

Lake Score Cards Highlight Restoration Progress and Protection Needs

Leslie Matthews, Kellie Merrell, Mark Mitchell, Amy Picotte and Angela Shambaugh



Vermont Lake Score Card



Goals:

- ★ Present a comprehensive perspective on Vermont lakes using easily interpreted graphics
- ★ Provide guidance on actions that residents can take to protect their lake

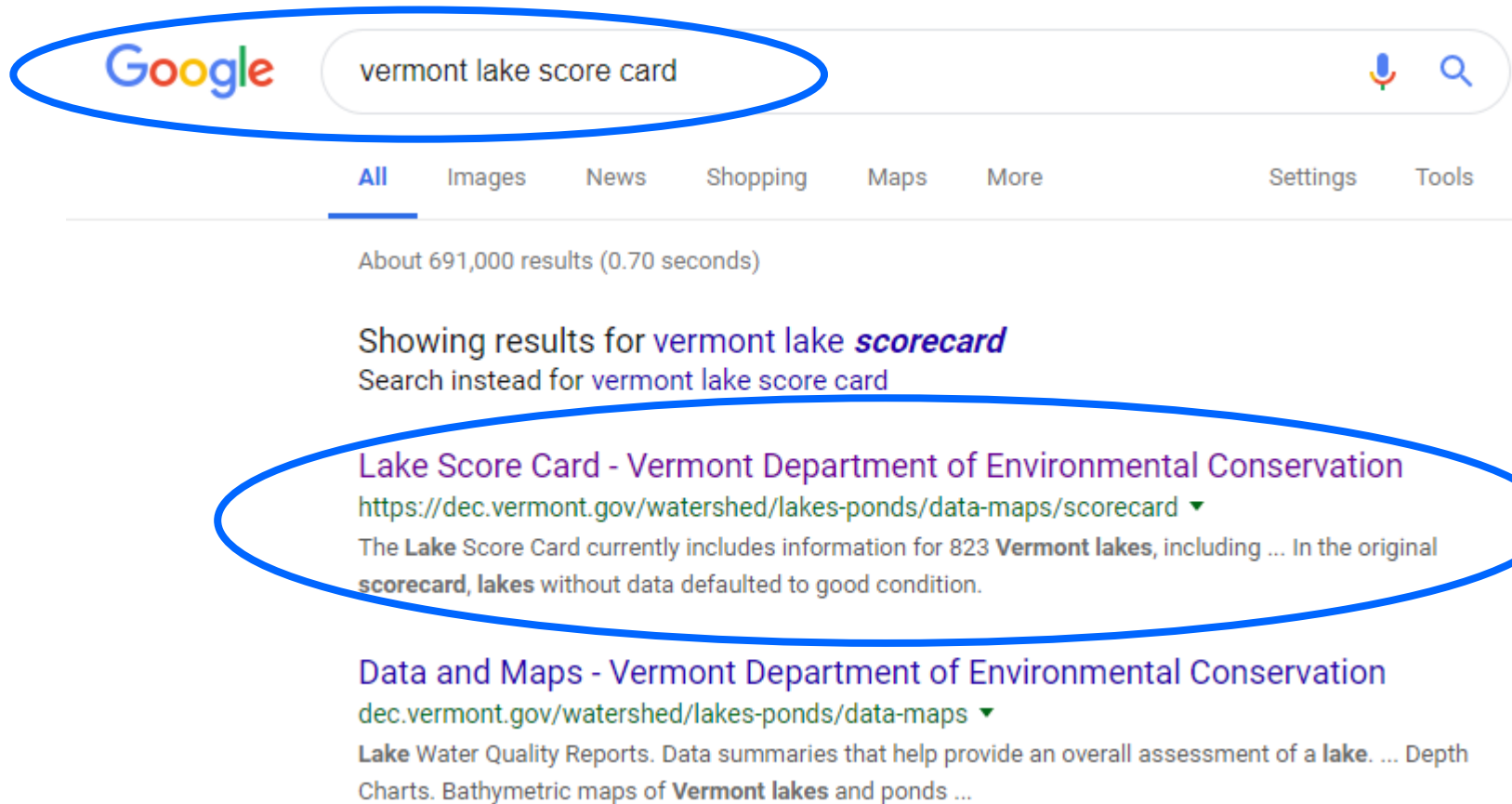
The Score Card

- is based on data we already collect
- is a public education tool based on science
- Uses PBJ backed with explanation



Amy Picotte

Getting There – Google “Vermont Lake Score Card”



Getting There – Google Earth

<https://dec.vermont.gov/watershed/lakes-ponds/data-maps/scorecard>



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Data and Maps

Depth Charts

Lake Score Card

Monitoring

Permitting

LAKE SCORE CARD

Vermont has over 800 lakes, with 220 of them larger than 20 acres in size. The Lake Score Card currently includes information for 823 Vermont lakes, including all those over 20 acres in size.

How to Access the Lake Score Card

The latest free version of Google Earth Pro must be installed on your computer's desktop.

Open the latest version of the Lake Score Card in Google Earth Pro

Once the image appears, click on a lake to view the lake's score or select a layer/lake from the list on the left sidebar. Lake-specific individual water quality and chemistry data can be accessed online through the [Vermont Integrated Watershed Assessment Information System \(IWIS\)](#) using Site Search.

If you are experiencing technical difficulties accessing the Vermont Lake Score Card via Google Earth, please email Perry Thomas: Perry.Thomas@vermont.gov

Alternatively, the Lake Score Card report links can be accessed directly as follows:

[View Detailed Nutrient Trends and Status](#)

[View Plant List, Including Invasive Plants](#)

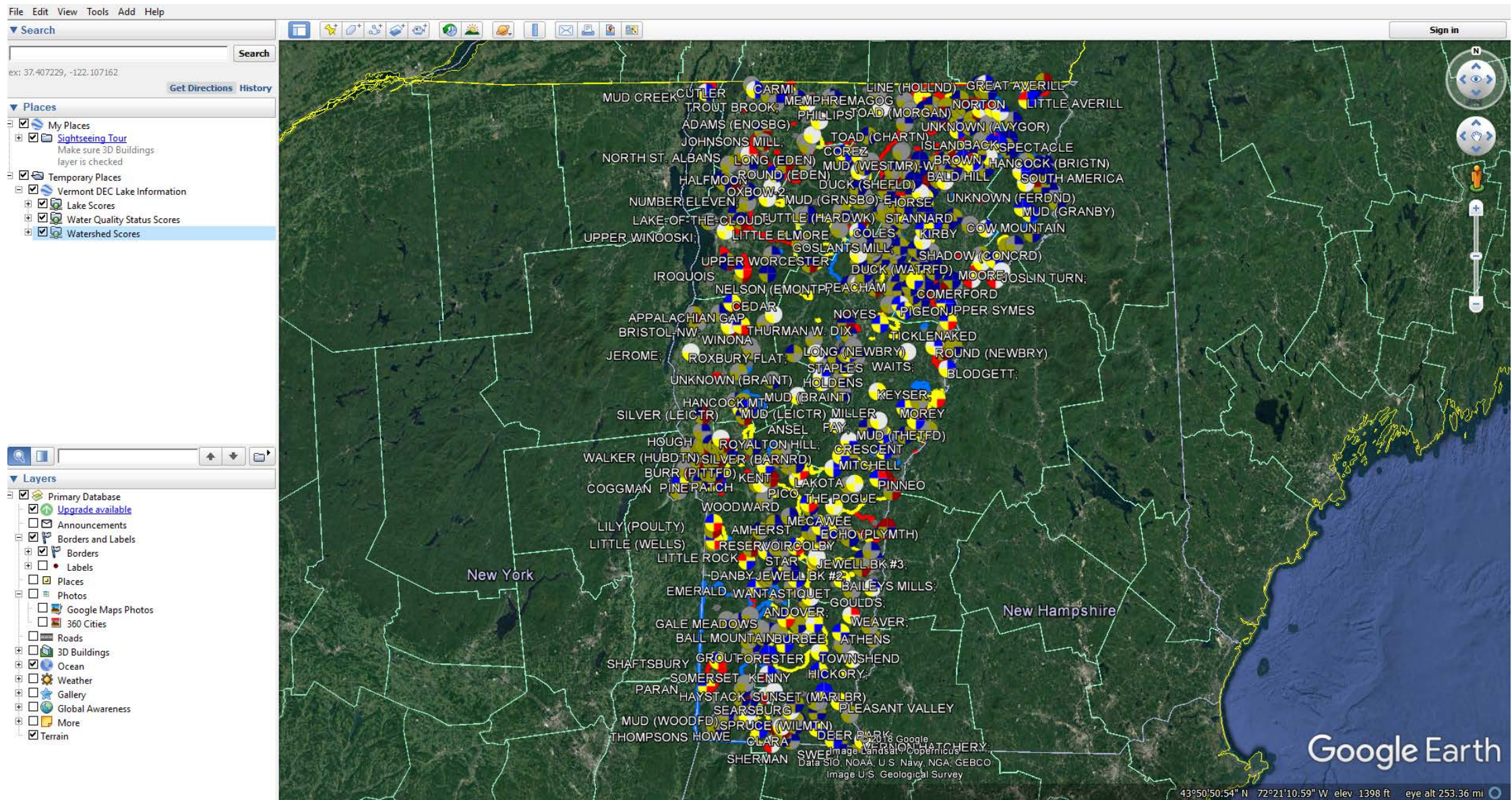
[View Fish List](#)

The New Vermont Inland Lake Score Card

What is the Vermont Inland Lakes Score Card?

The Vermont Inland Lake Score Card is a user-friendly interface developed by the Vermont Lakes and Ponds

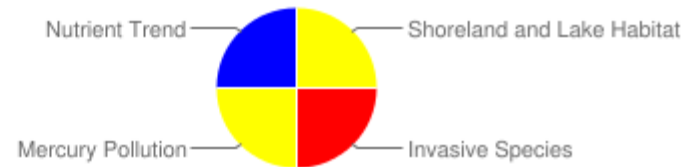
Google Earth



Zoom in!

Vermont Inland Lake Score Card

MILL (WINDSR)



[View Detailed Nutrient Trends and Status](#)

[View Plant List, Including Invasive Plants](#)

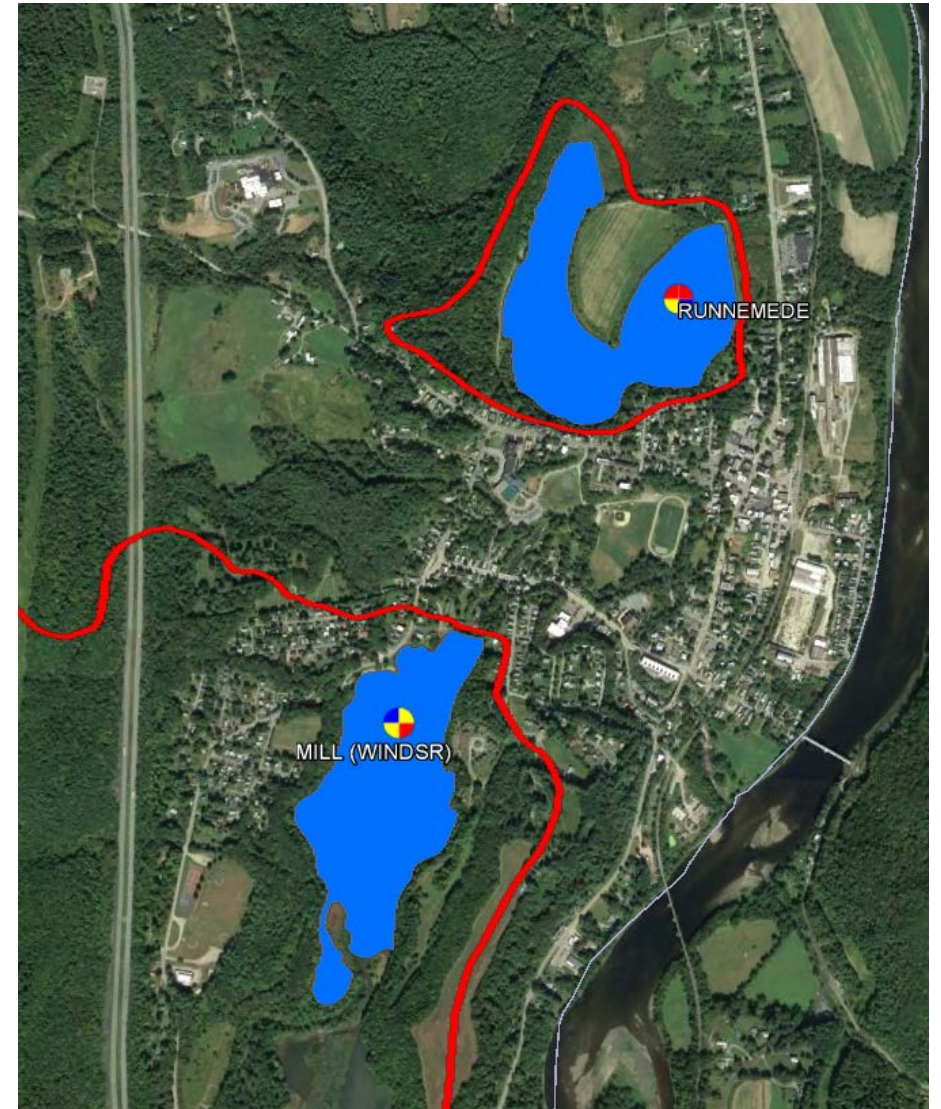
[View Fish List](#)

Scoring System

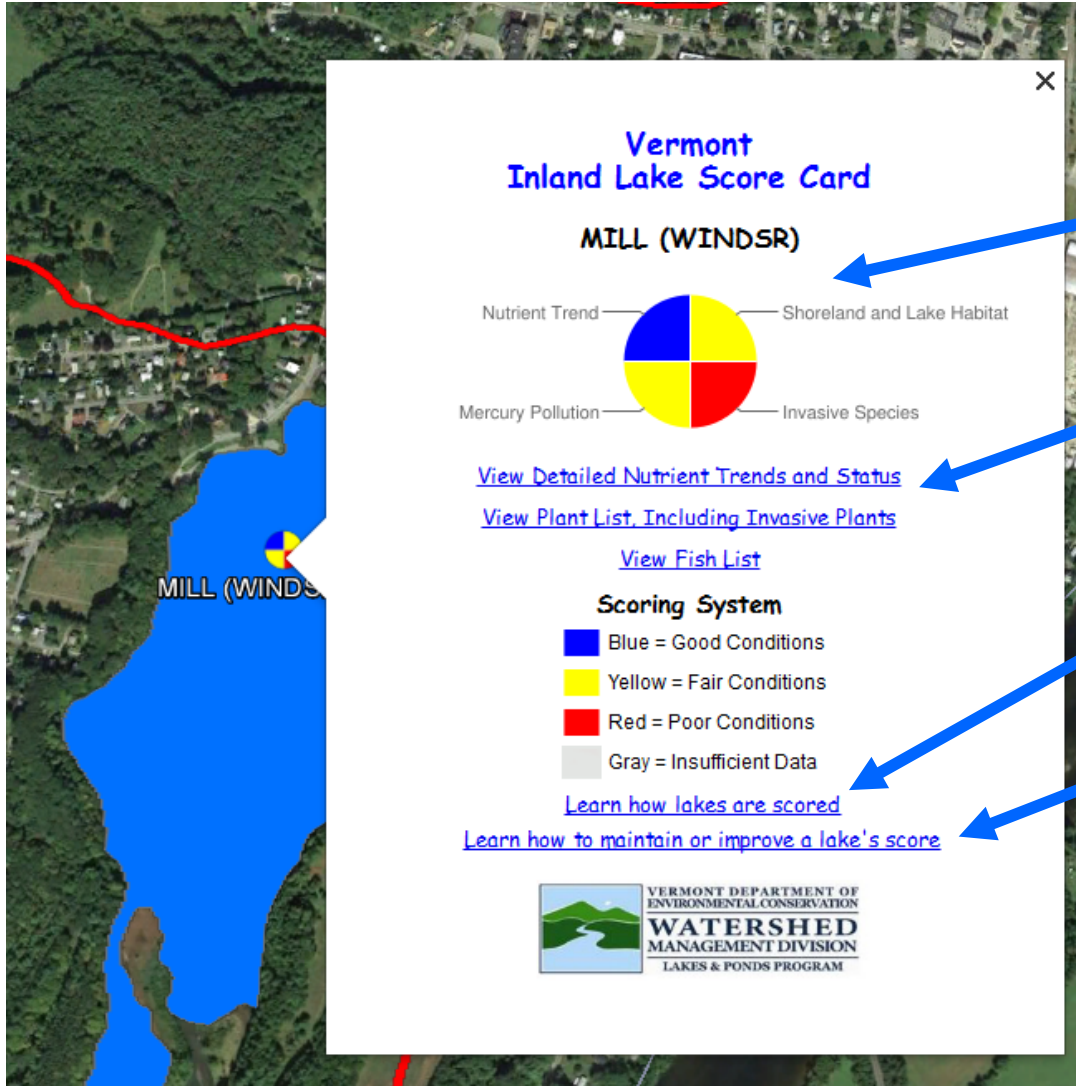
- Blue = Good Conditions
- Yellow = Fair Conditions
- Red = Poor Conditions
- Gray = Insufficient Data

[Learn how lakes are scored](#)

[Learn how to maintain or improve a lake's score](#)



The Score Card



Color-coded evaluation of 4 characteristics

View the underlying data

Learn how scores are calculated

Checklist of steps you can take to protect and improve your lake

Getting There – VT IWIS

<https://dec.vermont.gov/watershed/lakes-ponds/data-maps/scorecard>

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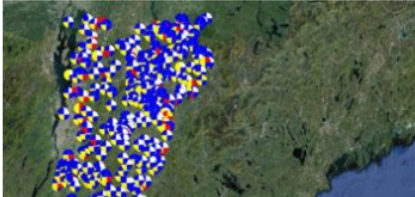
[View Plant List, Including Invasive Plants](#)

[View Fish List](#)

The New Vermont Inland Lake Score Card

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Integrated Watershed Information Service (IWIS) Data Viewer

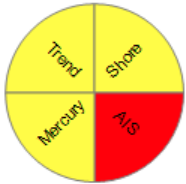
IWIS

Lake ID:

1 of 1

DUNMORE - data through 2018

[Learn How
Lakes Are
Scored](#)



Lake Area:
1039.6 acres

Basin Lake Area Ratio:
13

Max Depth:
32 meters

Mean Spring TP:
8.4 ug/L

Mean Summer TP:
12.7 ug/L

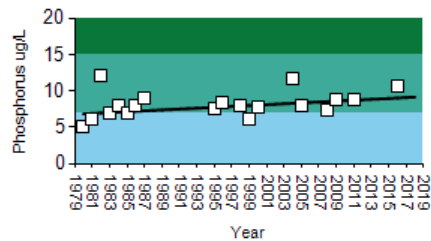
Mean Summer Chla:
3.3 ug/L

Mean Summer Secchi:
6.1 meters



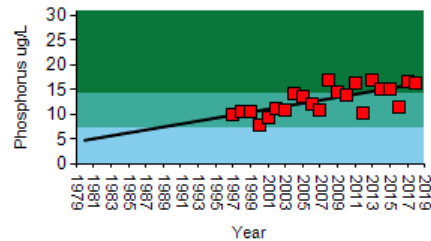
Spring TP Trend: $p = 0.0679$ | CV = 22
Stable

Spring TP Annual Means



Summer TP Trend: $p = 0.0009$ | CV = 22
Highly significantly increasing

Summer TP Annual Means



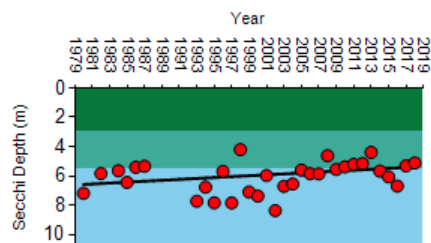
Trend Score: **Fair**

WQ Standards Status: **Altered**

Watershed Score: **Minimally Disturbed**

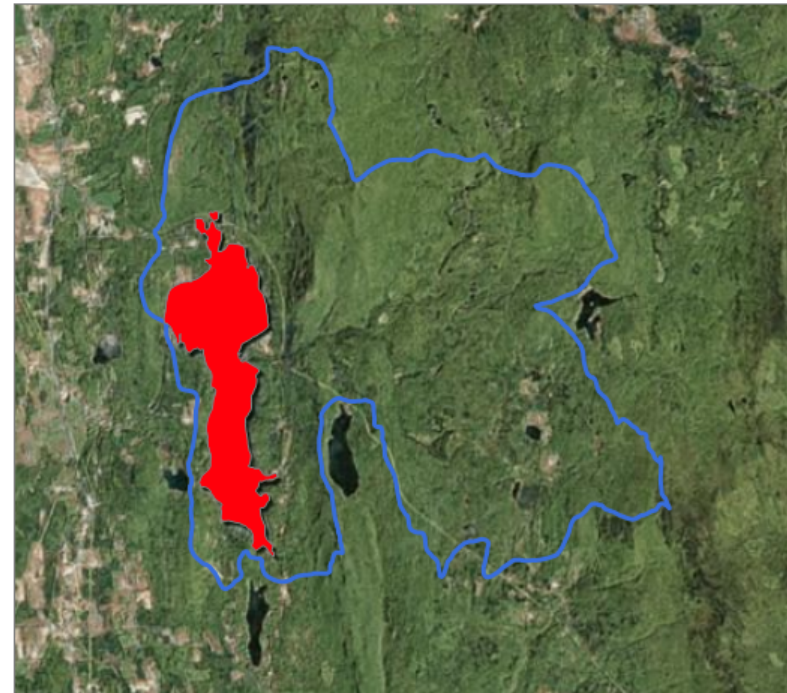
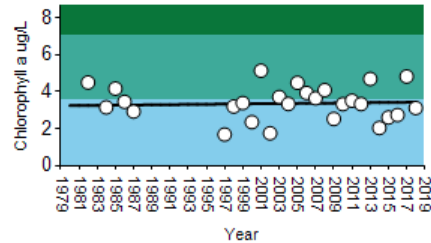
Summer Secchi Trend: $p = 0.0457$ | CV = 17
Significantly decreasing

Summer Secchi Annual Means



Summer Chla Trend: $p = 0.921$ | CV = 27
Stable

Summer Chla Annual Means


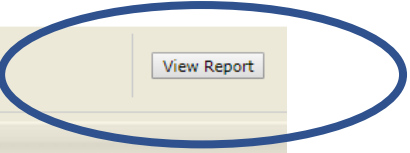


Stresses / Impairments

Altered -- Flow alteration

IWIS Data Viewer

IWIS

Lake ID: ARROWHEAD MOUNTAIN  

1 of 1 Find | Next

ARROWHEAD MOUNTAIN 19 Records

Basin 07 Lake Area = 760 acres

Species	Common Name	Most Recent Record	Rare, Threatened Endangered Info			
			State Rank	Global Rank	State Status	Federal Status
Ceratophyllum demersum	coontail	9/24/1992				
Ceratophyllum sp.	hornwort	9/24/1992				
Elodea canadensis	common elodea	9/24/1992				
Elodea sp.	waterweed	6/22/1994				
Equisetum sp.	horsetail	9/24/1992				
Myriophyllum spicatum	Eurasian watermilfoil	6/22/1994				
Potamogeton amplifolius	big-leaf pondweed	6/22/1994				
Potamogeton natans	floating-leaf pondweed	9/24/1992				
Potamogeton perfoliatus	claspingleaf pondweed	9/24/1992				
Potamogeton pusillus	small pondweed	7/12/1988				
Potamogeton richardsonii	Richard's pondweed	6/22/1994				
Potamogeton robbinsii	Robbin's pondweed	7/12/1988				
Potamogeton sp.	pondweed	9/24/1992				
Potamogeton zosteriformis	flatstem pondweed	9/24/1992				
Sagittaria sp.	arrowhead	6/22/1994				
Scirpus sp.	bulrush	7/12/1988				
Sparganium sp.	bur-reed	9/24/1992				
Vallisneria americana	wild celery or eelgrass	9/24/1992				
Zosterella dubia	water stargrass	9/24/1992				

