Kentuck Lake 2024 Cycle Assessment (WBIC 716800)

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Date: January 2024

Waterbody	**Water Type**: Lake	**Natural Community**: Deep Drainage
	Size: 1001.15 acres	**AL Designation**: Default FAL
	Assessment Unit ID: 128505	**PHW Designation**: Non-Drinking Water
	EPA ATTAINS ID: WI10007625	**REC Designation**: Full Body Contact

2022 Assessment (Prior)	**Category**: 5A	**Pollutants:** *Total Phosphorus, Mercury*
	Methodology: 2022 WisCALM	**Observed Effects:** *Organic Enrichment, Eutrophication, Excess Algal Growth, Mercury Contaminated Fish Tissue*
	Data Used: 2011 - 2020	**List:** Impaired Waters

2024 Assessment (Proposed)	**Category**: 2A	**Pollutants:** *None*
	Methodology: 2024 WisCALM	**Observed Effects:** *None*
	Data Used: 2017 - 2022	**List:** Waters Attaining Standards

Decision Summary	Remove all of the listings: phosphorus, eutrophication, excess algal growth, organic enrichments, mercury, and mercury in fish tissue. Change overall category to 2A.

Background

Kentuck Lake, in the Brule River Watershed, is a 1,001-acre lake that falls in Forest and Vilas Counties. Volunteers have been collecting annual water quality data since 1986 and WDNR's long term trend monitoring has been collecting data since 1988. This lake is typically classified as dimictic (only mixed in spring and fall) and eutrophic (high primary productivity). The Kentuck Lake Protection & Rehabilitation District, with a WDNR grant and a consultant group, created the Kentuck Lake Comprehensive Management Plan in 2015. The goal

http://www.kentucklakedistrict.org/index.php/photos/

of the lake management group and the plan was to consider the resource as a whole ecosystem, rather than solely a recreation resource.

Kentuck Lake was originally placed on the state's Impaired Waters List in 1998 due to mercury concentrations in fish tissue. Phosphorus and excess algal growth listings were added in 2014. The lake had elevated phosphorus every two-year assessment cycle from 2014 to 2022 stemming from poor water quality in 2011, 2013, 2015 and 2016.

The lake has been in a clear water state and meeting phosphorus and chlorophyll water quality standards for aquatic life (AL) use since 2017. This clearing of the lake is in part due to the presence of more large Daphnia zooplankton in the lake which graze on algae. The increase in large Daphnia coincides with an increase in walleye in the lake. Walleye eat the small fish that eat the Daphnia. The lake is being managed for a strong walleye population under a joint DNR-Tribal management plan. The aquatic plant community meets standards for general aquatic plant health (Mac-gen) in all four years assessed, but appears to not meet for aquatic plant phosphorus sensitivity (Mac-P) in 2019-2021. The aquatic plant community has expanded incredibly as the phosphorus and chlorophyll have declined since 2017. Aquatic plant species that are not phosphorus (P) sensitive have grown into large portions of the deeper water where no plants existed while the lake water quality was poor. This has caused the number of vegetated points in the aquatic plant surveys to increase and therefore the % of vegetated points with P sensitive plant species declined. At least in 2021 the coverage area of P sensitive species appears to be higher than ever and it is possible that the deeper expansion of other aquatic plant species is masking the coverage of P sensitive species and leading to an impairment listing. We need to determine if P sensitive species are actually indicating a non-attainment or if this is caused by the method of calculating the coverage of these species. The lake is clearly meeting phosphorus criteria and this continues into 2023. Chlorophyll has responded to lower phosphorus levels and is meeting AL criteria and with 2023 data included would meet recreational criteria. The aquatic plant community appears healthy and the distribution of P sensitive species needs more investigation before considering this a biotic impairment.

Total Phosphorus & Chlorophyll-a (Aquatic Life and Recreation Uses)

The 2024 assessment of phosphorus indicates levels are below the listing threshold (Table 1). Because statistical methods have been refined over time, for purposes of comparing current and past concentrations, the 2024 statistical methods were applied to the data from each prior cycle. The phosphorus mean and confidence interval calculated for the 2024 cycle are similar to those calculated for biennial cycles 2004 to 2012, indicating the lake may be returning to a stable state (Figure 1). This and the confidence values below the listing criterion support delisting phosphorus this cycle.

