2015 Annual Report
Part B

Illinois Volunteer Lake Monitoring Program

By
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Acknowledgements

First and foremost, thanks to the 266 volunteer lake scientists who make this program a possibility. Their dedication to Illinois lakes is greatly appreciated and acknowledged.

Lake/County	Volunteer
Altamont New Effingham Co.	Kevin Whitten Dustin Lightfoot Vaughn Voelker Ray Casselman
Antioch Lake Co.	Cal M Ulfsrud
Apple Canyon Jo Daviess Co.	Sharon Burmeister Darryle Burmeister Kim Rees Erin Winter
Barrington Lake Co.	Val Dyokas Tom McGonigle G. Van
Bass Lee Co.	Jerry Corcoran
Beaver Grundy Co.	Barb Arnold Jim Arnold
Beaver Pond DuPage Co.	Gavin Burseth Cheryl Burseth
Bird's Pond Sangamon Co.	Harry Hendrickson Phil Voth
Black Oak Lee Co.	Jerry Corcoran
Bloomington McLean Co.	Jill Mayes Tony Alwood
Bluff Lake Co.	John Krutsh Marjorie Krutsh
Briarwood Cook Co.	Mike Heaney
Butler Lake Co.	Mary Colwell Dan Colwell
Campton Kane Co.	Brenda Galauner Bruce Galauner
Campus Jackson Co.	Marjorie Brooks Alex Flevarakis Jared Bilak Luke Stegmann
Candlewick Boone Co.	Chuck Hart
Carbondale Res. Jackson Co.	Bill Daily Erica Stuart
Catatoga Macoupin Co.	Walter L Dawson Marie Dawson
Catherine Lake Co.	John Massman
Cedar Jackson Co.	John Wallace Chad Newberry Cole Craft Jerrod Looft Joel Kirby Karen Frailey Roy Buck Theresa Money
Cedar Lake Co.	April Vaos
Channel Lake Co.	James H Lubkeman
Charles DuPage Co.	Darlene Garay Brad Alexander Tadas Birutis
Charlotte Kane Co.	Mike Howell Nancy Howell Dan Hochstetter Reider Hahn

Chautaugua Jackson Co.	Nancy Spear Michael Madigan
Chicago Botanic Gardens Cook Co.	Robert Kirschner
Countryside Lake Co.	Ethan Butler Evan Butler Eric Butler Kayla Denson
Cross Lake Co.	Gregory Goldbogen Pam Goldbogen
Crystal McHenry Co.	Kristen Davis Sue DeThorne Alison Davis Cassie Preshlock
Dawson McLean Co.	Allan Zoerb Kenneth Callahan Roger Hagar
Deep Lake Co.	Ron Riesbeck Tom Cachur
Devils Kitchen Williamson Co.	Don Johnson George Dailey
Diamond Lake Co.	Greg Denny Alice Denny
Druce Lake Co.	Lori Rieth
Dunns Lake Co.	Gerard Urbanozo
East Loon Lake Co.	Bill Lomas James Dvorak
Evergreen McLean Co.	Jill Mayes Tony Alwood
Fischer Lake Co.	Dennis Owczarski Richard Hartman
Forest (RGZG) Lake Co.	Larry Stecker Joe Wachter
Forest (WHC) Lake Co.	Cynthia Dane
Fourth Lake Co.	Donald Wilson
Fox Lake Co.	Gerard Urbanozo Luke Janavicius
Fyre Mercer Co.	Ted Kloppenborg Vicki Kloppenborg
Gages Lake Co.	Matt Brueck
Galena Jo Daviess Co.	Madelynn Wilharm Steve Birkbeck
Gamlin St. Clair Co.	Scott Framsted
Golfview DuPage Co.	Donald Schultz Marti Schultz Cathy Walsh Linda Salerno Peter Salerno
Goose McHenry Co.	Ross K. Nelson Jennifer Olson
Governor Bond Bond Co.	Joe Craver Greg Riggins
Grass Lake Co.	Dan Wolski
Grays Lake Co.	Bill Soucie
Griswold McHenry Co.	Adam Garcia Melanie Kandler Jake White
Herrin New Williamson Co.	Stephen Phillips Matt Perrine
Highland Lake Co.	Mike Kalstrup
Highland Silver Madison Co.	Mike Buss Gary Pugh II Ryan Hummert Clint Kellson
Highwood McHenry Co.	Jean Boerman

Homer Champaign Co.	Brad Nelson Austin Haskett Jacob Pruiett Miranda Sanford Patrick Shea
Honey Lake Co.	Wyatt Byrd Alex Serrano Bob Byrd Cameron Thomson Peter Westfall
Island Lake Co.	Ken Wick
Jacksonville Morgan Co.	David Byus Mark Quinlan Tordan Allan
Jaycee Jefferson Co.	Chris Barker
Joliet Jr. College Will Co.	Virginia Piekarski Kim Crowe
Killarney McHenry Co.	Neil O'Brien Dennis Oleksy Jeff Joy Lauren Spears Mike Daurio Patricia O'Brien
Kinkaid Jackson Co.	Ryan Guthman
La Fox Pond Kane Co.	J. Brian Towey
Lake of Egypt Williamson Co.	JoAnn Malacarne Leroy Pfaltzgraff Lori Pfaltzgraff Sandra Anspaugh Tom Anspaugh Daisy Jasmine Grace Jasmine
Lake of the Hollows Lake Co.	Aimee Hoover
Lake of the Woods Champaign Co.	Brad Nelson Austin Haskett Jacob Pruiett Miranda Sanford Patrick Shea
Linden Lake Co.	Lyle Erickson
Little Silver Lake Co.	James Sheehan
Loch Lomond Lake Co.	Paul Papineau Jim Nelson Ruben Dixon
Long Lake Co.	Robert Ringa III Don McCurry
Longmeadow Cook Co.	Barb Schuetz
Louise Lake Co.	Geoff Ommen Gino Ommen
Marie Lake Co.	Norm Kleber
Matthews Lake Co.	Dan Wolski
Mattoon Shelby Co.	David Basham Heather McFarland
Mauvaise Terre Morgan Co.	David Byus Jordan Allen Mark Quinlan
McCullom McHenry Co.	Logan Gilbertsen Rich Gilbertsen
Miller Jefferson Co.	Joan Beckman Eddie Greer Jack Lietz Thomas Zielonko
Miltmore Lake Co.	Donald Wilson
Minear Lake Co.	David Johnson Ned Herchenbach Tom Barry
Murphysboro Jackson Co.	Ryan Guthman

Napa Suwe Lake Co.	Joe Sallak Joyce Sallak
Nippersink Lake Co.	Luke Janavicius Dan Wolski Gerard Urbanozo
Ossami Tazewell Co.	Todd Curtis Kari Curtis
Otter Macoupin Co.	Stan Crawford Brian Durbin Joe Hogan Otis Forster III Rudy Rodriguez Tim Walter
Paradise Coles Co.	David Basham Heather McFarland Kary Culp
Paris Twin East Edgar Co.	Chris Chapman Greg Whiteman Andy Bess
Paris Twin West Edgar Co.	Chris Chapman Greg Whiteman Andy Bess Cameron Malace
Petersburg Menard Co.	Tom Lawton
Petite Lake Co.	Bill Holleman Betty Holleman
Pierce Winnebago Co.	Jack Schroeder
Pine Lee Co.	Jerry Corcoran
Pistakee Lake Co.	Gerard Urbanozo Dan Wolski
Redhead Lake Co.	Brian Coyne
Richardson Wildlife Lee Co.	J. Brian Towey
Round Lake Co.	Frank Palmisano Timothy Pasternak
Sand Lake Co.	Michael Plishka
Sara Effingham Co.	Janet Kennedy
Silver McHenry Co.	Bruce Wallace Rob Wallace
Spring Lake Co.	Jim Grass Gerard Urbanozo
Spring McDonough Co.	Brian McIlhenny
Spring Arbor Jackson Co.	John Roseberry
Spring Ledge Lake Co.	Tom Heinrich Mike Heinrich
Springfield Sangamon Co.	Michelle Nicol Dan Brill
Sunset Champaign Co.	Brad Nelson Austin Haskett Jacob Pruiett Miranda Sanford Patrick Shea
Sunset Lee Co.	Jerry Corcoran
Sunset Macoupin Co.	Amy Jo Walkenbach Bill Walkenbach
Swan Cook Co.	John Kanzia Aneta Tyminski Maggie Woosley Michael Imburgia Victor Schultz
Taylorville Christian Co.	Mark Jacoby Luke McLeod Madison Taylor
Third Lake Co.	Tom Morthorst Patty Morthorst Patt Kure Rick Ruettiger

Three Oaks North McHenry Co.	Michael Wisinski Kenneth Krueger Dean Lee Kelsey Snell
Three Oaks South McHenry Co.	Michael Wisinski Kenneth Krueger Dean Lee Kelsey Snell
Timber Lake Co.	Dawn Cooper Tony Cooper
Tower Lake Co.	Richard Bahr Steve Burgoon Andrew Hay Adam Hay Anne Hay Darrin Funk Jack Johnson Judd Lautenschlager Justin Funk Tom Kabala
Twin Oaks Champaign Co.	Jim Roberts
Valley Lake Co.	Marian Kowalski John Kowalski
Vermilion Vermilion Co.	Bert C. Nicholson Keith Bates
Virginia Cook Co.	Paul Herzog Janet Herzog
Waterford Lake Co.	Lyle Erickson Nick Kostreva Ralph Kostreva
Weslake St. Clair Co.	Charles Meirink
West Loon Lake Co.	Bill Lomas James Dvorak
Wonder McHenry Co.	Ken Shaleen Dennis Gallo
Woodhaven Lee Co.	Jerry Corcoran
Woods Creek McHenry Co.	Bonnie Libka Robert Libka Adam Brink Charlie Mendoza Eric Baillargeon Gail Bruno James Davis John Kurtenbach Kayla Spauone Zach Hansen
Zurich Lake Co.	Dick Schick Anne Schick Tom Heimerle

This report represents the coordinated efforts of many individuals. The Illinois Environmental Protection Agency's Lakes Program, under the direction of Gregg Good, was responsible for the original design of the Volunteer Lake Monitoring Program (VLMP) and its continued implementation. Two Area-wide Planning Commissions: Chicago Metropolitan Agency for Planning (CMAP) and Greater Egypt Regional Planning and Development Commission (GERPDC), along with Lake County Health Department (LCHD), were responsible for program administration in their regions of the state under the statewide coordination of Greg Ratliff (IEPA).

Program coordination was provided by Teri Holland and Greg Ratliff (IEPA); Holly Hudson (CMAP); Tyler Carpenter and Cary Minnis (GERPDC); and Alana Bartolai and Mike Adam (LCHD). Training of volunteers was performed by Teri Holland, Greg Ratliff, Holly Hudson, Tyler Carpenter, and Alana Bartolai. Data handling was performed by Teri Holland, Greg Ratliff, Tara Norris (IEPA), Roy Smogor (IEPA), Holly Hudson (CMAP), Tyler Carpenter (GERPDC) and Alana Bartolai (LCHD). This report was written by Greg Ratliff and review by Gregg Good, Mike Bundren, Teri Holland and Tara Norris.

Acronyms and Abbreviations

AIS	Aquatic Invasive Species
ALU	Aquatic Life Use
AQU	Aesthetic Quality Use
CHL-*a*	Chlorophyll-*a*
CMAP	Chicago Metropolitan Agency for Planning
DO	Dissolved Oxygen
GERPDC	Greater Egypt Regional Planning and Development Commission
GPS	Global Positioning System
ICLP	Illinois Clean Lakes Program
IEPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
LCHD	Lake County Health Department
mg/L	Milligrams per Liter
ml	Milliliter
NPS	Non-point Source
NVSS	Non-volatile Suspended Solids
PLWIP	Priority Lake and Watershed Implementation Program
RFLA	Request for Lab Analysis
SD	Secchi Depth
SPU	Standard Platinum-Cobalt Units
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TN:TP	Total Nitrogen to Total Phosphorus ratio
TP	Total Phosphorus
TSI	Trophic State Index
TSI^{CHL}	TSI for Chlorophyll-*a*
TSI^{SD}	TSI for Secchi Depth
TSI^{TN}	TSI for Total Nitrogen
TSI^{TP}	TSI for Total Phosphorus
TSS	Total Suspended Solids
ug/L	Microgram per Liter
VLMP	Volunteer Lake Monitoring Program
VSS	Volatile Suspended Solids

Program Objectives

1. *Increase citizen knowledge of the factors that affect lake quality in order to provide a better understanding of lake/watershed ecosystems and promote informed decision making;*
2. *Encourage development and implementation of sound lake protection and management plans;*
3. *Encourage local involvement in problem solving by promoting self-reliance;*
4. *Enlist and develop local "grass roots" support and foster cooperation among citizen, organizations, and various units of government;*
5. *Gather fundamental information on Illinois lakes: with this information, current water quality can be determined as well as (with historical data) long term trends;*
6. *Provide a historic data baseline to document water quality impacts and support lake management decision-making; and*
7. *Provide an initial screening tool for guiding the implementation of lake protection/restoration techniques and framework for a technical assistance program.*

Annual Report Part A

The Annual Report Part A is the companion document for this report and is composed of the Volunteer Lake Monitoring Program's Background, Methods and Procedures, and Data Evaluation sections. This document is posted on the VLMP's web pages at http://www.epa.illinois.gov/topics/water-quality/monitoring/vlmp/data/index.