1. Select your lake from drop down menu

2. Click on “view report”

Lake ID

[View Report](#)

1 of 1 Find | Next

ARROWHEAD MOUNTAIN

13 Records

Basin

Lake Area = acres

Common Name	Scientific Name	Rare, Threatened Endangered Info			
		State Rank	Global Rank	State Status	Federal Status
Brown bullhead	Ameiurus nebulosus				
Banded killifish	Fundulus diaphanus				
Common shiner	Luxilus cornutus				
Golden shiner	Notemigonus crysoleucas				
Logperch	Percina caprodes				
Northern pike	Esox lucius				
Pumpkinseed	Lepomis gibbosus				
Rock bass	Ambloplites rupestris				
Shorthead redhorse	Moxostoma macrolepidotum	S2	G5		
Smallmouth bass	Micropterus dolomieu				
Walleye	Stizostedion vitreum				
White sucker	Catostomus commersoni				
Yellow perch	Perca flavescens				

Viewing the Data

CURTIS - data through 2018

[Learn How
Lakes Are
Scored](#)



Lake Area:
76.2 acres

Basin Lake Area Ratio:
12

Max Depth:
9.5 meters

Mean Spring TP:
22 ug/L

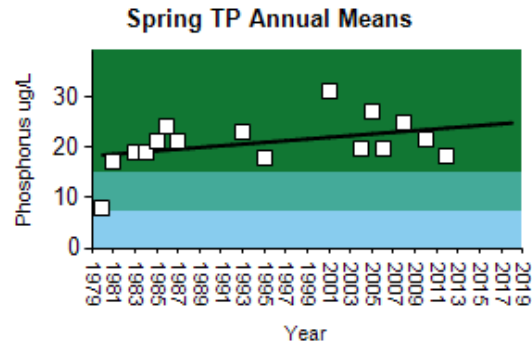
Mean Summer TP:
18.1 ug/L

Mean Summer Chla:
7.2 ug/L

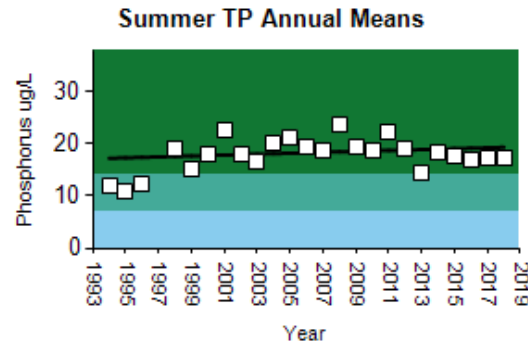
Mean Summer Secchi:
4.9 meters



Spring TP Trend: $p = 0.0865$ | CV = 24
Stable



Summer TP Trend: $p = 0.4718$ | CV = 18
Stable

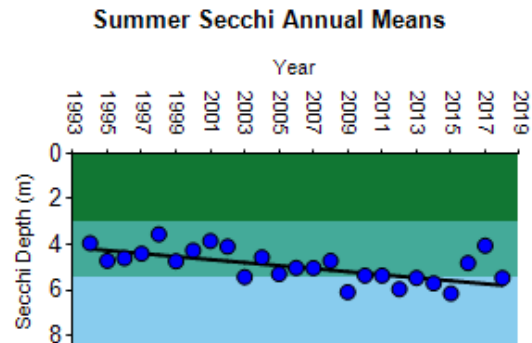


Trend Score: **Good**

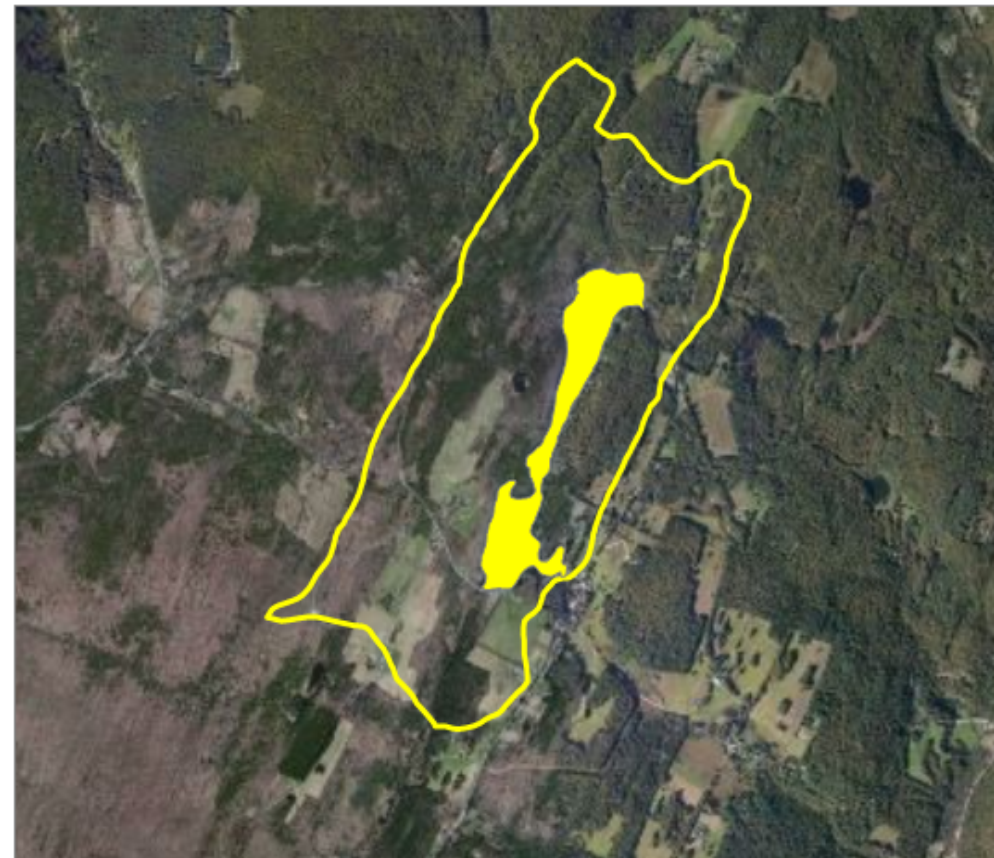
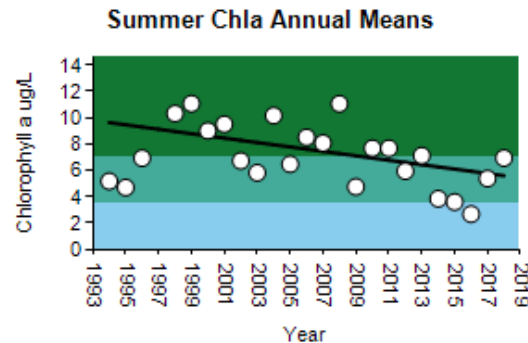
WQ Standards Status: **Stressed**

Watershed Score: **Moderately Disturbed**

Summer Secchi Trend: $p = 0.001$ | CV = 15
Highly significantly increasing



Summer Chla Trend: $p = 0.0593$ | CV = 34
Stable



Stresses / Impairments

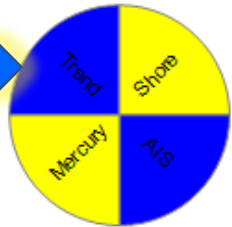
Stressed -- Nutrients

Stressed -- Phosphorus

The Nutrient Trend Score

CURTIS - data through 2018

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Lake Area:
76.2 acres
Basin Lake Area Ratio:
12

Max Depth:
9.5 meters

Mean Spring TP:
22 ug/L

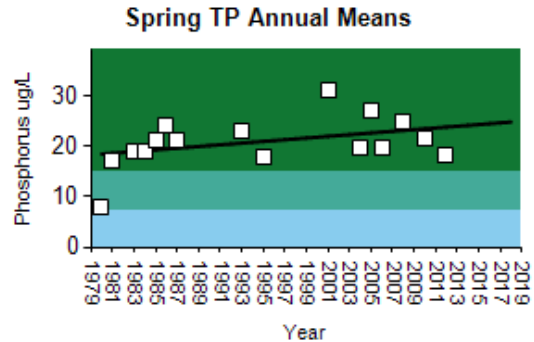
Mean Summer TP:
18.1 ug/L

Mean Summer Chla:
7.2 ug/L

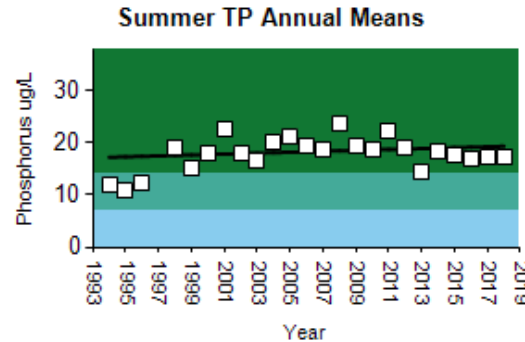
Mean Summer Secchi:
4.9 meters

Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic

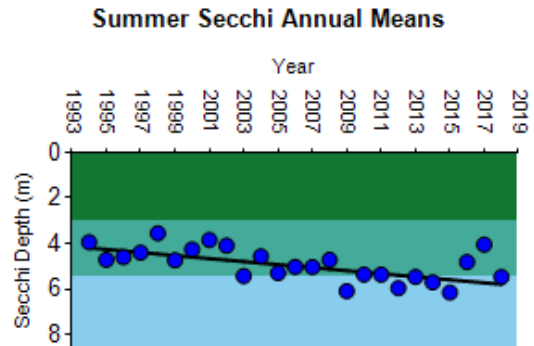
Spring TP Trend: $p = 0.0865$ | CV = 24
Stable



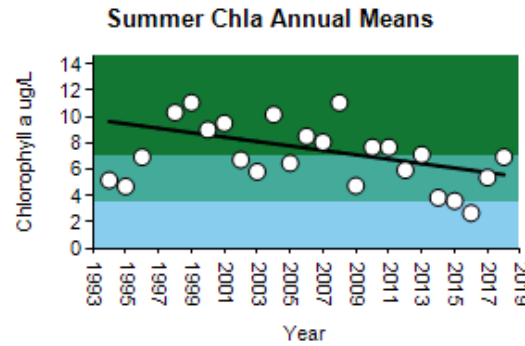
Summer TP Trend: $p = 0.4718$ | CV = 18
Stable



Summer Secchi Trend: $p = 0.001$ | CV = 15
Highly significantly increasing



Summer Chla Trend: $p = 0.0593$ | CV = 34
Stable



Trend Score: **Good**

WQ Standards Status: **Stressed**

Watershed Score: **Moderately Disturbed**

Kendall Tau Rank Correlation
of Annual Means

- Spring P
- Summer P
- Summer Secchi
- Summer Chlorophyll-a

Stresses / Impairments

Stressed -- Nutrients

Stressed -- Phosphorus

Calculating Trend Score

Step 1 – Individual Trend Scores

- Spring TP
- Summer TP
- Summer Chla
- Summer Secchi

Kendall-Tau Statistical Probability	Trend Indication	Score 2 = good, 1 = fair, 0 = poor
> 0.05	Not significant (stable)	2
Between 0.01 and 0.05	Significant -with improving slope -with worsening slope	2 1
< 0.01	Significant -with improving slope -with worsening slope	2 0

Calculating Trend Score

Step 2 – Summer Final Score

Individual Summer Scores (TP, Chla, Secchi)
Summed and Rescaled from 0 to 2

Sum of Individual Summer Scores	Final Adjusted Summer Score
6	2
4, 5	1
< 4	0

Calculating Trend Score

Step 3 –Final Score

Spring TP Score + Summer Score

-or-

2 x Spring TP Score

Final Numerical Score	Trend Condition Score
4	Good
2 or 3	Fair
< 2	Poor

Example: Fair Trend Score

Summer Score (0 + 2 + 2) = 5 | Adjusted Summer Score = 1 | Spring TP Score + Adj. Summer Score (1 + 1) = 2 **Fair**

CASPIAN - data through 2018

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Lake Area:
789.8 acres

Basin Lake Area Ratio:
5

Max Depth:
43.3 meters

Mean Spring TP:
7.6 ug/L

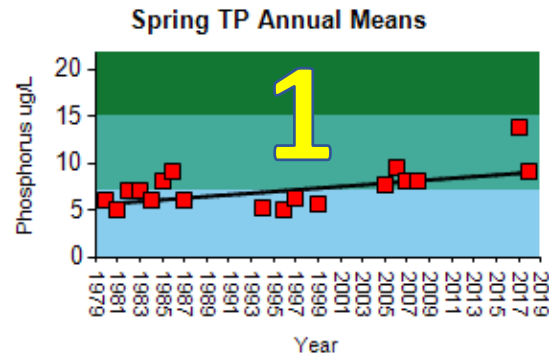
Mean Summer TP:
9.2 ug/L

Mean Summer Chla:
2.1 ug/L

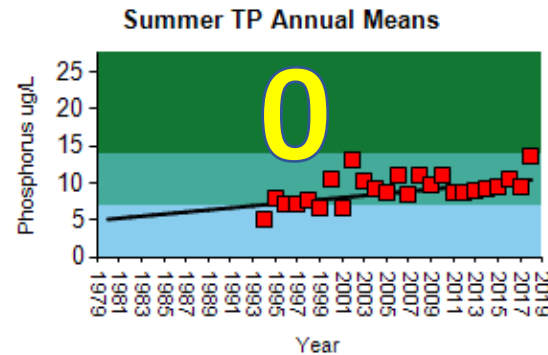
Mean Summer Secchi:
7.7 meters



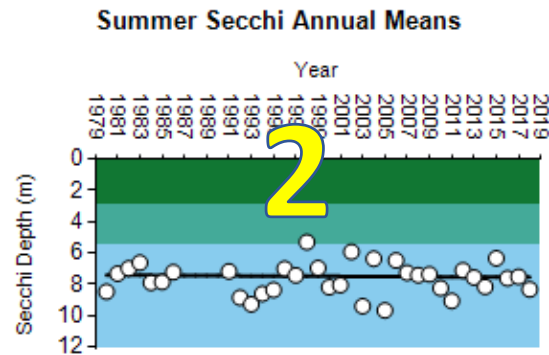
Spring TP Trend: $p = 0.0182$ | $CV = 29$
Significantly increasing



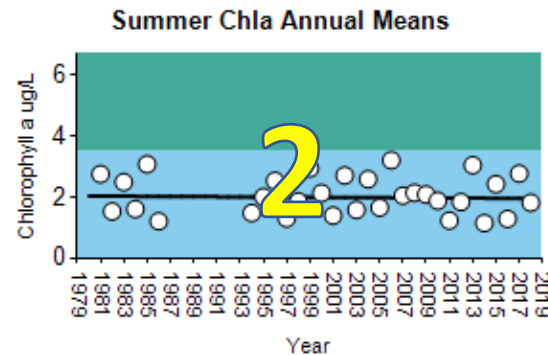
Summer TP Trend: $p = 0.005$ | $CV = 22$
Highly significantly increasing



Summer Secchi Trend: $p = 0.82$ | $CV = 13$
Stable



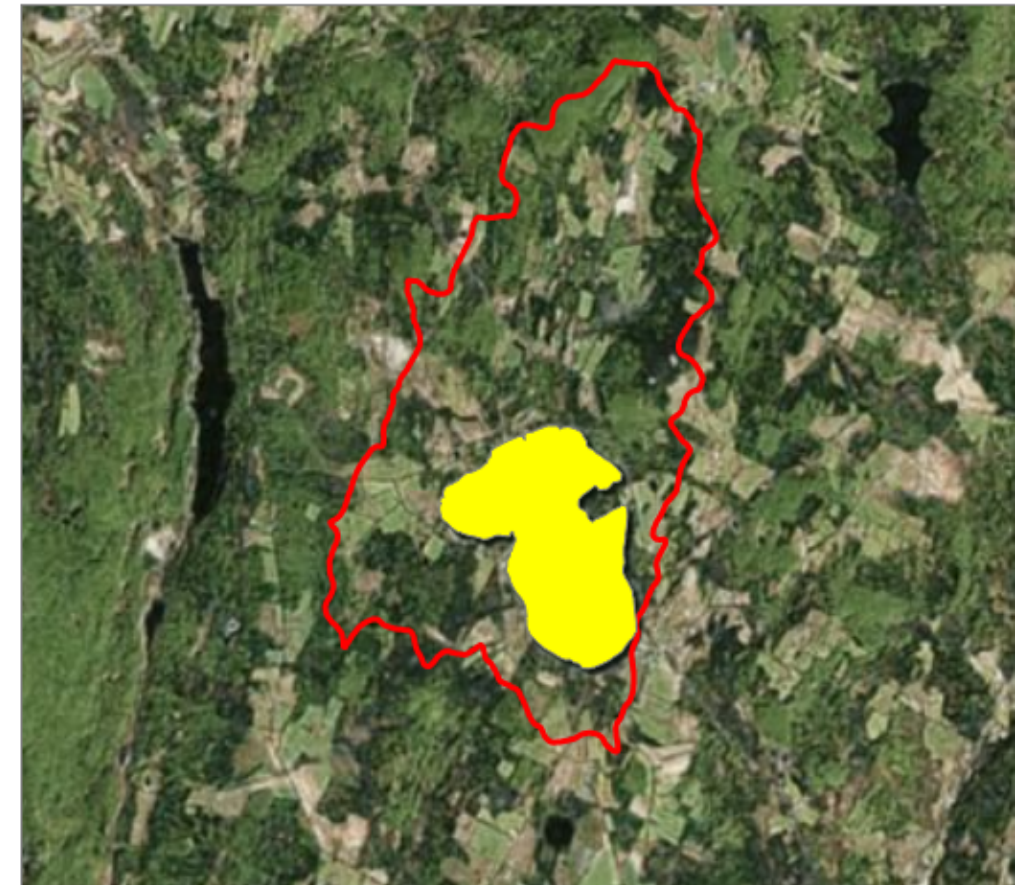
Summer Chla Trend: $p = 0.8517$ | $CV = 30$
Stable



Trend Score: **Fair**

WQ Standards Status: **Stressed**

Watershed Score: **Highly Disturbed**



Stresses / Impairments

Example: **Poor** Trend Score

Summer Score (0 + 2 + 2) = 5 | Adjusted Summer Score = 1 | Spring TP Score + Adj. Summer Score (0 + 1) = 1 **Poor**

WILLOUGHBY - data through 2018

[Learn How
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Lake Area:
1863.9 acres

Basin Lake Area Ratio:
7

Max Depth:
93.9 meters

Mean Spring TP:
7.5 ug/L

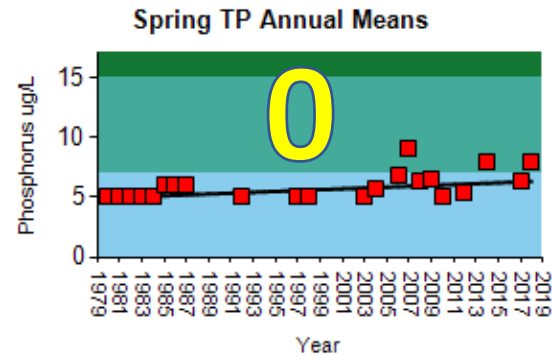
Mean Summer TP:
10.9 ug/L

Mean Summer Chla:
1.3 ug/L

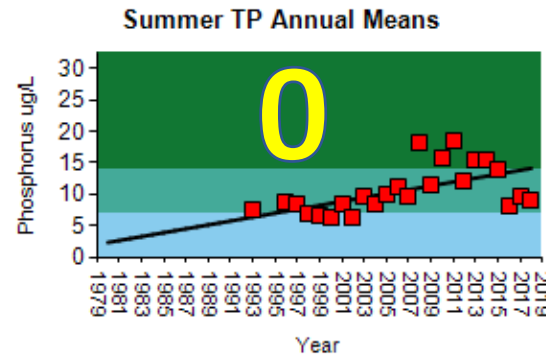
Mean Summer Secchi:
8 meters



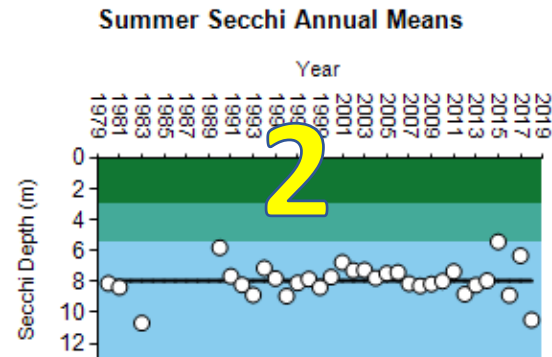
Spring TP Trend: $p = 0.0015$ | $CV = 20$
Highly significantly increasing



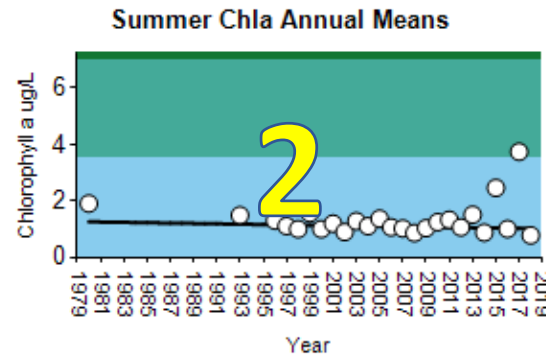
Summer TP Trend: $p = 0.006$ | $CV = 35$
Highly significantly increasing



Summer Secchi Trend: $p = 0.8199$ | $CV = 14$
Stable



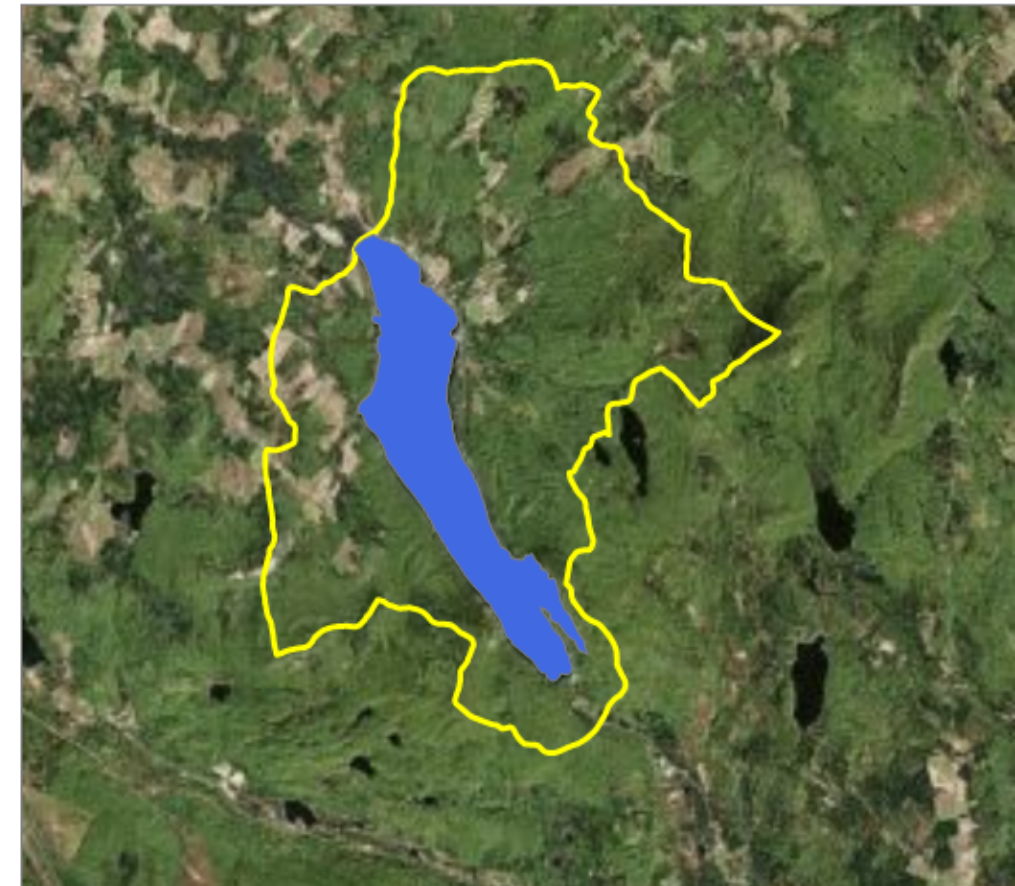
Summer Chla Trend: $p = 0.5187$ | $CV = 48$
Stable