Long term data indicate the summer algal densities are phosphorus dependent (Onterra 2015). Comparing long-term data to the current thresholds shows chlorophyll-a concentrations mirroring changes in phosphorus concentrations (Figures 1 and 2). Comparison of chlorophyll-a levels to the Aquatic Life threshold for the 2024 cycle show levels clearly below the listing threshold (Table 1). For Aquatic Life (AL) use the chlorophyll-a concentrations have been below listing thresholds for three cycles; the 'eutrophication' listing can be removed as a result (Figure 2).

Recreation use chlorophyll-a comparisons using the long-term record indicate the listing threshold may not be appropriate for Kentuck Lake (Figure 3). Even when phosphorus levels are clearly below the listing threshold the chlorophyll-a concentration's upper confidence limits do not stay at or below 20 ug/L for 95% of days in the growing season. Though the chlorophyll-a levels do not meet traditional delisting requirements, based on best professional judgment and the lower phosphorus concentrations, the 'excess algal growth' listing is proposed for removal.

Table 1. 2024 cycle phosphorus and chlorophyll-a calculations, threshold, and comparison to Recreation (REC) and Aquatic Life (AL) use thresholds. Header colors correspond to Figures 1 and 2.

Phosphorus

Uses	Station ID	Earliest Date	Latest Date	Grand Mean (ug/L)	LCL (ug/L)	UCL (ug/L)	TP Threshold (ug/L)	Relation to Threshold
REC & AL	643451	JUN 2018	SEP 2022	24	22	26	30	Clearly Meets

Chlorophyll-*a*

Use	Station ID	Earliest Date	Latest Date	Grand Mean	LCL	UCL	Chl-*a* Threshold	Relation to Threshold
REC	643451	JUL 2017	SEP 2022	13 %	4 %	30 %	5 %	May Exceed
AL				10 ug/L	8 ug/L	12 ug/L	27 ug/L	Clearly Meets

