



**2017 Data Report
for
Duck Lake, Muskegon County**

Site ID: 610778

43.33785°N, 86.39258°W

The CLMP is brought to you by:



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/CLMP-Manual.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: Marcy Knoll Wilmes, Jean Roth, Jo Latimore, Paul Steen, Scott Brown, Laura Kaminski, and Michele Leduc-Lapierre

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:

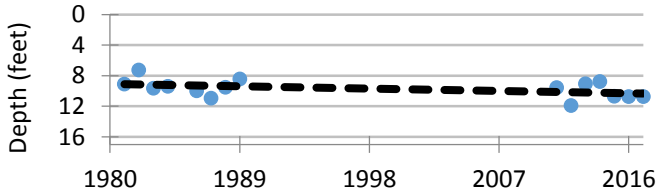
Paul Steen (psteen@hrwc.org), MiCorps Program Manager

Duck Lake, Muskegon County 2017 CLMP Results



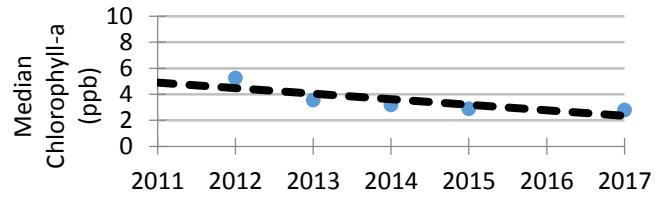
Secchi Disk Transparency (feet)

Year	# Readings	Min	Max	Average	Std. Dev	Carlson TSI
2017	16	8.0	13.0	10.7	1.5	43
2011-2016	74	6.5	14.5	10.7	1.4	44
1981-1989	157	4.5	15.5	9.3	1.9	45
2017 All CLMP Lakes	2949	1.0	52.0	12.3	2.7	43



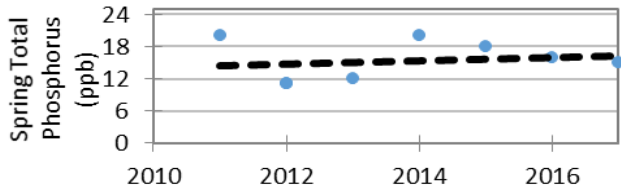
Chlorophyll-a (parts per billion)

Year	# Samples	Min	Max	Median	Std. Dev	Carlson TSI
2017	5	<1.0	4.0	2.8	1.3	41
2012-2016	21	1.1	7.8	3.4	1.6	42
2011	1	5.6	5.6			
2017 All CLMP Lakes	628	< 1.0	28.0	1.8	4.3	36



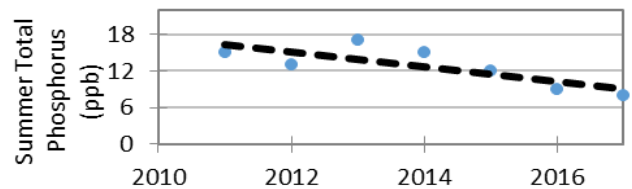
Spring Phosphorus (parts per billion)

Year	# Samples	Min	Max	Average	Std. Dev	Carlson TSI
2017	1	15.0	15.0	15.0	NA	
2012-2016	5	11.0	20.0	15.4	3.8	
2011	1	20.0	20.0	20.0	NA	
2017 All CLMP Lakes	188	<= 3	120	11.6	12.7	



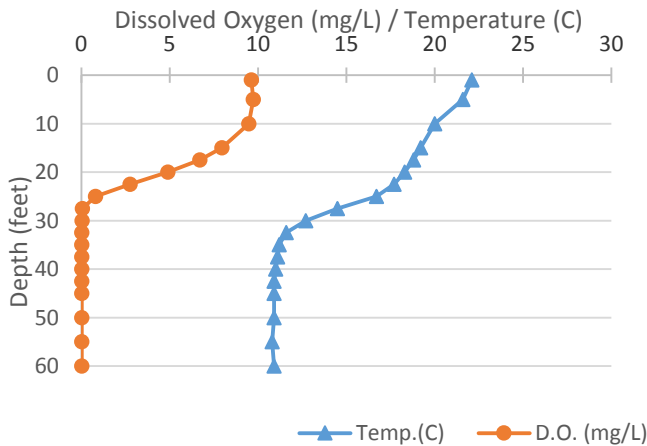
Summer Phosphorus (parts per billion)

Year	# Samples	Min	Max	Average	Std. Dev	Carlson TSI
2017	1	8.0	8.0	8.0	NA	34
2012-2016	5	9.0	17.0	13.2	3.0	41
2011	1	15.0	15.0	15.0	NA	43
2017 All CLMP Lakes	208	<= 3	52.0	11.1	8.4	39



Dissolved Oxygen and Temperature Profile

9/17/2017



Summary

Average TSI	2017	2011-2016	1981-1989
Duck Lake	39	42	44
All CLMP Lakes	40	40	45

With an average TSI score of 39 based on 2017 Secchi transparency, chlorophyll-a, and summer total phosphorus data, this lake is rated between the oligotrophic and mesotrophic lake classification. The lake leans slightly more mesotrophic than oligotrophic.

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

Long term monitoring shows slight downward slopes on the parameters, indicating a very slow movement toward lower nutrient

* = No sample received W= Value is less than the detection limit (<3 ppb) T= Value reported is less than the reporting limit (5 ppb). Result is estimated.
<1.0 = Chlorophyll-a: Sample value is less than limit of quantification (<1 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.

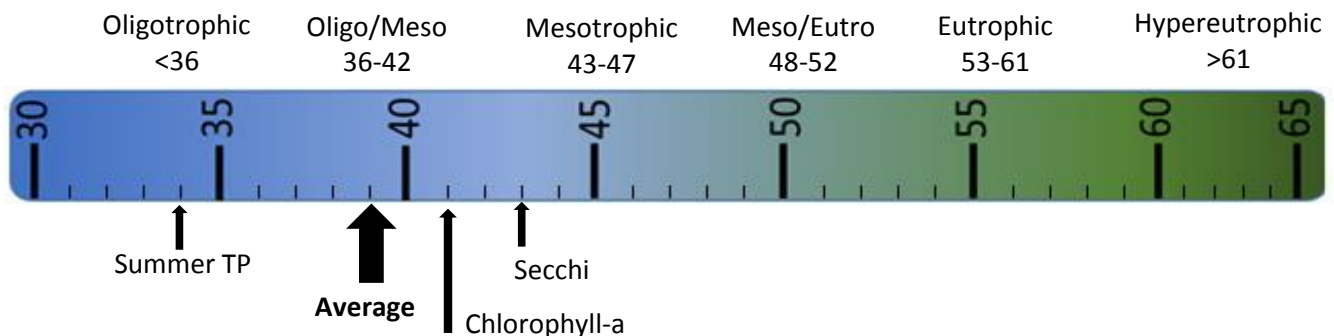
The tables below give the results-to-TSI conversions for the water quality data ranges normally seen in the CLMP. The formulas for this conversion can be found in the CLMP manual (<https://micorps.net/wp-content/uploads/CLMP-Manual.pdf>).

