A topographic map of Michigan's Inland Lakes region, showing contour lines and various islands. The map is oriented vertically with a north arrow on the left. The title "Morphometry and Michigan's Inland Lakes" is centered over the map in a blue serif font. The subtitle "How Lake Size and Shape Affect Water Quality" is centered below the title in a black serif font. The author's name "Pam Tynning" and the logo "progressive|ae" are in the bottom right corner.

Morphometry and Michigan's Inland Lakes

How Lake Size and Shape
Affect Water Quality

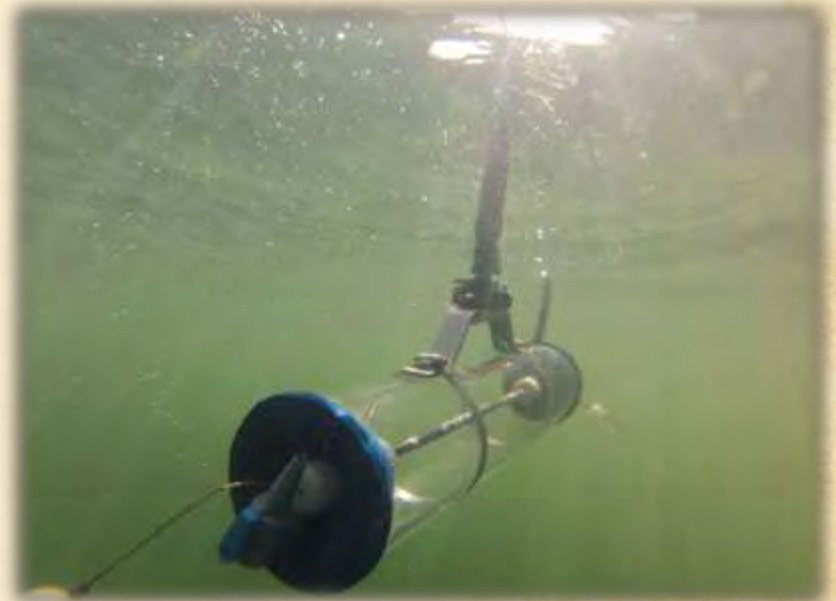
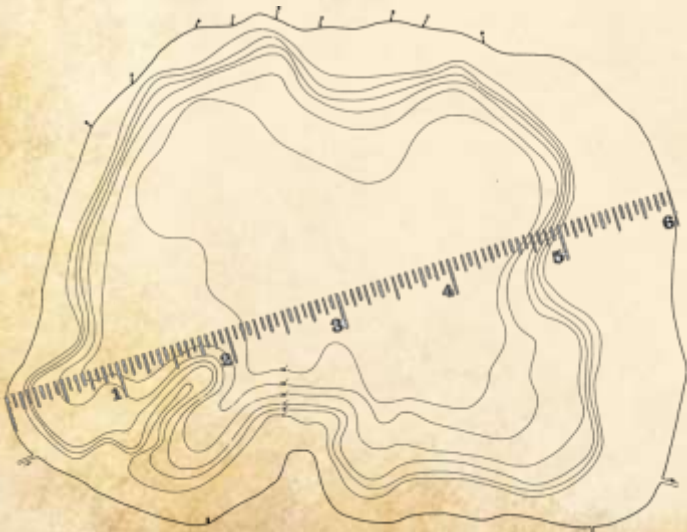
How Big is Big?

- What's the biggest lake? . . . the smallest?
- How does your lake compare?
- How do size and shape affect water quality?



Morphometry and Water Quality

- Lake Surface Area
- Shoreline Length
- Maximum Depth
- Average Depth
- Lake Volume
- Temperature
- Dissolved Oxygen
- Total Phosphorus



Information Sources

Morphometry

[Wells Hydraulic Property Database](#)

[Wells Summary Database](#)

HYDROGRAPHY

[Darcy Groundwater Movement Model, V2](#)

[DEQ Conservation Easements](#)

[Final Wetland Inventory](#)

[Great Lakes Shoreline](#)

[Inland Lake Contours](#)

[Lake points](#)

[Lake Polygons](#)

[Major Watersheds-Subbasins](#)

[MI Geographic Framework Hydrography \(v13a\)](#)

[MI Geographic Framework Hydrography Lines \(v13a\)](#)

[MI Geographic Framework Hydrography Polygons \(v13a\)](#)

[National Wetlands Inventory](#)

[Potential Wetland Restoration](#)

[Reach Files \(RF3\)](#)

[River Valley Segments](#)

[Watershed Boundary - 12 Digit](#)

[Watershed Boundary - 8 Digit](#)

HYDROLOGY

[Great Lakes Assessment Units](#)

[Inland Lake Assessment Units](#)

[Point Location Assessment Units](#)

[Stream Rivers Assessment Units](#)

