Cooperative Lakes Monitoring Program

Michigan Lakes– Ours to Protect

2023 Data Report for Duck Lake, Muskegon County

Site ID: 610778

43.3379°N, 86.3926°W

The CLMP is brought to you by:

Michigan Clean Water Corps

EGLE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

MICHIGAN STATE UNIVERSITY

MICHIGAN LAKES AND STREAMS ASSOCIATION

Huron River Watershed Council

About this report:
This report is a summary of the data that have been collected through the Cooperative Lakes Monitoring Program. The contents have been customized for your lake. The first page is a summary of the Trophic Status Indicators of your lake (Secchi Disk Transparency, Chlorophyll-a, Spring Total Phosphorus, and Summer Total Phosphorus). Where data are available, they have been summarized for the most recent field season, five years prior to the most recent field season, and since the first year your lake has been enrolled in the program.

If you did not take 8 or more Secchi disk measurements or 4 or more chlorophyll measurements, there will not be summary data calculated for these parameters. These numbers of measurements are required to ensure that the results are indicative of overall summer conditions.

If you enrolled in Dissolved Oxygen/Temperature, the summary page will have a graph of one of the profiles taken during the late summer (typically August or September). If your lake stratifies, we will use a graph showing the earliest time of stratification, because identifying the timing of this condition and the depth at which it occurs is typically the most important use of dissolved oxygen measurements.

The back of the summary page will be an explanation of the Trophic Status Index and where your lake fits on that scale.

The rest of the report will be aquatic plant summaries, Score the Shore results, and larger graphs, including all Dissolved Oxygen/Temperature Profiles that you recorded. For Secchi Disk, Chlorophyll, and Phosphorus parameters, you need to have two years of data for a graph to make logical sense. Therefore if this is the first year you have enrolled in the CLMP, you will not receive a graph for these parameters.

Remember that some lakes see a lot of fluctuation in these parameters from year to year. Until you have eight years worth of data, consider all trends to be preliminary.

To learn more about the CLMP monitoring parameters or get definitions to unknown terms, check out the CLMP Manual, found at: **https://micorps.net/wp-content/uploads/2021/03/CLMP-Manual-2019update2_2021.pdf**

Thank you!
The CLMP leadership team would like to thank you for all of your efforts over the past year. The CLMP would not exist without dedicated and hardworking volunteers!

The CLMP Leadership Team is made of: Jo Latimore, Erick Elgin, Jean Roth, Tamara Lipsey, Mike Gallagher, Melissa DeSimone, and Paul Steen

Questions?
If you have questions on this report or believe that the tabulated data for your lake in this report are in error please contact:
Paul Steen (psteen@hrwc.org), CLMP Data Analyst

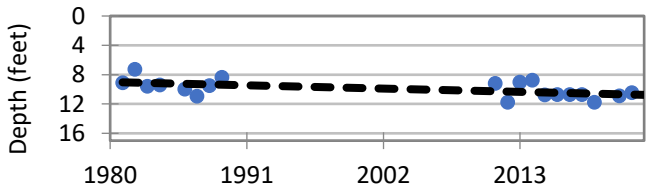
Site ID: 610778

Duck Lake, Muskegon County
2023 CLMP Results

Cooperative Lakes Monitoring Program

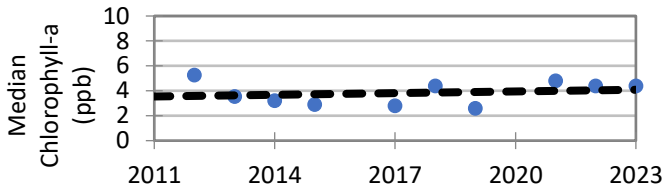
Secchi Disk Transparency (feet)

Year	# Readings	Min	Max	Average	Std. Dev	Carlson TSI
2023	6*	9.5	13.0			
2018-2022	50	6.5	17.0	10.9	2.0	43
1981-2017	248	4.5	15.5	9.7	1.7	44
2023 All CLMP Lakes	2825	0.5	51.0	12.2	2.7	43



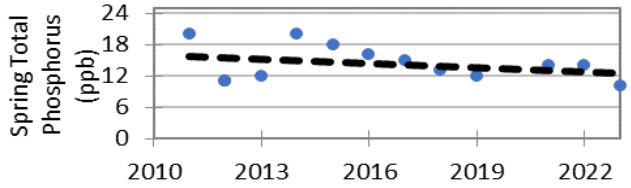
Chlorophyll-a (parts per billion)

Year	# Samples	Min	Max	Median	Std. Dev	Carlson TSI
2023	5	3.7	4.7	4.4	0.4	45
2018-2022	15	<1.0	5.3	4.4	1.4	45
2011-2017	27	<1.0	7.8	4.4	1.5	42
2023 All CLMP Lakes	687	< 1.0	43.0	3.7	5.3	43



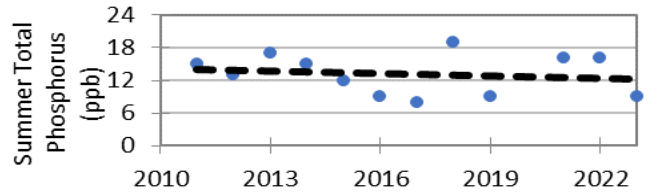
Spring Phosphorus (parts per billion)

Year	# Samples	Min	Max	Average	Std. Dev
2023	1	10.0	10.0	10.0	NA
2018-2022	4	12.0	14.0	13.3	1.0
2011-2017	8	11.0	20.0	15.4	3.8
2023 All CLMP Lakes	220	<5	220.0	20.7	21.3



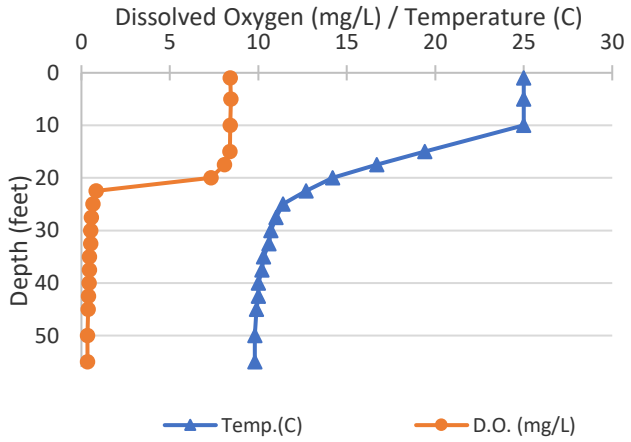
Summer Phosphorus (parts per billion)

Year	# Samples	Min	Max	Average	Std. Dev	Carlson TSI
2023	1	9.0	9.0	9.0	NA	36
2018-2022	3	9.0	19.0	14.7	5.1	42
2011-2017	7	8.0	17.0	12.7	3.3	40
2023 All CLMP Lakes	234	<= 3	150.0	17.4	15.3	45



Dissolved Oxygen and Temperature Profile

7/11/23



Summary

Average TSI	2023	2018-2022	1981-2017
Duck Lake	40	43	43
All CLMP Lakes	44	41	42

With an average TSI score of 40 based on 2023 Secchi transparency, chlorophyll-a, and summer total phosphorus data, this lake is rated between the oligotrophic and mesotrophic classification. The lake leans slightly more mesotrophic than oligotrophic.