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 2017	
Average	39
Secchi Disk	43
Summer TP	34
Chlorophyll-a	41



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 eutrophic lakes. These lakes exhibit extremely high productivity, such as nuisance algae and weed growth.

Duck Lake, Muskegon County 2017 CLMP Aquatic Plant Results



Duck Lake does not have aquatic plant data available for 2017. Consider enrolling in an aquatic plant parameter next year.

Why is monitoring aquatic plants important?

A major component of the plant community in lakes is the large, leafy, rooted plants. Compared to the microscopic algae the rooted plants are large. Sometimes they are collectively called the “macrophytes” (“macro” meaning large and “phyte” meaning plant). These macrophytes are the plants that people sometimes complain about and refer to as lake weeds.

Far from being weeds, macrophytes or rooted aquatic plants are a natural and essential part of the lake, just as grasses, shrubs and trees are a natural part of the land. Their roots are a fabric for holding sediments in place, reducing erosion and maintaining bottom stability. They provide habitat for fish, including structure for food organisms, nursery areas, foraging and predator avoidance. Waterfowl, shore birds and aquatic mammals use plants to forage on and within, and as nesting materials and cover.

Though plants are important to the lake, overabundant plants can negatively affect fish populations, fishing and other recreational activities. Rooted plant populations increase in abundance as nutrient concentrations increase in the lake. As lakes become more eutrophic rooted plant populations increase. They are rarely a problem in oligotrophic lakes, only occasionally a problem in mesotrophic lakes, sometimes a problem in eutrophic lakes, and often a problem in hypereutrophic lakes.

However, sometimes a lake is invaded by an aquatic plant species that is not native to Michigan. In these cases, even nutrient poor oligotrophic lakes can be threatened. Some of these exotic plants, like Curly-leaf Pondweed, Eurasian Milfoil, Starry Stonewort, and Hydrilla can be extremely disruptive to the lake’s ecosystem and recreational activities.

To avoid a takeover by exotic plants, it is necessary to use Integrated Pest Management (IPM) strategies: monitoring, early detection, rapid response, maintenance control, and preventive management. For more information on these strategies, check out Integrated Pest Management for Nuisance Exotics in Michigan Inland Lakes (MSU Extension Water Quality Publication WQ-56, available at <https://micorps.net/lake-monitoring/clmp-documents/>)

The CLMP offers two parameters on aquatic plants. In the Exotic Aquatic Plant Watch, volunteers concentrate on monitoring and early detection of exotic invasive plants only. In Aquatic Plant Identification and Mapping, volunteers identify all native and non-native plants. In both parameters, volunteers create lake maps or use digital tools to georeference where the plants are found.

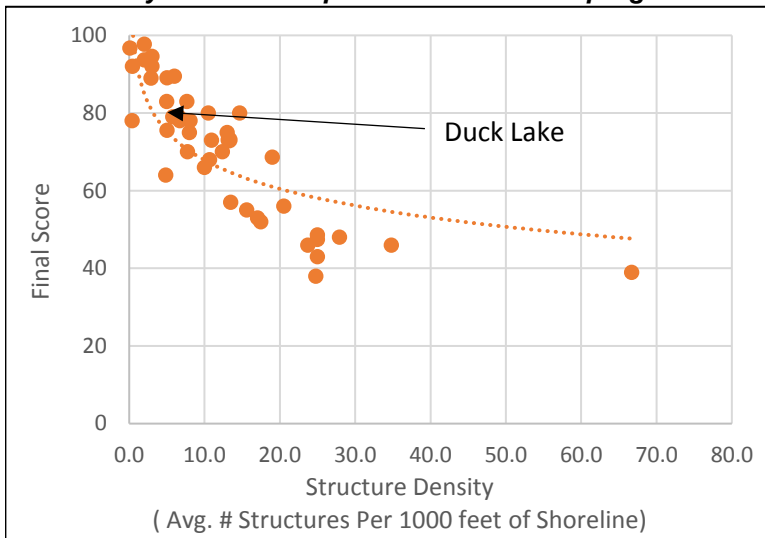
Duck Lake, Muskegon County 2015 Score the Shore Results



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

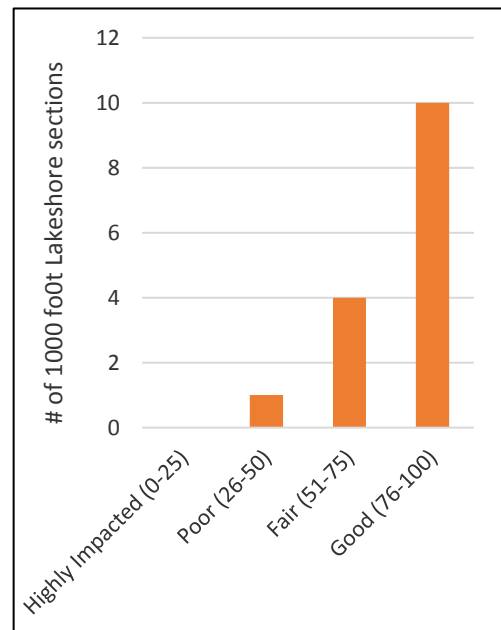
There is a very tight relationship between Final Score and Structure Density. It will be interesting to see if and how this changes as more lakes go through this scoring process.

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 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).



Duck Lake, Muskegon County 2017 Score the Shore Results



Duck Lake does not have shoreline habitat assessment results for 2017. Consider enrolling in this parameter next year!

Why is the Score the Shore parameter important?

Healthy shorelines are an important and valuable component of the lake ecosystem. The shoreline area is a transition zone between water and land, and should be a very diverse environment that provides habitat for a great variety of fish, plants, birds, and other animals. A healthy shoreline area is also essential for maintaining water quality, slowing runoff, and limiting erosion.

However, Michigan's inland lake shorelines are threatened. Extensive development, often combined with poor shoreline management practices, can reduce or eliminate natural shoreline habitat and replace it with lawn and artificial erosion control such as sea walls and rock. As a result, shoreline vegetation is dramatically altered, habitat is lost, and water quality declines.

Therefore, in 2017 the MiCorps Cooperative Lakes Monitoring Program introduced a new monitoring program – Score the Shore – that enables volunteers to assess the quality of their lake's shoreline habitat.