The VLMP Annual Report has been broken up into two volumes as Part A seldom needs to change and allows us to reduce the size of Part B. Part B is comprised of the acknowledgement to volunteers, results and summary portion of the report and allows for much easier manipulation in various media, such as email. These portions change every year, so Part B must be developed starting from a basic outline.

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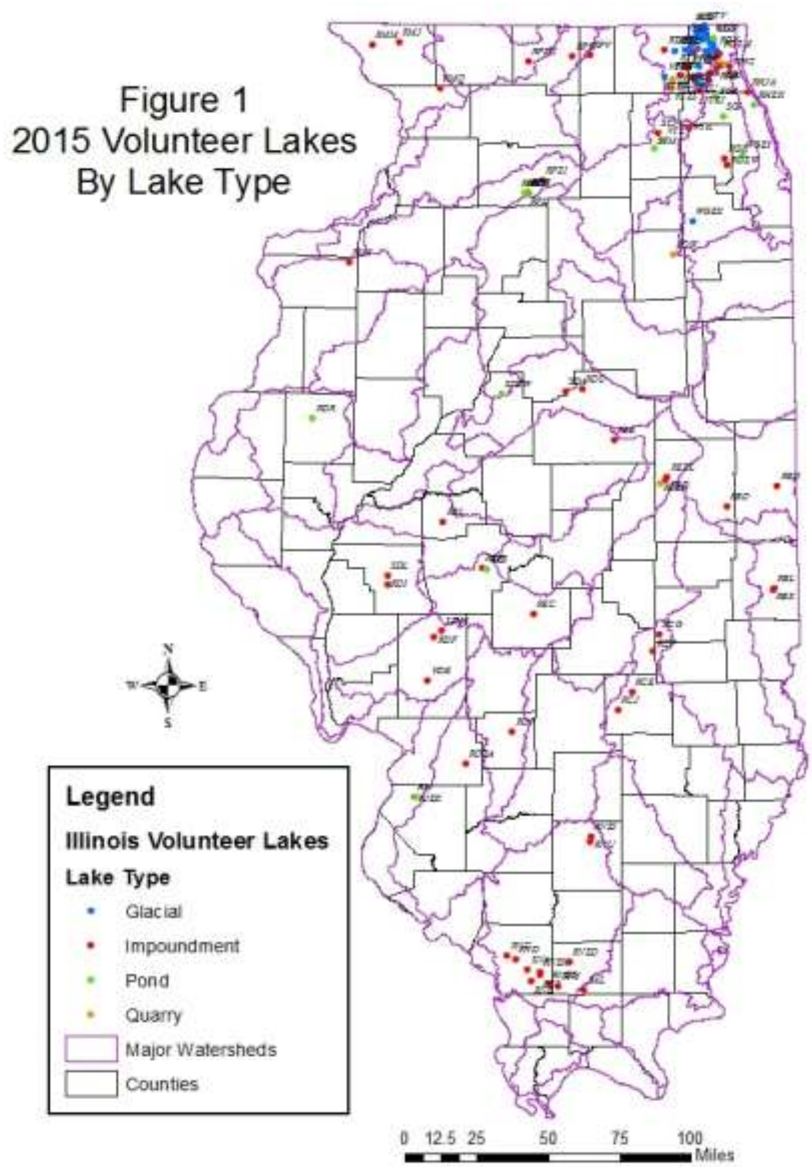
Results and Discussion

Basic Monitoring Program

<u>**Lakes**</u>

130 lakes were monitored at least once in 2015 (Appendix A, Table 1). These lakes are distributed across the state with clusters occurring in several areas. The type of lakes typically in the program include; backwater, glacial, impoundments (dammed and dug), old quarries (coal, sand, gravel and burrow pits) and ponds. Figures 1, 1-1, 1-2, and 1-3 show the distribution of the volunteer lakes, as well as differentiating them by lake type. Figure 1-1 volunteer lakes were coordinated by Alana Bartolai through the Lake County Health Department. Figure 1-2 lakes were coordinated by Holly Hudson through the Chicago Metropolitan Agency for Planning. Finally, Figure 1-3 lakes were coordinated by Tyler Carpenter through the Greater Egypt Regional Planning and Development Commission. Greg Ratliff coordinated those lakes not falling under the jurisdiction of the regional coordinators listed above, as well as, oversight assistance for the regional coordinators and overall data management for the program.



The size of the lakes in the program varied greatly, from a 4,200 acre impoundment reservoir, Springfield of Sangamon County, to two two-acre impoundment lakes, Charlotte of Kane County and Longmeadow of Cook County. Volunteers covered 38,229 acres of lake surface water (Appendix A: Table 2). The public's access to these lakes turned out to be 55 percent (Figure 3) by number of lakes. The private access ranged from single owner to multiple homeowner housing developments, even forest preserve lakes with limited access (Figure 4 and Appendix A: Table 2). The maximum depth of these lakes ranged from four and a half feet at Redhead in Lake County to 100 feet at Devil's Kitchen in Williamson County.

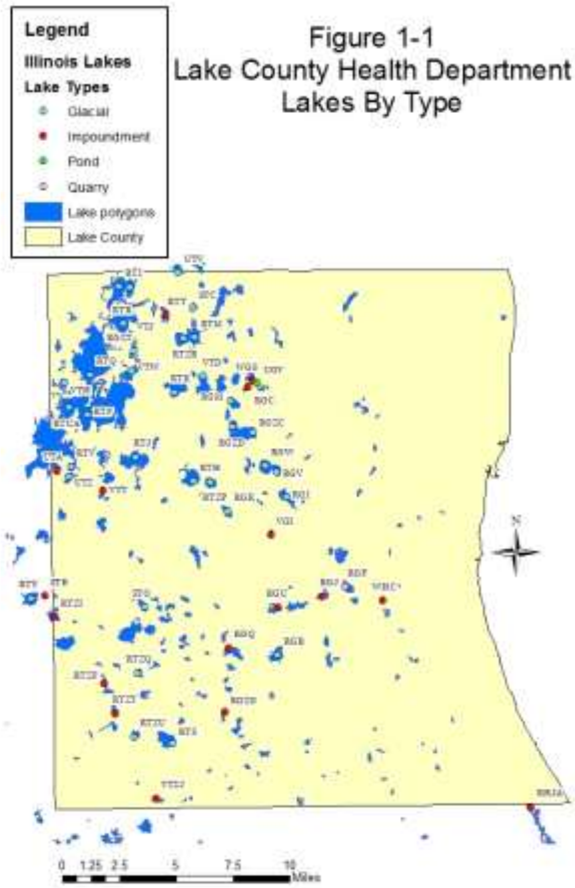


Figure 1-1
Lake County Health Department
Lakes By Type

The VLMP had lakes in 24 of the 33 major watersheds in the state. The three watersheds with the highest density of VLMP lakes were the Upper Fox with 49 lakes, Des Plaines with 23 lakes, and Big Muddy with 11 (Appendix A: Table 2). Figure 2 shows the distribution of the 33 major watersheds in Illinois.

A further breakdown indicates that the 130 lakes covered 72 HUC-12 watersheds across Illinois (Appendix A: Table 3). The top three HUC-12 watersheds for number of volunteer lakes were Nippersink Lake – Fox River watershed in First Place with nine lakes, Mill Creek watershed (071200040202) in Second Place with six lakes, and a six-way tie for Third Place for Woodhaven Lake – Green River, Bull Creek – Des Plaines River, Sequiot Creek, Squaw Creek, Cary Creek – Fox River, and Crystal Lake Outlet watersheds, all with five lakes each. The HUC code for Mill Creek watershed is provided above because more than one named Mill Creek watershed is listed in the table with volunteer lakes.

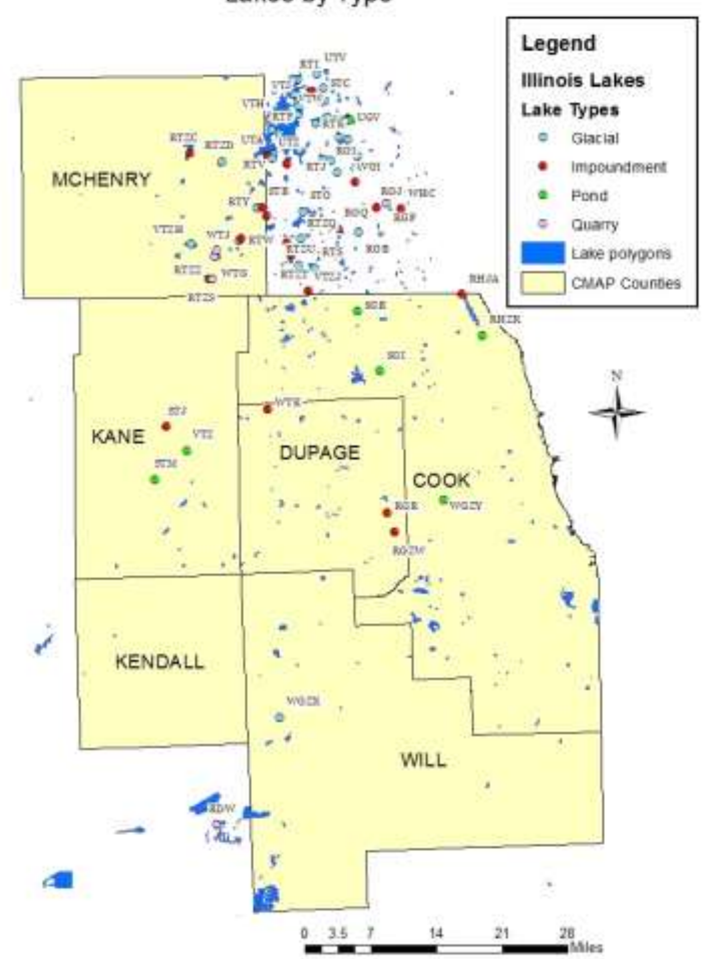
Volunteers

263 volunteers participated in the monitoring. These monitors donated over 2,917 volunteer-hours of their time for 1,014 monitoring events. Volunteers are primarily lakeshore residents, lake owner/managers, sportspersons, environmental group members, public water supply personnel, and interested citizens (Appendix A: Table 1 & Page 3: Acknowledgements).

Data Returns

This year, 33 lakes had a 100 percent data return. This means that these 33 lake monitors returned at least twelve monitoring reports covering the requested six-month period of time from May

Figure 1-2 Chicago Metropolitan Agency for Planning
Lakes by Type



through October. Following that 34 lakes had nine to eleven data returns, 19 had six to eight data returns, 26 had three to five data returns, and 18 had less than three data returns (Appendix A: Table 1 and Figure 5).

These 33 lakes were sampled all twelve periods of the Volunteer Program.		
Lake Name/County Name	**Lake Name/County Name**	**Lake Name/County Name**
Altamont New/Effingham	Fourth/Lake	Silver/McHenry
Barrington/Lake	Killarney/McHenry	Spring/McDonough
Bass/Lee	Kinkaid/Jackson	Spring Arbor/Jackson
Black Oak/Lee	La Fox Pond/Kane	Sunset/Lee
Bloomington/Mclean	Leopold/Lake	Swan/Cook (14)*
Candlewick	Little Silver/Lake	Third/Lake
Carbondale	Marie/Lake	Valley/Lake
Cedar/Jackson	Miller/Jefferson	Vermilion/Vermilion
Charles/DuPage (13)*	Miltmore/Lake	Virginia/Cook
Chautauqua/Jackson	Murphysboro/Jackson	Woodhaven/Lee
Forest/Lake	Pine/Lee	Woods Creek/McHenry (18)*
*The number in parenthesis denotes actual number of events monitored when more than twelve.		

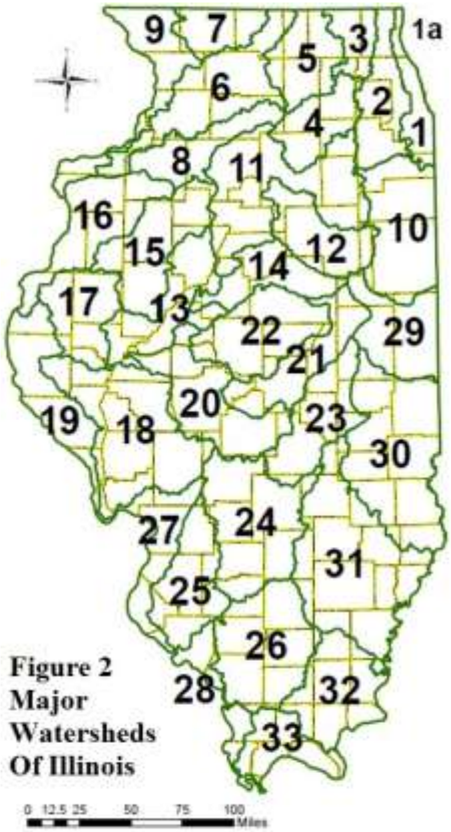


Figure 3 Public Access Available

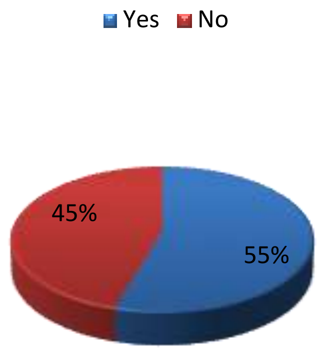
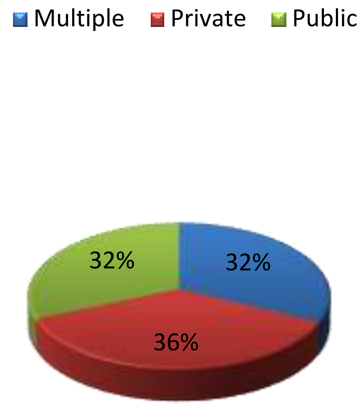


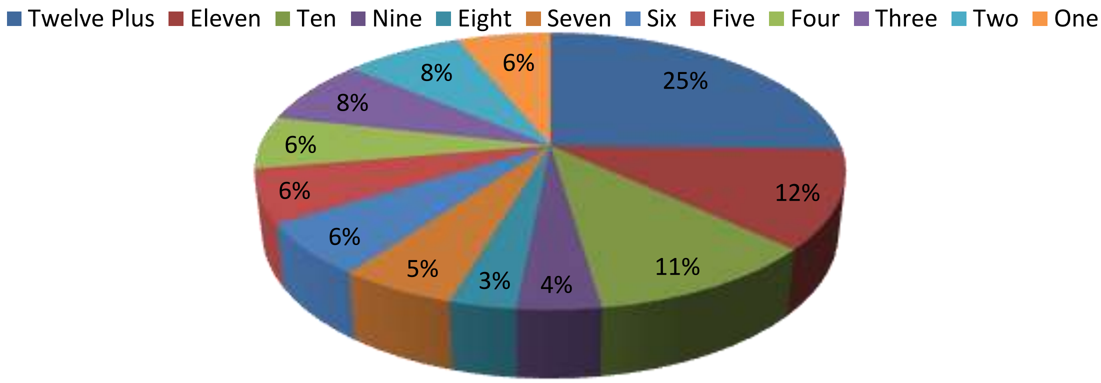
Figure 4 Lake Ownership



Key for Figure 2 Major Watersheds of Illinois.