The lake keeps some dissolved oxygen in the bottom waters through early summer, but by mid-summer the lake has stratified and the bottom water is devoid of oxygen.

Long term trends indicate that the trophic status parameters have not changed beyond minor year-to year variation since monitoring began.

** = Minimum # samples not met for average/median/TSI value*

<1.0 = Chlorophyll-a: Sample value is less than limit of quantification (<1 ppb).

W= Value is less than the detection limit (<3 ppb) T = Value reported is less than the reporting limit (5 ppb)

Trophic Status Index Explained

In 1977, limnologist Dr. Robert Carlson developed a numerical scale (0-100) where the numbers indicate the level of nutrient enrichment. Using the proper equations, we can convert results from Summer Total Phosphorus, Secchi Depth, and Chlorophyll-a to this Trophic Status Index (TSI). The TSI numbers are furthermore grouped into general categories (oligotrophic, mesotrophic, eutrophic, and hypereutrophic), to quickly give us a way to understand the general nutrient level of any lake.

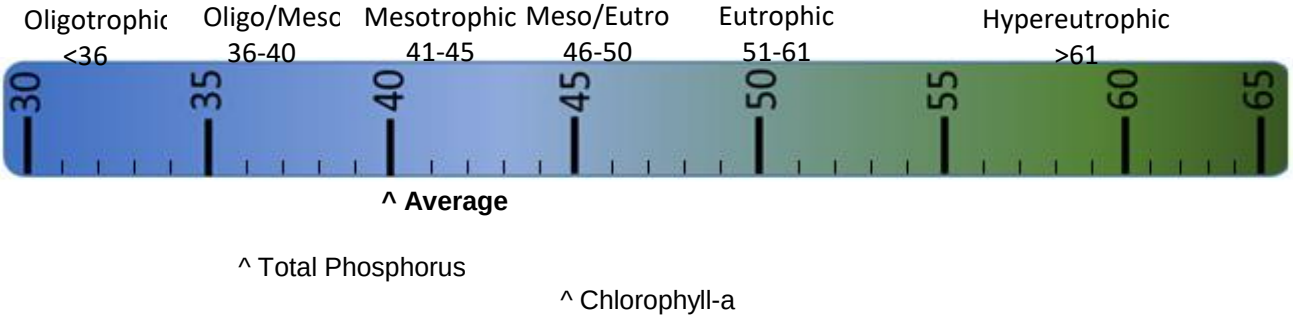
The tables below give the results-to-TSI conversions for the water quality data ranges normally seen in the CLMP. The formulas for this conversion can be found in the CLMP manual (link is on page 2 of this report).

Phosphorus (ppb)	TSI Value
<5	<27
6	30
8	34
10	37
12	40
15	43
18	46
21	48
24	50
32	54
36	56
42	58
48	60
>50	>61

Secchi Depth (ft)	TSI Value
>30	<28
25	31
20	34
15	38
12	42
10	44
7.5	48
6	52
4	57
<3	>61

Chlorophyll-a (ppb)	TSI Value
<1	<31
2	37
3	41
4	44
6	48
8	51
12	55
16	58
22	61
>22	>61

TSI for Duck Lake in 2023	
Average	40
Secchi Disk	
Summer TP	36
Chlorophyll-a	45



Oligotrophic: Generally deep and clear lakes with little aquatic plant or algae growth. These lakes maintain sufficient dissolved oxygen in the cool, deep-bottom waters during late summer to support cold water fish, such as trout and whitefish.

Mesotrophic: Lakes that fall between oligotrophic and eutrophic. Mid-ranged amounts of nutrients.

Eutrophic: Highly productive eutrophic lakes are generally shallow, turbid, and support abundant aquatic plant growth. In deep eutrophic lakes, the cool bottom waters usually contain little or no dissolved oxygen. Therefore, these lakes can only support warm water fish, such as bass and pike.

Hypereutrophic: A specialized category of euthrophic lakes. These lakes exhibit extremely high productivity, such as nuisance algae and weed growth.

Site ID: 610778

Duck Lake, Muskegon County
2019 Exotic Aquatic Plant Watch Results

The Exotic Aquatic Plant Watch was conducted on Duck Lake in 2019.

This survey involves sampling at multiple locations around the lake to detect new invaders, and document the extent of known invaders. While notes on other plant species may be recorded during the survey, the effort focuses on four highly invasive species: Eurasian watermilfoil (*Myriophyllum spicatum*), starry stonewort (*Nitellopsis obtusa*), curly-leaf pondweed (*Potamogeton crispus*), European Frogbit (*Hydrocharis morsus-ranae*), and Hydrilla (*Hydrilla verticillata*).

The table below summarizes the results of the 2019 Exotic Aquatic Plant Watch on Duck Lake.

Duck Lake, Muskegon County

2019 Exotic Aquatic Plant Watch Results

Survey Date(s): August 7, 14, and 20

Species	Status	Comments
Eurasian watermilfoil	FOUND	Found in all 10 transects surveyed.
Starry stonewort	not found	
Curly-leaf pondweed	FOUND	Found in 1 of 10 transects surveyed.
European Frogbit	not found	
Hydrilla	not found	

Visit the MiCorps Data Exchange (https://micorps.net) or contact the lead volunteer on your lake for more details on the survey, including sampling locations, maps, and abundance information, and for information on past surveys.