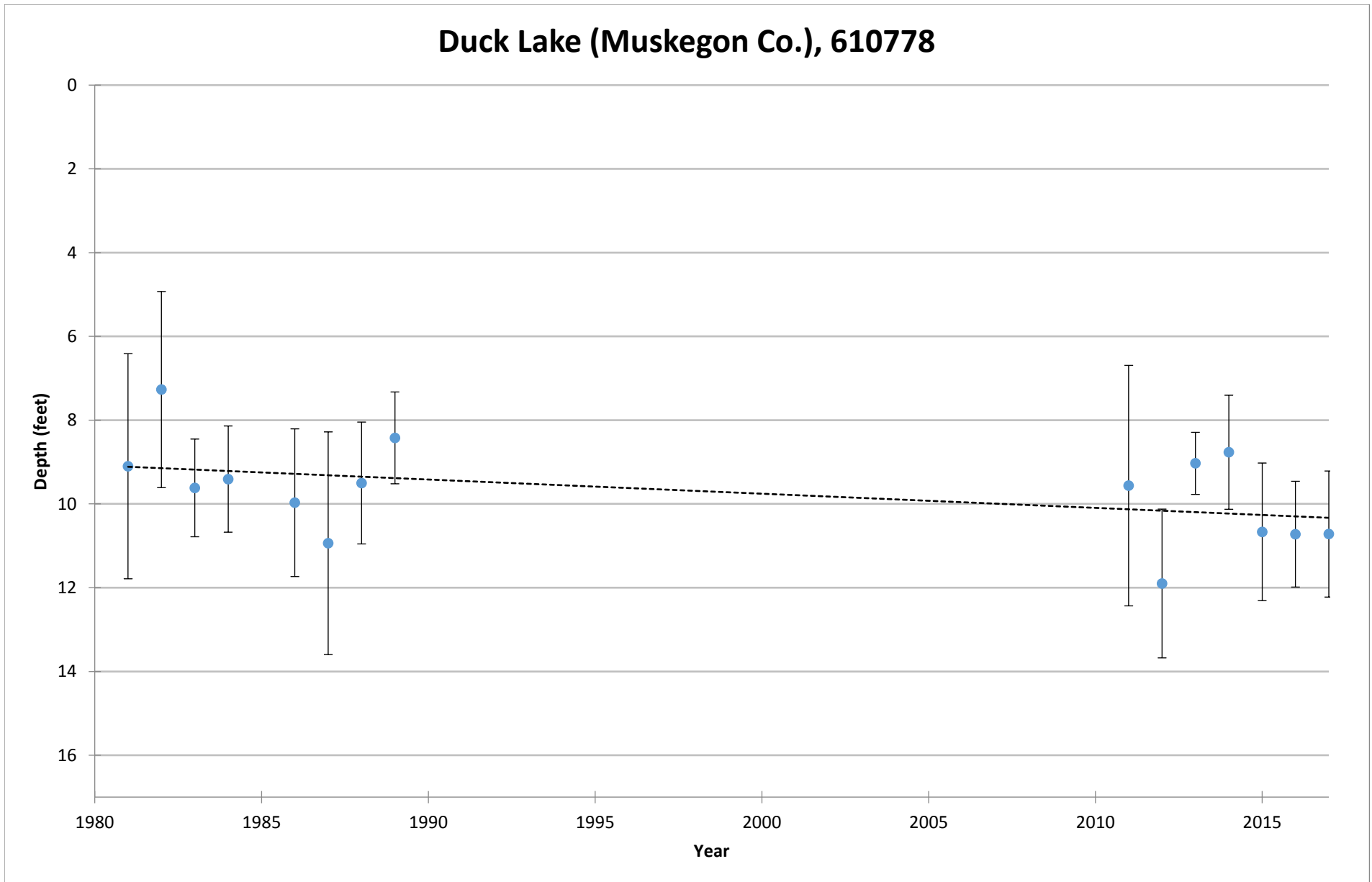
The information gathered during this assessment will allow lake communities to identify high-quality areas that can be protected, as well as opportunities for improvement. Score the Shore data, combined with educational resources describing the value of healthy shorelines and how to restore and maintain them, can be incorporated into lake management planning and used for educating lakefront property owners. The Michigan Natural Shoreline Partnership (MNSP) is a collaboration of agencies and professionals that promotes natural shoreline practices to protect Michigan's inland lakes. The MNSP website (www.mishorelinepartnership.org) includes materials and information that can be used in educational efforts. MNSP also offers training for professional educators and landscape contractors, and maintains a list of trained educators who may be available to speak to your community about natural shorelines.

Score the Shore data, just like all CLMP data, will also be available to any interested parties through the MiCorps Data Exchange (www.micorps.net). State agency staff and researchers regularly access CLMP data to better understand and manage Michigan's inland lakes.

Score the Shore is a descriptive process for assessing shoreline quality on Michigan's inland lakes. It is also a valuable educational tool. Score the Shore is not a regulatory program, nor is it intended to tell people what they can and cannot do on their property. The Michigan Department of Environmental Quality's Inland Lakes and Streams Program has responsibility for shoreline protection on public lakes. To learn about their shoreline protection program, including construction permitting and recommendations for shoreline management, visit www.mi.gov/deqinlandlakes.

