



SUBMITTED VIA EMAIL TO Kristi.Minahan@Wisconsin.gov AND HAND DELIVERY AT THE NOVEMBER 8, 2019 PUBLIC HEARING

November 7, 2019

Ms. Kristi Minahan
Wisconsin Dept. of Natural Resources
P.O. Box 7921
Madison, WI 53707

RE: **Courte Oreilles Lakes Association and the Lac Courte Oreilles Band of Chippewa Indians Comments Regarding the Wisconsin Department of Natural Resources' Draft Order Prepared for the Natural Resources Board for a Proposed Rule Establishing a Site Specific Phosphorus Criteria for Lac Courte Oreilles**

Dear Ms. Minahan:

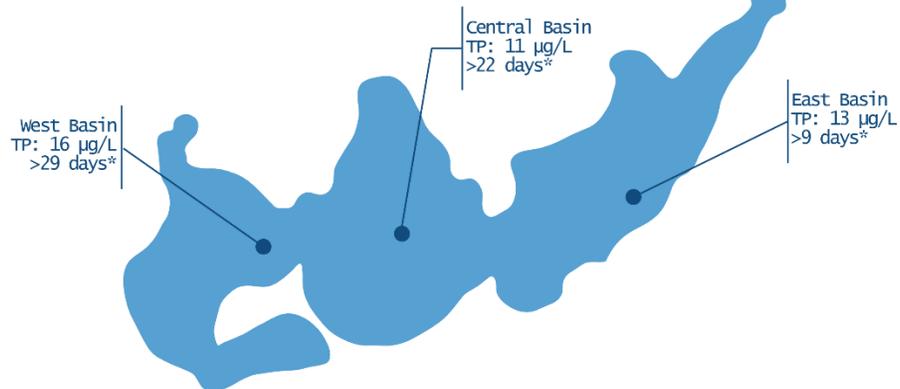
The Courte Oreilles Lakes Association (COLA) and the Lac Courte Oreilles Band of the Lake Superior Chippewa (LCO Tribe) submit this letter to comment on the Wisconsin Department of Natural Resources' (WDNR) draft Order, dated August 28, 2019, that proposes an Option A to set a site-specific criterion of 10 µg/L total phosphorus to protect Lac Courte Oreilles (LCO) designated uses and fishery, and an Option B to retain the current 15 µg/L total phosphorus criterion which currently applies to LCO.

COLA and the LCO Tribe support the WDNR's Option A that sets a 10 µg/L total phosphorus criterion for LCO. All parties—the WDNR, COLA and the LCO Tribe—agree that LCO is **not** currently meeting its designated uses pursuant to state and federal water quality statues and rules. In proposing a 10 µg/L phosphorus site specific criterion for LCO, the WDNR is appropriately setting a standard that when achieved will halt and reverse the declining water quality of LCO and protect for future generations this unique two-story, cold-water fishery that the State of Wisconsin has designated an Outstanding Resource Water (ORW). NR 102.10, (1m)17. COLA and the LCO Tribe, however, reject Option B. That option is **scientifically** flawed, **legally** flawed, and threatens the LCO Tribe's **treaty rights** under the **Treaties of 1837 and 1842**. These aspects of Option B are addressed below.

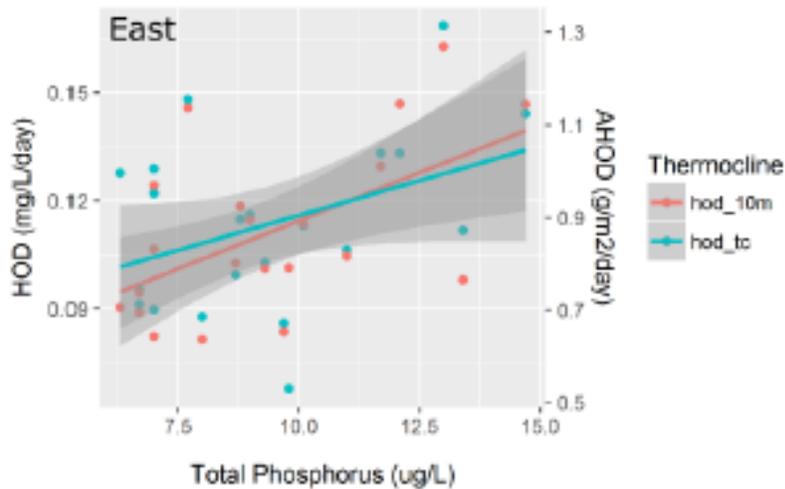
1. The WDNR Has Performed Substandard Science to Justify Retaining the Current, Inadequate Phosphorus Criterion of 15 µg/L for Lac Courte Oreilles.