Trend Score: **Poor**

WQ Standards Status: **Meets Standards**

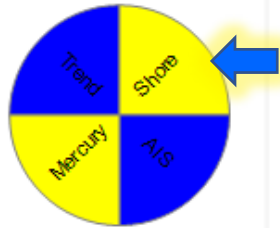
Watershed Score: **Moderately Disturbed**



The Shoreland and Lake Habitat Score

CURTIS - data through 2018

[Learn How
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Lake Area:
76.2 acres

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Max Depth:
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Mean Spring TP:
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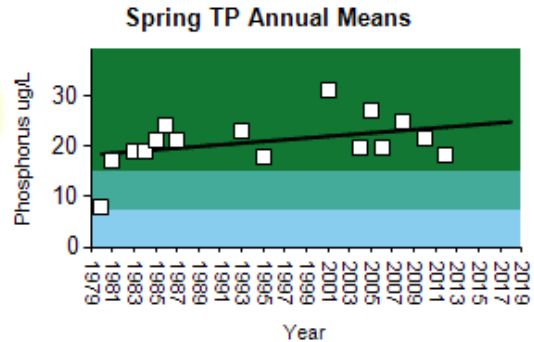
Mean Summer TP:
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7.2 ug/L

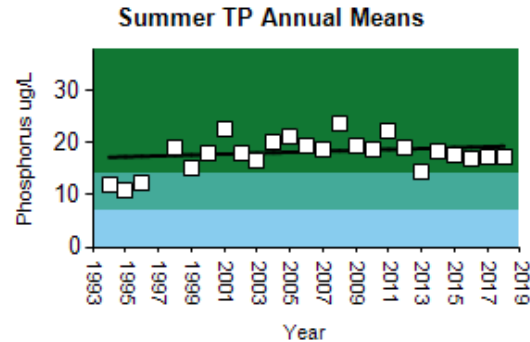
Mean Summer Secchi:
4.9 meters

Hypereutrophic
 Eutrophic
 Mesotrophic
 Oligotrophic

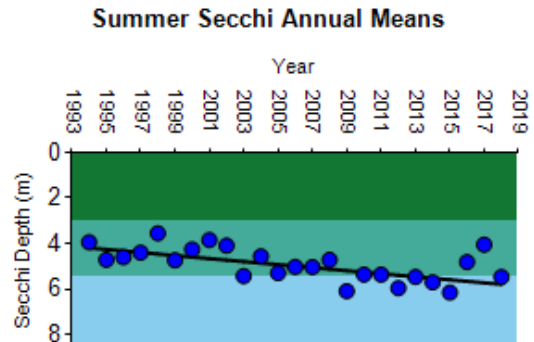
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Stable



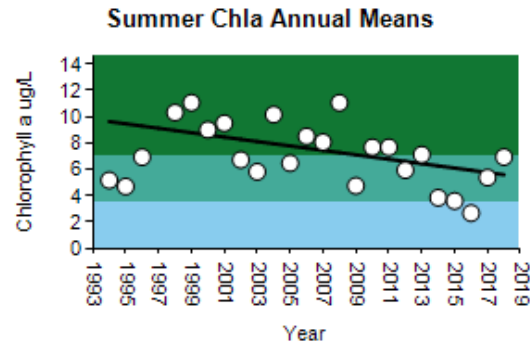
Summer TP Trend: $p = 0.4718$ | CV = 18
Stable



Summer Secchi Trend: $p = 0.001$ | CV = 15
Highly significantly increasing



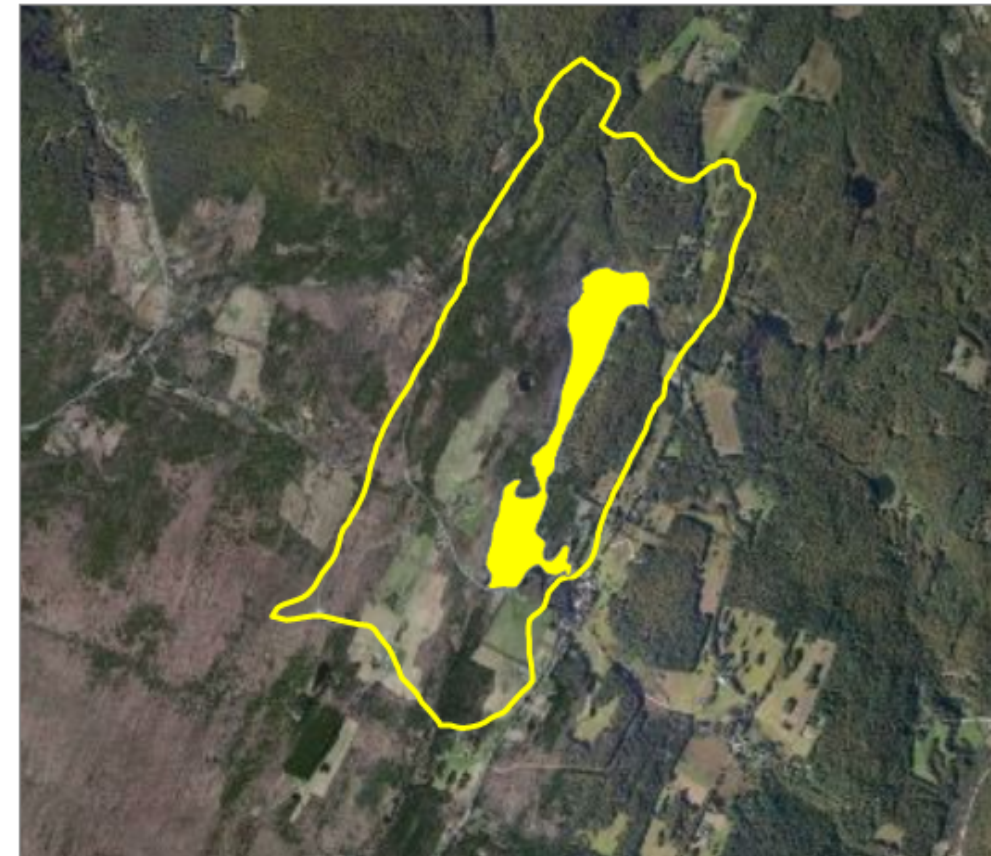
Summer Chla Trend: $p = 0.0593$ | CV = 34
Stable



Trend Score: **Good**

WQ Standards Status: **Stressed**

Watershed Score: **Moderately Disturbed**

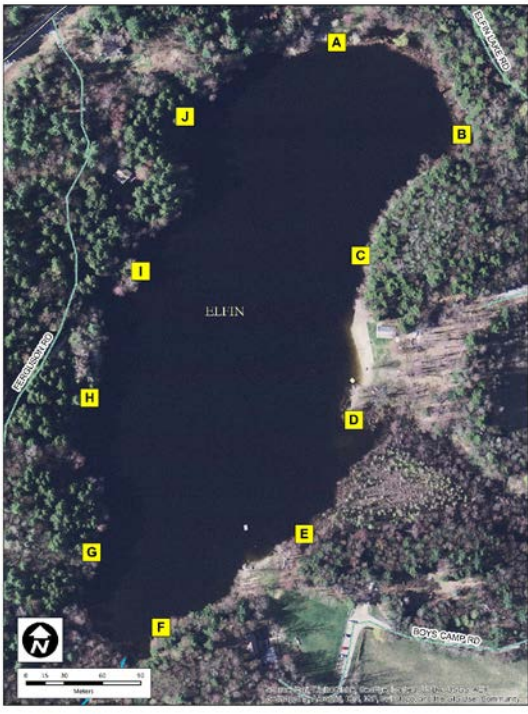


Stresses / Impairments

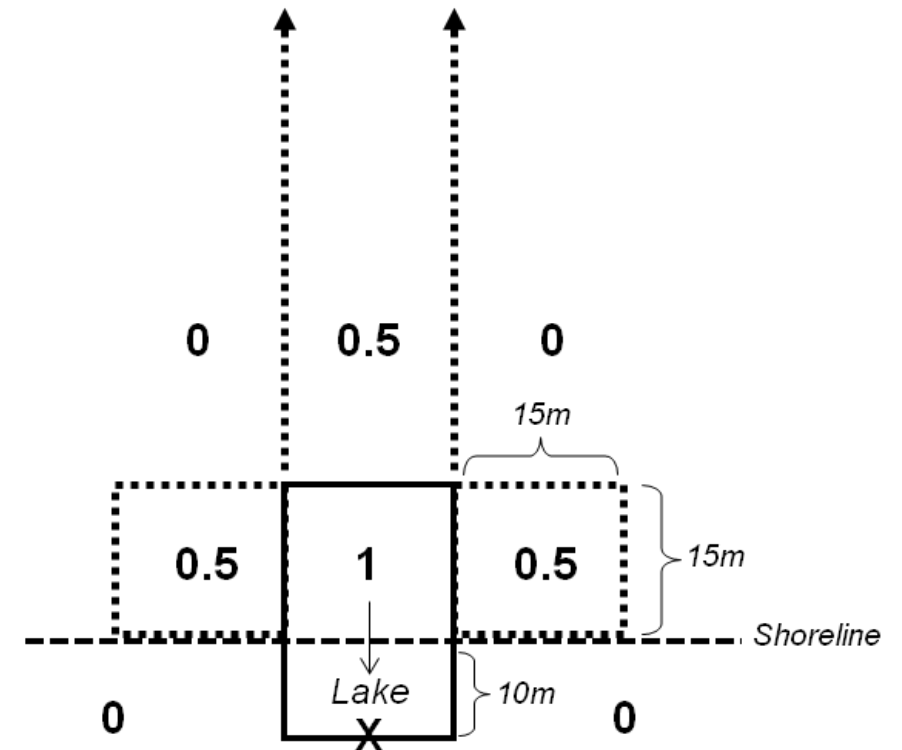
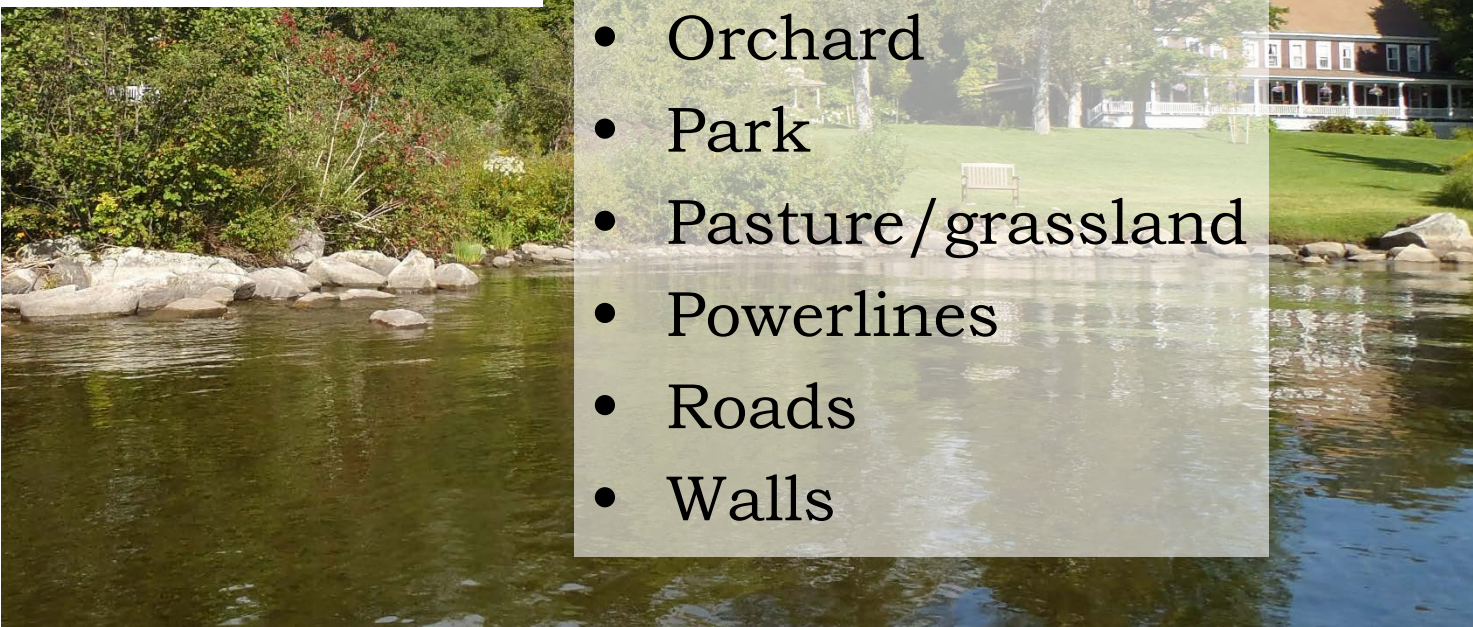
Stressed -- Nutrients

Stressed -- Phosphorus

NLA Lakeshore Disturbance Index



- Buildings
- Commercial
- Crops
- Docks
- Landfill/trash
- Lawn
- Orchard
- Park
- Pasture/grassland
- Powerlines
- Roads
- Walls



X = boat location

NLA Lakeshore Disturbance Index

Mean of the Proximity Weighted
Tally of Disturbances at the 10
Random Sites

Proportion of the 10 Sites
That Have at Least One
Disturbance

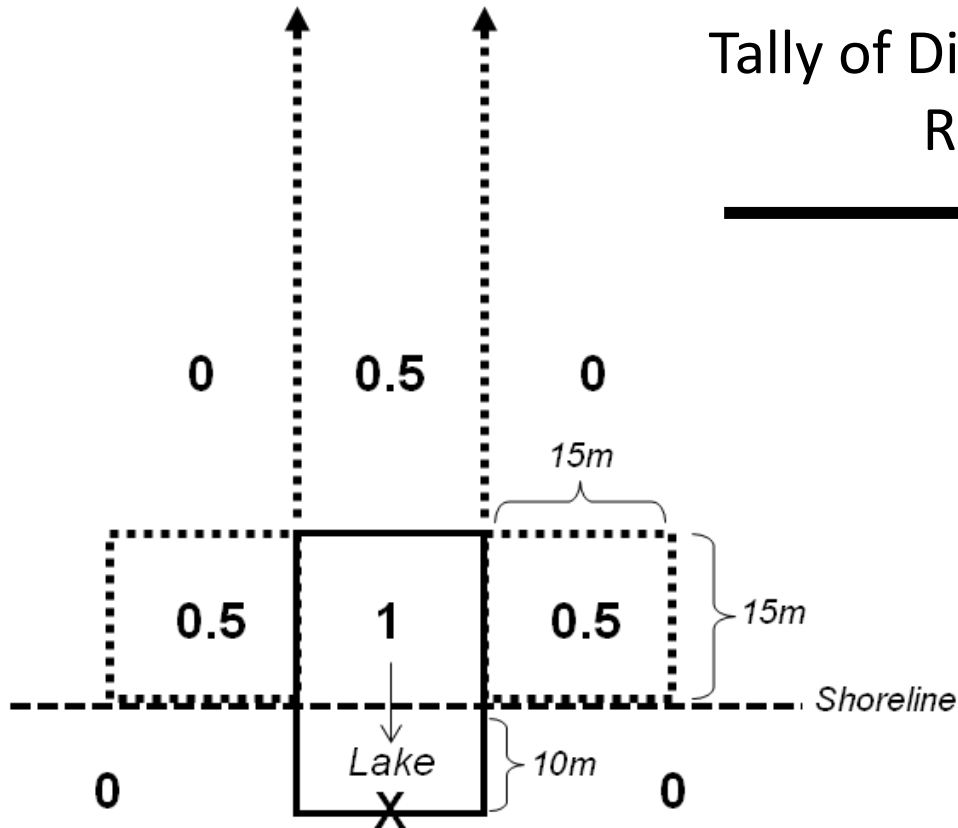
+

2



INTENSITY + EXTENT

2



X = boat location

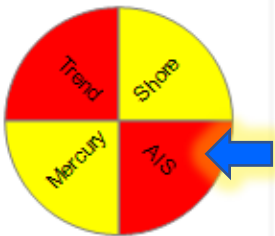
Scoring Shoreland and Lake Habitat

Lakeshore Disturbance Index	Shoreland and Lake Habitat Score
≤ 0.25	Good
0.25 – 0.75	Fair
≥ 0.75	Poor

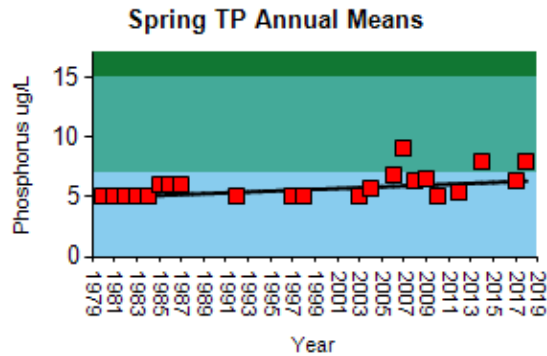
The Aquatic Invasive Species Score

WILLOUGHBY - data through 2018

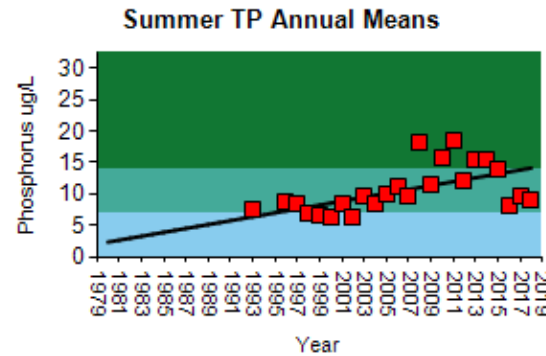
[Learn How
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Spring TP Trend: $p = 0.0015$ | $CV = 20$
Highly significantly increasing



Summer TP Trend: $p = 0.006$ | $CV = 35$
Highly significantly increasing



Trend Score: **Poor**

WQ Standards Status: **Meets Standards**

Watershed Score: **Moderately Disturbed**

Lake Area:
1863.9 acres

Basin Lake Area Ratio:
7

Max Depth:
93.9 meters

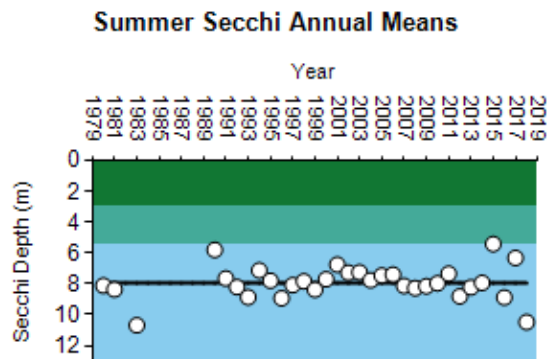
Mean Spring TP:
7.5 ug/L

Mean Summer TP:
10.9 ug/L

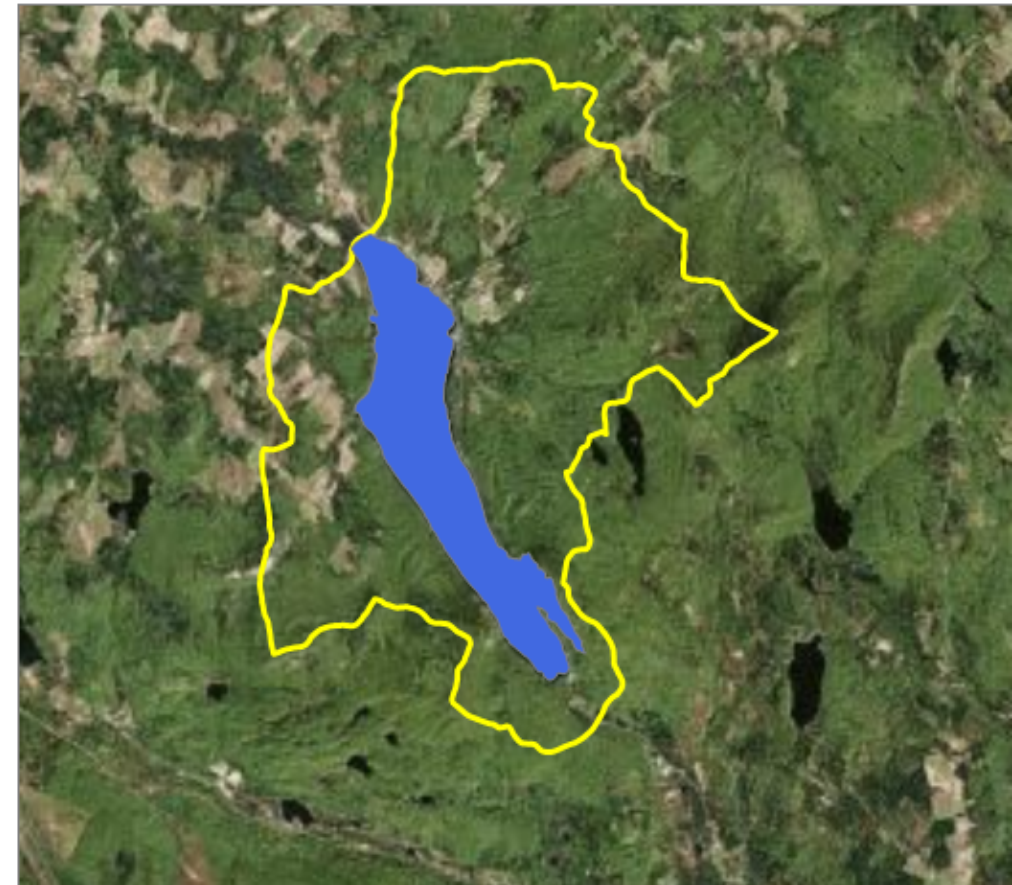
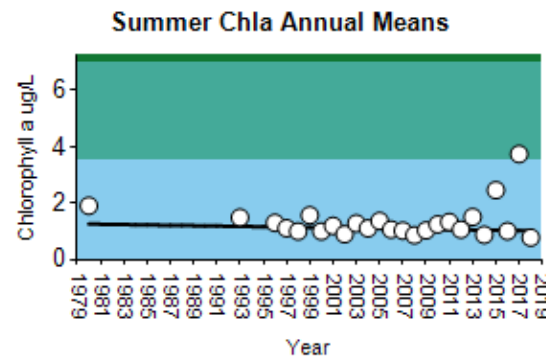
Mean Summer Chla:
1.3 ug/L

Mean Summer Secchi:
8 meters

Summer Secchi Trend: $p = 0.8199$ | $CV = 14$
Stable



Summer Chla Trend: $p = 0.5187$ | $CV = 48$
Stable



Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic

Scoring Aquatic Invasive Species

Eurasian watermilfoil
Variable leaf watermilfoil
Water chestnut
Zebra mussel

Alewife
Rusty crayfish
Spiny water flea
Asian clam

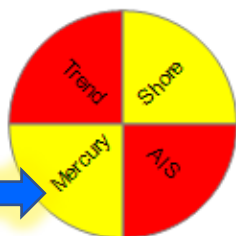
AIS Status	AIS Score
No known invasive species in lake	GOOD
At least one invasive species confirmed in lake	POOR

