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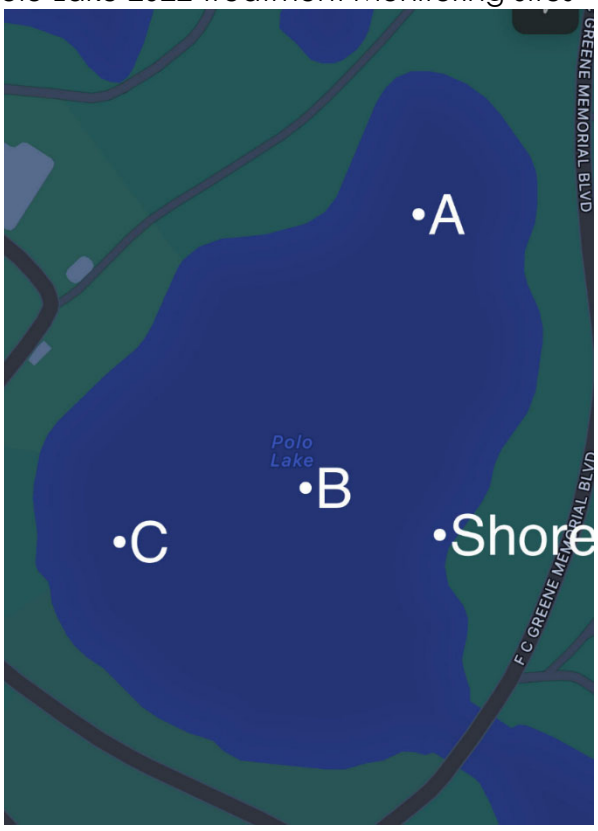
THINK BIG WE DO℠

URI Watershed Watch Program
Roger Williams Park Pond – Polo Lake Phoslock Treatment Monitoring Report
May 2023 - Elizabeth Herron and Dr Arthur Gold, URI Watershed Watch

Expanded monitoring of Polo Lake in the Roger Williams Pond was conducted in 2022 to document response to a phosphorus inactivation treatment with Phoslock. Polo Lake, like the other ponds within Roger Williams Park, is eutrophic, or nutrient enriched, and frequently experiences harmful algal blooms (HABs) as a result. Phos-Lock is a natural product designed to strip free nutrients from the water column and trap them in the bottom sediments. Reduced nutrients restrict growth of algae and plants, resulting in fewer HABs.

Figure 1: Polo Lake 2022 Treatment Monitoring Sites



To assess the impact of the Phoslock treatment four sites selected within the pond (figure 1). The Shore site has been monitored for several years and is near the outlet of the pond to the larger park ponds system. Site A is near an area which experiences overflow from the zoo pond during storm events. Site B is near the center of the pond, integrating overall pond conditions, although there is an aeration fountain located about midway between that site and the Shore site which keeps the pond water mixed. Site C is on the opposite the side, near a more vegetated shoreline, although likely receives road runoff.

Parameters monitored included the nutrients total and dissolved phosphorus (TP and DP) and nitrate+nitrite - , ammonia – and total nitrogen (NO3, NH4 and TN). Field data included water clarity, temperature, dissolved oxygen and chlorophyll, or algal productivity. Overall, treatment with Phoslock did not seem to demonstrate a notable reduction in overall nutrient levels. Continued nutrient sources may have overwhelmed benefits of phosphorus inactivation.