COOPERATIVE LAKES MONITORING PROGRAM
SUMMER MEAN TRANSPARENCY

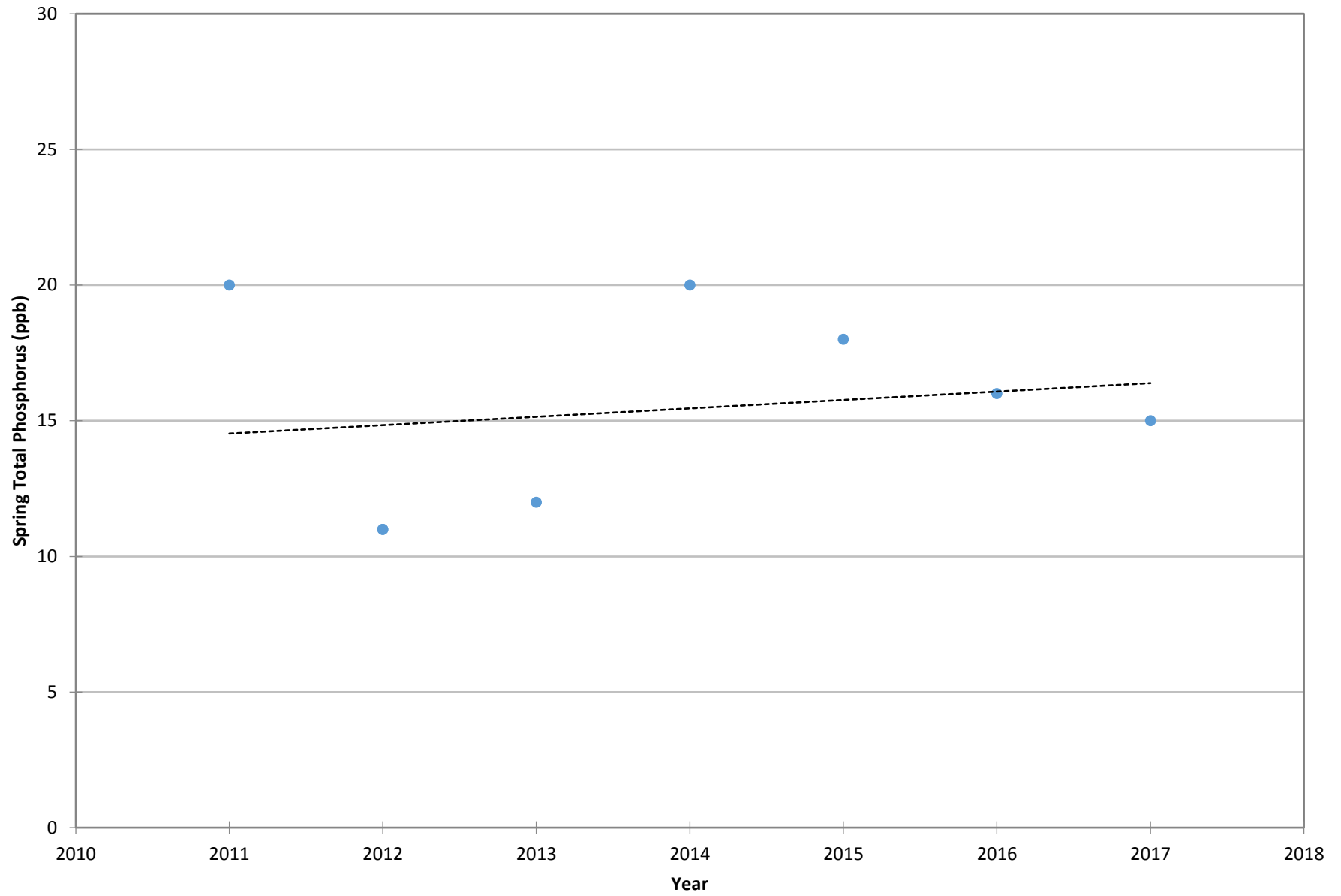
Duck Lake (Muskegon Co.), 610778



Vertical bars indicate standard deviation

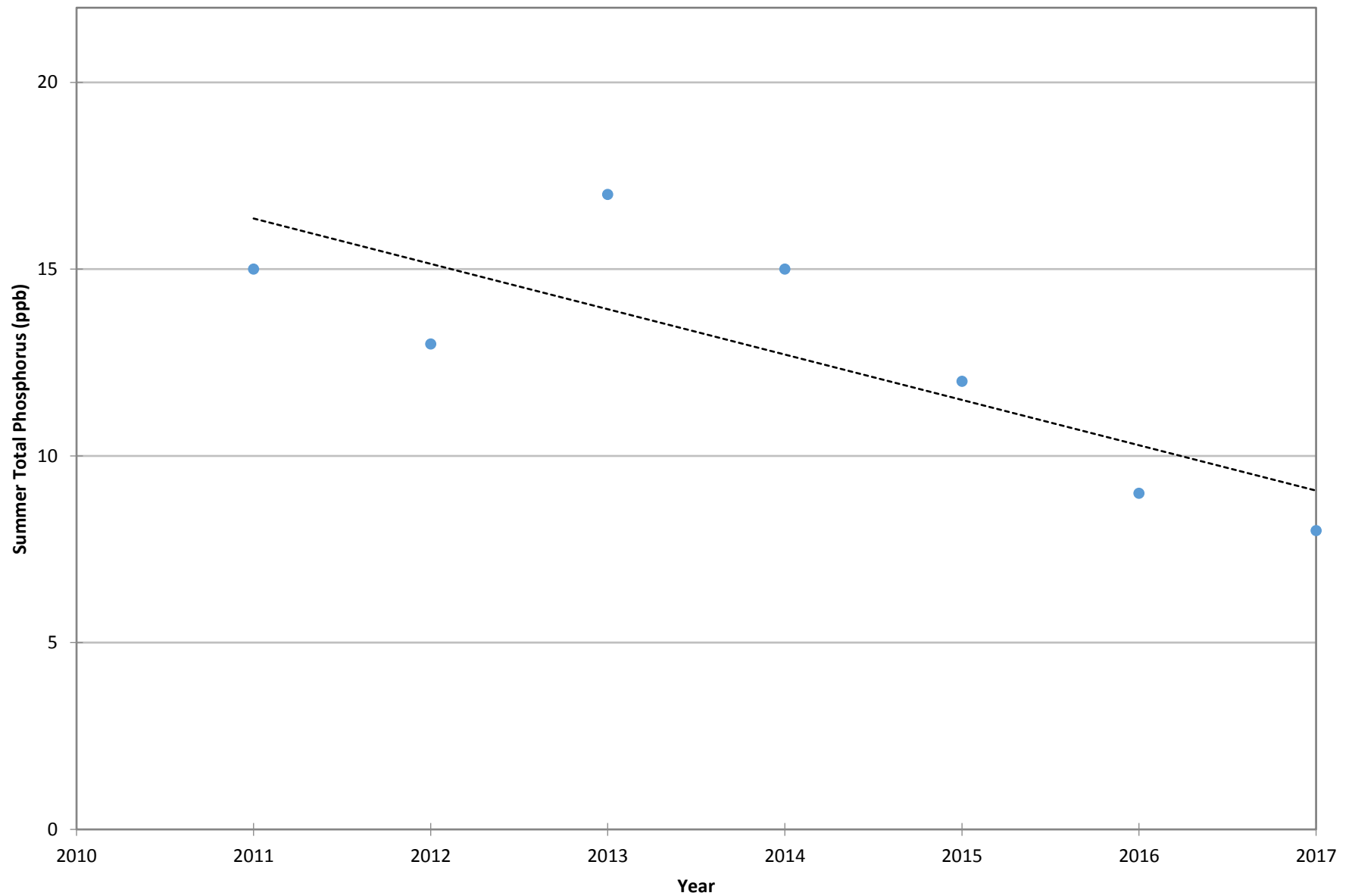
COOPERATIVE LAKES MONITORING PROGRAM
SPRING TOTAL PHOSPHORUS

Duck Lake (Muskegon Co.), 610778



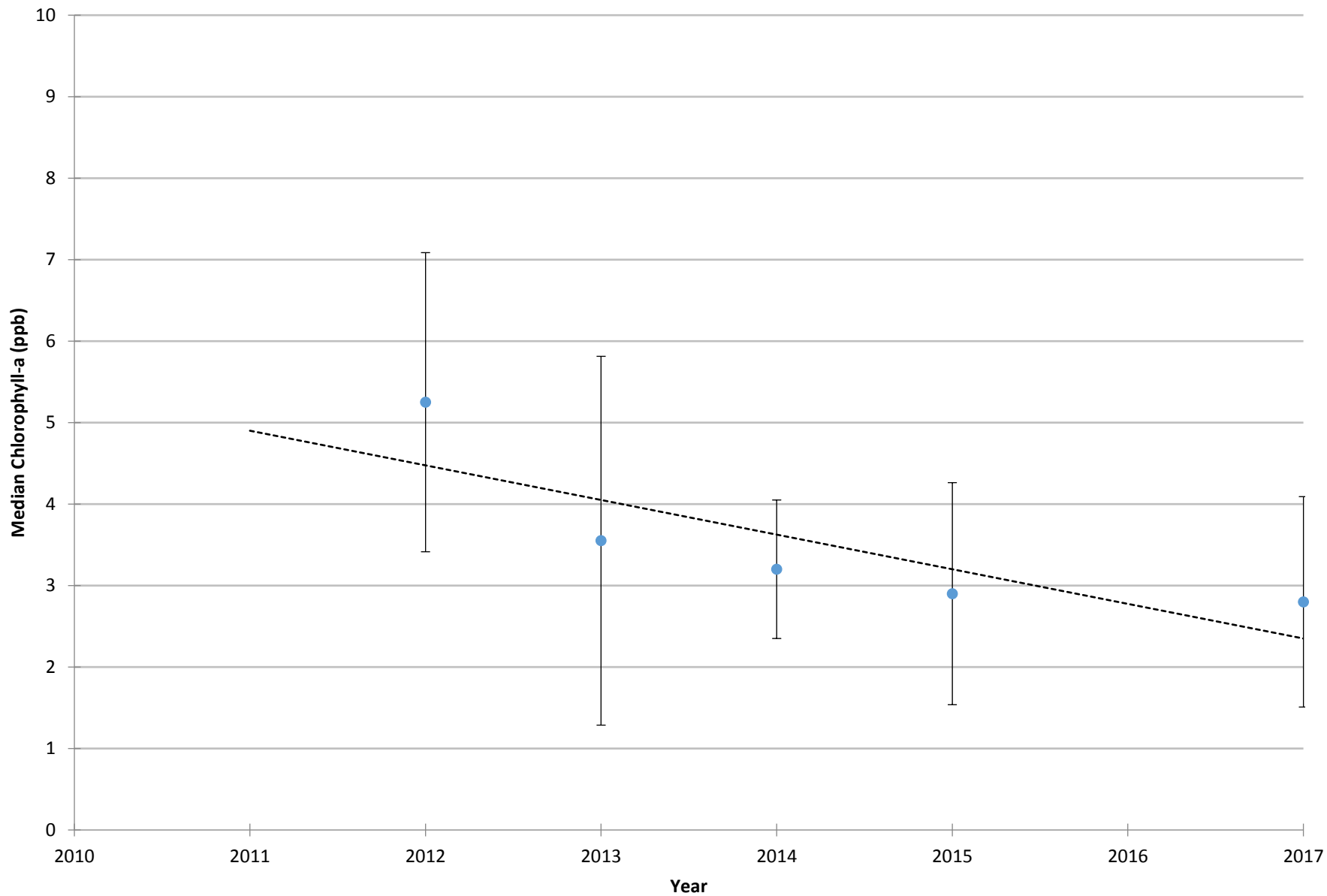
COOPERATIVE LAKES MONITORING PROGRAM
SUMMER TOTAL PHOSPHORUS

Duck Lake (Muskegon Co.), 610778



COOPERATIVE LAKES MONITORING PROGRAM