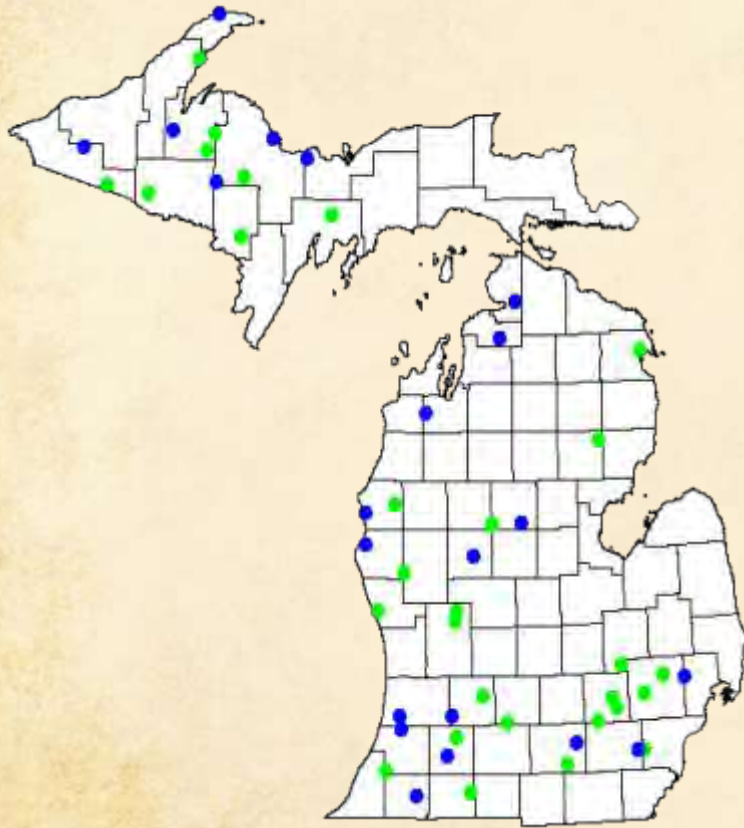
Water Quality

- National Lakes Assessment
- U.S. EPA STORET



Water Quality Data Sources

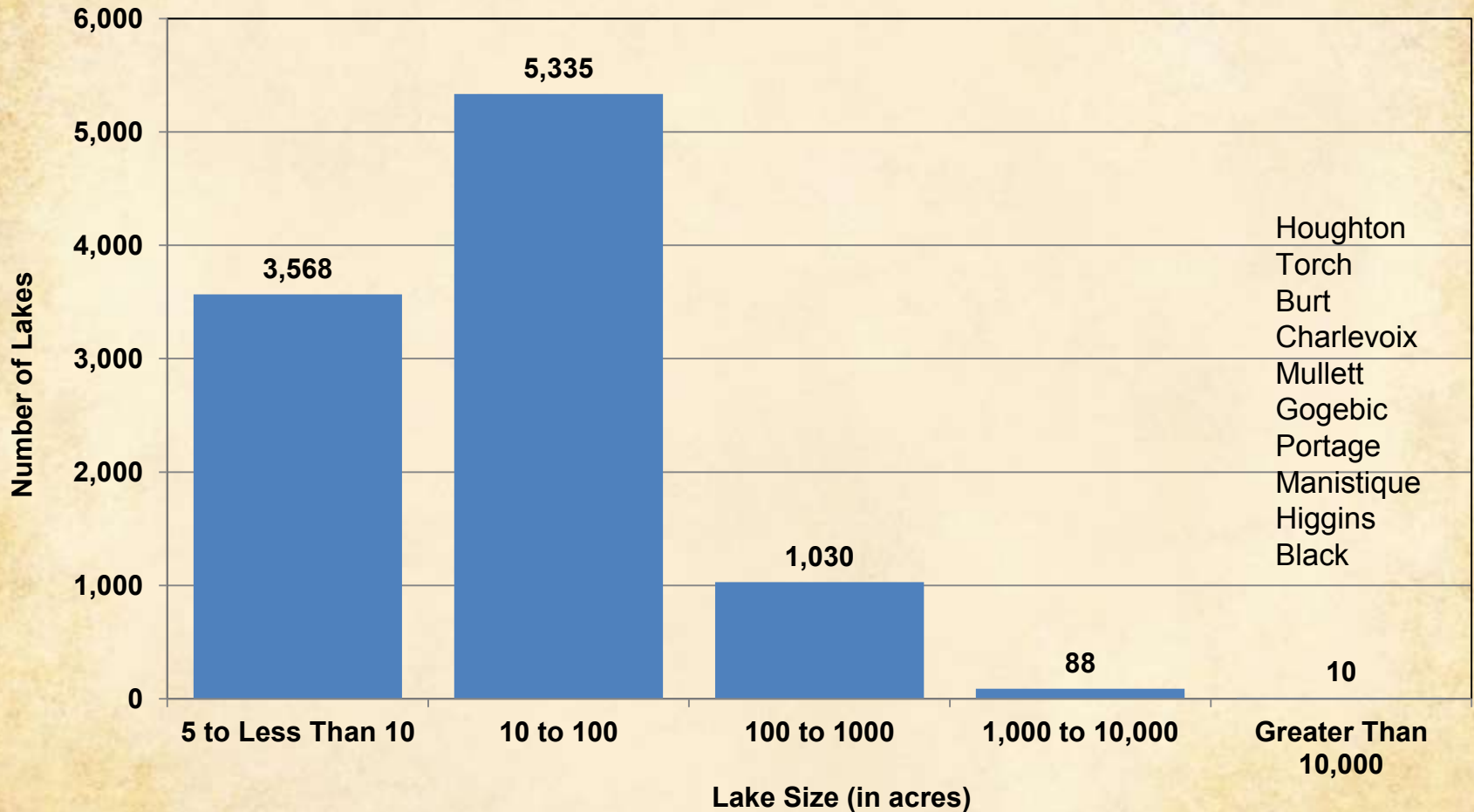
National Lakes Assessment

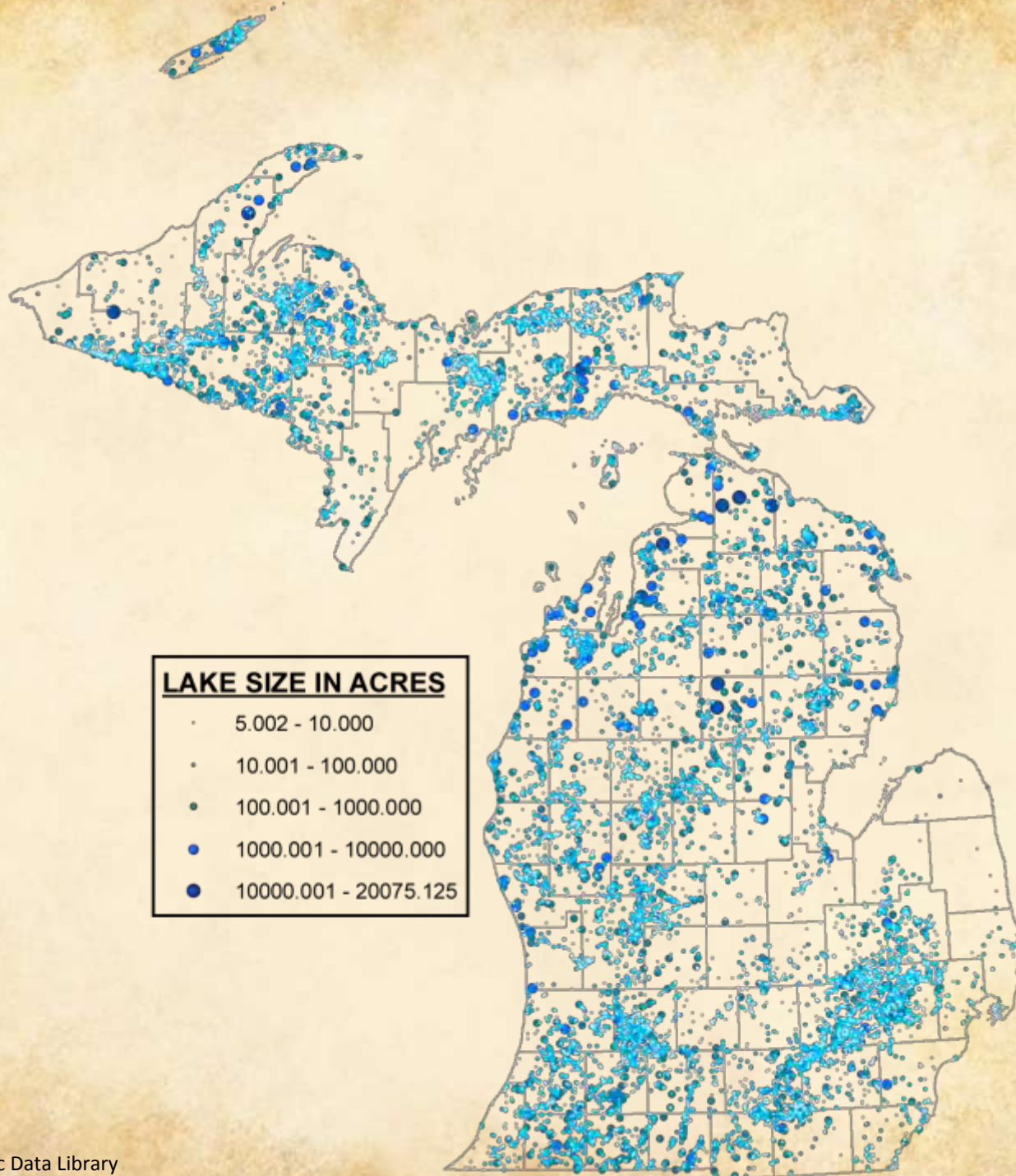


US EPA STORET



Lakes Greater Than 5 Acres: 10,031







James
Lake

Torch
Lake

Shoepac
Lake

Houghton
Lake

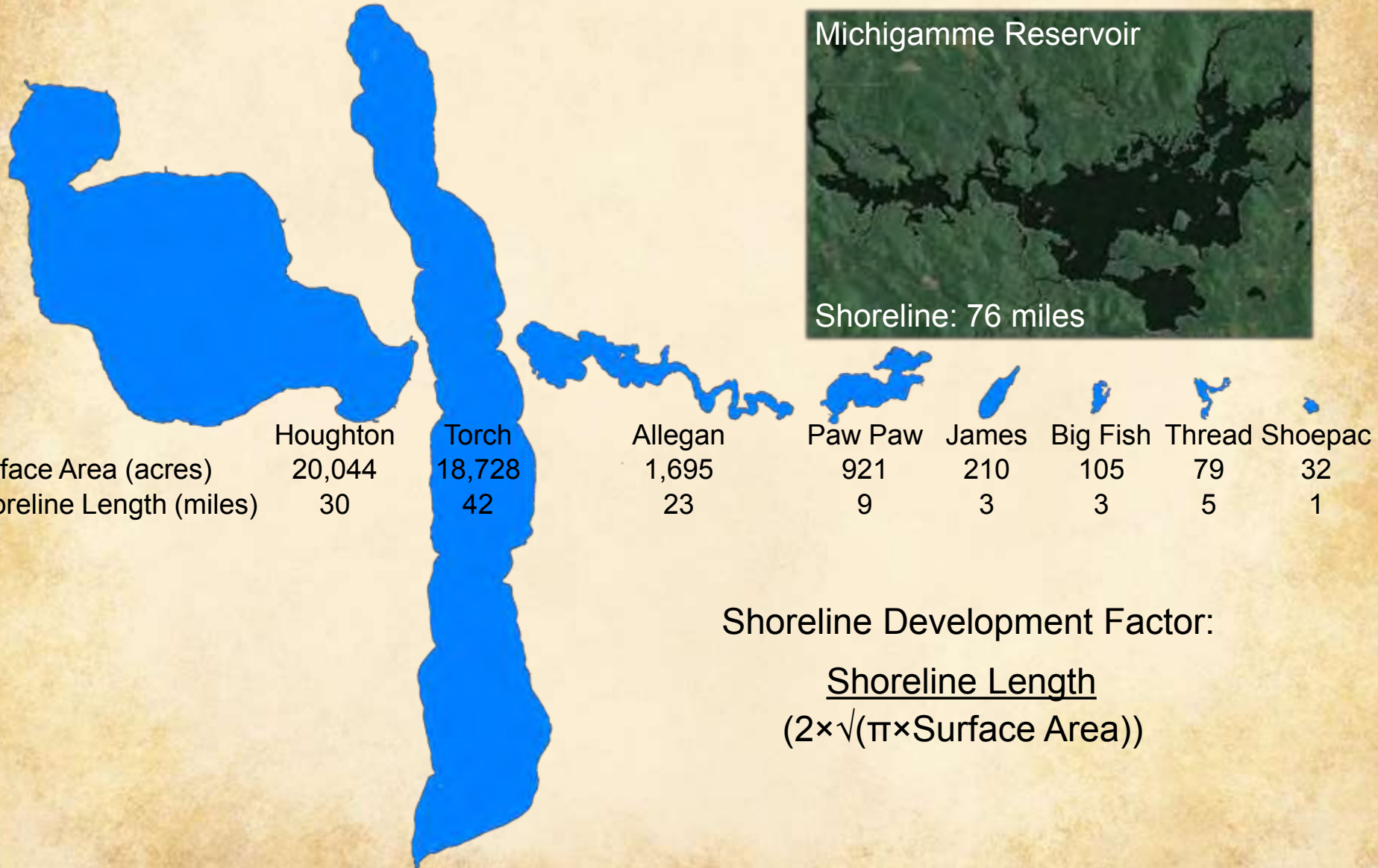
Thread
Lake

Big Fish
Lake

Lake
Allegan

Paw Paw
Lake

Surface Area and Shoreline Length



Shoreline Development Factor



Shoreline Development Factor

Highest SD

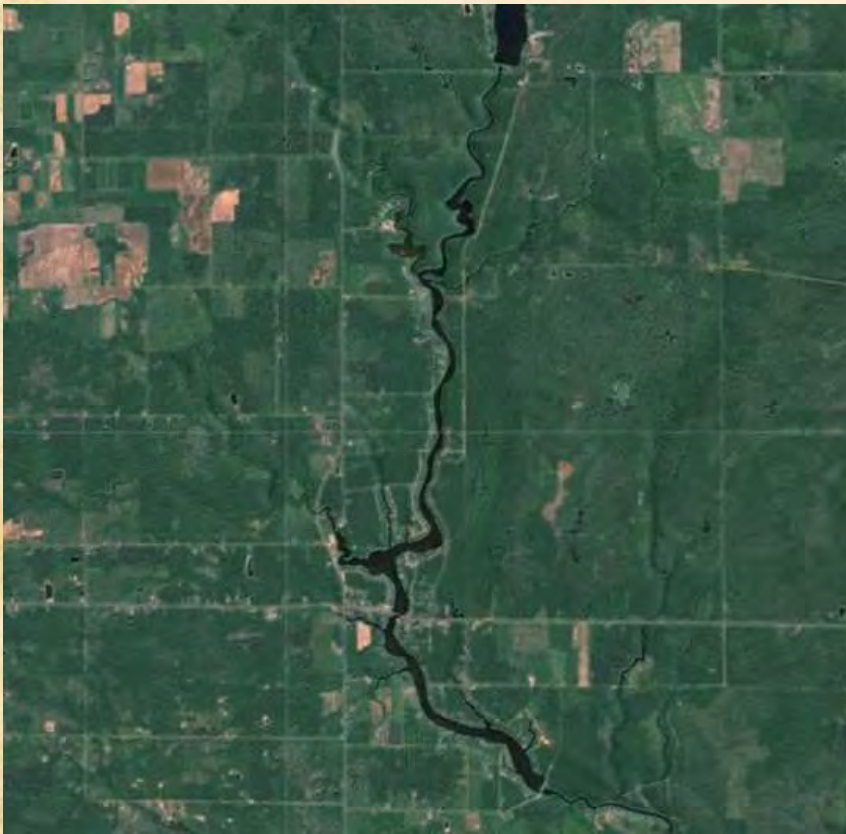
Lowest SD

LAKE_NAME	COUNTY	ACRES_GIS	PERIMETER	Shoreline Development	LAKE_NAME	COUNTY	ACRES_GIS	PERIMETER	Shoreline Development
1 Presque Isle River FI	Gogebic	87	28371	13.5	6439 Camp Seven Lake	Delta	52	1683	1.0
2 Smallwood Lake	Gladwin	371	49361	11.4	6440 Fifteen, Lake	Iron	61	1819	1.0
3 Shiawassee R. Flooding	Saginaw	88	23451	11.1	6441 Salma, Lake	Manistee	14	875	1.0
4 Widewaters, The	Chippewa	62	16631	9.4	6442 Cone Lake	Iron	11	782	1.0
5 Paw Paw River	Van Buren	18	8450	8.9	6443 Morgan Lake	Oakland	31	1308	1.0
6 No Name	Marquette	41	12001	8.4	6444 Lampman Lake	Montcalm	14	875	1.0
7 Ninth Street Pond	Alpena	366	35316	8.2	6445 Buckbee Lake	Genesee	18	997	1.0
8 Walton River	Menominee	36	11027	8.1	6446 Nolten Lake	Cheboygan	10	745	1.0
