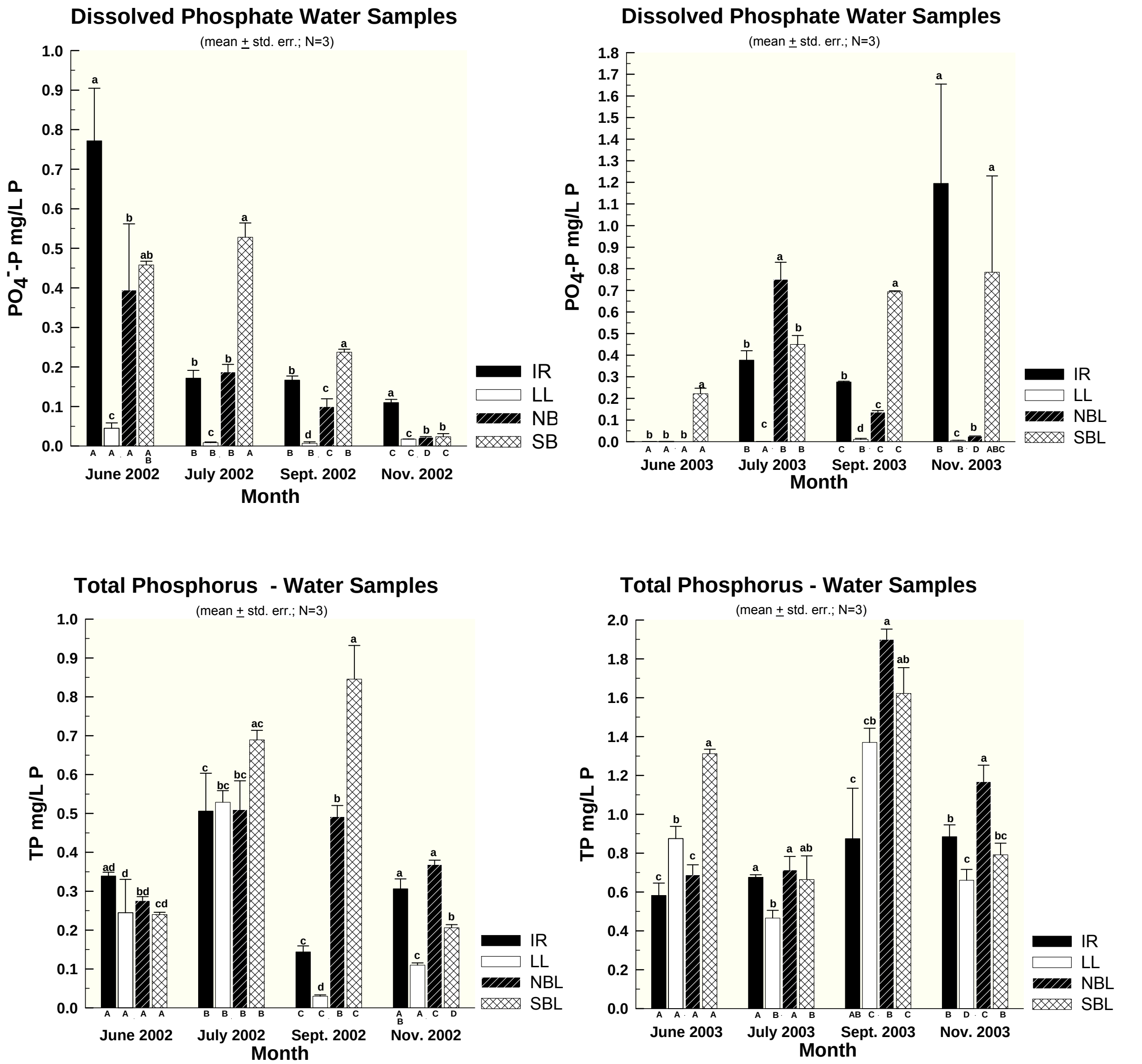


Figure 1. Top Set of Graphs: Phosphate as phosphorus measured in the LaGrange reach of the Illinois River in 2002 (left) and 2003 (right). **Bottom Set of Graphs:** Total Phosphorus measurements. IR = Illinois River, LL = Long Lake (at Spunky Bottoms, not connected), NBL and SBL = north and south Big Lake (seasonally connected to the IR).