SUMMER MEDIAN CHLOROPHYLL-A

Duck Lake (Muskegon Co.), 610778



Vertical bars indicate standard deviation

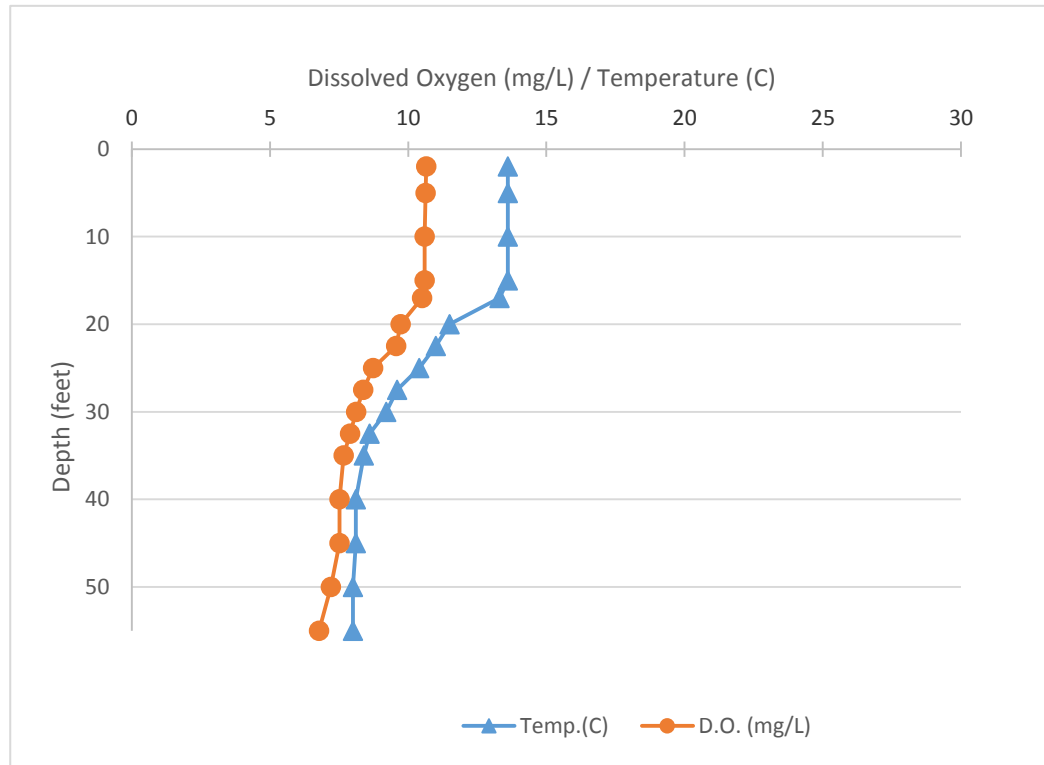
Name: Duck Lake
 County: Muskegon
 Site ID: 610778
 Date: 4/29/2017

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
2	13.6	10.65
5	13.6	10.63
10	13.6	10.59
15	13.6	10.59
17	13.3	10.5
20	11.5	9.73
22.5	11	9.57
25	10.4	8.73
27.5	9.6	8.37
30	9.2	8.12
32.5	8.6	7.9
35	8.4	7.67
40	8.1	7.51
45	8.1	7.51
50	8	7.2
55	8	6.78

Lake: Duck Lake (Muskegon Co.)