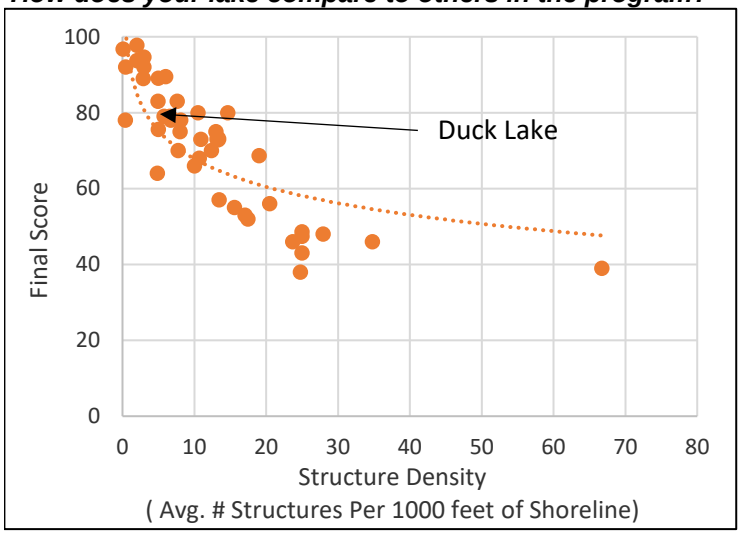
Site ID: 610778

Duck Lake, Muskegon County
2015 Score the Shore Results

The Score the Shore Habitat Assessment was conducted on Duck Lake in 2015.

This assessment involves rating 1000 foot sections of shoreline for aquatic vegetation, shoreline vegetation, erosion, and erosion control practices (like sea walls). Each shoreline section is given three scores ranging from 0-100 for the categories of Littoral, Riparian, and Erosion Management. The three scores are averaged to produce a average section score. Then a total score is given to the entire lake by averaging all of the average section scores. A score of 0 indicates a shoreline that has been extremely disturbed by human impacts and no natural shoreline remains. A score of 100 indicates a shoreline that is nearly pristine.

How does your lake compare to others in the program?



Duck Lake:	
Number of Sections:	15
Number of Structures:	87
Structure Density:	5.8
Final Score:	79

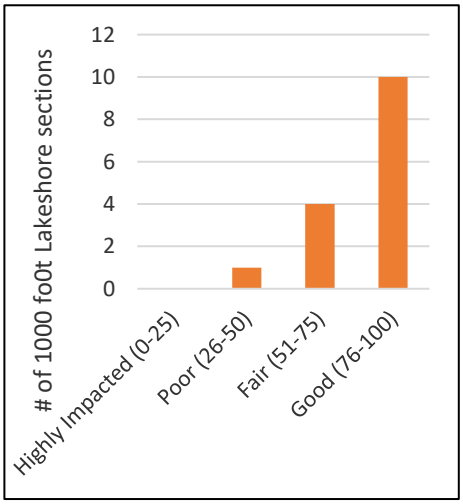
All 42 Participating Lakes from 2015-2017:	
Avg. Number of Sections:	16.3
Avg. Number of Structures:	248.5
Avg. Structure Density:	15.2
Avg. Final Score:	70.5

Analysis specific to Duck Lake:

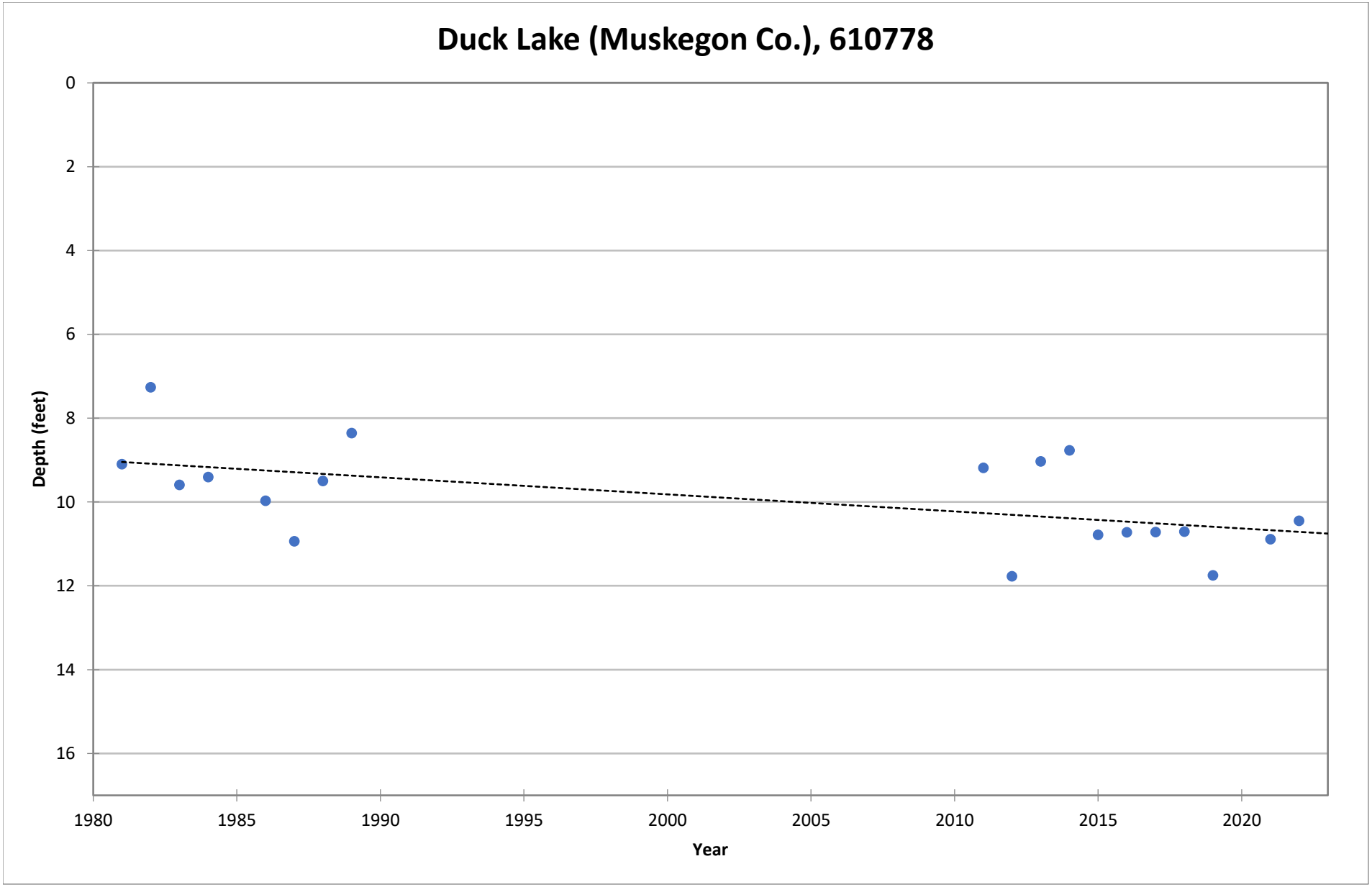
Duck Lake scored well in the riparian score, meaning that (in general) there were plentiful non-mowed areas. Duck Lake also scored well in erosion management, meaning that there was a low amount of sea walls and other shoreline erosion structures.