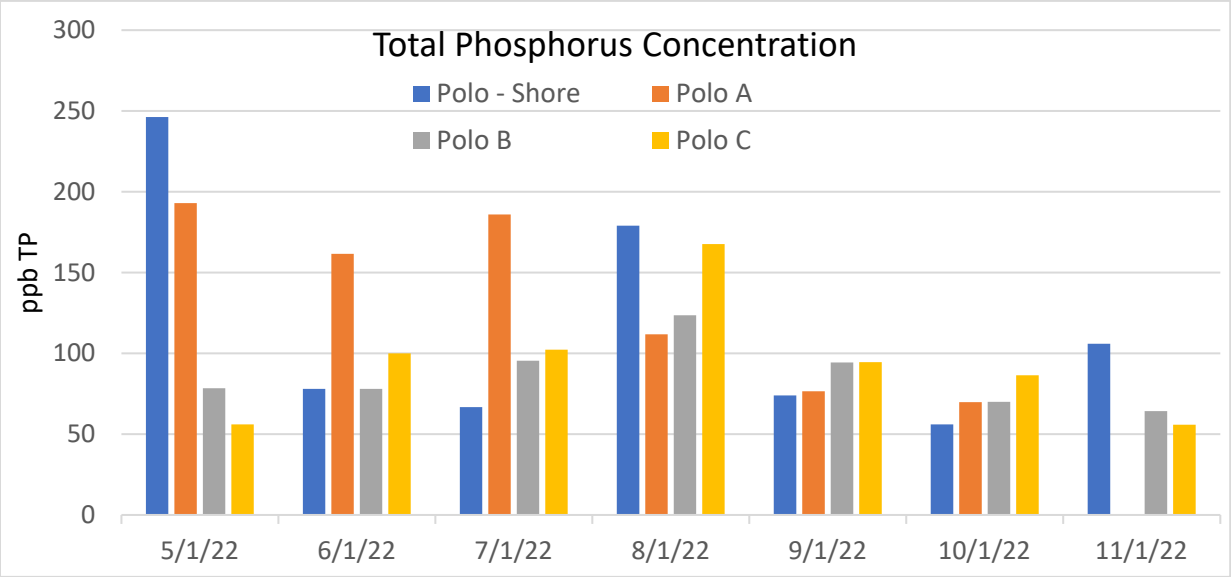
The pre-treatment nutrient data (5/6/2022) confirms that Polo Lake was eutrophic, with both TP and TN values exceeding the 25 parts per billion (ppb) TP and 750 ppb TN criteria for eutrophic ponds (table). Post-treatment values at several of the sites were lower immediately following treatment (June), but over the course of the season were not significantly reduced (table and figure 2). This may have been due to nutrient resuspension due to the aeration fountain or stormwater inflow during storm events, which the Phoslock is not designed to treat.

Table: 2022 Polo Lake 2022 Treatment Monitoring Data

Limit of detection for Nitrogen-N: 15 ppb; half of the detection limit (7.5 ppb) reported
Limit of detection for Phosphorus-P: 4 ppb; half of the detection limit (2 ppb) reported
ppb = Parts per billion