9 No Name	Roscommon	21	8150	7.9	6447 Sixteen, Lake	Delta	136	2713	1.0
10 Michigamme Reservoir	Iron	4867	121550	7.7	6448 Andrus Lake	Chippewa	31	1302	1.0
11 J Pool	Schoolcraft	180	23136	7.7	6449 Duck Lake	Livingston	12	815	1.0
12 Kalamazoo River	Calhoun	31	9570	7.6	6450 no name	Marquette	10	746	1.0
13 Lake James	Roscommon	191	23587	7.6	6451 Aldrich Lake	Schoolcraft	12	804	1.0
14 Wixom Lake	Gladwin	1142	57491	7.5	6452 Marsh Lake	Crawford	12	785	1.0
15 Cataract Basin	Marquette	179	22510	7.5	6453 Kitchners Lake	Menominee	11	766	1.0
16 Second Lake	Gladwin	400	31958	7.1	6454 Pretty Lake	Luce	45	1558	1.0
17 C-Two Pool	Schoolcraft	383	31212	7.1	6455 Timmerman Lake	Manistee	14	872	1.0
18 Michigamme River	Iron	72	13001	6.8	6456 Bohmier Lake	Houghton	11	772	1.0
19 Martiny Lake	Mecosta	1663	61184	6.7	6457 Glovers Lake	Manistee	25	1150	1.0
20 No Name	Marquette	13	5348	6.5	6458 Sand Lake	Mackinac	47	1579	1.0
21 First Lake	Chippewa	337	26680	6.4	6459 Mahaney Lake	Montcalm	13	821	1.0
22 Greenwood Reservoir	Marquette	1073	47464	6.4	6460 Number Eighteen, Lake	Menominee	27	1202	1.0
23 Howardsville Hydro El	St. Joseph	74	12357	6.4	6461 Mud Lake	Van Buren	30	1259	1.0
24 Flat River	Kent	93	13766	6.3	6462 Mahskeekee Lake	Delta	65	1841	1.0
25 Sunken Lake	Presque Isl	123	15617	6.3	6463 Brandts Lake	Menominee	12	797	1.0

