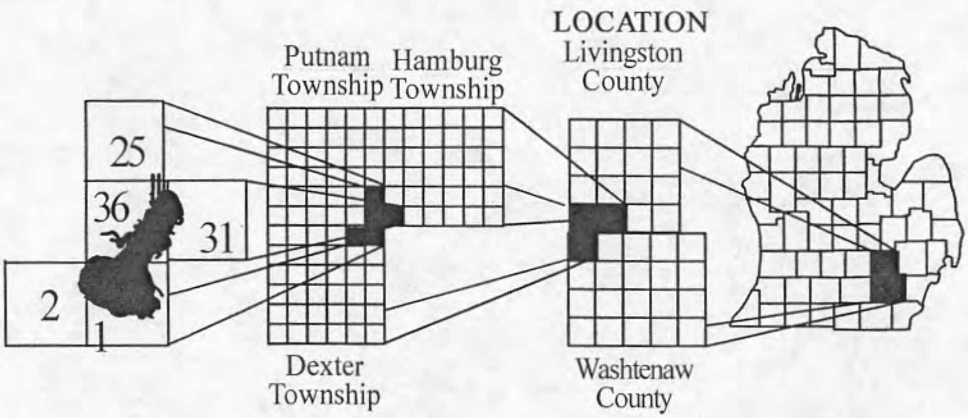
PORTAGE LAKE

WASHTENAW AND LIVINGSTON COUNTIES MICHIGAN

WATER QUALITY STUDIES 1994-2010



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PORTAGE LAKE

WASHTENAW AND

LIVINGSTON COUNTIES

1994 - 2010 WATER QUALITY STUDIES

PORTAGE LAKE DATA

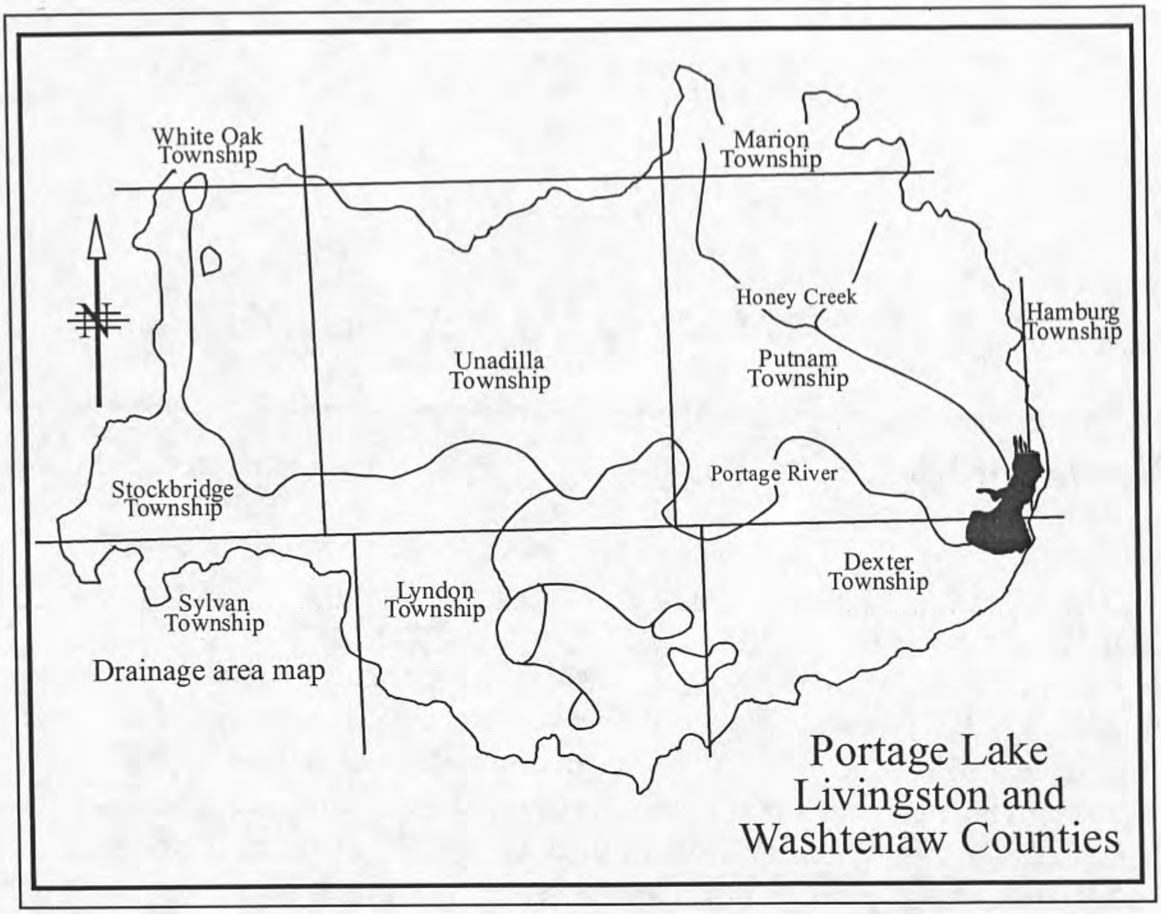
Portage Lake, also called Big Portage Lake, is a 725-acre natural hard-water kettle lake located in Sections 25 and 36, Putnam Township (T1N R4E), Section 31, Hamburg Township (T1N R5E) Livingston County, and Sections 1 and 2, Dexter Township (T1S R4E), Washtenaw County, Michigan. The lake consists of a north and south basin separated by a bar one to two feet below the surface. The northern basin makes up about one quarter of the lake and has a maximum depth of 50 feet. The southern basin, which makes up about three-quarters of the lake, has a maximum depth of 84 feet. The lake has a single 7-acre island on the northwest side of the south basin. Hence the surface area of the lake is 718 acres.

The hypsographic (depth-area) graph shows about 30 percent of the north basin and 25 percent of the south basin is five feet deep or less.

The lake contains 19,567 acre-feet of water, and has a mean depth of 27.3 feet. The shoreline length is 53,094 feet. However this includes the shoreline lengths of Wynn's and Colony canals located on the north end, and Camelot canal, which flows into Mud Bay, and then into the lake at the west end of the sand bar, plus several other bays. It does not however, include the shoreline of the island.

The lake has two inlets. Honey Creek, which drains 17,792 acres, flows into the north basin. The Portage River, which drains 54,784 acres, flows into Little Portage Lake, then under the Dexter Pinckney Road bridge and into

Portage Lake. The longitude and latitude of the 84-foot deep hole is 83° 53.384W and 42° 25.234N.



The lake was formed when two blocks of ice broke off the retreating glacier about 10,000 years ago and were then surrounded by the debris released as the glacier melted. Finally the blocks of ice melted, forming the present lake basins.

The John Flook dam on the Huron River below Portage Lake causes water from the Huron River to flow both into and out of the lake through the Gulf Canal and through the Portage River outlet, depending on time of year (and water volume). Hence, the entire Huron River watershed upstream of Portage Lake may from time to time be included in the Portage Lake watershed. The Huron River watershed above the Flook dam is 259,840 acres.

The watershed of Portage Lake is large, 74,795 acres. The drainage area, which includes the watershed plus the surface area of Portage Lake, is

75,520 acres. The watershed to lake ratio is large, 103 to 1. Because of this large ratio the flushing rate of the lake is about 0.36 years or 131 days.

The Flook dam can divert water from the upper Huron River watershed into the lake so although it is not part of the flushing rate calculations, it must be considered when lake levels are concerned.

THE SAMPLE DATES

Portage Lake residents took three spring surface samples for water quality testing plus Secchi disk readings at the three sites shown on the map June 1, 1994 and June 14, 1995.

WQI limnologists collected three spring surface samples for water quality testing plus Secchi disk readings June 9, 1996, May 12, 1997, April 19, 1998, April 26, 1999, April 15, 2000, May 13, 2001, April 15, 2002, April 28, 2003, April 16, 2004, April 18, 2005, April 19, 2006, April 21, 2007, April 18, 2008, April 18, 2009 and April 20, 2010.

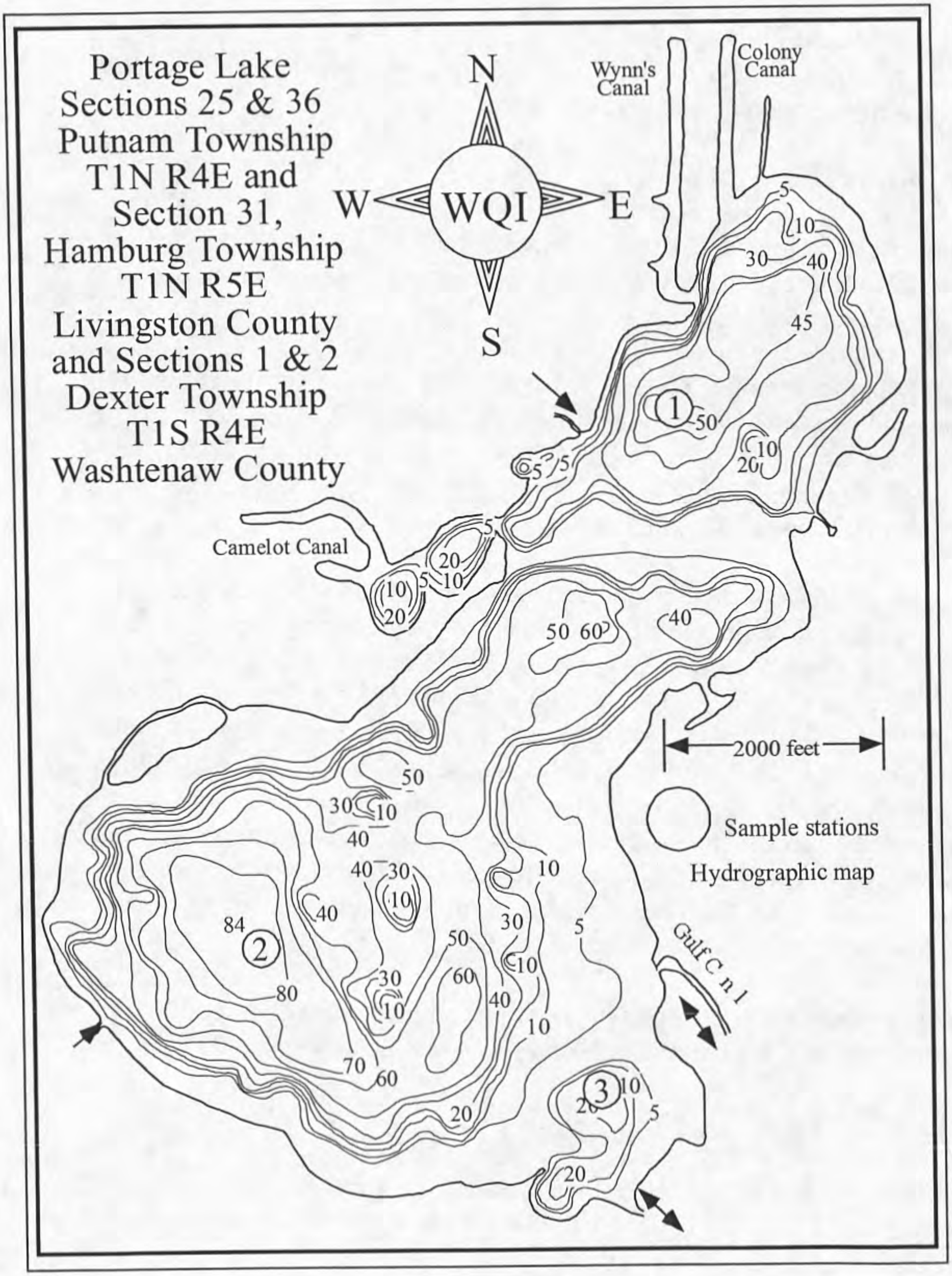
They also collected late summer surface samples for water quality testing plus Secchi disk readings at the stations shown on the map August 1, 1994, August 14, 1995 (6 samples), August 7, 1996, August 25, 1997, August 10, 1998, August 27, 1999, August 4, 2000, August 1, 2001, August 2, 2002, August 1, 2003, August 2, 2004, August 3, 2005, August 1, 2006, August 1, 2007, August 1, 2008, August 3, 2009 and August 2, 2010. Top to bottom temperature and dissolved oxygen profile data were collected each time the lake was sampled in late summer at the deepest part of the north and south basins. Bottom sediment samples were collected in 1995 in the north and south basins, and in the three canals. Bottom sediment samples from the three in-lake stations were collected in 2005.

The Portage River and Honey Creek were sampled monthly May 2004 through April 2005. The Portage River was sampled again in 2009-10.

THE ANALYSES

The tests performed on the samples included total phosphorus, total nitrate nitrogen, total alkalinity, pH, conductivity, chlorophyll a, Secchi disk depth, temperature, and dissolved oxygen.

Temperature, dissolved oxygen and Secchi disk depths were measured in the field. Chlorophyll a, phosphorus, nitrate nitrogen, alkalinity, pH and



conductivity tests were performed at the Water Quality Investigators laboratory in Dexter, Michigan. All test procedures followed those outlined in APHA's *Standard Methods for the Examination of Water and Wastewater* (1985).

THE SAMPLE STATIONS

The locations of the three in-lake sample stations are shown as circles on the hydrographic map of the lake.

The Portage River was sampled just before it flowed into Little Portage Lake. Honey Creek was sampled where it crossed under Darwin Road.

THE TEST RESULTS

The results of the tests are found in the text, in the tables at the end of this report, and on the enclosed atlas pages.

TEMPERATURE AND DISSOLVED OXYGEN

Temperature exerts a wide variety of influences on most lakes, such as the separation of layers of water (stratification), solubility of gasses and biological activity.

Dissolved oxygen is the test most often selected by lake scientists as being important. Besides providing oxygen for aquatic organisms, in natural lakes oxygen is involved in the capture and release of various chemicals, such as iron and phosphorus.

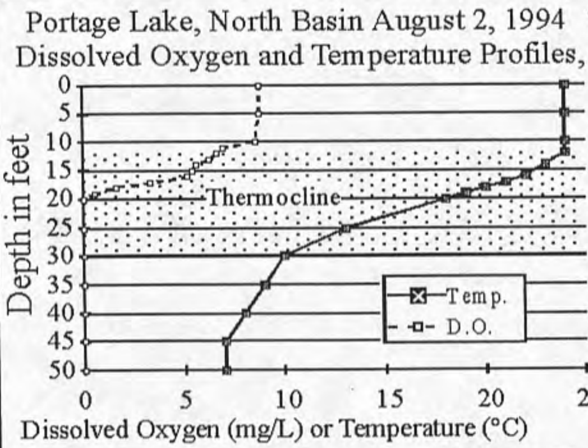
In spring top to bottom dissolved oxygen concentrations were not measured but since 1996 surface dissolved oxygen concentrations were.

On the other hand, dissolved oxygen and temperature profile data were collected in both the north and south basins every year when the lake was sampled in late summer. The late summer data are first shown for the north basin, then for the south basin.

NORTH BASIN

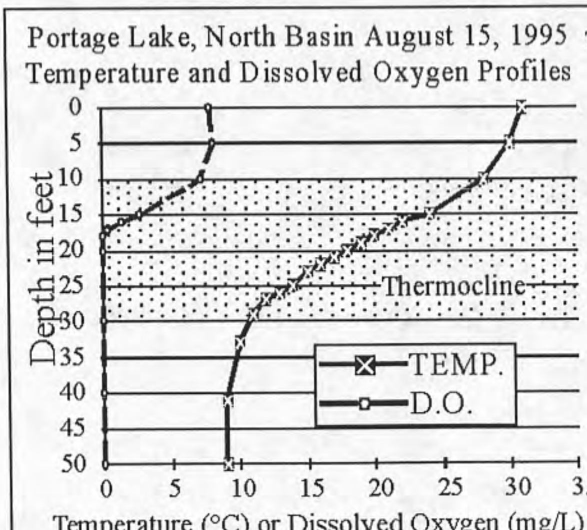
1994

In late summer 1994, the north basin formed a 20-foot-thick thermocline (defined as a layer of water in a lake where the temperature changes rapidly with depth and shown shaded on the graphs) from 10 to 30 feet. Dissolved oxygen was plentiful above the thermocline.



Temp	Depth	D.O.	Depth
24	0	8.8	0
24	5	8.8	5
24	10	8.6	10
24	12	6.9	11
23	14	6.6	12
22	16	6.2	13
21	17	5.6	14
20	18	5.4	15
19	19	5.1	16
18	20	3.3	17
13	25	1.6	18
10	30	0.6	19
9	35	0	20
8	40	0	25
7	45	0	30
7	50	0	35
		0	40
		0	50

At the top of the thermocline dissolved oxygen started to decrease. The basin ran out of dissolved oxygen at 20 feet. That condition remained to the bottom. The hypsographic (depth area) graph shows about 48 percent of the north basin is deeper than 20 feet.



Temp.	Depth	D.O.	Depth
31	0	7.9	0
30	5	8.1	5
28	10	7.2	10
24	15	2.7	15
22	16	1.4	16
21	17	0.3	17
20	18	0	18
19	19	0	20
18	20	0	30
17	21	0	40
16	22	0	50
15	23		
14	25		
13	26		
12	27		
11	29		
10	33		
9	41		
9	50		

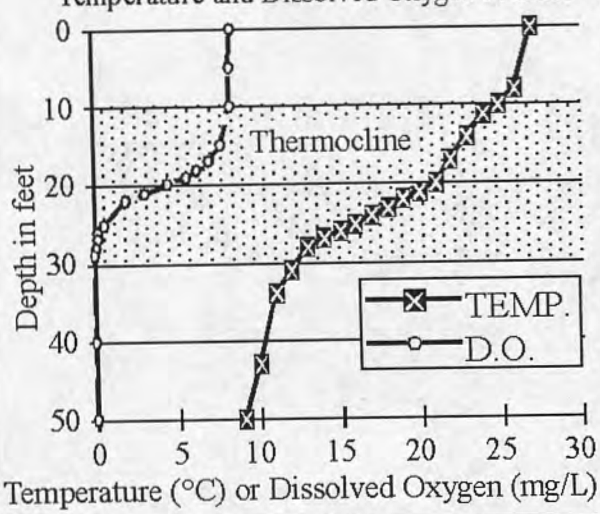
1995

In late summer 1995 the north basin formed a 20-foot-thick thermocline from 10 to 30 feet. Dissolved oxygen was plentiful above the thermocline. This basin ran out of dissolved oxygen at 18 feet. That condition remained to the bottom. About 50 percent of this basin is deeper than 18 feet.

1996

In late summer 1996 the north basin again formed a 20-foot-thick thermocline from 10 to 30 feet. Dissolved oxygen was again plentiful above the thermocline. The basin ran out of dissolved oxygen at 29 feet and that condition remained to the bottom at 50 feet.

Portage Lake North Basin August 8, 1996
Temperature and Dissolved Oxygen Profiles



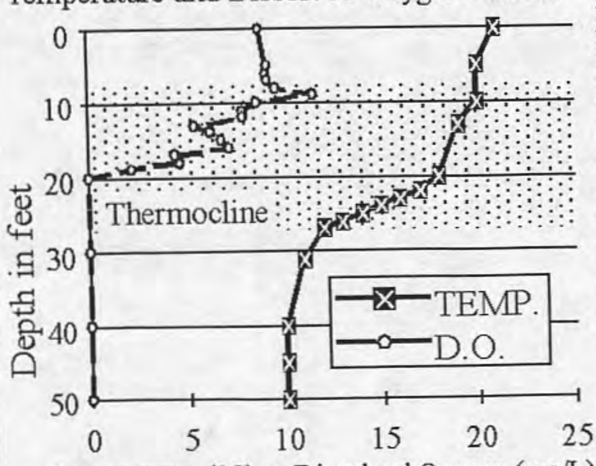
Temp.	Depth	D.O.	Depth
27	0	8.5	0
26	8	8.4	5
25	10	8.4	10
24	11	7.7	15
23	14	7.0	17
22	17	6.3	18
21	20	5.7	19
20	21	4.5	20
19	22	3.1	21
18	23	2.0	22
17	24	0.6	25
16	25	0.2	26
15	26	0.2	27
14	27	0.1	28
13	28	0.0	29
12	31	0.0	40
11	34	0.0	50
10	43		
9	50		

About 38 percent of the basin is deeper than 29 feet.

1997

In late summer 1997, the north basin formed a 19-foot thick thermocline from 8 to 27 feet. This year dissolved oxygen reached a maximum at the top of the thermocline, 11.5 milligrams per liter. The dissolved oxygen concentration peaked again at 15 feet. These dissolved oxygen maximums in the thermocline are often caused by algal blooms which settle there. They are not rare, nor do they indicate anything in particular except there was enough light at that particular depth for algae to grow. The second peak is unusual because the upper algal bloom should have blocked the sunlight needed by the second deeper bloom.

Portage Lake North Basin, August 26, 1997
Temperature and Dissolved Oxygen Profiles

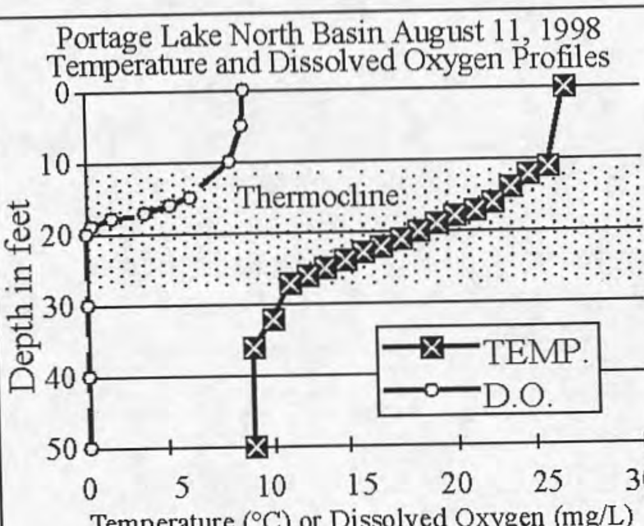


Temp.	Depth	D.O.	Depth
21	0	8.8	0
20	5	9.2	5
20	10	9.1	6
19	13	9.2	7
18	20	9.6	8
17	22	11.5	9
16	23	8.6	10
15	24	7.9	11
14	25	7.9	12
13	26	5.4	13
12	27	6.2	14
11	31	6.8	15
10	40	7.2	16
10	45	4.4	17
10	50	4.7	18
		2.2	19
		0.0	20
		0.0	30
		0.0	40
		0.0	50

In 1997 the north basin ran out of dissolved oxygen at 20 feet, and that condition again remained to the bottom.

1998

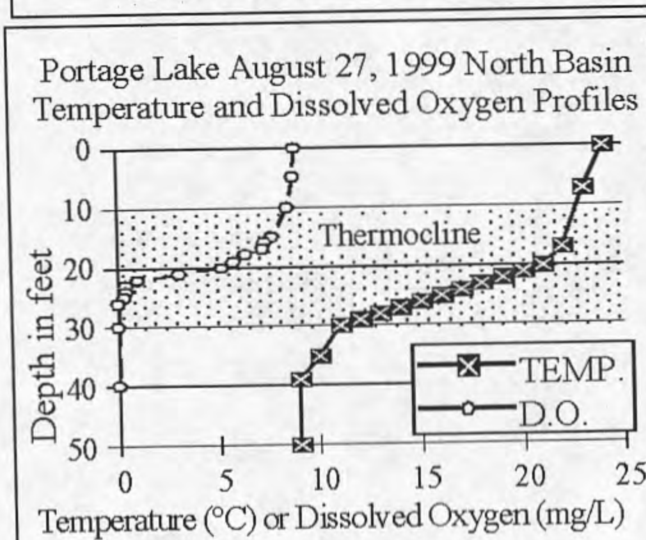
In late summer 1998 the north basin formed an 18-foot-thick thermocline from 10 to 28 feet. The basin again ran out of dissolved oxygen at 20 feet, and that condition remained to the bottom.



Temp.	Depth	D.O.	Depth
26	0	8.7	0
25	11	8.6	5
24	12	7.9	10
23	14	5.6	15
22	16	4.6	16
21	17	3.1	17
20	18	1.4	18
19	19	0.3	19
18	20	0.0	20
17	21	0.0	30
16	22	0.0	40
15	23	0.0	50
14	24		
13	25		
12	26		
11	27		
10	32		
9	36		
9	50		

1999

In late summer 1999, the north basin formed a 20-foot-thick thermocline from 10 to 30 feet. Dissolved oxygen was plentiful above the thermocline.

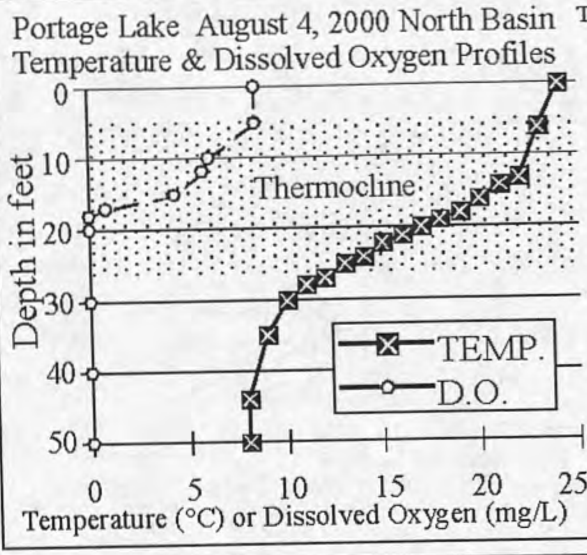


Temp.	Depth	D.O.	Depth
24	0	8.9	0
23	7	8.8	5
22	17	8.5	10
21	20	7.7	15
20	21	7.3	16
19	22	7.2	17
18	23	6.3	18
17	24	5.8	19
16	25	5.2	20
15	26	3.0	21
14	27	1.0	22
13	28	0.4	23
12	29	0.4	24
11	30	0.3	25
10	35	0.0	26
9	39	0.0	30
9	50	0.0	40
		0.0	50

This basin ran out of dissolved oxygen at 26 feet. That condition remained to the bottom. About 40 percent of the basin is deeper than 26 feet.

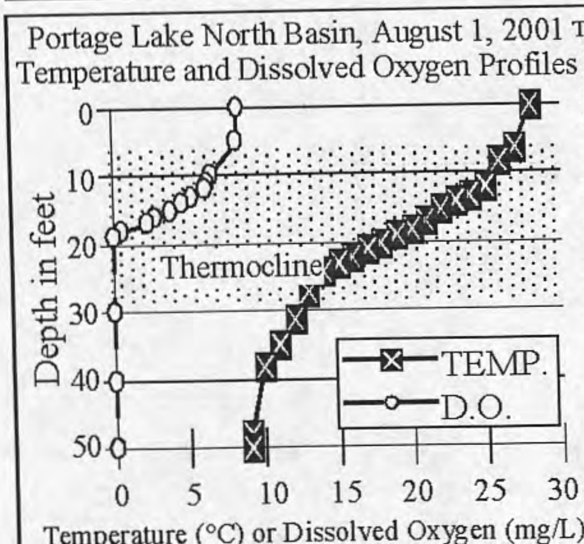
2000

In late summer, 2000, the north basin formed a 22-foot-thick thermocline



Temp.	Depth	D.O.	Depth
24	0	8.5	0
23	6	8.5	5
22	13	6.2	10
21	14	5.8	12
20	16	4.4	15
19	18	0.9	17
18	19	0.0	18
17	20	0.0	20
16	21	0.0	30
15	22	0.0	40
14	24	0.0	50
13	25		
12	27		
11	28		
10	30		
9	35		
8	44		
8	50		

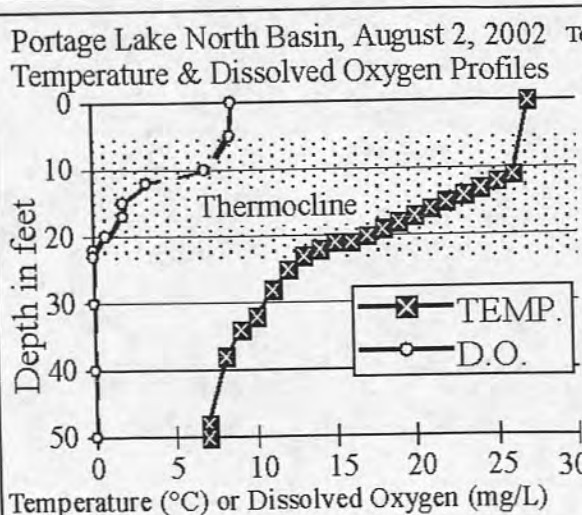
from 5 to 27 feet. Dissolved oxygen was plentiful above five feet. This year the basin ran out of dissolved oxygen at 18 feet. That condition remained to the bottom.



Temp.	Depth	D.O.	Depth
28	0	8.4	0
27	6	8.3	5
26	8	6.5	10
25	12	6.3	11
24	13	6.1	12
23	14	5.2	13
22	15	4.6	14
21	17	3.8	15
20	18	2.8	16
19	19	2.2	17
18	20	0.5	18
17	21	0.0	19
16	22	0.0	30
15	23	0.0	40
14	24	0.0	50
13	27		
12	31		
11	35		
10	38		
9	48		
9	50		

2001

In late summer, 2001, the north basin formed a 24-foot-thick thermocline from 5 to 29 feet. Dissolved oxygen was plentiful above five feet. This year the basin ran out of dissolved oxygen at 19 feet and that condition remained to the bottom. 49 percent of the basin is deeper than 19 feet.

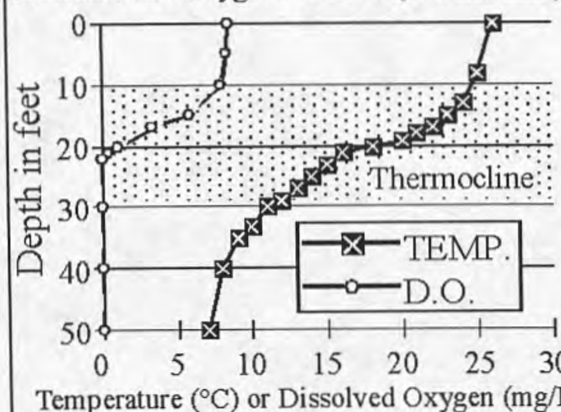


Temp.	Depth	D.O.	Depth
27	0	8.7	0
26	11	8.6	5
25	12	6.9	10
24	13	3.4	12
23	14	1.9	15
22	15	1.8	17
21	16	0.7	20
20	17	0.0	22
19	18	0.0	23
18	19	0.0	30
17	20	0.0	40
16	21	0.0	50
15	21		
14	22		
13	23		
12	25		
11	28		
10	32		
9	34		
8	38		
7	48		
7	50		

2002

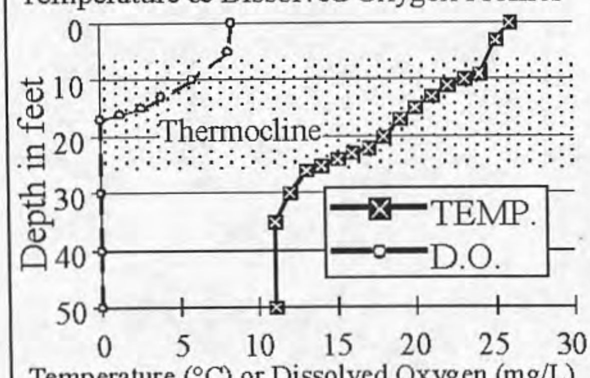
In late summer 2002, the north basin formed a 20-foot-thick thermocline from 5 to 25 feet. Dissolved oxygen was plentiful above five feet. This year the basin ran out of dissolved oxygen at 22 feet and that condition remained to the bottom. 45 percent of the basin is deeper than 22 feet.