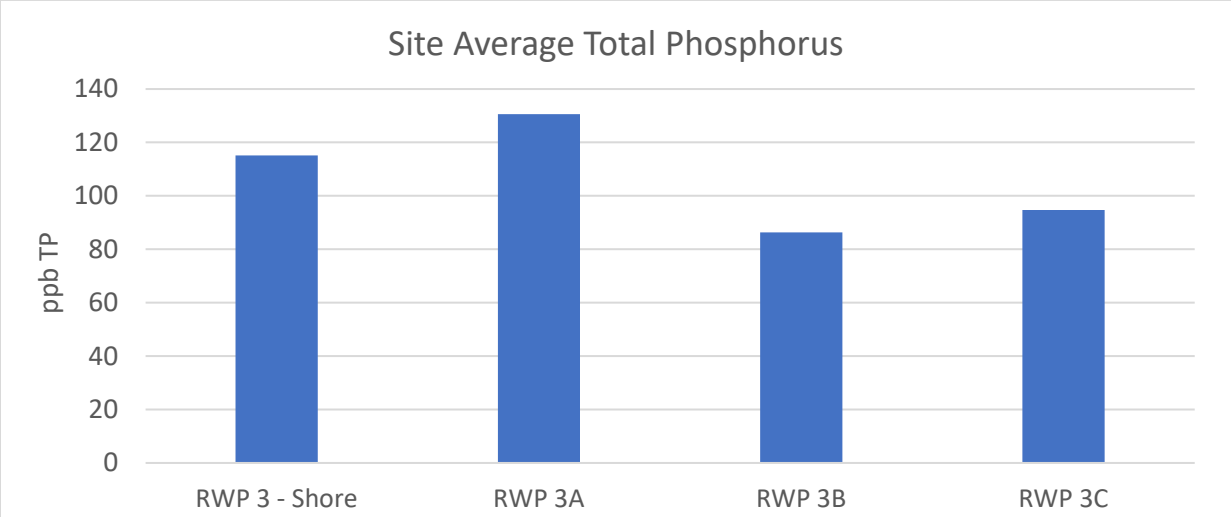
Site	Shallow Sample Depth (m)	Date of Sample	Nitrate-N (ppb)	Ammonia-N (ppb)	TN (ppb)	Diss P (ppb)	TP (ppb)
RWP 3 - Polo Lake	0.5	5/6/22	114	180	2414	7	246
RWP 3A - Polo Lake	0.7	5/6/22	102	177	1901	8	193
RWP 3B - Polo Lake	0.5	5/6/22	134	193	954	8	78
RWP 3C - Polo Lake	0.5	5/6/22	108	171	942	10	56
RWP 3 - Polo Lake	0.5	6/10/22			895		78
RWP 3B - Polo Lake	0.5	6/10/22			867		78
RWP 3C - Polo Lake	0.5	6/10/22			1201		100
RWP 3 - Polo Lake	0.5	7/15/22	15	144	1089	16	67
RWP 3A - Polo Lake	0.7	7/15/22	7.5	179	2108	2	162
RWP 3B - Polo Lake	0.5	7/15/22	7.5	161	1376	19	95
RWP 3C - Polo Lake	0.5	7/15/22	7.5	208	1478	2	102
RWP 3 - Polo Lake	0.5	8/19/22	17	279	2197	5	179
RWP 3A - Polo Lake	0.7	8/19/22	15	412	2014	5	186
RWP 3B - Polo Lake	0.5	8/19/22	16	303	1602	5	124
RWP 3C - Polo Lake	0.5	8/19/22	19	216	1991	7	168
RWP 3 - Polo Lake	0.5	9/16/22	15	48	999	5	74
RWP 3A - Polo Lake	0.7	9/16/22	15	37	1156	4	112
RWP 3B - Polo Lake	0.5	9/16/22	15	36	1097	4	94
RWP 3C - Polo Lake	0.5	9/16/22	15	32	1139	6	95
RWP 3 - Polo Lake	0.5	10/28/22	63	42	1007	5	56
RWP 3A - Polo Lake	0.7	10/28/22	67	29	1191	7	77
RWP 3B - Polo Lake	0.5	10/28/22	62	36	1247	5	70
RWP 3C - Polo Lake	0.5	10/28/22	63	43	1355	6	86
RWP 3 - Polo Lake	0.5	11/27/22	146		1184	7	106
RWP 3A - Polo Lake	0.7	11/27/22	113		1258	9	70
RWP 3B - Polo Lake	0.5	11/27/22	141		1155	7	64
RWP 3C - Polo Lake	0.5	11/27/22	126		1175	9	56

Figure 2: 2022 Polo Lake Total Phosphorus Concentrations



Total phosphorus concentrations were highly elevated – well above the thresholds for a eutrophic water body and in the range (> 50) associated with blue-algae (cyanobacteria) blooms (figure 7). The concentrations varied throughout the lake and the season. Values were well within the eutrophic range all season, with site A and the Shore site recording the highest TP concentrations (figure 3).