In 2014, both the EPA and the WDNR designated Musky Bay on LCO an impaired water body because of high phosphorus concentrations. In 2018, both the WDNR and EPA listed all of LCO as an impaired water body because of low dissolved oxygen (DO). The WDNR, COLA, and the LCO Tribe all agree that there is now insufficient habitat over too many days for cisco and whitefish to survive on LCO due to low DO. See, the diagrams below. Direct evidence of the insufficient habitat is the massive die-offs of whitefish and cisco over the last several years.

Conditions in 2018



*days with unsuitable oxythermal habitat conditions for cisco and whitefish



The WDNR, COLA, and the LCO Tribe agree that the total phosphorus (TP) concentration in a lake contributes to algal production, decaying algal growth consumes DO, and DO depletion adversely affects the water quality, the fishery, and the general recreational use of a lake. This mechanism is well documented and understood in the scientific literature. The WDNR fully understands this natural process:

“Small increases in phosphorus can fuel substantial increases in aquatic plant and algae growth, which in turn can reduce recreational use, property values, and public health.” – WDNR, <https://dnr.wi.gov/topic/surfacewater/phosphorus/>

The bottom line: DO conditions in LCO are impaired at current TP levels and lowering phosphorus will reduce DO consumption in LCO from algal decay.

But for some reason, the WDNR abandoned its understanding of this process when it comes to LCO, and instead suggests that more TP *won't* affect DO in the lake based upon poor statistical analysis. WDNR's conclusion is based on what they say is a lack of a correlation between annual average TP and the oxygen demand in the dense bottom layer of water in LCO (called the hypolimnion layer of a lake) observed over time, called hypolimnetic oxygen demand, or HOD. The WDNR *did* find this correlation in the East Basin of LCO (see diagram above from WDNR TSD) but rejected it because it improperly ran additional tests with datasets that were too small in the other basins and could not detect the correlation. These improper tests skew the results to support its position that there was no correlation between TP and the oxygen demand in the hypolimnion of LCO.

LimnoTech's detailed analysis of the deficiencies in the WDNR's science, as the Department laid it out in its February 23, 2018, Technical Support Document, is enclosed with this letter as **EXHIBIT A**. Upon a proper application of well-settled science and data from LCO, the proposed 10 µg/L phosphorus site specific criterion rule for LCO must be adopted to restore and preserve the fishery and water quality of LCO.

2. By Suggesting An “Option B” that Maintains the Status Quo of 15 µg/L of Total Phosphorus, the WDNR Violated the Court’s Order Requiring a New Total Phosphorus Standard for LCO. Adopting “Option B” Will Necessitate New Litigation.

As the Order accompanying the proposed rule notes, the rule is the result of a court case brought by James Coors, COLA, and the LCO Tribe (“Petitioners”). That case asked the Court to order WDNR to set a site-specific criterion (SSC) for phosphorus in Lac Courte Oreilles that was more protective than the current 15 µg/L standard applied to the lake's main basins and the 40 µg/L applied to Musky Bay, on the lake's southwest corner. As part of a settlement entered by the WDNR in 2017 and approved by the Court, the WDNR agreed to propose a more protective SSC for the lake.

Objection to “Option B”

The WDNR has now proposed a rule with what it calls “two alternatives.” Option A sets an SSC for Lac Courte Oreilles at 10 µg/L, which is the level the Petitioners originally requested in 2016 based on a report prepared by its technical consultants at LimnoTech. Option B is actually no option at all—it is “no change”

from the status quo. As the Petitioners argued and the Circuit Court evidently agreed, the status quo is unacceptable from a water quality and lake health perspective.