Portage Lake August 1, 2003 Temperature & Dissolved Oxygen Profiles (North basin)



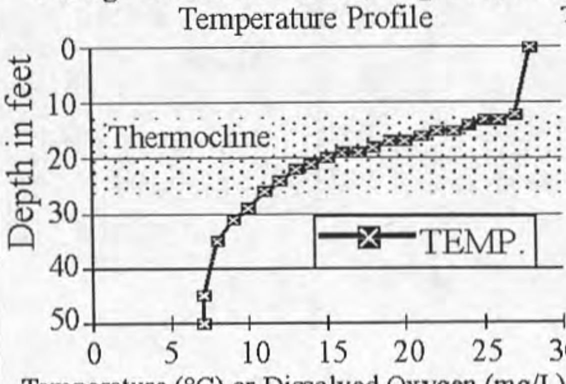
Temp.	Depth	D.O.	Depth
26	0	8.5	0
25	8	8.3	5
24	13	8.0	10
23	15	5.9	15
22	17	3.3	17
21	18	1.1	20
20	19	0.4	21
18	20	0.0	22
16	21	0.0	30
15	23	0.0	40
14	25	0.0	50
13	27		
12	29		
11	30		
10	33		
9	35		
8	40		
7	50		

Portage Lake North Basin, August 2, 2004 Temperature & Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
26	0	8.4	0
25	3	8.2	5
24	9	5.9	10
23	10	3.9	13
22	11	2.6	15
21	13	1.3	16
20	15	0.0	17
19	17	0.0	30
18	20	0.0	40
17	22	0.0	50
16	23		
15	24		
14	25		
13	26		
12	30		
11	35		
11	50		

Portage Lake North Basin, August 3, 2005 Temperature Profile



Temp.	Depth	Temp.	Depth
28	0	16	19
27	12	15	20
26	13	14	21
25	13	13	22
24	14	12	24
23	15	11	26
22	15	10	29
21	16	9	31
20	17	8	35
19	17	7	45
18	18	7	50
17	19		

2003

In late summer 2003, the north basin formed a 20-foot-thick thermocline from 10 to 30 feet. Dissolved oxygen was plentiful above the thermocline. This year the basin ran out of dissolved oxygen at 22 feet and that condition remained to the bottom.

2004

In late summer 2004 the north basin formed a 20-foot-thick thermocline from 5 to 25 feet. Dissolved oxygen was plentiful in the top five feet. It started to decrease at the top of the thermocline, and was zero a 17 feet. About half this basin is deeper than 17 feet.

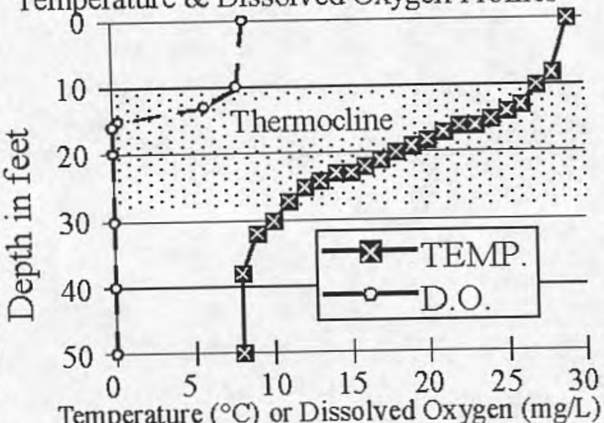
2005

In late summer 2005 the north basin formed a 15-foot-thick thermocline from 12 to 27 feet. Dissolved oxygen data were not available.

2006

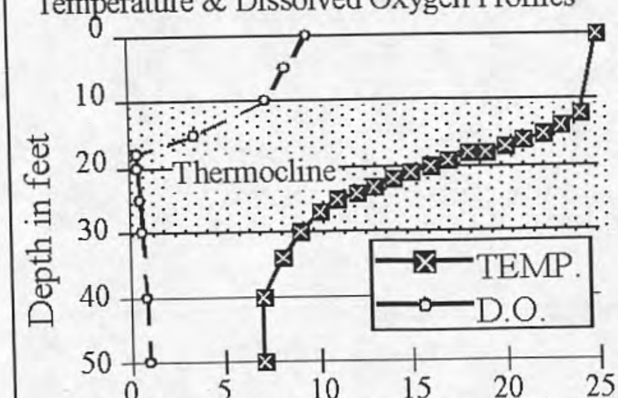
In late summer 2006 the north basin formed a 20-foot-thick thermocline from 10 to 30 feet.

Portage Lake North Basin, August 1, 2006
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	Temp.	Depth
29	0	8.4	0
28	8	7.8	10
27	10	5.8	13
26	13	0.4	15
25	14	0.0	16
24	15	0.0	20
23	16	0.0	30
21	17	0.0	40
20	18	0.0	50
19	19		
18	20		
17	21		
16	22		
15	23		
14	23		
13	24		
12	25		
11	27		
10	30		
9	32		
8	38		
8	50		

Portage Lake North Basin, August 1, 2007
Temperature & Dissolved Oxygen Profiles



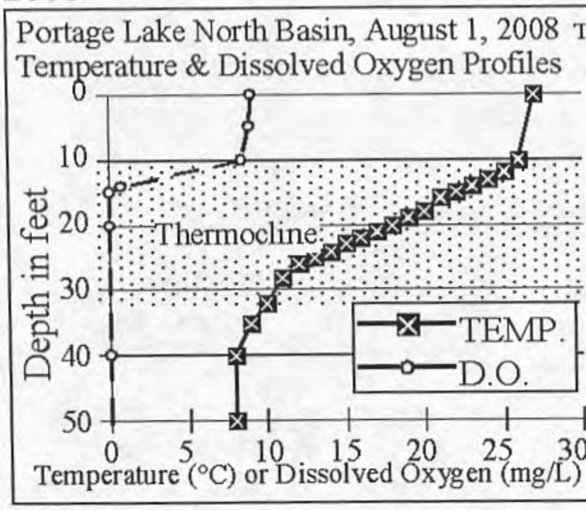
Temp.	Depth	Temp.	Depth
25	0	9.5	0
24	12	8.3	5
23	14	7.3	10
22	15	3.5	15
21	16	0.4	18
20	17	0.4	20
19	18	0.5	25
18	18	0.6	30
17	19	0.8	40
16	20	1.0	50
15	21		
14	22		
13	23		
12	24		
11	25		
10	27		
9	30		
8	34		
7	40		
7	50		

Dissolved oxygen concentrations were adequate to support fish life above 14 feet. This basin ran out of dissolved oxygen at 16 feet and that condition remained to the bottom.

2007

In late summer 2007 the north basin formed a 20-foot thick thermocline from 10 to 30 feet. Dissolved oxygen was supersaturated at the surface, and started to decrease immediately, reaching 0.4 mg/L at 18 feet. Below that it gradually increased on 1.0 mg/L at 50 feet, the bottom of the basin. This basin did not run out of dissolved oxygen in 2007.

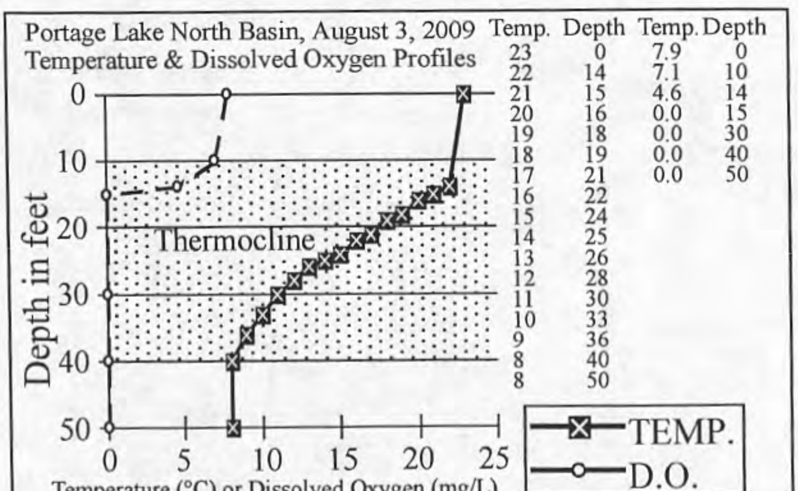
2008



Temp.	Depth	Temp.	Depth
27	0	9.1	0
26	10	9.0	5
25	12	8.5	10
24	13	0.7	14
23	14	0.0	15
22	15	0.0	20
21	16	0.0	30
20	18	0.0	40
19	19	0.0	50
18	20		
17	21		
16	22		
15	23		
14	24		
13	25		
12	26		
11	28		
10	32		
9	35		
8	40		
8	50		

In late summer 2008 the north basin formed a 22-foot thick thermocline from 10 to 32 feet. Dissolved oxygen was plentiful above the thermocline and started to decrease below 10 feet, the top of the thermocline. It was zero at 15 feet and that condition remained to the bottom.

2009

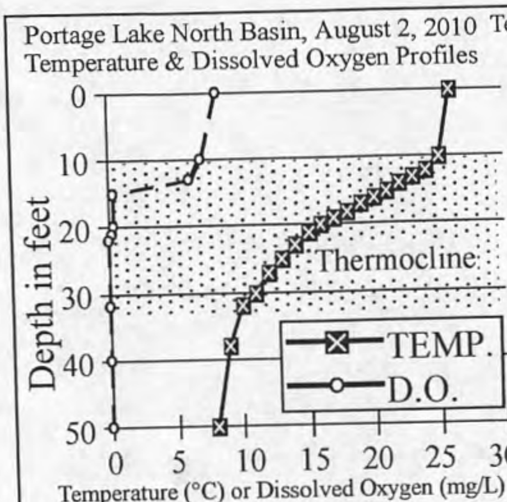


Temp.	Depth	Temp.	Depth
23	0	7.9	0
22	14	7.1	10
21	15	4.6	14
20	16	0.0	15
19	18	0.0	30
18	19	0.0	40
17	21	0.0	50
16	22		
15	24		
14	25		
13	26		
12	28		
11	30		
10	33		
9	36		
8	40		
8	50		

In late summer 2009 the north Basin formed a 30-foot thick thermocline from 10 to 40 feet. Dissolved oxygen supplies were low but adequate above the thermocline and started to decrease at 10 feet, the top of the thermocline. As in 2008 the basin ran out of dissolved oxygen at 15 feet, ant that condition remained to the bottom at 50 feet.

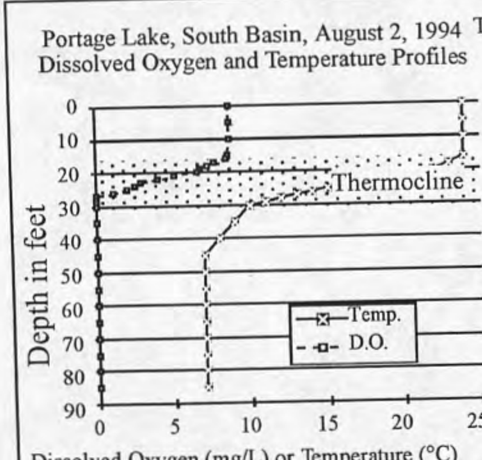
2010

In late summer 2010 the north basin formed a 22-foot thick thermocline from 10 to 32 feet. Dissolved oxygen was adequate in the layer above the



Temp.	Depth	Temp.	Depth
26	0	8.4	0
25	10	7.1	10
24	12	6.2	13
23	13	0.4	15
22	14	0.4	20
21	15	0.3	21
20	16	0.0	22
19	17	0.0	32
18	18	0.0	40
17	19	0.0	50
16	20		
15	21		
14	23		
13	25		
12	27		
11	30		
10	32		
9	38		
8	50		

thermocline although it started to decrease just below the surface. The concentration of dissolved oxygen dropped to 0.4 mg/L and remained at low levels until 22 feet, where it was zero. That condition remained to the bottom.

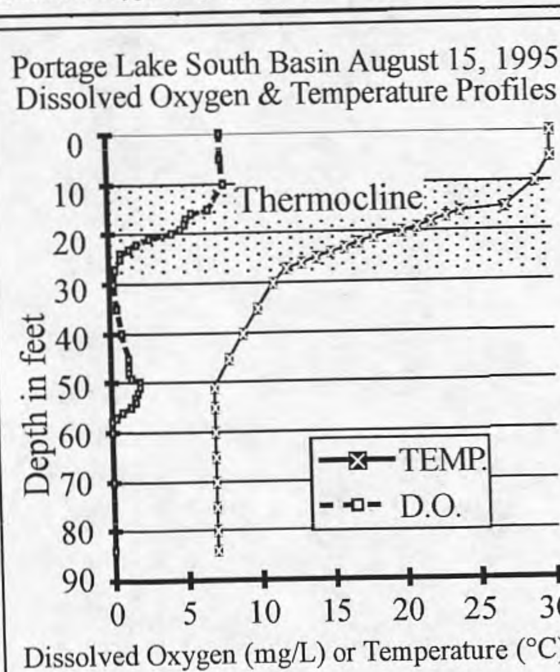


Temp	Depth	D.O.	Depth
24	0	8.7	0
24	5	8.7	5
24	10	8.7	10
24	16	8.6	15
23	18	8.5	16
22	20	7.7	17
21	21	7.3	18
19	22	6.8	19
17	23	6.6	20
16	24	5.1	21
15	25	4.0	22
14	26	2.9	23
13	27	2.5	24
12	28	2.0	25
11	29	1.1	26
10	30	0	27
9	35	0	28
8	40	0	29
7	50	0	35
7	70	0	55
7	85	0	75
		0	85

SOUTH BASIN

1994

In late summer 1994 the south basin formed a 12-foot-thick thermocline from 18 to 30 feet. Dissolved oxygen was plentiful above the thermocline. This basin ran out of dissolved oxygen at 27 feet. That condition



Temp.	Depth	D.O.	Depth
30	0	7.7	0
30	5	7.7	5
29	10	7.9	10
27	15	6.8	15
24	16	5.7	16
23	17	5.3	17
22	18	5.2	18
21	19	4.9	19
20	20	4.3	20
18	21	2.8	21
17	22	1.9	22
16	23	1.4	23
15	24	0.8	24
14	25	0.8	25
13	26	0.4	27
12	27	0.3	30
11	30	0.5	35
10	35	0.8	40
9	40	1.2	45
8	45	1.2	47
7	51	1.2	48
7	60	2.0	50
7	70	1.8	52
7	80	1.7	54
7	84	1.3	55
		0.7	56
		0.3	57
		0.0	58
		0.0	70
		0.0	84

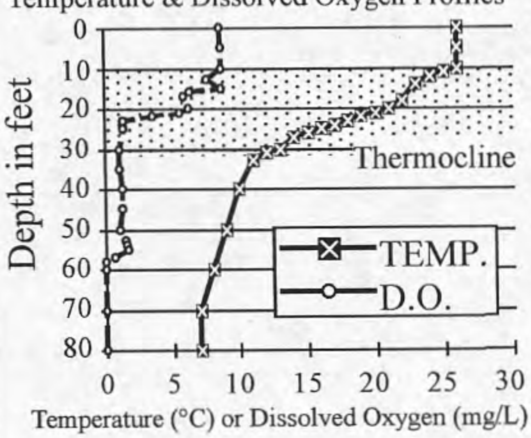
remained to the bottom at 84 feet. 52 percent of this basin is deeper than 27 feet.

1995

In late summer 1995, the south basin formed an 18-foot-thick thermocline from 10 to 28 feet. Dissolved oxygen was plentiful above the thermocline.

The basin started to run out of dissolved oxygen at the top of the thermocline and reached 0.8 milligrams per liter at 24 feet. From that depth to 58 feet, dissolved oxygen concentrations fluctuated between 0.3 and 2.0 milligrams per liter. The south basin ran out of dissolved oxygen at 58 feet and that condition remained to the bottom at 84 feet. 14 percent of this basin is deeper than 58 feet.

Portage Lake South Basin August 8, 1996
Temperature & Dissolved Oxygen Profiles

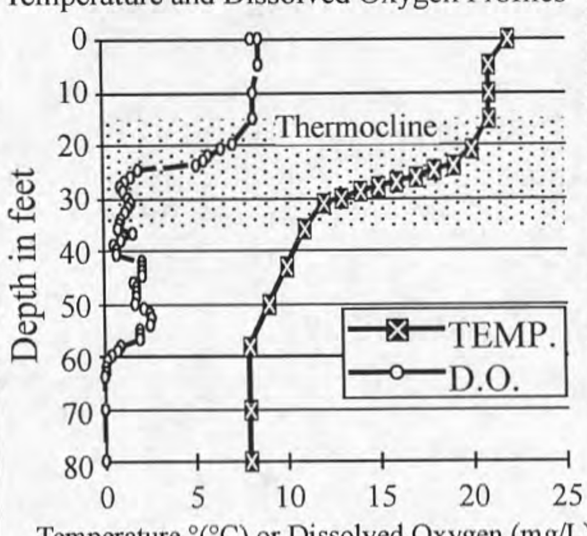


Temp.	Depth	D.O.	Depth
26	0	8.6	0
26	10	8.7	10
25	11	7.6	13
24	12	8.7	15
23	14	6.4	16
22	18	5.9	17
21	20	6.3	20
20	21	5.6	21
19	22	3.5	22
17	24	1.4	25
16	25	1.1	30
14	27	1.3	40
13	30	1.3	45
11	33	1.5	53
10	40	1.6	54
9	50	1.7	55
8	60	0.7	57
7	70	0.0	58
7	80	0.0	80

1996

In late summer 1996, the south basin formed an 18-foot-thick thermocline from 10 to 28 feet. Dissolved oxygen

Portage Lake, South Basin, August 26, 1997
Temperature and Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth	D.O.	Depth
22	0	8.6	0	0.7	40
22	5	8.6	0	0.7	41
21	10	8.3	5	2.1	42
21	15	8.3	10	2.1	43
21	21	7.2	15	2.1	44
20	24	6.5	20	2.1	45
19	25	5.8	21	1.6	46
18	26	5.6	22	1.8	47
17	27	5.2	23	1.8	49
16	28	1.9	24	1.7	50
15	29	1.5	25	2.2	51
14	30	1.2	26	2.5	52
13	31	1.0	27	2.6	53
12	36	1.1	28	2.5	54
11	43	1.4	29	1.9	55
10	50	1.5	30	1.9	56
9	58	1.4	31	1.9	57
8	70	1.2	32	0.9	58
8	80	1.0	33	0.7	59
		0.9	34	0.4	60
		0.8	35	0.2	61
		1.0	37	0.1	63
		0.6	38	0.0	64
		0.7	39	0.0	70

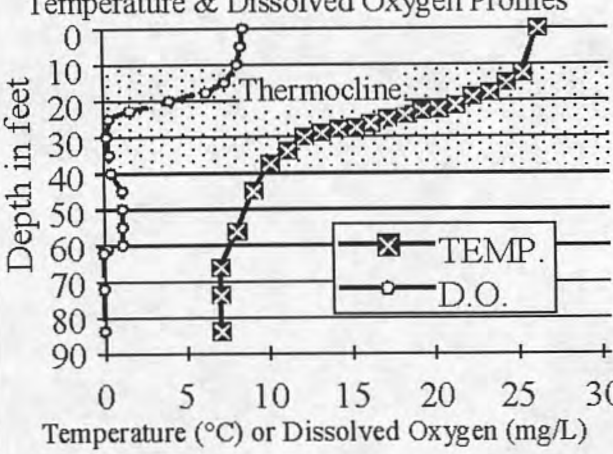
was plentiful above the thermocline.

Dissolved oxygen started to decrease at the top of the thermo-cline and reached 1.4 milli-grams per liter at 25 feet. From that depth to 58 feet, dissolved oxygen concentrations fluctuated between 0.7 and 1.7 milligrams per liter. The south basin ran out of dissolved oxygen at 58 feet and that condition remained to the bottom at 84 feet.

1997

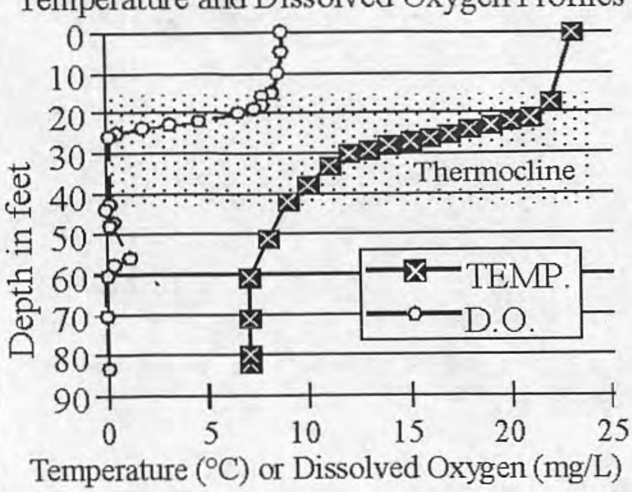
In late sum-mer 1997, the south basin formed a 20-foot-thick thermocline from 15 to 35 feet. Dissolved oxygen was plentiful above the thermocline. The lake started to run out of dissolved oxygen at the top of the thermocline and reached 1.0 milligrams per liter at 27 feet. From that depth to 64 feet, dissolved oxygen concentratio ns fluctuated between 0.1 and 2.6 milligrams per liter. The south basin ran out of dissolved oxygen at 64 feet that year and that condition remained to the bottom at 84 feet. 10 percent of the basin is

Portage Lake (South Basin) August 11, 1998
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
26	0	8.5	0
25	12	8.3	5
24	15	8.1	10
23	18	7.3	15
22	19	6.2	18
21	21	4.1	20
20	22	1.6	23
19	23	0.4	25
18	24	0.3	30
17	25	0.4	35
16	26	0.5	40
15	27	1.2	45
14	28	1.1	50
13	29	1.2	55
12	30	1.2	60
11	34	0.3	61
10	37	0.0	62
9	45	0.0	72
8	56	0.0	84
7	66		
7	84		

Portage Lake August 27, 1999 South Basin
Temperature and Dissolved Oxygen Profiles



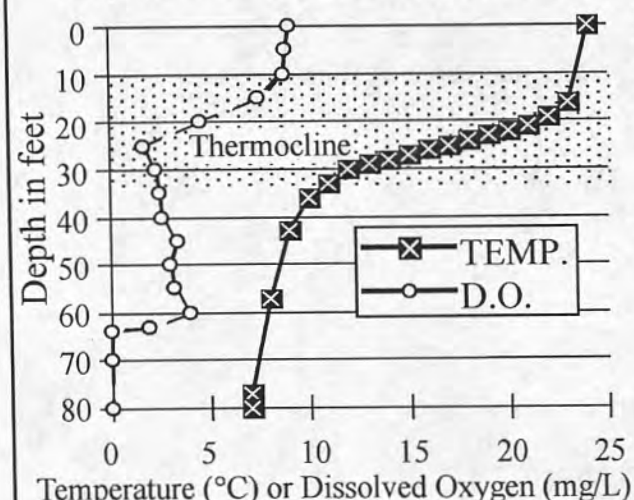
Temp.	Depth	D.O.	Depth
23	0	8.8	0
22	17	8.8	5
21	21	8.6	10
20	22	8.3	15
19	23	7.8	16
18	24	7.4	19
17	25	6.6	20
16	26	4.7	22
15	27	3.2	23
14	28	1.9	24
13	29	0.6	25
12	30	0.2	26
11	33	0.2	43
10	38	0.4	47
9	42	0.2	48
8	51	1.2	56
7	61	0.4	58
7	71	0.0	60
7	82	0.0	70
		0.0	82

deeper than 64 feet.

1998

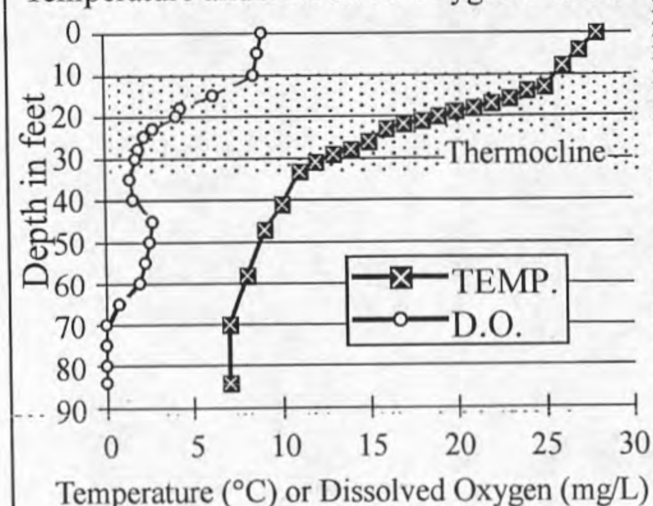
In late summer 1998, the south basin formed a 30-foot-thick thermocline from 10 to 40 feet. Dissolved oxygen was plentiful in the top ten feet. The lake started to run out of dissolved oxygen at the top of the thermocline and reached a low of 0.3 milligrams per liter at 30 feet. From that depth to 62 feet, dissolved oxygen concentrations fluctuated between 0.3 and 1.2 milligrams per liter. The basin ran out of dissolved oxygen at 62 feet and that condition remained to the bottom at 84 feet.

Portage Lake South Basin August 4, 2000
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
24	0	9.1	0
23	16	8.9	5
22	19	8.8	10
21	21	7.5	15
20	22	4.6	20
19	23	1.7	25
18	24	2.3	30
17	25	2.5	35
16	26	2.6	40
15	27	3.4	45
14	28	3.0	50
13	29	3.2	55
12	30	4.0	60
11	33	1.9	63
10	36	0.0	64
9	43	0.0	70
8	57	0.0	80
7	77		
7	80		

Portage Lake South Basin, August 1, 2001
Temperature and Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
28	0	9.0	0
27	4	8.8	5
26	8	8.5	10
25	13	6.2	15
24	14	4.4	18
23	16	4.1	20
22	17	2.8	23
21	18	2.3	25
20	19	1.9	28
19	20	1.8	30
18	21	1.4	35
17	22	1.6	40
16	23	2.7	45
15	26	2.5	50
14	28	2.3	55
13	29	1.9	60
12	31	0.8	65
11	33	0.0	70
10	41	0.0	75
9	47	0.0	80
8	58	0.0	84
7	70		
7	84		

1999

In late summer, 1999, the south basin formed an 18-foot-thick thermocline from 15 to 33 feet. Dissolved oxygen was plentiful above the thermocline, and started to decrease at the top of the thermocline, reaching 0.2 milligrams per liter at 26 feet.

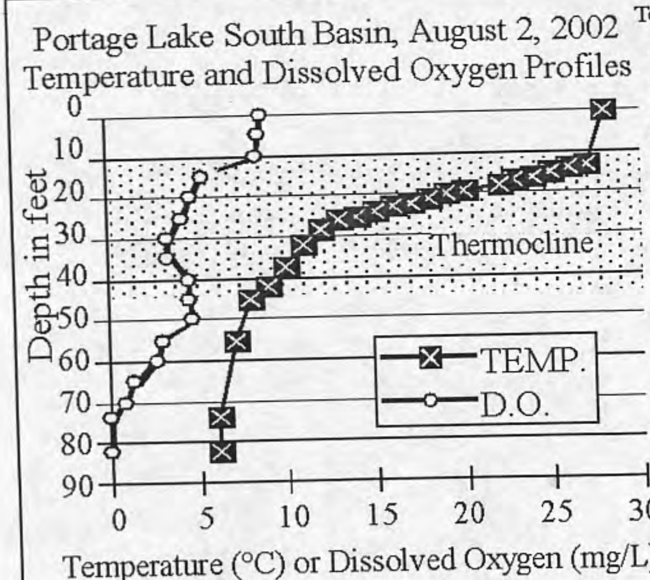
From that depth to 60 feet, dissolved oxygen concentra-tions fluctuated at low levels. The lake ran out of dissolved oxygen at 60 feet. That condition remained to the bottom.

2000

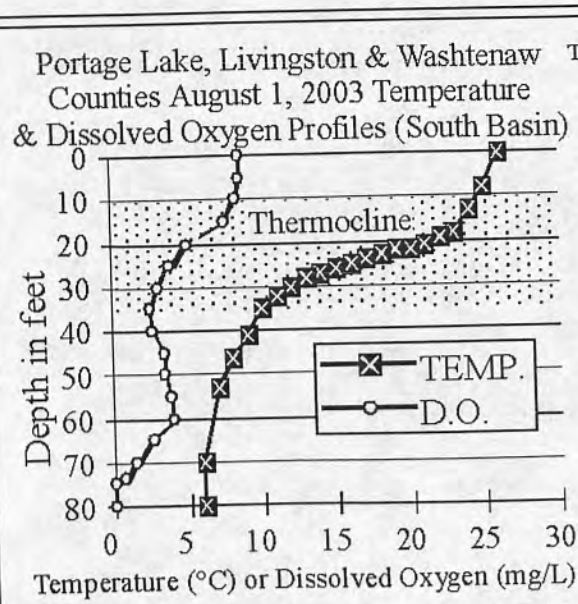
In late summer, 2000, the south basin formed a 22-foot-thick thermocline from 10 to 32 feet. Dissolved oxygen was again plentiful above the thermocline. This basin started to run out of dissolved oxygen at the top of the thermocline. It reached a low of 1.7 milligrams per liter at 25 feet. From that depth to 64 feet, dissolved oxygen fluctuated from 1.9 to 4 milligrams per liter. The basin ran out of dissolved oxygen at 64 feet. That condition remained to the bottom.

2001

In late summer 2001 the south basin formed a 23-foot-thick thermocline from 10 to 33 feet. Dissolved oxygen was plentiful above the thermocline, and started to drop at the top of the thermocline.



Temp.	Depth	D.O.	Depth
28	0	8.7	0
27	13	8.6	5
26	14	8.5	10
25	15	5.4	15
24	16	4.8	20
23	17	4.2	25
22	18	3.4	30
20	19	3.4	35
19	20	4.5	40
18	21	4.5	45
17	22	4.7	50
16	23	3.0	55
15	24	2.7	60
14	25	1.4	65
13	26	0.8	70
12	28	0.0	74
11	32	0.0	82
10	37		
9	42		
8	45		
7	55		
6	74		
6	82		

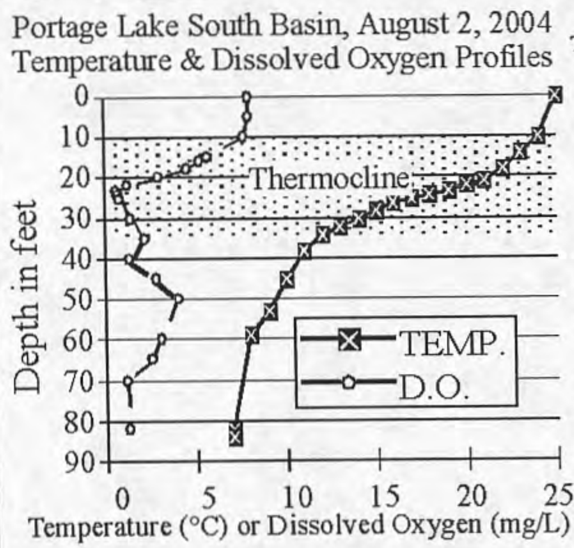


Temp.	Depth	D.O.	Depth
26	0	8.6	0
25	8	8.6	5
24	13	8.3	10
23	18	7.5	15
22	19	5.0	20
21	21	3.8	25
19	22	3.0	30
18	23	2.5	35
17	24	2.6	40
16	25	3.4	45
15	26	3.4	50
14	27	3.9	55
13	28	4.0	60
12	30	2.7	65
11	32	1.4	70
10	35	0.6	74
9	41	0.0	75
8	46	0	80
7	53		
6	70		
6	80		

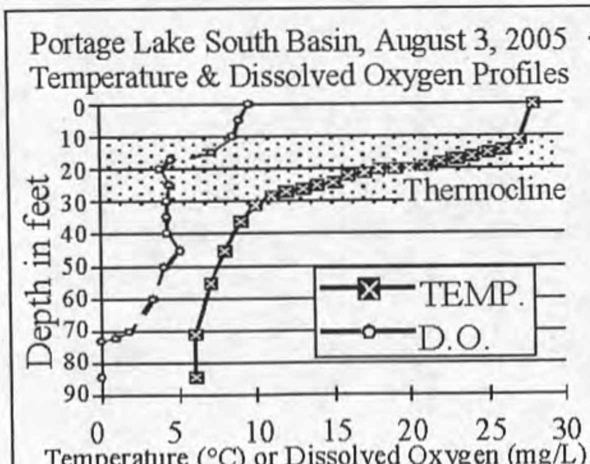
It reached a low of 1.4 milligrams per liter at 35 feet. From that depth to 70 feet, dissolved oxygen concentrations fluctuated at low levels. This basin ran out of dissolved oxygen at 70 feet and that condition remained to the bottom.

2002

In late summer 2002 the south basin formed an 18-foot-thick thermocline from 10 to 28 feet. Dissolved oxygen was plentiful above the thermocline, and started to drop at the top of the thermocline. It reached a low of 3.4 milligrams per liter at 30 feet. From that depth to 74 feet, dissolved oxygen concentrations fluctuated between 0.8 and 4.7 mg/L. This basin ran out of dissolved oxygen at 74 feet and that condition remained to the bottom.