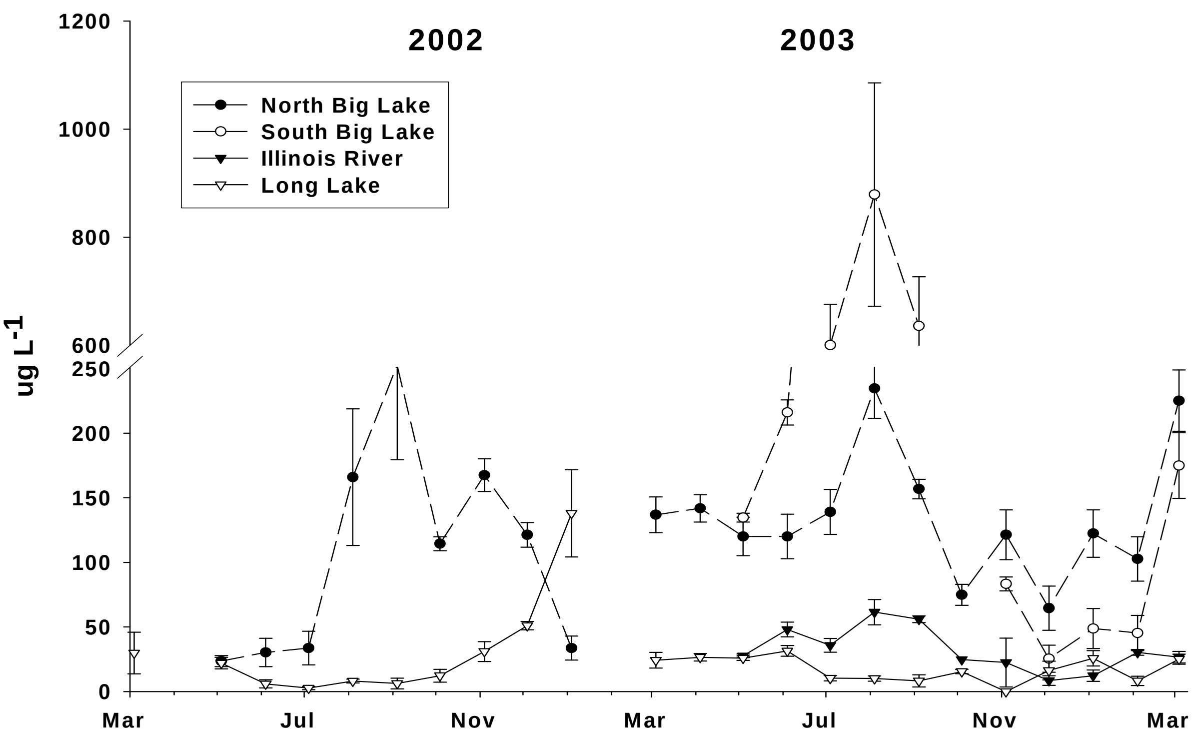


Figure 1. Chlorophyll a concentration for 2002 and 2003 in several aquatic habitats located at the LaGrange reach of the Illinois River.

Table 3. Soluble (SRP), total phosphate (TP), total particulate phosphate (TPP) for July 2003 in South Big Lake, LaGrange Reach of the Illinois River.

					mg/L PO4-P SRP	P mg/L TDP	P ug/L TPP
LaG	SBL	1	Top	07/25/03	0.3876	0.0000	419.5061
LaG	SBL	2	Top	07/25/03	0.5277	0.2629	539.8242
LaG	SBL	3	Top	07/25/03	0.4343	0.1990	569.3232

Nutrient levels appeared to also affect bacterial numbers. A very high number of total bacteria were counted during times of high nutrients, especially in July 2003 (Figure 3). Coliform bacteria, an established indicator of water quality, also showed increased numbers during these nutrient-enriched periods (Figure 4). Such high algal production and bacterial numbers result in fish kills (Figure 5) due to severely high algae + respiration rates at night and to increased decomposition and algal exudates (i.e., a source of bacterial carbon and nutrients).