*Lakes greater than 10 acres in area

Shoreline Development Factor

Smallwood Lake: 11.4



Lake Sixteen: 1.0



Shoreline Development Factor

Smallwood: 11.4

371 acres

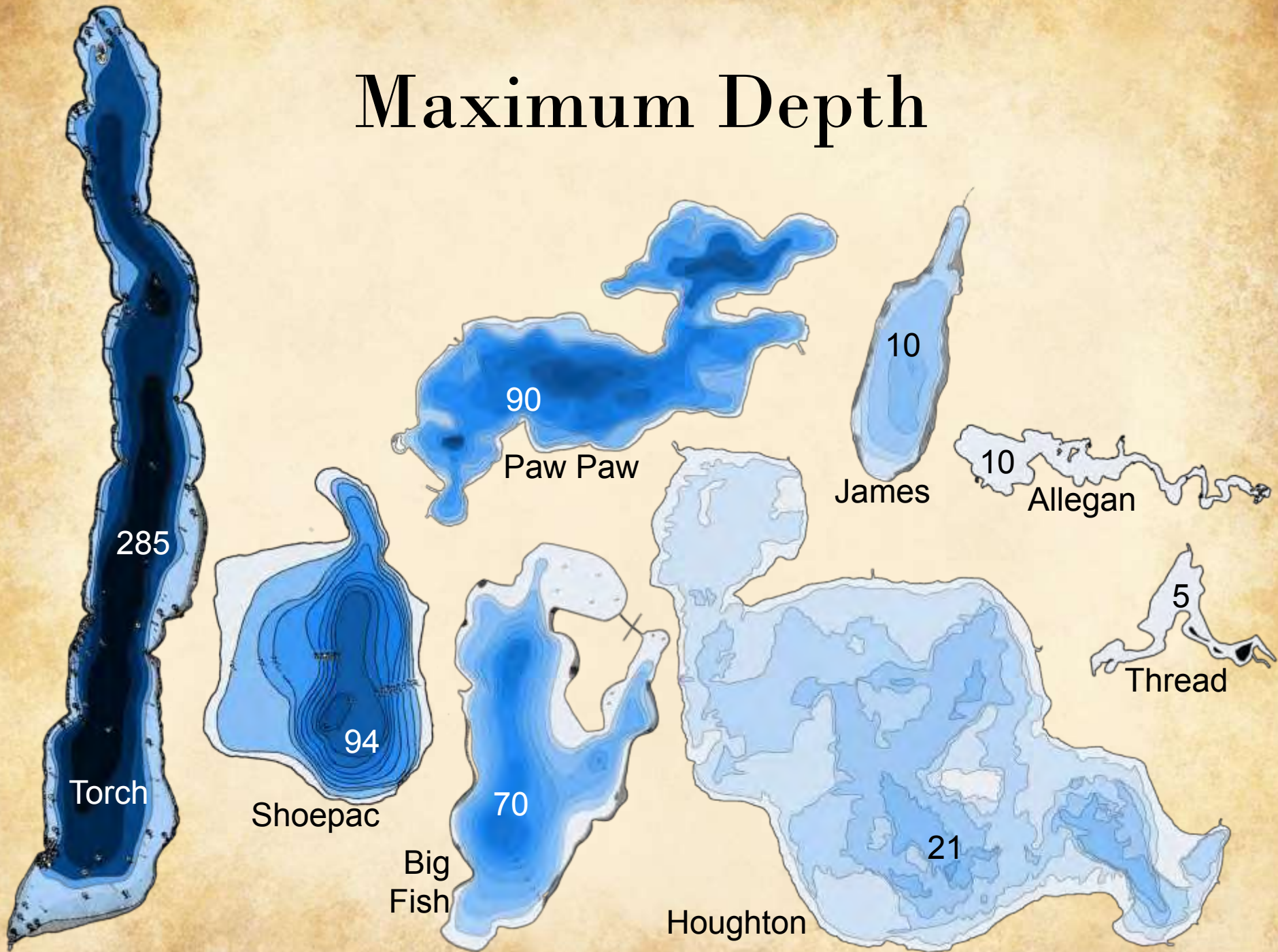


Goose Lake: 1.8

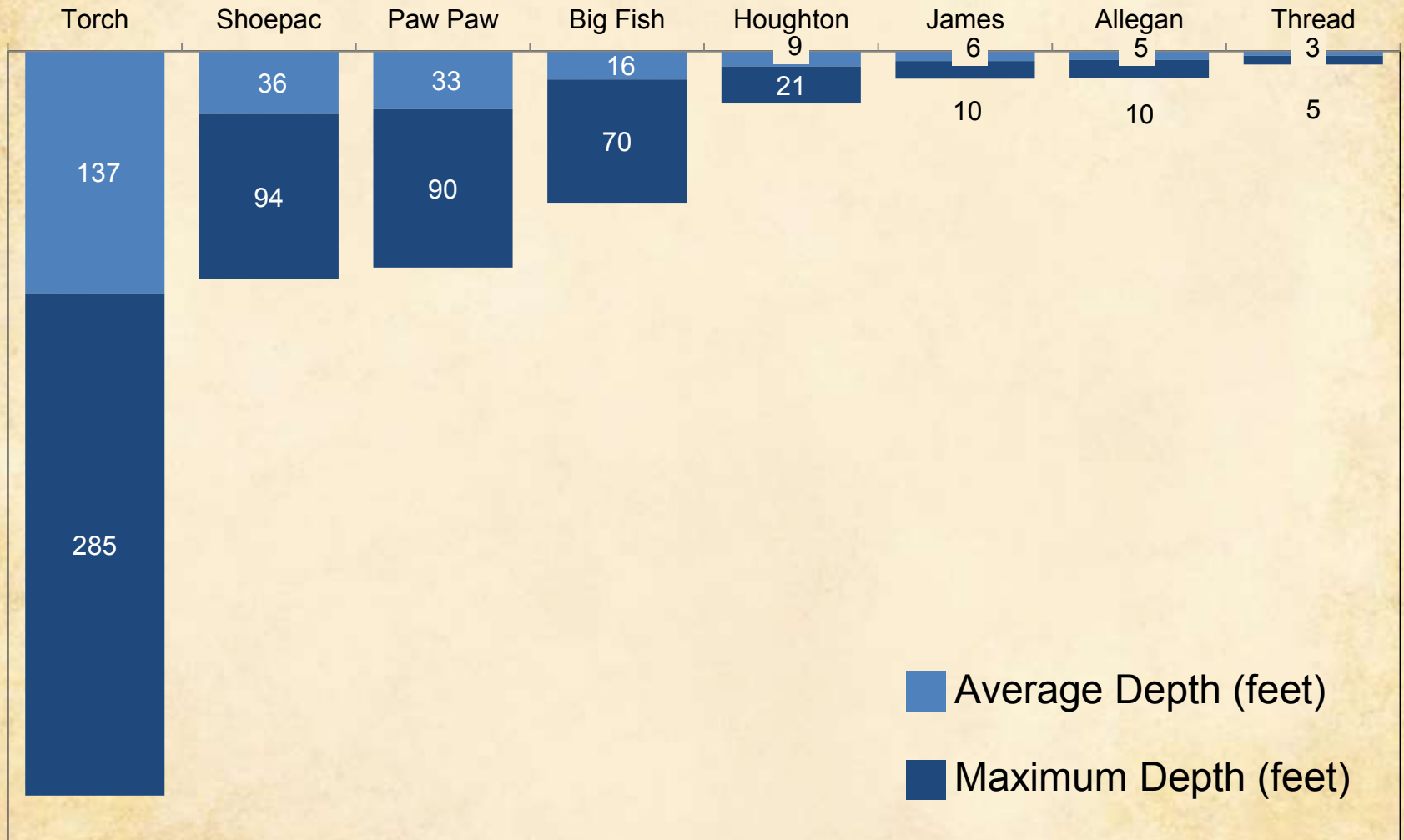