The Stipulation the WDNR agreed to in this case was that the Department would propose an SSC for Lac Courte Oreilles and pursue the necessary rulemaking process to do so. Should the WDNR propose and the Natural Resources Board (NRB) adopt “Option B,” this would allow the WDNR to discontinue the rulemaking process and maintain the 15 µg/L standard for the lake. Failing to pursue the SSC rulemaking change to 10 µg/L would violate the Stipulation. (See Stip., ¶¶ 3.a.-3.h.)

The Stipulation provides that the Petitioners may reinstate litigation should a dispute arise regarding the interpretation or implementation of the Stipulation, or the WDNR’s and NRB’s good faith in proceeding with the rulemaking. (*Id.* ¶¶ 3.h., 6-9.) Petitioners intend to pursue these options should the WDNR propose and **NRB adopt** the so-called “Option B.”

The 10 µg/L Standard is Legally Supported

The draft Order also neglects to fully explain the legal basis for the 10 µg/L standard, which the Petitioners argued to the circuit court and the Court agreed with. WDNR staff read the Department’s authority to set site-specific criterion too narrowly.

Wis. Stat. § 281.15 directs:

The department shall promulgate rules setting standards of water quality to be applicable to the waters of the state, recognizing that different standards may be required for different waters or portions thereof. Water quality standards shall consist of the designated uses of the waters or portions thereof and the water quality criteria for those waters based upon the designated use. ***Water quality standards shall protect the public interest, which include the protection of the public health and welfare and the present and prospective future use of such waters*** for public and private water systems, propagation of fish and aquatic life and wildlife, domestic and recreational purposes and agricultural, commercial, industrial and other legitimate uses. ***In all cases where the potential uses of water are in conflict, water quality standards shall be interpreted to protect the general public interest.***

Wis. Stat. § 281.15(1) (emphasis added).¹

Wis. Admin. Code § NR 102.06 contains phosphorus criteria for waters of the State. In relevant part, NR 102.06(4) states:

¹ As to portions of the lake in the Tribe’s ceded territory, the Treaty of 1837 recognizes that the right to hunt, fish, and gather includes a right to habitat protection, because the most fundamental prerequisite to exercising the right to harvest natural resources is the existence of natural resources to be taken. (R.2705.) In the implementation of this right, *Lac Courte Oreilles v. State of Wisconsin* (LCO VI) establishes that the State does not have the unfettered discretion to exercise its management prerogatives to the detriment of the tribes’ treaty reserved rights. 707 S. Supp. 1034 (W.D.Wis. 1989).

(4) RESERVOIRS AND LAKES. Except as provided in sub. (1), **to protect fish and aquatic life uses established in s. NR 102.04 (3) and recreational uses established in s. NR 102.04 (5)**, total phosphorus criteria are established for reservoirs and lakes, as follows:

....

b) For the following lakes that do not exhibit unidirectional flow, the following total phosphorus criteria are established:

1. **For stratified, two-story fishery lakes, 15 µg/L.**
2. For lakes that are both drainage and stratified lakes, 30 µg/L.
3. **For lakes that are drainage lakes, but are not stratified lakes, 40 µg/L.**
4. For lakes that are both seepage and stratified lakes, 20 µg/L.
5. For lakes that are seepage lakes, but are not stratified lakes, 40 µg/L.

Id. (emphasis added). Lac Courte Oreilles' main body, as a two-story fishery lake, is subject to a phosphorus standard of 15 µg/L. Musky Bay, classified by WDNR as a separate drainage lake, is subject to a 40 µg/L standard. R.4842 (Doc.#156.)

However, NR 102.06(7) goes on to say:

(7) SITE-SPECIFIC CRITERIA. A criterion contained within this section may be modified by rule for a specific surface water segment or waterbody. A site-specific criterion may be adopted in place of the generally applicable criteria in this section where site-specific data and analysis using scientifically defensible methods and sound scientific rationale demonstrate a different criterion is protective of the designated use of the specific surface water segment or waterbody.

Id. (emphasis added). The notes to the rule explain that “[r]eservoirs, **two-story fishery lakes** and water bodies with high natural background phosphorus concentrations **are the most appropriate water bodies for site-specific criteria.**” *Id.*, Note (emphasis added).