No.	Watershed Name	No.	Watershed Name	No.	Watershed Name
1	Great Lakes/Calumet River	12	Vermilion (Illinois) River	23	Upper Kaskaskia River
1a	Lake Michigan Beaches	13	Middle Illinois River	24	Middle Kaskaskia/Shoal Creek
2	Des Plaines River	14	Machinaw River	25	Lower Kaskaskia River
3	Upper Fox River	15	Spoon River	26	Big Muddy River
4	Lower Fox River	16	Mississippi North Central River	27	Mississippi South Central River
5	Kishwaukee River	17	La Moine River	28	Mississippe South River
6	Rock River	18	Lower Illinois/Macoupin Creek	29	Vermilion (Wabash) River
7	Pecatonica River	19	Mississippi Central River	30	Embarrass/Middle Wabash River
8	Green River	20	Lower Sangamon River	31	Little and Lower Wabash/Skillet Fork
9	Mississippi North River	21	Upper Sangamon River	32	Saline River/Bay Creek
10	Kankakee/Iroquois River	22	Salt Creek of Sangamon River	33	Cache River
11	Upper Illinois/Mazon River				

Figure 5
Volunteer Participation



Transparency Ranking

130 summer Secchi depths transparencies, in inches, are ranked highest to lowest and summarized in the lists below. The lists are divided into the four trophic classes. Appendix A: Table 4 lists the ranking from the highest median summer (1 June – 31 August) transparency to the lowest. Appendix A: Table 4 also indicates several lakes which did not provide readings during the summer months so those values are outside useful accuracy for our purposes; however in those circumstances non-summer data was used for educational purposes only and included below with the at sign (@) to indicate the data used did not meet our data objectives. Organizations using our data should take care to evaluate these data to ensure it meets their data objectives.

Oligotrophic

Rank	Lake/County/Code	SD	Rank	Lake/County/Code	SD
1	Deep/Lake/VTD	257.0	3	Three Oaks North/McHenry/WTJ	201.0
2	Virginia/Cook/SGB	223.0	4	Three Oaks South/McHenry/WTG	198.0

Mesotrophic

Rank	Lake/County/Code	SD	Rank	Lake/County/Code	SD
5	Minear/Lake/RGP	145.0	16	Charlotte/Kane/VTZ	105.0
6	Highwood/McHenry/STB@	144.0	17	Waterford/Lake/WGS	102.5
7	West Loon/Lake/RTZB	141.5	18	Crystal/McHenry/VTZH	101.0
8	Cross/Lake/UTV	138.0	19	Leopold/Lake/VGI	95.5
9	Carroll/Carroll/RMQ	132.0	20	Gages/Lake/RGI	93.0
10	Highland/Lake/RTZP	127.0	21	Silver/McHenry/RTW	92.0
11	Druce/Lake/RGV	120.0	22	Barrington/Lake/RTZT	90.0
11	Killarney/McHenry/RTZV	120.0	23	Catherine/Lake/RTD	86.0
11	Little Silver/Lake/STC	120.0	24	Channel/Lake/RTI	84.0
14	Zurich/Lake/RTS	114.0	25	Third/Lake/RGW	82.0
15	Cedar/Lake/RTK	110.5	26	Candlewick/Boone/RPV	81.0

Eutrophic

Rank	Lake/County/Code	SD	Rank	Lake/County/Code	SD
27	Butler/Lake/RGJ	78.0	66	Tower/Lake/RTZF	40.0
28	Lake of the Hollow/Lake/UTZ	75.5	66	Woods Creek/McHenry/RTZZ	40.0
29	Beaver/Grundy/RDW	75.0	69	Honey/Lake/RTZU	39.0
30	Linden/Lake/RGC	72.0	69	Pine/Lee/RPZB	39.0
31	Spring/Lake/RGZT@	69.0	71	Grays/Lake/RGK	37.5
32	Round/Lake/RTH	66.5	71	La Fox Pond/Kane/STM	37.5
33	Chicago Botanic Gardens/Cook/RHJA	66.0	73	Charles/DuPage/RGR	36.0
33	Devils Kitchen/Williamson/RNJ	66.0	73	Dawson/McLean/REE	36.0
33	Diamond/Lake/RGB	66.0	75	Sunset/Lee/RPL	34.5
33	Sunset/Champaign/REZN	66.0	76	Sara/Effingham/RCE	33.0
37	Spring Ledge/Lake/UGV	63.0	77	Fischer/Lake/VTT	32.0
38	Antioch/Lake/RTT@	60.0	77	Long/Lake/RTJ	32.0
38	Miltmore/Lake/RGZD	60.0	79	Island/Lake/RTZI	31.5
40	Sand/Lake/RGM	59.0	80	Ossami/Tazewell/SDZW	31.0
41	Kincaid/Jackson/RNC	58.0	81	Longmeadow/Cook/RHZK	30.5
42	Griswold/McHenry/RTY	57.5	81	Weslake/St. Clair/RJJ	30.5
43	Petersburg/Menard/REL	57.0	83	Campus/Jackson/RNZH	30.0
44	Catatoga/Macoupin/VDE	56.0	83	Fourth/Lake/RGZC	30.0
44	East Loon/Lake/RTM	56.0	83	Timber/Lake/RGZC	30.0
46	Forest/Lake/WHC	54.5	86	Richardson Wildlife/Lee/RPZI	29.0
47	Fyre/Mercer/RLH	54.0	87	Bluff/Lake/VTJ	28.0
47	Galena/Jo Daviess/RMM	54.0	88	Evergreen/McLean/SDA	27.0
49	Gamlin/St. Clair/RJZK	52.0	88	Jacksonville/Morgan/RDI	27.0
49	Lake of Egypt/Williamson/RAL	52.0	90	Bloomington/McLean/RDO	26.0
51	Joliet Jr College/Will/WGZ@	50.0	90	Loch Lomond/Lake/RGU	26.0
52	Swan/Cook/WGZY	49.5	92	Chautauqua/Jackson/SNA	25.5
53	Apple Canyon/Jo Daviess/RMJ	49.0	93	Miller/Jefferson/RNZI	25.0
54	Marie/Lake/RTR	47.0	94	Lake of the Woods/Champaign/REG	24.0
54	Woodhaven/Lee/RPM	47.0	94	Murphysboro/Jackson/RND	24.0
56	Cedar/Jackson/RNE	46.5	94	Petite/Lake/VTW	24.0
57	Bass/Lee/RPJ	46.0	97	Homer/Champaign/RBO	23.0
57	Herrin Old/Williamson/RNZD	46.0	98	Forest/Lake/RGZG	22.0
57	Sunset/Macoupin/UDH	46.0	98	Otter/Macoupin/RDF	22.0
57	Westlake/Winnebago/RPZK	46.0	100	Vermilion/Vermilion/RBD	21.5
61	Black Oak/Lee/RPK	45.0	101	Pistakee/Lake/RTU	20.0
62	Jaycee/Jefferson/RNU	41.5	102	Governor Bond/Bond/ROP	19.5
63	Altamont New/Effingham/RCJ	41.0	102	Valley/Lake/RGZM	19.5
63	Redhead/Lake/RTV	41.0	104	Fox/Lake/RTF	19.0
63	Spring Arbor/Jackson/RNZG	41.0	104	Wonder/McHenry/RTZC	19.0
66	Goose/McHenry/RTZS	40.0			

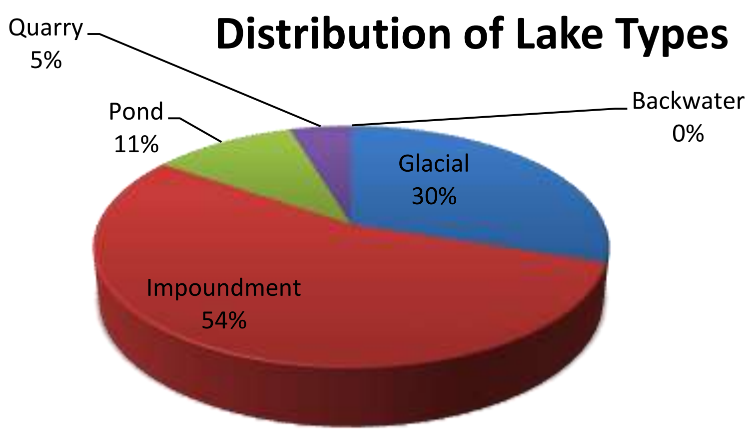
Hypereutrophic

Rank	Lake/County/Code	SD	Rank	Lake/County/Code	SD
106	Briarwood/Cook/SGI@	18.0	119	Highland Silver/Madison/ROZA	14.0
106	Matthews/Lake/UTA	18.0	119	Spring/McDonough/RDR	14.0
106	Paris Twin East/Edgar/RBL	18.0	119	Springfield/Sangamon/REF	14.0
106	Taylorville/Christian/REC	18.0	122	Grass/Lake/RTQ	13.0
110	Bird's Pond/Sangamon/SEB	17.5	122	Twin Oaks/Champaign/REZL	13.0
111	Mauvaise Terre/Morgan/SDL	17.0	124	Mattoon/Shelby/RCF	11.5
111	Pierce/Winnebago/RPC	17.0	125	Dunns/Lake/VTH	11.0
113	Beaver Pond/DuPage/WTK	16.0	125	Nippersink/Lake/RTUA	11.0
113	Campton/Kane/STJ	16.0	127	Napa Suwe/Lake/STO	10.0
113	Paris Twin West/Edgar/RBX	16.0	128	Louise/Lake/VTZJ	8.0
116	Countryside/Lake/RGQ	15.0	129	Paradise/Coles/RCG	7.5
116	Golfview/DuPage/RGZW	15.0	130	Carbondale/Jackson/RNI	7.0
116	McCullom/McHenry/RTZD	15.0			

To turn ranking the volunteer lakes into a more useful tool, we look at the lake type, geological region, and lake size. Therefore ranking in this report provides a means for participants to find and consider lakes undergoing similar processes as the lakes they manage. To help this comparison, Figures 6-1 through 6-4 rank the lakes within four of the five specific lake types categorized and studied within this report; Glacial, Impoundment, Quarry, and Pond. Backwater is the fifth lake type, but had no representative this year (Figure 6).

Deep Lake has the deepest transparency with a value of 257 inches. Deep Lake is a glacial lake located in Lake County. The lowest transparency goes to Carbondale Lake, a reservoir impoundment in Jackson County.

Figure 6
Distribution of Lake Types



The majority of the lakes in the volunteer program follow a similar linear morphology where turbid water from a stream or river flows into a wider lake bed. The water slows, allowing particulates to drop out of the water to form lake sediments and reducing turbidity. Site 1 is typically the furthest site from the inlets, as well as the deepest part of the lake, especially for impoundment lakes. Best management practices (BMP) that target reducing turbidity in the lakes that show this shift are likely to benefit water clarity to a high degree. See Appendix A: Table 14 for a list of BMPs. Additionally, this change in transparency highlights the necessity to use other means to predict algal biomass and trophic state in waters that have high turbidity related to NVSS.