Eurasian watermilfoil - Lake Hortonia, VT

The Mercury in Fish Score

WILLOUGHBY - data through 2018

[Learn How
Lakes Are
Scored](#)



Lake Area:
1863.9 acres

Basin Lake Area Ratio:
7

Max Depth:
93.9 meters

Mean Spring TP:
7.5 ug/L

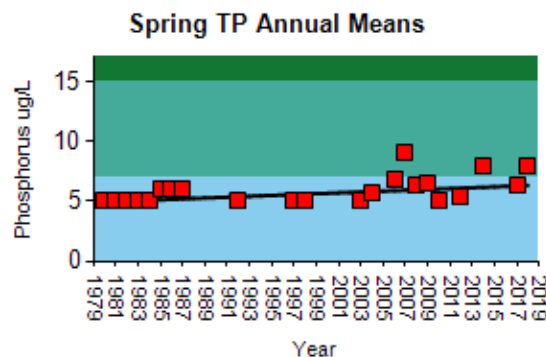
Mean Summer TP:
10.9 ug/L

Mean Summer Chla:
1.3 ug/L

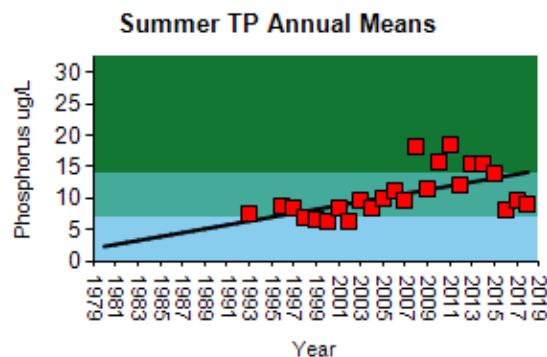
Mean Summer Secchi:
8 meters

Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic

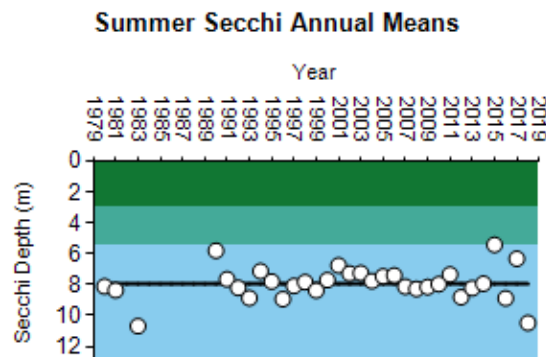
Spring TP Trend: $p = 0.0015$ | CV = 20
Highly significantly increasing



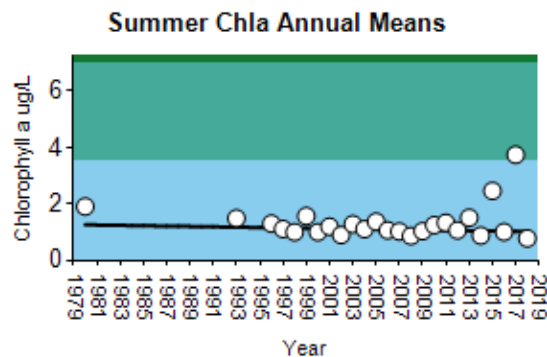
Summer TP Trend: $p = 0.006$ | CV = 35
Highly significantly increasing



Summer Secchi Trend: $p = 0.8199$ | CV = 14
Stable



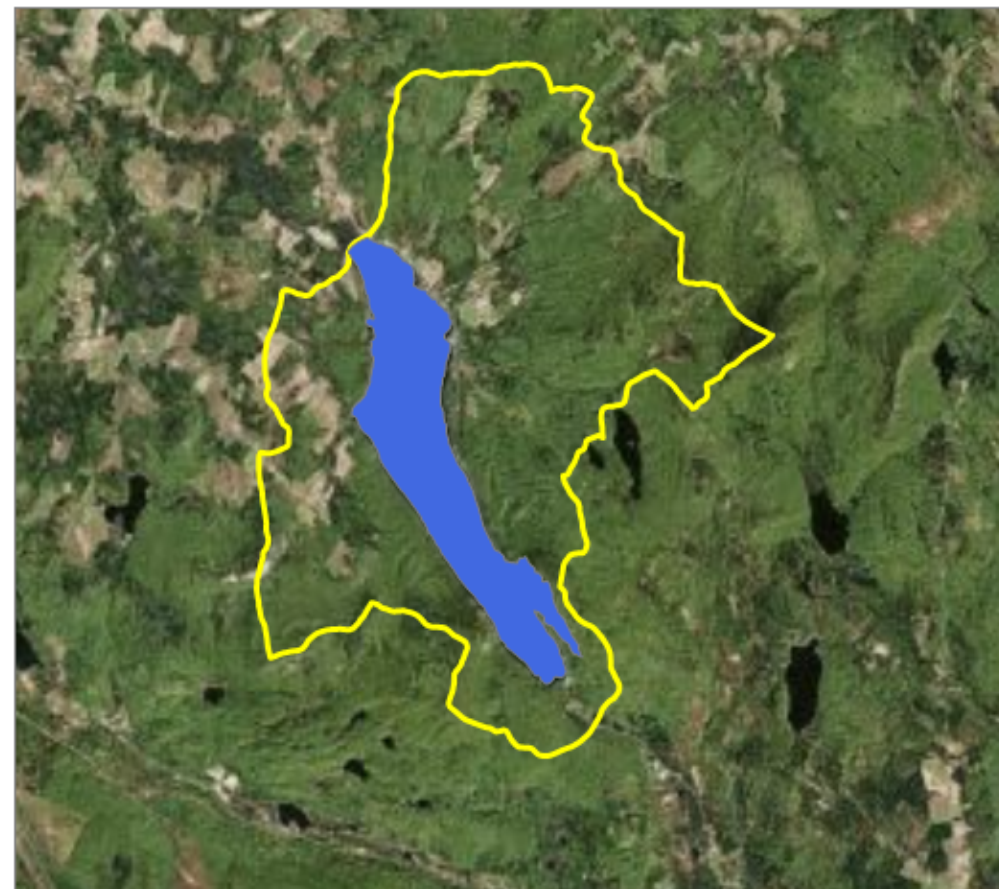
Summer Chla Trend: $p = 0.5187$ | CV = 48
Stable



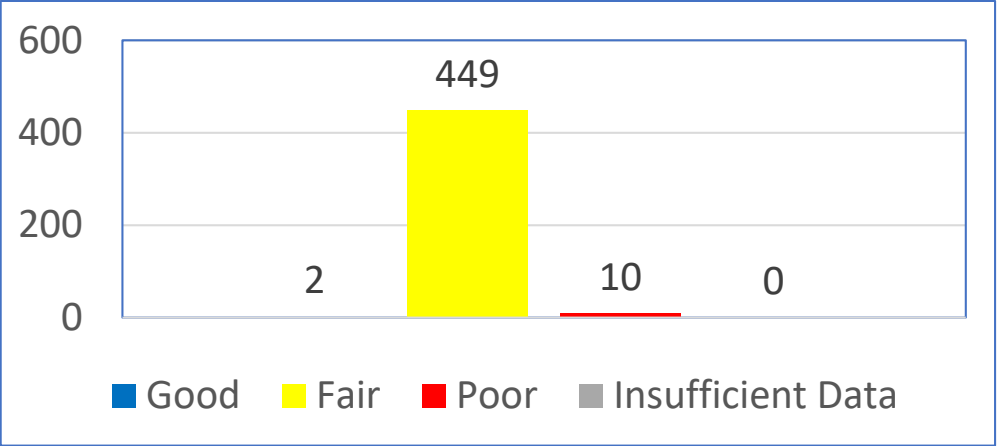
Trend Score: **Poor**

WQ Standards Status: **Meets Standards**

Watershed Score: **Moderately Disturbed**



Scoring Mercury in Fish



Mercury Thresholds

	Mercury Fish Tissue Contamination Score
low probability of Hg accumulation in fish tissue	Good
Hg accumulation in fish tissue is likely	Fair
Hg in fish tissue exceeds EPA guidelines	Poor

Based on a 2004 study conducted by the VT DEC

Water Quality Standards Status Score

CURTIS - data through 2018

[Learn How
Lakes Are
Scored](#)



Lake Area:
76.2 acres
Basin Lake Area Ratio:
12

Max Depth:
9.5 meters

Mean Spring TP:
22 ug/L

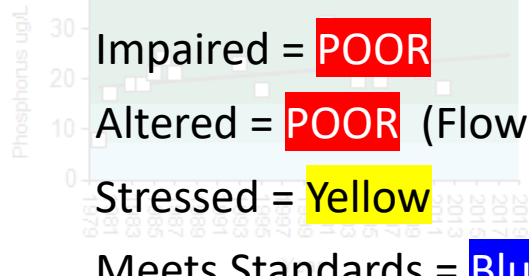
Mean Summer TP:
18.1 ug/L

Mean Summer Chla:
7.2 ug/L

Mean Summer Secchi:
4.9 meters

Spring TP Trend: $p = 0.0865$ | CV = 24
Stable

Summer TP Trend: $p = 0.4718$ | CV = 18
Stable



Impaired = **POOR**

Altered = **POOR** (Flow Alteration only)

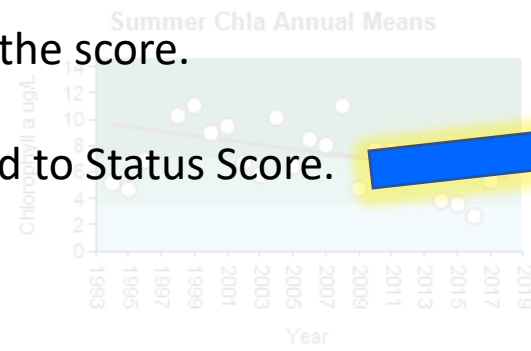
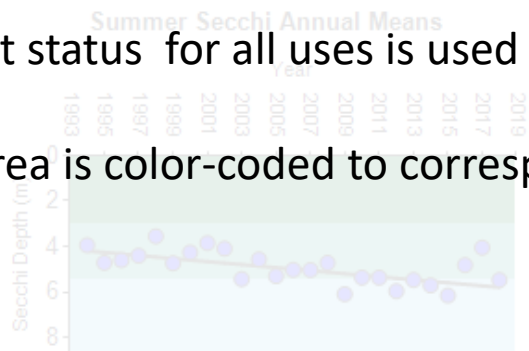
Stressed = **Yellow**

Meets Standards = **Blue**

Insufficient Data = **Gray**

Summer Secchi Trend: $p = 0.0001$ | CV = 34
Highly significantly increasing

Summer Chla Trend: $p = 0.0593$ | CV = 34
Stable



Trend Score: Good

WQ Standards Status: Stressed

Watershed Score: Moderately Disturbed

➤ Directly related to water quality assessment (ADB)

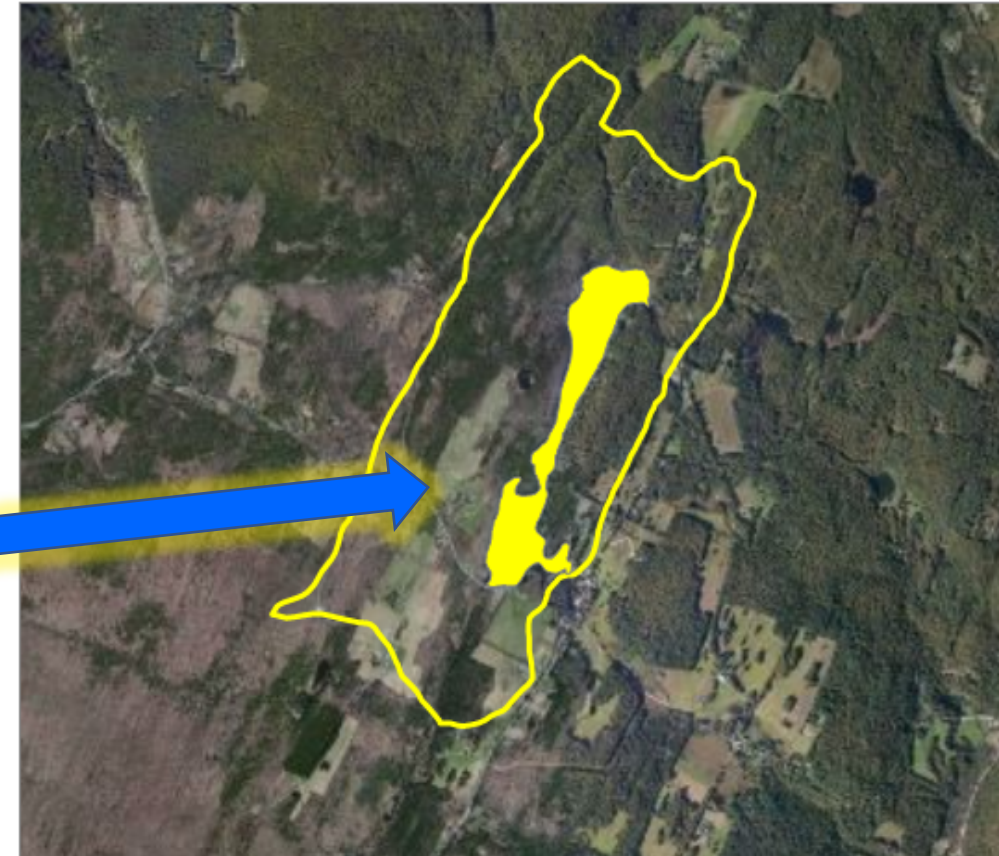
➤ Poorest status for all uses is used for the score.

➤ Lake area is color-coded to correspond to Status Score.

Stresses / Impairments

Stressed -- Nutrients

Stressed -- Phosphorus



Water Quality Standards Status Score

CURTIS - data through 2018

[Learn How
Lakes Are
Scored](#)



Lake Area:
76.2 acres
Basin Lake Area Ratio:
12

Max Depth:
9.5 meters

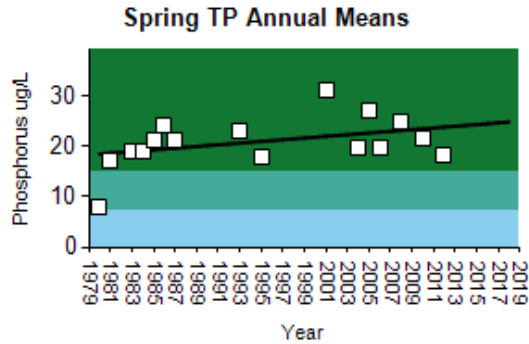
Mean Spring TP:
22 ug/L

Mean Summer TP:
18.1 ug/L

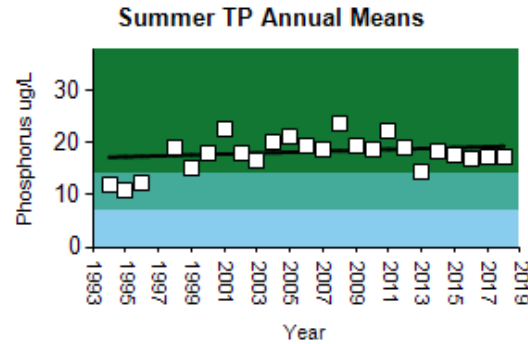
Mean Summer Chla:
7.2 ug/L

Mean Summer Secchi:
4.9 meters

Spring TP Trend: $p = 0.0865$ | CV = 24
Stable



Summer TP Trend: $p = 0.4718$ | CV = 18
Stable

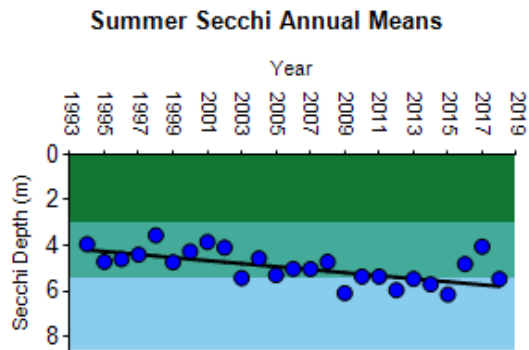


Trend Score: **Good**

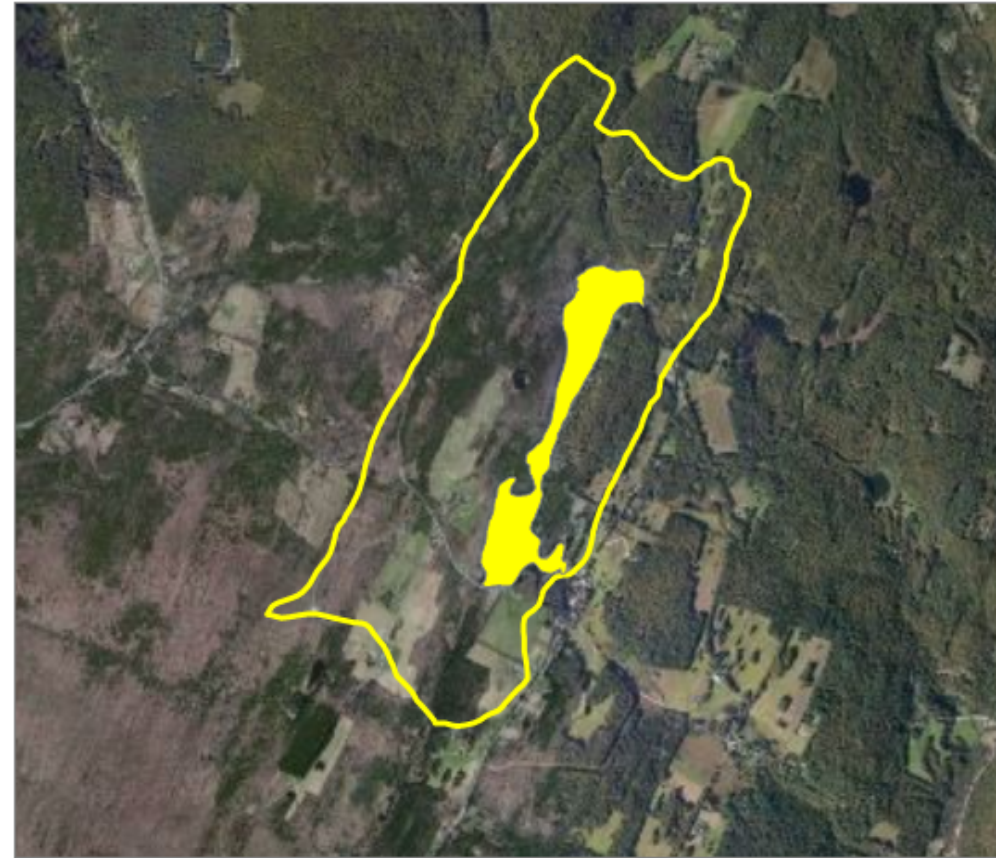
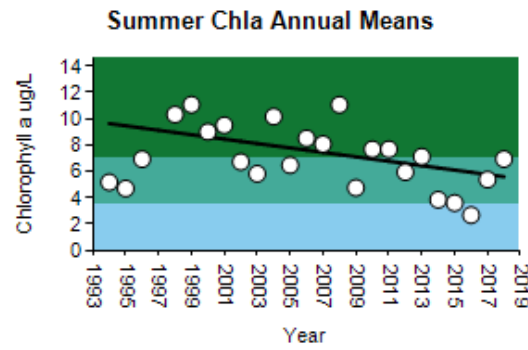
WQ Standards Status: **Stressed**

Watershed Score: **Moderately Disturbed**

Summer Secchi Trend: $p = 0.001$ | CV = 15
Highly significantly increasing



Summer Chla Trend: $p = 0.0593$ | CV = 34
Stable



Stresses / Impairments

Stressed -- Nutrients

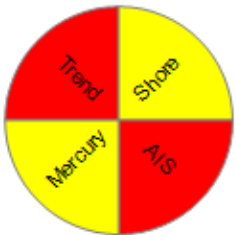
Stressed -- Phosphorus

Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic

Water Quality Standards Status Score

WILLOUGHBY - data through 2018

[Learn How
Lakes Are
Scored](#)



Lake Area:
1863.9 acres

Basin Lake Area Ratio:
7

Max Depth:
93.9 meters

Mean Spring TP:
7.5 ug/L

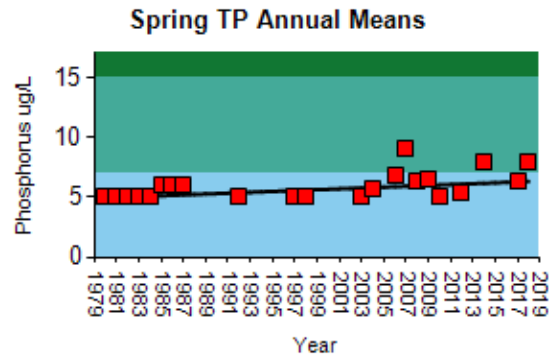
Mean Summer TP:
10.9 ug/L

Mean Summer Chla:
1.3 ug/L

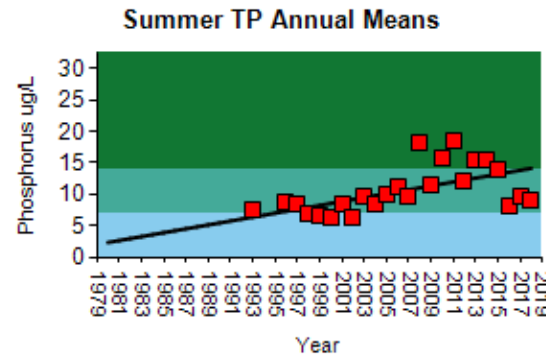
Mean Summer Secchi:
8 meters



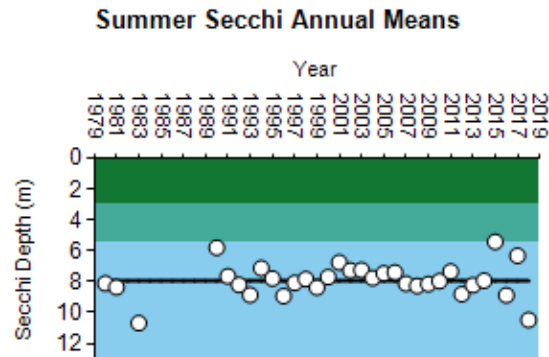
Spring TP Trend: $p = 0.0015$ | $CV = 20$
Highly significantly increasing



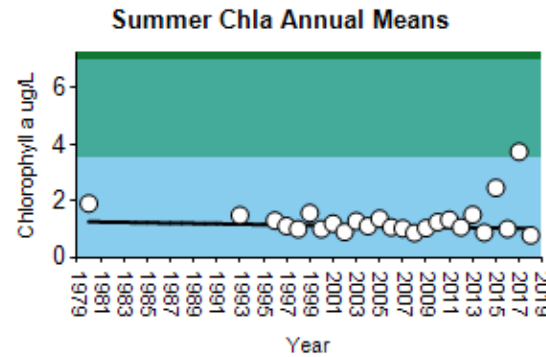
Summer TP Trend: $p = 0.006$ | $CV = 35$
Highly significantly increasing