370 acres



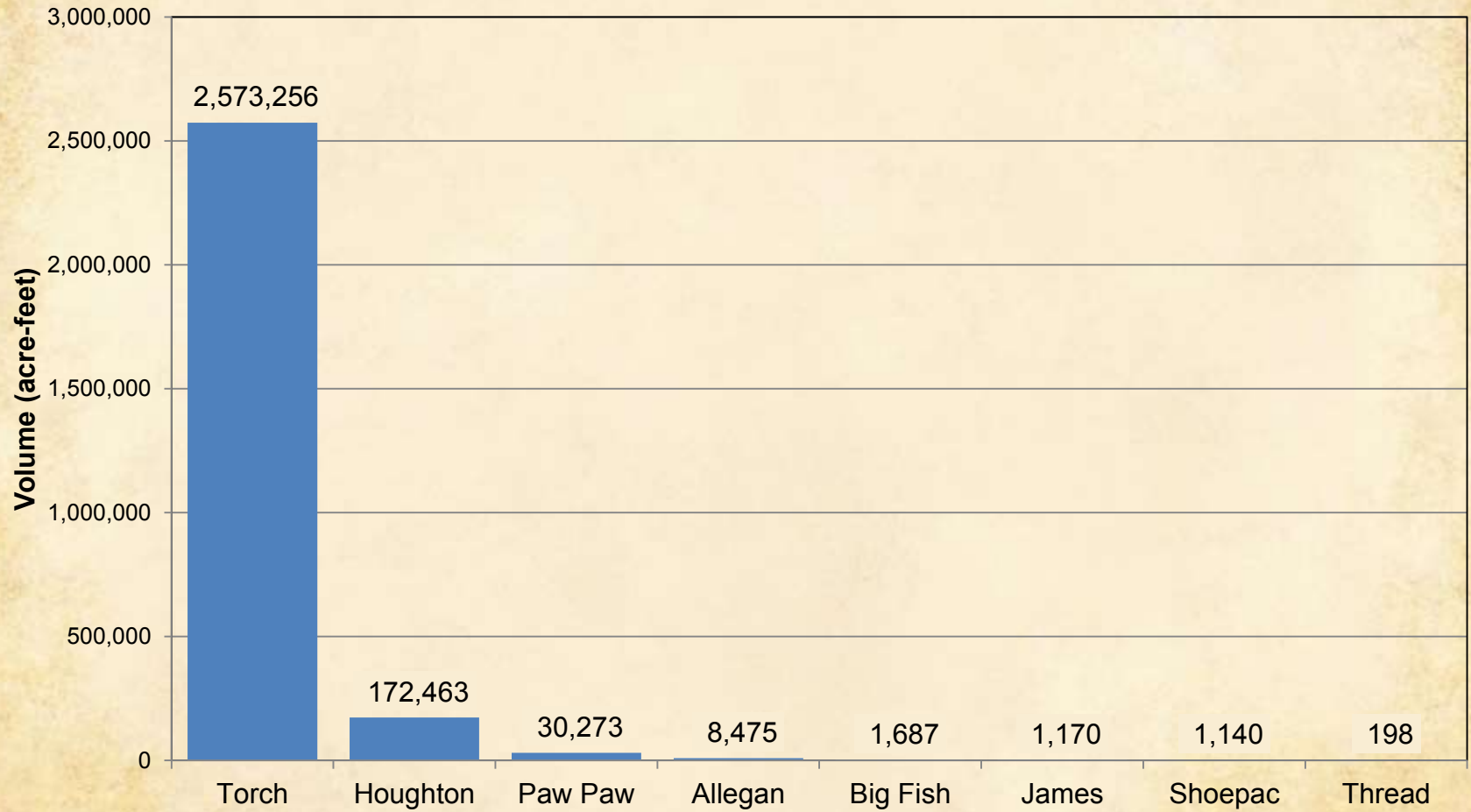
Maximum Depth



Depth



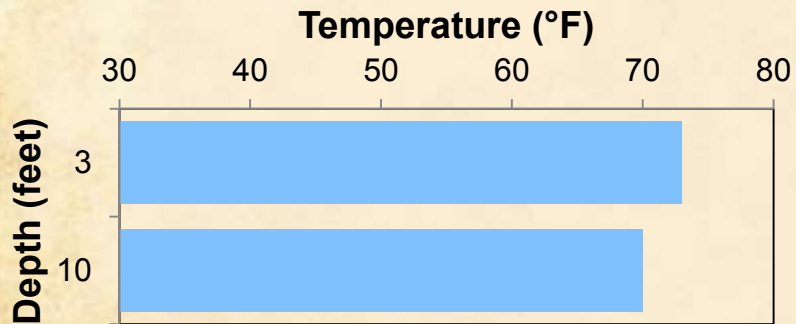
Volume



Temperature

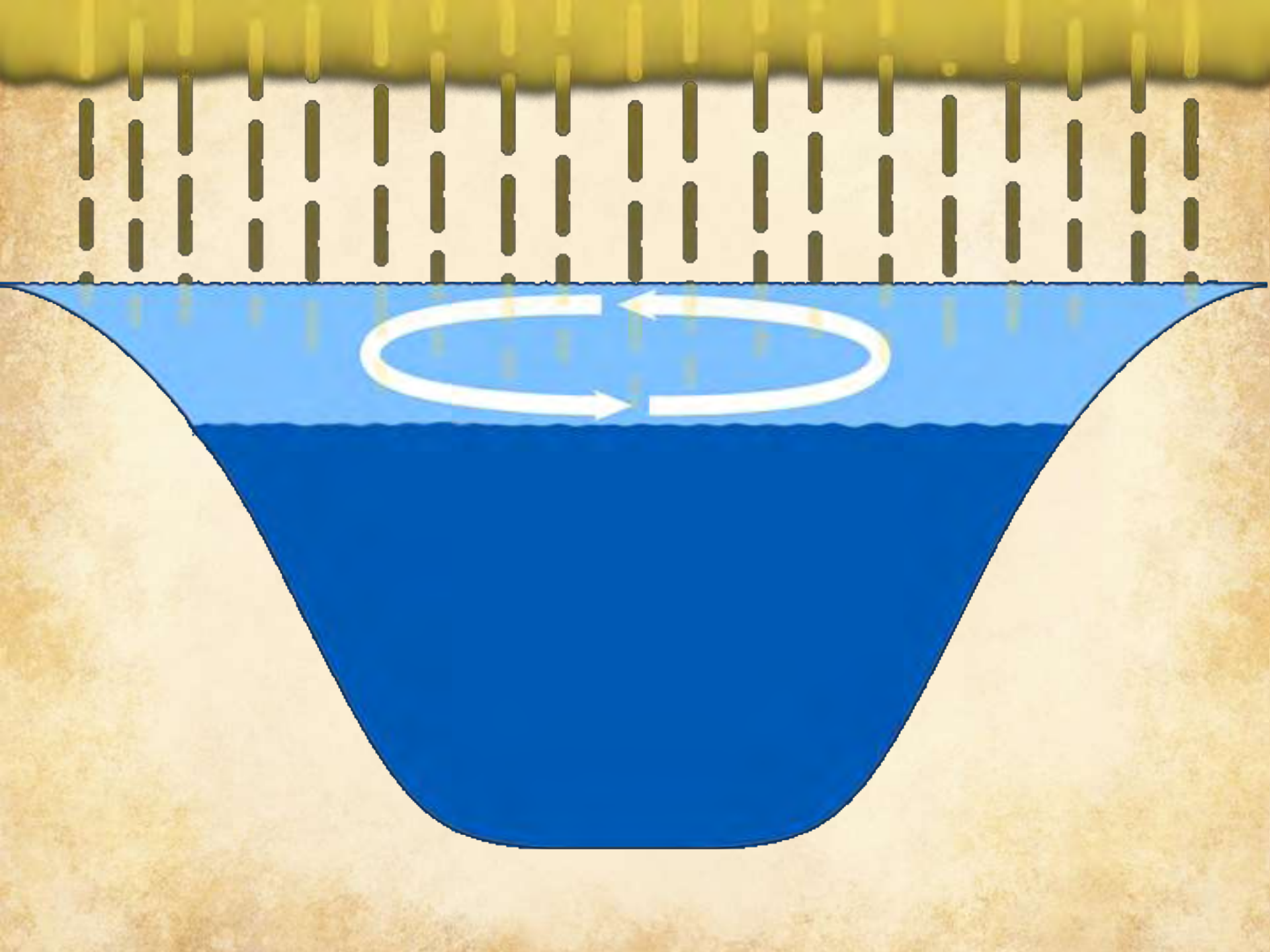


Temperature: Shallow Lake

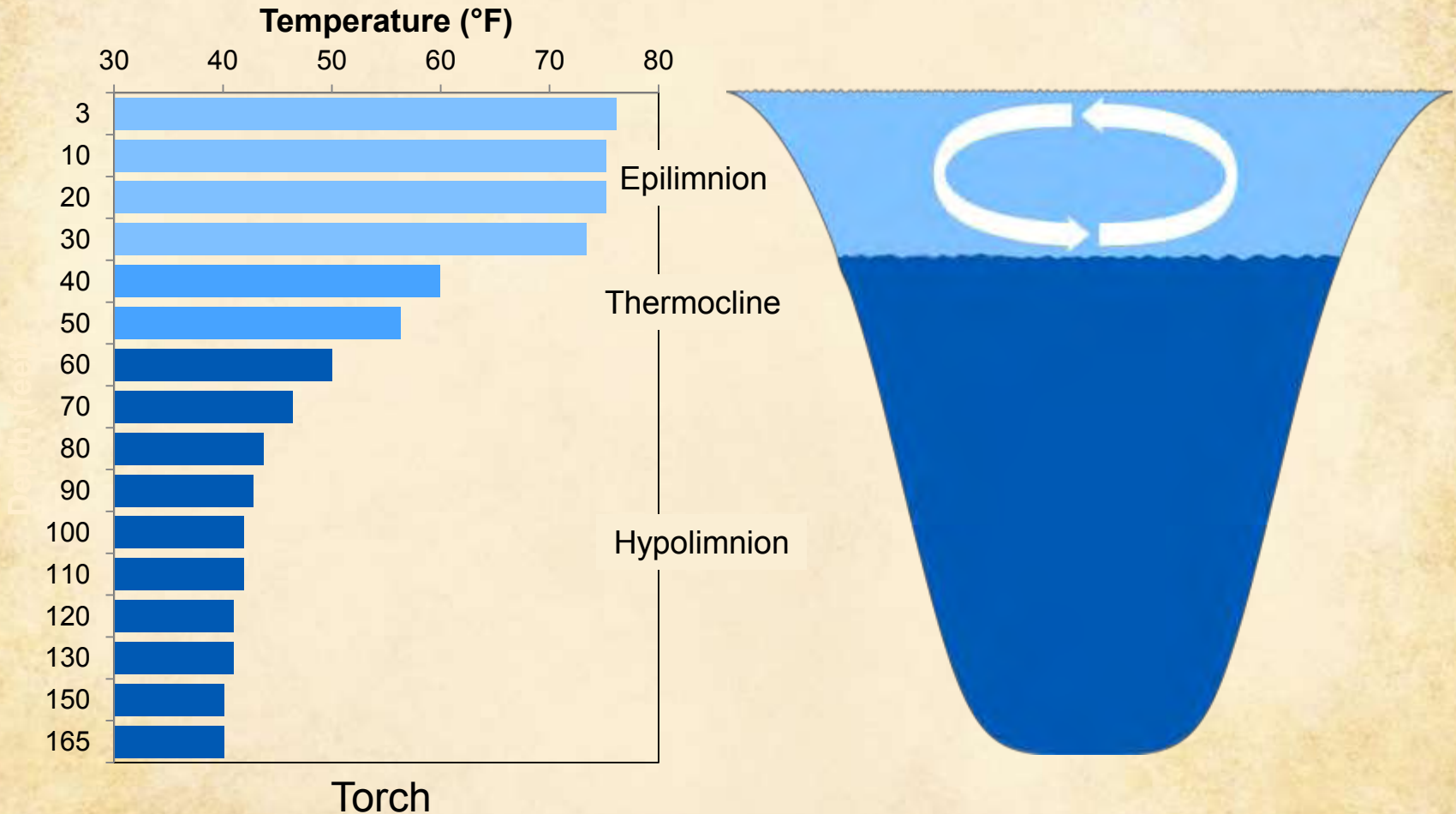