4/29/2017



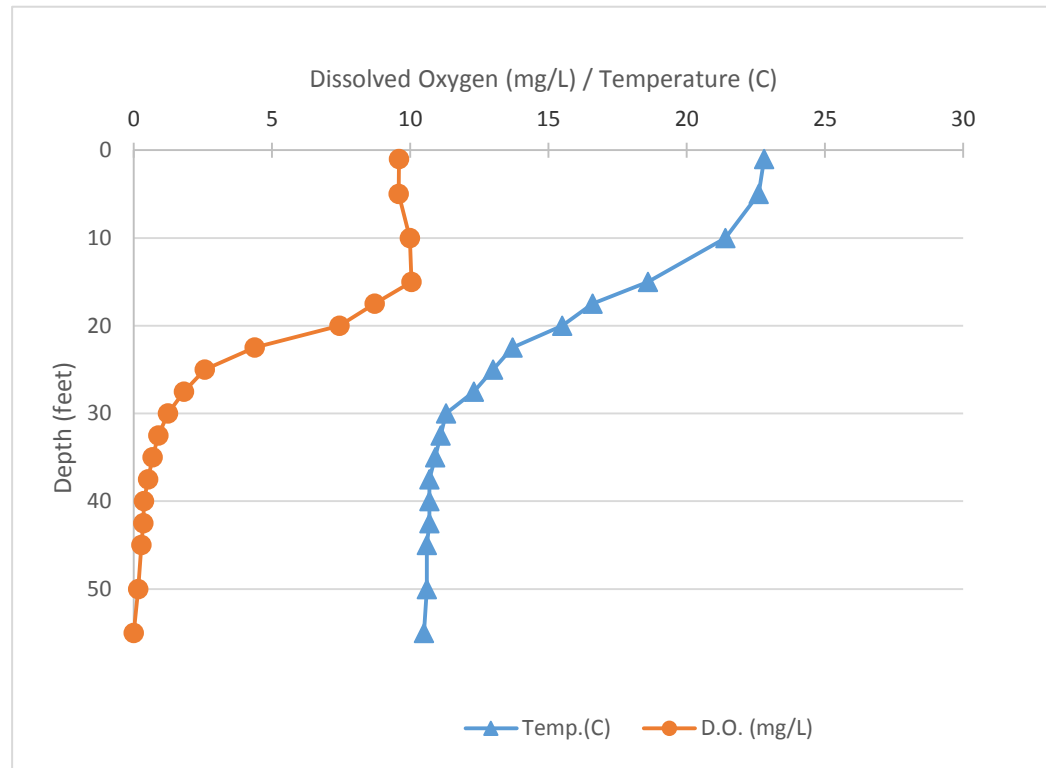
Name: Duck Lake
County: Muskegon
Site ID: 610778
Date: 6/10/2017

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	22.8	9.6
5	22.6	9.58
10	21.4	9.99
15	18.6	10.05
17.5	16.6	8.72
20	15.5	7.44
22.5	13.7	4.37
25	13	2.57
27.5	12.3	1.82
30	11.3	1.24
32.5	11.1	0.89
35	10.9	0.68
37.5	10.7	0.52
40	10.7	0.37
42.5	10.7	0.35
45	10.6	0.28
50	10.6	0.16
55	10.5	0

Lake: Duck Lake (Muskegon Co.)

6/10/2017



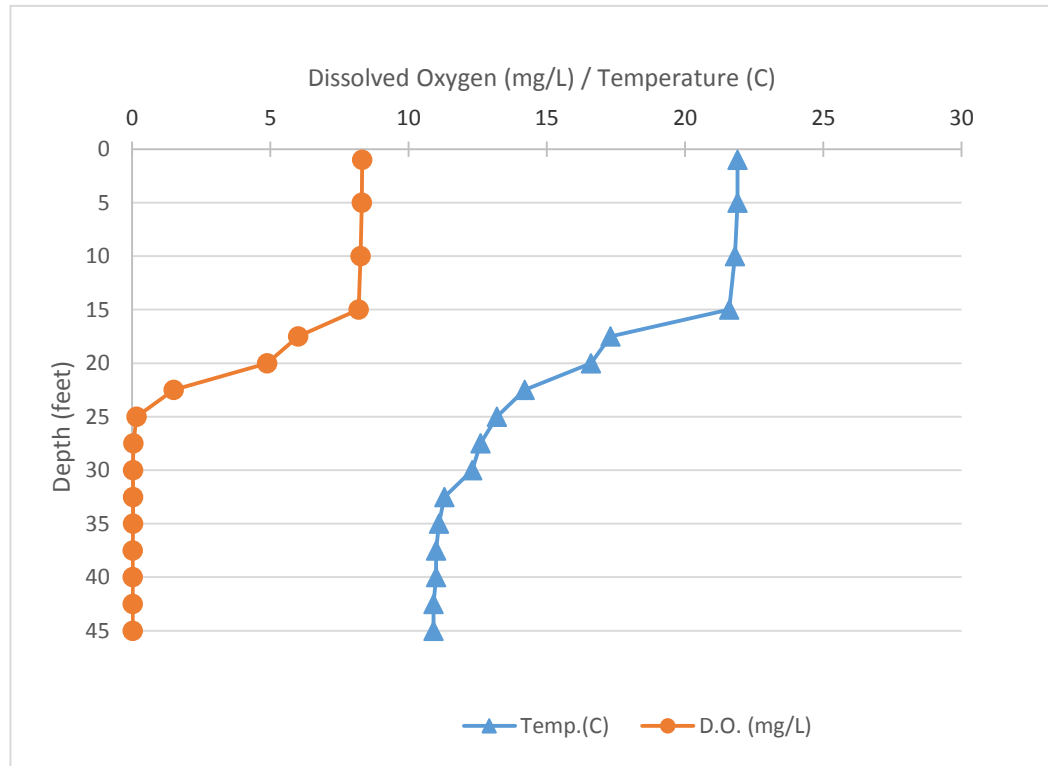
Name: Duck Lake
 County: Muskegon
 Site ID: 610778
 Date: 6/25/2017

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	21.9	8.32
5	21.9	8.31
10	21.8	8.26
15	21.6	8.2
17.5	17.3	6.01
20	16.6	4.89
22.5	14.2	1.5
25	13.2	0.16
27.5	12.6	0.05
30	12.3	0.04
32.5	11.3	0.03
35	11.1	0.03
37.5	11	0.02
40	11	0.02
42.5	10.9	0.02
45	10.9	0.02

Lake: Duck Lake (Muskegon Co.)