Figure 3: 2022 Polo Lake Average Total Phosphorus Concentration



A similar pattern was noted for TN, with the Shore site and site A typically having higher TN concentrations than the other sites (figure 4). Interesting, site C recorded higher nutrient values than site A in the August sample, collected during a very warm and dry period (figure 5), which eliminated overflow from the zoo pond, and likely other stormwater sources. Weather has a significant impact on water quality and needs to be considered when assessing the response to treatment. The TN:TP molar ratios indicate

are well above 16:1, in line with expectations that phosphorus is driving algal productivity and lowering phosphorus is the appropriate management strategy.

Figure 4: 2022 Polo Lake Total Nitrogen Concentration

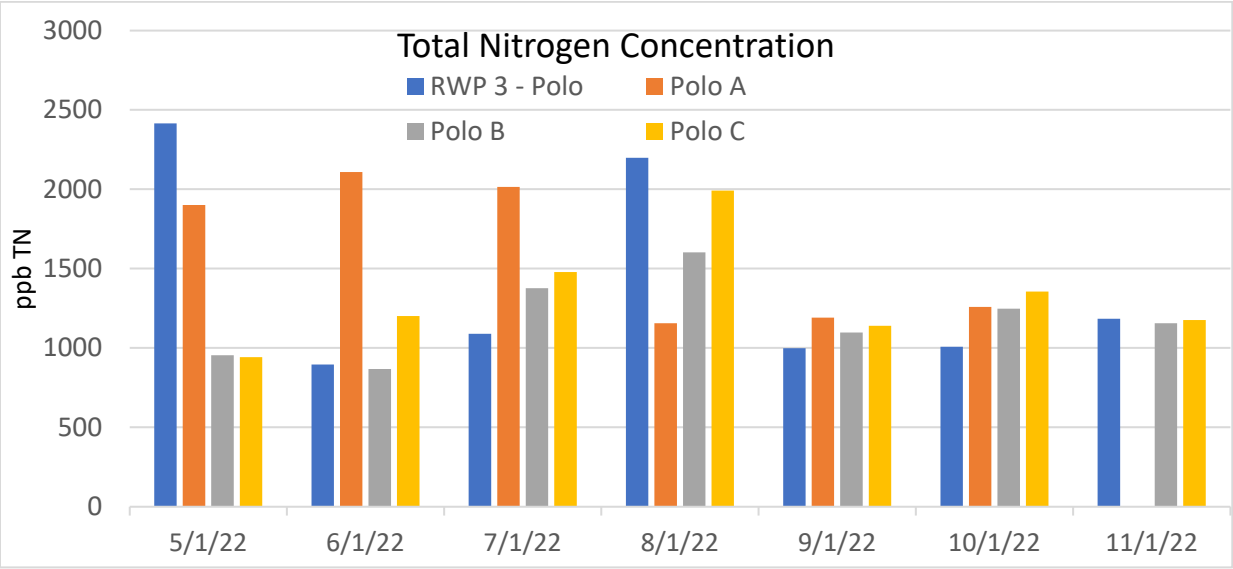
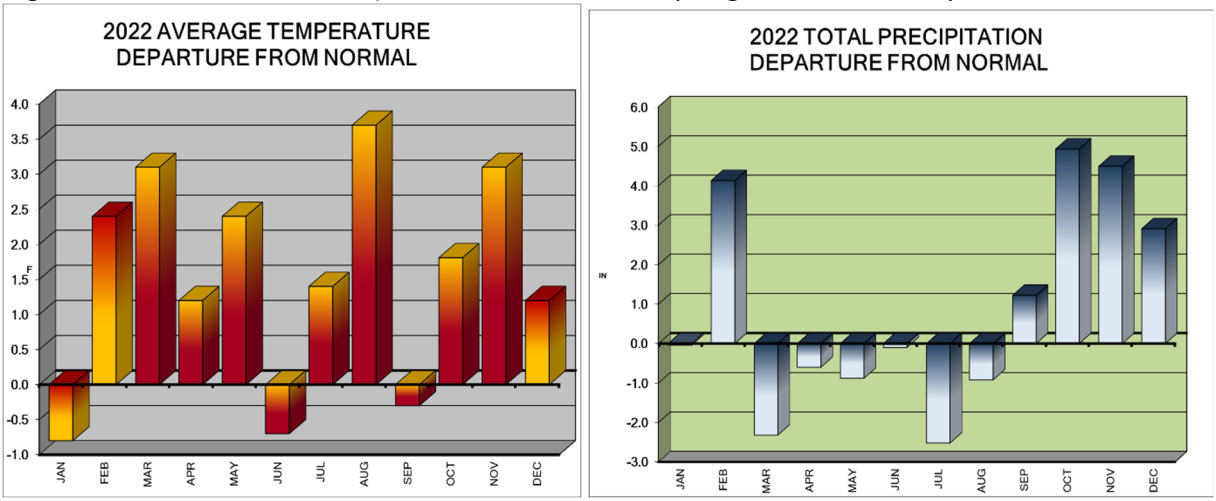