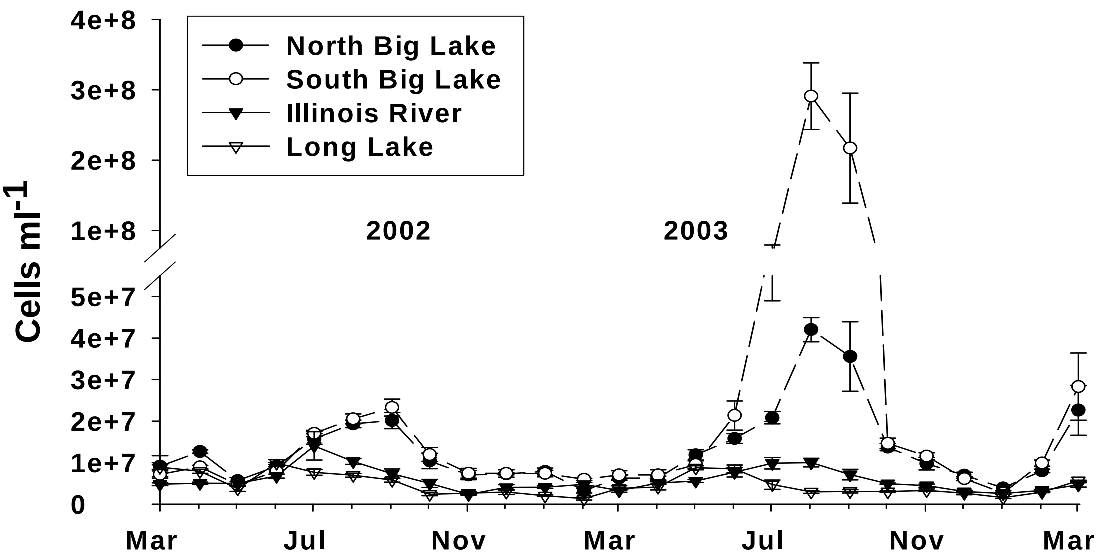


Figure 3. Total number of bacteria counted for aquatic habitats found in the LaGrange Reach of the Illinois River.