Summer Secchi Trend: $p = 0.8199$ | $CV = 14$
Stable



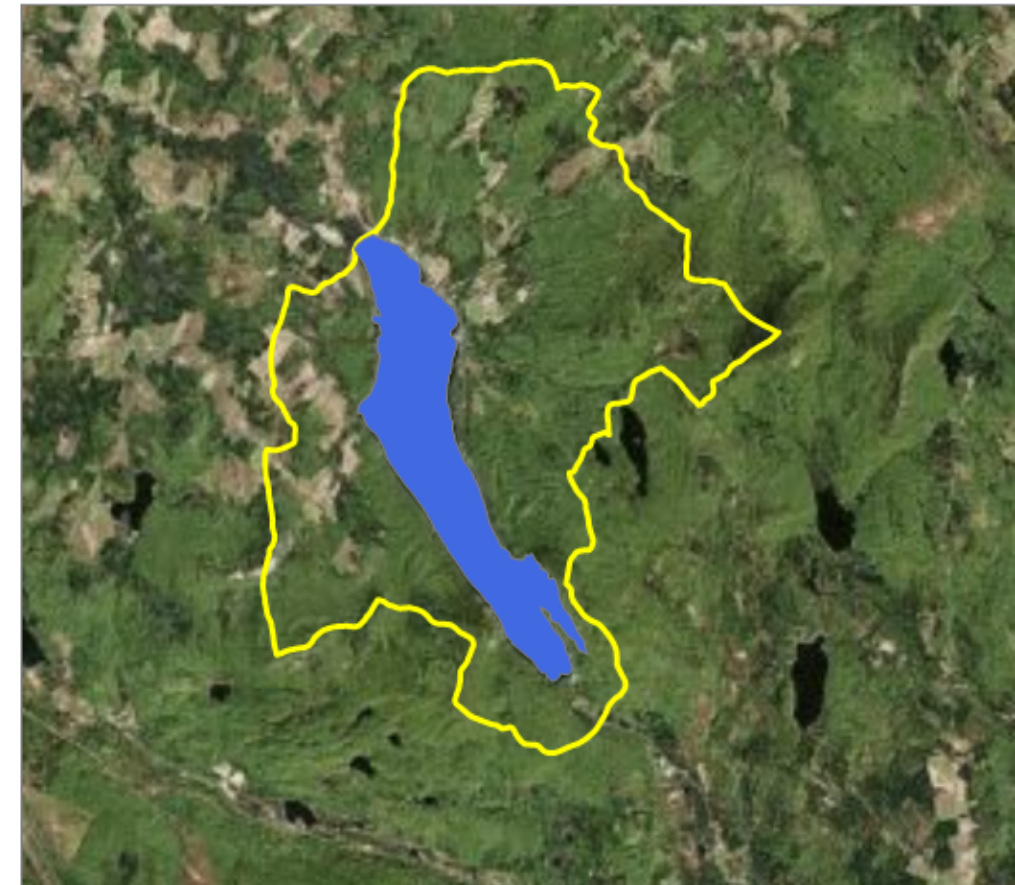
Summer Chla Trend: $p = 0.5187$ | $CV = 48$
Stable



Trend Score: **Poor**

WQ Standards Status: **Meets Standards**

Watershed Score: **Moderately Disturbed**



The Watershed Disturbance Score

CURTIS - data through 2018

[Learn How Lakes Are Scored](#)

Landscape Development Intensity Index (Brown and Vivas (2005))

- GIS imagery is used to quantify various land uses in the watershed
- Each land use type is weighted according to the degree to it's intensity – i.e. the degree to which it can negatively influence water quality
- Final Index is a weighted average of the various land use areas and their disturbance intensities

Lake Area:
76.2 acres

Basin
12

Max
9.5 meters

Mean Spring TP:
22 ug/L

Mean Summer TP:
18.1 ug/L

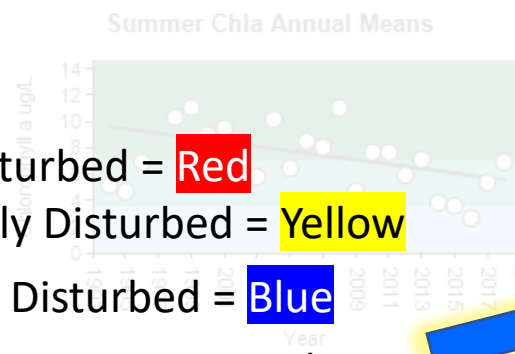
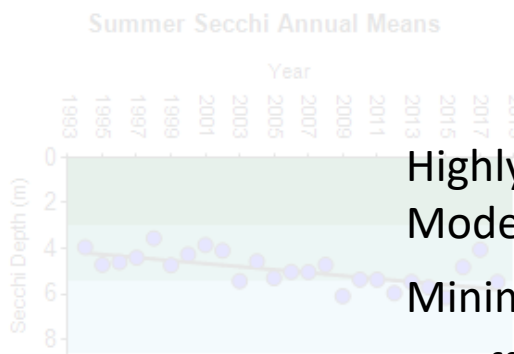
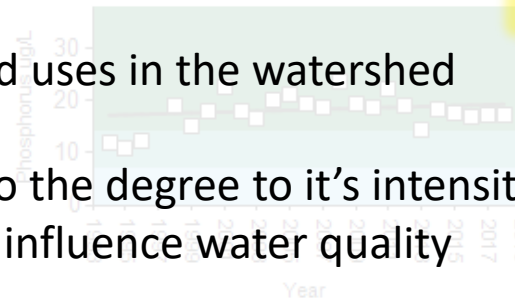
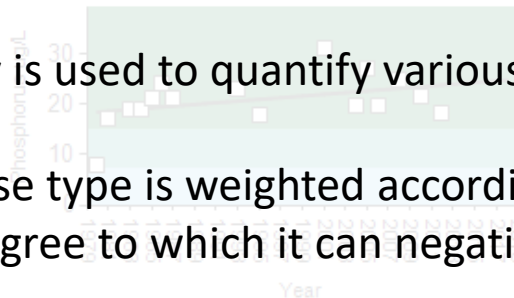
Mean Summer Chla:
7.2 ug/L

Mean Summer Secchi:
4.9 meters

Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic

Spring TP Trend: $p = 0.0865$ | CV = 24
Stable

Summer TP Trend: $p = 0.4718$ | CV = 18
Stable

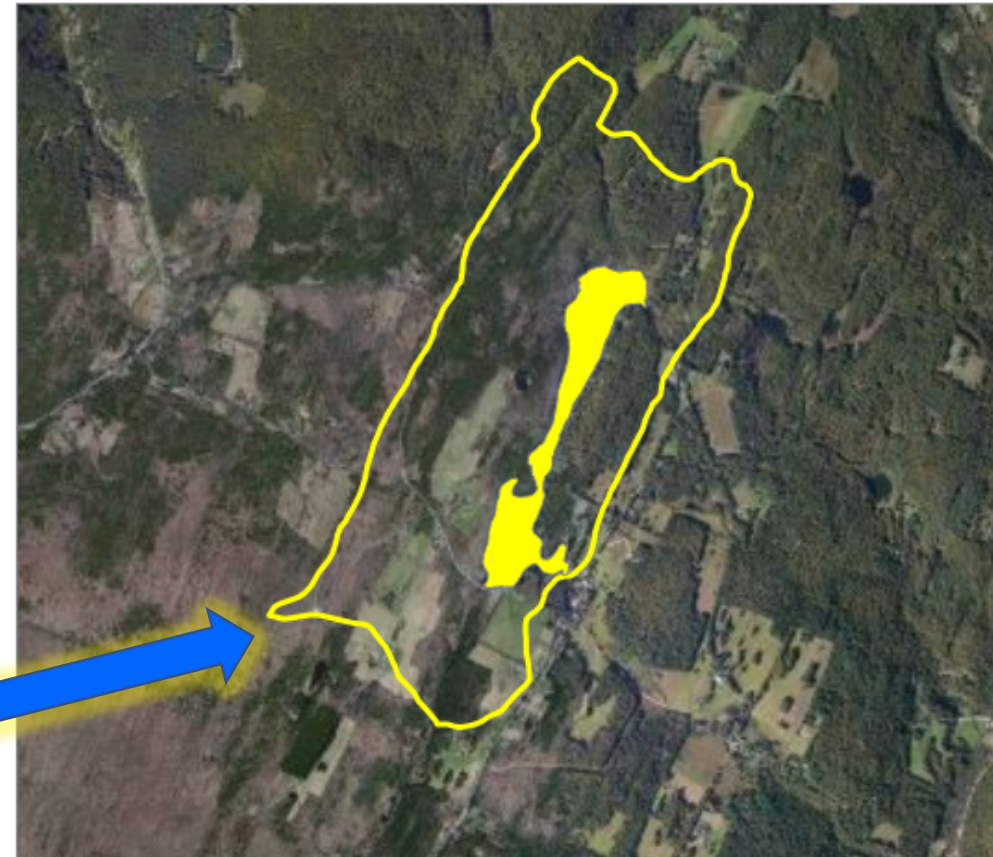


Highly Disturbed = Red
Moderately Disturbed = Yellow
Minimally Disturbed = Blue
Insufficient Data = No outline

Trend Score: Good

WQ Standards Status: Stressed

Watershed Score: Moderately Disturbed

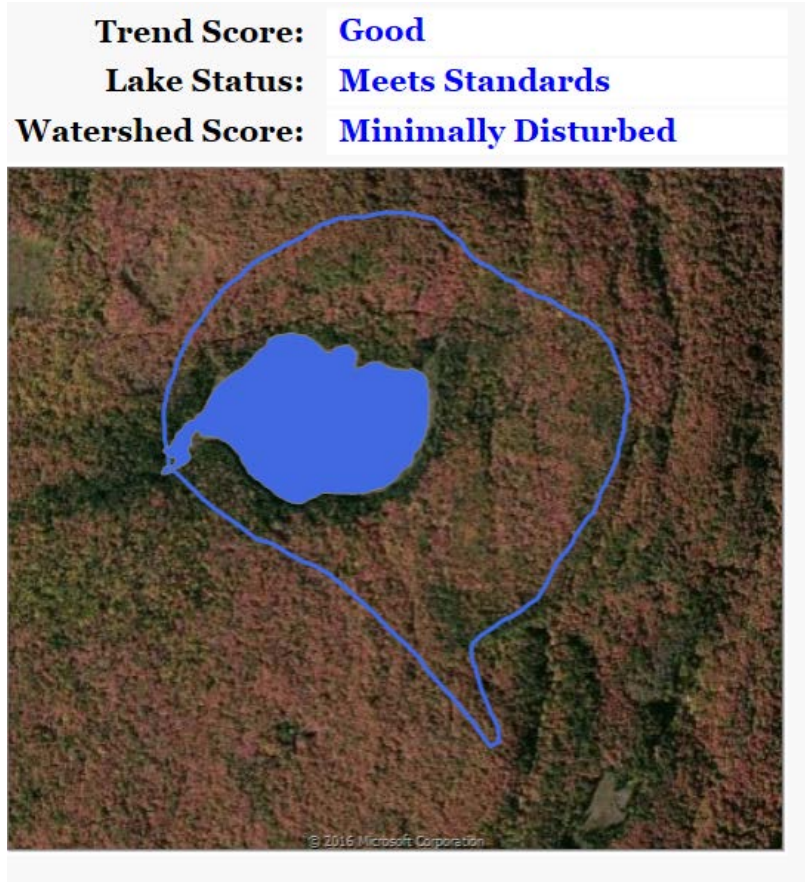


Stresses / Impairments

Stressed -- Nutrients

Stressed -- Phosphorus

Watershed Disturbance Index



NLCD Land Class	Description	Landscape Development Intensity (LDI) Coefficient
11	Open water	1
21	Developed, open space	6.92
22	Developed, low intensity	7.47
23	Developed, medium intensity	7.55
24	Developed, high intensity	9.42
31	Barren land	8.32
41	Deciduous forest	1
42	Evergreen forest	1
43	Mixed forest	1
52	Shrub/scrub	2.02
71	Grassland/herbaceous	3.41
81	Pasture/hay	3.74
82	Cultivated crops	4.54
90	Woody wetlands	1
95	Emergent herbaceous wetlands	1

Highly Disturbed > 1.7

Moderately Disturbed LDI ≥ 1.3 and ≤ 1.7

Minimally Disturbed LDI < 1.3

Environmental Monitoring and Assessment (2005) **101**: 289–309

© Springer 2005

LANDSCAPE DEVELOPMENT INTENSITY INDEX

MARK T. BROWN* and M. BENJAMIN VIVAS

Center for Environmental Policy, Department of Environmental Engineering Sciences,

University of Florida, Gainesville, Florida, U.S.A.

*(*author for correspondence, e-mail: mtb@ufl.edu)*

How we use the Score Card

Lake ID	Lake Area(acres)	Status	WQ Trend	AIS	Mercury	Shoreland	Watershed
ABENAKI	43						
ADAMANT	42						
ADAMS (WOODFD)	33.6						
ALBANY-NE;	22.2						
AMHERST	82.4						
ARROWHEAD MOUNTAIN	719.8						
ATHENS	20.6						
AUSTIN	33.4						
BAKER (BARTON)	56.1						
BAKER (BRKFLD)	37.7						
BALD HILL	108.6						
BALL MOUNTAIN	20.3						
BANCROFT	25.3						
BARBER	20.9						
BARKMILL;	20.9						
BEAN (LYNDON)	26.1						
BEAN (SUTTON)	36.4						
BEAVER (HOLLND)	38.9						
BEAVER MEADOW BRK-L;	27.7						
BEAVER MEADOW BRK-U;	21.6						
BEEBE (HUBDTN)	112.4						
BERLIN	289.6						

Lake Program Planning

- Where is more data needed?
- Where is more education needed?
- Where do we need on-the-ground action?

How we use the Score Card

Otter Creek Basin

Otter Creek Basin

Tactical Basin Planning

TBP timeline

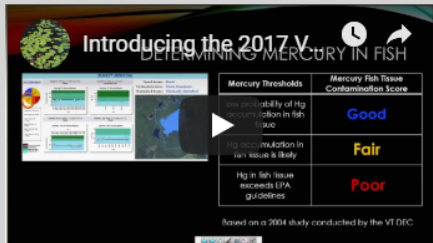
Lower Otter Creek Land Cover

Upper Otter Creek Land Cover

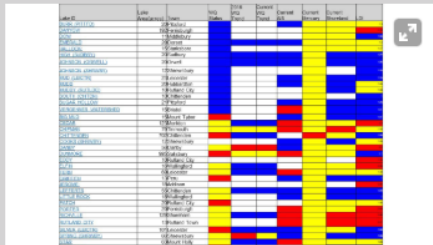
ACRWC—Little Otter Creek, Nitrogen

ACRWC: L

Inland Lakes Scorecard Webinar--

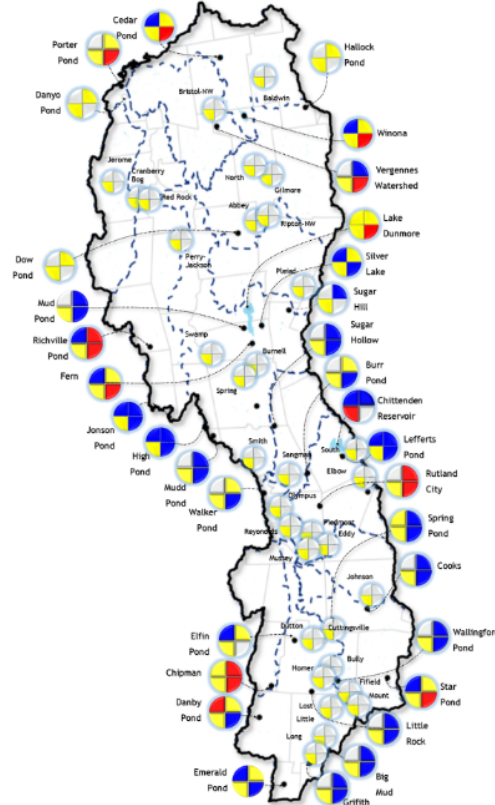


Vermont has over 800 lakes, with 220 of them larger than 20 acres in size. The Lake Score Card currently includes information for 823 Vermont lakes, including all those over 20 acres in size.



4 quadrants of the Secchi Disk:

1. Lakeshore and Habitat quadrant is a way to assign a score to the level of human disturbance around a lake and as of 2017, there were 157 lakes >=10 acres with no data.
2. Aquatic Invasive Species is presence/absence and red = presence (bad) and blue = absence (good).
3. Mercury is atmospheric pollutant from coal-fired power plants and other industrial sources in the Midwest, it drops onto landscape and is transported into lakes and their foodwebs. This quadrant assigns color based on Hg accum. in fish tissue and it's the most widespread stressor in lakes. Some eutrophic lakes with more phytoplankton are less likely to accum. Hg in fish (as of 2017 there were



Watershed Planning

See the Otter Creek Basin Story Map

- <https://www.arcgis.com/apps/MapSeries/index.html?appid=36fbc4d844a349f4912decb31efe1b02>

Checklist of Lake Protection Actions

This checklist provides guidance on actions that help protect Vermont lakes and is based on the [Lake Score Card](#).

Check-off all the helpful actions occurring around your lake. For those items not checked, decide which steps to take to maintain or help improve lake conditions. For more information, follow the links below, or contact the Lakes and Ponds Program at 802-490-6198.

Nutrient Trend and Shoreland Conditions Management Programs and Actions	
Does your lake have a Lake Association? Many lakes and ponds have associations dedicated to taking care of the lake. Join yours or consider starting one. Locate a lake association here .	<input type="checkbox"/>
Do you know if your lake is sampled by the Spring Phosphorus monitoring program? Spring phosphorus data can predict the amount of algal growth that will occur during the summer and show if a lake's water quality is changing. To learn more, click here.	<input type="checkbox"/>
Does your lake participate in the Lay Monitoring Program? Volunteers collect water clarity and nutrient enrichment data during the summer to document the conditions of the lake and show how the lake may be changing over time. Read more.	<input type="checkbox"/>
Does your lake community work with the local town officials? Town Select Boards, Planning and Conservation Commissions make good partners for lakes.	<input type="checkbox"/>
Does your lake participate in the Lake Wise Program? Shoreland owners are taught lake friendly practices which leads to earning the Lake Wise Award for excellent shoreland management. To learn more, click here.	<input type="checkbox"/>
Does your lake community practice Shoreland BMPs? Shoreland Best Management Practices and Fact Sheets are available to explain the best techniques for developing and living along a lake. Click here for BMPs.	<input type="checkbox"/>
Are private roads and driveways maintained according to the standards of the Better Roads Program? Read more.	<input type="checkbox"/>
Are most septic tanks around the lake pumped every 3 to 5 years? A poor or overloaded system can introduce disease-causing organisms into the lake, resulting in a human health threat and can introduce nutrients into the lake. Here's more.	<input type="checkbox"/>
Has your lake held a Septic Social? Septic socials are fun gatherings that showcase septic system care and improvements.	<input type="checkbox"/>

Permitting Required for Lakes	
Are your lake residents informed on the Shoreland Protection Act? Vermont's Shoreland Protection Act regulates land use within 250 feet of the lake's mean water level. Click here to learn more.	<input type="checkbox"/>
Are your lake residents aware of the Lake Encroachment Permit? A Lake Encroachment permit is required for many activities occurring in the water, including seawalls, riprap, and fill. Click here to learn more.	<input type="checkbox"/>

How our partners can use the Score Card



Richard Harter,
LMP



Septic System Primer

The basics and Vermont on-site regulation

Septic System Primer

Description and Purpose:
Septic systems are wastewater treatment systems that collect, treat, and disperse wastewater generated by a home or business. The wastewater is treated and discharged to the soils rather than collected and transported to a wastewater treatment plant. The typical septic system consists of a septic tank and a leachfield to disperse the wastewater into the ground.

The first point of treatment of a septic system is the SEPTIC TANK that is a buried, watertight container usually made of concrete, fiberglass or polyethylene. Its job is to hold the wastewater long enough for solids to settle to the bottom (forming sludge) and for the oil and grease to float to the top (as scum).

Typical Septic System

- 1 septic tank
- 2 4" perforated pipe
- 3 absorption field
- 4 crushed rock or gravel lined trench
- 5 inspection ports
- 6 distribution box

Lake friendly living means using lakeshore BEST MANAGEMENT PRACTICES

BMP
Septic System Primer

STANDARDS
Structures/Septic
• Properly functioning
Leachfield

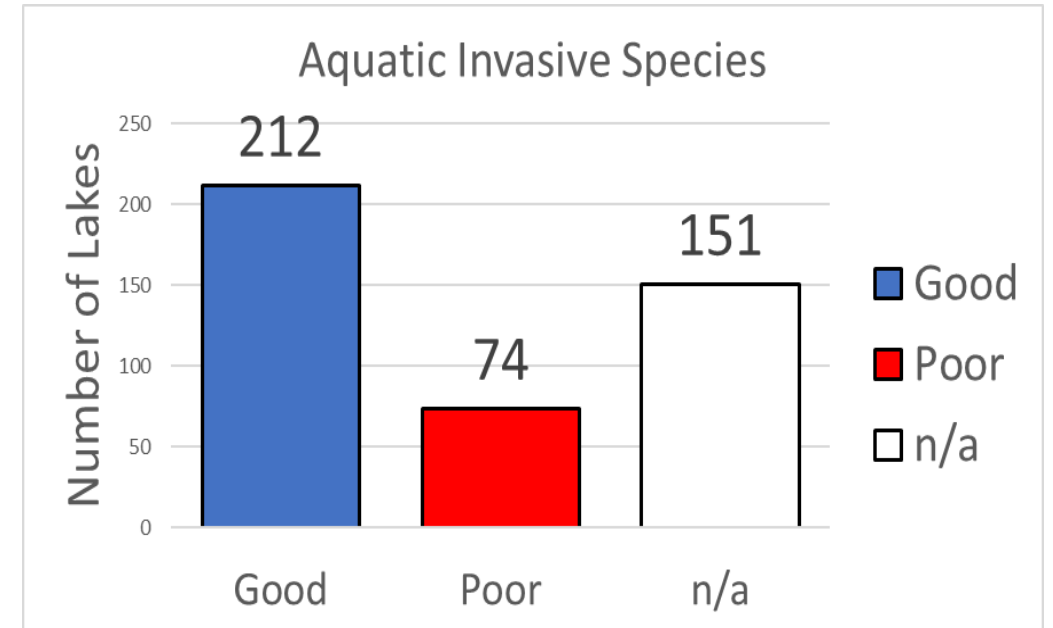
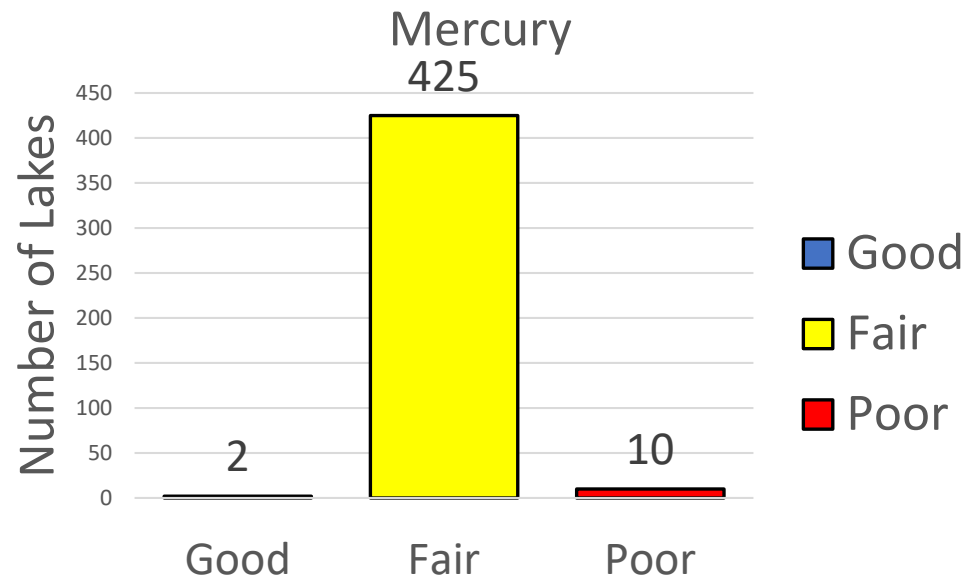
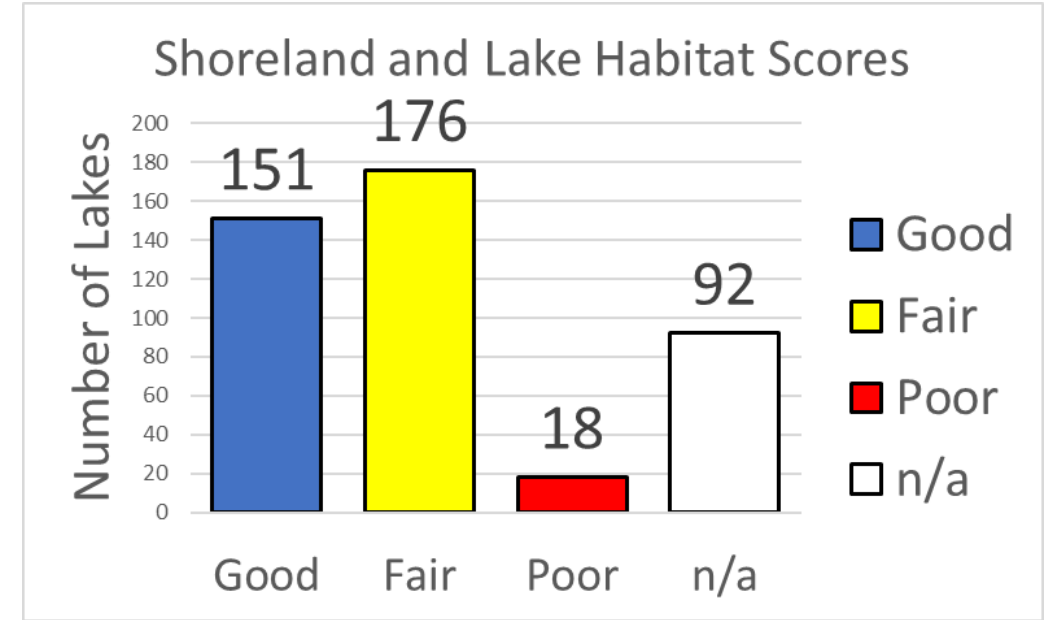
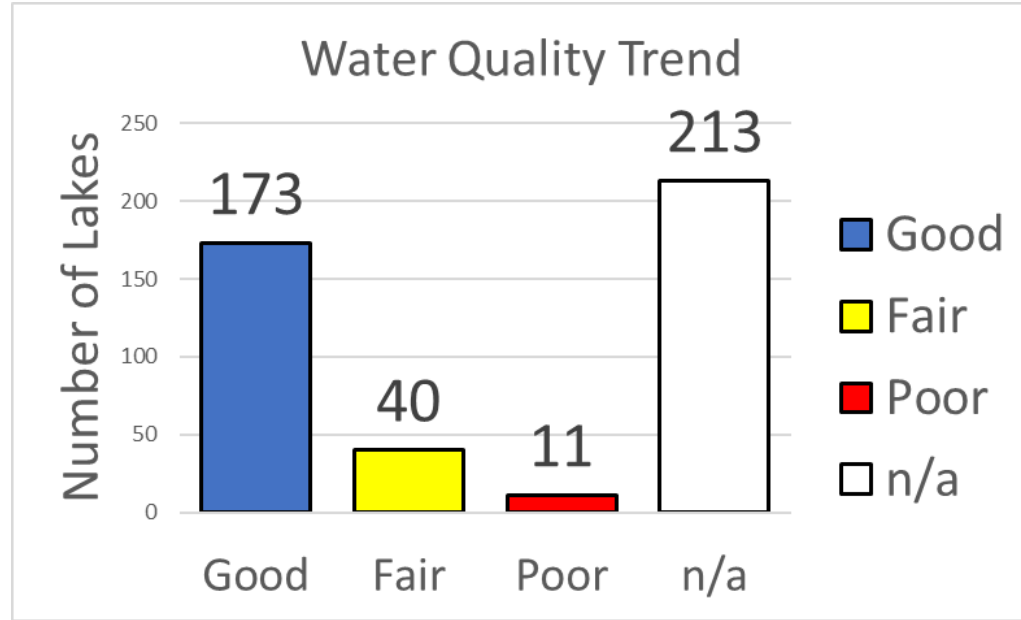
LAKE BENEFITS
Knowing the layout of your septic system and how it works ensures that you will get the most efficient use out of it, while preventing any contamination to the lake.