Figure 5: 2022 Weather Departure from Normal (Kingston, RI Station)



Of course, the impetus for treatment was the recurring harmful algal blooms. Chlorophyll, the photosynthetic pigment in algae is often used as an indicator of algal blooms and is regularly monitored at URI Watershed Watch sites. Chlorophyll concentrations of greater than 7.2 ppb are considered eutrophic, and greater than 35 ppb considered hypereutrophic, or extremely elevated. Carlson's trophic Index, an index (figure 7) suggests blue-green algae blooms begin to occur at chlorophyll levels > 20 ppb (ug/L). Chlorophyll levels at all four sites were well within the eutrophic and hypereutrophic range throughout the 2022 monitoring season (figure6). As is common, mid-summer, concentrations were generally higher, with a smaller peak visible in October, a particularly rainy period. But there did not seem to be any response to the treatment.

Figure 6: 2022 Polo Lake Chlorophyll Concentrations

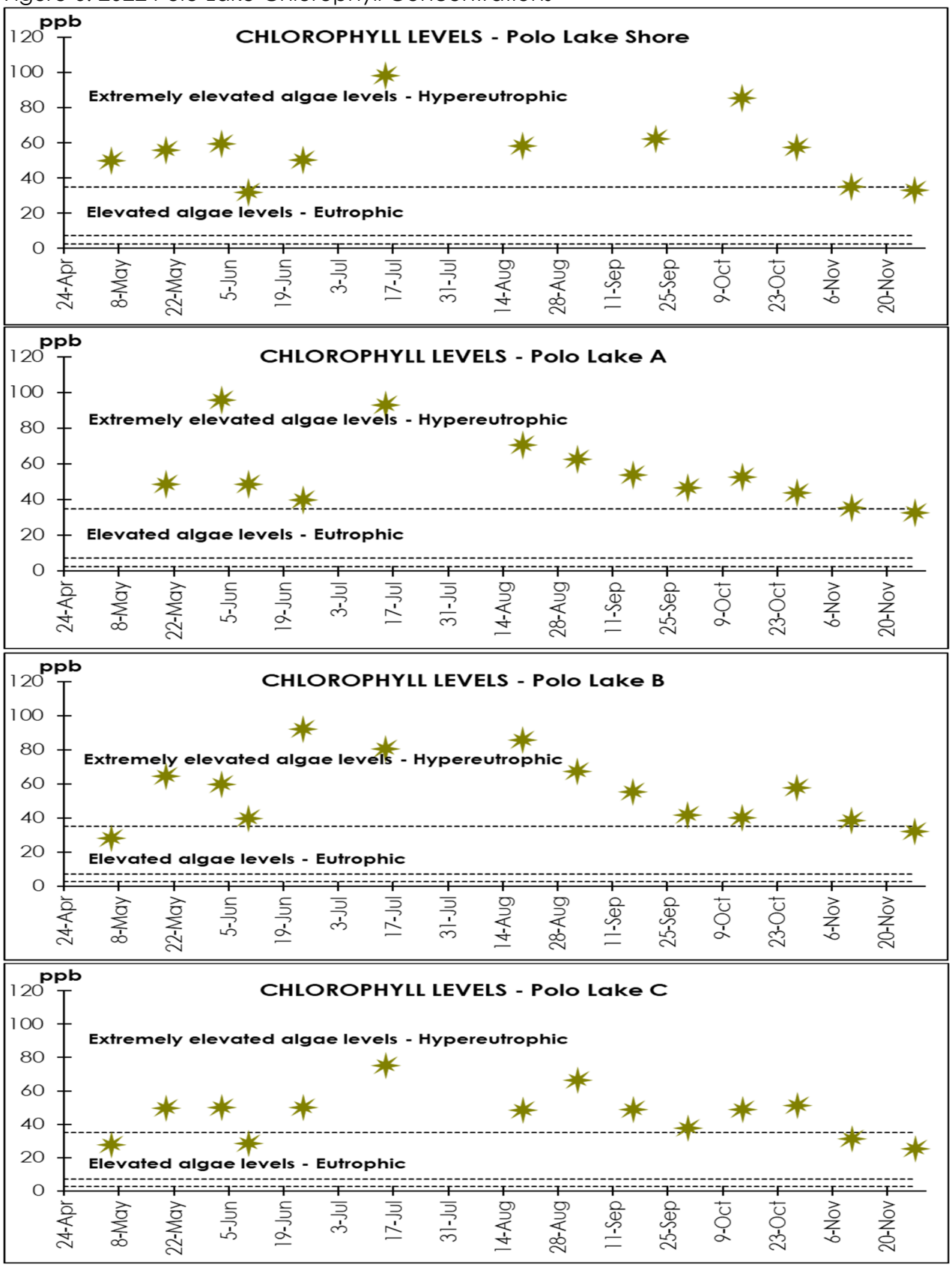


Figure 7. Carlson's Trophic Index. (Note that ppb is the same as µg/L)

A list of possible changes that might be expected in a north temperate lake as the amount of algae changes along the trophic state gradient.