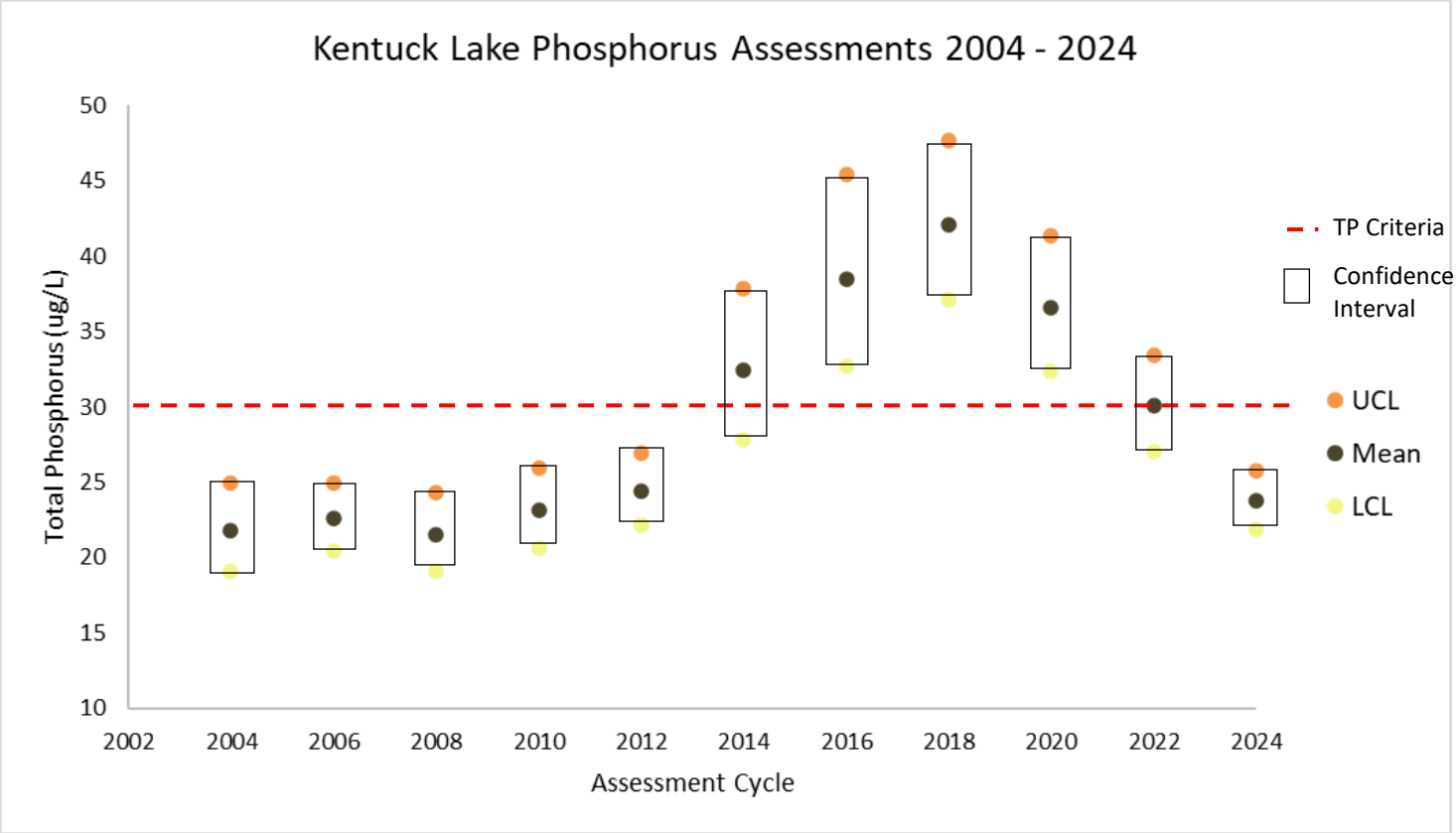

Figure 1. Total phosphorus assessments across eleven cycles with the criterion of 30 ug/L. Upper and lower confidence limits, mean, and interval are shown. Because statistical methods have been refined over time, for purposes of comparing current and past concentrations in this figure, the 2024 statistical methods were applied to the data from each prior cycle.