SHARING THE EDGE



A Guide for Lakeshore
Property Owners in Vermont

How are we doing?



How we use the score card – Digging Even Deeper

WILLOUGHBY

[Learn How
Lakes Are
Scored](#)



Lake Area:
1687 acres

Basin Lake Area Ratio:
7

Max Depth:
94 meters

Mean Spring TP:
5.5 ug/L

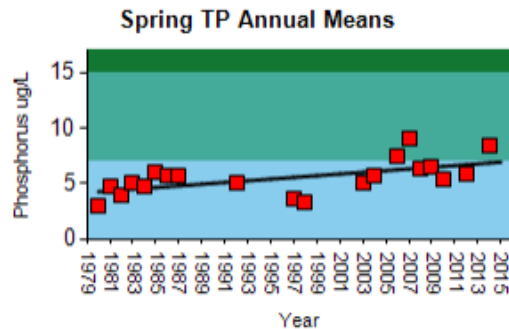
Mean Summer TP:
11 ug/L

Mean Summer Chla:
1.2 ug/L

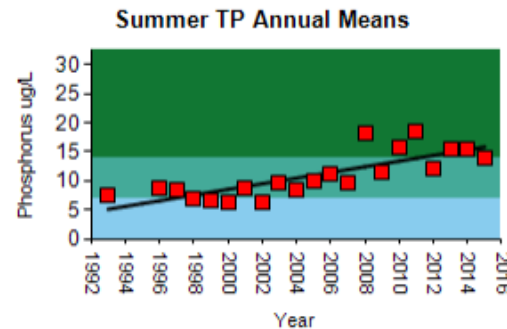
Mean Summer Secchi:
7.9 m



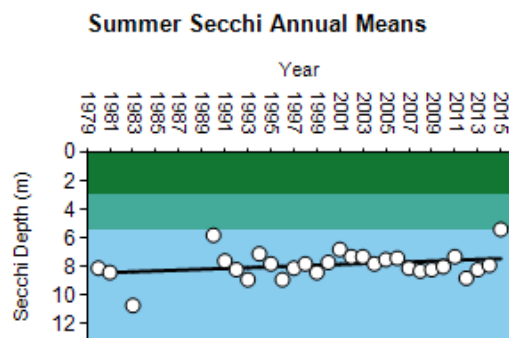
Spring TP Trend: $p = 0.003$ | CV = 28
Highly significantly increasing



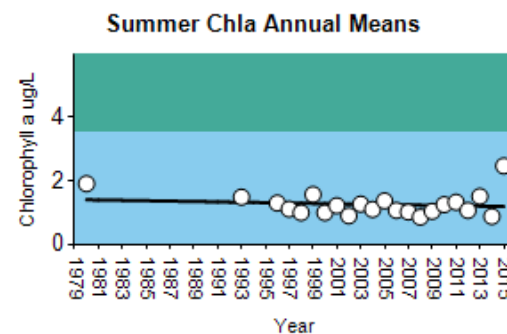
Summer TP Trend: $p = 0.0002$ | CV = 36
Highly significantly increasing



Summer Secchi Trend: $p = 0.4294$ | CV = 12
Stable



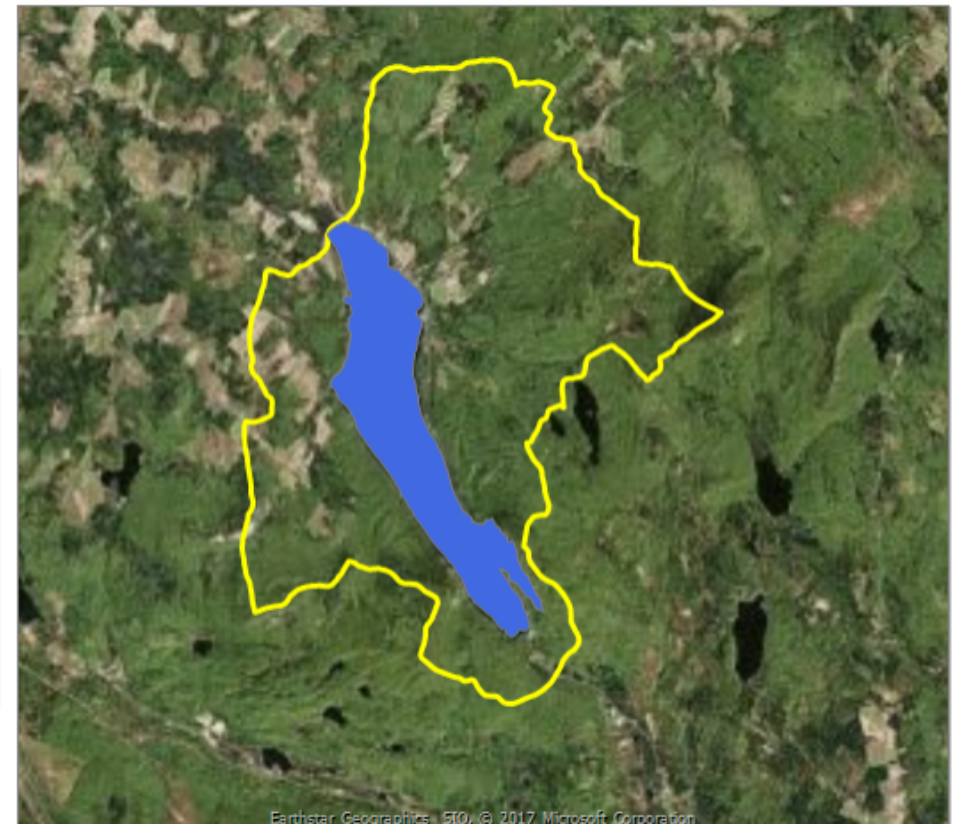
Summer Chla Trend: $p = 0.4805$ | CV = 30
Stable



Trend Score: **Poor**

WQ Standards Status: **Meets Standards**

Watershed Score: **Moderately Disturbed**



Vermont Lake Score Card

SHADOW (GLOVER)

Trend Score: Poor

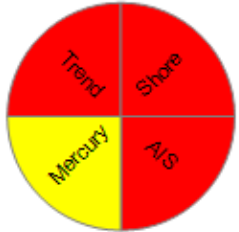
WQ Standards Status: Altered

Watershed Score: Moderately Disturbed



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[Go To Main Menu](#)



Lake Area: 210 acres

Max Depth: 42 meters

Mean Spring TP:
8.3 ug/L

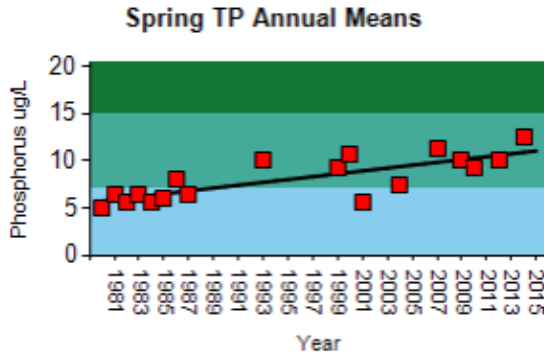
Mean Summer TP:
8.6 ug/L

Mean Summer Chla:
2.4 ug/L

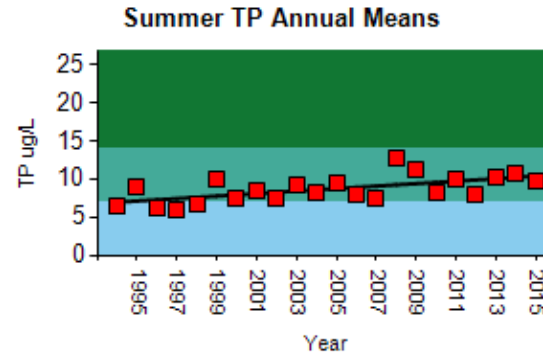
Mean Summer Secchi:
7.7 ug/L



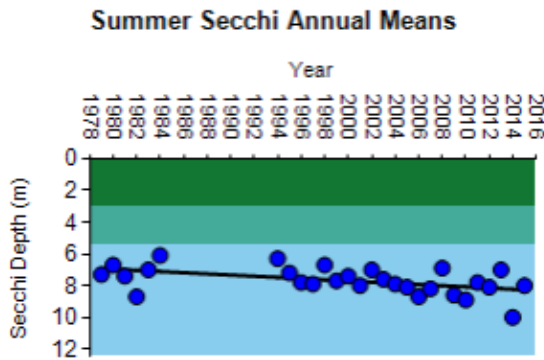
Spring TP Trend: $p = 0.001$ | $CV = 29$
Highly significantly increasing



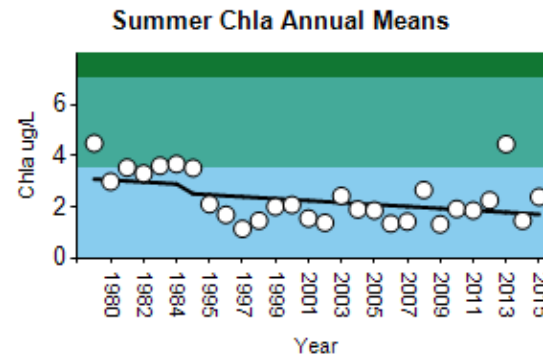
Summer TP Trend: $p = 0.0048$ | $CV = 20$
Highly significantly increasing



Summer Secchi Trend: $p = 0.01$ | $CV = 11$
Significantly increasing



Summer Chla Trend: $p = 0.1178$ | $CV = 40$
Stable



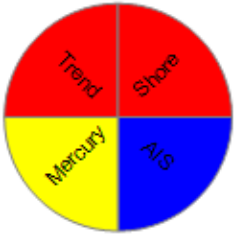
Stresses / Impairments

Altered -- Flow alteration

Vermont Lake Score Card

MAIDSTONE

[Go To Main Menu](#)



Lake Area: 745 acres

Max Depth: 37 meters

Mean Spring TP:
6.1 ug/L

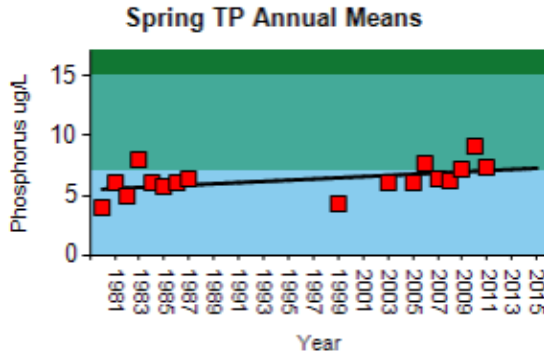
Mean Summer TP:
6.6 ug/L

Mean Summer Chla:
1.6 ug/L

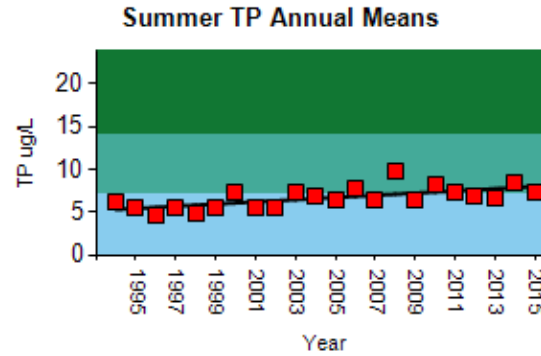
Mean Summer Secchi:
8.7 ug/L



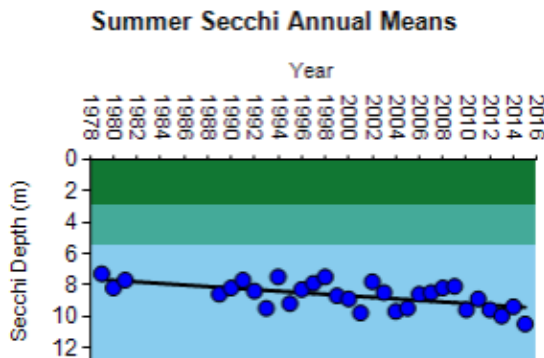
Spring TP Trend: $p = 0.0037$ | CV = 20
Highly significantly increasing



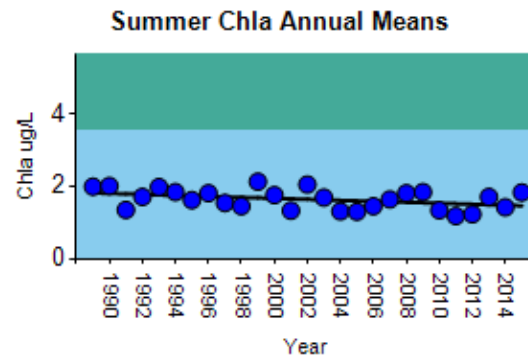
Summer TP Trend: $p = 0.0008$ | CV = 19
Highly significantly increasing



Summer Secchi Trend: $p = 0.0038$ | CV = 9
Highly significantly increasing



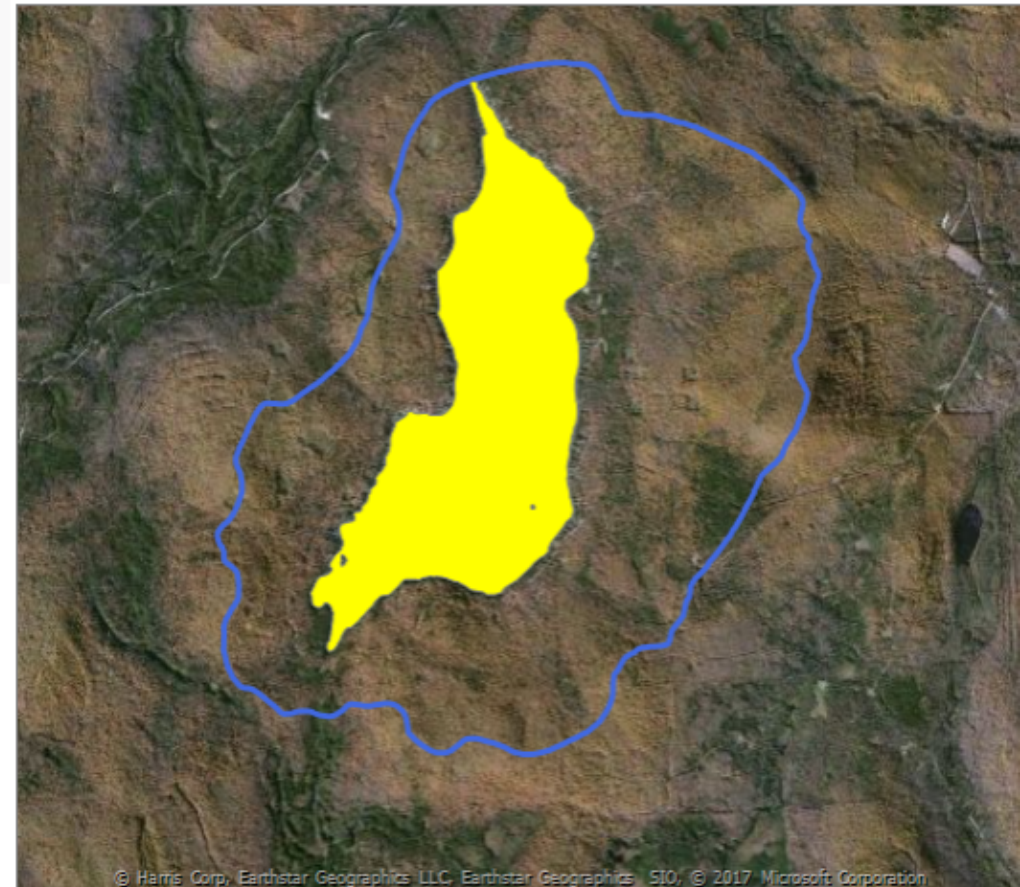
Summer Chla Trend: $p = 0.043$ | CV = 17
Significantly decreasing



Trend Score: **Poor**

WQ Standards Status: **Stressed**

Watershed Score: **Minimally Disturbed**



Stresses / Impairments

Stressed -- pH



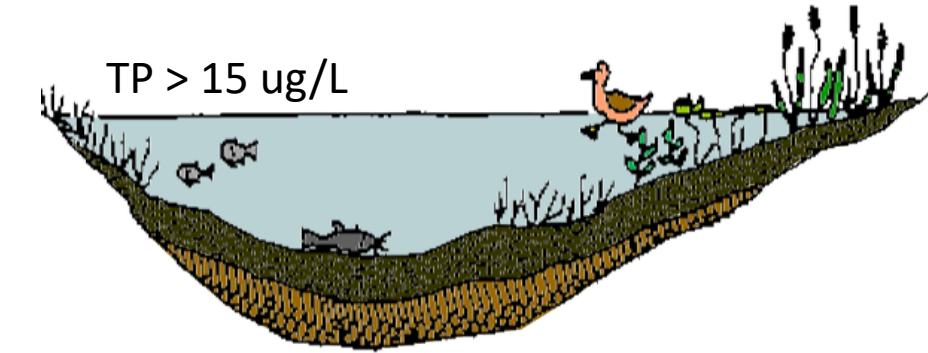
A deeper dive:

Spring TP Long Term Dataset

153 Lakes \geq 20 acres

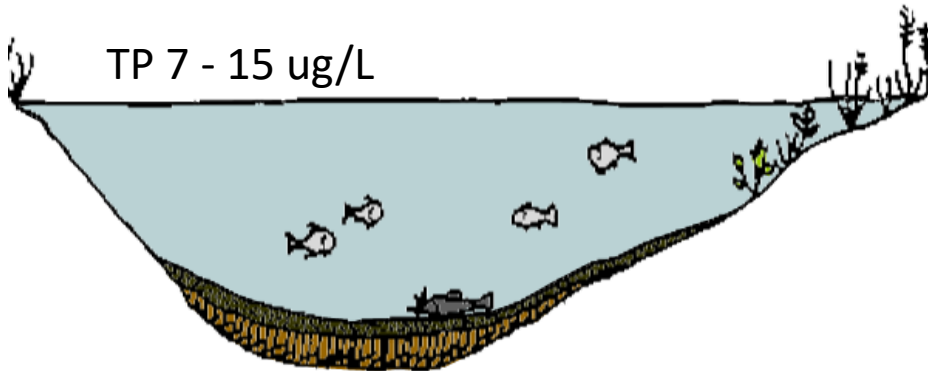
- Sampled at least 3 times (median=11)
- Sampled at least once in 1980s and once since 2000

Lake Trophic Status – Average TP concentration in the 1980s



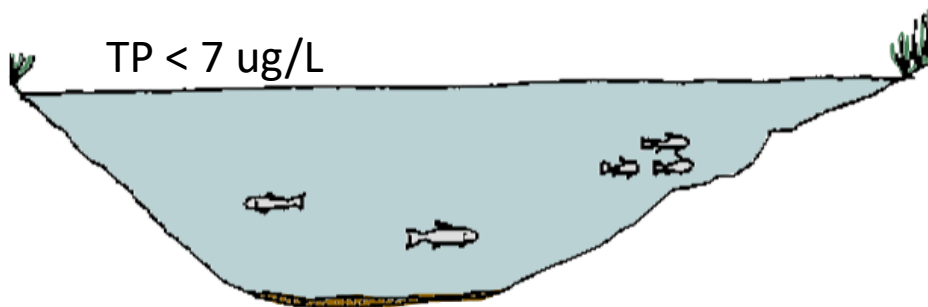
Eutrophic n = 41

- high nutrient enrichment
- abundant algae and plant growth
- only supports warmwater fish species