6/25/2017



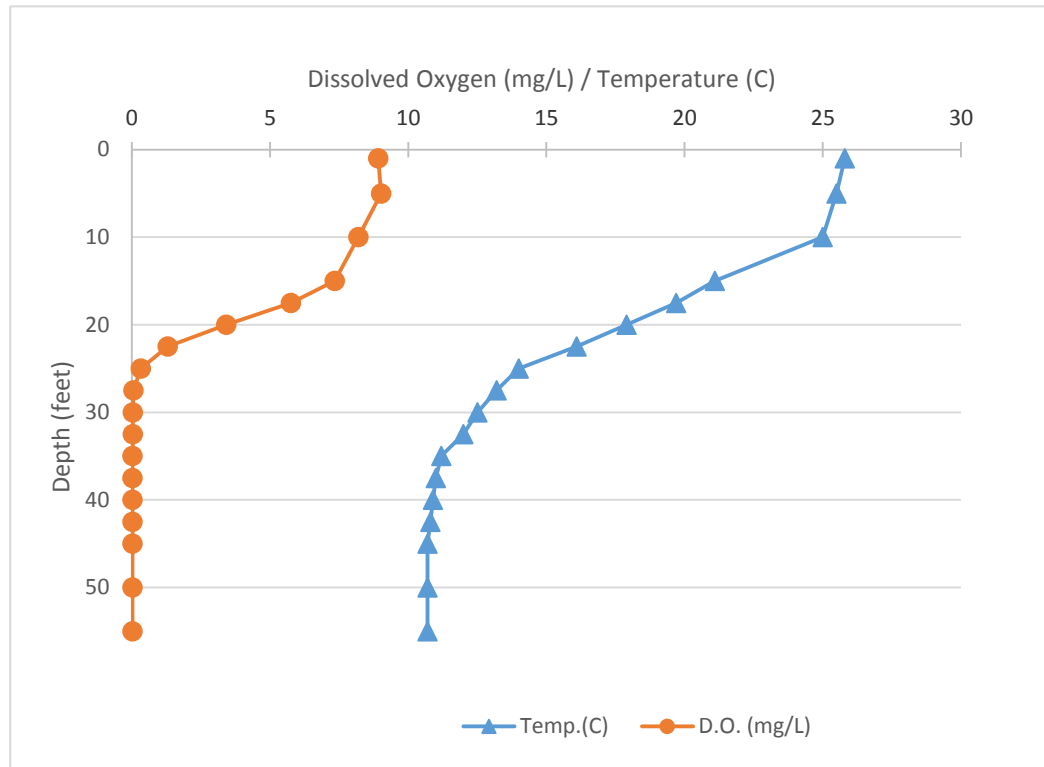
Name: Duck Lake
 County: Muskegon
 Site ID: 610778
 Date: 7/12/2017

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	25.8	8.92
5	25.5	9.02
10	25	8.2
15	21.1	7.34
17.5	19.7	5.75
20	17.9	3.42
22.5	16.1	1.3
25	14	0.32
27.5	13.2	0.06
30	12.5	0.04
32.5	12	0.04
35	11.2	0.03
37.5	11	0.03
40	10.9	0.03
42.5	10.8	0.03
45	10.7	0.02
50	10.7	0.02
55	10.7	0.02

Lake: Duck Lake (Muskegon Co.)

7/12/2017



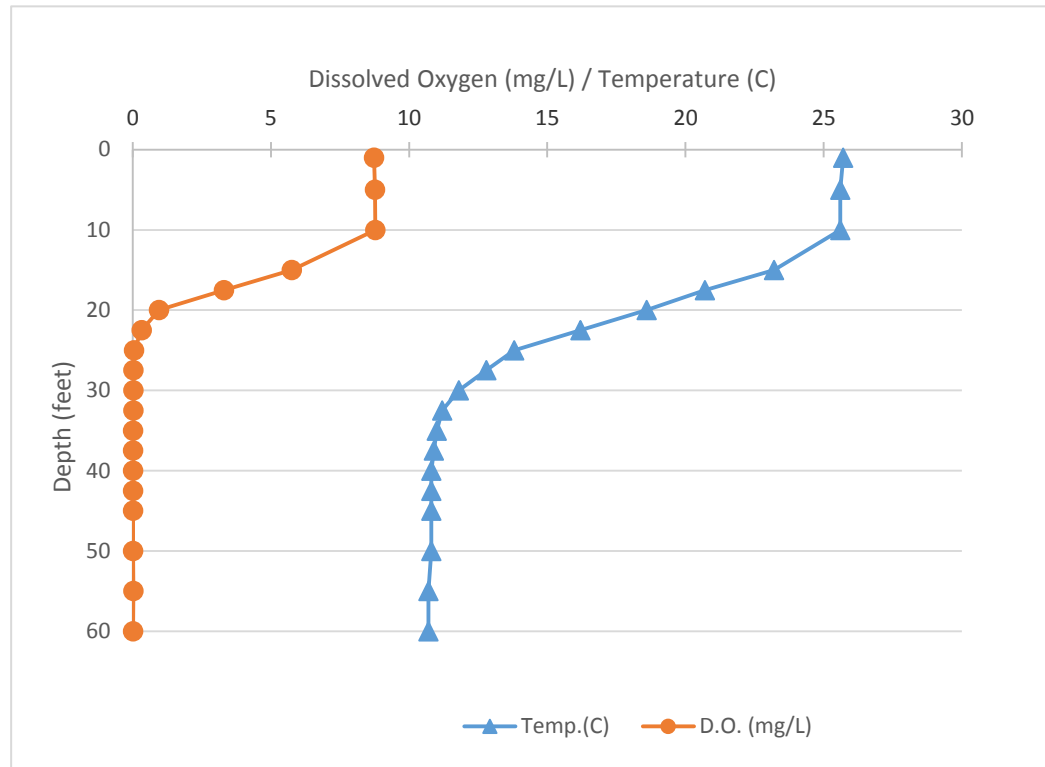
Name: Duck Lake
 County: Muskegon
 Site ID: 610778
 Date: 7/28/2017

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	25.7	8.73
5	25.6	8.76
10	25.6	8.78
15	23.2	5.75
17.5	20.7	3.3
20	18.6	0.95
22.5	16.2	0.33
25	13.8	0.05
27.5	12.8	0.03
30	11.8	0.03
32.5	11.2	0.02
35	11	0.01
37.5	10.9	0.01
40	10.8	0.01
42.5	10.8	0.01
45	10.8	0.01
50	10.8	0.01
55	10.7	0.03
60	10.7	0.01

Lake: Duck Lake (Muskegon Co.)