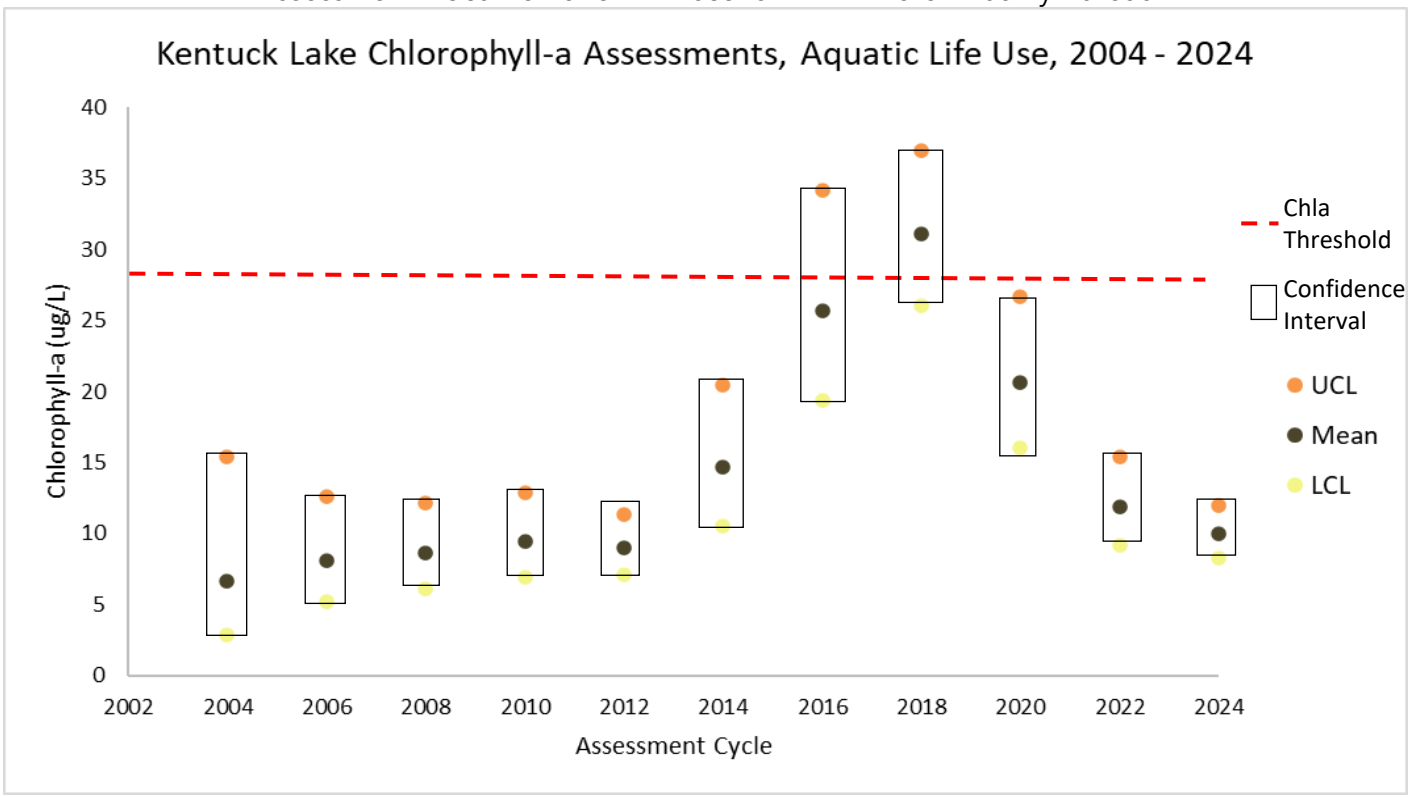

Figure 2. Chlorophyll-a (AL) assessments across eleven cycles with a Chl-a threshold of 27 ug/L. Upper and lower confidence limits, mean, and interval are shown. Because statistical methods have been refined over time, for purposes of comparing current and past concentrations in this figure, the 2024 statistical methods were applied to the data from each prior cycle.