To summarize, Wis. Stat. §281.15(2)(c) states that “[i]n adopting or revising any water quality criteria for the waters of the state,” the WDNR shall “[e]stablish criteria which are no more stringent than **reasonably necessary** to **assure attainment** of the designated use for the water bodies in question.” Wis. Stat. §281.15(2). Note (emphasis added). This reflects the priorities in Wis. Stat. §281.15(1): DNR has leeway in assessing the stringency of a criteria, based on the Legislature’s use of the words “reasonably necessary” as a modifier to the phrase “no more stringent than.” However, the statute is clear that whatever criteria WDNR selects must **assure attainment** of the designated use for the water bodies in question. It does not mandate that WDNR set a standard that “strives for” attainment, that is “likely to” achieve attainment, or even that will accomplish attainment “in most cases.” WDNR must promulgate a criterion that will assure—i.e., guarantee—attainment. See MERRIAM WEBSTER DICTIONARY (11th ed. 2004) (defining “assure” as “to make certain the coming or attainment of; guarantee”).

In initially rejecting the Petitioners' suggested 10 µg/L SSC, the WDNR flipped the script: it wished to "assure" the SSC would not be too stringent, while accepting a lake water condition that they viewed as reasonably close to achieving Lac Courte Oreilles' designated uses.² The WDNR disagreed that "a phosphorus SSC should be established if phosphorus contributes to any amount of oxygen depletion," and that "a higher bar is required."

The Court rejected this analysis. It stated:

Wisconsin Statute 281.15(2)(c) requires the WDNR to establish criteria which are no more stringent than reasonably necessary to assure attainment of the designated use for the water bodies in question. Water bodies in question here is a two-story fishery. I am not a fisherman, so I really don't know what that means, but I know it's important. And also, two-story fishery lakes like the water body at issue here are the most appropriate water bodies for site-specific criteria. That's NR 102.06(7).

....

And so it seems to me that you have a lake that everybody says is in trouble, the parties reach an agreement that says there is going to be a site-specific criteria, that the body of water needs one, the Court signs that order, and now I come back a year later and the answer is, well, we can't do it, so we are not going to do it. Well, that's not, in my mind, good enough. It seems to say that the WDNR is claiming that unless there is a hundred percent certainty that this is going to work, then we don't need to do it because it's not more stringent than reasonably necessary.

Under the state of the law now, the Wisconsin Supreme Court says that we don't defer to conclusions of law, we give respectful appropriate consideration, but we have to exercise our independent judgment interpreting the requirements of the statute and the administrative code.

The WDNR's reading would give just bare minimum standards. And that is inconsistent with 281.11, where the department shall protect, maintain, and improve the quality of management of the waters of the State. And also saying that two-story fishery lakes are the most appropriate for site-specific criteria. That's what we have here.

(Court transcript, 3/12/19, at 12-13, Coors et al. v. DNR, Dane County Case No. 16-CV-1564.)

Based on Wis. Stat. §§ 281.15(1) and (2), the WDNR must set standards that are more protective to "assure compliance" with designated uses, and not set standards that permit impairment based on concerns that

² This is reflected in the 2018 Technical Support Document, where WDNR omitted any mention of what was "reasonably" necessary, and used a three-pronged rubric that is not reflected in the statutes and rules:

In order to establish a more-stringent phosphorus SSC, we must demonstrate 1) the designated uses are **not protected** by the statewide phosphorus criterion, 2) a **clear link** between phosphorus concentrations and protection of these designated uses, and 3) **that scientific evidence demonstrates that a more-stringent phosphorus concentration is necessary to protect the designated uses.**

they are too stringent, or before every other possible source of impairment has been ruled out. NR 102.06(7) provides specific authority to do so in this case, where “site-specific data and analysis using scientifically defensible methods and sound scientific rationale demonstrate a different criterion is protective of the designated use of the specific surface water segment or waterbody.”

As these Comments elsewhere demonstrate, these standards are satisfied here for the 10 µg/L phosphorus SSC. “Option B” should be rejected to preserve the water quality of LCO.

3. Adopting “Option B,” the Current 15 µg/L Total Phosphorus Standard for LCO, and Not the Proposed Lower 10 µg/L Phosphorus Standard, Will Adversely Affect the LCO Tribe’s Rights Under the Treaty of 1837 and May Necessitate Federal Litigation.