7/28/2017



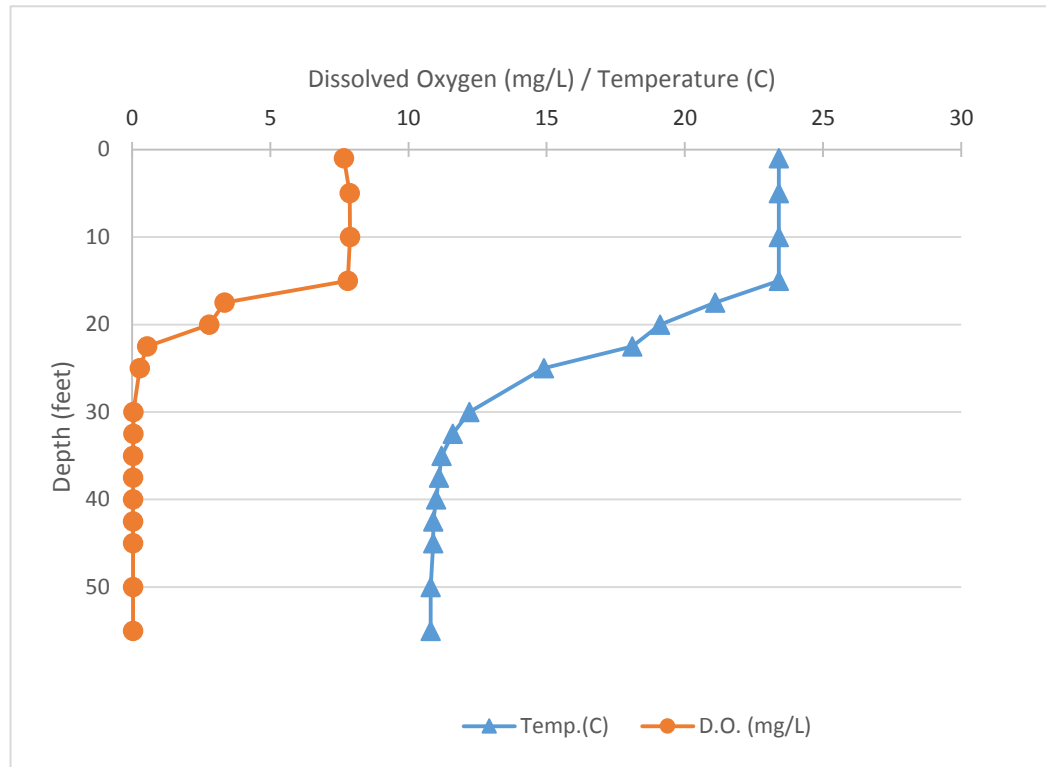
Name: Duck Lake
 County: Muskegon
 Site ID: 610778
 Date: 8/12/2017

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	23.4	7.67
5	23.4	7.87
10	23.4	7.89
15	23.4	7.8
17.5	21.1	3.35
20	19.1	2.79
22.5	18.1	0.54
25	14.9	0.28
30	12.2	0.05
32.5	11.6	0.05
35	11.2	0.04
37.5	11.1	0.04
40	11	0.04
42.5	10.9	0.04
45	10.9	0.04
50	10.8	0.04
55	10.8	0.04

Lake: Duck Lake (Muskegon Co.)

8/12/2017



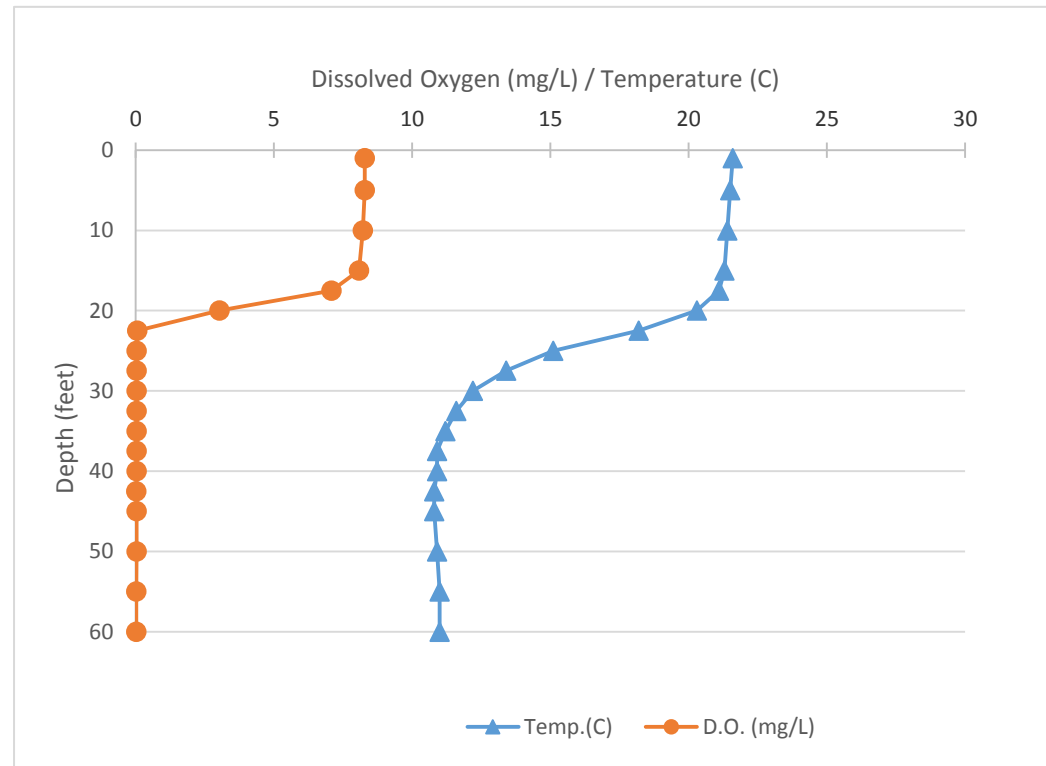
Name: Duck Lake
 County: Muskegon
 Site ID: 610778
 Date: 8/28/2017

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	21.6	8.29
5	21.5	8.29
10	21.4	8.22
15	21.3	8.08
17.5	21.1	7.08
20	20.3	3.03
22.5	18.2	0.06
25	15.1	0.03
27.5	13.4	0.03
30	12.2	0.03
32.5	11.6	0.03
35	11.2	0.03
37.5	10.9	0.03
40	10.9	0.03
42.5	10.8	0.02
45	10.8	0.03
50	10.9	0.03
55	11	0.02
60	11	0.02

Lake: Duck Lake (Muskegon Co.)

8/28/2017



Name: Duck Lake
 County: Muskegon
 Site ID: 610778
 Date: 9/17/2017

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temp.(C)	D.O. (mg/L)
1	22.1	9.63
5	21.6	9.74
10	20	9.47
15	19.2	7.95
17.5	18.8	6.7
20	18.3	4.9
22.5	17.7	2.75
25	16.7	0.8
27.5	14.5	0.06
30	12.7	0.04
32.5	11.6	0.03
35	11.2	0.03
37.5	11.1	0.03
40	11	0.03
42.5	10.9	0.03
45	10.9	0.03
50	10.9	0.03
55	10.8	0.02
60	10.9	0.02

Lake: Duck Lake (Muskegon Co.)

9/17/2017