Temp.	Depth	D.O.	Depth
25	0	8.0	0
24	10	8.0	5
23	14	7.7	10
22	18	5.7	15
21	21	5.3	16
20	22	4.6	18
19	23	3.0	20
18	24	1.2	22
17	25	0.6	23
16	26	0.7	24
15	28	0.8	25
14	30	1.4	30
13	32	2.2	35
12	34	1.3	40
11	38	2.8	45
10	45	4.0	50
9	53	3.1	60
8	59	2.5	65
7	82	1.1	70
7	84	1.2	82



Temp.	Depth	D.O.	Depth
28	0	9.7	0
27	11	9.1	5
26	14	8.6	10
24	16	7.3	15
22	18	4.6	17
21	19	3.9	20
19	20	4.5	25
17	21	4.3	30
15	24	4.3	35
13	26	4.3	40
11	28	5.2	45
10	31	4.1	50
9	36	3.4	60
8	45	1.8	70
7	55	0.9	72
6	71	0.0	73
6	84	0.0	84

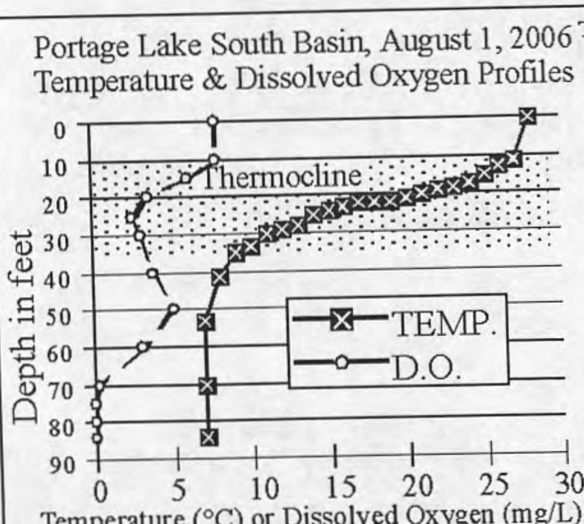
2003

In late summer 2003 the south basin formed a 25-foot-thick thermocline from 10 to 35 feet. Dissolved oxygen was plentiful above the thermocline, and started to drop at the top of the thermocline. It reached a low of 2.5 milligrams per liter at 35 feet. From that depth to 74 feet, dissolved oxygen concentrations fluctuated between 0.6 and 4.0 mg/L. This basin ran out of dissolved oxygen at 75 feet and that condition remained to the bottom.

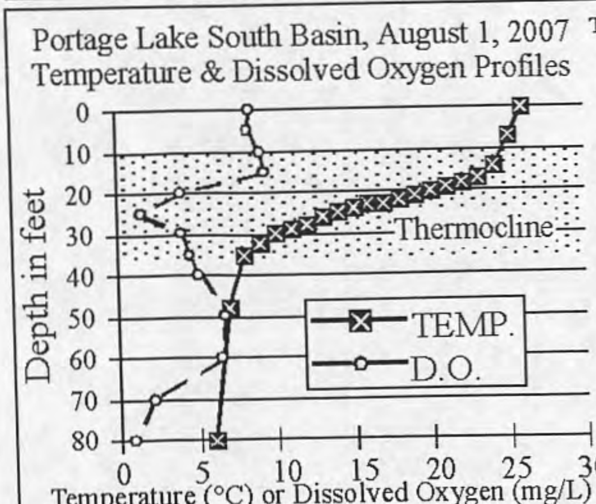
About 5 percent of the basin is deeper than 75 feet.

2004

In late summer 2004 the south basin formed a 24-foot-thick thermocline from 10 to 34 feet. Dissolved oxygen was plentiful above the thermocline, and started to drop at the top of the thermocline. It reached a low of 0.6 milligrams per liter at 23 feet. From that depth to the bottom, dissolved oxygen concentrations fluctuated between 1.1 and 4.0 mg/L. This basin did not run out of dissolved oxygen at any depth in 2004.



Temp.	Depth	D.O.	Depth
28	0	7.9	0
27	11	7.8	10
26	13	6.1	15
25	15	3.5	20
24	17	2.5	25
23	18	3.0	30
22	19	3.8	40
21	20	5.0	50
20	21	3.0	60
18	22	0.3	70
16	23	0.0	75
15	24	0.0	80
14	25	0.0	84
13	28		
12	29		
11	30		
10	33		
9	35		
8	41		
7	53		
7	70		
7	84		



Temp.	Depth	D.O.	Depth
26	0	8.5	0
25	7	8.3	5
24	14	9.1	10
23	17	9.4	15
22	18	4.1	20
21	19	1.5	25
20	20	4.0	30
19	21	4.6	35
18	22	5.1	40
17	23	6.7	50
16	23	6.4	60
15	24	2.2	70
14	25	0.9	80
13	26		
12	28		
11	29		
10	30		
9	32		
8	35		
7	48		
6	80		

2005

In late summer 2005 the south basin formed a 21-foot-thick thermocline from 10 to 31 feet. Dissolved oxygen was plentiful above the thermocline, and started to drop at the top of the thermocline. It reached a low of 3.9 milligrams per liter at 20 feet. From that depth to 72 feet dissolved oxygen concentrations fluctuated between 0.9 and 4.5 mg/L. This basin ran out of dissolved oxygen at 73 feet in 2005.

2006

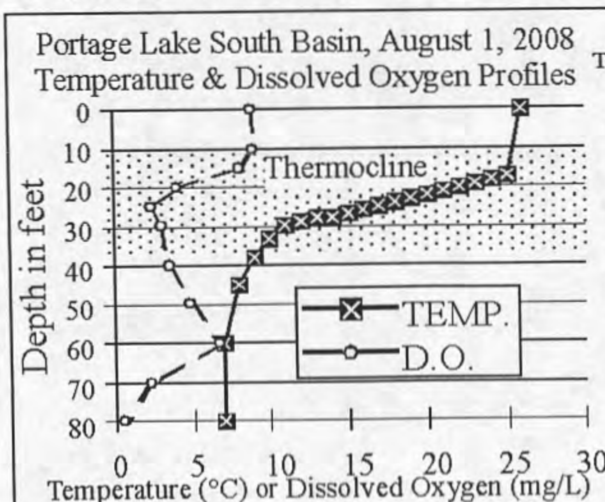
In late summer 2006 the south basin formed a 25-foot-thick thermocline from 10 to 35 feet. Dissolved oxygen was adequate above the thermocline, and started to drop at the top of the thermocline. It reached a low of 2.5 milligrams per liter at 25 feet, then increased to 4.0 mg/L at 50 feet. From that depth dissolved oxygen concentrations gradually decreased. This basin ran out of dissolved oxygen at 75 feet in 2006.

2007

In late summer 2007 the south basin formed a 25-foot-thick thermocline from 10 to 35 feet. Dissolved oxygen concentrations were adequate above the thermocline and increased to 9.4 mg/L at 15 feet in the thermocline, probably the result of an algal bloom which settled there. Below that dissolved oxygen decreased to 1.5 mg/L at 25 feet, before increasing to 6.7 mg/L at 50 feet and 6.4 mg/L at 60 feet. Below that depth dissolved oxygen decreased to 0.9 mg/L at 80 feet. The basin did not run out of dissolved oxygen at any depth this year.

2008

In late summer 2008 the south basin formed a 23-foot thick thermocline from 10 to 33 feet. Dissolved oxygen was plentiful above the thermocline and started to decrease at 10 feet. It reached a low of 2.4 mg/L at 25 feet before increasing to 6.7 mg/L at 60 feet. At 80 feet it was 0.5 mg/L. This year the south basin did not run out of dissolved oxygen at any depth. That's a real plus.

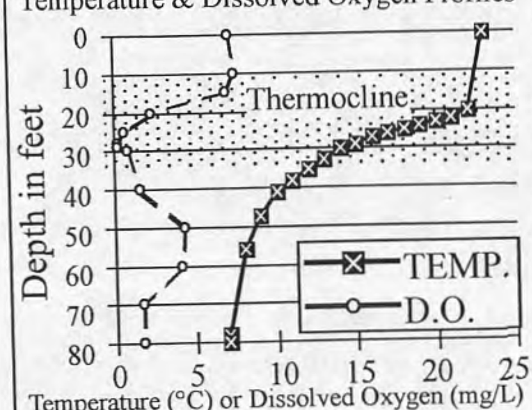


Temp.	Depth	D.O.	Depth
26	0	8.8	0
25	17	9.0	10
24	18	8.1	15
23	19	4.1	20
22	20	2.4	25
21	21	3.1	30
20	22	3.6	40
19	23	4.8	50
18	24	6.7	60
17	25	2.3	70
16	26	0.5	80
15	27		
14	28		
12	29		
11	30		
10	33		
9	38		
8	45		
7	60		
7	80		

2009

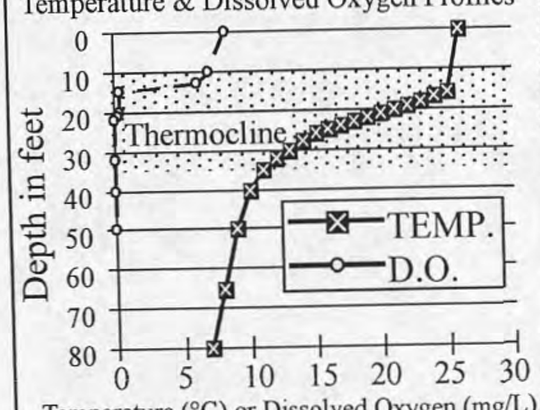
In late summer 2009 the south basin formed a 31-foot thick thermocline from 10 to 41 feet. Dissolved oxygen was adequate above the thermocline and started to decrease below 10 feet, the top of the thermocline. It reached 0.2 mg/L at 28 and 29 feet before increasing to 4.3 mg/L at 50 feet and 4.1 mg/L at 60 feet. At 80 feet it was 1.7 mg/L. This basin did not run out of dissolved oxygen at any depth in 2009.

Portage Lake South Basin, August 3, 2009
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
23	0	7.2	0
22	20	7.5	10
21	22	7.0	15
20	23	2.3	20
19	24	0.6	25
18	25	0.2	28
17	26	0.2	29
16	27	0.8	30
15	29	1.6	40
14	30	4.3	50
13	33	4.1	60
12	35	1.7	70
11	38	1.7	80
10	41		
9	47		
8	56		
7	78		
7	80		

Portage Lake South Basin, August 2, 2010
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
26	0	8.4	0
25	16	7.1	10
24	17	6.2	13
23	18	0.4	15
22	19	0.4	20
21	20	0.3	21
20	21	0.0	22
19	22	0.0	32
18	23	0.0	40
17	24	0.0	50
16	25		
15	26		
14	28		
13	30		
12	32		
11	35		
10	40		
9	50		
8	65		
7	80		

2010

In late summer 2010 the south basin formed a 25-foot thick thermocline from 10 to 35 feet. Dissolved oxygen concentrations were adequate at the surface and started to decrease below the surface. As in the north basin, they were low at 15 feet, and zero at 22 feet. That condition remained to the bottom. This was unusual. This basin generally has some dissolved oxygen under the thermocline almost to the bottom. This year the basin ran out of dissolved oxygen at 22 feet,

It is unusual (but not rare) for a lake to have low levels of dissolved oxygen for a considerable depth under the thermocline as occurred in past years. There are several other lakes we study with the same conditions. This is better than when the lake runs out of dissolved oxygen in the thermocline as it did in 2010.

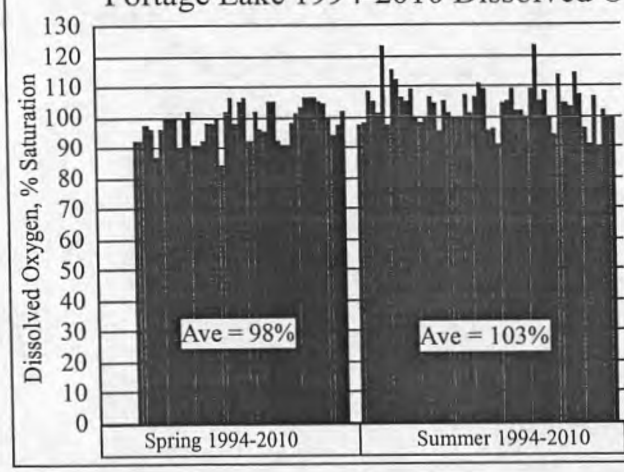
A NOTE ABOUT THE FOLLOWING GRAPHS

The data on the graphs below are first sorted by spring and summer then by date. The purpose of this is to detect differences and/or trends between the spring and summer data over time.

DISSOLVED OXYGEN SATURATION

Because the amount of dissolved oxygen a water can hold is temperature dependent, with cold water holding more than warm water, dissolved oxygen saturation is often a better way to determine if dissolved oxygen supplies are adequate. Best is between 90 and 110 percent.

Portage Lake 1994-2010 Dissolved Oxygen Saturation



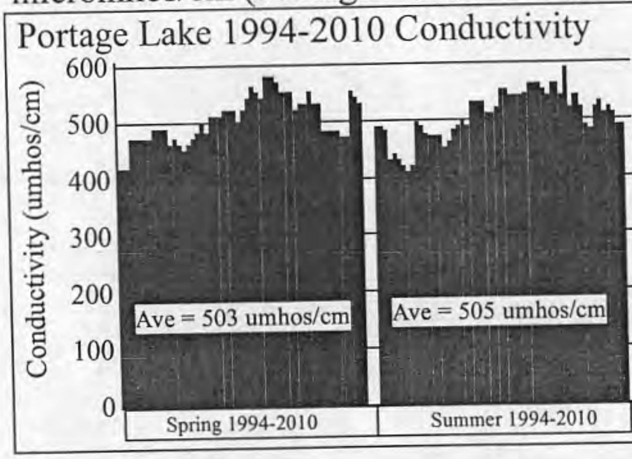
Spring		4/15/02	84	Summer		8/1/01	109
6/1/94	---	4/15/02	102	8/1/94	97	8/2/02	95
6/1/94	---	4/15/02	106	8/1/94	98	8/2/02	96
6/1/94	---	4/28/03	98	8/1/94	108	8/2/02	91
6/14/95	---	4/28/03	105	8/14/95	105	8/1/03	104
6/14/95	---	4/28/03	106	8/14/95	101	8/1/03	105
6/14/95	---	4/16/04	92	8/14/95	123	8/1/03	109
6/14/95	---	4/16/04	102	8/14/95	97	8/2/04	102
6/14/95	---	4/16/04	96	8/14/95	115	8/2/04	102
6/9/96	92	4/18/05	95	8/14/95	112	8/2/04	100
6/9/96	92	4/18/05	105	8/7/96	106	8/3/05	109
6/9/96	97	4/18/05	105	8/7/96	105	8/3/05	123
5/12/97	96	4/19/06	92	8/7/96	109	8/3/05	105
5/12/97	87	4/19/06	91	8/25/97	100	8/1/06	108
5/12/97	96	4/19/06	91	8/25/97	98	8/1/06	100
4/19/98	100	4/21/07	98	8/25/97	100	8/1/06	94
4/19/98	100	4/21/07	101	8/10/98	106	8/1/07	113
4/19/98	99	4/21/07	103	8/10/98	104	8/1/07	104
4/26/99	90	4/18/08	106	8/10/98	95	8/1/07	103
4/26/99	99	4/18/08	106	8/27/99	105	8/1/08	114
4/26/99	102	4/18/08	106	8/27/99	101	8/1/08	107
4/15/00	91	4/18/09	105	8/27/99	100	8/1/08	96
4/15/00	91	4/18/09	104	8/4/00	100	8/3/09	91
4/15/00	92	4/18/09	100	8/4/00	107	8/3/09	106
5/13/01	98	4/20/10	94	8/4/00	101	8/3/09	90
5/13/01	98	4/20/10	97	8/1/01	106	8/2/10	102
5/13/01	99	4/20/10	102	8/1/01	111	8/2/10	100
						8/2/10	100

The graph shows spring dissolved oxygen saturation values of surface samples range from 84 and 106 percent, and average 98 percent. Summer dissolved oxygen saturation values range from 90 to 123 percent and average 104 percent. 2010 values ranged from 94 to 102 percent in spring and from 100 to 102 percent in summer.

CONDUCTIVITY

Conductivity, measured with a meter, detects the capacity of a water to conduct an electric current. More importantly however, it measures the amount of materials dissolved in the water, since only dissolved materials (salts) will permit an electric current to flow. Theoretically, pure water will not conduct an electric current. It is the perception of the experts that poor quality water has more dissolved materials than good quality water. I agree. Lower is usually better.

The graph shows spring conductivities range from 420 to 580 micromhos/cm (average = 503 umhos/cm) and summer conductivities range

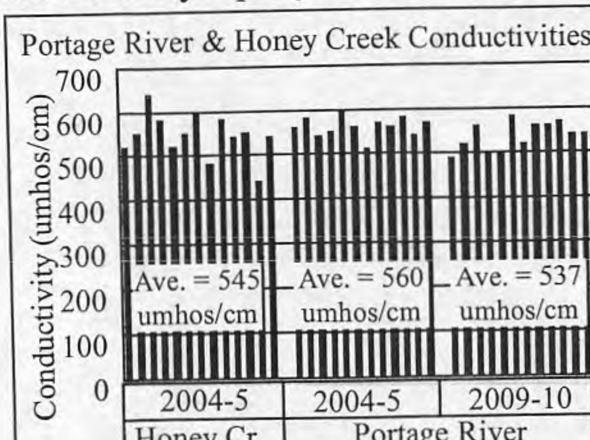


Spring		4/15/02	500	Summer		8/1/01	520
6/1/94	420	4/15/02	520	8/1/94	490	8/2/02	550
6/1/94	420	4/15/02	540	8/1/94	490	8/2/02	550
6/1/94	420	4/28/03	560	8/1/94	480	8/2/02	540
6/14/95	470	4/28/03	550	8/14/95	430	8/1/03	540
6/14/95	470	4/28/03	540	8/14/95	440	8/1/03	540
6/14/95	470	4/16/04	580	8/14/95	430	8/1/03	545
6/14/95	470	4/16/04	580	8/14/95	420	8/2/04	560
6/14/95	470	4/16/04	570	8/14/95	410	8/2/04	560
6/9/96	490	4/18/05	550	8/14/95	420	8/2/04	560
6/9/96	490	4/18/05	550	8/7/96	495	8/3/05	550
6/9/96	490	4/18/05	550	8/7/96	490	8/3/05	540
5/12/97	460	4/19/06	520	8/7/96	475	8/3/05	560
5/12/97	470	4/19/06	530	8/25/97	470	8/1/06	560
5/12/97	460	4/19/06	530	8/25/97	470	8/1/06	540
4/19/98	450	4/21/07	550	8/25/97	470	8/1/06	590
4/19/98	460	4/21/07	530	8/10/98	450	8/1/07	520
4/19/98	470	4/21/07	530	8/10/98	460	8/1/07	540
4/26/99	480	4/18/08	480	8/10/98	480	8/1/07	520
4/26/99	500	4/18/08	480	8/27/99	490	8/1/08	490
4/26/99	480	4/18/08	480	8/27/99	500	8/1/08	480
4/15/00	510	4/18/09	480	8/27/99	490	8/1/08	520
4/15/00	510	4/18/09	470	8/4/00	530	8/3/09	530
4/15/00	510	4/18/09	470	8/4/00	530	8/3/09	510
5/13/01	520	4/20/10	550	8/4/00	530	8/3/09	520
5/13/01	520	4/20/10	540	8/1/01	510	8/2/10	510
5/13/01	520	4/20/10	530	8/1/01	510	8/2/10	490
						8/2/10	490

from 410 to 590 umhos/cm (average = 505 umhos/cm).

These are on the high end of normal for conductivities in a Michigan inland lake. The graph shows conductivities, and hence salts, were increasing in the lake through about 2006, but have been generally decreasing since then.

The graph shows an interesting hump in the conductivity readings in both spring and summer. They were low for a number of years then increased from 2002 through 2006. The graph shows a decrease in conductivity (salts) in 2007, 2008, 2009 and summer 2010 which is after the DNR required water softener salt to be removed from the sewage system and discharged into the soils surrounding the lake. One would expect these salts to get into the lake fairly rapidly and cause an increase in conductivity The salts in the



Honey Cr.		Portage R.		Portage R.	
7/20/95	520	7/20/95	560	5/28/09	490
8/1/03	550	5/26/04	580	6/29/09	520
5/26/04	640	6/29/04	540	7/31/09	560
6/29/04	580	7/28/04	550	8/28/09	500
7/28/04	520	8/29/04	600	9/22/09	500
8/29/04	550	10/1/04	560	10/21/09	580
10/1/04	600	11/30/04	510	11/23/09	520
11/30/04	480	12/31/04	570	12/26/09	560
12/31/04	580	1/28/05	560	1/23/10	560
1/28/05	540	2/26/05	580	3/9/10	570
2/26/05	550	3/29/05	540	3/31/10	540
3/29/05	440	4/18/05	570	4/20/10	540
4/18/05	540				

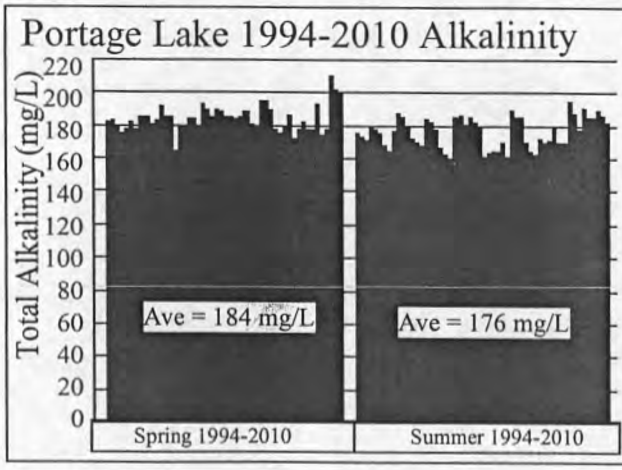
soils may not yet have reached the lake. We'll have to wait and see what happens in future years.

Normal conductivities in Michigan inland lakes range from 75 to 450 micromhos per centimeter.

The graph shows the results of the year-long (2004-5) study of Honey Creek and the Portage River and a second year-long study of the Portage River (also known as Hell Creek) in 2009-10. It shows the conductivities of the two inlets were about the same as the lake in 2004-05. The later study found lower salt concentrations in the Portage River compared to the earlier study. That's a plus.

TOTAL ALKALINITY

Alkalinity measures carbonates and bicarbonates in water. Soft water lakes have alkalinities below 75 milligrams per liter. Moderately hard water lakes have alkalinities between 75 and 150 milligrams per liter. Hard water lakes have alkalinities above 150 milligrams per liter.



Spring		4/15/02	190	Summer		8/1/01	180
6/1/94	---	4/15/02	188	8/1/94	175	8/2/02	161
6/1/94	---	4/15/02	185	8/1/94	173	8/2/02	163
6/1/94	---	4/28/03	185	8/1/94	171	8/2/02	164
6/14/95	182	4/28/03	184	8/14/95	180	8/1/03	165
6/14/95	183	4/28/03	185	8/14/95	178	8/1/03	170
6/14/95	179	4/16/04	188	8/14/95	175	8/1/03	161
6/14/95	175	4/16/04	181	8/14/95	168	8/2/04	190
6/14/95	178	4/16/04	180	8/14/95	165	8/2/04	185
6/9/96	182	4/18/05	195	8/14/95	176	8/2/04	185
6/9/96	178	4/18/05	195	8/7/96	187	8/3/05	170
6/9/96	185	4/18/05	190	8/7/96	185	8/3/05	165
5/12/97	185	4/19/06	178	8/7/96	180	8/3/05	162
5/12/97	181	4/19/06	175	8/25/97	172	8/1/06	172
5/12/97	183	4/19/06	180	8/25/97	170	8/1/06	170
4/19/98	192	4/21/07	186	8/25/97	168	8/1/06	171
4/19/98	185	4/21/07	172	8/10/98	184	8/1/07	180
4/19/98	185	4/21/07	178	8/10/98	182	8/1/07	170
4/26/99	165	4/18/08	182	8/10/98	178	8/1/07	170
4/26/99	180	4/18/08	177	8/27/99	167	8/1/08	195
4/26/99	180	4/18/08	177	8/27/99	162	8/1/08	187
4/15/00	184	4/18/09	193	8/27/99	160	8/1/08	178
4/15/00	184	4/18/09	174	8/4/00	185	8/3/09	191
4/15/00	180	4/18/09	177	8/4/00	186	8/3/09	185
5/13/01	193	4/20/10	210	8/4/00	181	8/3/09	185
5/13/01	190	4/20/10	202	8/1/01	185	8/2/10	190
5/13/01	185	4/20/10	200	8/1/01	182	8/2/10	186
						8/2/10	182

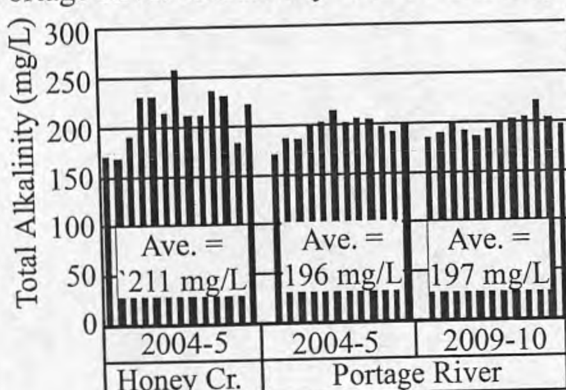
The graph shows the spring and summer surface alkalinity of Portage Lake ranges from 160 to 210 milligrams per liter. These data indicate the lake is a hard water lake. Spring alkalinities are generally higher than summer alkalinities, which is not unusual because surface carbonates and bicarbonates precipitate to the bottom sediments when the water warms in summer.

Hard water lakes are tougher than soft water lakes because they have the ability to precipitate some phosphorus to the bottom sediments as calcium phosphate where it is permanently tied up.

Spring alkalinities average 184 mg/L while summer alkalinities average 176 mg/L. This is normal because carbonates and bicarbonates, which are what the alkalinity test measures precipitate to the sediments in warm water.

The 2004-5 alkalinities of the two inlets are higher than the lake, but this is normal. Streams usually have higher alkalinities than lakes, because the carbonates and bicarbonates, which are what the alkalinity test measures, enter streams with the groundwater but precipitate in lakes. The two data sets from the Portage River show no change, which is normal and expected.

Portage River and Honey Creek Alkalinity

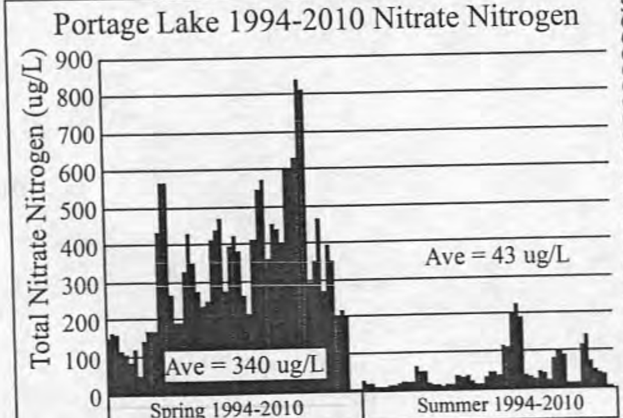


Honey Cr.		Portage R.		Portage R.	
7/20/95	170	7/20/95	170	5/28/09	184
8/1/03	168	5/26/04	186	6/29/09	189
5/26/04	190	6/29/04	185	7/31/09	197
6/29/04	230	7/28/04	200	8/28/09	191
7/28/04	230	8/29/04	202	9/22/09	185
8/29/04	213	10/1/04	213	10/21/09	192
10/1/04	257	11/30/04	201	11/23/09	198
11/30/04	210	12/31/04	205	12/26/09	202
12/31/04	210	1/28/05	204	1/23/10	204
1/28/05	235	2/26/05	196	3/9/10	220
2/26/05	230	3/29/05	191	3/31/10	203
3/29/05	182	4/18/05	199	4/20/10	196
4/18/05	221				

NITRATE NITROGEN

Most Michigan inland lakes have spring nitrate nitrogen concentrations around 200 micrograms per liter (or parts per billion). Summer nitrate

Portage Lake 1994-2010 Nitrate Nitrogen



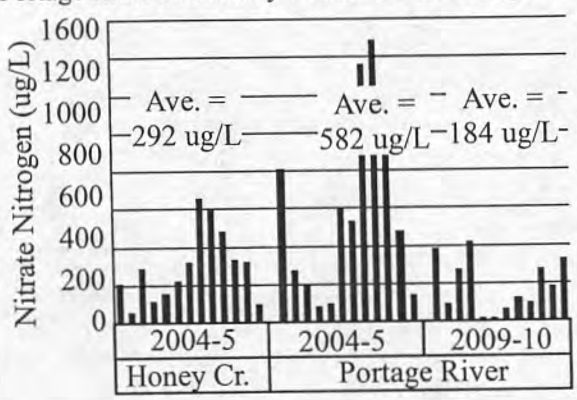
Spring		4/15/02	270	Summer		8/1/01	11
6/1/94	149	4/15/02	393	8/1/94	23	8/2/02	28
6/1/94	160	4/15/02	419	8/1/94	12	8/2/02	38
6/1/94	154	4/28/03	380	8/1/94	14	8/2/02	42
6/14/95	111	4/28/03	258	8/14/95	5	8/1/03	32
6/14/95	104	4/28/03	211	8/14/95	3	8/1/03	110
6/14/95	78	4/16/04	411	8/14/95	5	8/1/03	105
6/14/95	116	4/16/04	545	8/14/95	7	8/2/04	198
6/14/95	45	4/16/04	571	8/14/95	7	8/2/04	221
6/9/96	139	4/18/05	356	8/14/95	12	8/2/04	189
6/9/96	165	4/18/05	449	8/7/96	17	8/3/05	31
6/9/96	165	4/18/05	438	8/7/96	16	8/3/05	27
5/12/97	433	4/19/06	396	8/7/96	17	8/3/05	22
5/12/97	564	4/19/06	599	8/25/97	57	8/1/06	42
5/12/97	564	4/19/06	599	8/25/97	43	8/1/06	37
4/19/98	264	4/21/07	629	8/25/97	43	8/1/06	17
4/19/98	185	4/21/07	836	8/10/98	12	8/1/07	74
4/19/98	185	4/21/07	812	8/10/98	10	8/1/07	92
4/26/99	325	4/18/08	290	8/10/98	11	8/1/07	83
4/26/99	427	4/18/08	347	8/27/99	5	8/1/08	7
4/26/99	347	4/18/08	463	8/27/99	8	8/1/08	7
4/15/00	274	4/18/09	269	8/27/99	7	8/1/08	10
4/15/00	230	4/18/09	391	8/4/00	31	8/3/09	112
4/15/00	244	4/18/09	346	8/4/00	25	8/3/09	140
5/13/01	412	4/20/10	200	8/4/00	33	8/3/09	65
5/13/01	436	4/20/10	213	8/1/01	16	8/2/10	44
5/13/01	469	4/20/10	194	8/1/01	8	8/2/10	36
						8/2/10	32

nitrogen concentrations are generally much lower, in the 10 to 40 micrograms per liter range.

Spring nitrate nitrogen concentrations range from a low of 45 micrograms per liter (in 1995) to a high of 836 micrograms per liter in 2007 (average – 340 ug/L). The spring nitrate concentrations above 300 ug/L are higher than we normally see in Michigan inland lakes. The graph shows spring nitrates were generally increasing although 2008, 2009 and 2010 spring nitrates did not follow that trend. Increasing nitrates is not a plus.

Summer values are lower, ranging from 3 to 221 micrograms per liter (average = 43 ug/L). These data indicate Portage Lake is probably phosphorus limited in spring and nitrate limited in summer. It also means no fertilizers containing either nitrogen or phosphorus should be used on near-lake areas.