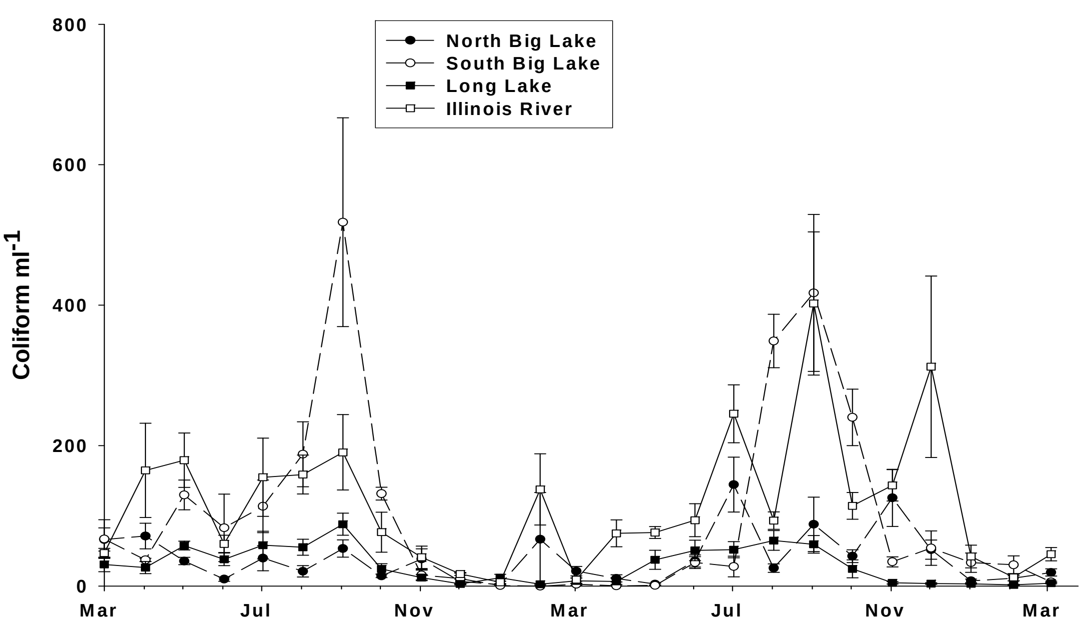
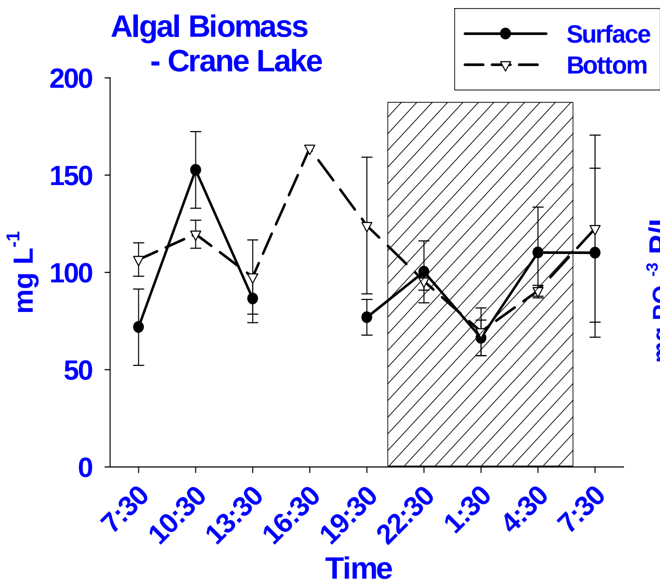
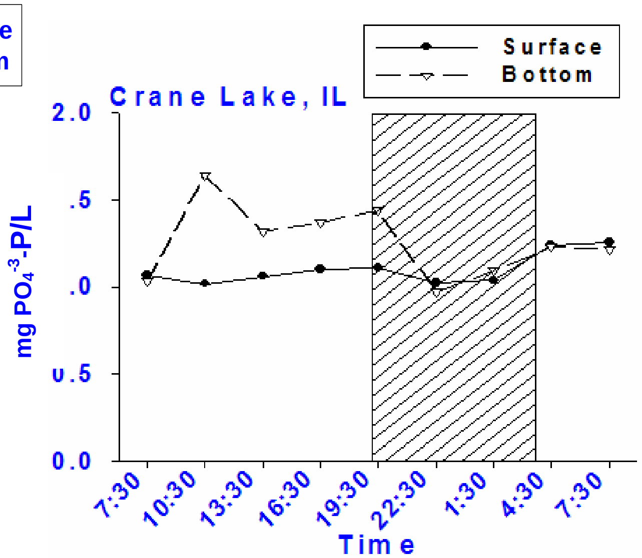


Figure 4. Total coliform number for aquatic habitats in the LaGrange Reach of the Illinois River. (March 2002 – March 2004)

Figure 5. Fish kill, South Big Lake, IL in July 2003.