The weakest point of Duck Lake assessment was the littoral zone (shallow water near the shore). Increasing aquatic vegetation, allowing fallen trees to remain in the water, and reducing shoreline erosion would be the primary way to boost the this score. A score of 67 for the littoral zone is not bad, but if residents in Duck Lake want to improve the overall shoreline quality, this is the component to concentrate on.

There was one 1000 foot section that was particularly problematic in Duck Lake. The graph above shows that 14/15 of the 1000 foot sections score either a Good (score of 51-75) or Excellent (score greater than 75), but one section scored as Fair (score of 26-50). This section was section 5, which had a total score of 41 (littoral score of 50, riparian score of 27, and shoreline management score of 44).

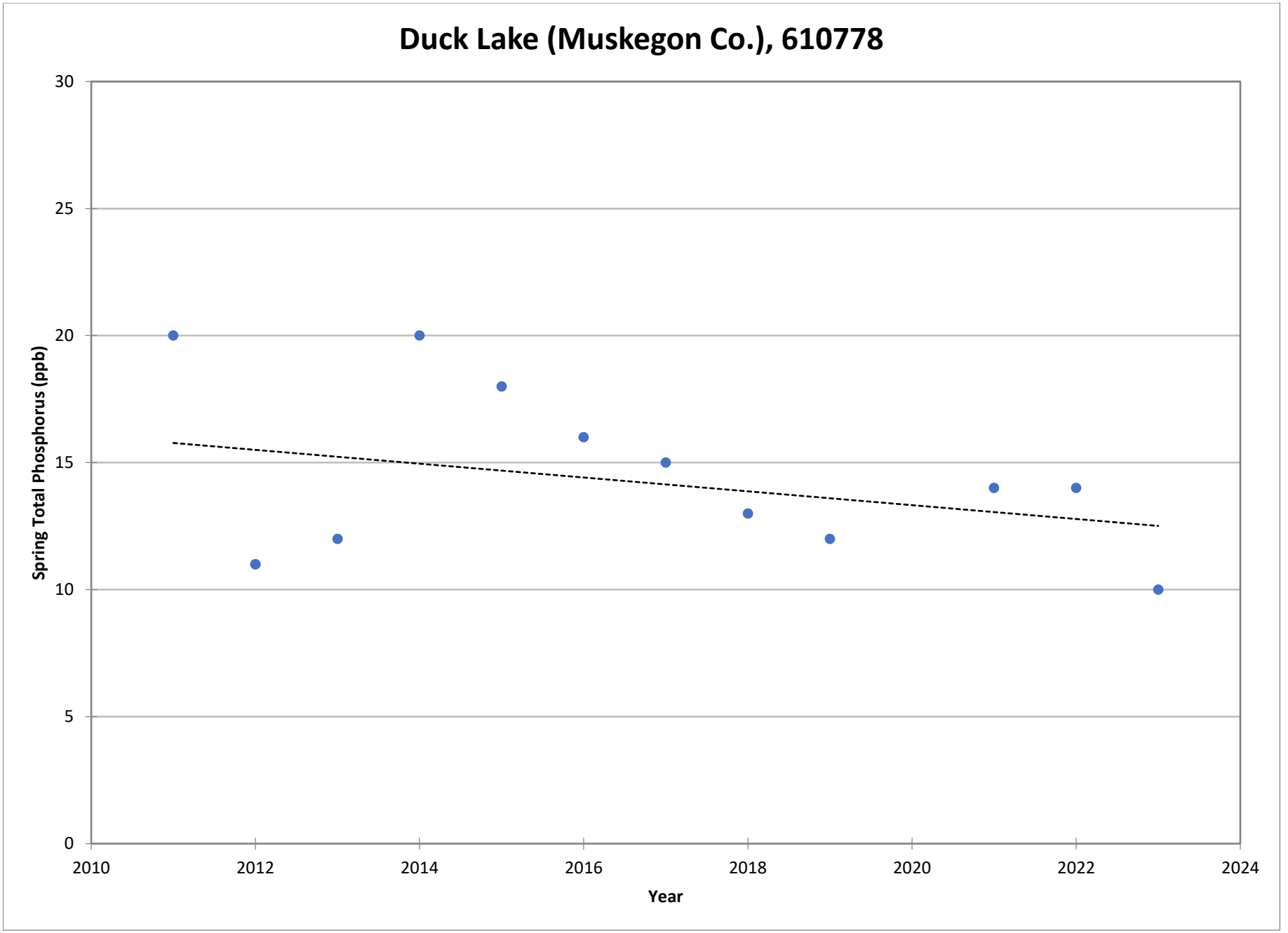


COOPERATIVE LAKES MONITORING PROGRAM
SUMMER MEAN TRANSPARENCY

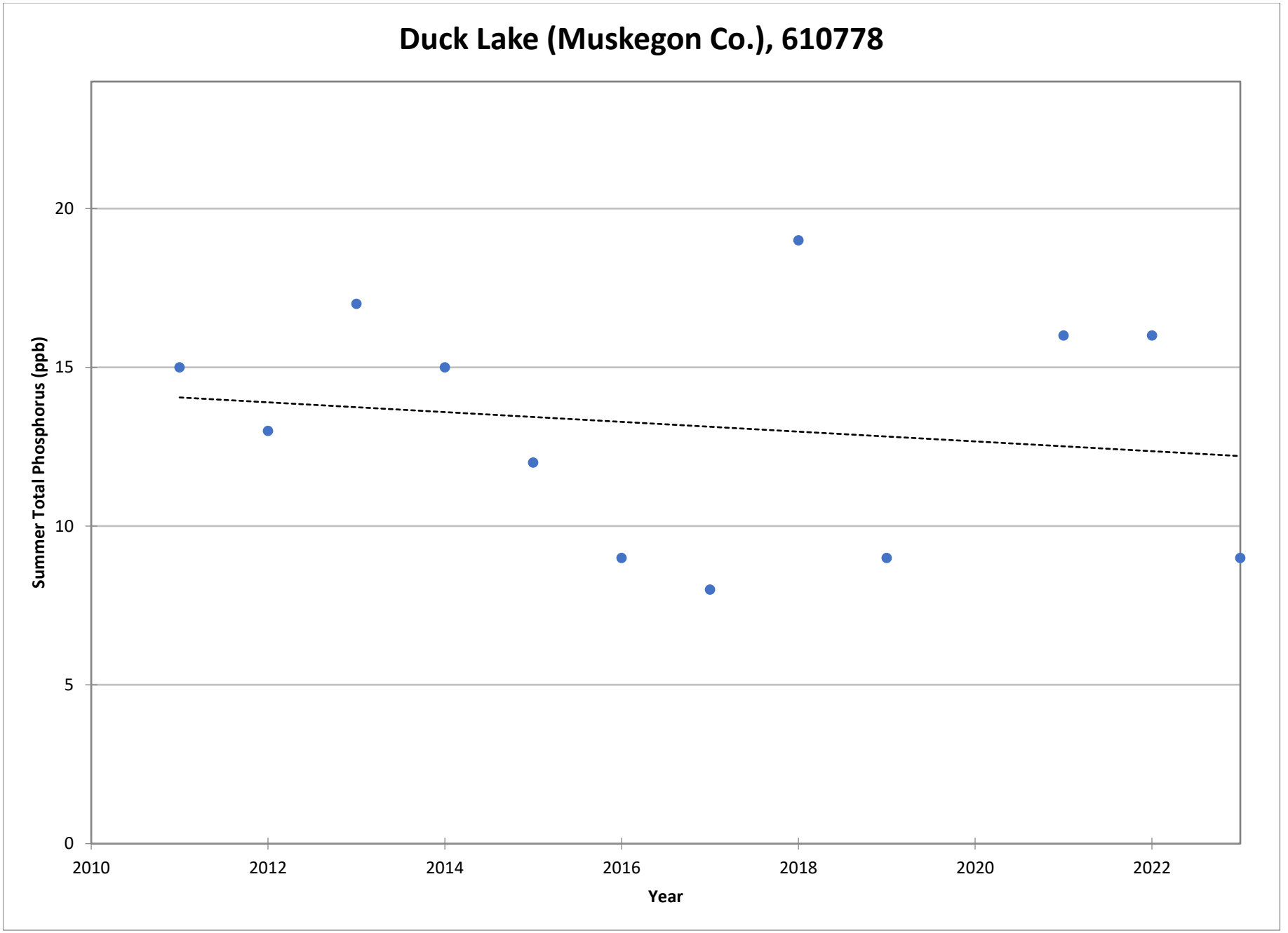


Vertical bars indicate standard deviation

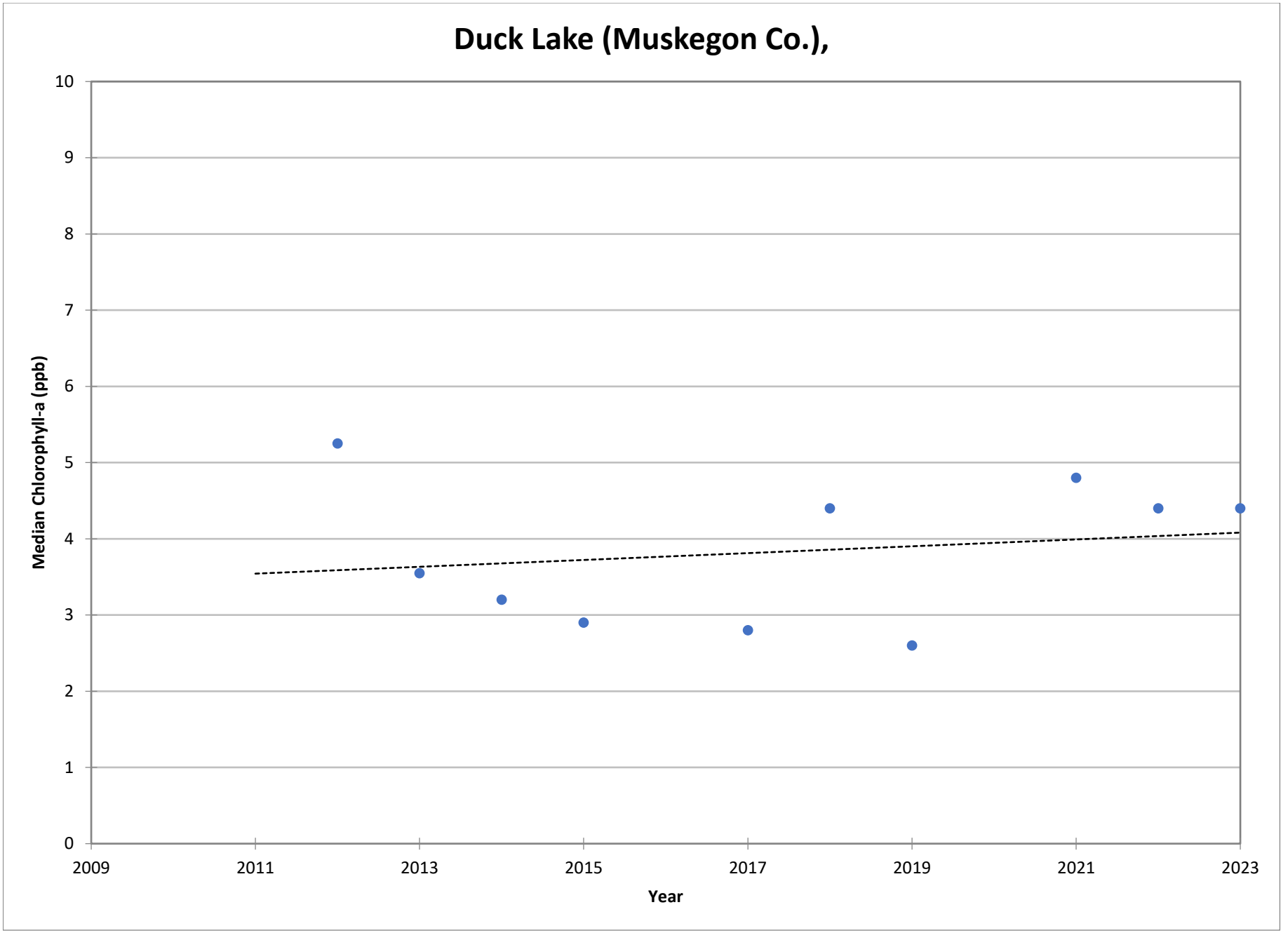
COOPERATIVE LAKES MONITORING PROGRAM
SPRING TOTAL PHOSPHORUS



COOPERATIVE LAKES MONITORING PROGRAM
SUMMER TOTAL PHOSPHORUS



COOPERATIVE LAKES MONITORING PROGRAM
SUMMER MEDIAN CHLOROPHYLL-A



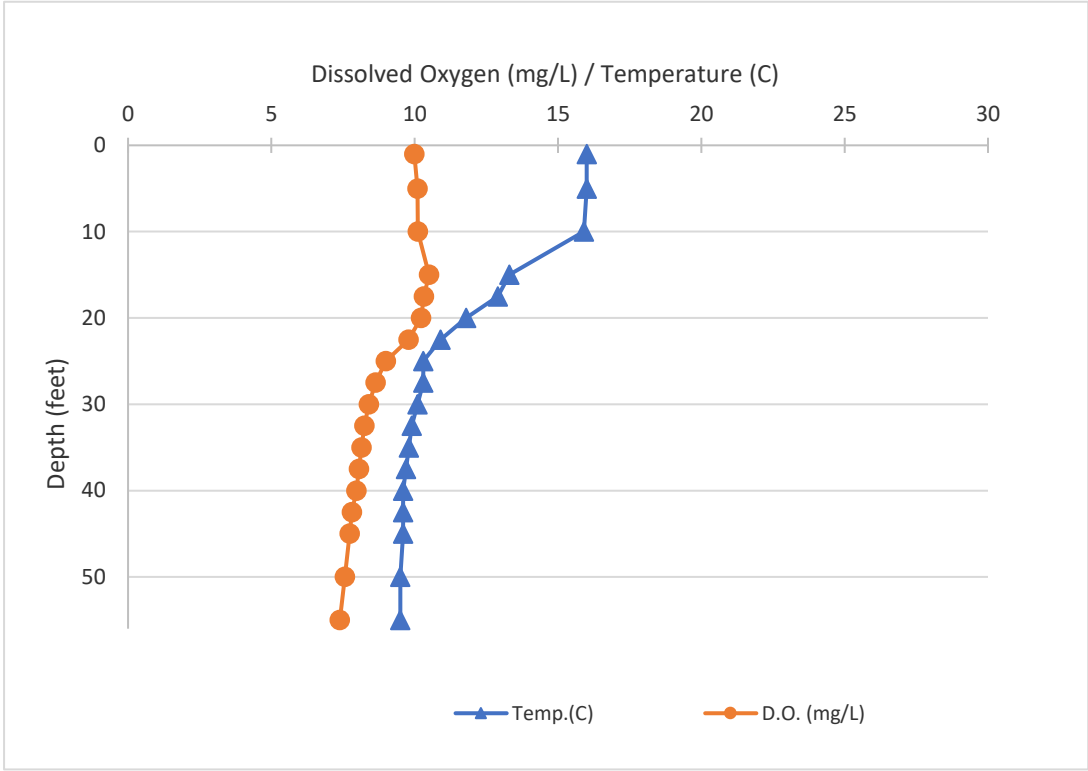
Vertical bars indicate standard deviation

Name: Duck Lake
County: Muskegon
Site ID: 610778
Date: 5/17/2023

Dissolved Oxygen and Temperature Profile