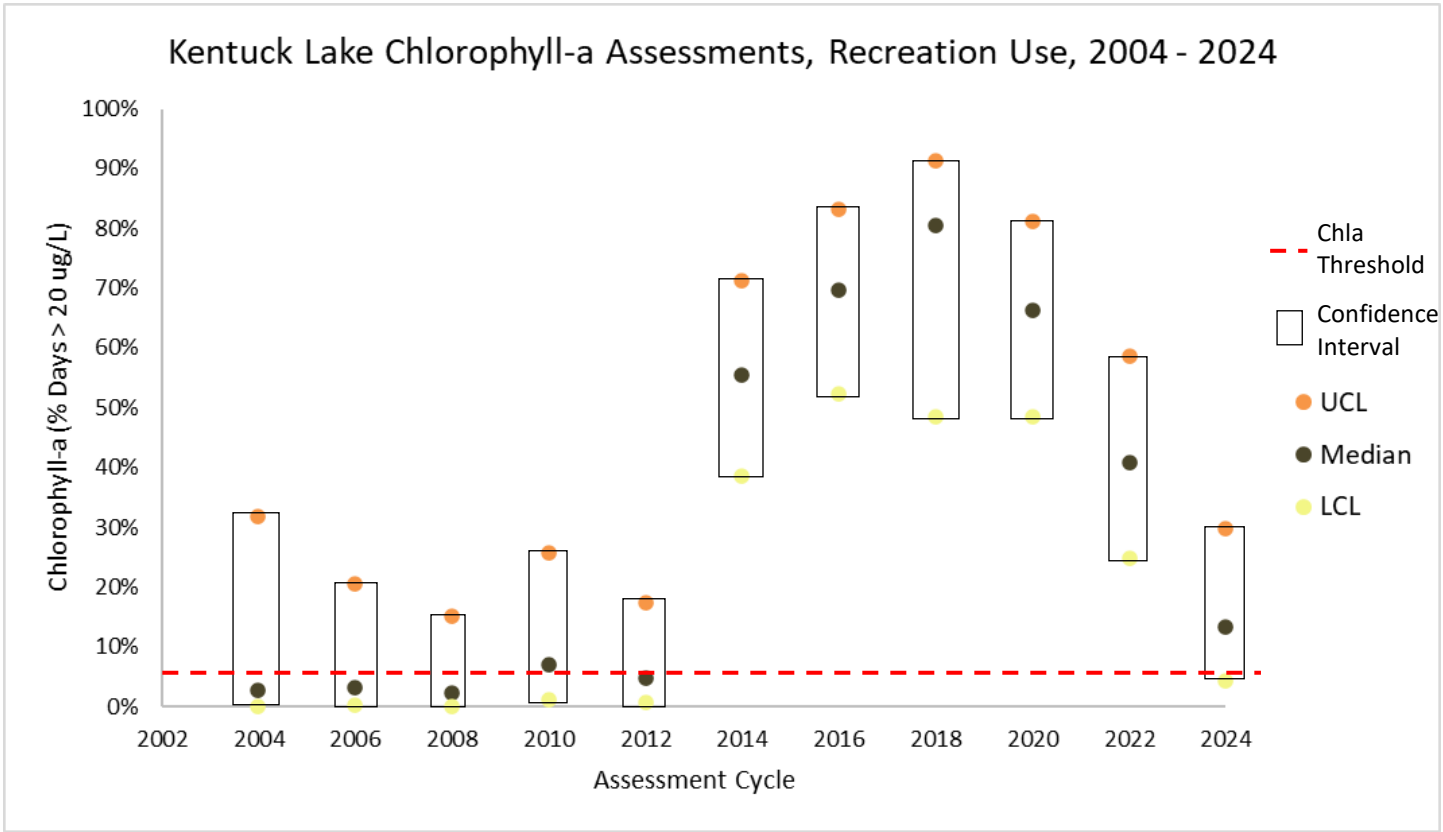

Figure 3. Chlorophyll-a (REC) assessments across eleven cycles with a threshold of no more than 5% of days at or above 20 ug/L chlorophyll-a. Upper and lower confidence limits, mean, and interval are shown. Because statistical methods have been refined over time, for purposes of comparing current and past concentrations in this figure, the 2024 statistical methods were applied to the data from each prior cycle.

Macrophytes (Aquatic Life Use)

Plant surveys from 2017 to 2021 all attain the general macrophyte condition threshold, while the most recent three surveys do not attain the phosphorus-specific threshold (Table 2). Considering the elevated phosphorus and chlorophyll-a levels in prior years it makes sense for the macrophyte populations to be impacted. These non-attainments will not result in a new listing for macrophytes; the lake is going through a shift from an algal to macrophyte dominated system.

Table 2. Macrophyte survey dates and attainment of the general and phosphorus macrophyte thresholds.

Survey Date	MAC-Gen	Mac-P
8/23/2021	Attained	Not Attained
8/26/2020	Attained	Not Attained
7/18/2019	Attained	Not Attained
7/31/2018	Attained	Attained
8/16/2017	Attained	Attained

Mercury in Fish Tissue

Fish tissue samples were taken fall 2023 and analysis was completed by the Department of Health Services in January 2024. The mercury levels in fish tissue were low enough to warrant removal of the specific fish consumption guidance. As a result this pollutant listing is proposed for removal this cycle.

Assessment Determination

With continued monitoring on Kentuck Lake the long-term changes in phosphorus and chlorophyll-a levels will be further documented. Based on the evaluations done in this assessment document it is possible that Kentuck Lake has periods of higher phosphorus and chlorophyll-a on a decadal scale as there were some higher values in the 1980s (Onterra 2015). Kentuck Lake may be a candidate for site-specific criteria (SSC) for either phosphorus or chlorophyll-a. Based on the current evaluation the phosphorus, eutrophication, excess algal growth, and organic enrichments are recommended for removal. The mercury in fish tissue listing is also recommended for removal. With these changes, three of five uses are fully supporting (Table 3).

Table 3. Use support for each use with parameters used for the decision.

Uses	Aquatic Life	Recreation	Public Health & Welfare	Fish Consumption	Wildlife
Support	Fully Supporting	Fully Supporting	NA	Fully Supporting	NA
Parameters	TP, Algae, Macrophytes	TP	NA	Mercury	NA

Recommendations

For the 2024 cycle it is recommended that the phosphorus, eutrophication, excess algal growth, organic enrichments, mercury, and mercury in fish tissue listings are removed. Continued monitoring will indicate if these parameters need to be listed again in the future.

References

WI DNR. 2023. Wisconsin Consolidated Listing and Assessment Methodology (WisCALM) 2024. https://apps.dnr.wi.gov/swims/Documents/DownloadDocument?id=343906539

Onterra, LLC. 2015. Kentuck Lake Comprehensive Management Plan. http://www.kentucklakedistrict.org/wp-content/uploads/2015/10/KentuckForest-Vilas_CompManagementPlan_Oct15_Final.pdf

Kentuck Lake District website: http://www.kentucklakedistrict.org/