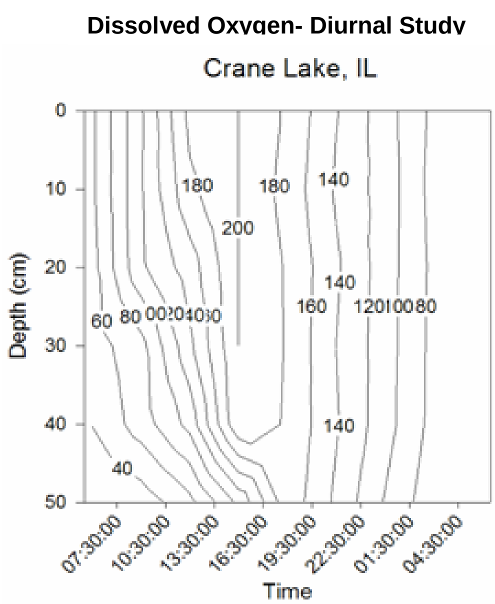


Figure 6. Results from a diurnal study at Crane Lake in the IL State Sanganois Management Unit. A very high amount of chl a was evident (top left) during this Aug. 2002 study. Note the high amount of phosphate as phosphorus (top right) in bottom water samples taken at sediment-water interface, likely a result of the previous night's anoxic conditions. Note the widely ranging dissolved oxygen levels (% saturation) (lower left). The picture of the Secchi disk (bottom, center) illustrates the amount of particulate matter in this Illinois River flowage.

Effects of addition of phosphorus to phosphorus-enriched water bodies

It is harmful to add phosphorus to systems that are already to some extent phosphorus enriched. The amount of vegetative growth, as shown by the chl a levels, depends on the availability of the most limited nutrient. In most freshwater systems, the limited nutrient is phosphorus. Phosphorus entering a system can become attached to particles and become unavailable for further vegetative growth in the short term, yet can be re-suspended and available if conditions change that affect phosphorus solubility (Welch 1992). For a system in which phosphorus is most limiting, addition of phosphorus to the system will result directly in increased levels of chl a up to the point where phosphorus is no longer limiting.

Just because a water body is already “eutrophic” does not mean that it cannot become worse through addition of more phosphorus. Addition of more phosphorus to the water body will continue to result in worsened eutrophication up to the point at which something else (nitrogen, light, carbon dioxide, volume of water) become limiting and/or will increase the spatial extent of eutrophic waters. Continued addition of phosphorus to a system that is already saturated with phosphorus can result in more phosphorus being stored in the sediments of the system which will make it hard to restore the system through reductions of phosphorus in the future. Also, adding phosphorus to an eutrophic water body can result in greater export of the nutrient and have effects downstream (Wetzel 2001), a large scale example being the case of Gulf Hypoxia.

Restoration of phosphorus-enriched water bodies

Just as nutrient amendment can result in “unhealthy” levels of trophic conditions, so too can nutrient limitation become an important factor in controlling eutrophication. Three concepts underline this approach to water quality management: 1) one key nutrient should be the most limiting factor for plant growth in an ecosystem; 2) the growth of the plant (or algae) should be proportional to the supply of the limiting nutrient, and 3) control of eutrophication can be done by restricting the loading of the key limiting nutrient to the ecosystem (Smith et al. 1999, Smith 1998). Enough research has gone into this very important problem that advanced modeling of systems has yield recommendations for nutrient levels (Dodds et al. 1997). To keep benthic algal biomass below nuisance levels (i.e., 100 mg/m2), less than 350 mg/m3 (< 0.35 mg/L) TOTAL N and < 30 mg/m3 (<0.03 mg/L) TOTAL P (not to be confused with SRP) are recommended.

Point source additions of phosphates continue to have a large impact on stream ecosystems (Haggard et al. 2002). Recent studies have shown increased phosphorus content of sediments below wastewater treatment plants (Dorioz et al. 1998, House and Denison 1998) and increased deoxygenation of sediments up to 20 km below point source releases in general (Rutherford et al. 1991).

Reduction of point source discharge can help manage growth of nuisance aquatic plants and affect algae (periphyton) biomass, although the extent of the benefit depends on the composition of biological communities, sediment characteristics, and whether nutrients in the sediments and river water exceed levels required for growth (Sosiak 2002). As the discussion of the Redfield ratio indicated, the largest effect on biomass reduction may be made by limiting phosphorus (of the three limiting nutrients listed in the ratio). Therefore, if additions of phosphorus stop, the water body can eventually recover as the now limited phosphorus is scavenged into biomass, transported from the system, or enters other ecological “sinks.” It has been documented that broad-scale phosphorus reduction can yield improvements to such large, phosphate-enriched systems as Lake Michigan (Barbiero et al. 2002).