TSI	Chl(µg/L)	SD(m)	TP (µg/L)	Attributes	Water Supply	Fisheries & Recreation
< 30	< 0.95	> 8	< 6	**Oligotrophy:** Clear water, oxygen throughout the year in the hypolimnion.	Water may be suitable for an unfiltered water supply.	Salmonid fisheries dominate.
30 – 40	0.95 – 2.6	8 – 4	6 – 12	Hypolimnia of shallower lakes may become anoxic.		Salmonid fisheries in deep lakes only.
40 – 50	2.6 – 7.3	4 – 2	12 – 24	**Mesotrophy:** Water moderately clear; increasing probability of hypolimnetic anoxia during summer.	Iron, manganese, taste, and odor problems worsen. Raw water turbidity requires filtration.	Hypolimnetic anoxia results in loss of salmonids. Walleye may predominate.
50 – 60	7.3 – 20	2 – 1	24 – 48	**Eutrophy:** Anoxic hypolimnia, macrophyte problems possible.		Warm-water fisheries only. Bass may dominate.
60 – 70	20 – 56	0.5 – 1	48 – 96	Blue-green algae dominate, algal scums and macrophyte problems.	Episodes of severe taste and odor possible.	Nuisance macrophytes, algal scums, and low transparency may discourage swimming and boating.
70 – 80	56 – 155	0.25 – 0.5	96 – 192	**Hypereutrophy:** (light limited productivity). Dense algae and macrophytes.		
> 80	> 155	< 0.25	192 – 384	Algal scums, few macrophytes		Rough fish dominate; summer fish kills possible.