The Treaty of 1837 recognizes that the right to hunt, fish, and gather includes a right to habitat protection, because the most fundamental prerequisite to exercising the right to harvest natural resources is the existence of natural resources to be taken. In the implementation of this right, *Lac Courte Oreilles v. State of Wisconsin* (LCO VI) establishes that the State does not have the unfettered discretion to exercise its management prerogatives to the detriment of the Tribes’ treaty reserved rights. 707 S. Supp. 1034 (W.D.Wis. 1989). As pointed out in the first section of this letter, Musky Bay is an impaired water body because of high phosphorus concentrations. All of LCO is an impaired water because of low DO. All parties agree that there is now insufficient habitat over too many days for cisco and whitefish to survive on LCO due to low DO. Direct evidence of the insufficient habitat is the massive die-offs of whitefish and cisco over the last several years. Option B, the status quo, is not an option.

Preserving the LCO fishery is crucial to the LCO Tribe. To fully understand the loss of this natural resource, one must understand the significance it has to the Lac Courte Oreilles people. Prior to French explorers arrival in the mid-1600s, this body of water was named Odaawaa-Zaaga’iganiing (Lake of the Ottawa) by the original inhabitants of the area; the name still referred to by the Lac Courte Oreilles people. Historically, this precious body of water provided the anishinaabeg (original man) or LCO Ojibwe people with all the resources needed to sustain a community. Fish species such as Muskellunge, Walleye and panfish were bountiful and considered gifts from the creator. From a Tribal perspective, it is nearly impossible to quantify the loss of the LCO habitat. Lac Courte Oreilles Tribal members harvest fish, hunt waterfowl, trap, and gather aquatic medicines from this lake. But just as important are the spiritual and physiological connections this lake represents to the people of Odaawaa-Zaaga’iganiing.

All of these uses by the LCO Tribe will be directly affected with the deterioration of the natural habitat of LCO, and that habitat loss directly implicates the LCO Tribe’s treaty rights under the Treaty of 1837. Hence, a site-specific phosphorus criterion of 10 µg/L is necessary to preserve the water quality and the fishery of LCO.

CONCLUSION

For all the reasons stated above—the science, the law, and the Treaty implications--the site-specific phosphorus criterion of 10 µg/L for Lac Courte Oreilles must be adopted as rule.

LAC COURTE OREILLES LAKES
ASSOCIATION

LAC COURTE OREILLES BAND
OF CHIPPEWA INDIANS

 /s/ Kevin Horrocks
By: Kevin Horrocks
Its: President

 /s/ Brian Bisonette
By: Brian Bisonette
Its: Conservation Director

Memorandum (Update to submittal on April 23, 2019)

From: Hans Holmberg, P.E., David Dilks, PhD,
Dendy Lofton, PhD, Ben Crary **Date:** September 23, 2019
Project: LCO

To: Gary Pulford, COLA **CC:**
Dan Tyrolt, LCOCD

SUBJECT: Updated Review of WDNR Technical Support Document for LCO SSC (original review delivered on April 23, 2019)

Overview

At the direction of the Courte Oreilles Lakes Association (COLA), and in cooperation with the Lac Courte Oreille Band of Lake Superior Chippewa Indians Conservation Department (LCOCD), LimnoTech has conducted a preliminary review of the Technical Support Document (TSD) for the Lac Courte Oreilles, Sawyer County Phosphorus Site-Specific Criteria Analysis prepared by the Wisconsin Department of Natural Resources (WDNR). WDNR provided the TSD to COLA on February 23, 2018. LimnoTech provided COLA with preliminary comments, which were then provided to WDNR on March 13, 2018. COLA, LCOCD, and WDNR met to discuss the TSD and review our preliminary comments with WDNR during a meeting on March 15, 2018.

Subsequent to the March 15, 2018 meeting, an open-records request was made to obtain the supporting data and files DNR used in the development of the TSD. DNR provided those files on April 5, 2018. We initiated a review of these files, however, a complete review requires additional time. Based on our initial review, we do not expect substantial changes to the comments we have developed thus far on the TSD. LimnoTech's comments on the TSD were originally submitted on April 23, 2019. Updates and additions to the original comments have been made in underlined text, below.