Lake: Duck Lake (Muskegon Co.) **5/17/2023**

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	16	9.99
5	16	10.1
10	15.9	10.11
15	13.3	10.5
17.5	12.9	10.32
20	11.8	10.22
22.5	10.9	9.79
25	10.3	8.99
27.5	10.3	8.64
30	10.1	8.4
32.5	9.9	8.25
35	9.8	8.14
37.5	9.7	8.06
40	9.6	7.97
42.5	9.6	7.81
45	9.6	7.73
50	9.5	7.57
55	9.5	7.39

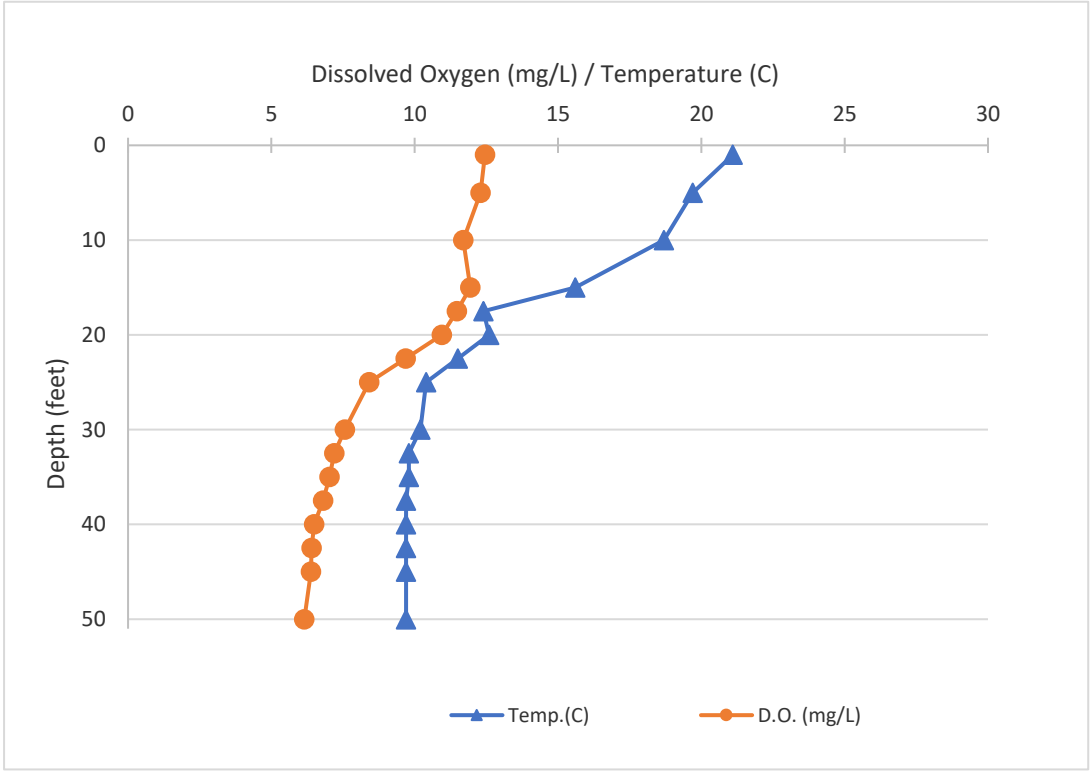


Name: Duck Lake
County: Muskegon
Site ID: 610778
Date: 5/30/2023

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	21.1	12.45
5	19.7	12.3
10	18.7	11.7
15	15.6	11.94
17.5	12.4	11.47
20	12.6	10.95
22.5	11.5	9.69
25	10.4	8.41
30	10.2	7.57
32.5	9.8	7.2
35	9.8	7.03
37.5	9.7	6.8
40	9.7	6.49
42.5	9.7	6.4
45	9.7	6.38
50	9.7	6.15