Figure 6-1
39 Glacial Lake Transparencies
(Inches)

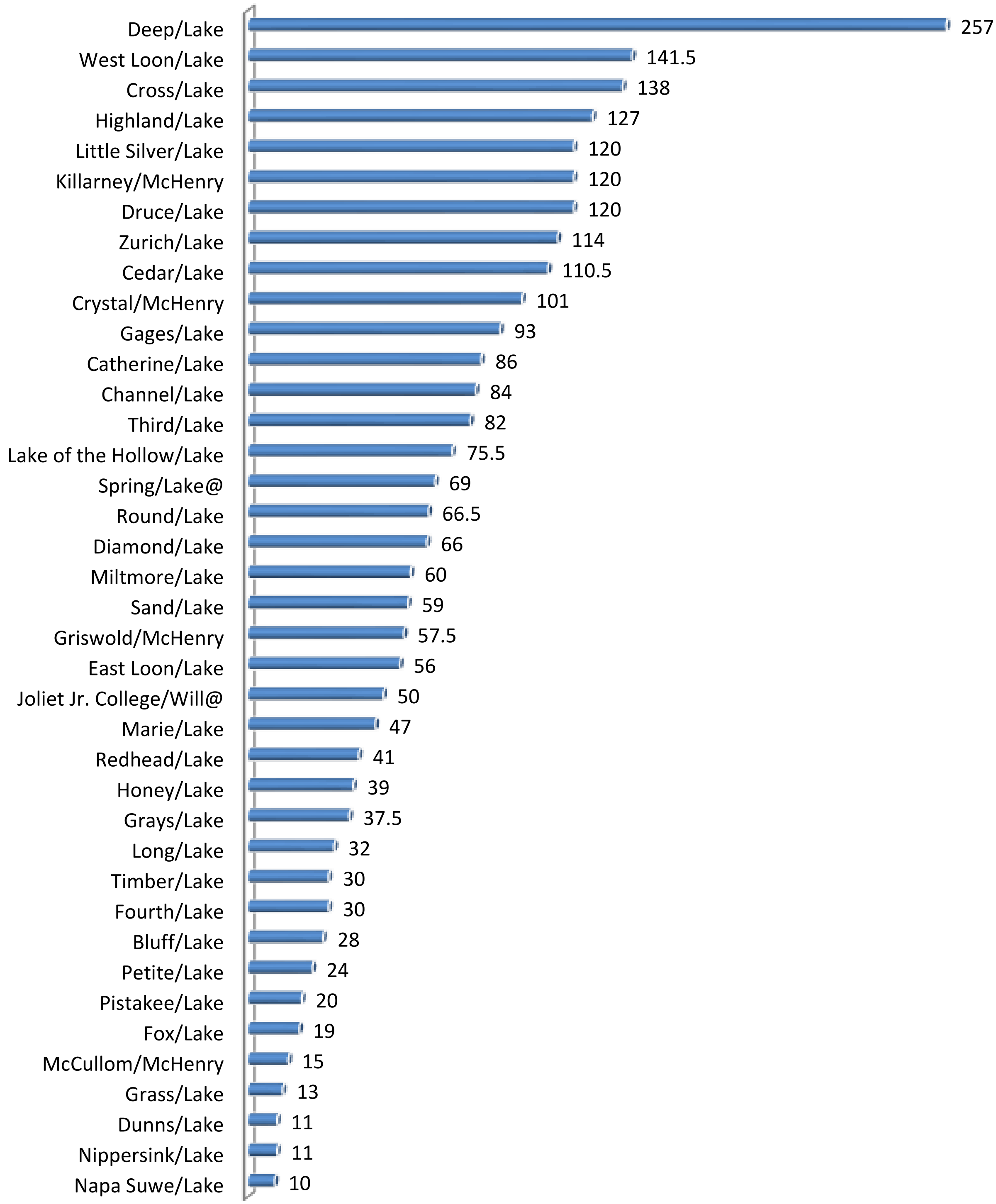


Figure 6-2
71 Impoundment Lake Transparencies
(Inches)

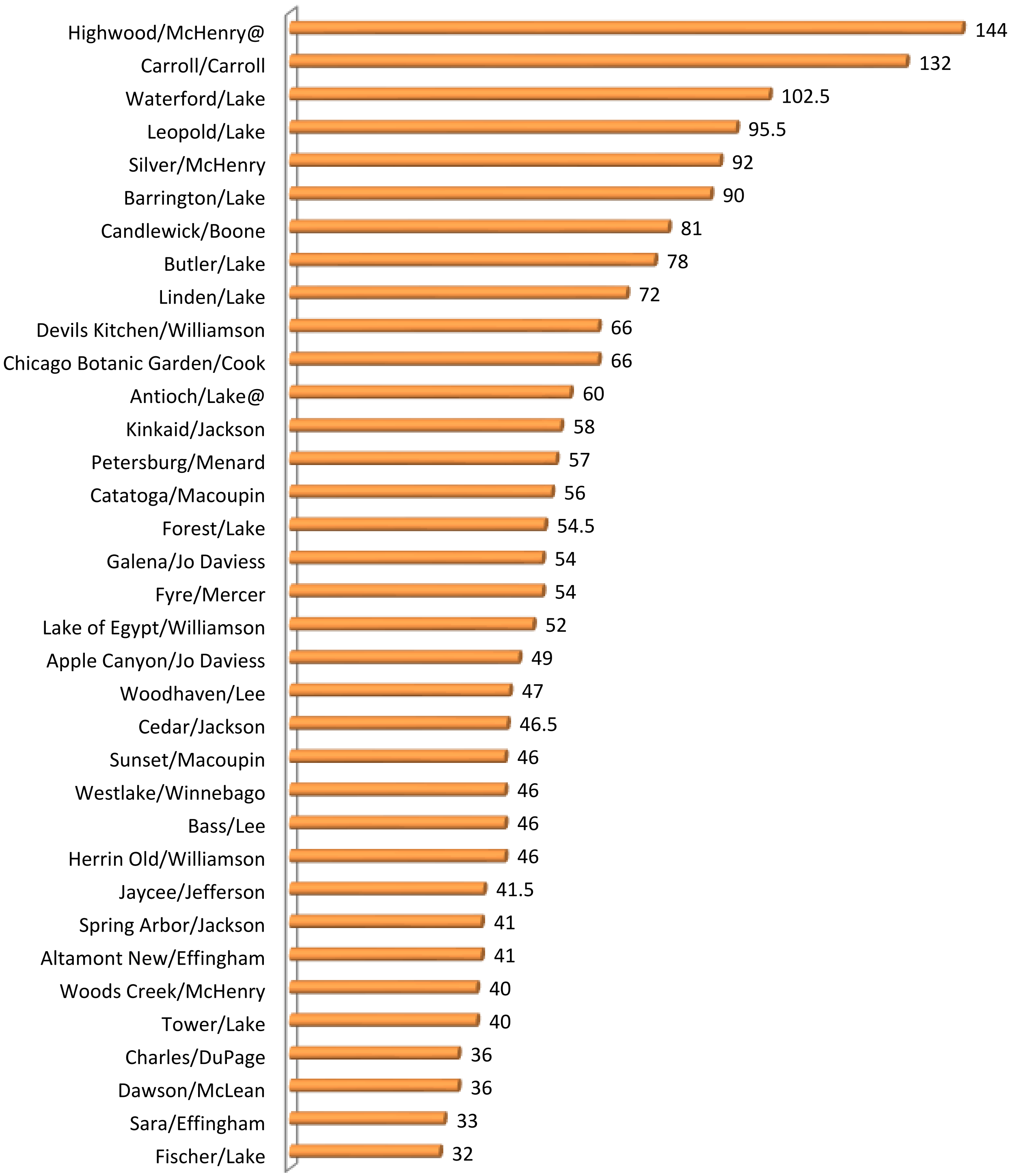


Figure 6-2
71 Impoundment Lake Transparencies (Inches) Continued

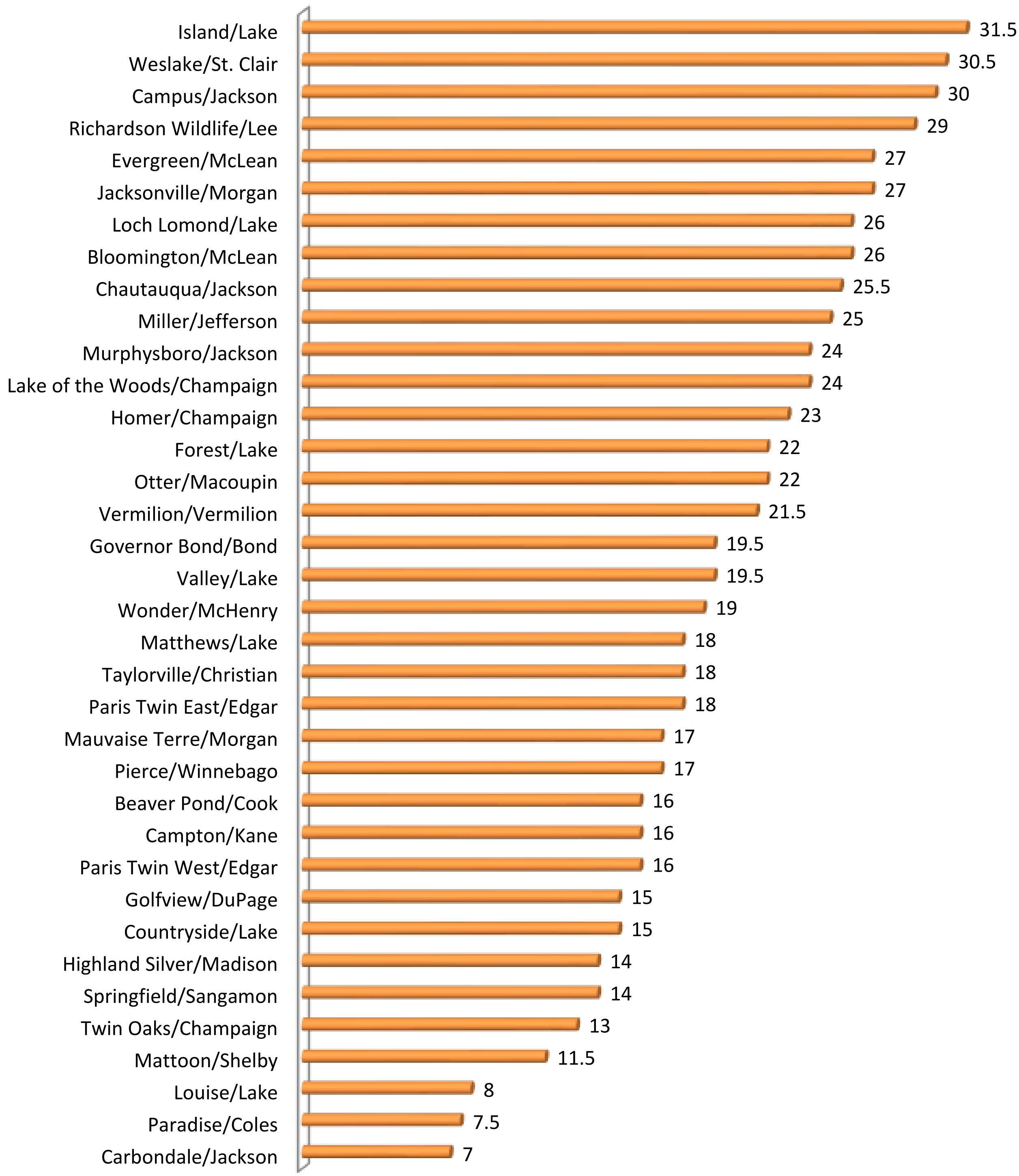


Figure 6-3
14 Pond Transparencies
(Inches)

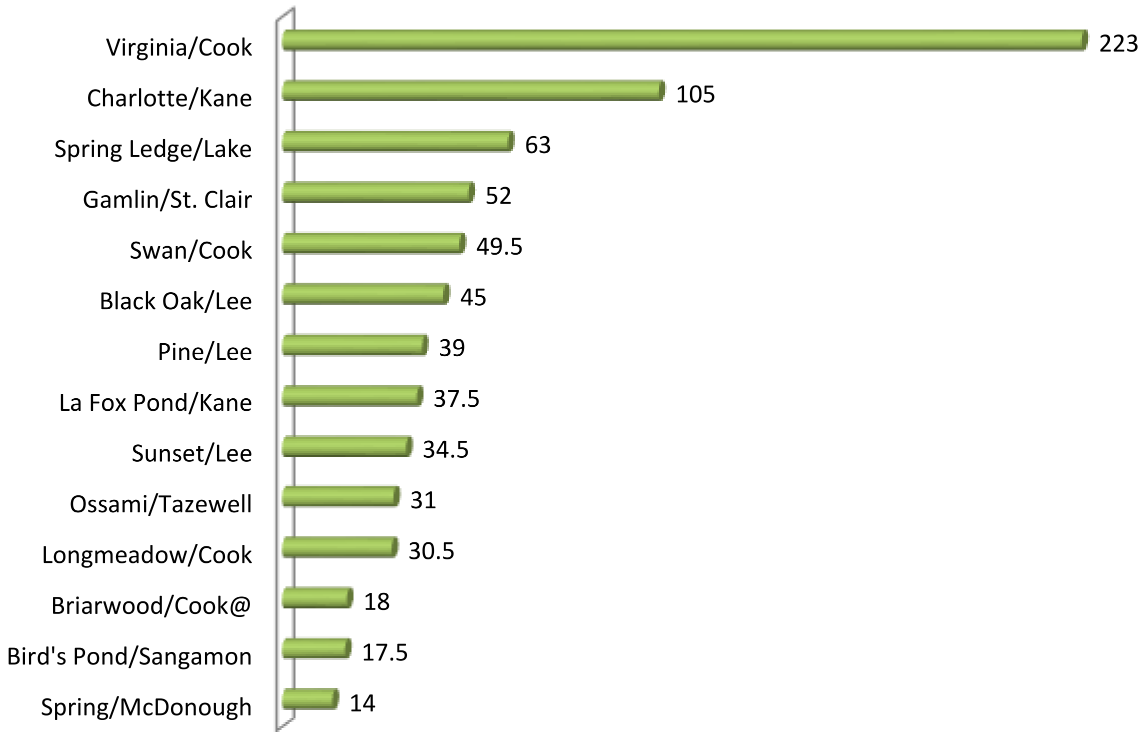
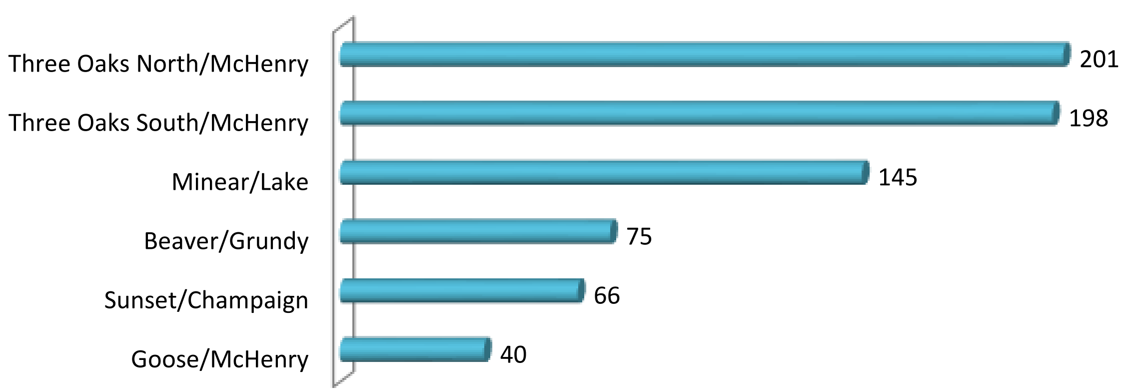


Figure 6-4
6 Quarry Lake Transparencies
(Inches)



Transparency Variability

Average transparency data for all the years a lake has been monitored is available online at http://dataservices.epa.illinois.gov/waBowSurfaceWater. The collection of annual average Secchi transparencies helps establish a "trend" for that lake. A trend is a way to describe the pattern of data over a certain time period. Increasing, decreasing, stable, and fluctuating are all terms used to describe the Secchi transparency trend for a particular lake.