Portage River and Honey Creek Nitrate Nitrogen



Honey Cr.		Portate R.		Portate R.	
7/20/95	204	5/26/04	806	5/28/09	380
8/1/03	53	6/29/04	268	6/29/09	87
5/26/04	284	7/28/04	186	7/31/09	266
6/29/04	110	8/29/04	76	8/28/09	412
7/28/04	154	10/1/04	96	9/22/09	10
8/29/04	216	11/30/04	590	10/21/09	10
10/1/04	316	12/31/04	528	11/23/09	58
11/30/04	656	1/28/05	1356	12/26/09	119
12/31/04	587	2/26/05	1485	1/23/10	95
1/28/05	480	3/29/05	989	3/9/10	270
2/26/05	326	4/18/05	473	3/31/10	178
3/29/05	315	7/20/95	133	4/20/10	319
4/18/05	93				

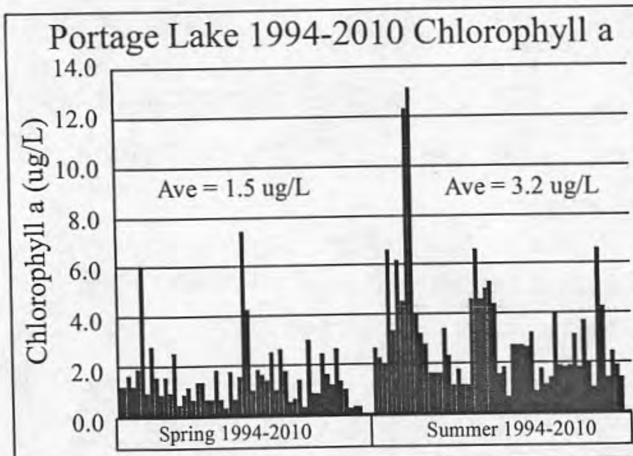
The graph shows the results of the 2004-5 and 2009-10 year-long stream studies. It shows in 2004-5, nitrates in 13 Honey Creek samples ranged from 53 to 656 micrograms per liter and averaged 292 micrograms per liter. The nitrate nitrogen concentrations of the 12 Portage River samples in 2004-5 ranged from 76 to 1485 micrograms per liter, and averaged 582 micrograms per liter in 2004-5. And the nitrate data from the 12 2009-10 Portage River samples ranged from 10 to 412 ug/L and averaged 184 ug/L. That's a significant drop in the nitrate concentration of Portage River water since 2004-5. And it's a plus.

These data indicate in 2004-5, the Portage River average nitrate concentrations twice as high as Honey Creek. But in 2009-10 the nitrate concentrations were actually lower than Honey Creek.

It looks like something happened upstream in the Portage River to reduce the nitrates so much.

CHLOROPHYLL A

Chlorophyll a, reported in micrograms per liter (or parts per billion) generally gives an estimate of algal densities. Best is below 1 ug/L.



Spring		4/15/02	1.5	8/1/94	2.6	8/2/02	1.5
6/1/94	1.2	4/15/02	7.4	8/1/94	2.2	8/2/02	1.8
6/1/94	1.2	4/15/02	4.2	8/1/94	2.0	8/2/02	0.6
6/1/94	1.6	4/28/03	1.0	8/14/95	6.6	8/1/03	2.7
6/14/95	1.2	4/28/03	1.8	8/14/95	3.3	8/1/03	2.7
6/14/95	1.9	4/28/03	1.6	8/14/95	6.2	8/1/03	2.7
6/14/95	6.0	4/16/04	1.4	8/14/95	4.5	8/2/04	2.6
6/14/95	0.9	4/16/04	2.5	8/14/95	12.3	8/2/04	3.2
6/14/95	2.8	4/16/04	1.0	8/14/95	13.1	8/2/04	0.8
6/9/96	1.5	4/18/05	2.6	8/7/96	4.0	8/3/05	1.7
6/9/96	0.8	4/18/05	1.7	8/7/96	3.2	8/3/05	1.1
6/9/96	1.5	4/18/05	0.5	8/7/96	2.8	8/3/05	1.4
5/12/97	0.9	4/19/06	0.6	8/25/97	1.6	8/1/06	4.0
5/12/97	2.5	4/19/06	1.4	8/25/97	1.6	8/1/06	1.9
5/12/97	0.4	4/19/06	0.3	8/25/97	1.6	8/1/06	1.8
4/19/98	0.8	4/21/07	3.0	8/10/98	3.4	8/1/07	1.9
4/19/98	1.1	4/21/07	0.8	8/10/98	2.3	8/1/07	3.1
4/19/98	0.6	4/21/07	0.8	8/10/98	1.1	8/1/07	1.8
4/26/99	1.3	4/18/08	2.4	8/27/99	1.7	8/1/08	3.7
4/26/99	1.3	4/18/08	1.6	8/27/99	1.1	8/1/08	2.0
4/26/99	0.6	4/18/08	1.2	8/27/99	1.1	8/1/08	1.0
4/15/00	0.6	4/18/09	2.6	8/4/00	4.6	8/3/09	6.6
4/15/00	1.8	4/18/09	1.3	8/4/00	6.6	8/3/09	4.2
4/15/00	0.6	4/18/09	1.0	8/4/00	4.6	8/3/09	1.4
5/13/01	0.3	4/20/10	0.2	8/1/01	5.0	8/2/10	2.4
5/13/01	1.7	4/20/10	0.3	8/1/01	5.3	8/2/10	1.9
5/13/01	0.6	4/20/10	0.3	8/1/01	4.4	8/2/10	1.4

The chlorophyll data shows in spring Portage Lake has smaller algal blooms than in summer. The graph really doesn't show any specific trend in either spring or summer. 2010 spring chlorophylls ranged from 0.2 to 0.4 ug/L, which is very good, while summer chlorophylls ranged from 1.4 to 2.4 ug/L. As usual, summer values were higher.

pH (Hydrogen ion concentration) (no graph)

1994 through 2010 spring and summer surface pH values ranged from 7.8 to 8.8. These are normal pH values for a Michigan inland lake fed by a river.

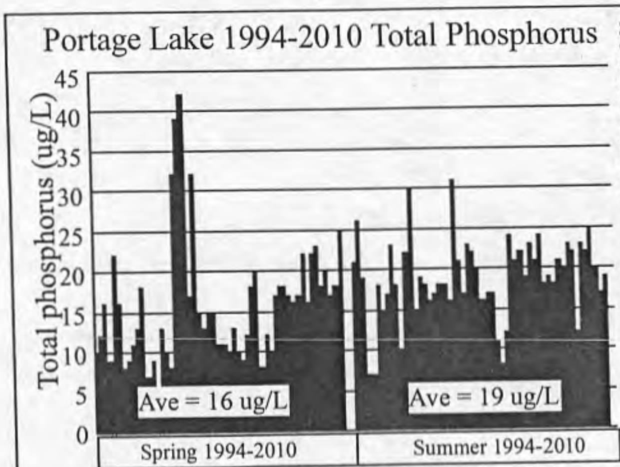
Lakes with extensive plant communities often have high summer pH values (greater than 9) because the plants use the carbonates in the water as a carbon source. This causes a decrease in the buffering capacity of the water, and allows the pH to rise.

TOTAL PHOSPHORUS

Although there are several forms of phosphorus found in lakes, the experts selected total phosphorus as being most important. This is probably because all forms of phosphorus can be converted to the other forms. Currently, most lake scientists feel phosphorus, which is measured in parts per billion (1 part per billion is one second in 31 years) or micrograms per liter (ug/L), is the one nutrient which might be controlled. If its addition to lake water could be limited, the lake might not become covered with the algal communities so often found in eutrophic lakes.

However, based on our studies of many Michigan inland lakes, we've found many lakes were phosphorus limited in spring (so don't add phosphorus) and nitrate limited in summer (so don't add nitrogen).

10 parts per billion is considered a low concentration of phosphorus in a lake and 50 parts per billion is considered high by many limnologists.



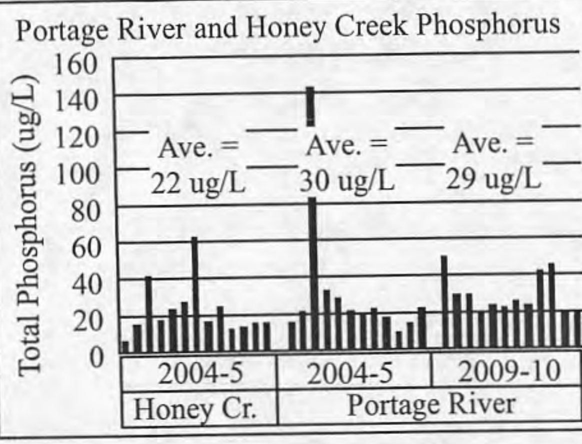
Spring		4/15/02	11	Summer		8/1/01	20
6/1/94	10	4/15/02	11	8/1/94	21	8/2/02	16
6/1/94	12	4/15/02	10	8/1/94	26	8/2/02	17
6/1/94	16	4/28/03	13	8/1/94	19	8/2/02	17
6/14/95	9	4/28/03	10	8/14/95	7	8/1/03	11
6/14/95	22	4/28/03	9	8/14/95	7	8/1/03	8
6/14/95	16	4/16/04	12	8/14/95	18	8/1/03	12
6/14/95	8	4/16/04	18	8/14/95	15	8/2/04	24
6/14/95	9	4/16/04	20	8/14/95	17	8/2/04	21
6/9/96	11	4/18/05	8	8/14/95	23	8/2/04	22
6/9/96	13	4/18/05	12	8/7/96	18	8/3/05	19
6/9/96	18	4/18/05	10	8/7/96	10	8/3/05	23
5/12/97	7	4/19/06	17	8/7/96	22	8/3/05	21
5/12/97	9	4/19/06	18	8/25/97	30	8/1/06	24
5/12/97	5	4/19/06	18	8/25/97	15	8/1/06	18
4/19/98	13	4/21/07	17	8/25/97	19	8/1/06	19
4/19/98	10	4/21/07	16	8/10/98	18	8/1/07	18
4/19/98	8	4/21/07	17	8/10/98	16	8/1/07	21
4/26/99	32	4/18/08	22	8/10/98	17	8/1/07	20
4/26/99	39	4/18/08	16	8/27/99	18	8/1/08	23
4/26/99	42	4/18/08	22	8/27/99	18	8/1/08	22
4/15/00	17	4/18/09	23	8/27/99	16	8/1/08	12
4/15/00	32	4/18/09	18	8/4/00	31	8/3/09	23
4/15/00	15	4/18/09	20	8/4/00	21	8/3/09	22
5/13/01	13	4/20/10	17	8/4/00	17	8/3/09	25
5/13/01	15	4/20/10	18	8/1/01	23	8/2/10	20
5/13/01	15	4/20/10	25	8/1/01	22	8/2/10	17
						8/2/10	19

The graph shows spring phosphorus concentrations range from 5 to 42 micrograms per liter (and average 16 ug/L), but are generally in the 10 to 20 microgram per liter range. The graph shows summer phosphorus concentrations range from 7 to 31 ug/L and average 19 ug/L. The graph seems to show a slight trend to higher phosphorus concentrations in both spring and summer.

In 2010 spring phosphorus concentrations ranged from 17 to 25 ug/L while summer phosphorus concentrations ranged from 17 to 20 ug/L.

When in-lake phosphorus concentrations approach or exceed 20 ug/L excessive amounts of plants and/or algae will grow in the lake if other nutrients are also present in adequate quantities.

The 2004-5 year-long study of Honey Creek and the Portage River found phosphorus concentrations in Honey Creek ranged from 6 to 62 micrograms per liter, and averaged 22 ug/L, while the phosphorus concentrations of the



Honey Cr.		Portage R.		Portage R.	
7/20/95	6	7/20/95	15	5/28/09	50
8/1/03	15	5/26/04	21	6/29/09	29
5/26/04	41	6/29/04	143	7/31/09	29
6/29/04	17	7/28/04	32	8/28/09	18
7/28/04	23	8/29/04	28	9/22/09	23
8/29/04	27	10/1/04	21	10/21/09	22
10/1/04	62	11/30/04	18	11/23/09	25
11/30/04	16	12/31/04	22	12/26/09	23
12/31/04	24	1/28/05	17	1/23/10	42
1/28/05	12	2/26/05	9	3/9/10	45
2/26/05	13	3/29/05	14	3/31/10	18
3/29/05	15	4/18/05		4/20/10	18
4/18/05	15				

Portage River ranged from 9 to 143 ug/L, and averaged 30 ug/L.

The 2009-10 study of the Portage River found slightly higher phosphorus connections compared to the earlier study, although the average doesn't really indicate that but the graph does.

The average phosphorus concentration of Portage Lake is 18 ug/L liter.

It appears the Portage River adds almost 50 percent more phosphorus to the lake compared Honey Creek, based on concentration.

SECCHI DISK TRANSPARENCY (originally Secchi's disk)

In 1865, Angelo Secchi, the Pope's astronomer in Rome, Italy devised a 20 centimeter (8 inch) white disk for studying the transparency of the water in the Mediterranean Sea. Later an American limnologist (lake scientist) named Whipple divided the disk into black and white quadrants which many are familiar with today.

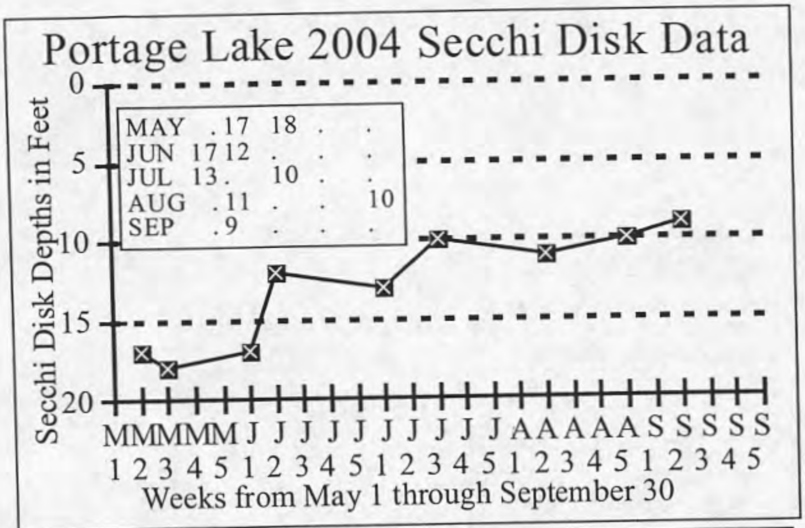
The Secchi disk transparency is a lake test widely used and accepted by limnologists. The experts generally felt the greater the Secchi disk depth, the better quality the water. However, one Canadian scientist pointed out acid lakes have very deep Secchi disk readings. Most lakes in southeast Michigan have Secchi disk transparencies of less than ten feet. On the other hand, Elizabeth Lake in Oakland County had 34 foot Secchi disk readings in summer 1996, evidently caused by a zebra mussel invasion a couple of years earlier.

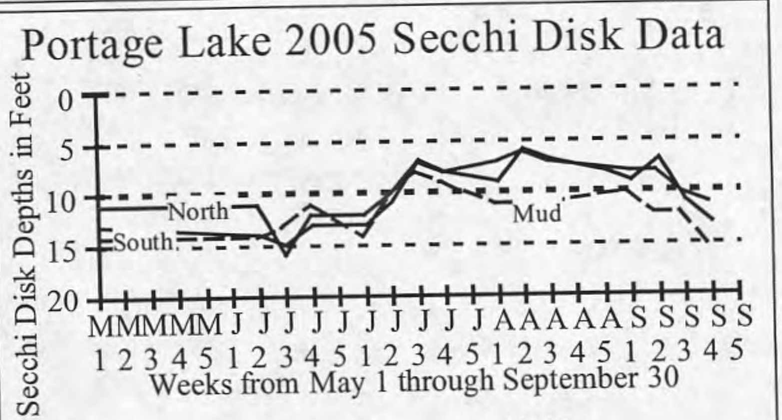
Most limnology texts recommend the following: to take a Secchi disk transparency reading, lower the disk into the water on the shaded side of an anchored boat to a point where it disappears. Then raise it to a point where it's visible. The average of these two readings is the Secchi disk transparency depth.

We do it slightly differently. We lower the disk on the shaded side of an anchored boat until the disk disappears, and note the depth, then report the depth to the next deepest foot. For example if the disk disappears at six and a half feet, we report the Secchi disk depth as 7 feet. The reason we do this is that some suggest using a water telescope (a device that works like an underwater mask and eliminates water roughness) to view the disk as it disappears. Since we don't use this device, we compensate for it by noting the slightly deeper depth.

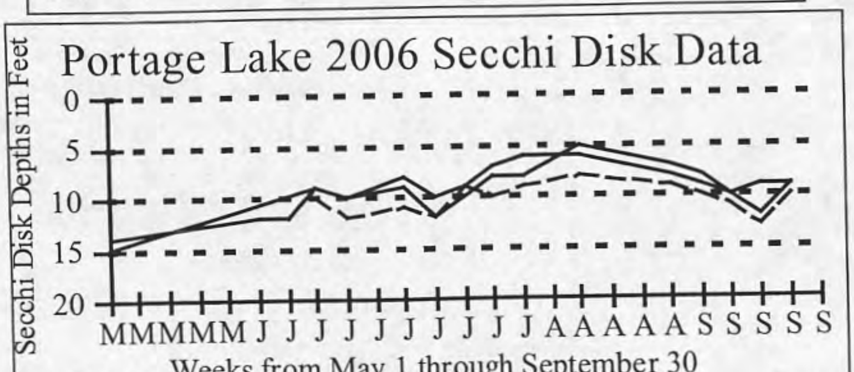
We feel it is only necessary to report Secchi disk measurements to the closest foot. Secchi disk measurements should be taken between 10 AM and 4 PM. Rough water will give slightly shallower readings than smooth water. Sunny days will give slightly deeper readings than cloudy days. However, roughness influences the visibility of the disk more than sunny or cloudy days. Furthermore, it's been reported that most adults can see the Secchi disk disappear at about the same depth, but grand-children see it disappear 3-4 feet deeper than grand-parents.

If there are sample sites where the lake is too shallow and the disk is visible when resting on the bottom, the reading should be taken at a nearby deeper site. Since the sampling procedure is designed to obtain "representative samples" moving the boat to an area where a Secchi disk transparency reading can be properly taken is appropriate. In the case of Secchi disk readings, this procedure is more valid than reporting the disk is visible on the lake bottom.





South basin					North basin					Mud bay				
MAY	13	.	.	.	MAY	11	.	.	.	MAY	14	.	.	.
JUN	.	14	15	13	JUN	.	11	16	12	JUN	.	14	13	11
JUL	13	11	7	8	JUL	12	10	7	8	JUL	14	10	8	9
AUG	9	6	7	8	AUG	7	6	7	.	AUG	11	11	11	.
SEP	9	7	11	13	SEP	8	8	10	11	SEP	10	12	12	15



South basin						North basin						Mud bay ------					
MAY		14	.	.	.	MAY		15	.	.	.	MAY		.	.	.	.
JUN		12	12	9	10	JUN		.	.	9	10	JUN		.	.	10	12
JUL	9	12	10	8	8	JUL	8	10	9	7	6	JUL	11	12	9	10	9
AUG		.	5	.	7	AUG		.	6	.	8	AUG		.	8	.	9
SEP	8	10	9	9	.	SEP	9	10	12	9	.	SEP	10	11	13	10	.

PORTAGE LAKE SECCHI DISK DATA

2004

Jim Meyer took Secchi disk readings in Portage Lake in 2004. The graph shows his data. It shows 17-18 foot readings when the water was cool in spring, and then as the water warmed, the clarity decreased to 9 to 11 feet.

2005

Bill Ferrington did a good job taking Secchi disk readings at three sites in the lake in 2005, the north basin, the south basin and Mud Bay. The graph shows his data.

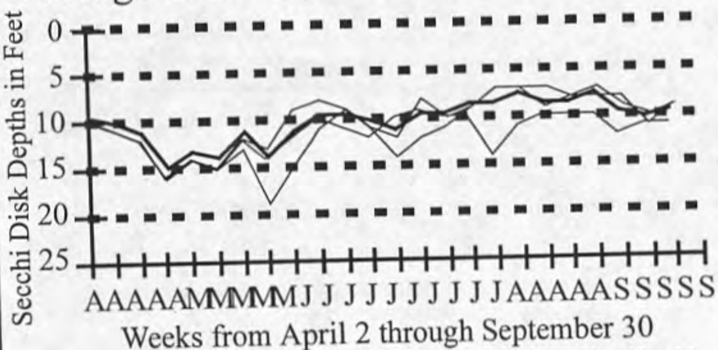
It shows deeper spring readings and shallower summer readings, as did the 2004 data. Surprisingly, Mud Bay had deeper August and September readings than either the north or south basins.

2006

Bill Ferrington did a good job taking Secchi disk readings at three sites in the lake in 2006, the north basin, the south basin and Mud Bay. The graph shows his data.

It shows deeper spring readings and shallower summer readings, as did Meyer's 2004 data. Surprisingly, Mud Bay had deeper readings than did either the north or south basins this year as well.

Portage Lake 2007 Secchi Disk Data



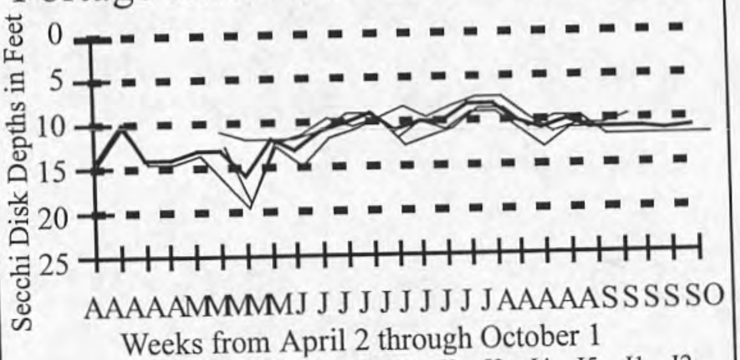
	A1	A2	A3	A4	M1	M2	M3	M4	J1	J2	J3	J4
North	10	11	12	16	14	15	12	13	9	8	9	11
South	10	11	12	16	14	15	13	19	15	11	9	11
Mud Bay	10	11	12	16	14	15	12	14	12	10	11	12
Average	10	11	12	16	14	15	12	15	12	10	10	11

	J1	J2	J3	J4	J5	A1	A2	A4	S1	S2	S3	S4
North	12	8	10	9	7	7	7	8	7	9	10	9
South	14	12	11	9	7	7	9	8	8	8	11	9
Mud Bay	10	9	10	10	14	11	10	10	10	12	11	11
Average	12	10	10	9	9	8	9	9	8	10	11	10

2007

Ferrington did an excellent job taking Secchi disk readings in 2007. He took them in the north and south basins and Mud Bay April through September. The graph shows his data.
The light lines are the individual station data and the dark line is the average of the three stations. The graph

Portage Lake 2008 Secchi Disk Data



	M1	M2	M3	M4	M5	J1	J2	J3	J4	J5	J1	J2
North	----	----	----	----	----	12	18	12	14	11	10	9
South	14	10	14	14	13	16	19	12	11	9	10	9
Mud Bay	----	----	----	----	----	11	12	12	12	11	9	9
Average	14	10	14	14	13	13	16	12	13	11	10	9

	J3	J4	J5	A1	A2	A3	A4	A5	S1	S2	S5
North	12	11	10	8	8	10	9	9	11	11	11
South	8	9	8	7	7	9	11	10	10	9	----
Mud Bay	12	10	11	9	9	11	13	11	11	11	----
Average	11	10	10	8	8	10	11	10	11	11	11

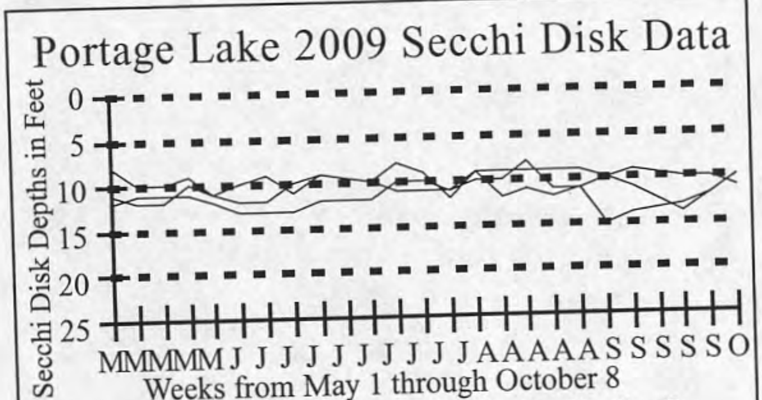
shows the clarity of the lake did not change much between spring and summer. Mud Bay again had the deepest readings.

The graph shows Secchi disk readings in 2007 ranged from 7 to 19 feet, but most of the time were within 7 to 15 feet.

2008

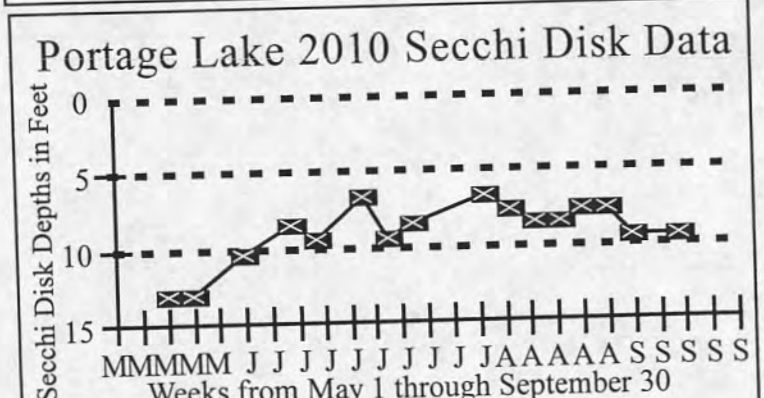
Ferrington again did an excellent job taking Secchi disk readings in 2008. As in past years, he took them in the north and south basins and Mud Bay April through September. The graph shows his data.

The light lines are the individual station data and the dark line is the average of the three stations. The graph shows the clarity of the lake did not change much between spring and summer. The south basin had the deepest readings this year, 19 feet.



	M1	M2	M3	M4	M5	J1	J2	J3	J4	J1	J2
North	12	11	11	11	12	13	13	13	12	12	10
South	11	12	12	10	11	12	12	10	9	10	11
Mud Bay	8	10	10	9	11	10	9	11	9	10	8

	J3	J4	J5	A1	A2	A3	A4	A5	S1	S3	S4	S5
North	10	11	10	10	8	11	11	10	9	10	10	11
South	11	11	9	9	9	9	9	10	11	14	12	10
Mud Bay	9	12	9	12	11	12	11	15	14	13	12	



MAY	.	.	14	14	.
JUN	11	.	9	10	.
JUL	7	10	9	.	.
AUG	7	8	9	9	8
SEP	8	10	.	10	.

2009

The graph of Ferrington's 2009 data shows almost a straight line from spring through summer and fall. These data indicate the clarity of the lake didn't change much as the water warmed from spring to summer, and then cooled in the fall.

2010

Ferrington's 2010 data shows deep (14 feet) readings in May, decreasing to a minimum of 7 feet the first part of July. The remainder of the summer, the water clarity varied between 7 and 10 feet, ending up at 10 feet in September.

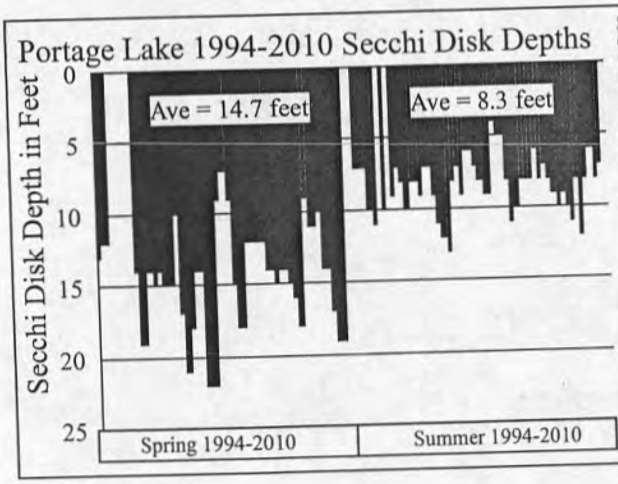
SECCHI DISK READINGS TAKEN WITH THE SAMPLES

The graph shows the Secchi disk readings taken with the samples, first sorted by spring and summer, then by year.

It shows spring 2001 was best at 22 feet. Since that time the water clarity in spring has been decreasing. The graph shows the summer readings are pretty much remaining steady, with no specific trend.

In 2010 spring readings were 19 while summer readings were 6, 7 and 8 feet.

The graph shows spring readings are quite a bit deeper (average = 14.7 feet) than summer readings (average = 8.3 feet).

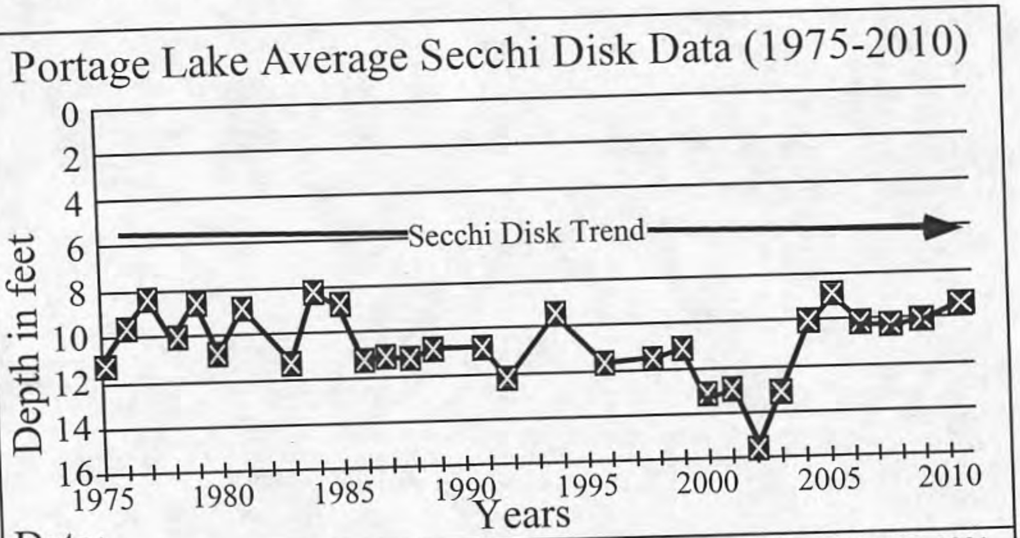


Spring		4/15/02	9	Summer		8/2/02	8
6/1/94	13	4/15/02	7	8/1/94	7	8/2/02	9
6/1/94	12	4/15/02	9	8/1/94	7	8/2/02	9
6/1/94	12	4/28/03	15	8/1/94	7	8/1/03	4
6/14/95	---	4/28/03	18	8/14/95	10	8/1/03	5
6/14/95	---	4/28/03	18	8/14/95	11	8/1/03	5
6/14/95	---	4/16/04	12	8/14/95	---	8/2/04	8
6/14/95	---	4/16/04	12	8/14/95	10	8/2/04	11
6/14/95	---	4/16/04	12	8/14/95	---	8/2/04	10
6/9/96	14	4/18/05	12	8/14/95	9	8/3/05	8
6/9/96	19	4/18/05	14	8/7/96	7	8/3/05	8
6/9/96	19	4/18/05	14	8/7/96	8	8/3/05	8
5/12/97	14	4/19/06	15	8/7/96	10	8/1/06	6
5/12/97	15	4/19/06	14	8/25/97	8	8/1/06	8
5/12/97	14	4/19/06	14	8/25/97	8	8/1/06	7
4/19/98	15	4/21/07	15	8/25/97	9	8/1/07	8
4/19/98	15	4/21/07	16	8/10/98	7	8/1/07	9
4/19/98	15	4/21/07	18	8/10/98	7	8/1/07	10
4/26/99	10	4/18/08	9	8/10/98	9	8/1/08	9
4/26/99	17	4/18/08	11	8/27/99	11	8/1/08	10
4/26/99	21	4/18/08	11	8/27/99	12	8/1/08	11
4/15/00	18	4/18/09	10	8/27/99	13	8/3/09	8
4/15/00	14	4/18/09	14	8/4/00	8	8/3/09	12
4/15/00	14	4/18/09	14	8/4/00	7	8/3/09	8
5/13/01	22	4/20/10	17	8/4/00	9	8/2/10	6
5/13/01	22	4/20/10	19	8/1/01	6	8/2/10	8
5/13/01	22	4/20/10	19	8/1/01	6	8/2/10	7

THE SECCHI DISK TREND GRAPH

Because Portage Lake residents have been taking Secchi disk readings on a regular basis since 1975, we were able to construct a Secchi Disk Trend

Graph which shows the clarity of Portage Lake was not changing from 1976 through 1985. From 1986 through 2003 the clarity was getting better. However, after 2003 average Secchi disk readings were not as good as earlier years. Let's hope this trend doesn't continue.