Lake: Duck Lake (Muskegon Co.) **5/30/2023**

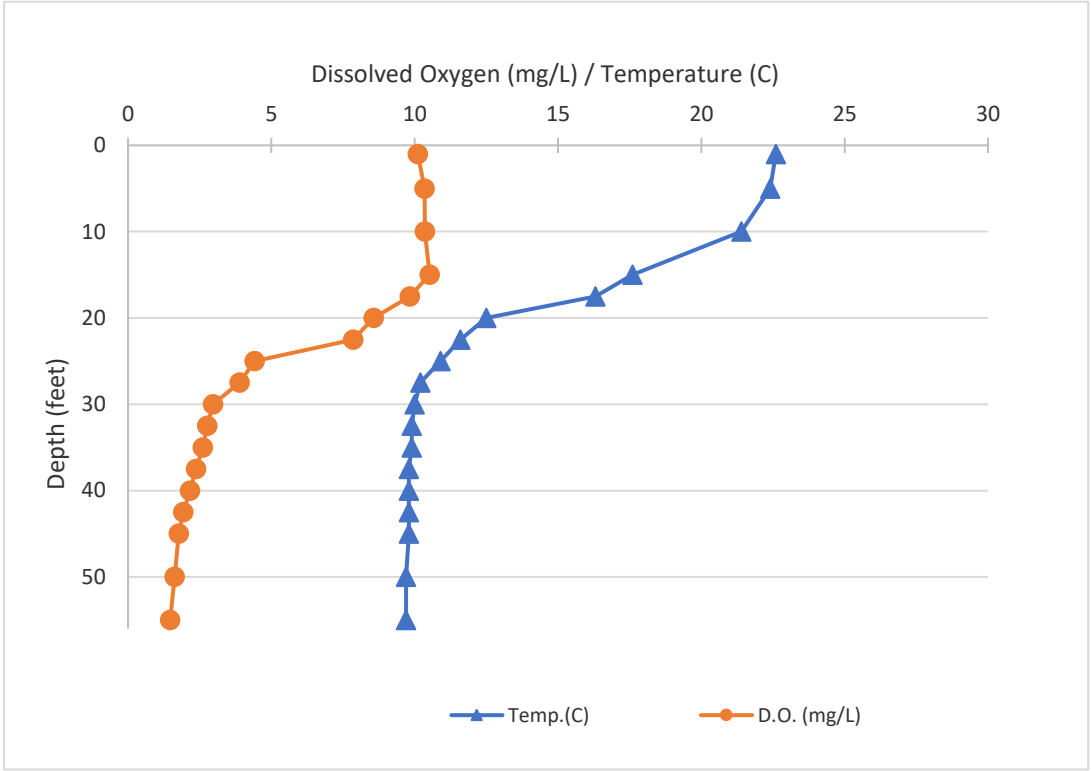


Name: Duck Lake
County: Muskegon
Site ID: 610778
Date: 6/20/2023

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	22.6	10.11
5	22.4	10.34
10	21.4	10.36
15	17.6	10.52
17.5	16.3	9.83
20	12.5	8.57
22.5	11.6	7.85
25	10.9	4.42
27.5	10.2	3.89
30	10	2.96
32.5	9.9	2.76
35	9.9	2.61
37.5	9.8	2.37
40	9.8	2.16
42.5	9.8	1.93
45	9.8	1.77
50	9.7	1.63
55	9.7	1.47

Lake: Duck Lake (Muskegon Co.) **6/20/2023**

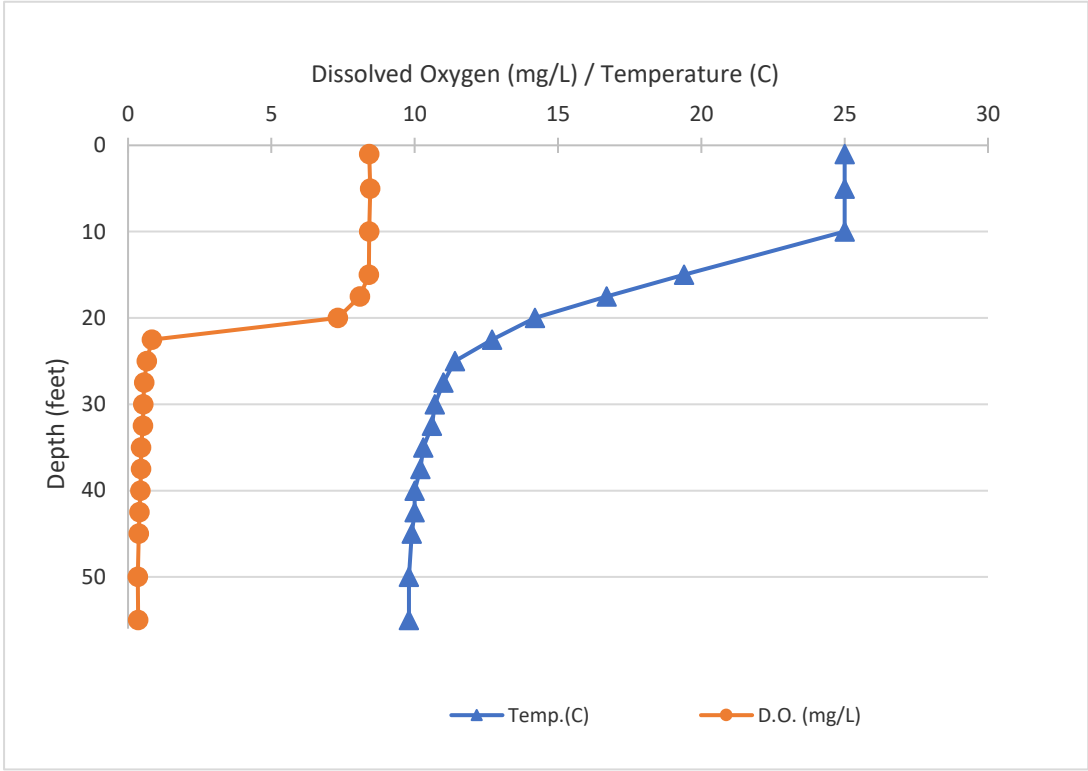


Name: Duck Lake
County: Muskegon
Site ID: 610778
Date: 7/11/2023

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	25	8.41
5	25	8.45
10	25	8.41
15	19.4	8.4
17.5	16.7	8.09
20	14.2	7.32
22.5	12.7	0.83
25	11.4	0.65
27.5	11	0.57
30	10.7	0.53
32.5	10.6	0.52
35	10.3	0.45
37.5	10.2	0.45
40	10	0.43
42.5	10	0.4
45	9.9	0.38
50	9.8	0.34
55	9.8	0.35