Mesotrophic n = 89

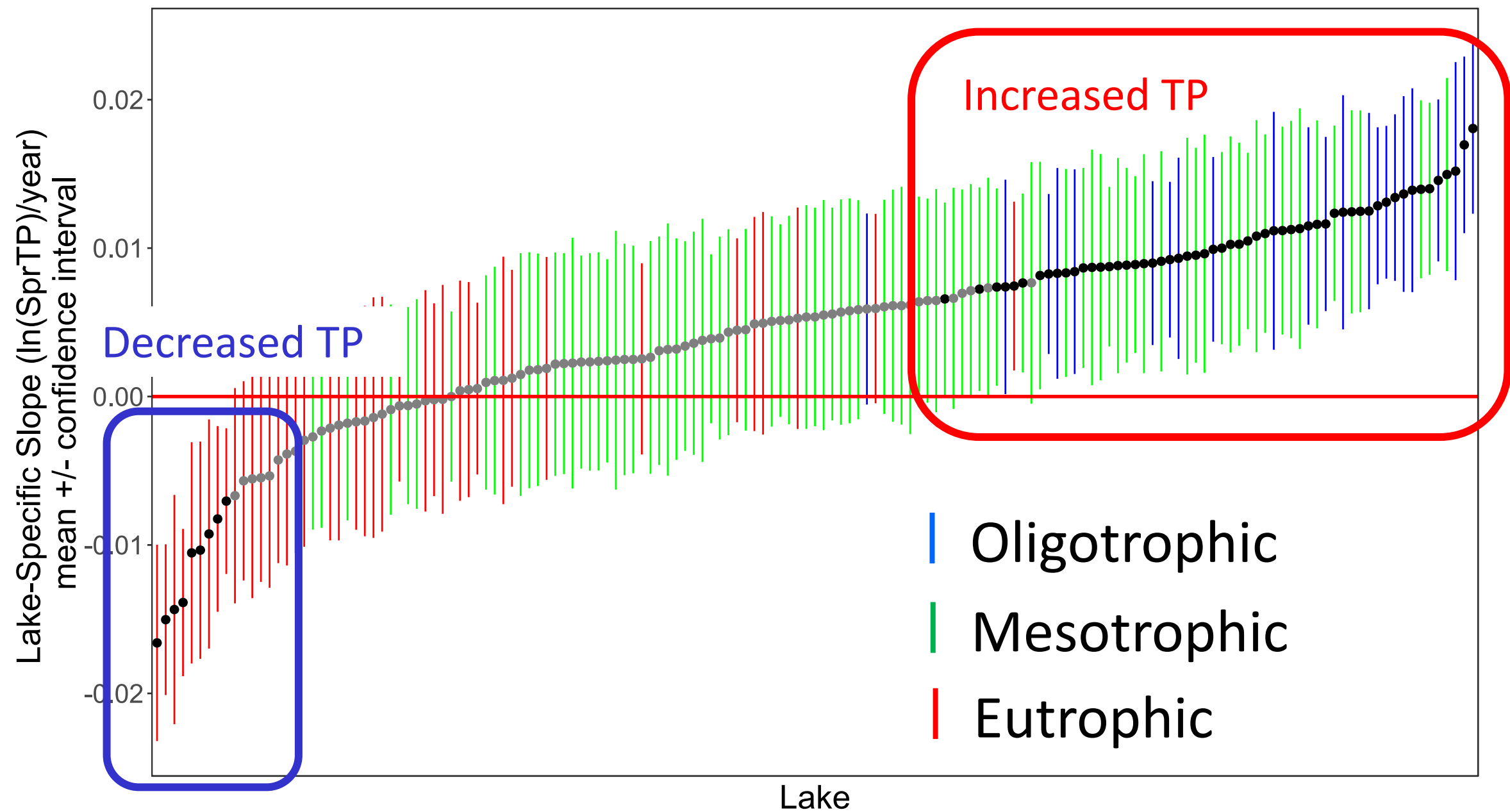
- moderate nutrient enrichment
- moderate algae and plant growth
- usually supports warmwater fish species



Oligotrophic n = 23

- low nutrient enrichment
- deep, clear water
- well oxygenated to the bottom
- supports coldwater fish species

Estimated rate of change (slope) from linear mixed effects model



Percentage of lakes for which Total Phosphorus is estimated to have increased, decreased or stayed the same over 38 years.

Trophic Status ~ 1980s	Increased %	Decreased %	No Change %
Eutrophic n=41	2	22	76
Mesotrophic n=89	38	0	62
Oligotrophic n=23	96	0	4

Summer Total Phosphorus



43 Lakes with continuous
TP data going back to the
late 1980s or 1990s:

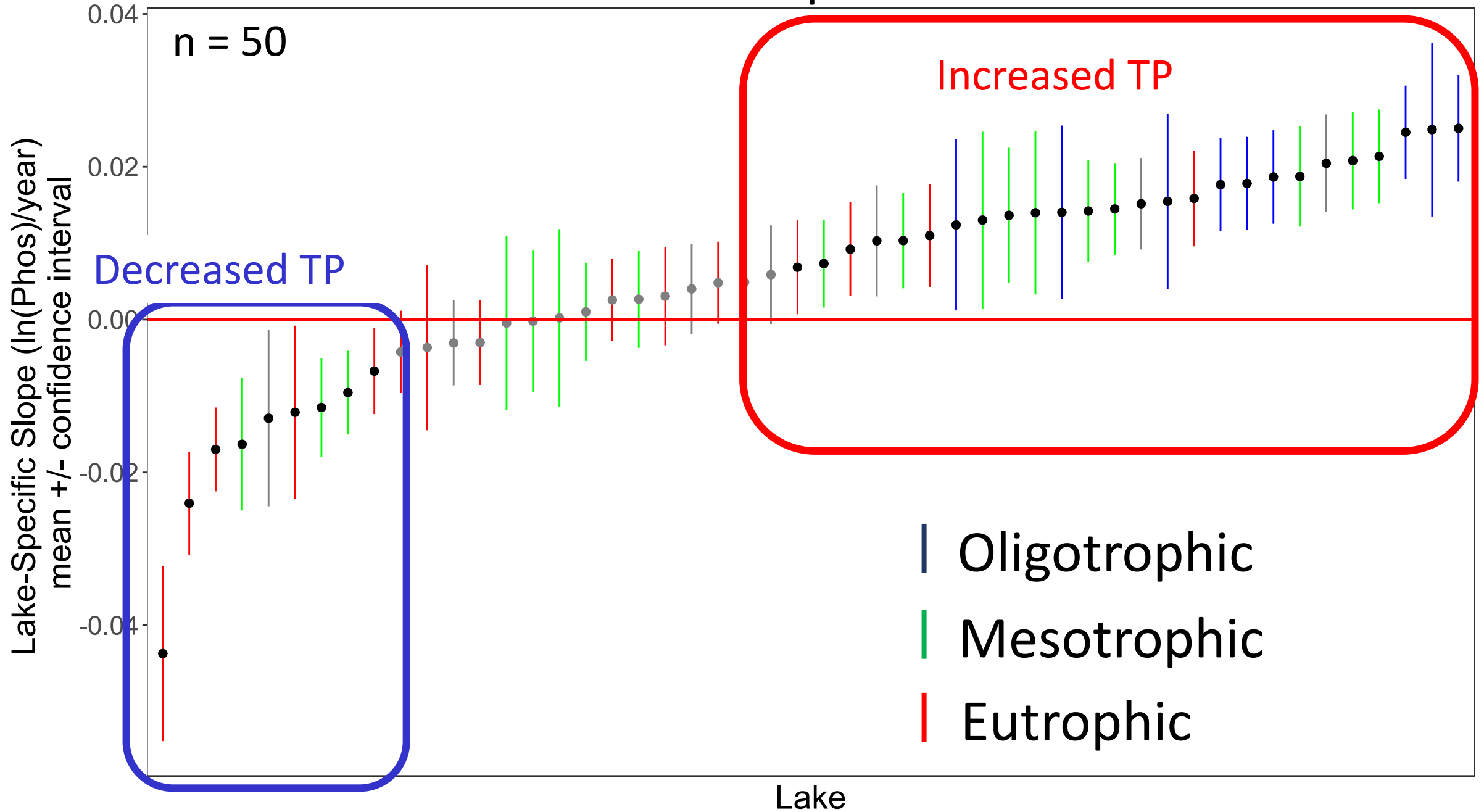
15 **Eutrophic**

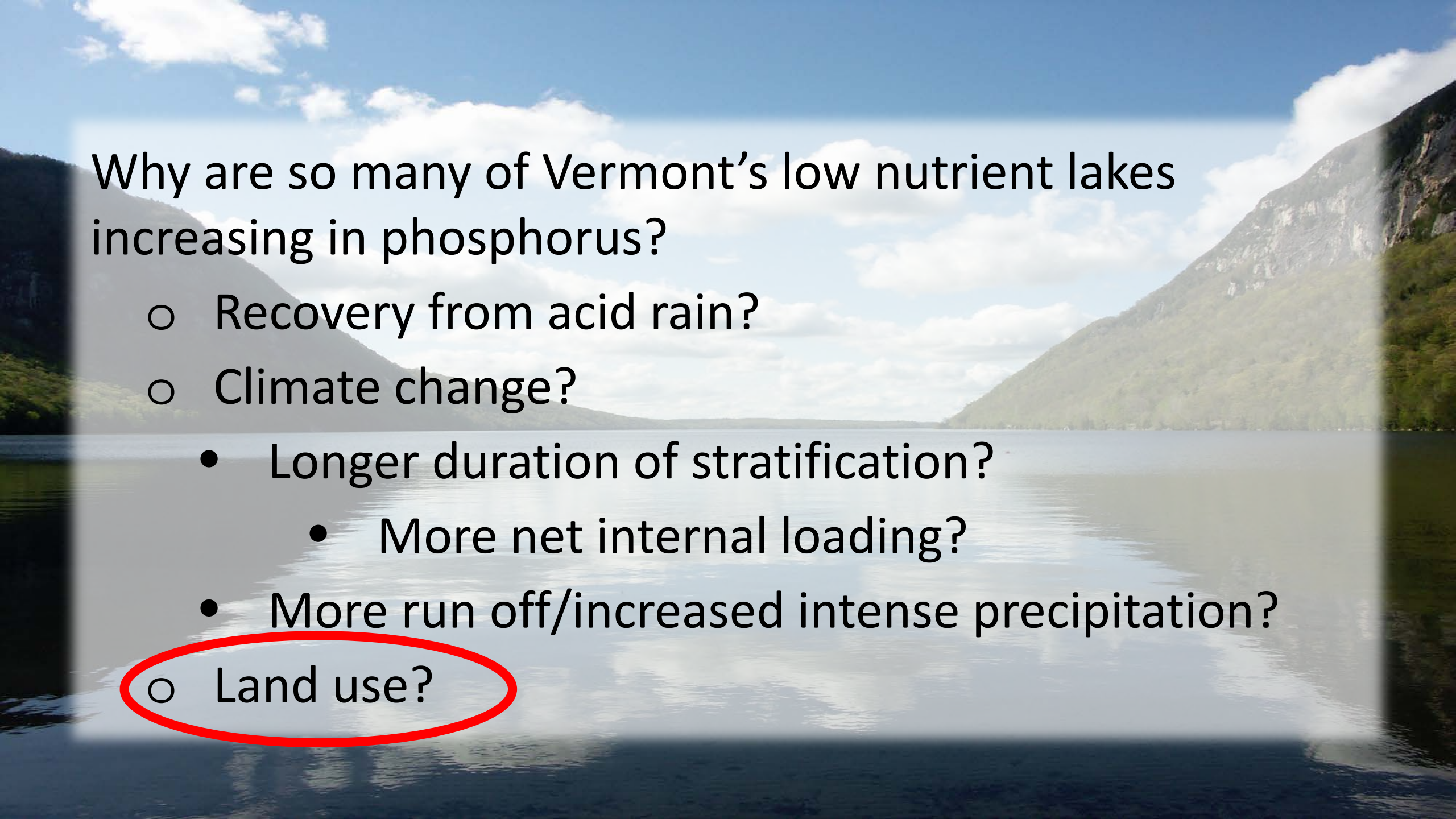
19 **Mesotrophic**

9 **Oligotrophic**



Summer Total Phosphorus Trends

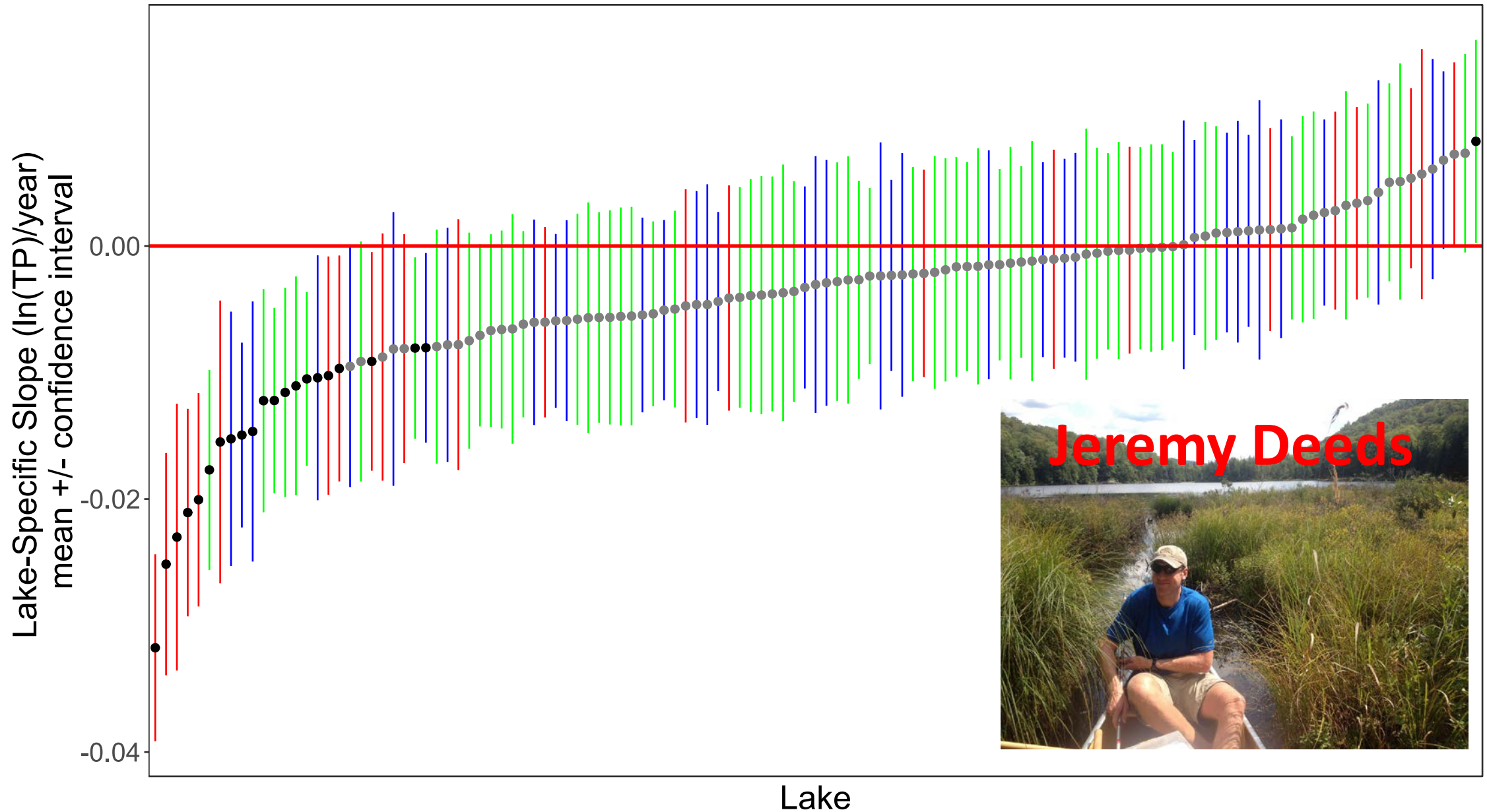




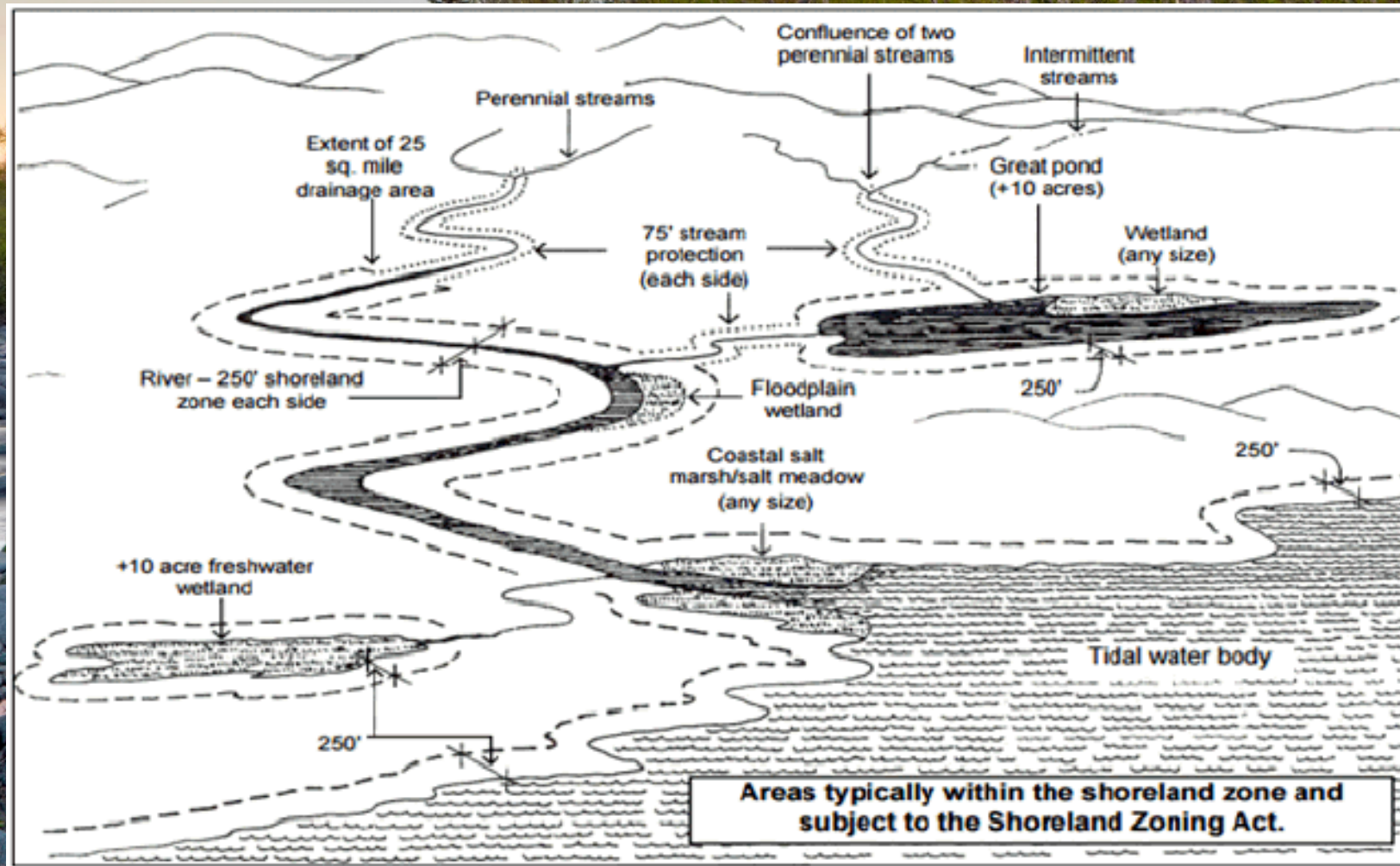
Why are so many of Vermont's low nutrient lakes increasing in phosphorus?

- Recovery from acid rain?
- Climate change?
 - Longer duration of stratification?
 - More net internal loading?
 - More run off/increased intense precipitation?
- Land use?

Almost none of Maine's lakes have increasing phosphorus trends!