Trends based on lake median should be interpreted with caution. A lake's median transparency for a particular year can be affected by a number of factors, such as:

1. Variations in meteorological conditions and precipitation patterns;
2. Water depths;
3. Variations in the timing and frequency of monitoring;
4. Variations in monitoring techniques and perceptions by different volunteers;
5. Exact location of sampling sites;
6. Growth of aquatic plants that can inhibit the depth to which the Secchi disk can physically be lowered;
7. Variations in management of lake, like plant treatments, drawdowns etc.; and
8. Spills, construction, or other temporary human impacts.

A technical analysis of lake trends should always consider these types of potential sampling errors and variability. Factors such as the minimum and maximum transparencies for each year, seasonal patterns in transparency, effects of a particular storm event or management practice on transparency, and many other factors also should be examined when interpreting Secchi transparency trends. Hence, it is apparent that the most reliable data means are those derived from consistent and frequent monitoring throughout the season and over a period of years.

Percent Macrophyte Coverage

Volunteers made an estimate of the percent coverage of macrophytes (aquatic plants) visible on the lake surface (Appendix A, Table 5). On many of Illinois' lakes, the turbidity of the water limits the estimates to emergent species. Each range was given a weighted point value in regards to whether that coverage range is good (0 points) to poor (15 points) for "Aquatic Life Uses" and "Aesthetic Quality Uses." See Appendix A: Tables 11 and 12, under the subheading of Macrophyte Points.

Expanded Monitoring Programs

Water Quality Monitoring

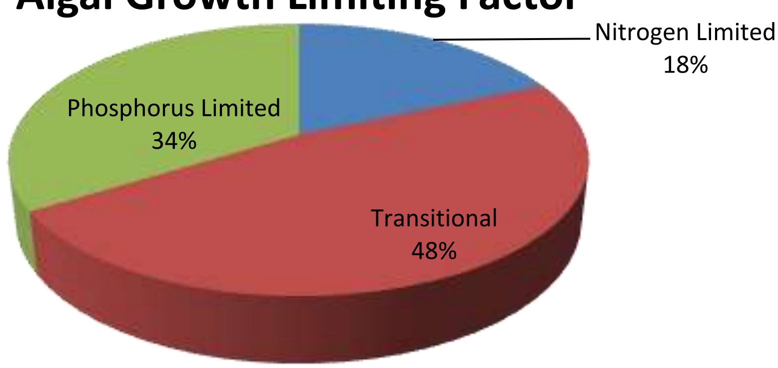
In 2015, volunteers at 65 lakes collected water samples from one foot below the lake water surface. Four of these lakes collected water samples for analysis at multiple stations on the lake under Tier 3, while the 61 other lakes sampled at the representative site only under Tier 2. Appendix A: Tables 6, 7 and 8 provide the mean values for all of the analytes studied. All of the water quality data are provided in Appendix C. Not all samples were analyzed for all constituents. For the most part, Chloride analysis was limited to the general Chicago metropolitan area of Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties. One Tier II lake collected chlorophyll samples.

Total Phosphorus: The median values ranged from 0.0034 mg/L to 0.884 mg/L. The single highest value overall was found at Swan Lake in Cook County, 0.902 mg/L. 29 lakes had median values of TP over the 0.05 mg/L. It should be noted that nine of 13 lakes with median TP under 0.05 mg/L had one or more sampling events with levels over that benchmark. Lake TSI^{TP}'s were calculated and are summarized in Appendix A: Table 9 and 10. The 23 lakes with values **all** under the benchmark are:

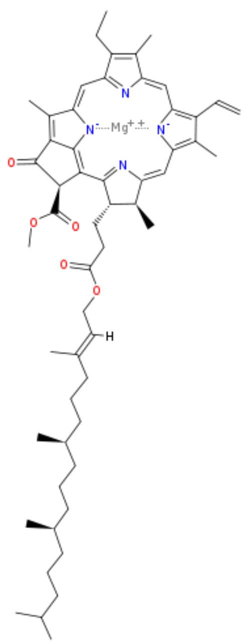
Butler/Lake	Candlewick/Boone	Carroll/Carroll	Cedar/Jackson
Charlotte[2]/Kane	Dawson/Mclean	Deep/Lake	Devils Kitchen/Williamson
Druce/Lake	Highwood/McHenry	Homer/Champaign	Killarney/McHenry
Lake of Egypt/Williamson	Miltmore/Lake	Ossami/Tazewell	Silver/McHenry
Spring Arbor/Jackson	Sunset/Champaign	Third/Lake	Three Oaks North/McHenry
Three Oaks South/McHenry	Tower/Lake	Virginia/Cook	

Nitrogen: Lakes were analyzed for three sources of nitrogen; ammonia, nitrites + nitrates (inorganic nitrogen), and Total Kjeldahl Nitrogen (TKN). Total Nitrogen to Total Phosphorus (TN/TP) ratios calculated for the lakes are presented in Appendix A: Table 9. These ratios indicate that 12 lakes are nitrogen limited, 31 are transitional, and 22 are phosphorus limited (Figure 7). This spread of limiting nutrients highlights the need to consider both nutrients when creating a management plan.

Figure 7
Algal Growth Limiting Factor



Whether or not the nutrient identified as the limiting nutrient is truly the limiting factor for algal growth depends also on light availability. The amount of light available for algal growth varies depending on the amount of suspended solids in the water column, as well as the absorbency of the water's true color. Predation by zooplankton can also limit algal growth. It should be noted that some cyanobacteria have additional metabolic mechanisms to compensate for low phosphorus availability. Additionally, plotting the change of ratios over the course of the growing season for a particular lake may be useful for spotting seasonal trends, but is not within the scope of this report.



TN/TP ratios ranged from two at Swan Lake in Cook County to 215 at Three Oaks South in McHenry County. As mentioned earlier, when inorganic nitrogen (nitrate + nitrite + ammonia) is available over 0.3 mg/L in a lake, summer algae blooms should be expected. In lakes where inorganic nitrogen is low, but phosphorus is readily available, the lake's nutrient factors favor blue-green algae growth. Appendix A: Table 9 summarizes the median inorganic nitrogen, organic nitrogen, total nitrogen, TN/TP ratios and are assigned a nutrient category; nitrogen limited (less than 15), phosphorus limited (greater than 30) or transitional (15 to 30).

Figure 8a is created from data collected at Tier II lakes and shows the distribution of the growth limiting nutrient categories. Remember, Tier II lakes collect water chemistry at site 1 only. Figure 8b is created from data collected at Tier 3 lakes and also shows the distribution of the growth limiting nutrient categories. These nutrient data were collected at multiple locations at the lake.

Chlorophyll-a

Chlorophyll-a: Lake TSI^{CHL} was calculated from chlorophyll data collected at five lakes. Data are summarized in Appendix A: Table 8. Median chlorophyll-a concentration values ranged from 23.0 μg/L at Apple Canyon in Jo Daviess County to 79.3 μg/L at Springfield in Sangamon County. The median phosphorus levels for these two lakes were 0.057 mg/L and 0.223 mg/L, respectively. Additionally, Apple Canyon is transitional (N/P = 17), while Springfield is nitrogen limited (N/P = 7). Appendix A: Table 8 does not show a direct correlation between increasing phosphorus levels and increased chlorophyll-a concentration. This is likely due to this year's very limited number of data points for chlorophyll-a.

Non-volatile Suspended Solids (NVSS): NVSS median values were calculated by subtracting the volatile suspended solids (VSS) from the total suspended solids (TSS). (TSS – VSS = NVSS). Appendix A: Table 9, 11 and 12 summarizes these median values. 55 of the 65 lakes showed no significant amounts of NVSS, less than 3 mg/L; while the rest were 10 mg/L or less.

Chloride: None of the 28 lakes sampled for chloride had median values over the Agency's water quality standard (WQS) for surface water of 500 mg/L. The median values ranged from 14 mg/L at Dawson in Mclean County, to 374 mg/L at Three Oaks South in McHenry County (Appendix A: Table 7). Chloride sampling was generally limited to the general Chicago metropolitan area of Cook, Kane, DuPage, McHenry, Lake, Will and Kendall counties. The WQS was not exceeded this year by any single sample for the lakes in this study. The highest single value returned was 383 mg/L at Three Oaks North in McHenry County and the single lowest value returned was 14 mg/L at Dawson in Mclean County.

Alkalinity: This year all lakes analyzed for alkalinity appear to be well buffered, with a range of 28 mg/L at Herrin New in Williamson County to 281 mg/L at Longmeadow in Cook County (Appendix A: Table 7). As mentioned previously, values greater than 25 mg/L are considered "well buffered," (Figure 8-1).

Using the USGS Hardness Scale; 17 were "Very Hard," 29 were "Hard," 13 were "Moderately Hard," and six were "Soft" (Figure 8-2). Five of six with soft water were all found in Southern Illinois; Devils Kitchen, Lake of Egypt and Herrin Old of Williamson County, Cedar of Jackson County and Miller of Jefferson County. Highland Silver of Madison County had a median alkalinity in the soft water range this year in the Central Illinois Region.

Figure 8-1
Sensitivity to Acid Rain

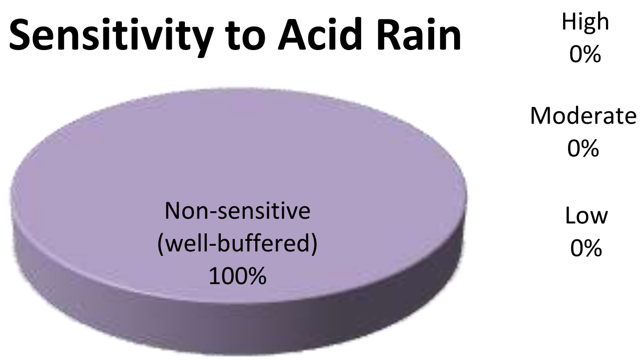
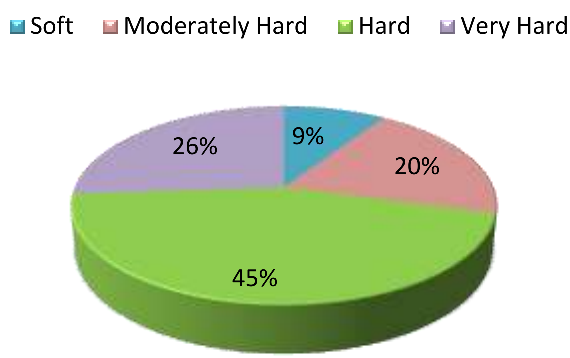


Figure 8-2
Water Hardnes



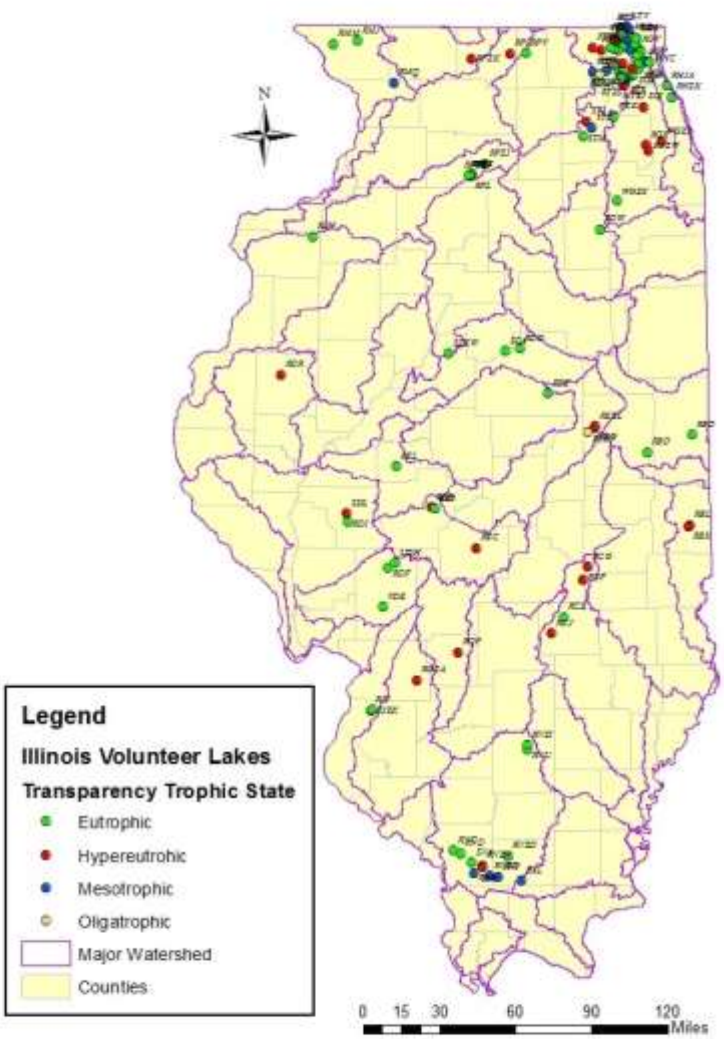
Trophic State Index

Trophic State Indexes were calculated for 130 lakes based on Secchi depth transparencies. A TSI^{TP} was also calculated for 65 of these lakes and a TSI^{CHL} was calculated for a further subset of the TSI^{TP} lakes. (Appendix A: Table 10). 65 lakes were Tier I and only had a single TSI to base the trophic state upon, TSI^{SD}. Those lakes reflect the same data as found in the discussion of the Secchi depth transparency ranking section, above.