Data:

1975	1976	1977	1978	1979	1980	1981	1983	1984	1985	1986	1987	1988	1989	1991
11.2	9.7	8.4	10.2	8.5	10.8	8.9	11.3	8.3	8.9	11.3	11.2	11.3	10.8	10.8

1992	1994	1996	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010
12.3	9.6	11.7	11.5	10.9	13.5	13.3	15.4	13.1	10.0	8.78	10.1	10.5	10.2	9.4

THE LAKE WATER QUALITY INDEX

The Lake Water Quality Index used in this study to define the water quality of Portage Lake was developed for two reasons. First, there was no agreement among lake scientists regarding which tests should be used to define the water quality of lakes, and second, there was no agreement among lake scientists regarding what the results of various tests meant in terms of lake water quality.

Development of the index involved the use of two questionnaires sent to a panel of 555 lake scientists who were members of the American Society of Limnology and Oceanography. The panel was specifically selected because they were chemists and biologists with advanced degrees who studied lake water quality.

The first questionnaire asked the scientists to select tests which they felt should be used to define lake water quality. The tests most often selected by the panel became the index parameters (or tests). They were:

Dissolved oxygen (percent saturation)
Total phosphorus
Chlorophyll a
Secchi disk depth
Total nitrate nitrogen
Total alkalinity
Temperature
Conductivity
pH

The second questionnaire, sent out after the first was returned, asked the scientists what the results of the tests they selected as good indicators of lake water quality meant.

After the responses to the second questionnaire were returned and tabulated, the nine parameters and the accompanying rating curves were combined into a Lake Water Quality Index.

The index ranges from 1 to 100 and rates lakes about the same way professors rate students: 90-100=A, 80-90=B, 70-80=C, 60-70=D, and below 60 = E. The lake with the highest LWQI was Long Lake in Grand Traverse County, with a spring LQWI of 100. The lowest was 16 at an Ottawa County lake.

THE LAKE WATER QUALITY INDEX CALCULATION SHEETS

The Lake Water Quality Index calculation sheets which follow were developed to show graphically what the results of the nine different lake water quality tests mean in terms of lake water quality.

HOW TO READ THE LAKE WATER QUALITY INDEX CALCULATION SHEETS.

Listed across the top of the calculation sheets are the tests selected by the panel of experts as being good indicators of lake water quality. The results of the tests are entered into the square boxes immediately under the names of the tests.

The figures which look like thermometers are actually graphs which convert the test results (the numbers found outside the thermometer) to a uniform 1-100 lake water quality rating (found inside the thermometer).

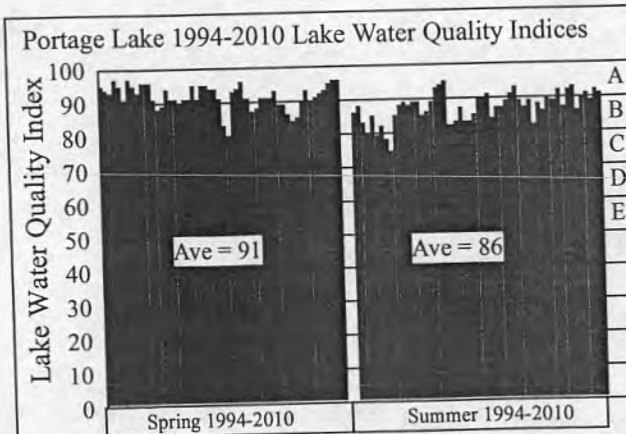
The calculation sheet permits calculation of the Lake Water Quality Index, using the results of all nine lake water quality tests.

The position of the red lines across the thermometer indicates how the results of each test compare in terms of lake water quality. Test results indicating excellent water quality are indicated by red lines near the top of the thermometer. Test results indicating poor water quality are indicated by red lines lower on the thermometer. And the lower the red line on the thermometer, the greater the water quality problem. A glance at the top of the calculation sheet indicates the test and the actual test results.

The thermometer rating scales also allow you to determine what test results would be considered excellent in terms of lake water quality. They are the numbers found outside the thermometer near the top.

The index is shown three different ways, as a number between 1 and 100 in the circle marked LWQI, and by a color and position on the sheet edge scale. The purpose of the sheet edge scale is to review quickly large numbers of lakes or test sites within a lake, and determine how the water quality of the various lakes, or test sites within a lake compare.

THE 1994-2010 PORTAGE LAKE WATER QUALITY INDICES



Spring		4/15/02	90	Summer		8/1/01	84
6/1/94	94	4/15/02	82	8/1/94	85	8/2/02	89
6/1/94	93	4/15/02	79	8/1/94	87	8/2/02	89
6/1/94	92	4/28/03	92	8/1/94	82	8/2/02	90
6/14/95	96	4/28/03	93	8/14/95	79	8/1/03	83
6/14/95	94	4/28/03	95	8/14/95	84	8/1/03	86
6/14/95	90	4/16/04	90	8/14/95	78	8/1/03	86
6/14/95	96	4/16/04	86	8/14/95	81	8/2/04	88
6/14/95	94	4/16/04	87	8/14/95	77	8/2/04	90
6/9/96	92	4/18/05	90	8/14/95	74	8/2/04	92
6/9/96	95	4/18/05	90	8/7/96	84	8/3/05	88
6/9/96	95	4/18/05	90	8/7/96	87	8/3/05	86
5/12/97	90	4/19/06	92	8/7/96	88	8/3/05	88
5/12/97	87	4/19/06	88	8/25/97	87	8/1/06	81
5/12/97	88	4/19/06	88	8/25/97	88	8/1/06	87
4/19/98	93	4/21/07	85	8/25/97	88	8/1/06	85
4/19/98	90	4/21/07	83	8/10/98	84	8/1/07	89
4/19/98	90	4/21/07	84	8/10/98	85	8/1/07	88
4/26/99	89	4/18/08	89	8/10/98	88	8/1/07	91
4/26/99	90	4/18/08	92	8/27/99	92	8/1/08	86
4/26/99	90	4/18/08	89	8/27/99	93	8/1/08	91
4/15/00	94	4/18/09	90	8/27/99	94	8/1/08	92
4/15/00	90	4/18/09	91	8/4/00	81	8/3/09	85
4/15/00	94	4/18/09	92	8/4/00	82	8/3/09	89
5/13/01	94	4/20/10	94	8/4/00	86	8/3/09	90
5/13/01	93	4/20/10	95	8/1/01	82	8/2/10	88
5/13/01	93	4/20/10	95	8/1/01	82	8/2/10	91
						8/2/10	90

The graph shows the spring Lake Water Quality Indices for Portage Lake range from 79 to 96 (C to A) in spring and from 74 to 94 (C to A) in summer. The graph seems to show spring LWQIs are not changing much while summer LWQIs may increasing.

In 2010, the spring Lake Water Quality Indices for Portage Lake were 94 or 95 (average = 91) or in the A range. In summer 2010 the lake water quality indices were 88, 91 or 90 (average = 86) or in the B to A range.

THE LAKE WATER QUALITY INDEX CALCULATION SHEETS

Because the spring 2010 Lake Water Quality Indices at the three surface stations were similar (94 95 95), one LWQI calculation sheet is included in this report for the three spring surface samples, using averaged data.

In summer 2010 the LWQIs were similar (88 91 90) so a second LWQI calculation sheet is included for the three summer surface samples, again using averaged data.

In the report marked MASTER, all 6 of the 2010 LWQI calculation sheets are included. That is the only difference between the MASTER and the rest of the reports.

PORTAGE LAKES BOTTOM SEDIMENTS

Many times bottom sediments tell us more about what is happening in a lake than the water quality tests do. That's because bottom sediments provide sort of a history of what's been happening in a lake, while water testing just provides a snapshot.

Bottom sediments are collected with a Pederson dredge, transferred to pint freezer containers and allowed to air dry. Once they are dry, the (usually) shrunken block of material is measured to determine volume, then ground, placed in porcelain dishes, dried at 100 degrees C, weighed, burned at 550 degrees C, and weighed again. Color after air-drying and after burning is also noted.

Bottom sediments almost always come up from the lake bottom black, and many people consider these black sediments "muck". However that's not usually the case.

The bottom sediments are black because no oxygen penetrates them, so the decomposition processes which occur use sulfur rather than oxygen, and in this process, they produce iron sulfides, which are black. However once the sediments are exposed to air, they usually turn some other color.

If the sediments remain black after air drying it usually means they are less than about 65 percent mineral (or more than 35% organic material). Sediments also remain black if they are from soft water lakes, but there's a reason for that.

If the sediments turn gray after air drying it usually means they are made up primarily of carbonates. This is what we usually see in moderately hard water and hard water lakes.

If the sediments turn tan, it usually means they are made up primarily of clays. Further evidence of this occurs when we burn the sediments at 550 degrees C.

We determine how much bottom sediments shrink when they air dry because this information is useful when considering dredging a lake. Normal shrinkage after air-drying is in the range of 50 to 80 percent. However sands and gravels don't shrink at all. Excessive shrinkage is more than 95 percent. In other words, there is only five percent or less of the material remaining after air-drying.

If the gray bottom sediments remain gray after burning they are considered carbonates, and the loss of material during this process is considered organic material. The results are expressed in the percentage of minerals in the bottom sediments.

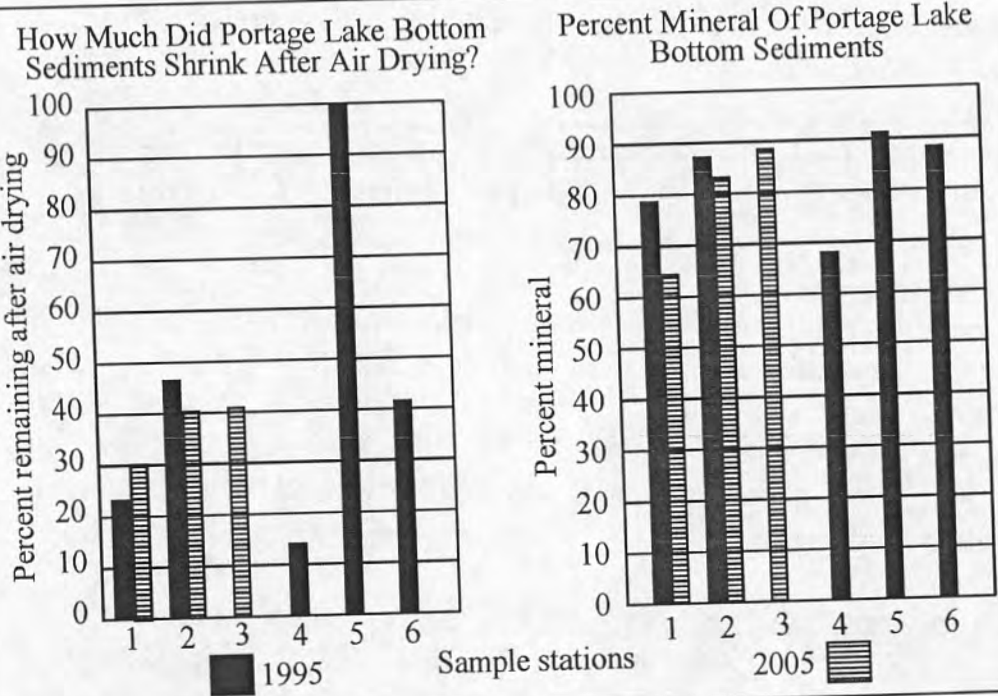
If the tan bottom sediments turn red after burning, it means the lake is filling with clay. Clay enters the lake from near-lake activities such as road building, home building or farming. Usually clay is not a material that makes up the bottom sediments of most inland lakes.

Highly organic sediments that remained black after air drying usually turn tan after burning, but the mineral content is usually quite low.

I consider high quality bottom sediments from natural lakes to be above 85 percent mineral. And I consider bottom sediments less than 50 percent mineral to be muck.

PORTAGE LAKE BOTTOM SEDIMENTS

Five bottom sediment samples were collected from Portage Lake and associated canals in 1995. Three bottom sediment samples were collected from the in-lake stations in 2005. The graph below shows the data.



Characteristics of Portage Lake Bottom Sediments (1995 & 2005)

Sample I.D.	Percent Shrinkage	Percent Mineral	Dried at 100°C Color & Description	Color after burning at 550°C	Depth of water (feet)
1 (1995)	76	79	Tan	Red	50
1 (2005)	70	63	Gray	Red	50
2 (1995)	53	87	Tan	Tan	80
2 (2005)	60	83	Gray	Gray	80
3 (2005)	59	89	Gray	Gray	19
4 (1995)	86	68	Gray	Dark red gray	19
5 (1995)	0	91	Tan	Black sand	3
6 (1995)	59	88	Gray	Dark gray	9

Average mineral content of bottom sediments (1985 = 83%, 2005 = 78%)

The 1995 sample from Station 1 (the north basin) collected in 50 feet of water shrunk 76 percent, and was 79 percent mineral. It turned tan after air drying and red after burning at 550 degrees C.

The 2005 sample from Station 1 (the north basin), again collected in 50 feet of water, was black when recovered, shrunk 70 percent, turned gray after air drying, and red after burning at 550 degrees C. It was 63 percent mineral.

The red color is the result of clay entering the lake from near shore activities such as home building and road building. Clay is not a normal constituent of lake bottom sediments.

Sample 2 collected from the south basin in 1995 from 80 feet of water, shrunk 53 percent, and was 87 percent mineral. It turned tan after air-drying and remained tan after burning at 550 degrees C.

The 2005 sample from Station 2 (the south basin), collected in 80 feet of water, was black when recovered, shrunk 60 percent, turned gray after air drying, and remained gray after burning at 550 degrees C. It was 83 percent mineral.

These are very good bottom sediments collected from the deepest hole in the lake.

The 2005 sample from Station 3 (the south basin), collected in 19 feet of water, was black when recovered, shrunk 59 percent, turned gray after air drying, and remained gray after burning at 550 degrees C. It was 89 percent mineral.

The 2005 samples from stations 1 & 2 both have lower mineral contents than the 1995 samples from the same stations. This indicates the lake is building up organic material in the sediments at a faster than normal rate.

In 1995, Sample 4 was collected from 19 feet of water in Mud Bay. It shrunk the most, 86 percent, and had the lowest mineral content of the 1995 samples, 68 percent. It also turned dark red gray indicating clay was present. This was probably the result of the recent home building activity along the canal.

In 1995, Sample 5, taken from Wynn's Canal in 3 feet of water had the highest mineral content (91%), and shrunk the least (0%). The sample was essentially sand. And these are characteristics of sandy bottom sediments.

In 1995, Sample 6 was collected from 9 feet of water in Colony Canal. It shrunk 59 percent and was 88 percent mineral. It turned gray after air-drying and remained gray after burning at 550°C.

The 1995 Sample 5 and 6 canal sediments collected in shallow water show the canals were recently dug, and have not had a lot of time to accumulate organics.

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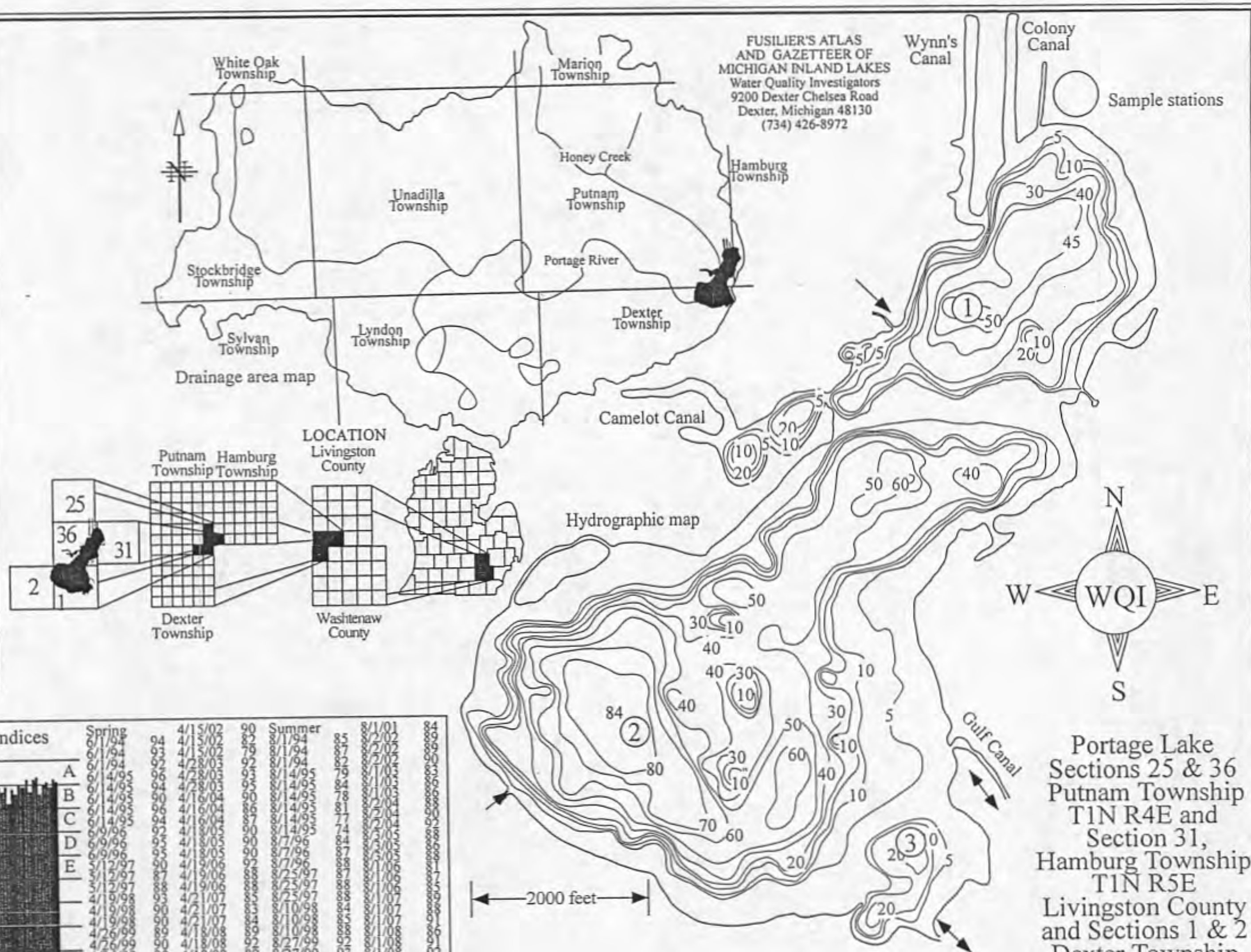
May 2011

Surface Lake and Inlets Water Quality Data

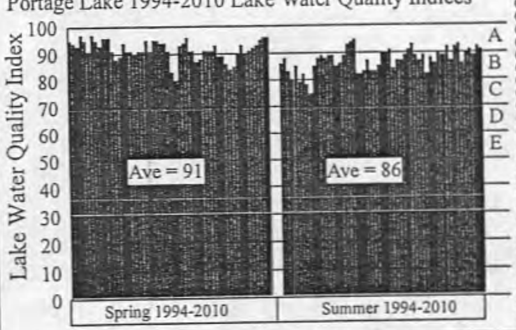
Date	Sample Station Number	Temperature °C	Dissolved Oxygen (mg/L)	Dissolved Oxygen Percent Saturation	Chlorophyll a ug/L	Secchi Disk Depth (feet)	Total Nitrate Nitrogen ug/L	Alkalinity mg/L	pH	Conductivity umhos /cm@ 25°C	Total Phosphorus ug/L	Lake Water Quality Index	Grade
4/20/10	1	13	10.0	94	0.2	17	200	210	8.3	550	17	94	A
6/1/94	1	---	---	---	1.2	13	149	---	8.2	420	10	94	A
6/1/94	2	---	---	---	1.2	12	160	---	8.2	420	12	93	A
6/1/94	3	---	---	---	1.6	12	154	---	8.3	420	16	92	A
8/1/94	1	24	8.8	97	2.6	7	23	175	8.3	490	21	85	B
8/1/94	2	24	8.7	98	2.2	7	12	173	8.3	490	26	87	B
8/1/94	3	24	9.2	108	2.0	7	14	171	8.3	480	19	82	B
6/14/95	1	---	---	---	1.2	---	111	182	7.9	470	9	96	A
6/14/95	2	---	---	---	1.9	---	104	183	7.7	470	22	94	A
6/14/95	3	---	---	---	6.0	---	78	179	8.0	470	16	90	A
6/14/95	4	---	---	---	0.9	---	116	175	7.7	470	8	96	A
6/14/95	5	---	---	---	2.8	---	45	178	7.8	470	9	94	A
7/20/95	Access	---	---	---	---	---	12	176	8.1	450	10	---	---
7/20/95	Bridge	---	---	---	---	---	11	173	8.6	500	15	---	---
7/20/95	Honey Cr.	---	---	---	---	---	204	170	8.1	520	6	---	---
7/20/95	Mud bay	---	---	---	---	---	9	172	8.6	560	13	---	---
7/20/95	Portage cr.	---	---	---	---	---	133	170	8.1	560	15	---	---
7/20/95	South end	---	---	---	---	---	11	187	8.6	470	8	---	---
8/14/95	1	31	7.9	105	6.6	10	5	180	8.8	430	7	79	C
8/14/95	2	30	7.7	101	3.3	11	3	178	8.8	440	7	84	B
8/14/95	3	31	9.2	123	6.2	---	5	175	8.8	430	18	78	C
8/14/95	4	32	7.2	97	4.5	10	7	168	8.6	420	15	81	B
8/14/95	5	32	8.5	115	12.3	---	7	165	8.3	410	17	77	C
8/14/95	6	32	8.3	112	13.1	9	12	176	8.7	420	23	74	C
6/9/96	1	21	8.3	92	1.5	14	139	182	8.4	490	11	92	A
6/9/96	2	21	8.3	92	0.8	19	165	178	8.3	490	13	95	A
6/9/96	3	22	8.5	97	1.5	19	165	185	8.2	490	18	95	A
8/7/96	1	27	8.5	106	4.0	7	17	187	8.4	495	18	84	B
8/7/96	2	26	8.6	105	3.2	8	16	185	8.4	490	10	87	B
8/7/96	3	27	8.7	109	2.8	10	17	180	8.3	475	22	88	B
5/12/97	1	12	10.4	96	0.9	14	433	185	8.3	460	7	90	A
5/12/97	2	11	9.7	87	2.5	15	564	181	8.2	470	9	87	B
5/12/97	3	12	10.4	96	0.4	14	564	183	8.3	460	5	88	B
8/25/97	1	21	9.0	100	1.6	8	57	172	8.5	470	30	87	B
8/25/97	2	22	8.6	98	1.6	8	43	170	8.6	470	15	88	B
8/25/97	3	21	9.1	100	1.6	9	43	168	8.6	470	19	88	B
4/19/98	1	13	10.6	100	0.8	15	264	192	8.3	450	13	93	A
4/19/98	2	12	10.8	100	1.1	15	185	185	8.3	460	10	90	A
4/19/98	3	12	10.7	99	0.6	15	185	185	8.3	470	8	90	A
8/10/98	1	26	8.7	106	3.4	7	12	184	8.8	450	18	84	B
8/10/98	2	26	8.5	104	2.3	7	10	182	8.8	460	16	85	B
8/10/98	3	26	7.8	95	1.1	9	11	178	8.7	480	17	88	B
4/26/99	1	14	9.4	90	1.3	10	325	165	8.0	480	32	89	B
4/26/99	2	13	10.5	99	1.3	17	427	180	8.2	500	39	90	A
4/26/99	3	14	10.6	102	0.6	21	347	180	8.3	480	42	90	A
8/27/99	1	24	8.9	105	1.7	11	5	167	8.4	490	18	92	A
8/27/99	2	23	8.8	101	1.1	12	8	162	8.4	500	18	93	A
8/27/99	3	24	8.5	100	1.1	13	7	160	8.3	490	16	94	A
4/15/00	1	9	10.5	91	0.6	18	274	184	8.4	510	17	94	A
4/15/00	2	9	10.6	91	1.8	14	230	184	8.3	510	32	90	A
4/15/00	3	10	10.4	92	0.6	14	244	180	8.3	510	15	94	A
8/4/00	1	24	8.5	100	4.6	8	31	185	8.8	530	31	81	B
8/4/00	2	24	9.1	107	6.6	7	25	186	8.7	530	21	82	B
8/4/00	3	24	8.6	101	4.6	9	33	181	8.6	530	17	86	B
5/13/01	1	19	9.2	98	0.3	22	412	193	8.5	520	13	94	A
5/13/01	2	19	9.2	98	1.7	22	436	190	8.4	520	15	93	A
5/13/01	3	19	9.3	99	0.6	22	469	185	8.4	520	15	93	A
8/1/01	1	28	8.4	106	5.0	6	16	185	8.3	510	23	82	B
8/1/01	2	28	8.8	111	5.3	6	8	182	8.2	510	22	82	B
8/1/01	3	28	8.6	109	4.4	7	11	180	8.1	520	20	84	B
4/15/02	1	10	9.5	84	1.5	9	270	190	8.3	500	11	90	A
4/15/02	2	12	11.0	102	7.4	7	393	188	8.4	520	11	82	B
4/15/02	3	12	11.4	106	4.2	9	419	185	8.3	540	10	79	C
8/2/02	1	27	7.6	95	1.5	8	28	161	8.6	550	16	89	B
8/2/02	2	28	7.6	96	1.8	9	38	163	8.7	550	17	89	B
8/2/02	3	28	7.2	91	0.6	9	42	164	8.6	540	17	90	A
4/28/03	1	14	10.2	98	1.0	15	380	185	8.3	560	13	92	A
4/28/03	2	13	11.1	105	1.8	18	258	184	8.2	550	10	93	A
4/28/03	3	13	11.2	106	1.6	18	211	185	8.2	540	9	95	A
8/1/03	1	26	8.5	104	2.7	4	32	165	8.7	540	11	83	B
8/1/03	2	26	8.6	105	2.7	5	110	170	8.6	540	8	86	B
8/1/03	3	26	8.9	109	2.7	5	105	161	8.6	545	12	86	B
8/1/01	Mumford 1	28	7.4	95	---	3	45	190	7.8	520	36	---	---
8/1/01	Mumford 2	26	5.4	67	---	3	51	190	7.5	520	29	---	---
8/1/01	Mumford 3	26	5.7	70	---	3	56	190	7.7	520	32	---	---
4/16/04	1	9	10.7	92	1.4	12	411	188	8.1	580	12	90	A
4/16/04	2	9	11.8	102	2.5	12	545	181	8.2	580	18	86	B
4/16/04	3	9	11.1	96	1.0	12	571	180	8.1	570	20	87	B
8/2/04	1	26	8.4	102	2.6	8	198	190	8.2	560	24	88	B
8/2/04	2	25	8.5	102	3.2	11	221	185	8.3	560	21	90	A
8/2/04	3	25	8.3	100	0.8	10	189	185	8.2	560	22	92	A

TABLE OF LAKE DATA

Lake name	Portage Lake
Counties	Washtenaw
and	Livingston
U.S.G.S. Map	Pinckney
Type of lake	Natural kettle
River basin	Huron
Lake area (acres)	725
Island area (acres)	7
Surface area (acres)	718
Maximum depth (feet)	84
Mean depth (feet)	27.3
Lake volume (acre feet)	19567
Shoreline length (feet)	53094
Watershed area (acres)	74795
Drainage area (acres)	75520
Watershed to lake ratio	103.2
Flushing rate	0.36 years
Elevation	850
Longest dimension (feet)	9752
Ice out date	3/25/96
	3/31/97
	3/24/01
	3/9/03
	3/30/05
	3/26/07
	4/6/08
	3/17/09
Date lake mixed	4/7/01
	3/10/03
	2/17/06
	3/27/07
	4/6/08
	3/31/09
Bottom Sediments, % mineral	
1995	79 87 -- 68 91 88
2005	63 83 89
Latitude	42° 25.234N
Longitude	83° 53.384W
Official lake monitors	Bill Ferrington

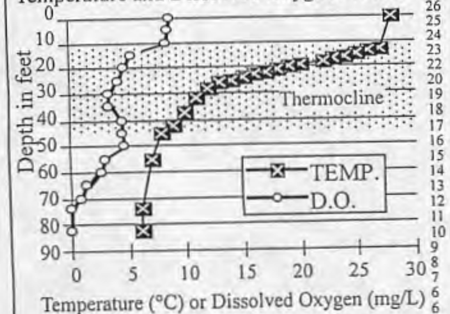


Portage Lake 1994-2010 Lake Water Quality Indices



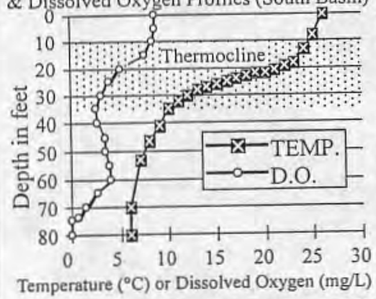
Spring		4/15/02	90	Summer		8/1/01	84
6/1/94	94	4/15/02	82	8/1/94	85	8/2/02	89
6/1/94	93	4/15/02	79	8/1/94	87	8/2/02	89
6/1/94	92	4/28/03	92	8/1/94	82	8/2/02	90
6/14/95	96	4/28/03	93	8/14/95	79	8/1/03	83
6/14/95	94	4/28/03	95	8/14/95	84	8/1/03	86
6/14/95	90	4/16/04	90	8/14/95	78	8/1/03	86
6/14/95	96	4/16/04	86	8/14/95	81	8/2/04	88
6/14/95	94	4/16/04	87	8/14/95	77	8/2/04	90
6/9/96	92	4/18/05	90	8/14/95	74	8/2/04	92
6/9/96	93	4/18/05	90	8/7/96	84	8/3/05	88
6/9/96	95	4/18/05	90	8/7/96	87	8/3/05	86
5/12/97	90	4/19/06	92	8/7/96	88	8/3/05	88
5/12/97	87	4/19/06	88	8/25/97	87	8/1/06	81
5/12/97	88	4/19/06	88	8/25/97	88	8/1/06	87
4/19/98	93	4/21/07	85	8/25/97	88	8/1/06	85
4/19/98	90	4/21/07	83	8/10/98	84	8/1/07	89
4/19/98	90	4/21/07	84	8/10/98	85	8/1/07	88
4/26/99	89	4/18/08	89	8/10/98	88	8/1/07	91
4/26/99	90	4/18/08	92	8/27/99	92	8/1/08	86
4/26/99	90	4/18/08	89	8/27/99	93	8/1/08	91
4/13/00	94	4/18/09	90	8/27/99	94	8/1/08	92
4/13/00	90	4/18/09	91	8/4/00	81	8/3/09	85
4/13/00	94	4/18/09	92	8/4/00	82	8/3/09	89
5/13/01	94	4/20/10	94	8/4/00	86	8/3/09	90
5/13/01	93	4/20/10	95	8/1/01	82	8/2/10	88
5/13/01	93	4/20/10	95	8/1/01	82	8/2/10	91
						8/2/10	90

Portage Lake South Basin, August 2, 2002
Temperature and Dissolved Oxygen Profiles



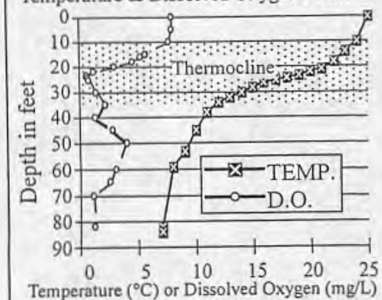
Temp.	Depth	D.O.	Depth
28	0	8.7	0
27	13	8.6	5
26	14	8.5	10
25	15	5.4	15
24	16	4.8	20
23	17	4.2	25
22	18	3.4	30
20	19	3.4	35
19	20	4.5	40
18	21	4.5	45
17	22	4.7	50
16	23	3.0	55
15	24	2.7	60
14	25	1.4	65
13	26	0.8	70
12	28	0.0	74
11	32	0.0	82
10	37		
9	42		
8	45		
7	55		
6	74		
6	82		