General Comments

In general, LimnoTech supports WDNR's key findings that LCO is impaired for the designated beneficial use as a stratified two story cold-water fishery, that a reduction in the oxythermal layer thickness (OLT) is the primary stressor, and that phosphorus is a contributing cause of low dissolved oxygen in LCO. Specifically:

- On page 4, WDNR states that "Data suggest that coldwater fish habitat is impacted by limitations of the "oxythermal layer" within which those species can survive. Because of this, in 2018 the main basins of Lac Courte Oreilles are proposed for listing as impaired based on not attaining the designated cold water aquatic life use due to low dissolved oxygen. Low dissolved oxygen can be caused by a number of factors, including high concentrations of phosphorus within a waterbody."

EXHIBIT A

- On page 31, WDNR states “Phosphorus can accelerate oxygen depletion by fueling algal growth and bacterial respiration of resulting organic matter.”
- On page 5, WDNR states “All phosphorus criteria must be set to be protective of the resource’s designated uses.”
- On page 5, WDNR states that “None of the three basins attains the [oxythermal layer thickness] OLT threshold for whitefish...”
- On page 6, WDNR states “Habitat for coldwater fish can be limited by warming temperatures near the surface and by oxygen depletion in the deep, cold water.”

Based on these findings, we would expect WDNR to conclude that a phosphorus SSC is needed to restore and protect LCO. However, WDNR concludes in the TSD that:

- WDNR “cannot verify that phosphorus is reducing the oxythermal layer” and
- “reduced phosphorus is not likely to significantly improve the two-story fishery habitat deficiencies.”

On these points, and others, we strongly disagree. WDNR’s general conclusion is that a phosphorus SSC is not necessary to protect aquatic life uses in LCO. Available data demonstrate an impairment for low dissolved oxygen manifested in non-attainment of the OLT. Widely accepted scientific understanding concludes that a change in phosphorus loadings and in-lake phosphorus concentrations in a phosphorus-limited lake system will impact algae growth and the subsequent processes of algae death, decay, and oxygen consumption, whether in the water column or in the sediment^{1,2,3,4,5}. From this, we can be certain a reduction in phosphorus concentrations will have a positive impact on the oxythermal layer and resulting support of designated uses. In the same way, we can be certain that increases in phosphorus concentrations above existing levels will have a negative impact.

By not establishing a phosphorus SSC for LCO, WDNR is basically taking a position that an increase in phosphorus concentrations in LCO, an Outstanding Resource Water (ORW), is acceptable despite the clear impairment of its designated uses. WDNR’s WisCALM guidance requires the lower 90th confidence interval of the monthly TP averages to exceed the existing 15 µg/L statewide criterion. This would mean a 50% increase in TP over existing levels in LCO

¹ <https://dnr.wi.gov/topic/surfacewater/phosphorus/> “Phosphorus has long been recognized as the controlling factor in plant and algae growth in Wisconsin lakes and streams. Small increases in phosphorus can fuel substantial increases in aquatic plant and algae growth, which in turn can reduce recreational use, property values, and public health.”

² Limnology: Lake and River Ecosystems. Third Edition. By Robert G Wetzel. San Diego (California): Academic Press

³ Reckhow, K.H and S.C. Chapra. 1983. Engineering approaches for lake management Volume 1: data analysis and empirical modeling. 340p.

⁴ Walker WW. 1996. Simplified procedures for eutrophication assessment and prediction: User manual. Instruction Report W-96-2, September, 1996, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, USA.

⁵ Canfield, Daniel & W. Bachmann, Roger. (1981). Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes. Canadian Journal of Fisheries and Aquatic Sciences - CAN J FISHERIES AQUAT SCI. 38. 414-423. 10.1139/f81-058.



before WDNR would consider the lake impaired by phosphorus. This is insufficient for protecting LCO, a unique and highly valued State, Tribal, and public resource.