A watershed map (Figure 9) was created to show the distribution of the Secchi Depth trophic state across the state. The heaviest grouping of study lakes are found in the Upper Fox, the Des Plaines, and the Big Muddy watersheds, with 45, 23, and 12 VLMP lakes, respectively. The map presents the Lake County portion of the Upper Fox and Des Plaines watersheds in an expanded box in the upper left of the figure. Breakouts maps of the densely populated watershed are seen in Figures 9-1 through 9-3. Appendix A: Table 2 lists the major watershed for each volunteer lake with their corresponding basin number, as well as the national hydrologic unit code (HUC) system. A HUC is a sequence of numbers or letters that identify a hydrological feature like a river, river reach, lake, or as in this case, a watershed. For more information on HUC, visit the USGS's Water Resource pages at http://water.usgs.gov/GIS/huc.html.

It should be noted that Carlson considers the TSI^{CHL} to be the most accurate predictor of plant biomass; however, the Illinois EPA believes that the chlorophyll-a data collected by volunteers may have a greater margin for error. Therefore, in Illinois, the TSI^{TP} has been shown to be a better predictor for a hypereutrophic state.

Figure 9 Secchi Depth Transparency Map
130 Volunteer Lakes by Trophic State



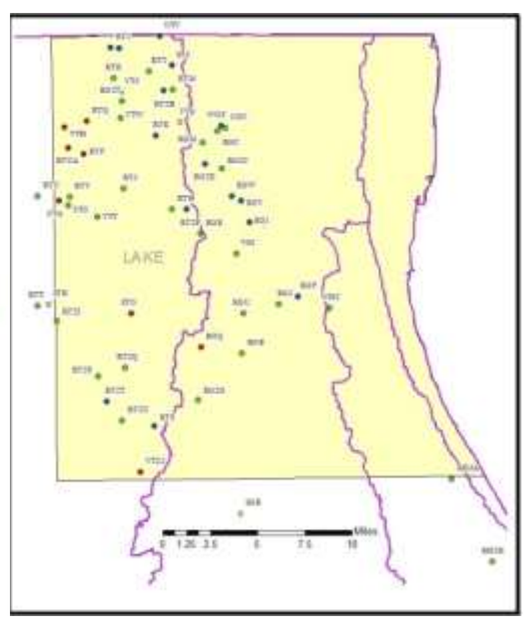


Figure 9-1 Watershed Lake Density
Upper Fox Watershed, 45 Volunteer Lakes

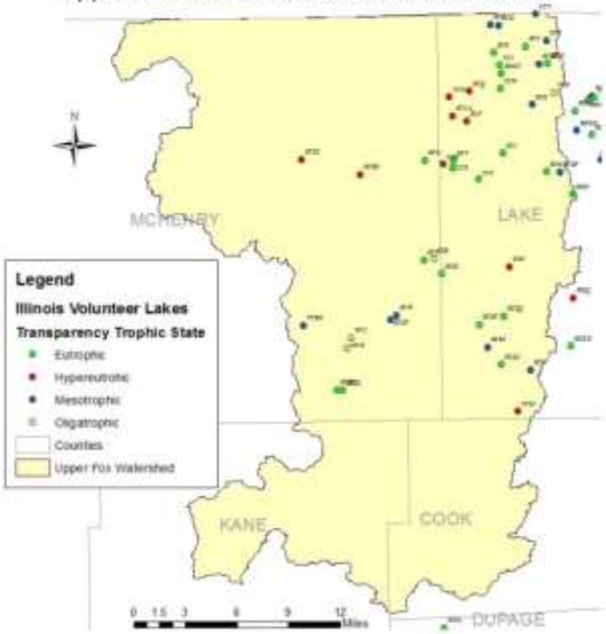


Figure 9-2 Watershed Lake Density
Des Plaines Watershed, 23 Volunteer Lakes

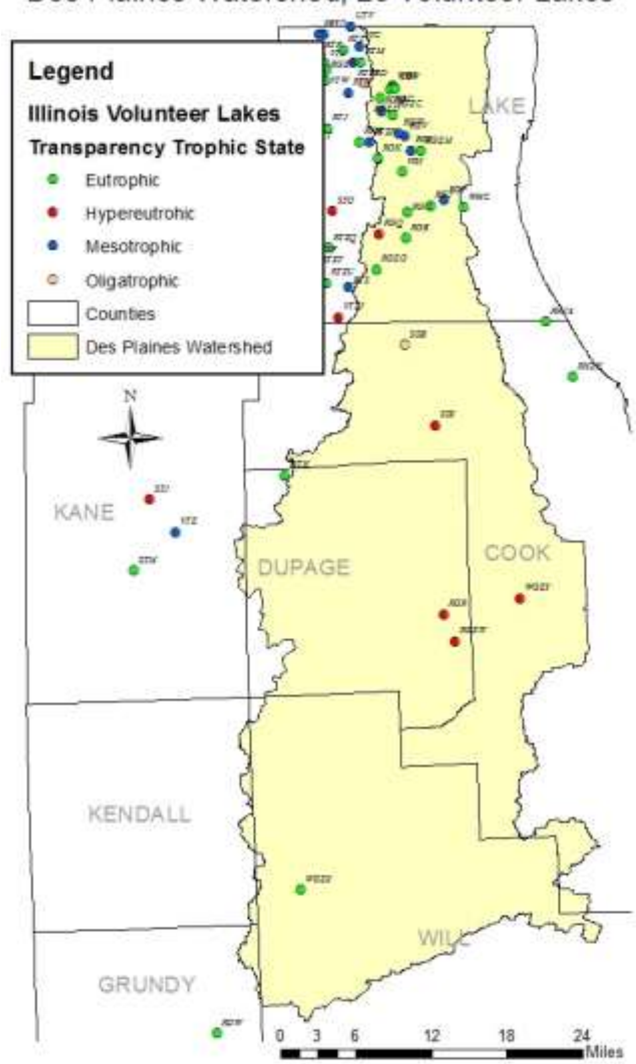


Figure 9-3 Watershed Lake Density
Big Muddy Watershed, 11 Volunteer Lakes

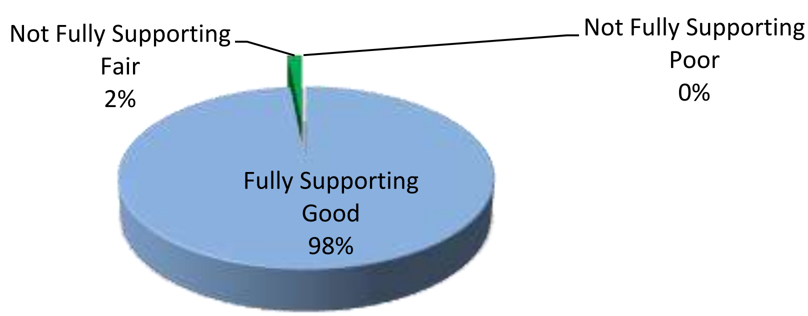
Evaluation of Aquatic Life Use

The sample results were used to calculate 130 TSI values for Secchi depth, 65 TSI values for TP, and five TSI values for chlorophyll-a, as seen in Appendix A: Table 10.

The TSIs, macrophyte coverage assessment and NVSS medians are assigned point values as indicated under Weighting Criteria for ALU in the Data Evaluation section in the VLMP Report Part A. All ALU components are summarized in Appendix A: Table 11.

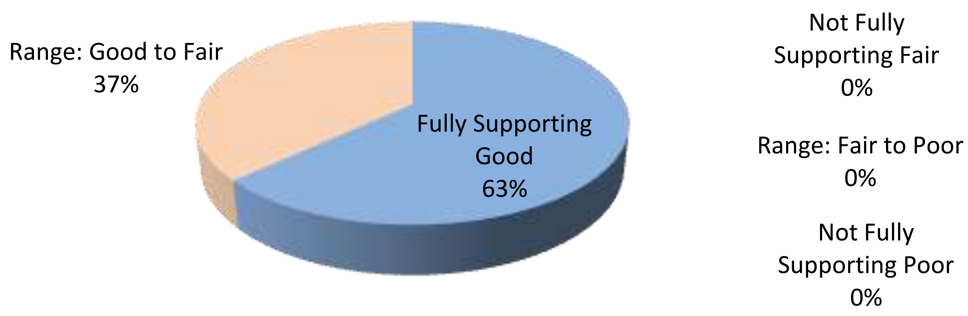
As with TSI values, the ratings are weighted by using the two out of three rule when all three values are available, then by ALU^{TP} first and ALU^{CHL} second when only two TSI values. The ALU^{SD} alone cannot be used, unless NVSS was calculated in the absence of usable Total Phosphorus data. Therefore, lakes only collecting Secchi information cannot be used to directly determine aquatic life use in a lake, but they can be compared with similar lakes of their type using TSI^{SD} and macrophyte coverage. 64 of 65 lakes with chemical data available were rated Fully Supporting **Good** for aquatic life use. The other lake was rated Not Full Supporting **Fair** (Figure 10-1).

Figure 10-1
Aquatic Life Use for 65 Tier 2 & 3 Lakes



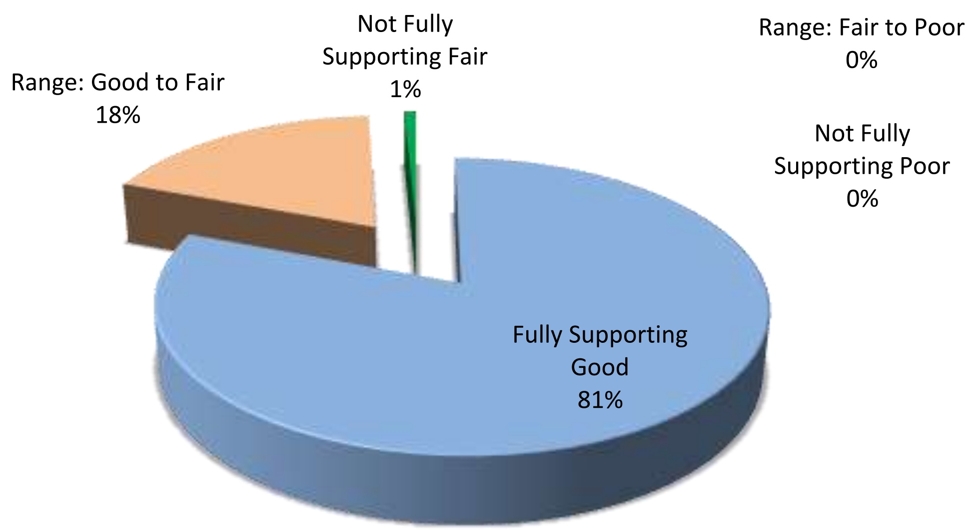
65 lakes had only Secchi monitoring data. This data was used to extrapolate ALU using the Secchi Depth TSI and the percent of macrophyte coverage over the lake bottom. A high and low NVSS range was estimated using the minimum value (0) and the maximum value (15), since water samples were not taken. Two final scores were then generated, a high value and a low value, providing a numerical range for the final ALU score. If the two values both fell into the same category, the lake was rated for that category. If the scores fell into different categories, a category range was determined to describe the outcome, either Two Category Range: Good-Fair or Two Category Range: Fair-Poor. 41 lakes were rated Fully Supported **Good** and 24 were given a range of Two Category Range: **Good-Fair** for ALU.

Figure 10-2
Aquatic Life Use for 65 Tier 1 Lakes



Overall, 105 of the lakes evaluated for their ability to support aquatic life are Fully Supporting **Good** condition. The others are divided between 24 in the range of Two Category Range: **Good-Fair** and one in Not Fully Supporting **Fair**.