Portage Lake, Livingston & Washtenaw Counties August 1, 2003 Temperature & Dissolved Oxygen Profiles (South Basin)



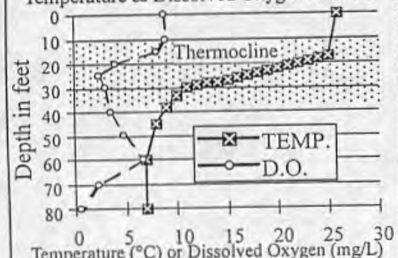
Temp.	Depth	D.O.	Depth
26	0	8.6	0
25	8	8.6	5
24	13	8.3	10
23	18	7.5	15
22	19	5.0	20
21	21	3.8	25
19	22	3.0	30
18	23	2.5	35
17	24	2.6	40
16	25	3.4	45
15	26	3.4	50
14	27	3.9	55
13	28	4.0	60
12	30	2.7	65
11	32	1.4	70
10	35	0.6	74
9	41	0.0	75
8	46	0	80
7	53		
6	70		
6	80		

Portage Lake South Basin, August 2, 2004
Temperature & Dissolved Oxygen Profiles



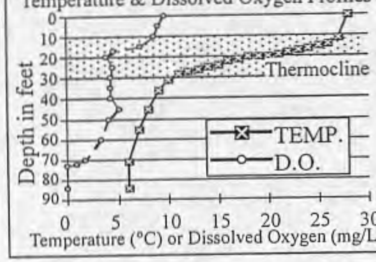
Temp.	Depth	D.O.	Depth
25	0	8.0	0
24	10	8.0	5
23	14	7.7	10
22	18	5.7	15
21	21	5.3	16
20	22	4.6	18
19	23	3.0	20
18	24	1.2	22
17	25	0.6	23
16	26	0.7	24
15	28	0.8	25
14	30	1.4	30
13	32	2.2	35
12	34	1.3	40
11	38	2.8	45
10	45	4.0	50
9	53	3.1	60
8	59	2.5	65
7	82	1.1	70
7	84	1.2	82

Portage Lake South Basin, August 1, 2008
Temperature & Dissolved Oxygen Profiles



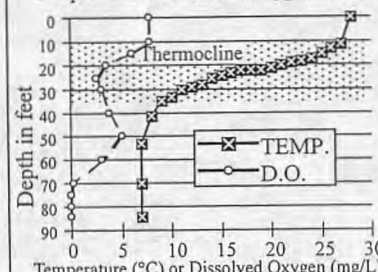
Temp.	Depth	D.O.	Depth
26	0	8.8	0
25	17	9.0	10
24	18	8.1	15
23	19	4.1	20
22	20	2.4	25
21	21	3.1	30
20	22	3.6	40
19	23	4.8	50
18	24	6.7	60
17	25	2.3	70
16	26	0.5	80
15	27		
14	28		
12	29		
11	30		
10	33		
9	38		
8	45		
7	60		
7	80		

Portage Lake South Basin, August 3, 2005
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
28	0	9.7	0
27	11	9.1	5
26	14	8.6	10
24	16	7.3	15
22	18	4.6	17
21	19	3.9	20
19	20	4.5	25
17	21	4.3	30
15	24	4.3	35
13	26	4.3	40
11	28	5.2	45
10	31	4.1	50
9	36	3.4	60
8	45	1.8	70
7	55	0.9	72
6	71	0.0	73
6	84	0.0	84

Portage Lake South Basin, August 1, 2006
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
28	0	7.9	0
27	11	7.8	10
26	13	6.1	15
25	15	3.5	20
24	17	2.5	25
23	18	3.0	30
22	19	3.8	40
21	20	5.0	50
20	21	3.0	60
18	22	0.3	70
16	23	0.0	75
15	24	0.0	80
14	25	0.0	84
13	28		
12	29		
11	30		
10	33		
9	35		
8	41		
7	53		
7	70		
7	84		

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Dexter, Michigan 48130
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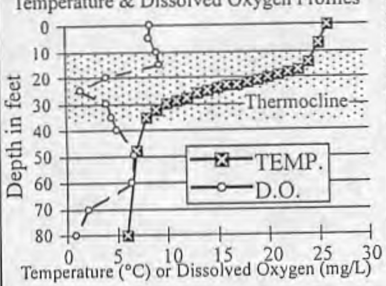
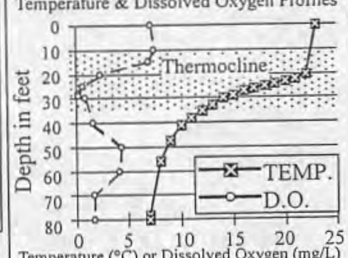
Portage Lake South Basin, August 1, 2007
Temperature & Dissolved Oxygen Profiles



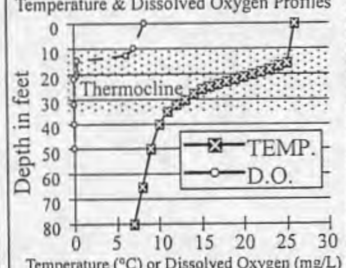
Temp.	Depth	D.O.	Depth
26	0	8.5	0
25	7	8.3	5
24	14	9.1	10
23	17	9.4	15
22	18	4.1	20
21	19	1.5	25
20	20	4.0	30
19	21	4.6	35
18	22	5.1	40
17	23	6.7	50
16	23	6.4	60
15	24	2.2	70
14	25	0.9	80
13	26		
12	28		
11	29		
10	30		
9	32		
8	35		
7	48		
6	80		

Portage Lake South Basin, August 3, 2009
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
23	0	7.2	0
22	20	7.5	10
21	22	7.0	15
20	23	2.3	20
19	24	0.6	25
18	25	0.2	28
17	26	0.2	29
16	27	0.8	30
15	29	1.6	40
14	30	4.3	50
13	33	4.1	60
12	35	1.7	70
11	38	1.7	80
10	41		
9	47		
8	56		
7	78		
7	80		

Portage Lake South Basin, August 2, 2010
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
26	0	8.4	0
25	16	7.1	10
24	17	6.2	13
23	18	0.4	15
22	19	0.4	20
21	20	0.3	21
20	21	0.0	22
19	22	0.0	32
18	23	0.0	40
17	24	0.0	50
16	25		
15	26		
14	28		
13	30		
12	32		
11	35		
10	40		
9	50		
8	65		
7	80		

Portage Lake
Sections 25 & 36
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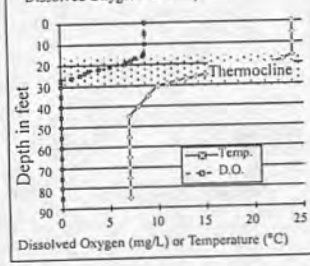
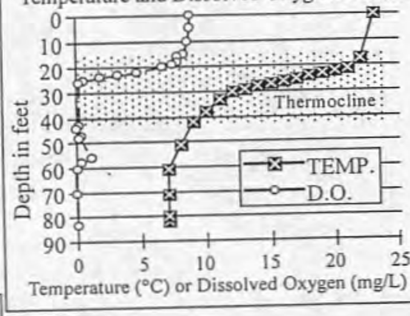
T1N R4E
and Section 31,
Hamburg Township
T1N R5E
Livingston County
and Sections 1 & 2
Dexter Township
T1S R4E
Washtenaw County

Portage Lake, South Basin, August 2, 1994
Dissolved Oxygen and Temperature Profiles



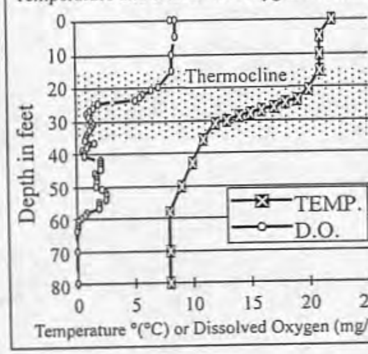
Temp	Depth	D.O.	Depth
24	0	8.7	0
24	5	8.7	5
24	10	8.7	10
24	16	8.6	15
23	18	8.5	16
22	20	7.7	17
21	21	7.3	18
19	22	6.8	19
17	23	6.6	20
16	24	5.1	21
15	25	4.0	22
14	26	2.9	23
13	27	2.5	24
12	28	2.0	25
11	29	1.1	26
10	30	0	27
9	35	0	28
8	40	0	29
7	50	0	35
7	70	0	55
7	85	0	75
		0	85

Portage Lake August 27, 1999 South Basin
Temperature and Dissolved Oxygen Profiles



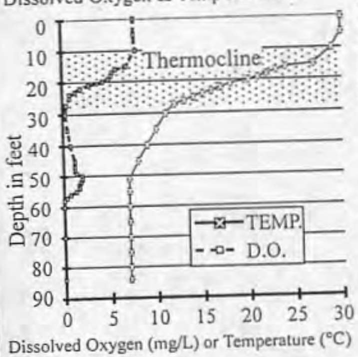
Temp.	Depth	D.O.	Depth
23	0	8.8	0
22	17	8.8	5
21	21	8.6	10
20	22	8.3	15
19	23	7.8	16
18	24	7.4	19
17	25	6.6	20
16	26	4.7	22
15	27	3.2	23
14	28	1.9	24
13	29	0.6	25
12	30	0.2	26
11	33	0.2	43
10	38	0.4	47
9	42	0.2	48
8	51	1.2	56
7	61	0.4	58
7	71	0.0	60
7	82	0.0	70
		0.0	82

Portage Lake, South Basin, August 26, 1997
Temperature and Dissolved Oxygen Profiles



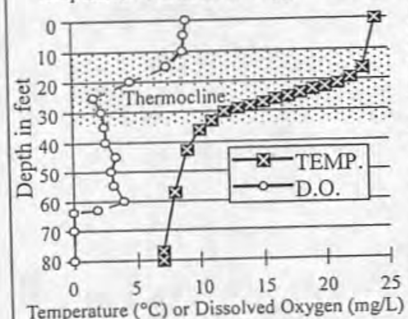
Temp.	Depth	D.O.	Depth	D.O.	Depth
22	0	8.6	0	0.7	40
22	5	8.6	0	0.7	41
21	10	8.3	5	2.1	42
21	15	8.3	10	2.1	43
21	21	7.2	15	2.1	44
20	24	6.5	20	2.1	45
19	25	5.8	21	1.6	46
18	26	5.6	22	1.8	47
17	27	5.2	23	1.8	49
16	28	1.9	24	1.7	50
15	29	1.5	25	2.2	51
14	30	1.2	26	2.5	52
13	31	1.0	27	2.6	53
12	36	1.1	28	2.5	54
11	43	1.4	29	1.9	55
10	50	1.5	30	1.9	56
9	58	1.4	31	1.9	57
8	70	1.2	32	0.9	58
8	80	1.0	33	0.7	59
		0.9	34	0.4	60
		0.8	35	0.2	61
		1.0	37	0.1	63
		0.6	38	0.0	64
		0.7	39	0.0	70

Portage Lake South Basin August 15, 1995
Dissolved Oxygen & Temperature Profiles



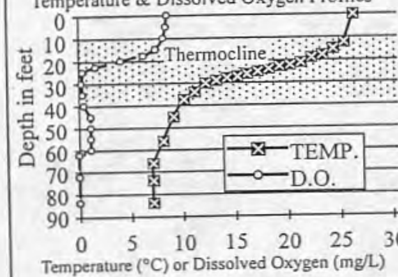
Temp.	Depth	D.O.	Depth
30	0	7.7	0
30	5	7.7	5
29	10	7.9	10
27	15	6.8	15
24	16	5.7	16
23	17	5.3	17
22	18	5.2	18
21	19	4.9	19
20	20	4.3	20
18	21	2.8	21
17	22	1.9	22
16	23	1.4	23
15	24	0.8	24
14	25	0.8	25
13	26	0.4	27
12	27	0.3	30
11	30	0.5	35
10	35	0.8	40
9	40	1.2	45
8	45	1.2	47
7	51	1.2	48
7	60	2.0	50
7	70	1.8	52
7	80	1.7	54
7	84	1.3	55
		0.7	56
		0.3	57
		0.0	58
		0.0	70
		0.0	84

Portage Lake South Basin August 4, 2000
Temperature & Dissolved Oxygen Profiles



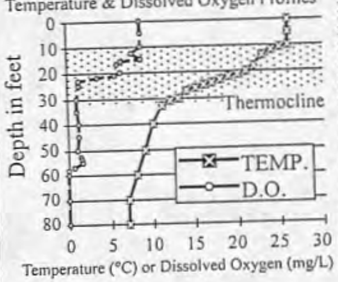
Temp.	Depth	D.O.	Depth
24	0	9.1	0
23	16	8.9	5
22	19	8.8	10
21	21	7.5	15
20	22	4.6	20
19	23	1.7	25
18	24	2.3	30
17	25	2.5	35
16	26	2.6	40
15	27	3.4	45
14	28	3.0	50
13	29	3.2	55
12	30	4.0	60
11	33	1.9	63
10	36	0.0	64
9	43	0.0	70
8	57	0.0	80
7	77		
7	80		

Portage Lake (South Basin) August 11, 1998
Temperature & Dissolved Oxygen Profiles



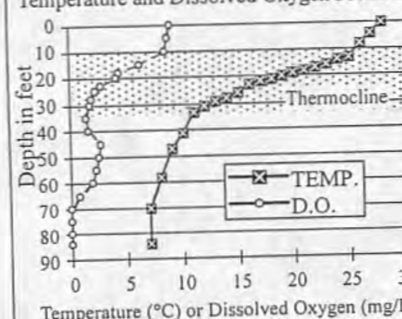
Temp.	Depth	D.O.	Depth
26	0	8.5	0
25	12	8.3	5
24	15	8.1	10
23	18	7.3	15
22	19	6.2	18
21	21	4.1	20
20	22	1.6	23
19	23	0.4	25
18	24	0.3	30
17	25	0.4	35
16	26	0.5	40
15	27	1.2	45
14	28	1.1	50
13	29	1.2	55
12	30	1.2	60
11	34	0.3	61
10	37	0.0	62
9	45	0.0	72
8	56	0.0	84
7	66		
7	84		

Portage Lake South Basin August 8, 1996
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
26	0	8.6	0
26	10	8.7	10
25	11	7.6	13
24	12	8.7	15
23	14	6.4	16
22	18	5.9	17
21	20	6.3	20
20	21	5.6	21
19	22	3.5	22
17	24	1.4	25
16	25	1.1	30
14	27	1.3	40
13	30	1.3	45
11	33	1.5	53
10	40	1.6	54
9	50	1.7	55
8	60	0.7	57
7	70	0.0	58
7	80	0.0	80

Portage Lake South Basin, August 1, 2001
Temperature and Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
28	0	9.0	0
27	4	8.8	5
26	8	8.5	10
25	13	6.2	15
24	14	4.4	18
23	16	4.1	20
22	17	2.8	23
21	18	2.3	25
20	19	1.9	28
19	20	1.8	30
18	21	1.4	35
17	22	1.6	40
16	23	2.7	45
15	26	2.5	50
14	28	2.3	55
13	29	1.9	60
12	31	0.8	65
11	33	0.0	70
10	41	0.0	75
9	47	0.0	80
8	58	0.0	84
7	70		
7	84		

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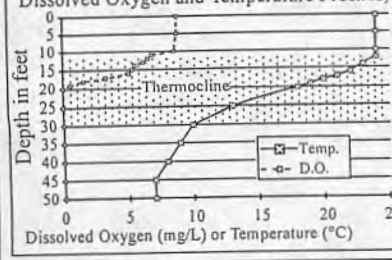
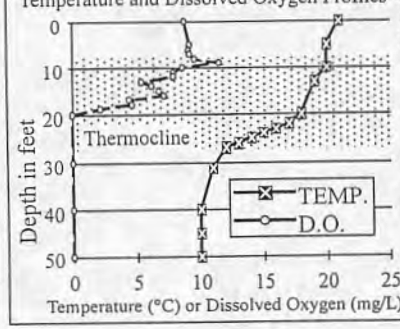
Livingston County
and Sections 1 & 2
Dexter Township T1S R4E
Washtenaw County

Portage Lake, North Basin August 2, 1994
Dissolved Oxygen and Temperature Profiles,



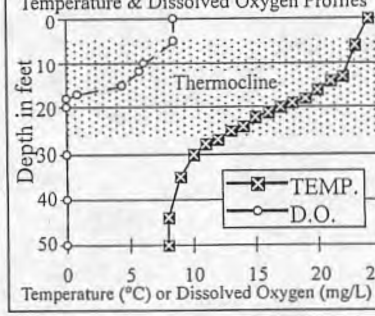
Temp	Depth	D.O.	Depth
24	0	8.8	0
24	5	8.8	5
24	10	8.6	10
24	12	6.9	11
23	14	6.6	12
22	16	6.2	13
21	17	5.6	14
20	18	5.4	15
19	19	5.1	16
18	20	3.3	17
13	25	1.6	18
10	30	0.6	19
9	35	0	20
8	40	0	25
7	45	0	30
7	50	0	35
		0	40
		0	50

Portage Lake North Basin, August 26, 1997
Temperature and Dissolved Oxygen Profiles



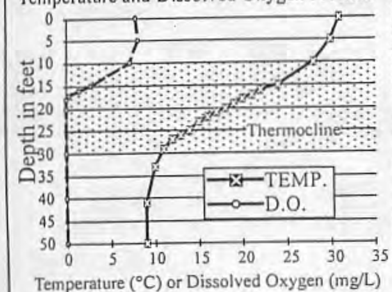
Temp.	Depth	D.O.	Depth
21	0	8.8	0
20	5	9.2	5
20	10	9.1	6
19	13	9.2	7
18	20	9.6	8
17	22	11.5	9
16	23	8.6	10
15	24	7.9	11
14	25	7.9	12
13	26	5.4	13
12	27	6.2	14
11	31	6.8	15
10	40	7.2	16
10	45	4.4	17
10	50	4.7	18
		2.2	19
		0.0	20
		0.0	30
		0.0	40
		0.0	50

Portage Lake August 4, 2000 North Basin
Temperature & Dissolved Oxygen Profiles



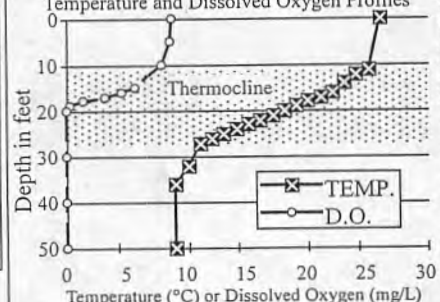
Temp.	Depth	D.O.	Depth
24	0	8.5	0
23	6	8.5	5
22	13	6.2	10
21	14	5.8	12
20	16	4.4	15
19	18	0.9	17
18	19	0.0	18
17	20	0.0	20
16	21	0.0	30
15	22	0.0	40
14	24	0.0	50
13	25		
12	27		
11	28		
10	30		
9	35		
8	44		
8	50		

Portage Lake, North Basin August 15, 1995
Temperature and Dissolved Oxygen Profiles



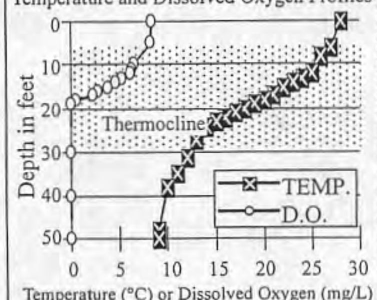
Temp.	Depth	D.O.	Depth
31	0	7.9	0
30	5	8.1	5
28	10	7.2	10
24	15	2.7	15
22	16	1.4	16
21	17	0.3	17
20	18	0	18
19	19	0	20
18	20	0	30
17	21	0	40
16	22	0	50
15	23		
14	25		
13	26		
12	27		
11	29		
10	33		
9	41		
9	50		

Portage Lake North Basin August 11, 1998
Temperature and Dissolved Oxygen Profiles



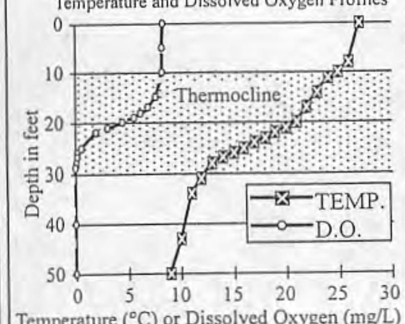
Temp.	Depth	D.O.	Depth
26	0	8.7	0
25	11	8.6	5
24	12	7.9	10
23	14	5.6	15
22	16	4.6	16
21	17	3.1	17
20	18	1.4	18
19	19	0.3	19
18	20	0.0	20
17	21	0.0	30
16	22	0.0	40
15	23	0.0	50
14	24		
13	25		
12	26		
11	27		
10	32		
9	36		
9	50		

Portage Lake North Basin, August 1, 2001
Temperature and Dissolved Oxygen Profiles



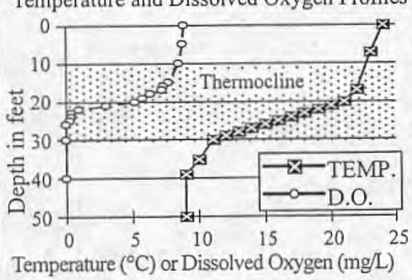
Temp.	Depth	D.O.	Depth
28	0	8.4	0
27	6	8.3	5
26	8	6.5	10
25	12	6.3	11
24	13	6.1	12
23	14	5.2	13
22	15	4.6	14
21	17	3.8	15
20	18	2.8	16
19	19	2.2	17
18	20	0.5	18
17	21	0.0	19
16	22	0.0	30
15	23	0.0	40
14	24	0.0	50
13	27		
12	31		
11	35		
10	38		
9	48		
9	50		

Portage Lake North Basin August 8, 1996
Temperature and Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
27	0	8.5	0
26	8	8.4	5
25	10	8.4	10
24	11	7.7	15
23	14	7.0	17
22	17	6.3	18
21	20	5.7	19
20	21	4.5	20
19	22	3.1	21
18	23	2.0	22
17	24	0.6	25
16	25	0.2	26
15	26	0.2	27
14	27	0.1	28
13	28	0.0	29
12	31	0.0	40
11	34	0.0	50
10	43		
9	50		

Portage Lake August 27, 1999 North Basin
Temperature and Dissolved Oxygen Profiles



Temp.	Depth	D.O.	Depth
24	0	8.9	0
23	7	8.8	5
22	17	8.5	10
21	20	7.7	15
20	21	7.3	16
19	22	7.2	17
18	23	6.3	18
17	24	5.8	19
16	25	5.2	20
15	26	3.0	21
14	27	1.0	22
13	28	0.4	23
12	29	0.4	24
11	30	0.3	25
10	35	0.0	26
9	39	0.0	30
9	50	0.0	40
		0.0	50

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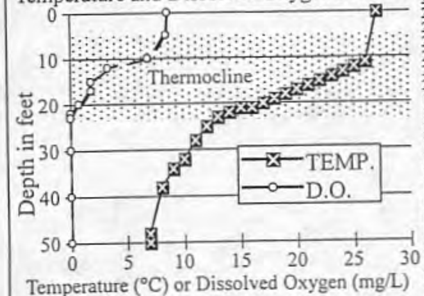
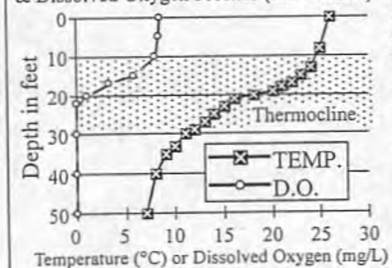
T1S R4E
Washtenaw County

Portage Lake North Basin, August 2, 2002
Temperature and Dissolved Oxygen Profiles



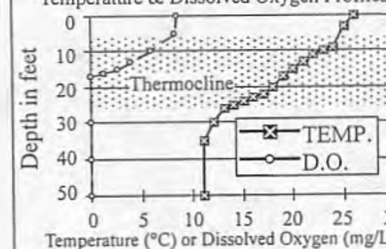
Temp.	Depth	D.O.	Depth
27	0	8.7	0
26	11	8.6	5
25	12	6.9	10
24	13	3.4	12
23	14	1.9	15
22	15	1.8	17
21	16	0.7	20
20	17	0.0	22
19	18	0.0	23
18	19	0.0	30
17	20	0.0	40
16	21	0.0	50
15	21		
14	22		
13	23		
12	25		
11	28		
10	32		
9	34		
8	38		
7	48		
7	50		

Portage Lake August 1, 2003 Temperature
& Dissolved Oxygen Profiles (North basin)



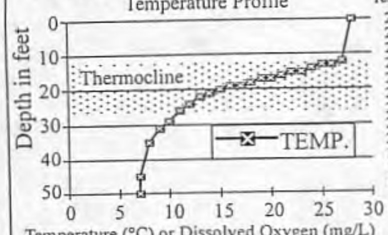
Temp.	Depth	D.O.	Depth
26	0	8.5	0
25	8	8.3	5
24	13	8.0	10
23	15	5.9	15
22	17	3.3	17
21	18	1.1	20
20	19	0.4	21
18	20	0.0	22
16	21	0.0	30
15	23	0.0	40
14	25	0.0	50
13	27		
12	29		
11	30		
10	33		
9	35		
8	40		
7	50		

Portage Lake North Basin, August 2, 2004
Temperature & Dissolved Oxygen Profiles



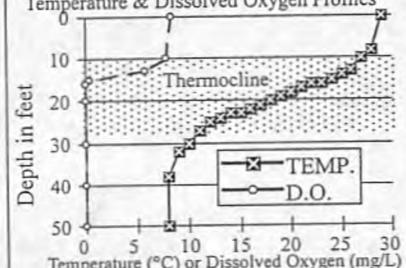
Temp.	Depth	D.O.	Depth
26	0	8.4	0
25	3	8.2	5
24	9	5.9	10
23	10	3.9	13
22	11	2.6	15
21	13	1.3	16
20	15	0.0	17
19	17	0.0	30
18	20	0.0	40
17	22	0.0	50
16	23		
15	24		
14	25		
13	26		
12	30		
11	35		
11	50		

Portage Lake North Basin, August 3, 2005
Temperature Profile



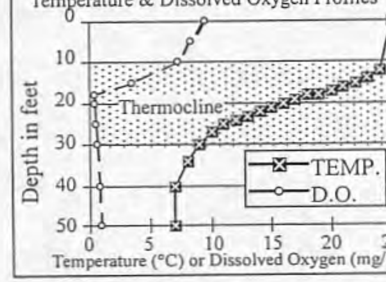
Temp.	Depth	Temp.	Depth
28	0	16	19
27	12	15	20
26	13	14	21
25	13	13	22
24	14	12	24
23	15	11	26
22	15	10	29
21	16	9	31
20	17	8	35
19	17	7	45
18	18	7	50
17	19		

Portage Lake North Basin, August 1, 2006
Temperature & Dissolved Oxygen Profiles



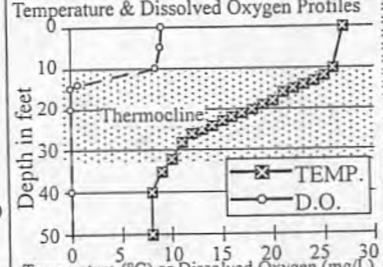
Temp.	Depth	Temp.	Depth
29	0	8.4	0
28	8	7.8	10
27	10	5.8	13
26	13	0.4	15
25	14	0.0	16
24	15	0.0	20
23	16	0.0	30
21	17	0.0	40
20	18	0.0	50
19	19		
18	20		
17	21		
16	22		
15	23		
14	23		
13	24		
12	25		
11	27		
10	30		
9	32		
8	38		
8	50		

Portage Lake North Basin, August 1, 2007
Temperature & Dissolved Oxygen Profiles



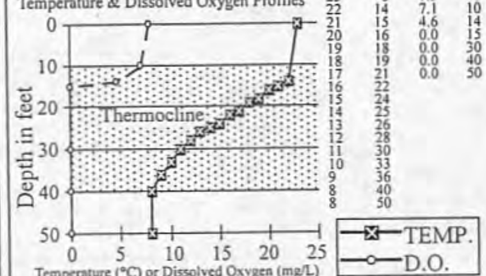
Temp.	Depth	Temp.	Depth
25	0	9.5	0
24	12	8.3	5
23	14	7.3	10
22	15	3.5	15
21	16	0.4	18
20	17	0.4	20
19	18	0.5	25
18	18	0.6	30
17	19	0.8	40
16	20	1.0	50
15	21		
14	22		
13	23		
12	24		
11	25		
10	27		
9	30		
8	34		
7	40		
7	50		

Portage Lake North Basin, August 1, 2008
Temperature & Dissolved Oxygen Profiles



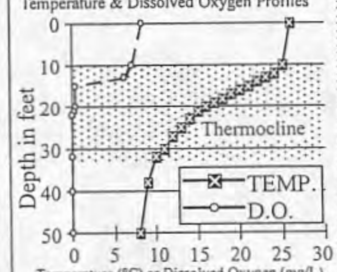
Temp.	Depth	Temp.	Depth
27	0	9.1	0
26	10	9.0	5
25	12	8.5	10
24	13	0.7	14
23	14	0.0	15
22	15	0.0	20
21	16	0.0	30
20	18	0.0	40
19	19	0.0	50
18	20		
17	21		
16	22		
15	23		
14	24		
13	25		
12	26		
11	28		
10	32		
9	35		
8	40		
8	50		

Portage Lake North Basin, August 3, 2009
Temperature & Dissolved Oxygen Profiles



Temp.	Depth	Temp.	Depth
23	0	7.9	0
22	14	7.1	10
21	15	4.6	14
20	16	0.0	15
19	18	0.0	30
18	19	0.0	40
17	21	0.0	50
16	22		
15	24		
14	25		
13	26		
12	28		
11	30		
10	33		
9	36		
8	40		
8	50		

Portage Lake North Basin, August 2, 2010
Temperature & Dissolved Oxygen Profiles

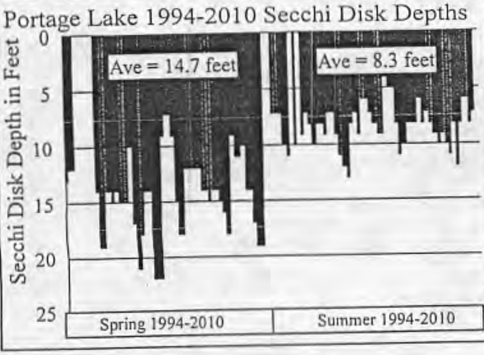


Temp.	Depth	Temp.	Depth
26	0	8.4	0
25	10	7.1	10
24	12	6.2	13
23	13	0.4	15
22	14	0.4	20
21	15	0.3	21
20	16	0.0	22
19	17	0.0	32
18	18	0.0	40
17	19	0.0	50
16	20		
15	21		
14	23		
13	25		
12	27		
11	30		
10	32		
9	38		
8	50		

Portage Lake
Sections 25 & 36
Putnam Township
T1N R4E
and Section 31,
Hamburg Township
T1N R5E
Livingston County
and Sections 1 & 2
Dexter Township
T1S R4E
Washtenaw County

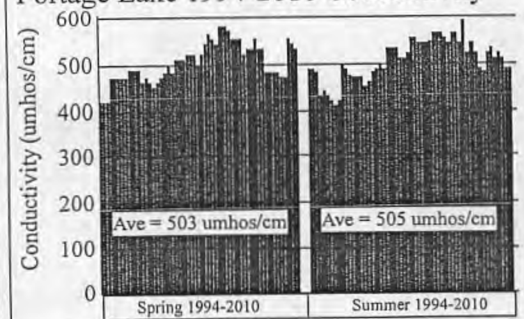
FUSILIER'S ATLAS
AND GAZETTEER OF
MICHIGAN INLAND LAKES
Water Quality Investigators
9200 Dexter Chelsea Road
Dexter, Michigan 48130
(734) 426-8972