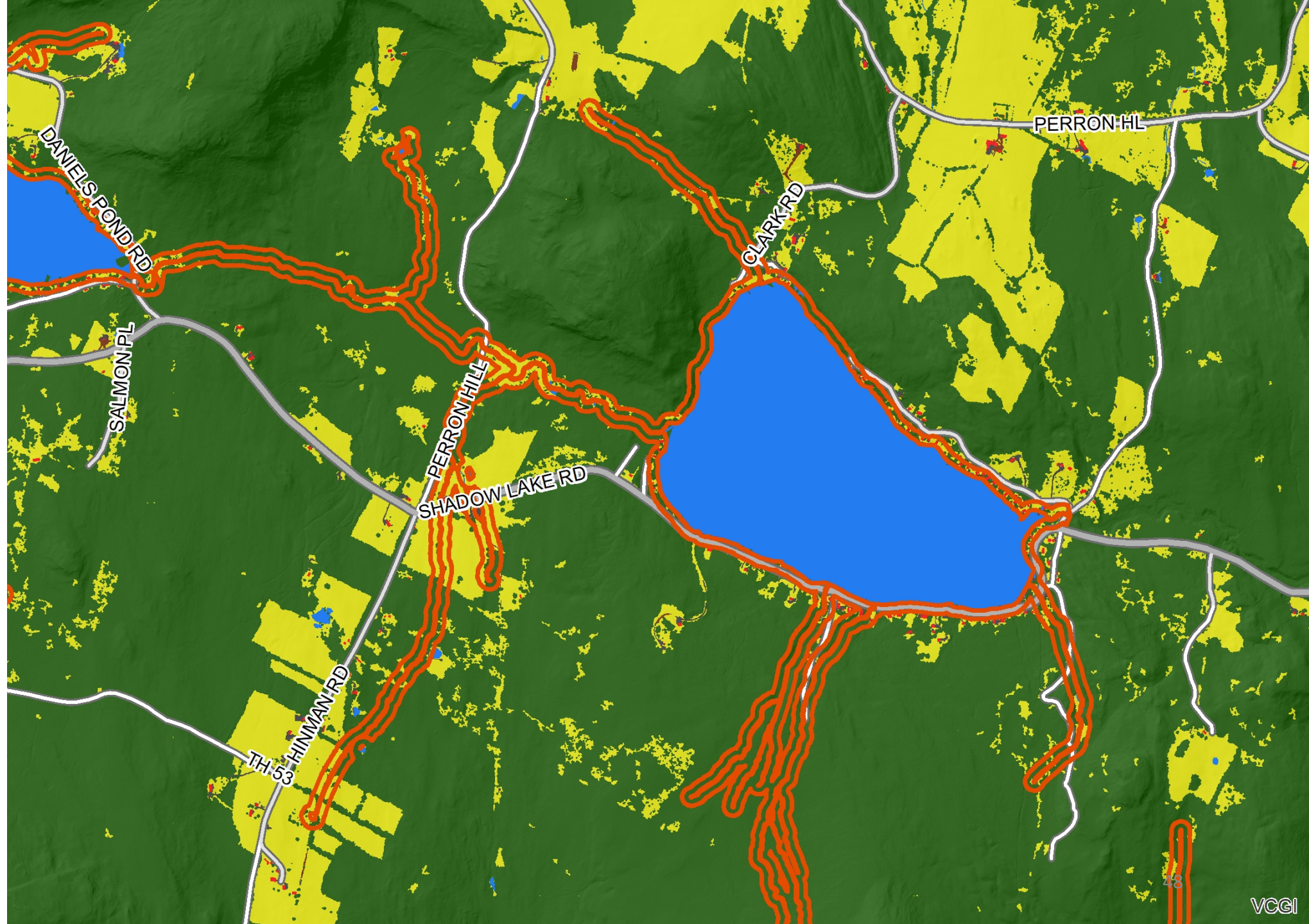
Maine Shoreland Zoning Act



❖ 1 m
Resolution
Land Use

❖ 100 foot
buffers
around
lakeshores
and inlets

❖ \$\$\$

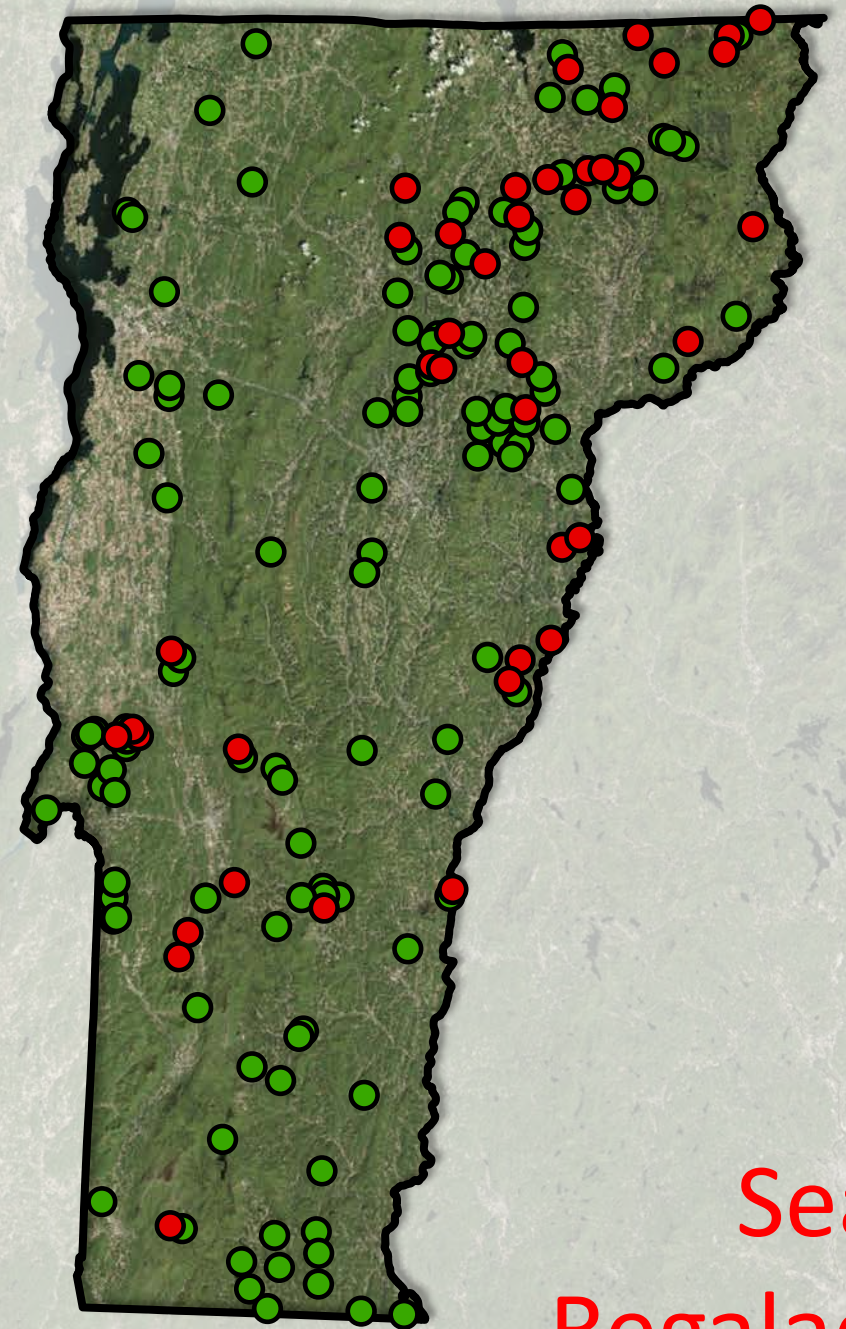
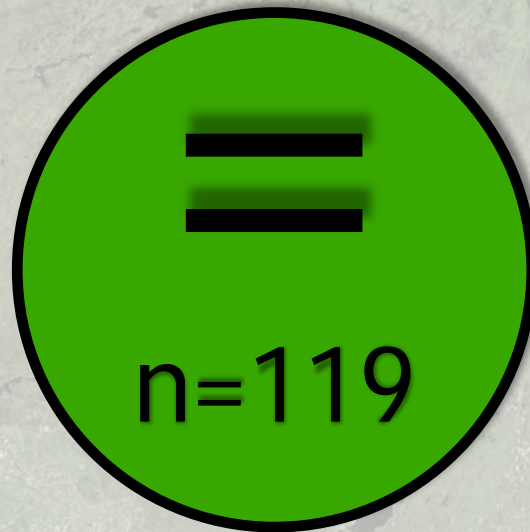


An aerial photograph of a large, irregularly shaped lake. The lake's surface is a uniform grey. The shoreline is irregular and is marked by a thick black line. Along this shoreline, numerous small red squares are placed, indicating the locations of buildings. The surrounding area is a mix of green trees and brownish ground, with some residential structures visible in the upper left and lower right. A red rectangular box is centered over the lake, containing the word "Buildings".

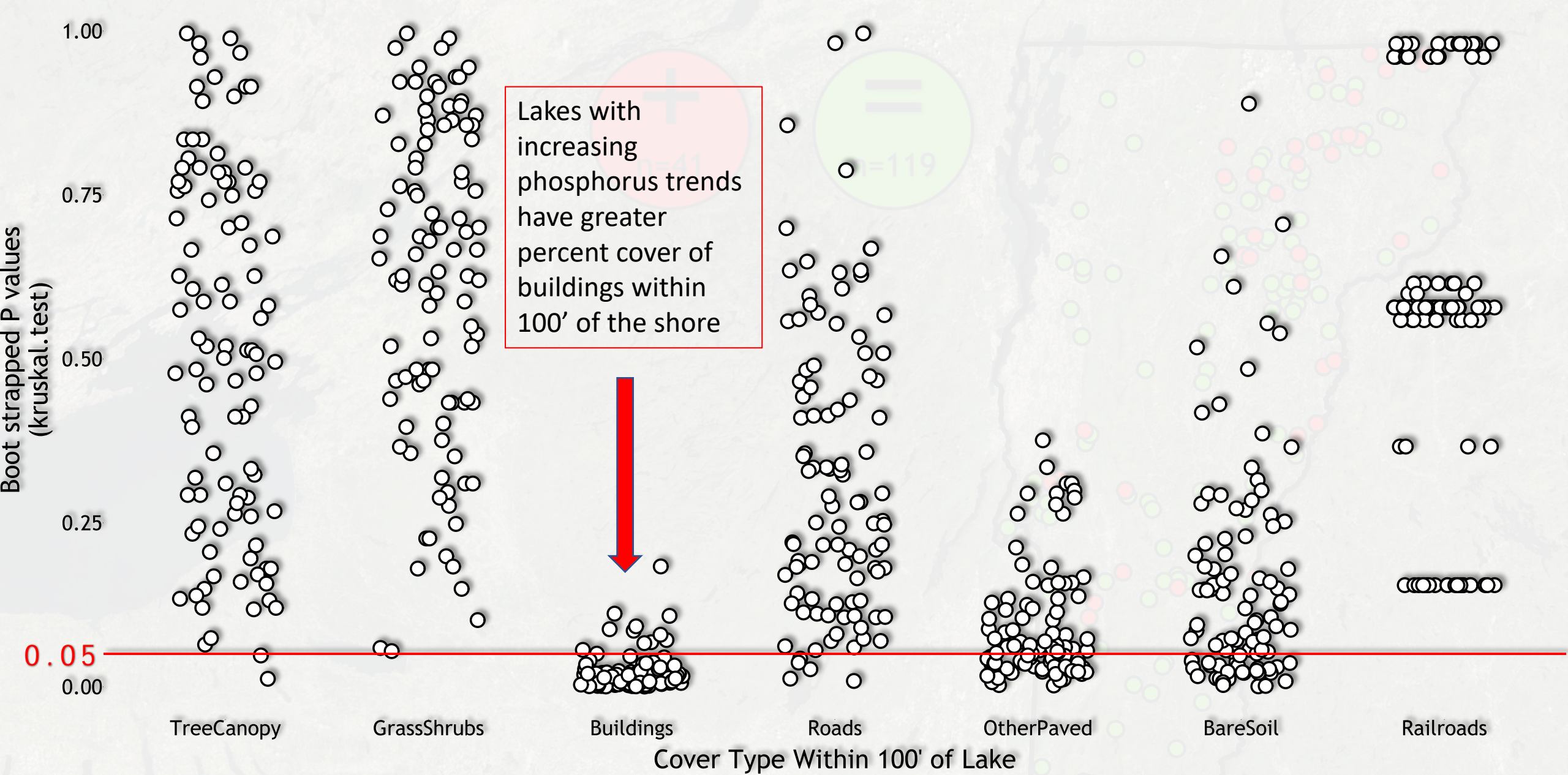
Buildings

Sean Regalado

SPRING OR SUMMER TOTAL PHOSPHORUS TREND



Sean
Regalado



Sean Regalado



April 30, 2011

Shoreline Erosion at North Point of Isle LaMotte, Lake Champlain

Photo: Lake Champlain Basin Program

Vegetative

- Infiltrate
- Filter
- Benefit Wildlife

Structural

- Infiltrate
- Filter

Amy Picotte

Shoreland BMPs

DRIVEWAY

Standards

- Defined and minimized driveway
- Minimized soil compaction
- No erosion
- Runoff channeled away from the lake

BMPs

- Crowned drive-ways, good gravel, & rock or grass-lined drainage ditches
- Open-top culverts & rock aprons
- Infiltration trenches
- Vegetated Swales
- Turn-outs
- Waterbars
- Pervious pavement

RECREATION AREA

Yards, Footpaths, Gardens, Patios

Standards

- Minimum of 15 ft of vegetation from shoreline
- Minimal lawn area
- Soil erosion is not occurring on site
- No pet waste accumulation
- No solid waste scattered
- No pesticide, fertilizer, or runoff to lake

BMPs

- Infiltration steps
- Rain gardens
- Waterbars
- Vegetative swales
- **Vegetated Berms**
- Establishing no-mow zones
- Planting and maintaining vegetative zones
- Planning pathways
- Lake-friendly yard maintenance

STRUCTURES/SEPTIC

Standards

- Less than 20% of property contains impervious surfaces
- Properly functioning leach field
- No uncovered oil tanks
- No erosion caused from impervious surface runoff

BMPs

- Dripline trenches
- Infiltration trenches
- Rooftop downspout disconnection and drywells
- Rain gardens
- Vegetated swales
- Septic system primer
- Ensuring septic system quality
- Non-structural

SHOREFRONT

Standards

- Natural conditions
- Stable bank
- Minimum of 15 ft width of vegetation area for developed sites
- Minimum of 100 ft width for undeveloped sites
- No unfiltered runoff to the lake
- Shallow water areas natural and not "cleaned up"

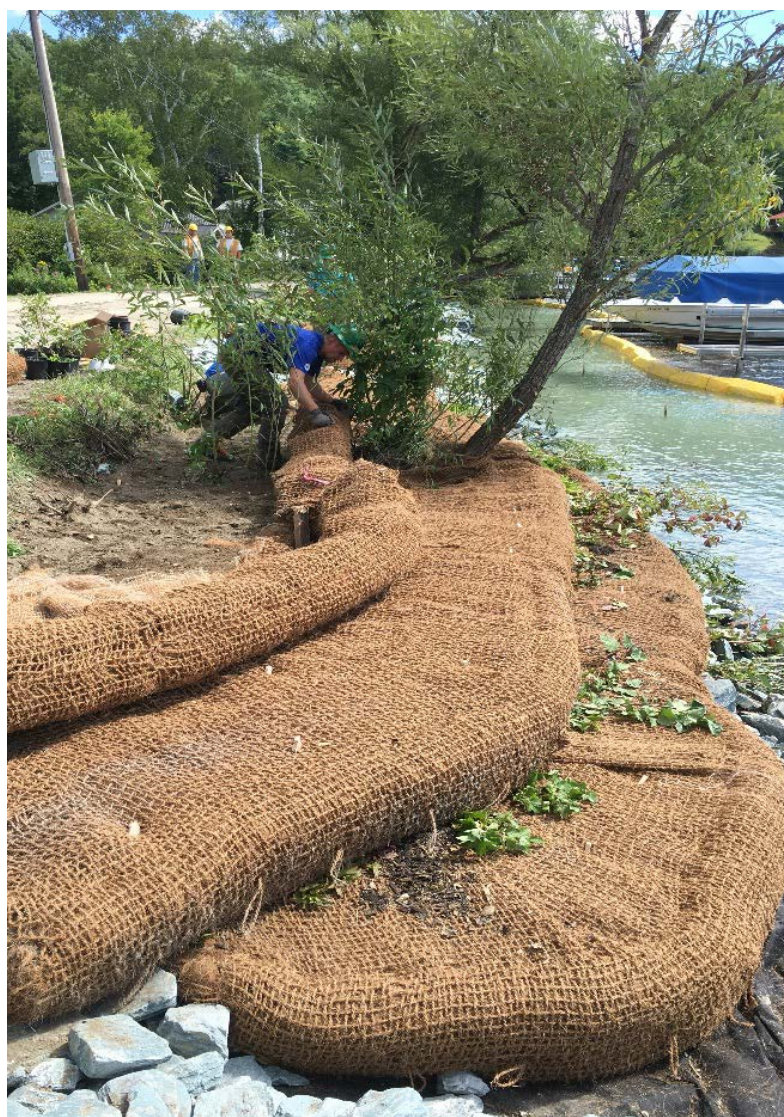
BMPs

- Conserving lake-shores
- Managing shoreland vegetation
- Resloping, rock toe & riprap
- Live staking
- Establishing no-mow zones
- Planting and maintaining vegetated areas
- Planning pathways
- Waterbars
- Permits needed?

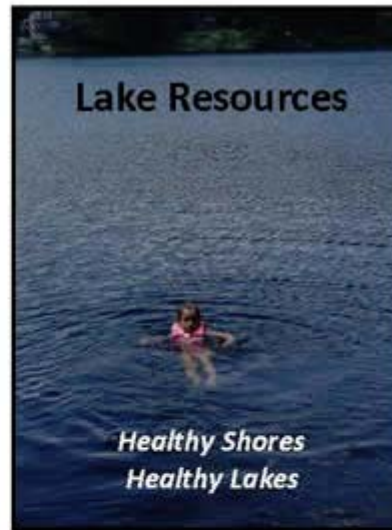
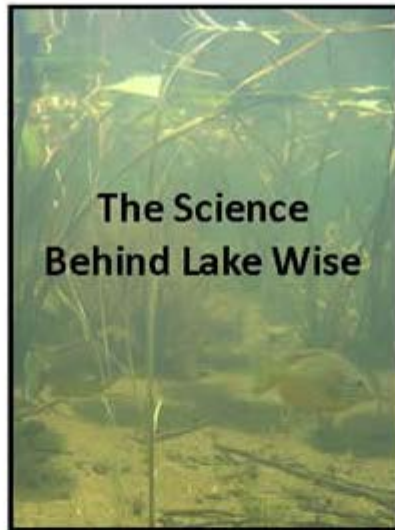
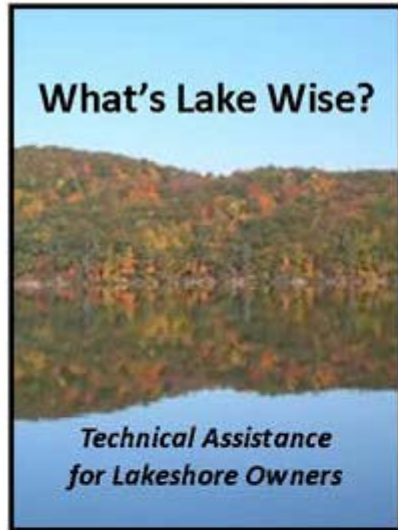


Amy Picotte

Living Shorelands Restored with Encapsulated Soil Lifts



<https://dec.vermont.gov/watershed/lakes-ponds/lakeshores-lake-wise>



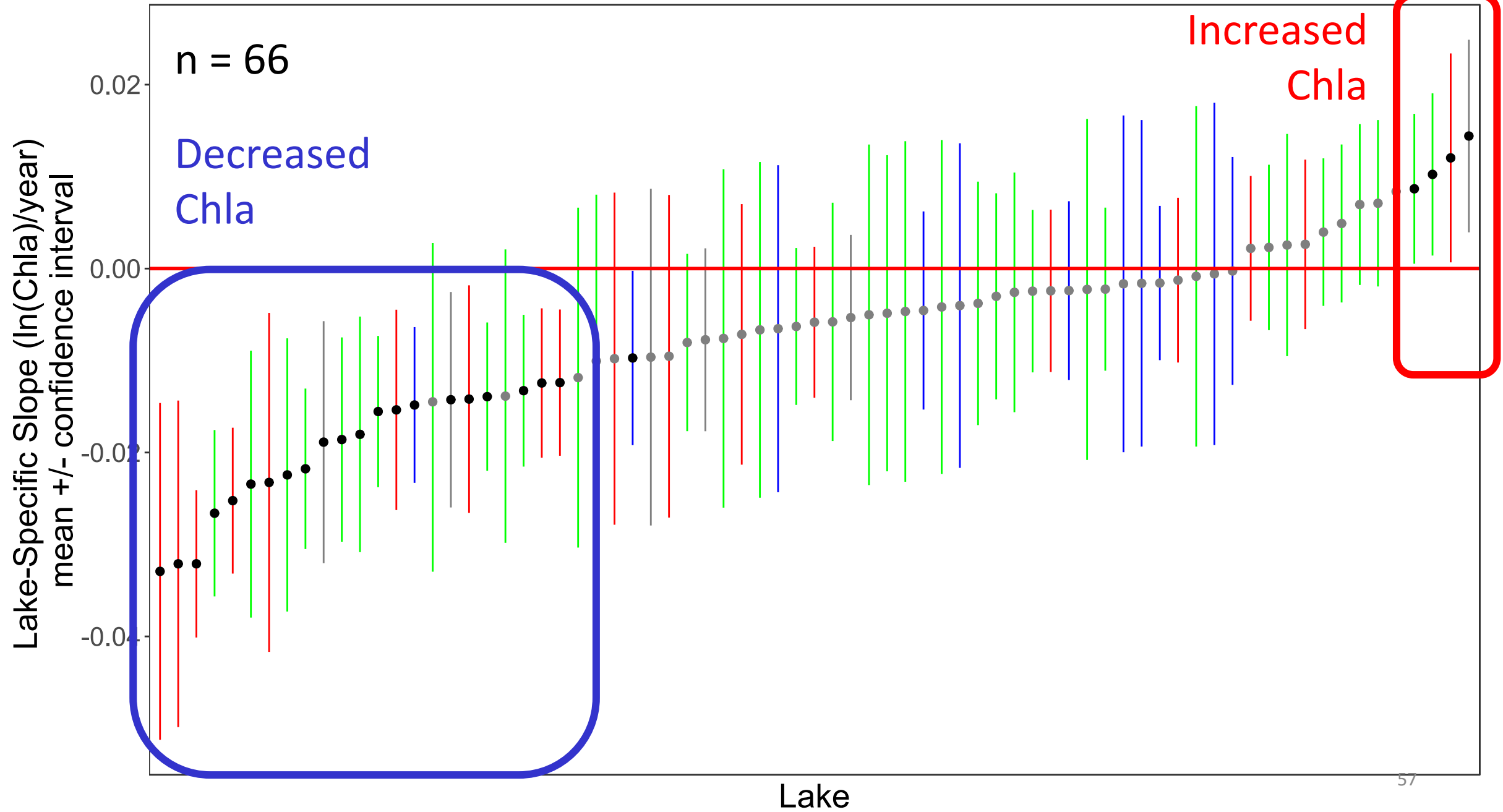
Amy Picotte

amy.picotte@vermont.gov

Summary

- The Vermont Lake Score Card summarizes and interprets multiple datasets to help us understand each lake's trends and status
- Long-term monitoring data is critical for identifying both our successes and challenges over time
- Long-term trends for our most nutrient-polluted lakes suggest improvement efforts may be paying off
- A renewed focus on our precious oligotrophic lakes is needed to reverse the disturbing trends our long-term data has revealed

Summer Chlorophyll a Trends

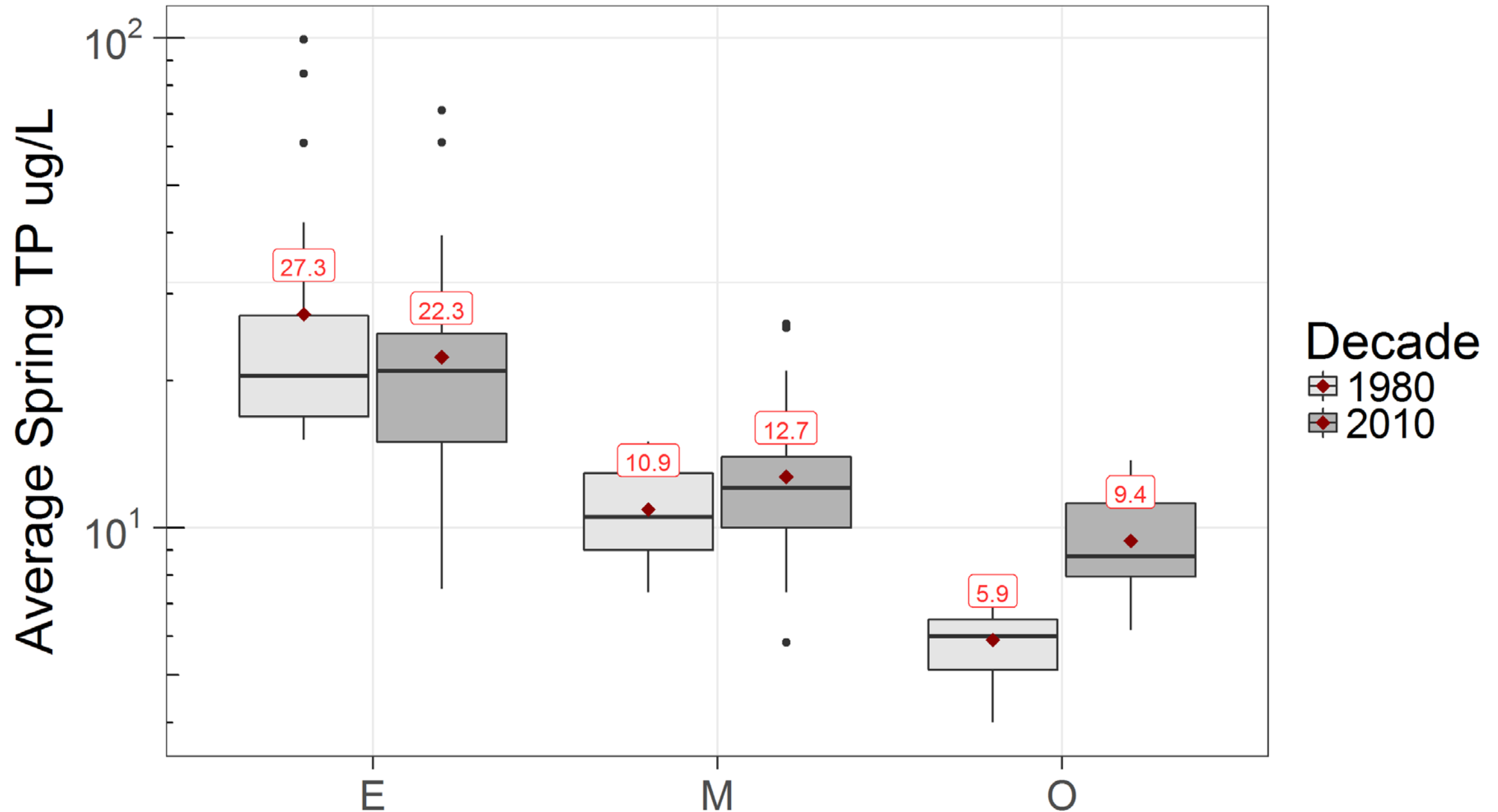


Could the tipping point be changing?

- Shifting to more cyanobacteria relative to green algae?
- Browning?



Median and average Spring TP during the 1980s versus since 2010



Theil-Sen slope estimates