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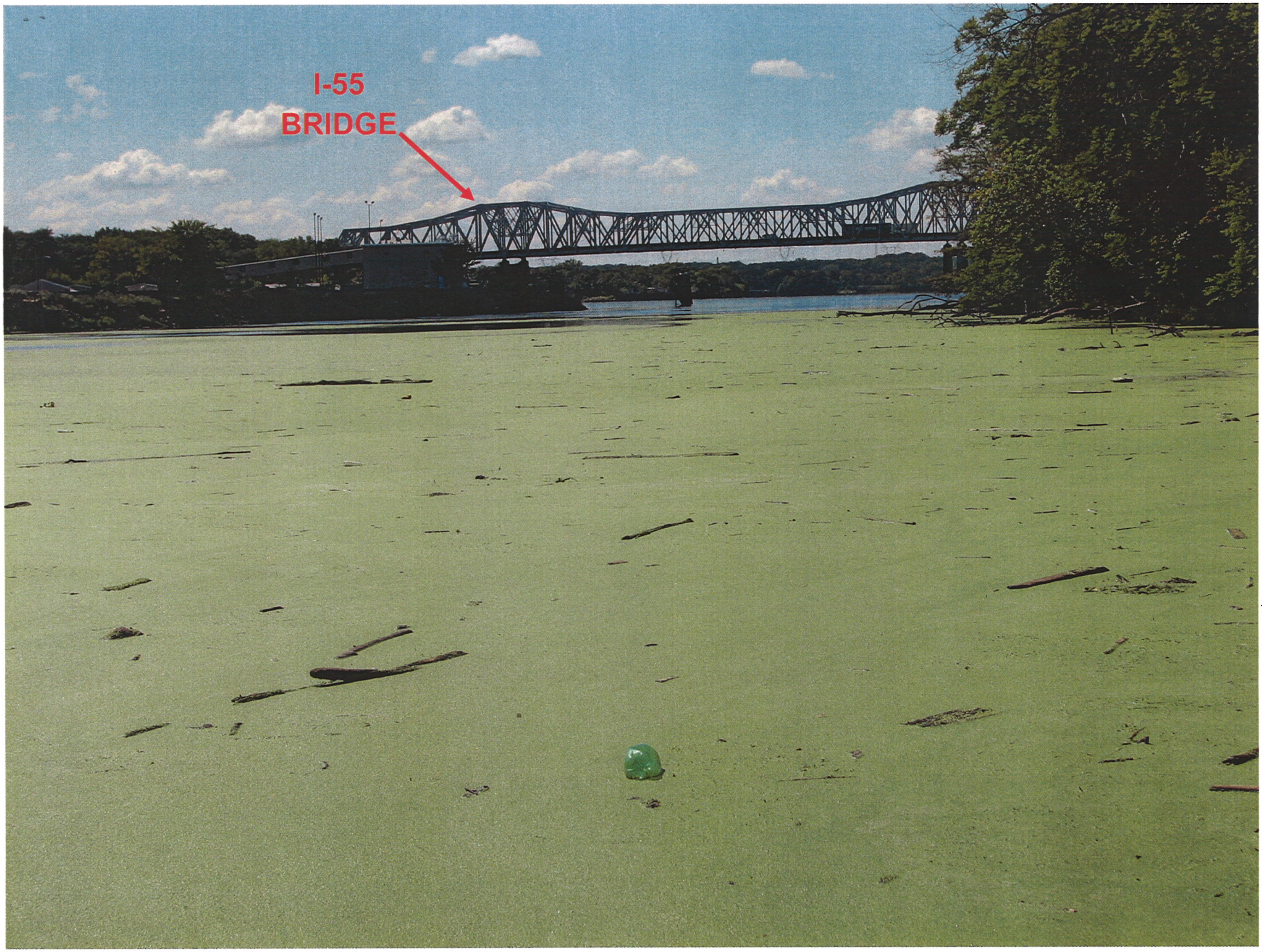
ATTACHMENT 6

EXHIBIT



Photograph Depicting Dense Mat of Algae/Duckweed at Midwest Generation Fish Sampling Location 408 (mouth of Jackson Creek embayment, RM 278.3) Located just Upstream of the I-55 Bridge, September 10, 2008.