Portage Lake 1994-2010 Secchi Disk Depths



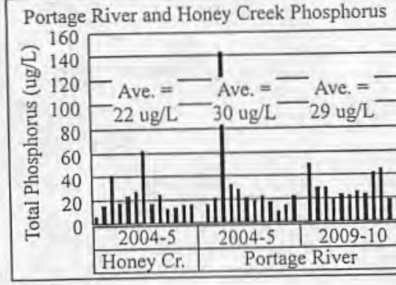
Spring		4/15/02	9	Summer		8/2/02	8
6/1/94	13	4/15/02	7	8/1/94	7	8/2/02	9
6/1/94	12	4/15/02	9	8/1/94	7	8/2/02	9
6/1/94	12	4/28/03	15	8/1/94	7	8/1/03	4
6/14/95	---	4/28/03	18	8/14/95	10	8/1/03	5
6/14/95	---	4/28/03	18	8/14/95	11	8/1/03	5
6/14/95	---	4/16/04	12	8/14/95	---	8/2/04	8
6/14/95	---	4/16/04	12	8/14/95	10	8/2/04	11
6/14/95	---	4/16/04	12	8/14/95	---	8/2/04	10
6/9/96	14	4/18/05	12	8/14/95	9	8/3/05	8
6/9/96	19	4/18/05	14	8/7/96	7	8/3/05	8
6/9/96	19	4/18/05	14	8/7/96	8	8/3/05	8
5/12/97	14	4/19/06	15	8/7/96	10	8/1/06	8
5/12/97	15	4/19/06	14	8/25/97	8	8/1/06	8
5/12/97	14	4/19/06	14	8/25/97	8	8/1/06	7
4/19/98	15	4/21/07	15	8/25/97	9	8/1/07	8
4/19/98	15	4/21/07	16	8/10/98	7	8/1/07	8
4/19/98	15	4/21/07	18	8/10/98	7	8/1/07	10
4/26/99	10	4/18/08	9	8/10/98	9	8/1/08	9
4/26/99	17	4/18/08	11	8/27/99	11	8/1/08	10
4/26/99	21	4/18/08	11	8/27/99	12	8/1/08	11
4/15/00	18	4/18/09	10	8/27/99	13	8/3/09	8
4/15/00	14	4/18/09	14	8/4/00	8	8/3/09	12
4/15/00	14	4/18/09	14	8/4/00	7	8/3/09	8
5/13/01	22	4/20/10	17	8/4/00	9	8/2/10	6
5/13/01	22	4/20/10	19	8/1/01	6	8/2/10	8
5/13/01	22	4/20/10	19	8/1/01	6	8/2/10	7

Portage Lake 1994-2010 Conductivity



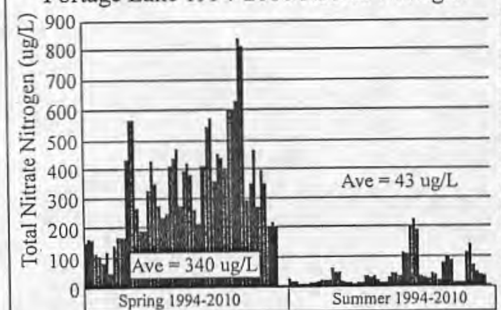
Spring		4/15/02	500	Summer		8/1/01	520
6/1/94	420	4/15/02	520	8/1/94	490	8/2/02	550
6/1/94	420	4/15/02	540	8/1/94	490	8/2/02	550
6/1/94	420	4/28/03	560	8/1/94	480	8/2/02	540
6/14/95	470	4/28/03	550	8/14/95	430	8/1/03	540
6/14/95	470	4/28/03	540	8/14/95	440	8/1/03	540
6/14/95	470	4/16/04	580	8/14/95	430	8/1/03	545
6/14/95	470	4/16/04	580	8/14/95	420	8/2/04	560
6/14/95	470	4/16/04	570	8/14/95	410	8/2/04	560
6/9/96	490	4/18/05	550	8/14/95	420	8/2/04	560
6/9/96	490	4/18/05	550	8/7/96	495	8/3/05	550
6/9/96	490	4/18/05	550	8/7/96	490	8/3/05	540
5/12/97	460	4/19/06	520	8/7/96	475	8/3/05	560
5/12/97	470	4/19/06	530	8/25/97	470	8/1/06	560
5/12/97	460	4/19/06	530	8/25/97	470	8/1/06	540
4/19/98	450	4/21/07	550	8/25/97	470	8/1/06	590
4/19/98	460	4/21/07	530	8/10/98	450	8/1/07	520
4/19/98	470	4/21/07	530	8/10/98	460	8/1/07	540
4/26/99	480	4/18/08	480	8/10/98	480	8/1/07	520
4/26/99	500	4/18/08	480	8/27/99	490	8/1/08	490
4/26/99	480	4/18/08	480	8/27/99	500	8/1/08	480
4/15/00	510	4/18/09	480	8/27/99	490	8/1/08	520
4/15/00	510	4/18/09	470	8/4/00	530	8/3/09	530
4/15/00	510	4/18/09	470	8/4/00	530	8/3/09	510
5/13/01	520	4/20/10	550	8/4/00	530	8/3/09	520
5/13/01	520	4/20/10	540	8/1/01	510	8/2/10	510
5/13/01	520	4/20/10	530	8/1/01	510	8/2/10	490
						8/2/10	490

Portage River and Honey Creek Phosphorus



Honey Cr.		Portage R.		Portage R.	
7/20/95	6	7/20/95	15	5/28/09	50
8/1/03	15	5/26/04	21	6/29/09	29
5/26/04	41	6/29/04	143	7/31/09	29
6/29/04	17	7/28/04	32	8/28/09	18
7/28/04	23	8/29/04	28	9/22/09	23
8/29/04	27	10/1/04	21	10/21/09	22
10/1/04	62	11/30/04	18	11/23/09	25
11/30/04	16	12/31/04	22	12/26/09	23
12/31/04	24	1/28/05	17	1/23/10	42
1/28/05	12	2/26/05	9	3/9/10	45
2/26/05	13	3/29/05	14	3/31/10	18
3/29/05	15	4/18/05		4/20/10	18
4/18/05	15				

Portage Lake 1994-2010 Nitrate Nitrogen



Spring		4/15/02	270	Summer		8/1/01	11
6/1/94	149	4/15/02	393	8/1/94	23	8/2/02	28
6/1/94	160	4/15/02	419	8/1/94	12	8/2/02	38
6/1/94	154	4/28/03	380	8/1/94	14	8/2/02	42
6/14/95	111	4/28/03	258	8/14/95	5	8/1/03	32
6/14/95	104	4/28/03	211	8/14/95	3	8/1/03	110
6/14/95	78	4/16/04	411	8/14/95	3	8/1/03	105
6/14/95	116	4/16/04	545	8/14/95	7	8/2/04	198
6/14/95	45	4/16/04	571	8/14/95	7	8/2/04	221
6/9/96	139	4/18/05	356	8/14/95	12	8/2/04	189
6/9/96	165	4/18/05	449	8/7/96	17	8/3/05	31
6/9/96	165	4/18/05	438	8/7/96	16	8/3/05	27
5/12/97	433	4/19/06	396	8/7/96	17	8/3/05	22
5/12/97	564	4/19/06	599	8/25/97	57	8/1/06	45
5/12/97	564	4/19/06	599	8/25/97	43	8/1/06	37
4/19/98	264	4/21/07	629	8/25/97	43	8/1/06	17
4/19/98	185	4/21/07	836	8/10/98	12	8/1/07	74
4/19/98	185	4/21/07	812	8/10/98	10	8/1/07	92
4/26/99	325	4/18/08	290	8/10/98	1	8/1/07	83
4/26/99	427	4/18/08	347	8/27/99	5	8/1/08	7
4/26/99	347	4/18/08	463	8/27/99	8	8/1/08	7
4/15/00	274	4/18/09	269	8/27/99	7	8/1/08	10
4/15/00	230	4/18/09	391	8/4/00	31	8/3/09	112
4/15/00	244	4/18/09	346	8/4/00	25	8/3/09	140
5/13/01	412	4/20/10	200	8/4/00	33	8/3/09	65
5/13/01	436	4/20/10	213	8/1/01	16	8/2/10	44
5/13/01	469	4/20/10	194	8/1/01	8	8/2/10	36
						8/2/10	32

FUSILIER'S ATLAS
AND GAZETTEER OF
MICHIGAN INLAND LAKES

Water Quality Investigators
9200 Dexter Chelsea Road
Dexter, Michigan 48130
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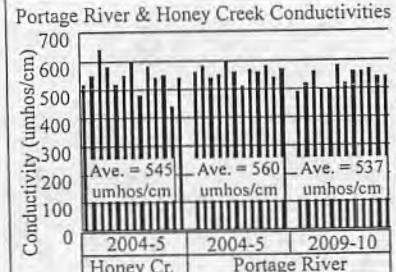
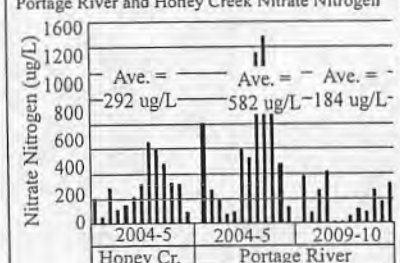
Portage River & Honey Creek Conductivities



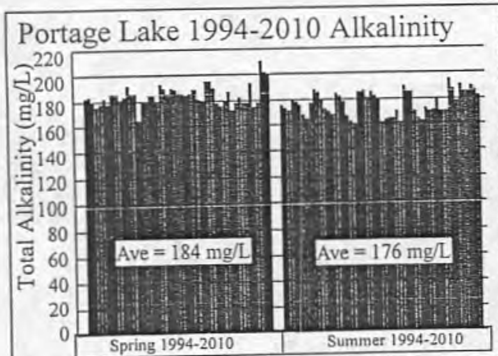
Honey Cr.		Portage R.		Portage R.	
7/20/95	520	7/20/95	560	5/28/09	490
8/1/03	550	5/26/04	580	6/29/09	520
5/26/04	640	6/29/04	540	7/31/09	560
6/29/04	580	7/28/04	550	8/28/09	500
7/28/04	520	8/29/04	600	9/22/09	500
8/29/04	550	10/1/04	560	10/21/09	580
10/1/04	600	11/30/04	510	11/23/09	520
11/30/04	480	12/31/04	570	12/26/09	560
12/31/04	580	1/28/05	560	1/23/10	560
1/28/05	540	2/26/05	580	3/9/10	570
2/26/05	550	3/29/05	540	3/31/10	540
3/29/05	440	4/18/05	570	4/20/10	540
4/18/05	540				

Portage River and Honey Creek Nitrate Nitrogen

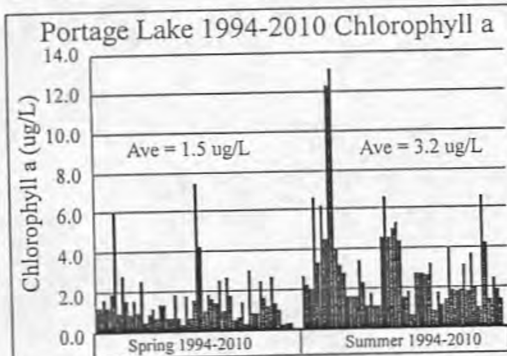


Honey Cr.		Portate R.		Portate R.	
7/20/95	204	5/26/04	806	5/28/09	380
8/1/03	53	6/29/04	268	6/29/09	87
5/26/04	284	7/28/04	186	7/31/09	266
6/29/04	110	8/29/04	76	8/28/09	412
7/28/04	154	10/1/04	96	9/22/09	10
8/29/04	216	11/30/04	590	10/21/09	10
10/1/04	316	12/31/04	528	11/23/09	58
11/30/04	656	1/28/05	1356	12/26/09	119
12/31/04	587	2/26/05	1485	1/23/10	95
1/28/05	480	3/29/05	989	3/9/10	270
2/26/05	326	4/18/05	473	3/31/10	178
3/29/05	315	7/20/95	133	4/20/10	319
4/18/05	93				

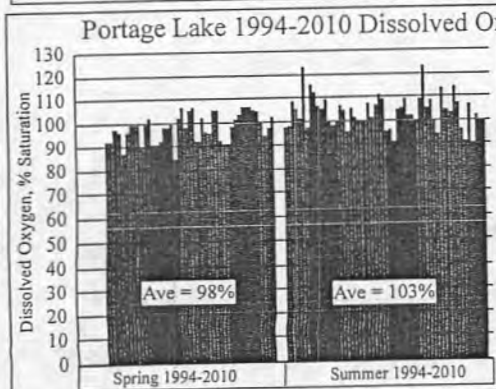
Portage Lake
Sections 25 & 36
Putnam Township
T1N R4E and
Section 31,
Hamburg Township
T1N R5E
Livingston County
and Sections 1 & 2
Dexter Township
T1S R4E
Washtenaw County



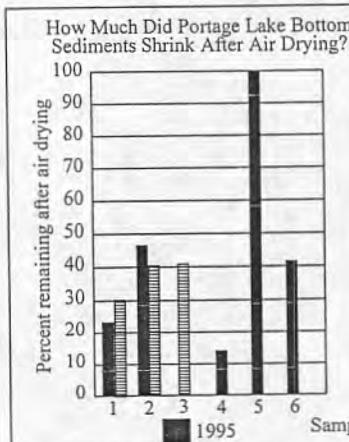
Spring		4/15/02	190	Summer		8/1/01	180
6/1/94	---	4/15/02	188	8/1/94	175	8/2/02	161
6/1/94	---	4/15/02	185	8/1/94	173	8/2/02	163
6/1/94	---	4/28/03	185	8/1/94	171	8/2/02	164
6/14/95	182	4/28/03	184	8/14/95	180	8/1/03	165
6/14/95	183	4/28/03	185	8/14/95	178	8/1/03	170
6/14/95	179	4/16/04	188	8/14/95	175	8/1/03	161
6/14/95	175	4/16/04	181	8/14/95	168	8/2/04	190
6/14/95	178	4/16/04	180	8/14/95	165	8/2/04	185
6/9/96	182	4/18/05	195	8/14/95	176	8/2/04	185
6/9/96	178	4/18/05	195	8/7/96	187	8/3/05	170
6/9/96	185	4/18/05	190	8/7/96	185	8/3/05	165
5/12/97	185	4/19/06	178	8/7/96	180	8/3/05	162
5/12/97	181	4/19/06	175	8/25/97	172	8/1/06	172
5/12/97	183	4/19/06	180	8/25/97	170	8/1/06	170
4/19/98	192	4/21/07	186	8/25/97	168	8/1/06	171
4/19/98	185	4/21/07	172	8/10/98	184	8/1/07	180
4/19/98	185	4/21/07	178	8/10/98	182	8/1/07	170
4/26/99	165	4/18/08	182	8/10/98	178	8/1/07	170
4/26/99	180	4/18/08	177	8/27/99	167	8/1/08	195
4/26/99	180	4/18/08	177	8/27/99	162	8/1/08	187
4/15/00	184	4/18/09	193	8/27/99	160	8/1/08	178
4/15/00	184	4/18/09	174	8/4/00	185	8/3/09	191
4/15/00	180	4/18/09	177	8/4/00	186	8/3/09	185
5/13/01	193	4/20/10	210	8/4/00	181	8/3/09	185
5/13/01	190	4/20/10	202	8/1/01	185	8/2/10	190
5/13/01	185	4/20/10	200	8/1/01	182	8/2/10	186
						8/2/10	182

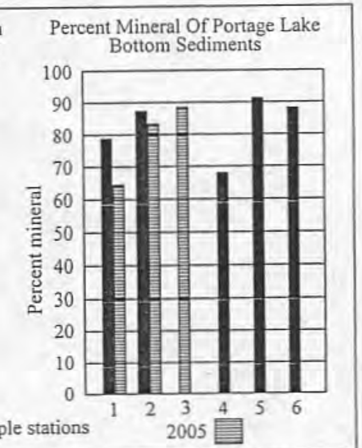


Spring		4/15/02	1.5	8/1/94	2.6	8/2/02	1.5
6/1/94	1.2	4/15/02	7.4	8/1/94	2.2	8/2/02	1.8
6/1/94	1.2	4/15/02	4.2	8/1/94	2.0	8/2/02	0.6
6/1/94	1.6	4/28/03	1.0	8/14/95	6.6	8/1/03	2.7
6/14/95	1.2	4/28/03	1.8	8/14/95	3.3	8/1/03	2.7
6/14/95	1.9	4/28/03	1.6	8/14/95	6.2	8/1/03	2.7
6/14/95	6.0	4/16/04	1.4	8/14/95	4.5	8/2/04	2.6
6/14/95	0.9	4/16/04	2.5	8/14/95	12.3	8/2/04	3.2
6/14/95	2.8	4/16/04	1.0	8/14/95	13.1	8/2/04	0.8
6/9/96	1.5	4/18/05	2.6	8/7/96	4.0	8/3/05	1.7
6/9/96	0.8	4/18/05	1.7	8/7/96	3.2	8/3/05	1.1
6/9/96	1.5	4/18/05	0.5	8/7/96	2.8	8/3/05	1.4
5/12/97	0.9	4/19/06	0.6	8/25/97	1.6	8/1/06	4.0
5/12/97	2.5	4/19/06	1.4	8/25/97	1.6	8/1/06	1.9
5/12/97	0.4	4/19/06	0.3	8/25/97	1.6	8/1/06	1.8
4/19/98	0.8	4/21/07	3.0	8/10/98	3.4	8/1/07	1.9
4/19/98	1.1	4/21/07	0.8	8/10/98	2.3	8/1/07	3.1
4/19/98	0.6	4/21/07	0.8	8/10/98	1.1	8/1/07	1.8
4/26/99	1.3	4/18/08	2.4	8/27/99	1.7	8/1/08	3.7
4/26/99	1.3	4/18/08	1.6	8/27/99	1.1	8/1/08	2.0
4/26/99	0.6	4/18/08	1.2	8/27/99	1.1	8/1/08	1.0
4/15/00	0.6	4/18/09	2.6	8/4/00	4.6	8/3/09	6.6
4/15/00	1.8	4/18/09	1.3	8/4/00	6.6	8/3/09	4.2
4/15/00	0.6	4/18/09	1.0	8/4/00	4.6	8/3/09	1.4
5/13/01	0.3	4/20/10	0.2	8/1/01	5.0	8/2/10	2.4
5/13/01	1.7	4/20/10	0.3	8/1/01	5.3	8/2/10	1.9
5/13/01	0.6	4/20/10	0.3	8/1/01	4.4	8/2/10	1.4



Spring		4/15/02	84	Summer		8/1/01	109
6/1/94	---	4/15/02	102	8/1/94	97	8/2/02	95
6/1/94	---	4/15/02	106	8/1/94	98	8/2/02	96
6/1/94	---	4/28/03	98	8/1/94	108	8/2/02	91
6/14/95	---	4/28/03	105	8/14/95	105	8/1/03	104
6/14/95	---	4/28/03	106	8/14/95	101	8/1/03	105
6/14/95	---	4/16/04	92	8/14/95	123	8/1/03	109
6/14/95	---	4/16/04	102	8/14/95	97	8/2/04	102
6/14/95	---	4/16/04	96	8/14/95	115	8/2/04	105
6/9/96	92	4/18/05	95	8/14/95	112	8/2/04	100
6/9/96	92	4/18/05	105	8/7/96	106	8/3/05	109
6/9/96	97	4/18/05	105	8/7/96	105	8/3/05	123
5/12/97	96	4/19/06	92	8/7/96	109	8/3/05	105
5/12/97	87	4/19/06	91	8/25/97	100	8/1/06	108
5/12/97	96	4/19/06	91	8/25/97	98	8/1/06	100
4/19/98	100	4/21/07	98	8/25/97	100	8/1/06	94
4/19/98	100	4/21/07	101	8/10/98	106	8/1/07	113
4/19/98	99	4/21/07	103	8/10/98	104	8/1/07	104
4/26/99	90	4/18/08	106	8/10/98	95	8/1/07	103
4/26/99	99	4/18/08	106	8/27/99	105	8/1/08	114
4/26/99	102	4/18/08	106	8/27/99	101	8/1/08	107
4/15/00	91	4/18/09	105	8/27/99	100	8/1/08	96
4/15/00	91	4/18/09	104	8/4/00	100	8/3/09	91
4/15/00	92	4/18/09	100	8/4/00	107	8/3/09	106
5/13/01	98	4/20/10	94	8/4/00	101	8/3/09	90
5/13/01	98	4/20/10	97	8/1/01	106	8/2/10	102
5/13/01	99	4/20/10	102	8/1/01	111	8/2/10	100
						8/2/10	100





Characteristics of Portage Lake Bottom Sediments (1995 & 2005)

Sample I.D.	Percent Shrinkage	Percent Mineral	Dried at 100°C Color & Description	Color after burning at 550°C	Depth of water (feet)
1 (1995)	76	79	Tan	Red	50
1 (2005)	70	63	Gray	Red	50
2 (1995)	53	87	Tan	Tan	80
2 (2005)	60	83	Gray	Gray	80
3 (2005)	59	89	Gray	Gray	19
4 (1995)	86	68	Gray	Dark red gray	19
5 (1995)	0	91	Tan	Black sand	3
6 (1995)	59	88	Gray	Dark gray	9

Average mineral content of bottom sediments (1985 = 83%, 2005 = 78%)

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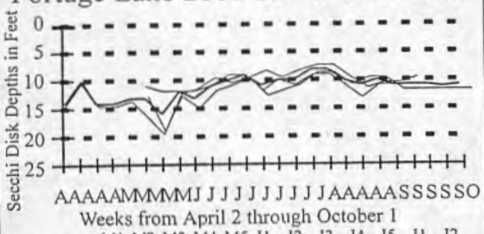
Sections 25 & 36
Putnam Township
T1N R4E
and Section 31,
Hamburg Township
T1N R5E
Livingston County
and Sections 1 & 2
Dexter Township
T1S R4E
Washtenaw County

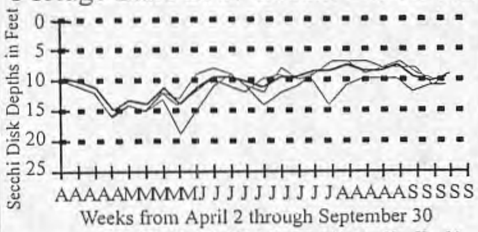
Portage Lake 2008 Secchi Disk Data



	M1	M2	M3	M4	M5	J1	J2	J3	J4	J5	J1	J2
North	----	----	----	----	----	12	18	12	14	11	10	9
South	14	10	14	14	13	16	19	12	11	9	10	9
Mud Bay	----	----	----	----	----	11	12	12	12	11	9	9
Average	14	10	14	14	13	13	16	12	13	11	10	9

	J3	J4	J5	A1	A2	A3	A4	A5	S1	S2	S5
North	12	11	10	8	8	10	9	9	11	11	11
South	8	9	8	7	7	9	11	10	10	9	----
Mud Bay	12	10	11	9	9	11	13	11	11	11	----
Average	11	10	10	8	8	10	11	10	11	11	11

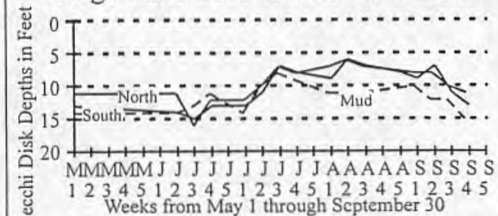
Portage Lake 2007 Secchi Disk Data



	A1	A2	A3	A4	M1	M2	M3	M4	J1	J2	J3	J4
North	10	11	12	16	14	15	12	13	9	8	9	11
South	10	11	12	16	14	15	13	19	15	11	9	11
Mud Bay	10	11	12	16	14	15	12	14	12	10	11	12
Average	10	11	12	16	14	15	12	15	12	10	10	11

	J1	J2	J3	J4	J5	A1	A2	A4	S1	S2	S3	S4
North	12	8	10	9	7	7	7	8	7	9	10	9
South	14	12	11	9	7	7	9	8	8	8	11	9
Mud Bay	10	9	10	10	14	11	10	10	10	12	11	11
Average	12	10	10	9	9	8	9	9	8	10	11	10

Portage Lake 2005 Secchi Disk Data



South basin				
MAY	13	.	.	.
JUN	. 14	15	13	
JUL	13 11	7	8	
AUG	9 6	7	8	
SEP	9 7	11	13	

North basin				
MAY	11	.	.	.
JUN	. 11	16	12	
JUL	12 10	7	8	
AUG	7 6	7	.	
SEP	8 8	10	11	

Mud bay				
MAY	14	.	.	.
JUN	.	14	13	11
JUL	14	10	8	9
AUG	11	11	11	.
SEP	10	12	12	15

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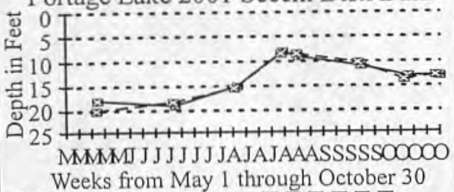
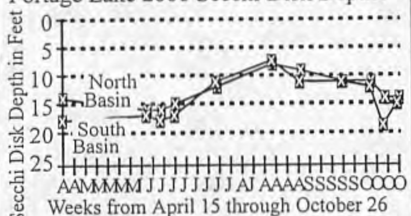
Portage Lake 2001 Secchi Disk Data



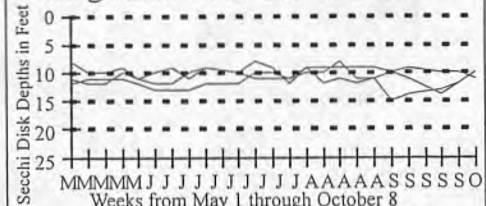
North basin						
MAY	.	.	18	.	.	
JUN	.	.	19	.	.	
JUL	.	15	.	.	8	
AUG	9	.	.	.	11	
SEP	.	.	13	.	13	

South basin					
MAY	.	.	20	.	.
JUN	.	.	18	.	.
JUL	.	15	.	.	7
AUG	7	.	.	.	9
SEP	.	.	13	.	12

Portage Lake 2000 Secchi Disk Depths



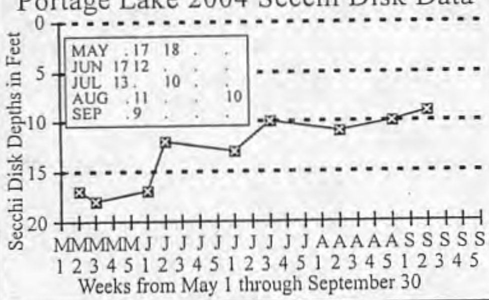
Portage Lake 2009 Secchi Disk Data



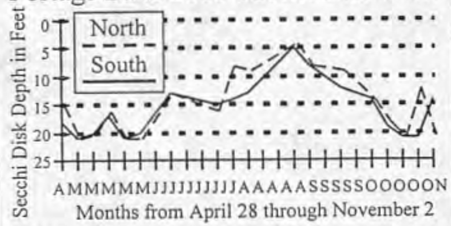
	M1	M2	M3	M4	M5	J1	J2	J3	J4	J1	J2
North	12	11	11	11	12	13	13	13	12	12	10
South	11	12	12	10	11	12	12	10	9	10	11
Mud Bay	8	10	10	9	11	10	9	11	9	10	8

	J3	J4	J5	A1	A2	A3	A4	A5	S1	S3	S4	S5
North	10	11	10	10	8	11	11	10	9	10	10	11
South	11	11	9	9	9	9	9	10	11	14	12	10
Mud Bay	9	12	9	12	11	12	11	15	14	13	12	

Portage Lake 2004 Secchi Disk Data



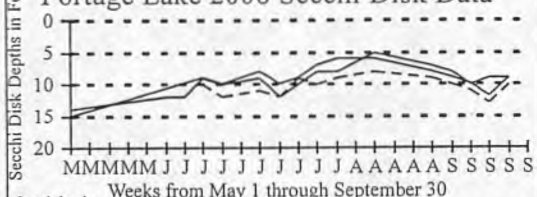
Portage Lake 2003 Secchi Disk Data



North basin					
MAY	15	21	20	16	21
JUN	21	.	13	.	.
JUL	16	8	9	.	.
AUG	4	8	.	9	.
SEP	14	18	21	12	21

South basin					
MAY	18	21	20	17	21
JUN	20	.	13	.	.
JUL	15	14	13	.	.
AUG	5	8	.	12	.
SEP	14	19	21	21	14

Portage Lake 2006 Secchi Disk Data



South basin				
MAY	14	.	.	.
JUN	12	12	9	10
JUL9	12	10	8	8
AUG	.	5	.	7
SEP8	10	9	9	.

North basin				
MAY	15	.	.	.
JUN	.	.	9	10
JUL8	10	9	7	6
AUG	.	6	.	8
SEP9	10	12	9	.

Mud bay - - - - -				
MAY	.	.	.	.
JUN	.	.	10	12
JUL11	12	9	10	9
AUG	.	8	.	9
SEP10	11	13	10	.

Portage Lake
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Section 31
Hamburg Township
T1N R5E
Livingston County
and Sections 1 & 2
Dexter Township
T1S R4E
Washtenaw County

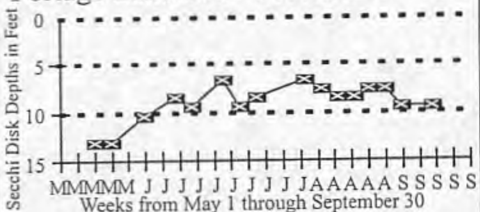
TABLE OF LAKE DATA

Lake name .... Portage Lake

Lake Water Quality Indices

Spring 1994	94 93 92
Summer 1994	85 87 82
Spring 1995	96 94 90 96 94
Summer 1995	79 84 78 81 77 74
Spring 1996	96 94 90 96 94
Summer 1996	92 95 95
Spring 1997	90 87 87
Summer 1997	87 88 88
Spring 1998	93 90 90
Summer 1998	84 85 88
Spring 1999	89 89 90
Summer 1999	92 93 94
Spring 2000	94 90 94
Summer 2000	81 82 86
Spring 2001	94 93 93
Summer 2001	82 82 84
Spring 2002	90 82 79
Summer 2002	89 89 90
Spring 2003	92 94 94
Summer 2003	89 90 89
Spring 2004	90 86 87
Summer 2004	88 90 92
Spring 2005	90 90 90
Summer 2005	88 86 88
Spring 2006	92 88 88
Summer 2006	81 87 85
Spring 2007	85 83 84
Summer 2007	89 88 91
Spring 2008	89 92 89
Summer 2008	86 91 92
Spring 2009	90 91 92
Summer 2009	85 89 90
Spring 2010	94 95 95
Summer 2010	88 91 90

Portage Lake 2010 Secchi Disk Data



MAY	.	.	14	14	.
JUN	11	.	9	10	.
JUL	7	10	9	.	.
AUG	7	8	9	9	8
SEP	8	10	.	10	.