Figure 10-3
Aquatic Life Use
All Tiers - 130 Lakes



Potential Causes: Some of the potential causes for impairment for ALU in the 24 lakes rated by the range of Good to Fair and the lake rated Not Fully Supporting Fair include not having sufficient aquatic plant coverage, having too much aquatic plant coverage, and total phosphorus exceeding the WQS of 0.05 mg/L.

Potential Sources: The volunteer or lake managing body should look for the source of the cause. Appendix A: Table 16 contains a list of potential lake impairment sources to consider.

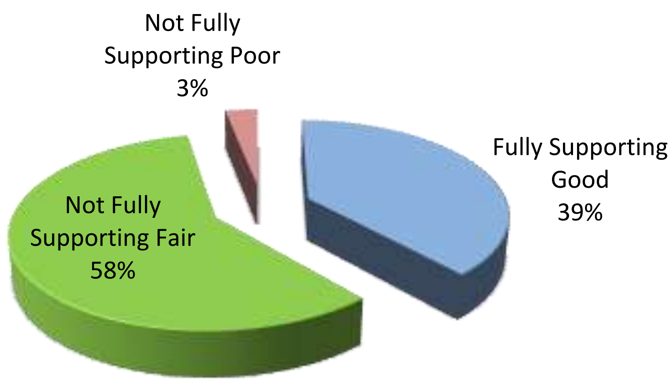
Evaluation of Aesthetic Quality Use

The sample results were used to calculate 130 TSI values for Secchi depth, 65 TSI values for TP, and five TSI values for chlorophyll-a, as seen in Appendix A: Table 10.

The TSIs, macrophyte coverage assessment and NVSS medians are assigned point values as indicated under Weighting Criteria for AQU in the Data Evaluation section. All AQU components are summarized in Appendix A: Table 12.

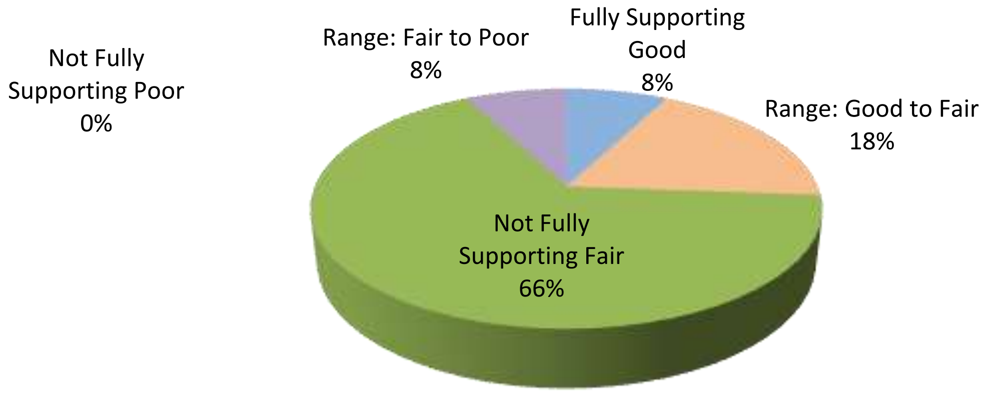
As with TSI values, the ratings are weighted by using the two out of three rule when all three values are available, then by AQU^{TP} first and AQU^{CHL} second when only two TSI values. The AQU^{SD} alone cannot be used, unless NVSS was calculated in the absence of usable total Phosphorus data. Therefore, lakes only collecting Secchi information cannot be used to directly determine aesthetic quality conditions in a lake, but they can be compared with similar lakes of their type using TSI^{SD} and macrophyte coverage. 25 lakes were rated Fully Supporting **Good**, 38 were rated Not Fully Supporting **Fair** and two were rated Not Fully Supporting **Poor** for aesthetic quality use (Figure 11-1).

Figure 11-1
Aesthetic Quality Use for 65 Tier 2 & 3 Lakes



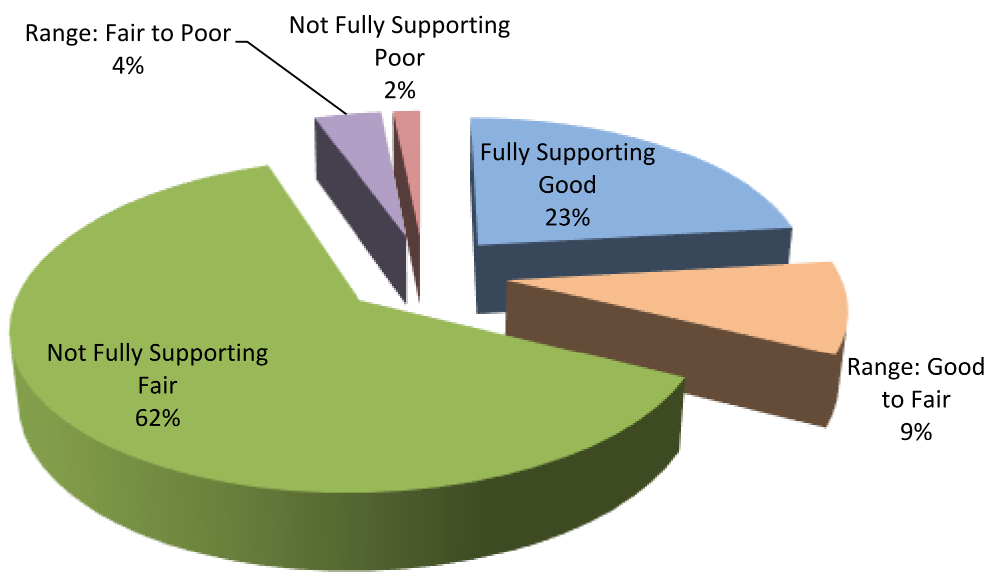
65 lakes had only Secchi monitoring data. This data was used to extrapolate AQU using the Secchi Depth TSI and the percent of macrophyte coverage over the lake. A high and low NVSS range was estimated using the minimum value (0) and the maximum value (15), since water samples were not taken. Two final scores were then generated, a high value and a low value, providing a numerical range for the final AQU score. If the two values both fell into the same category, the lake was rated for that category. If the scores fell into different categories, a category range was determined to describe the outcome, either Two Category Range: Good-Fair or Two Category Range: Fair-Poor. Five lakes were rated Fully Supporting **Good**, 12 were Two Category Range: **Good-Fair**, 43 were rated Not Supporting **Fair** and five were rated Two Category Range: **Fair-Poor** for AQU (Figure 11-2).

Figure 11-2
Aesthetic Quality Use for 65 Tier I Lakes



Overall, 30 of the lakes evaluated for their aesthetic quality are Fully Supporting **Good**. The others are divided between 12 in the range of Two Category Range: **Good-Fair**, 81 in Not Fully Supporting **Fair**, five in the range of Two Category Range: **Fair-Poor**, and two in Not Fully Supporting **Poor**.

Figure 11-3
Aesthetic Quality Use
All Tiers - 130 Lakes



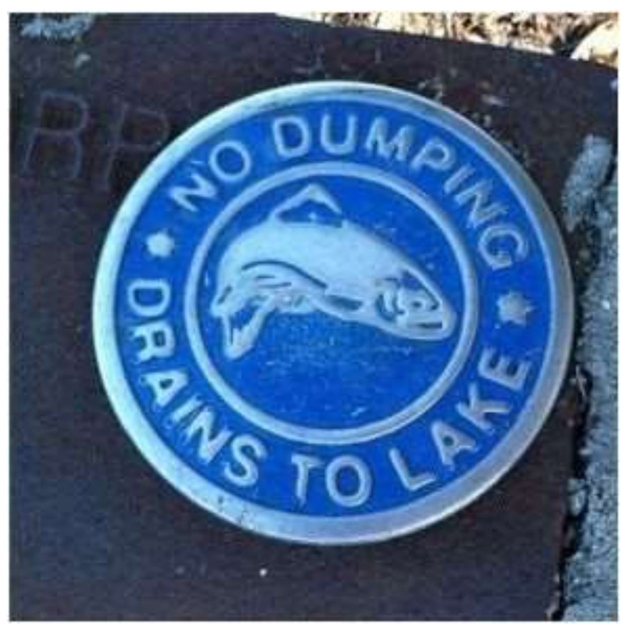
Potential Causes: The potential causes for impairment for AQU in the 100 lakes rated less than Fully Supporting Good have a variety of causes: an over-abundance of aquatic plant coverage, severe algae blooms, high turbidity and total phosphorus levels over the WQS for lakes over 20 acres.

Potential Sources: The volunteer or lake managing body should look for the source of the cause. Appendix A: Table 16 contains a list of potential lake impairment sources to consider.

Summary

Data from the Volunteer Lake Monitoring Program continues to show heavy loading of nutrients, such as phosphorus, into Illinois lakes. Data for the sixty-five lakes with total phosphorus values had a median range of 0.0034 mg/L to 0.8840 mg/L. The median value of 0.0034 is actually the laboratory method detection limit for total phosphorus; therefore, this lake's median value was a non-detection of phosphorus in the sample. The lowest single value for total phosphorus that was not non-detection was 0.004 mg/L and the highest was 0.9260 mg/L. The water quality standard for Illinois surface water is 0.05 mg/L (Appendix A: Table 13). Median total phosphorus values at thirty-six lakes were below the water quality standard, but fourteen of the thirty-six lakes had at least one sampling event value over 0.05 mg/L. The other nutrient of concern is Total Nitrogen (which is adding Nitrate/Nitrite values to TKN). Total Nitrogen values had a median range of 0.267 mg/L to 8.850 mg/L. Two lakes, Sunset in Champaign County and Three Oaks North in McHenry County, in the middle of August, had the lowest single values for total nitrogen as "not detected" (meaning both Nitrate/Nitrite and TKN values were both "not detected") which (for laboratory purposes) is less than 0.19 mg/L and the highest was 12.45 mg/L at Vermilion, in Vermilion County, in late June.

Other than nutrients, macrophyte coverage appears to be the number one factor that determines favorable conditions for both aquatic life and aesthetic quality uses. Thirty-eight of the one-hundred thirty lakes studied had good macrophyte coverage for supporting aquatic life while maintaining good recreational use



Setting Goals with Volunteer Data

There are a number of options for improving the water quality of a lake – from picking up litter to implementing best management practices (BMPs) in the watershed. BMPs have been developed for construction, cropland, and forestry, as well as other similar land-use activities. Managers of lakes and streams can focus their best management practices to control water runoff, erosion, nutrient loading and contaminant loading. Appendix A: Table 14 contains a long list of best management practices with a set of priorities assigned at low, medium, or high for agriculture, construction, urban runoff, hydrologic modification, resource extraction, groundwater, and wetlands.

The volunteer data helps to identify and justify the use of a particular set of BMPs. Are the issues caused by nutrient loading, high suspended solids, aquatic plant growth, or a combination of the three? Are the plant issues caused by invasive species? If so, maybe there is grant money through a local, state or federal program to eradicate that invasive species. In all cases of grant applications, data to confirm your need is valuable.

Illinois EPA publishes a series of fact sheets called "Lake Notes" that provide information on a wide range of lake- and watershed-related topics. Aquatic Exotics, Aquatic Plant Management Options, Common Lake Water Quality Parameters, Lake Dredging, Shoreline Bugger Strips, and Where to Go For Lake Information are just a few of the subjects covered by the fact sheets. They can be found at the following link:

http://www.epa.illinois.gov/topics/water-quality/monitoring/vlmp/data/index

Grants Available to Control Nonpoint Source Pollution in Illinois

319 Grants are available to local units of government and other organizations to protect water quality in Illinois. Projects must address water quality issues relating directly to nonpoint source pollution. Funds can be used for the implementation of watershed management plans including the development of information and/or education programs and for the installation of best management practices.

IEPA receives these funds through Section 319(h) of the Clean Water Act and administers the program within Illinois. The maximum federal funding available is 60 percent. The program period is two years unless otherwise approved. This is a reimbursement program.

Applications are accepted June 1 through August 1. If August 1 is a Saturday or Sunday, the deadline becomes the prior Friday before 5 p.m. At this time, electronic submittals are not accepted. Please mail applications to the address provided to the right.