Houghton





Temperature: Deep Lake



Dissolved Oxygen

Sources



Saturation

Temperature	Dissolved Oxygen (ppm)
32	15
40	13
50	11
60	10
70	9
80	8

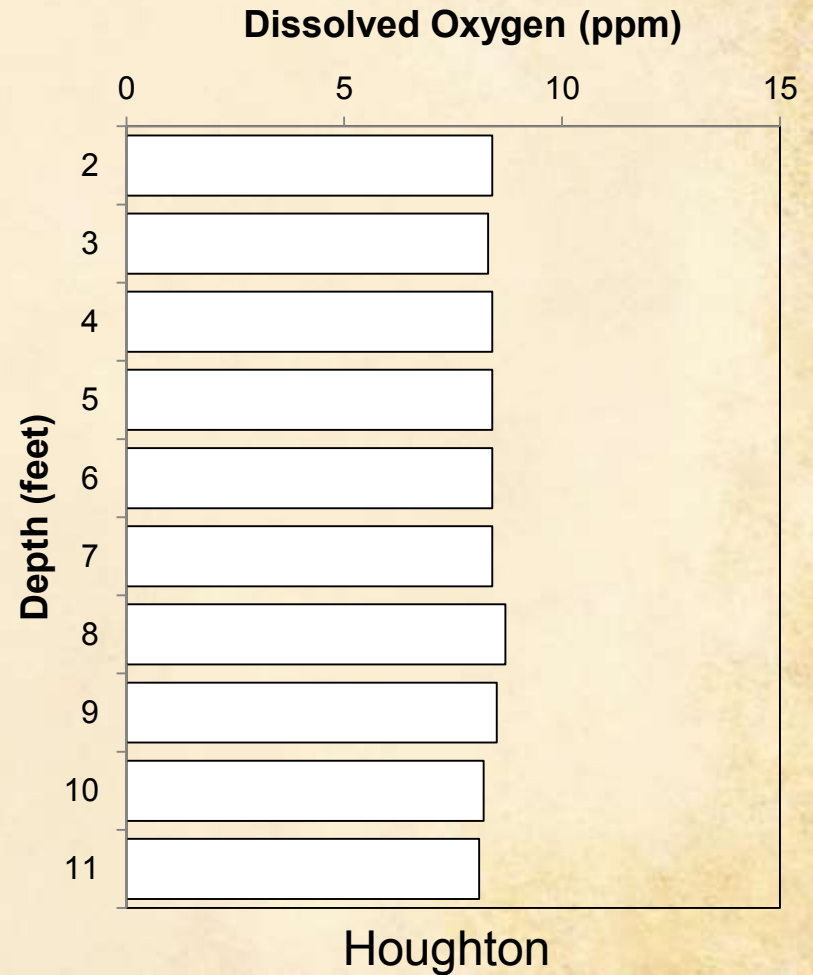
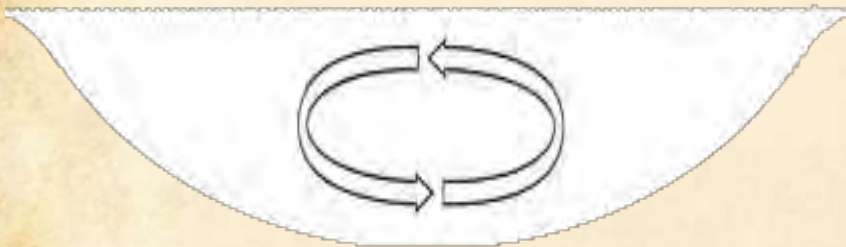
Minimum Requirements