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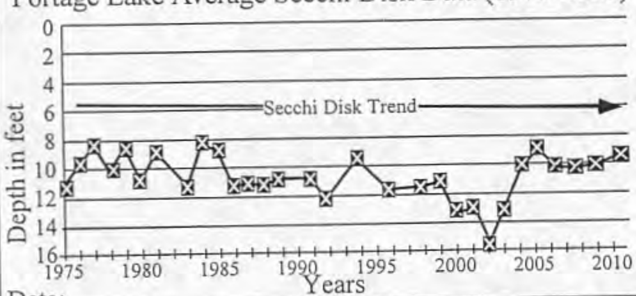
Portage Lake Average Secchi Disk Data (1975-2010)



Data:

1975	1976	1977	1978	1979	1980	1981	1983	1984	1985	1986	1987	1988	1989	1991
11.2	9.7	8.4	10.2	8.5	10.8	8.9	11.3	8.3	8.9	11.3	11.2	11.3	10.8	10.8
1992	1994	1996	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010
12.3	9.6	11.7	11.5	10.9	13.5	13.3	15.4	13.1	10.0	8.78	10.1	10.5	10.2	9.4

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Dexter Township
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Washtenaw County

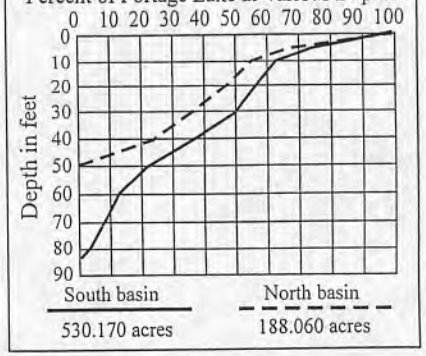
Surface Lake Water Quality Data

Date	Sample Station Number	Temperature °C	Dissolved Oxygen (mg/L)	Dissolved Oxygen Percent Saturation	Chlorophyll a ug/L	Secchi Disk Depth (feet)	Total Nitrate Nitrogen ug/L	Alkalinity mg/L	pH	Conductivity umhos /cm@ 25°C	Total Phosphorus ug/L	Lake Water Quality Index	Grade
6/1/94	1	---	---	---	1.2	13	149	---	8.2	420	10	94	A
6/1/94	1	---	---	---	1.2	13	149	---	8.2	420	10	94	A
6/1/94	2	---	---	---	1.2	12	160	---	8.2	420	12	93	A
6/1/94	3	---	---	---	1.6	12	154	---	8.3	420	16	92	A
8/1/94	1	24	8.8	97	2.6	7	23	175	8.3	490	21	85	B
8/1/94	2	24	8.7	98	2.2	7	12	173	8.3	490	26	87	B
8/1/94	3	24	9.2	108	2.0	7	14	171	8.3	480	19	82	B
6/14/95	1	---	---	---	1.2	---	111	182	7.9	470	9	96	A
6/14/95	2	---	---	---	1.9	---	104	183	7.7	470	22	94	A
6/14/95	3	---	---	---	6.0	---	78	179	8.0	470	16	90	A
6/14/95	4	---	---	---	0.9	---	116	175	7.7	470	8	96	A
6/14/95	5	---	---	---	2.8	---	45	178	7.8	470	9	94	A
7/20/95	Access	---	---	---	---	---	12	176	8.1	450	10	---	---
7/20/95	Bridge	---	---	---	---	---	11	173	8.6	500	15	---	---
7/20/95	Honey Cr.	---	---	---	---	---	204	170	8.1	520	6	---	---
7/20/95	Mud bay	---	---	---	---	---	9	172	8.6	560	13	---	---
7/20/95	Portage cr.	---	---	---	---	---	133	170	8.1	560	15	---	---
7/20/95	South end	---	---	---	---	---	11	187	8.6	470	8	---	---
8/14/95	1	31	7.9	105	6.6	10	5	180	8.8	430	7	79	C
8/14/95	2	30	7.7	101	3.3	11	3	178	8.8	440	7	84	B
8/14/95	3	31	9.2	123	6.2	---	5	175	8.8	430	18	78	C
8/14/95	4	32	7.2	97	4.5	10	7	168	8.6	420	15	81	B
8/14/95	5	32	8.5	115	12.3	---	7	165	8.3	410	17	77	C
8/14/95	6	32	8.3	112	13.1	9	12	176	8.7	420	23	74	C
6/9/96	1	21	8.3	92	1.5	14	139	182	8.4	490	11	92	A
6/9/96	2	21	8.3	92	0.8	19	165	178	8.3	490	13	95	A
6/9/96	3	22	8.5	97	1.5	19	165	185	8.2	490	18	95	A
8/7/96	1	27	8.5	106	4.0	7	17	187	8.4	495	18	84	B
8/7/96	2	26	8.6	105	3.2	8	16	185	8.4	490	10	87	B
8/7/96	3	27	8.7	109	2.8	10	17	180	8.3	475	22	88	B
5/12/97	1	12	10.4	96	0.9	14	433	185	8.3	460	7	90	A
5/12/97	2	11	9.7	87	2.5	15	564	181	8.2	470	9	87	B
5/12/97	3	12	10.4	96	0.4	14	564	183	8.3	460	5	88	B
8/25/97	1	21	9.0	100	1.6	8	57	172	8.5	470	30	87	B
8/25/97	2	22	8.6	98	1.6	8	43	170	8.6	470	15	88	B
8/25/97	3	21	9.1	100	1.6	9	43	168	8.6	470	19	88	B
4/19/98	1	13	10.6	100	0.8	15	264	192	8.3	450	13	93	A
4/19/98	2	12	10.8	100	1.1	15	185	185	8.3	460	10	90	A
4/19/98	3	12	10.7	99	0.6	15	185	185	8.3	470	8	90	A
8/10/98	1	26	8.7	106	3.4	7	12	184	8.8	450	18	84	B
8/10/98	2	26	8.5	104	2.3	7	10	182	8.8	460	16	85	B
8/10/98	3	26	7.8	95	1.1	9	11	178	8.7	480	17	88	B
4/26/99	1	14	9.4	90	1.3	10	325	165	8.0	480	32	89	B
4/26/99	2	13	10.5	99	1.3	17	427	180	8.2	500	39	90	A
4/26/99	3	14	10.6	102	0.6	21	347	180	8.3	480	42	90	A
8/27/99	1	24	8.9	105	1.7	11	5	167	8.4	490	18	92	A
8/27/99	2	23	8.8	101	1.1	12	8	162	8.4	500	18	93	A
8/27/99	3	24	8.5	100	1.1	13	7	160	8.3	490	16	94	A
4/15/00	1	9	10.5	91	0.6	18	274	184	8.4	510	17	94	A
4/15/00	2	9	10.6	91	1.8	14	230	184	8.3	510	32	90	A
4/15/00	3	10	10.4	92	0.6	14	244	180	8.3	510	15	94	A
8/4/00	1	24	8.5	100	4.6	8	31	185	8.8	530	31	81	B
8/4/00	2	24	9.1	107	6.6	7	25	186	8.7	530	21	82	B
8/4/00	3	24	8.6	101	4.6	9	33	181	8.6	530	17	86	B
5/13/01	1	19	9.2	98	0.3	22	412	193	8.5	520	13	94	A
5/13/01	2	19	9.2	98	1.7	22	436	190	8.4	520	15	93	A
5/13/01	3	19	9.3	99	0.6	22	469	185	8.4	520	15	93	A
8/1/01	1	28	8.4	106	5.0	6	16	185	8.3	510	23	82	B
8/1/01	2	28	8.8	111	5.3	6	8	182	8.2	510	22	82	B
8/1/01	3	28	8.6	109	4.4	7	11	180	8.1	520	20	84	B
4/15/02	1	10	9.5	84	1.5	9	270	190	8.3	500	11	90	A
4/15/02	2	12	11.0	102	7.4	7	393	188	8.4	520	11	82	B
4/15/02	3	12	11.4	106	4.2	9	419	185	8.3	540	10	79	C
8/2/02	1	27	7.6	95	1.5	8	28	161	8.6	550	16	89	B
8/2/02	2	28	7.6	96	1.8	9	38	163	8.7	550	17	89	B
8/2/02	3	28	7.2	91	0.6	9	42	164	8.6	540	17	90	A
4/28/03	1	14	10.2	98	1.0	15	380	185	8.3	560	13	92	A
4/28/03	2	13	11.1	105	1.8	18	258	184	8.2	550	10	93	A
4/28/03	3	13	11.2	106	1.6	18	211	185	8.2	540	9	95	A

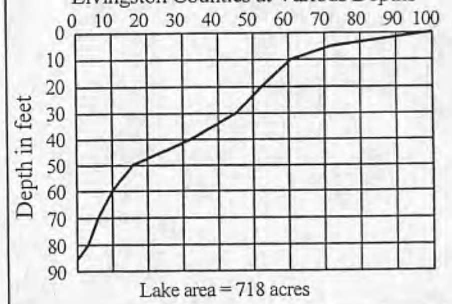
Surface Lake and Inlets Water Quality Data

Date	Sample Station Number	Temperature °C	Dissolved Oxygen (mg/L)	Dissolved Oxygen Percent Saturation	Chlorophyll a ug/L	Secchi Disk Depth (feet)	Total Nitrate Nitrogen ug/L	Alkalinity mg/L	pH	Conductivity umhos /cm@ 25°C	Total Phosphorus ug/L	Lake Water Quality Index	Grade
8/1/03	1	26	8.5	104	2.7	4	32	165	8.7	540	11	83	B
8/1/03	2	26	8.6	105	2.7	5	110	170	8.6	540	8	86	B
8/1/03	3	26	8.9	109	2.7	5	105	161	8.6	545	12	86	B
8/1/01	Mumford 1	28	7.4	95	---	3	45	190	7.8	520	36	---	---
8/1/01	Mumford 2	26	5.4	67	---	3	51	190	7.5	520	29	---	---
8/1/01	Mumford 3	26	5.7	70	---	3	56	190	7.7	520	32	---	---
4/16/04	1	9	10.7	92	1.4	12	411	188	8.1	580	12	90	A
4/16/04	2	9	11.8	102	2.5	12	545	181	8.2	580	18	86	B
4/16/04	3	9	11.1	96	1.0	12	571	180	8.1	570	20	87	B
8/2/04	1	26	8.4	102	2.6	8	198	190	8.2	560	24	88	B
8/2/04	2	25	8.5	102	3.2	11	221	185	8.3	560	21	90	A
8/2/04	3	25	8.3	100	0.8	10	189	185	8.2	560	22	92	A
5/26/04	Portage R.	---	---	---	---	---	806	186	7.9	580	21	---	---
6/29/04	Portage R.	---	---	---	---	---	268	185	8.6	540	143	---	---
7/28/04	Portage R.	---	---	---	---	---	186	200	8.0	550	32	---	---
8/29/04	Portage R.	---	---	---	---	---	76	202	8.1	600	28	---	---
10/1/04	Portage R.	---	---	---	---	---	96	213	7.9	560	21	---	---
11/30/04	Portage R.	---	---	---	---	---	590	201	8.0	510	18	---	---
12/31/04	Portage R.	---	---	---	---	---	528	205	8.0	570	22	---	---
1/28/05	Portage R.	---	---	---	---	---	1356	204	7.8	560	17	---	---
2/26/05	Portage R.	---	---	---	---	---	1485	196	7.9	580	9	---	---
3/29/05	Portage R.	---	---	---	---	---	989	191	8.0	540	14	---	---
4/18/05	Portage R.	---	---	---	---	---	473	199	8.2	570	22	---	---
8/1/03	Honey Cr.	---	---	---	---	---	53	168	8.7	550	15	---	---
5/26/04	Honey Cr.	---	---	---	---	---	284	190	7.8	640	41	---	---
6/29/04	Honey Cr.	---	---	---	---	---	110	230	8.1	580	17	---	---
7/28/04	Honey Cr.	---	---	---	---	---	154	230	8.0	520	23	---	---
8/29/04	Honey Cr.	---	---	---	---	---	216	213	7.9	550	27	---	---
10/1/04	Honey Cr.	---	---	---	---	---	316	257	7.9	600	62	---	---
11/30/04	Honey Cr.	---	---	---	---	---	656	210	7.8	480	16	---	---
12/31/04	Honey Cr.	---	---	---	---	---	587	210	7.7	580	24	---	---
1/28/05	Honey Cr.	---	---	---	---	---	480	235	7.7	540	12	---	---
2/26/05	Honey Cr.	---	---	---	---	---	326	230	7.8	550	13	---	---
3/29/05	Honey Cr.	---	---	---	---	---	315	182	7.8	440	15	---	---
4/18/05	Honey Cr.	---	---	---	---	---	93	221	8.3	540	15	---	---
4/18/05	1	16	9.5	95	2.6	12	356	195	8.2	550	8	90	A
4/18/05	2	14	10.9	105	1.7	14	449	195	8.2	550	12	90	A
4/18/05	3	15	10.4	105	0.5	14	438	190	8.2	550	10	90	A
8/3/05	1	28	8.6	109	1.7	8	31	170	8.5	550	19	88	B
8/3/05	2	28	9.7	123	1.1	8	27	165	8.4	540	23	86	B
8/3/05	3	28	8.3	105	1.4	8	22	162	8.4	560	21	88	B
4/19/06	1	13	9.8	92	0.6	15	396	178	8.1	520	17	92	A
4/19/06	2	13	9.7	91	1.4	14	599	175	8.2	530	18	88	B
4/19/06	3	13	9.7	91	0.3	14	599	180	8.1	530	18	88	B
8/1/06	1	29	8.4	108	4.0	6	42	172	8.7	560	24	81	B
8/1/06	2	28	7.9	100	1.9	8	37	170	8.6	540	18	87	B
8/1/06	3	28	7.3	94	1.8	7	17	171	8.6	590	19	85	B
4/21/07	1	11	10.9	98	3.0	15	629	186	8.3	550	17	85	B
4/21/07	2	12	10.9	101	0.8	16	836	172	8.1	530	16	83	B
4/21/07	3	13	10.9	103	0.8	18	812	178	8.2	530	17	84	B
8/1/07	1	25	9.5	113	1.9	8	74	180	8.4	520	18	89	B
8/1/07	2	26	8.5	104	3.1	9	92	170	8.5	540	21	88	B
8/1/07	3	26	8.4	103	1.8	10	83	170	8.4	520	20	91	A
4/18/08	1	12	11.4	106	2.4	9	290	182	7.9	480	22	89	B
4/18/08	2	11	11.8	106	1.6	11	347	177	7.8	480	16	92	A
4/18/08	3	11	11.8	106	1.2	11	463	177	7.8	480	22	89	B
8/1/08	1	27	9.1	114	3.7	9	7	195	8.5	490	23	86	B
8/1/08	2	26	8.8	107	2.0	10	7	187	8.4	480	22	91	A
8/1/08	3	27	7.7	96	1.0	11	10	178	8.4	520	12	92	A
4/18/09	1	12	11.3	105	2.6	10	269	193	8.0	480	23	90	A
4/18/09	2	10	11.8	104	1.3	14	391	174	8.1	470	18	91	A
4/18/09	3	11	11.1	100	1.0	14	346	177	8.1	470	20	92	A
8/3/09	1	23	7.9	91	6.6	8	112	191	8.3	530	23	85	B
8/3/09	2	23	9.2	106	4.2	12	140	185	8.3	510	22	89	B
8/3/09	3	23	8.8	90	1.4	8	65	185	8.3	520	25	90	A

Percent of Portage Lake at Various Depths



Percent of Portage Lake, Washtenaw & Livingston Counties at Various Depths



Portage Lake Contour Areas & Volumes

Area of various contours	Volume in Acre Feet
Lake area = 725.35 acres	
Island = 7.41 acres	
Surface area = 717.90 acres	
5 feet = 516.89 acres	3090
10 feet = 437.73 acres	2380
20 feet = 383.02 acres	4091
30 feet = 324.99 acres	3582
40 feet = 232.48 acres	2820
50 feet = 115.49 acres	1740
60 feet = 71.06 acres	922
70 feet = 44.16 acres	575
80-84 feet = 20.66 acres	322
	41
Lake volume = 19567 acre feet	

Portage Lake Contour Areas & Volumes

Area of various contours	Volume in Acre Feet
South basin	
Surface area = 537.591 acres	
Island area = 7.421 acres	
Lake area = 530.170 acres	2303
5 foot = 391.246 acres	1807
10 foot = 331.383 acres	3128
20 foot = 294.228 acres	2799
30 foot = 265.545 acres	2297
40 foot = 193.768 acres	1536
50 foot = 113.436 acres	922
60 foot = 70.890 acres	575
70 foot = 44.157 acres	322
80-84 foot = 20.656 acres	41
South basin volume = 15730 acre feet	
North basin	
Surface area = 188.060 acres	787
5 foot = 126.698 acres	573
10 foot = 102.609 acres	963
20 foot = 90.036 acres	783
30 foot = 66.623 acres	523
40 foot = 38.005 acres	149
45 foot = 21.704 acres	59
50 foot = 2.035 acres	
North basin volume = 3837 acre feet	
Lake area = 725.35 acres	
Island = 7.41 acres	
Surface area = 717.9 acres	
Lake volume = 19567 acre feet	

FUSILIER'S ATLAS
AND GAZETTEER OF
MICHIGAN INLAND LAKES

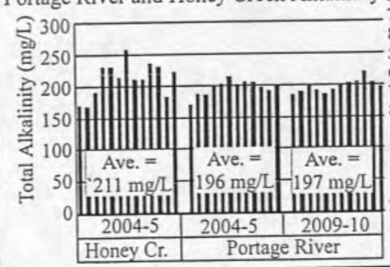
Water Quality Investigators
9200 Dexter Chelsea Road
Dexter, Michigan 48130
(734) 426-8972

Portage Lake
Sections 25 & 36
Putnam Township T1N R4E
and Section 31,
Hamburg Township T1N R5E
Livingston County
and Sections 1 & 2
Dexter Township T1S R4E
Washtenaw County

Surface Lake and Inlets Water Quality Data

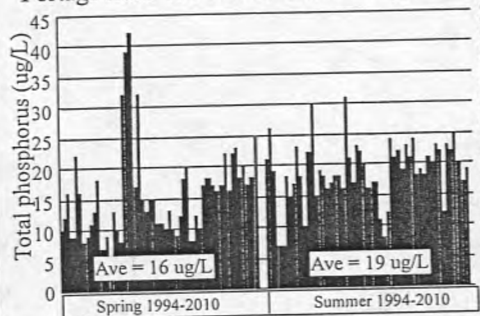
Date	Sample Station Number	Temperature °C	Dissolved Oxygen (mg/L)	Dissolved Oxygen Percent Saturation	Chlorophyll a ug/L	Secchi Disk Depth (feet)	Total Nitrate Nitrogen ug/L	Alkalinity mg/L	pH	Conductivity umhos /cm@ 25°C	Total Phosphorus ug/L	Lake Water Quality Index	Grade
4/20/10	1	13	10.0	94	0.2	17	200	210	8.3	550	17	94	A
4/20/10	2	13	10.3	97	0.3	19	213	202	8.3	540	18	95	A
4/20/10	3	13	10.8	102	0.3	19	194	200	8.3	530	25	95	A
8/2/10	1	26	8.4	102	2.4	6	44	190	8.5	510	20	88	B
8/2/10	2	26	8.2	100	1.9	8	36	186	8.5	490	17	91	A
8/2/10	3	26	8.2	100	1.4	7	32	182	8.5	490	19	90	A
5/28/09	Portage R.	20	5.2	---	---	---	380	184	7.7	490	50	---	---
6/29/09	Portage R.	24	6.2	---	---	---	87	189	8.0	520	29	---	---
7/31/09	Portage R.	23	7.3	---	---	---	266	197	8.0	560	29	---	---
8/28/09	Portage R.	19	7.4	---	---	---	412	191	8.0	500	18	---	---
9/22/09	Portage R.	21	6.3	---	---	---	10	185	7.9	500	23	---	---
10/21/09	Portage R.	13	9.4	---	---	---	10	192	8.0	580	22	---	---
11/23/09	Portage R.	10	11.2	---	---	---	58	198	8.1	520	25	---	---
12/26/09	Portage R.	2	11.8	---	---	---	119	202	8.0	560	23	---	---
1/23/10	Portage R.	7	12.2	---	---	---	95	204	8.0	560	42	---	---
3/9/10	Portage R.	7	12.2	---	---	---	270	220	8.1	570	45	---	---
3/31/10	Portage R.	12	10.5	---	---	---	178	203	8.2	540	18	---	---
4/20/10	Portage R.	12	11.6	---	---	---	319	196	8.2	540	18	---	---

Portage River and Honey Creek Alkalinity



Honey Cr.		Portage R.		Portage R.	
7/20/95	170	7/20/95	170	5/28/09	184
8/1/03	168	5/26/04	186	6/29/09	189
5/26/04	190	6/29/04	185	7/31/09	197
6/29/04	230	7/28/04	200	8/28/09	191
7/28/04	230	8/29/04	202	9/22/09	185
8/29/04	213	10/1/04	213	10/21/09	192
10/1/04	257	11/30/04	201	11/23/09	198
11/30/04	210	12/31/04	205	12/26/09	202
12/31/04	210	1/28/05	204	1/23/10	204
1/28/05	235	2/26/05	196	3/9/10	220
2/26/05	230	3/29/05	191	3/31/10	203
3/29/05	182	4/18/05	199	4/20/10	196
4/18/05	221				

Portage Lake 1994-2010 Total Phosphorus



Spring			
		4/15/02	11
6/1/94	10	4/15/02	11
6/1/94	12	4/15/02	10
6/1/94	16	4/28/03	13
6/14/95	9	4/28/03	10
6/14/95	22	4/28/03	9
6/14/95	16	4/16/04	12
6/14/95	8	4/16/04	18
6/14/95	9	4/16/04	20
6/9/96	11	4/18/05	8
6/9/96	13	4/18/05	12
6/9/96	18	4/18/05	10
5/12/97	7	4/19/06	17
5/12/97	9	4/19/06	18
5/12/97	5	4/19/06	18
4/19/98	13	4/21/07	17
4/19/98	10	4/21/07	16
4/19/98	8	4/21/07	17
4/26/99	32	4/18/08	22
4/26/99	39	4/18/08	16
4/26/99	42	4/18/08	22
4/15/00	17	4/18/09	23
4/15/00	32	4/18/09	18
4/15/00	15	4/18/09	20
5/13/01	13	4/20/10	17
5/13/01	15	4/20/10	18
5/13/01	15	4/20/10	25

Summer		8/1/01	20
8/1/94	21	8/2/02	16
8/1/94	26	8/2/02	17
8/1/94	19	8/2/02	17
8/14/95	7	8/1/03	11
8/14/95	7	8/1/03	8
8/14/95	18	8/1/03	12
8/14/95	15	8/2/04	24
8/14/95	17	8/2/04	21
8/14/95	23	8/2/04	22
8/7/96	18	8/3/05	19
8/7/96	10	8/3/05	23
8/7/96	22	8/3/05	21
8/25/97	30	8/1/06	24
8/25/97	15	8/1/06	18
8/25/97	19	8/1/06	19
8/10/98	18	8/1/07	18
8/10/98	16	8/1/07	21
8/10/98	17	8/1/07	20
8/27/99	18	8/1/08	23
8/27/99	18	8/1/08	22
8/27/99	16	8/1/08	12
8/4/00	31	8/3/09	23
8/4/00	21	8/3/09	22
8/4/00	17	8/3/09	25
8/1/01	23	8/2/10	20
8/1/01	22	8/2/10	17
		8/2/10	19

FUSILIER'S ATLAS
AND GAZETTEER OF
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Portage Lake
Sections 25 & 36
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Hamburg Township T1N R5E
Livingston County
and Sections 1 & 2
Dexter Township T1S R4E
Washtenaw County

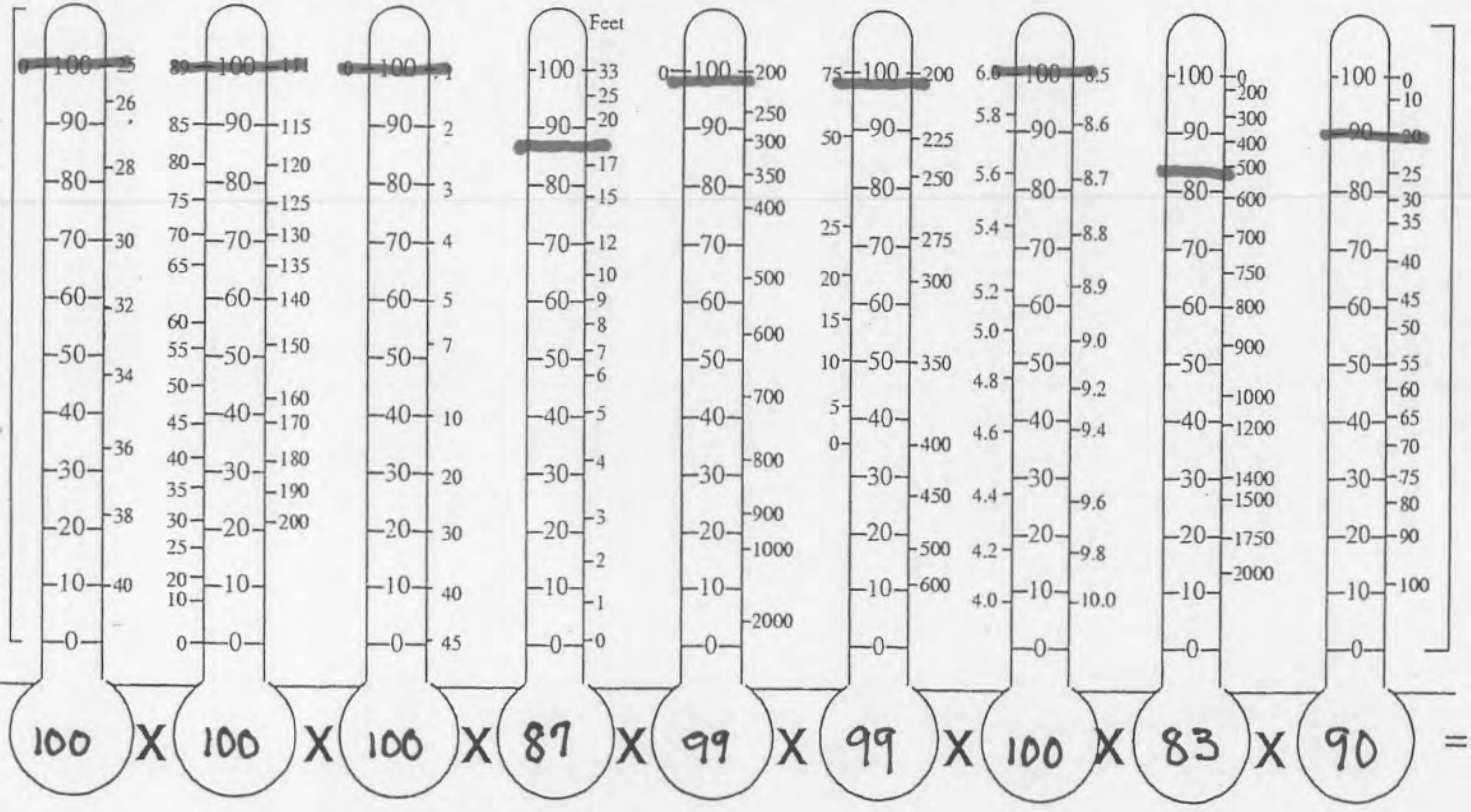
CALCULATION SHEET FOR THE UNWEIGHTED MULTIPLICATIVE LAKE WATER QUALITY INDEX

W. Fusilier, Ph.D.

QUALITY RATING CURVES

(Individual Quality Ratings never exceed 100)

Temperature in degrees C	Dissolved Oxygen, % Saturation	Chlorophyll a ug/L	Secchi Disk Depth in feet	Nitrate-N ug/L	Alkalinity mg/L	pH S. U.	Specific Conductivity umhos/cm@ 25C	Total Phosphorus ug/L
13°	10.4/10.6 98	0.2	18'	202	204	8.3	540	20



$\sqrt[9]{100 \times 100 \times 100 \times 87 \times 99 \times 99 \times 100 \times 83 \times 90} = 95$ LWQI

104
Watershed to lake ratio

3.09 years
Flushing rate

Huron
Drainage Basin

75520
Drainage Area

19328
Lake Volume

Livingston-Washtenaw
County

Putnam-Hamburg-Dexter
Township

WQI
Analyst

84'
Lake Depth

725
Lake Area

SET THE PARAMETER QUALITY RATING AT 1 IF THE EXTERNAL EXTREME VALUE RANGE IS EXCEEDED

LAKE WATER QUALITY INDEX

0–15	15–25	25–35	35–45	45–55	55–65	65–75	75–85	85–100
Red	Red Orange	Orange	Orange Yellow	Yellow	Yellow green	Green	Blue Green	Blue

DATE 20 April 2010

STATION AVE 1-3

LAKE Portage

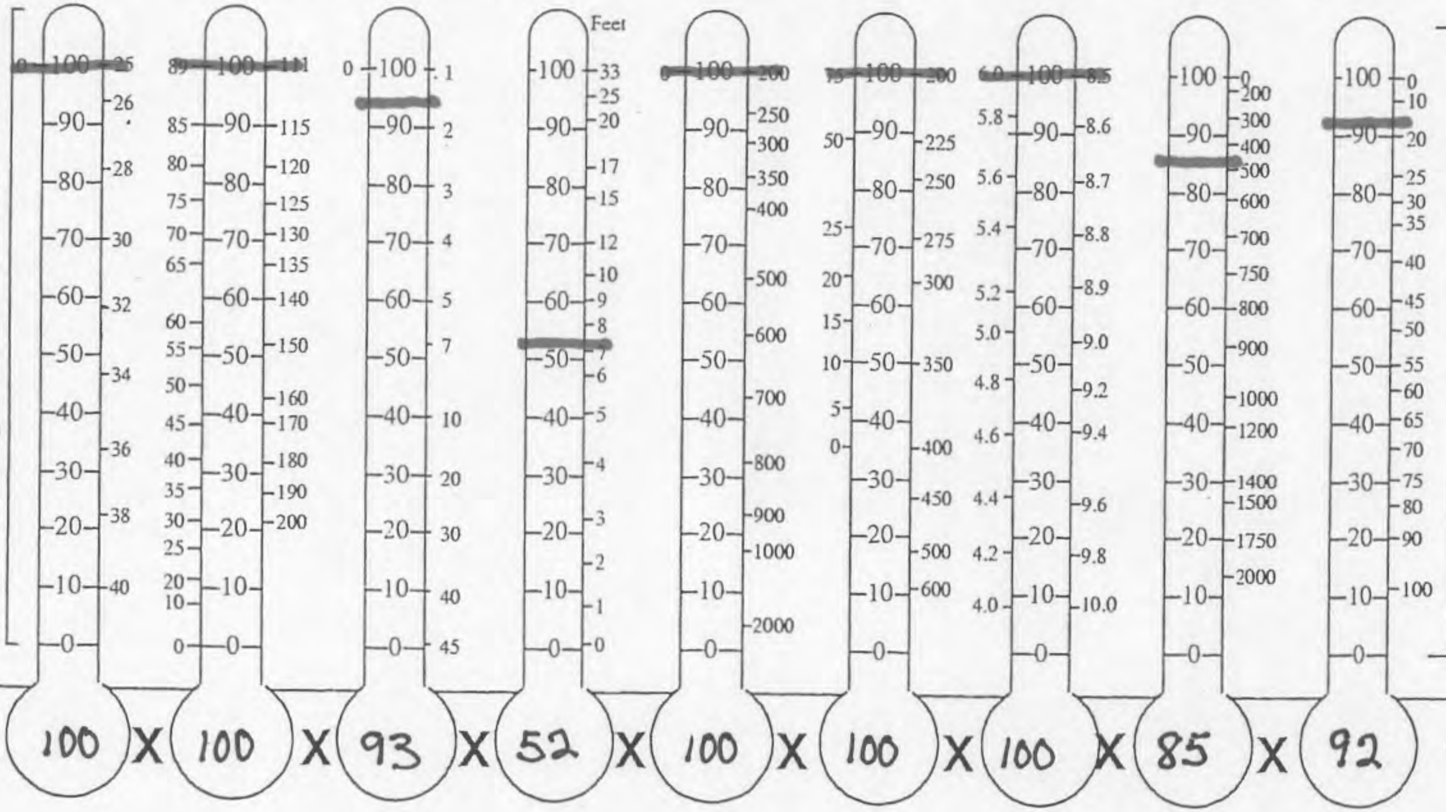
CALCULATION SHEET FOR THE UNWEIGHTED MULTIPLICATIVE LAKE WATER QUALITY INDEX

W. Fusilier, Ph.D.

QUALITY RATING CURVES

(Individual Quality Ratings never exceed 100)

Parameter	Value	Quality Rating
Temperature in degrees C	26°	100
Dissolved Oxygen, % Saturation	8.3/8.2 / 101	100
Chlorophyll a ug/L	1.7	93
Secchi Disk Depth in feet	7'	52
Nitrate-N ug/L	37	100
Alkalinity mg/L	186	100
pH S. U.	8.5	100
Specific Conductivity umhos/cm@ 25C	497	85
Total Phosphorus ug/L	18	92



$\sqrt[9]{100 \times 100 \times 93 \times 52 \times 100 \times 100 \times 100 \times 85 \times 92} = 90$

LWQI: 90

104
Watershed to lake ratio

3.09 years
Flushing rate

Huron
Drainage Basin

75520
Drainage Area

19328
Lake Volume

Livingston - Washtenaw
County

Putnam - Hamburg - Dexter
Township

WQI
Analyst

84'
Lake Depth

725
Lake Area

SET THE PARAMETER QUALITY RATING AT 1 IF THE EXTERNAL EXTREME VALUE RANGE IS EXCEEDED

LAKE WATER QUALITY INDEX

0–15	15–25	25–35	35–45	45–55	55–65	65–75	75–85	85–100
Red	Red Orange	Orange	Orange Yellow	Yellow	Yellow green	Green	Blue Green	Blue

DATE 2 August 2010

STATION AVE 1-3

LAKE Portage