Lake: Duck Lake (Muskegon Co.) **7/11/2023**

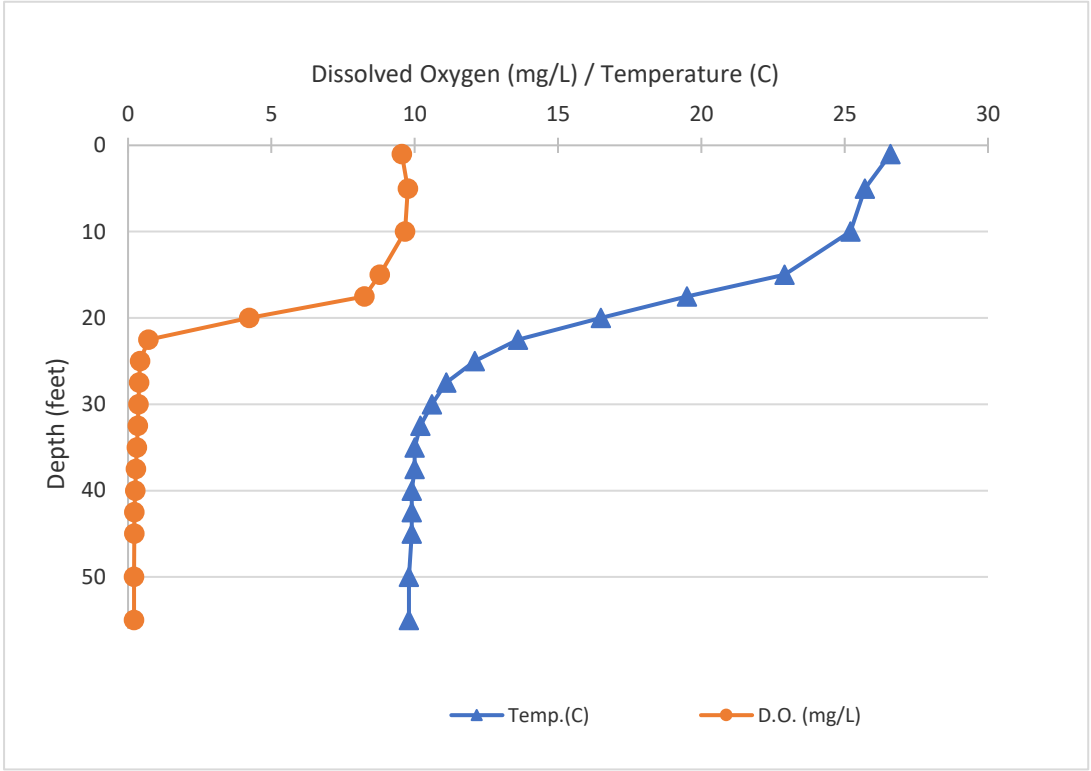


Name: Duck Lake
County: Muskegon
Site ID: 610778
Date: 7/27/2023

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	26.6	9.55
5	25.7	9.76
10	25.2	9.66
15	22.9	8.78
17.5	19.5	8.24
20	16.5	4.23
22.5	13.6	0.71
25	12.1	0.42
27.5	11.1	0.39
30	10.6	0.36
32.5	10.2	0.34
35	10	0.31
37.5	10	0.28
40	9.9	0.25
42.5	9.9	0.22
45	9.9	0.22
50	9.8	0.21
55	9.8	0.21

Lake: Duck Lake (Muskegon Co.) **7/27/2023**

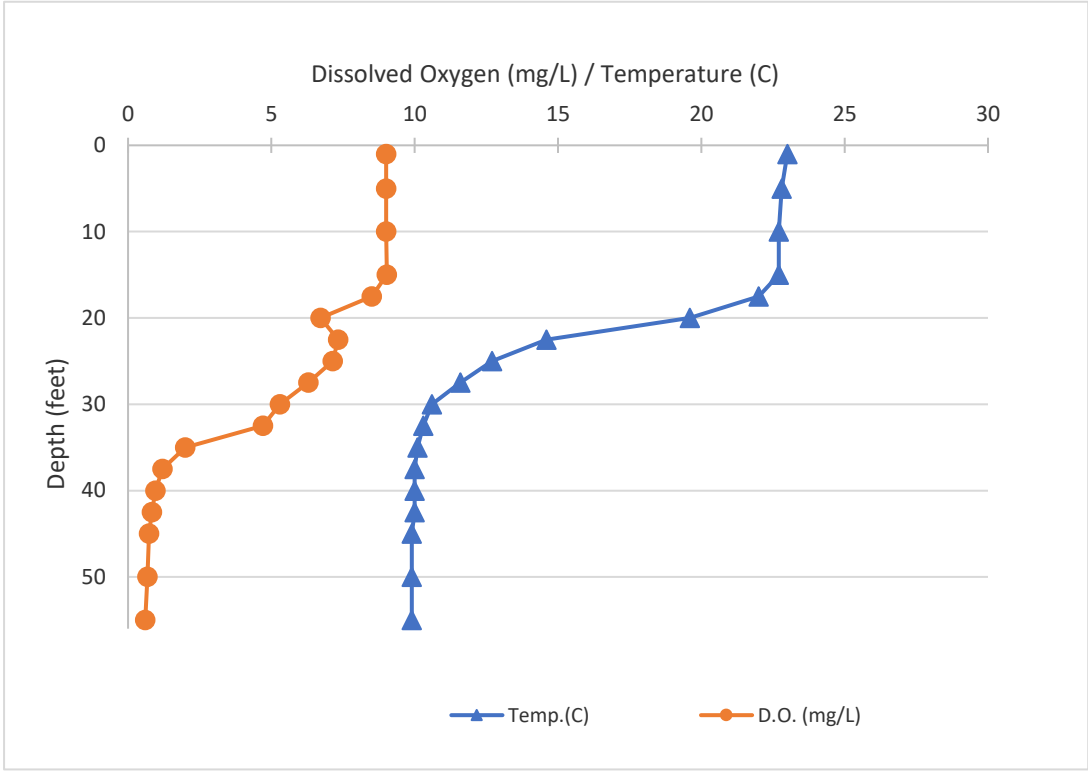


Name: Duck Lake
County: Muskegon
Site ID: 610778
Date: 8/16/2023

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	23	9.01
5	22.8	9
10	22.7	9.01
15	22.7	9.03
17.5	22	8.5
20	19.6	6.72
22.5	14.6	7.33
25	12.7	7.14
27.5	11.6	6.29
30	10.6	5.3
32.5	10.3	4.71
35	10.1	1.99
37.5	10	1.2
40	10	0.96
42.5	10	0.83
45	9.9	0.73
50	9.9	0.68
55	9.9	0.6

Lake: Duck Lake (Muskegon Co.) **8/16/2023**



Name: Duck Lake
County: Muskegon
Site ID: 610778
Date: 9/15/2023

Dissolved Oxygen and Temperature Profile

Lake: Duck Lake (Muskegon Co.) **9/15/2023**

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	20.8	7.14
5	20.4	7.3
10	20.2	7.13
15	19.9	7
17.5	19.8	6.64
20	19.1	6.19
22.5	17.1	4.61
25	14.1	3.63
27.5	11.8	2.52
30	10.8	0.38
32.5	10.6	0.24