Trout, salmon	7
Bass, pike	5
Caddisflies	4
Leeches	3
Bloodworms	2



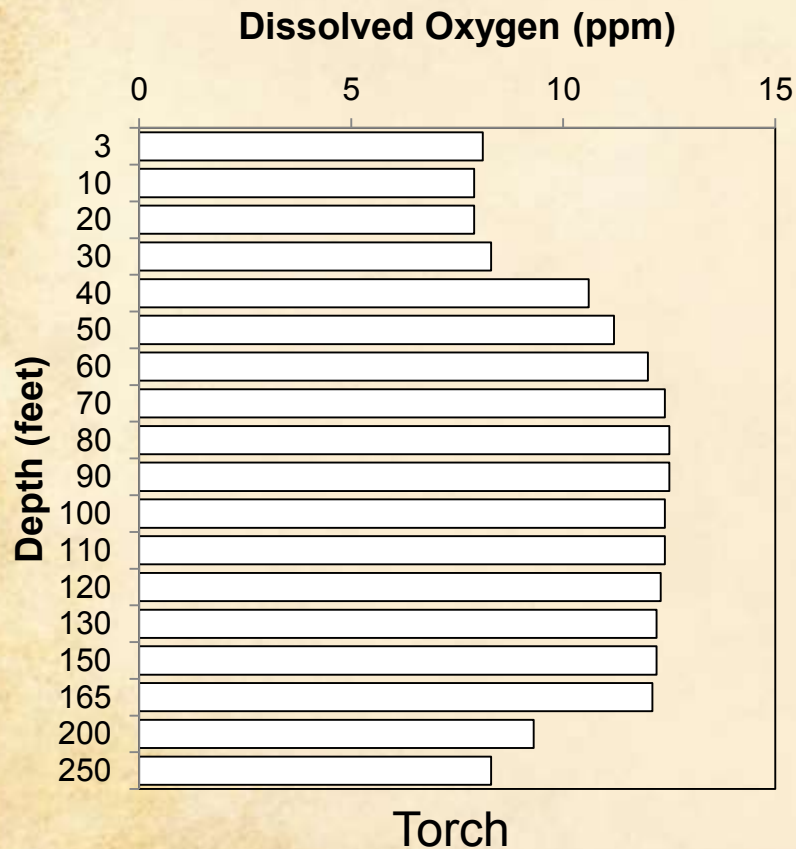
Dissolved Oxygen: Shallow Lake

- Constantly mixed
- Uniform temperature
- Well oxygenated

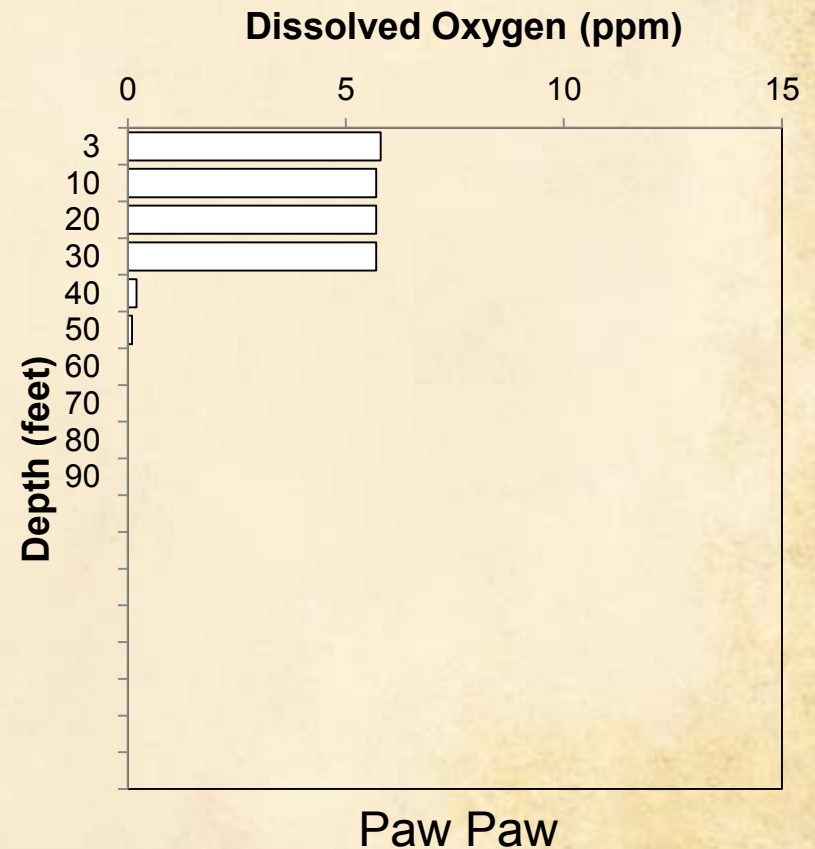


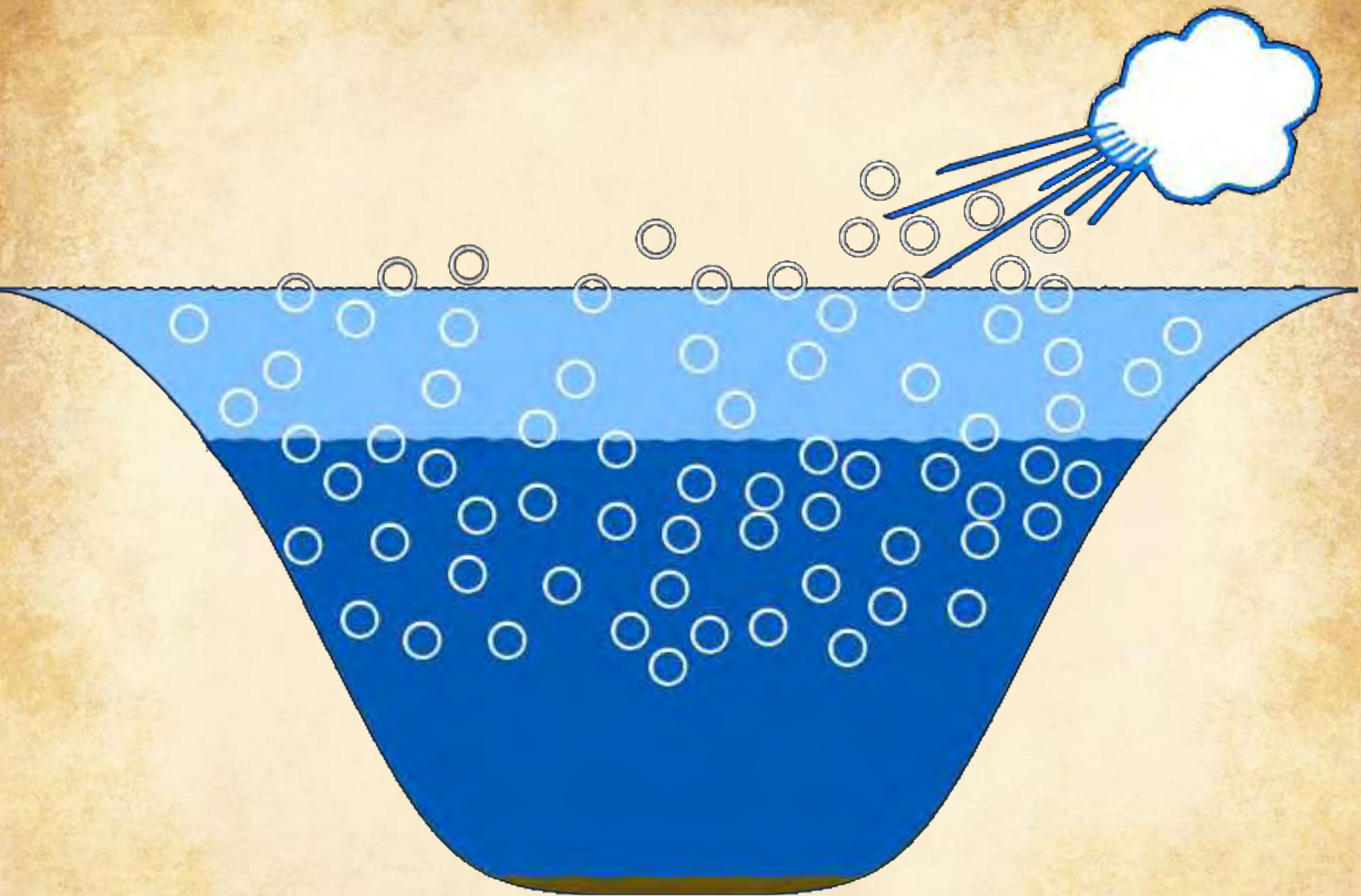
Dissolved Oxygen: Deep Lakes

Aerobic Hypolimnion



Anaerobic Hypolimnion



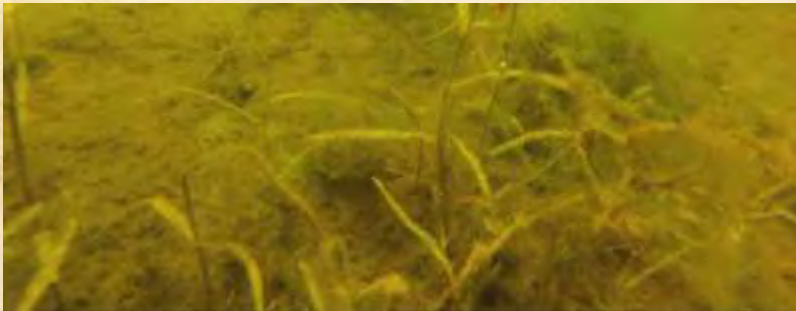


Phosphorus

External Sources (Watershed)



Internal Sources



Concentrations (ppb)