WDNR's conclusions in the TSD appear to be based on three key analyses:

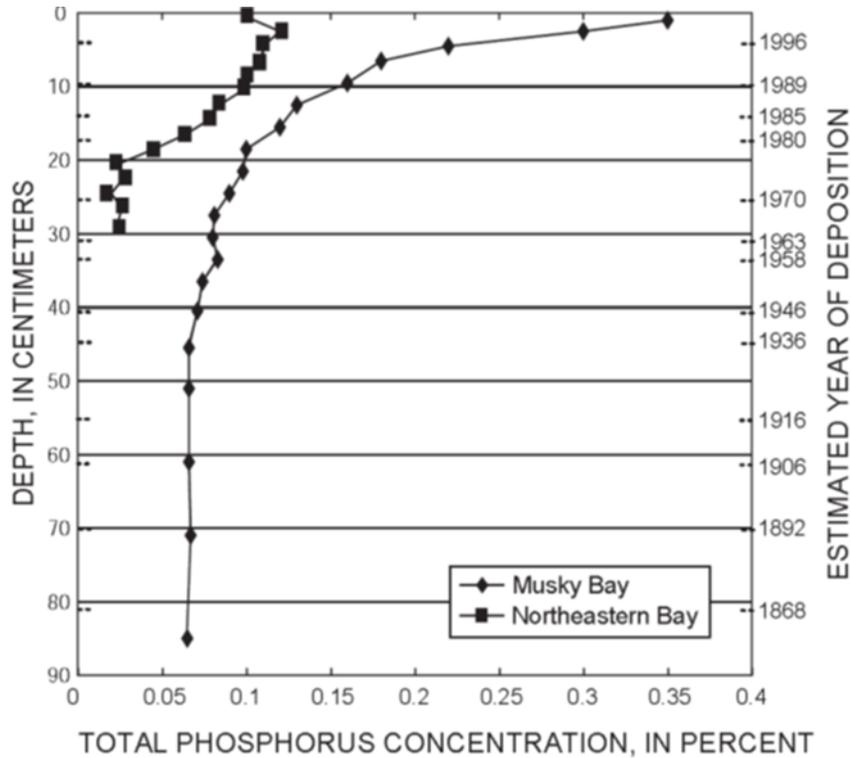
- WDNR did not identify consistent statistically significant trends of increasing phosphorus, increasing chlorophyll *a*, increasing HOD, or decreasing OLT in LCO over the timeframe of the observed data.
- WDNR did not identify a consistent statistically significant correlation between phosphorus and chlorophyll *a*, HOD, or OLT in the observed data.
- WDNR believes sources other than phosphorus are likely the major cause of oxygen depletion and discounts phosphorus as a cause that should be controlled. Their argument against a phosphorus SSC is strongly based on their determination that reduced substances contribute to a large portion of the HOD in LCO. In multiple places in the TSD document WDNR states "Reducing phosphorus will not affect oxidation of reduced substances." This is incorrect. Reducing phosphorus would have an impact on all components of HOD, including oxidation of reduced substances, because long-term reduction of phosphorus will decrease organic matter production and, consequently, carbon substrate availability in the sediments. Decreased substrate availability will directly impact the rate of reduced substance cycling in sediments. Therefore, reducing phosphorus will indirectly affect oxidation of reduced substances through reduction of autochthonous organic matter production.

Below are comments that directly relate to WDNR's conclusions, questions and concerns with WDNR's analyses or conclusions, and recommendations to improve the TSD.

Specific Comments and Recommendations

1. WDNR states repeatedly in the TSD that TP concentrations have not significantly changed over time in the Central and West basins. WDNR does not clarify that this assessment is based on data from 2001-2017. Increases in TP may not be expected to have increased significantly in that timeframe as loading sources may not have changed significantly during that timeframe. Figure 4, however, does show an apparent increase in TP concentrations from 2012-2017. WDNR does show that TP has increased significantly in the East Basin where a longer time period of data is available (1988-2017). Based on these assessments, WDNR could conclude that TP has likely increased over time throughout LCO. Such a conclusion would be consistent with the TP trends estimated by USGS from sediment cores (Fitzpatrick, F.A., P.J. Garrison, S.A Fitzgerald, and J.F. Elder. 2003. *Nutrient, Trace-Element, and Ecological History of Musky Bay, Lac Courte Oreilles, Wisconsin, as Inferred from Sediment Cores*. U.S. Geological Survey Water-Resources Investigations Report 02-4225). As shown in the figure below from the USGS report, phosphorus concentrations have increased significantly since the late 1970's and early 1980's, nearly seven-fold.