Illinois Environmental Protection Agency
Bureau of Water
Watershed Management Section
Nonpoint Source Unit
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Contact Number: (217)782-3362

Links for 319 Grants

- Section 319 Request for Proposals
- Section 319 Application
- Section 319 Application Instructions
- Section 319 Certifications and Grant Conditions

References

- 35 Illinois Administrative Code; Subtitle C: Part 302 Water Quality Standards
- Allum, M. 0., Glessner, R. E., and Gakstatter, J. H. 1977. An Evaluation of the National Eutrophication Survey Data Working Paper No. 900. Corvallis Environmental Research Laboratory, Corvallis, Oregon, National Eutrophication Survey, Office of Research and Development, U.S. Environmental Protection Agency, GPO 699-440.
- Camargo, Julio A. and Alonso, Álvaro 2006. Ecological and toxicological effects of inorganic nitrogen pollution in aquatic ecosystems: A global assessment. Environmental International 32 (2006) 831–849.
- Carlson, R.E. 1977. A tropic state index for lakes. Volume 22; Issue 2, American Society of Limnology and Oceanography, Pages 361-369.
- Carson, R. and Simpson, J. 1996. A Coordinator's Guide to Volunteer Lake Monitoring Methods. North American Lake Management Society.
- Illinois State Water Survey 2000. Major Watersheds of Illinois. Map Series 2000-01, revised 01/11.
- McComas, Steve 1993. Lake Smarts The First Lake Management Handbook, 4th Edition. Terrene Institute, Alexandria, Virginia.
- North American Lake Management Society and Terrene Institute 2001. Managing Lakes and Reservoirs (3rd Edition).
- Shaw, Byron. Mechenich, Christine, and Klessig, Lowell 2004. Understanding Lake Data (G3582). University of Wisconsin Extension. Cooperative Extension Publishing Operations.
- Taylor, J. W. ed. 1984. "The Acid Test." Natural Resources Magazine. Wis. Dept. of Natural Resources. 40 pp.
- USEPA, Criteria and Standards Division 1988 (EPA-440/5-88-002) The Lake and Reservoir Restoration Guidance Manual, 1st Edition.
- USEPA, Office of Water 2000. (EPA-822-B-00-008) Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria: Lakes and Reservoirs in Nutrient Ecoregion VI
- USEPA, Office of Water 2000. (EPA-822-B-00-011) Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria: Lakes and Reservoirs in Nutrient Ecoregion IX
- USEPA, Water Division 1993 (EPA-841-R-93-002) Fish and Fisheries Management in Lake and Reservoirs. Technical Supplement to: The Lake and Reservoir Restoration Guidance Manual.
- Wetzel, R. G. 2000. Limnological Analyses. (3rd Edition) Springer-Verlag.
- Wetzel, R. G. 2001. Limnology Lake and River Ecosystems. (3rd Edition). Academic Press

Glossary of Terms

Algae: a group of photosynthetic eukaryotes that are single celled, colonial, or filamentous aquatic plants, often microscopic.

Algal bloom: A condition which occurs when excessive nutrient levels and other physical and chemical conditions facilitate rapid growth of algae. Algal blooms may cause changes in water color. The decay of the algal bloom may reduce dissolved oxygen levels in the water.

Alkalinity: A measure of the capacity of water to neutralize acids. It is a measure of the amount of carbonates, bicarbonates, and hydroxide present in water. Low alkalinity is the main indicator of susceptibility to acid rain. Increasing alkalinity is often related to increased algae productivity. (Expressed as milligrams per liter (mg/L) of calcium carbonate ($CaCO_3$), or as micro equivalents per liter (µeq/l). 20 µeq/l = 1 mg/L of $CaCO_3$.)

Ammonia: A form of nitrogen found in organic materials and many fertilizers. It is the first form of nitrogen released when organic matter decays. It can be used by most aquatic plants and is therefore an important nutrient. It converts rapidly to nitrate (NO_3^-) if oxygen is present. The conversion rate is related to water temperature. Ammonia is toxic to fish at relatively low concentrations in pH-neutral or alkaline water. Under acid conditions, non-toxic ammonium ions (NH_4^+) form, but at high pH values the toxic ammonium hydroxide (NH_4OH) occurs. The water quality standard for indigenous aquatic life is 0.1 mg/L of unionized ammonia. At a pH of 7 and a temperature of 68^o Fahrenheit (20^o Celsius), the ratio of ammonium ions to ammonium hydroxide is 250:1; at pH 8, the ratio is 26:1.

Anaerobic: Any process that can occur without molecular oxygen; also applicable to organisms that can survive without free oxygen.

Aquatic Invasive Species (AIS): AIS is a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Aquatic invertebrates: Aquatic animals without an internal skeletal structure such as insects, mollusks, and crayfish.

Beneficial use: The uses of a water resource that are protected by state laws called water quality standards. Uses include aquatic life, recreation, human consumption, and fish or wildlife habitat.

Benthic: Living in or on the bottom of a body of water.

Benthos: Collectively, all organisms living in, on, or near the bottom substrate in aquatic habitats (examples are oysters, clams, burrowing worms).

Best management practices (BMPs): Management practices (such as nutrient management) or structural practices (such as terraces) designed to reduce the quantities of pollutants — such as sediment, nitrogen, phosphorus, and animal wastes — that are washed by rain and snow melt from lands into nearby receiving waters, such as lakes, creeks, streams, rivers, estuaries, and ground water.

Biomass: The total quantity of plants and animals in a lake. Measured as organisms or dry matter per cubic meter, biomass indicates the degree of a lake system's eutrophication or productivity.

Blue-green algae: Algae which are often associated with problem blooms in lakes. Some produce chemicals toxic to other organisms, including humans. They often form floating scum as they die. Many can fix nitrogen (N_2) from the air to provide their own nutrient.

Chlorophyll: Green pigments essential to photosynthesis.

Chlorophyll-a: A green photosynthetic pigment found in the cells of all algae and other plants. The chlorophyll-*a* level in lake water is used to estimate the concentration of planktonic algae in the lake.

Chlorophyll-*b*: A type of chlorophyll found in green algae and euglenoids. Both of these are good food for zooplankton which is good fish food.

Chlorophyll-*c*: A type of chlorophyll found in diatoms and golden brown algae. Both of these are good food for zooplankton which is good fish food.

Conductivity: The ability of water or other substance to carry an electric current.

Color: Measured in color units that relate to a standard. A yellow-brown natural color is associated with lakes or rivers receiving wetland drainage. Color also affects light penetration and therefore the depth at which plants can grow.

Cultural Eutrophication: The enrichment of lakes with nutrients (especially phosphorus) as a result of human activity, resulting in an acceleration of the natural ageing process of the lake.

Detritus: Fragments of plant material.

Diatoms: Any number of microscopic algae whose cell walls consist of two box-like parts or valves and contain silica.

Dinoflagellates: Unicellular biflagellate algae with thick cellulose plates.

Dissolved Oxygen: Dissolved oxygen is the amount of oxygen dissolved in the water. The DO concentration in water is affected by the water temperature, water quality, and other factors.

Epilimnion: the upper (usually warmer) circulated zone of water in a temperature stratified lake.

Erosion: Wearing of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical, chemical, or biological forces.

Euphotic: the zone of vertical light penetration in a lake.

Eutrophic: water which are rich in plant nutrients and capable of supporting high amounts of plant and animal growth (Secchi transparency less than 6.6 feet and TSI 50 to 70).

Eutrophication: the lake aging process via nutrient enrichment and sedimentation; both a natural and human induced process.

Hypereutrophic: a lake with extreme level of nutrients and nuisance plant growth, often as a result of human activities (a TSI greater than 70).

Hypolimnion: the lower (usually cooler) non-circulated zone of water in a temperature stratified lake.

Invasive Species: An alien species whose introduction does, or is likely to, cause economic or environmental harm to human health.

Lake: A man-made impoundment or natural body of fresh water of considerable size, whose open-water and deep-bottom zones (no light penetration to bottom) are large compared to the shallow-water (shoreline) zone, which has light penetration to its bottom.

Limnology: The scientific study of the life and phenomena of lakes, ponds and streams.

Littoral Zone: The near shore shallow water zone of a lake, where light penetrates to the bottom and aquatic plants grow. Some shallow ponds are entirely littoral.

Macroinvertebrate: Any non-vertebrate organism that is large enough to be seen without the aid of a microscope.

Macrophyte: water plants that are visible to the unaided eye.

Mesotrophic: waters intermediate in eutrophy between oligotrophic and eutrophic (Secchi transparency 6.6 to 12.1 feet and TSI 40 to 50).

Metabolism: the sum of the physical and chemical processes ongoing in all living things.

Methemoglobinemia: a condition brought on by drinking water high in nitrates, that reduces the ability of blood to carry oxygen and may also cause respiratory problems. Infants are particularly at risk.

Native Species: A species naturally occurring of originating in a geographical region or in a specific ecosystem.

Nonpoint source (NPS) pollution: Unlike pollution from industrial and sewage treatment plants, NPS pollution comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands and even our underground sources of drinking water. It has been determined that over 60 percent of the (national) documented water pollution problem can be traced to nonpoint sources.

Nutrients: Chemicals that are needed by plants and animals for growth (e.g., nitrogen, phosphorus). In water resources, if other physical and chemical conditions are optimal, excessive amounts of nutrients can lead to degradation of water quality by promoting excessive growth, accumulation, and subsequent decay of plants, especially algae. Some nutrients can be toxic to animals at high concentrations.

Oligotrophic: water with low concentrations of plant nutrients and hence relatively low amounts of plant and animal growth (Secchi transparency greater than 12.1 feet and TSI less than 40).

Online Lakes Database: An online interface for volunteer lake monitors to input their data into the IEPA Lake's Data Management System. It also provides a means for all citizens to view current and historical water quality information on monitored lakes. Database currently contains only those lakes sampled since 1999. Previous to 1999, all data may be accessed through USEPA's **STORET**.

pH: A measure of the acidic or basic (alkaline) nature of water, relating to the number of hydrogen ions. A pH of 7 is neutral. Acid waters are below 7; alkaline waters are above 7.

Pheophytin: The dead chlorophyll of algal cells. Can indicate when an algal bloom dies off.

Phosphorus: One of the major nutrients needed for plant growth. Phosphorus is the critical nutrient for algae growth in lake and ponds.

Photosynthesis: the process by which green plants use sunlight, water, and carbon dioxide to produce oxygen.

Plankton: Small organisms that float passively (or swim weakly) in open water. The two groups of plankton are: phytoplankton, also called algae; and planktonic animals, also called zooplankton.

Pollutant: A contaminant that adversely alters the physical, chemical, or biological properties of the environment. The term includes nutrients, sediment, pathogens, toxic metals, carcinogens, oxygen-demanding materials, and all other harmful substances. With reference to nonpoint sources, the term is sometimes used to apply to contaminants released in low concentrations from many activities which collectively degrade water quality. As defined in the federal Clean Water Act, pollutant means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water.

Protoplasm: the living substance of in a cell (includes the cytoplasm and nucleus).

Representative Site: generally is the deepest area of the lake and is called Site 1.

Saturation: the maximum concentration that water can hold (of any substance, in this case oxygen). This is a function of temperature and pressure.

Secchi Disk Transparency: the depth in the water column that an eight inch, black and white disk disappears from view. Two or three time the Secchi depth is the depth that sunlight can reach into the water column and thereby support plant growth. A healthy plant community is needed for animal (fish) habitat within the lake.

Sediment: Particles and/or clumps of particles of sand, clay, silt, and plant or animal matter carried in water.

STORET: USEPA's old national data storage database; it is housed in a computer mainframe system.

Stratification: The layering of water due to differences in density. Water's greatest density occurs at 39^o Fahrenheit (4^o Celsius). As water warms during the summer, it remains near the surface while colder water remains near the bottom. Wind mixing determines the thickness of the warm surface water layer **(epilimnion),** which usually extends to a depth of about 20 feet. The narrow transition zone between the epilimnion and cold bottom water **(hypolimnion)** is called the **thermocline**.

Super-Saturation: a concentration of a substance (in this case oxygen) above the maximum concentration that water can hold at a given temperature and pressure. This can happen when temperature or pressure changes, or as a result of biological activity.

Suspended solids: Suspended solids refer to small solid particles which remain in suspension in water as a colloid or due to the motion of the water. It is used as one indicator of water quality

Thermal Stratification: As lake water is warmed in the summer, the water in the deep pond or lake is layered into three levels: 1) warmer (less dense) epilimnion layer at the surface; 2) the thin thermocline or transition layer; and 3) the cold and deep hypolimnion layer.

Thermally Stratified: Lake water often separates into zones or layers by temperature difference.

Thermocline: the zone in a temperature-stratified lake between the epilimnion and the hypolimnion, also referred to as the "metalimnion."

Total Phosphorus: A measure of all forms of phosphorus (organic and inorganic) in water.

Total Suspended Solid (TSS): The weight of particles that are suspended in water. Suspended solids in water reduce light penetration in the water column, can clog the gills of fish and invertebrates, and are often associated with toxic contaminants because organics and metals tend to bind to particles. Total suspended solids are differentiated from total dissolved solids by a standardized filtration process, the dissolved portion passing through the filter.

Transparency: A measure of water clarity that, in lakes and ponds, indirectly measures algal productivity. Transparency is determined by the depth at which a Secchi disk lowered into the water column is no longer visible.

Trophic: A level of nutrition, nutrient enrichment within a lake.

Trophic State Index (TSI): A simplified index of biological productivity in lakes.

Turbidity: A measure of the amount of light intercepted by a given volume of water due to the presence of suspended and dissolved matter and microscopic biota. Increasing the turbidity of the water decreases the amount of light that penetrates the water column. High levels of turbidity are harmful to aquatic life.

Volatile suspended solids (VSS): That fraction of suspended solids, including organic matter and volatile inorganic salts, which will ignite and burn when placed in an electric muffle furnace at 550 °C for 15 minutes.

Watershed: A region or area divided by points of high land that drains into a lake, stream, or river.

Watershed Based Plan: A watershed based plan is a document designed to protect and improve water quality by controlling nonpoint source pollution and related water quality problems. Such plans provide an integrated, holistic process to effectively and efficiently protect, enhance and restore the physical, chemical and biological integrity of water resources within a defined hydrologic area (watershed). Watershed based plans present assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to development and implementation of the plan. Watershed based plans should be consistent with the nine minimum elements of watershed based plan as defined by USEPA watershed based plan guidance, the Chicago Metropolitan Agency for Planning's Guidance for Developing Watershed Action Plans in Illinois, total maximum daily load (TMDL) implementation plan requirements, and current watershed planning principles.

Water quality standards: Established limits of certain chemical, physical, and biological parameters in a water body; water quality standards are established for the different designated uses of a water body.

Wetlands: Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Zooplankton: microscopic animals found in the water of lakes and rivers.