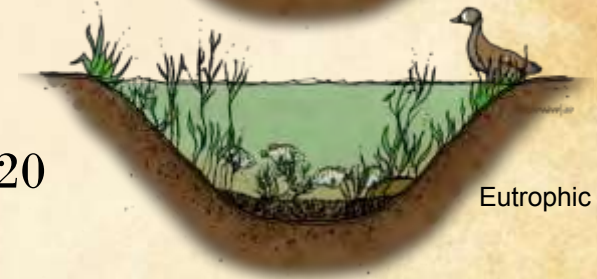
- Low
 - Less than 10



- Moderate
 - 10 to 20

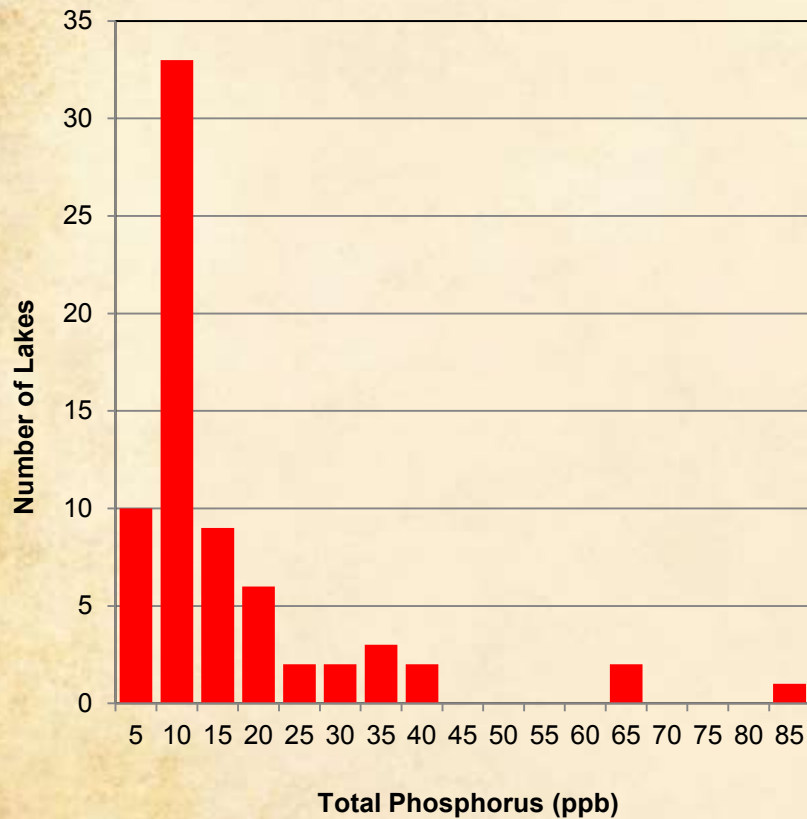


- High
 - Above 20

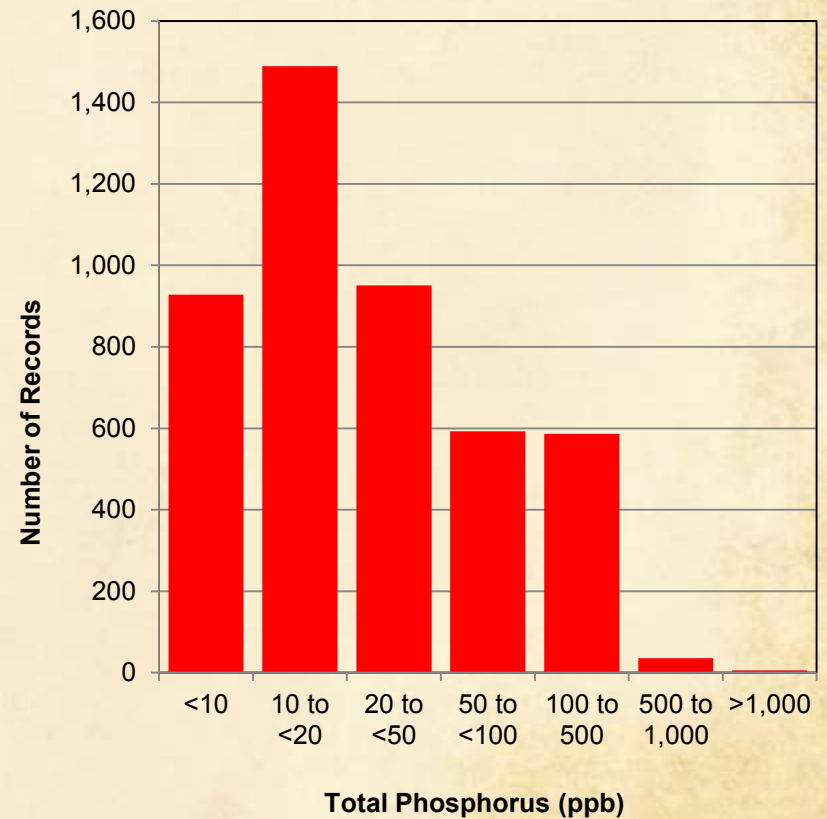


Phosphorus in Michigan

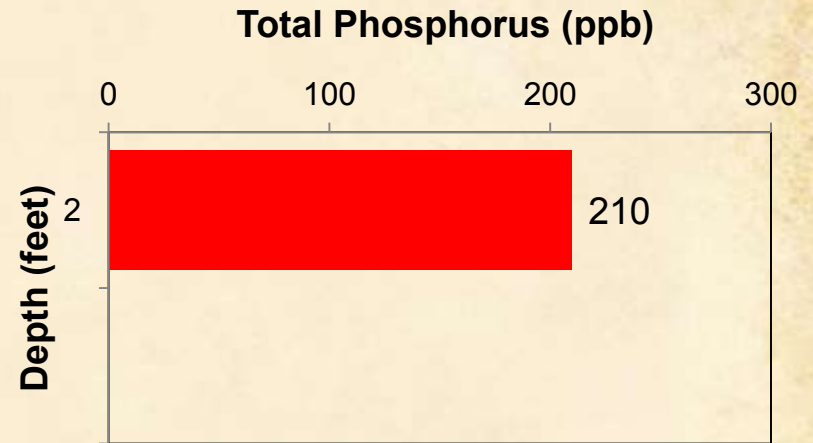
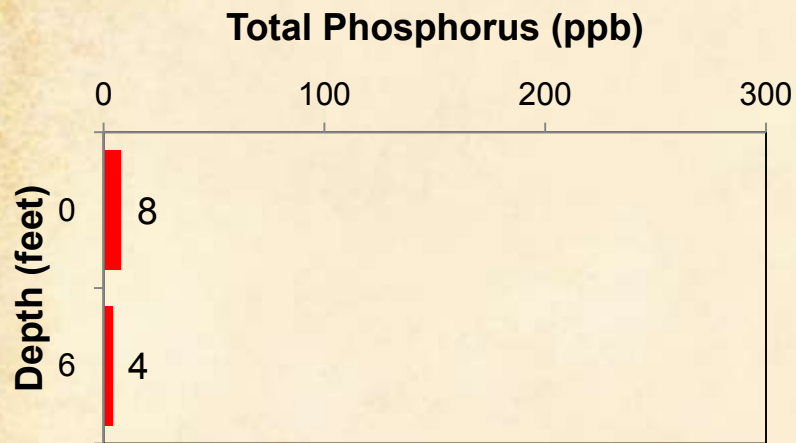
National Lakes Assessment



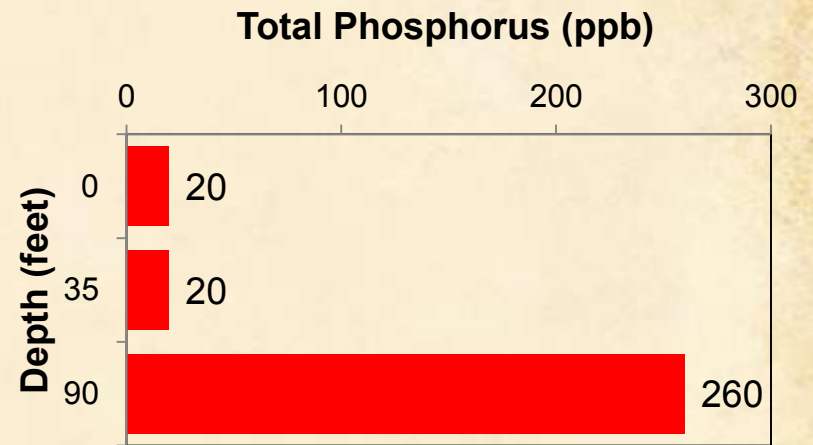
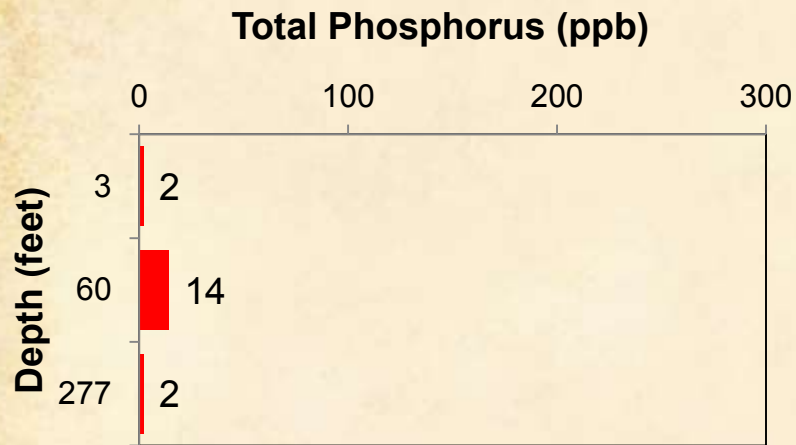
US EPA STORET

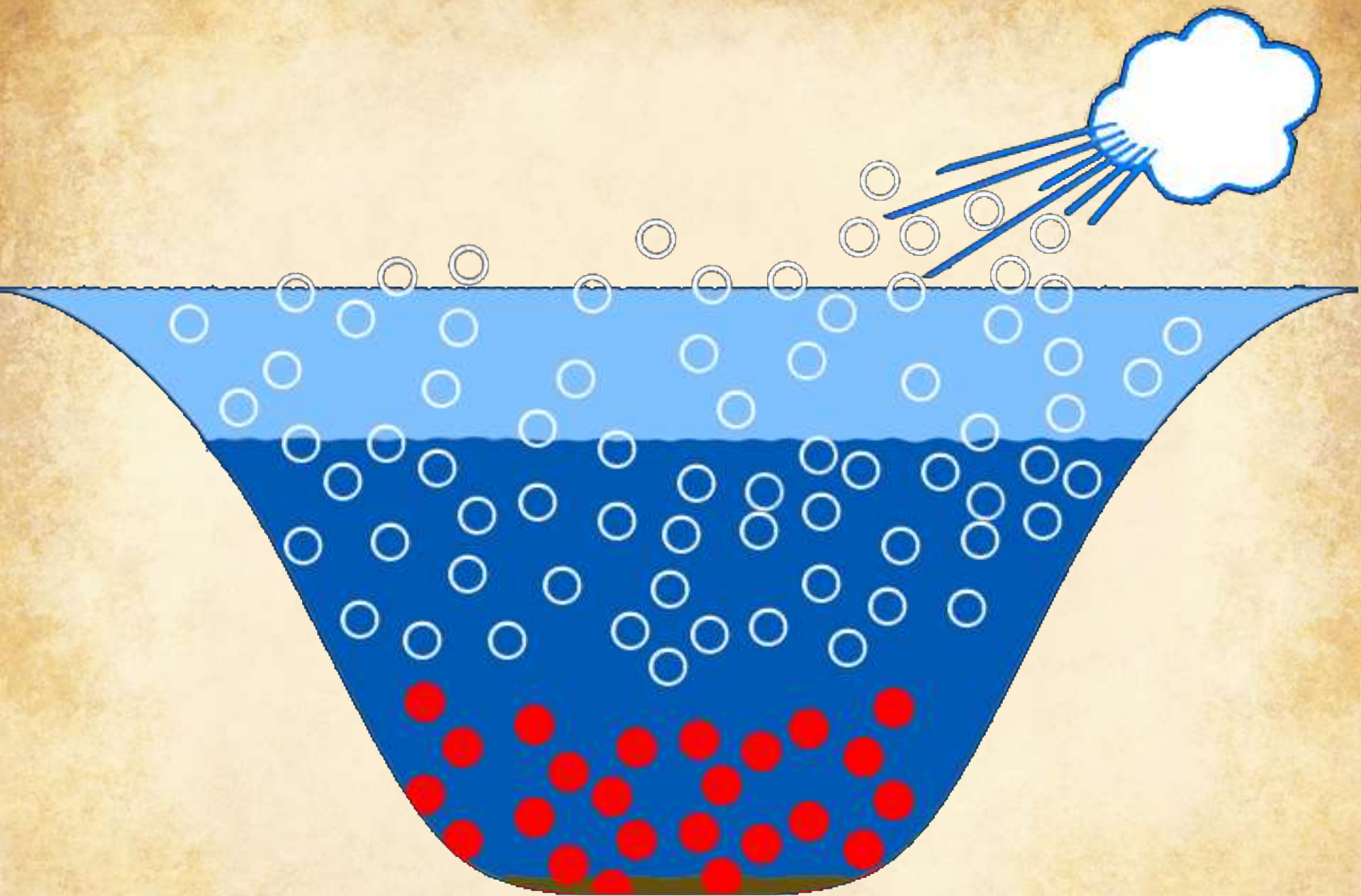


Phosphorus in Shallow Lakes



Phosphorus in Deep Lakes





Summary

- Over 10,000 lakes greater than 5 acres
- Wide variety of shapes and sizes
- Wide range in water quality
- Current quality due *in part* to morphometry
- Morphometry is difficult to alter