2. On page 5 and Sections 5.2 and 5.3, WDNR compares conditions in LCO to statewide metrics for chlorophyll *a* and aquatic plants. WDNR concludes all three basins attain statewide chlorophyll *a* threshold values. We agree that chlorophyll *a* concentrations are low as compared to statewide metrics, and they should be. This is a unique ORW in a highly forested watershed with extensive efforts taken by multiple parties to reduce phosphorus loads to the lake. If statewide metrics are being met in LCO, but designated uses are impaired, it is a clear sign that a TP SSC is needed to restore designated uses and protect LCO. Additionally, at the low levels of chlorophyll *a* observed in LCO, around 2 µg/L, a small increase in magnitude, such as 0.5 µg/L, would likely have a significant impact on the organic matter composition in the lake as it would constitute a 25% increase.
3. WDNR concludes chlorophyll *a* has not changed significantly over time in any of the main basins based on data from 2000-2017. Figure 5 of the TSD appears to show an increase in chlorophyll *a* between 2010 and 2017 in all three basins, doubling over that timeframe. Concluding that chlorophyll *a* has not significantly changed over time is a narrow interpretation of the specific statistical test WDNR applied, and does not consider any break-point analysis. WDNR’s conclusion also does not address potential increases in chlorophyll *a* prior to 2000.
4. WDNR states on page 24: “In most lakes, the increase in chlorophyll *a* per unit increase in TP begins after TP reaches 15-20 µg/L.” WDNR does not provide a basis for this statement. Widely accepted scientific understanding concludes that a change in phosphorus loadings and in-lake phosphorus concentrations in a phosphorus-limited



- lake system will impact algae growth. WDNR's own assessment of TP-chlorophyll *a* relationships in Wisconsin lakes shows an increasing trend of chlorophyll *a* with increasing TP (Figure 27 of the TSD). WDNR should acknowledge that increasing TP concentration will increase chlorophyll *a* concentrations in LCO.
5. WDNR's assessment of the OLT data indicated that habitat for cisco has been maintained in all basins over the past 5 years (pages 5 and 26). LimnoTech's analysis of the data indicates impairments of the cisco OLT criteria. COLA and WDNR need to clarify the discrepancy.
 6. WDNR states that the OLT has not declined from 1975 to the present (pages 5 and 26), however the basis for this conclusion is not clear. WDNR's assessment of the OLT only goes back to 1975 in the East Basin. The quality of temperature and DO profile data is not described, especially considering the older data. The time of year and the vertical resolution of the profile data are critically important to understand and assess. The model developed by WDNR to assess the OLT anomalies does not consider climatic factors that influence the OLT on a given day of the year, such as ice-out date, air temperatures, and wind conditions. The importance of these issues can be observed in the wide spread in the value of the OLT on a given day of the year in Figure 8.
 7. WDNR suggests that "the whitefish population in Lac Courte Oreilles may be supported by immigration from Whitefish Lake" (pages 5 and 26). However, WDNR does not provide any evidence that Lake Whitefish do not or have not successfully spawned in LCO. Hundreds of mature dead Lake Whitefish were found floating or washing up in LCO in 2016. Dead Lake Whitefish were also found in 2015. There is an un-substantiated report of Tribal speared, spawning Lake Whitefish in Anchor Bay of LCO in November, 2016. To support its statement that Lake Whitefish in LCO may be coming from Whitefish Lake, WDNR would have to obtain more evidence, such as surveys of the Lake Whitefish population in LCO that would include boom shocking of potential spawning areas in the fall prior to ice-in, conduct creel surveys, or potentially tag and track movement of Lake Whitefish. The statement is speculation.
 8. WDNR concludes on page 38 that "based on available data, there is not sufficient evidence for an increasing trend in AHOD over time for any of the three deep hole stations." However, Figure 15 shows increasing trends in all basins, just not statistically significant trends given the tests applied by WDNR. Also, WDNR assessments show a significant relationship when hypolimnetic depth is calculated by the change in thermocline depth based on actual profiles, but not significant when the hypolimnetic depth is standardized to 10 meters. WDNR chose to assume a thermocline at 10 meters as the more robust approach rather than conduct further examination. Further examination is warranted when two approaches are yielding different outcomes, and would tend to rely more heavily on the approach that makes full use of the available data (more robust), rather than a simplification. Based on these assessments, WDNR should conclude that an increasing trend in HOD in LCO is very likely occurring.
 9. On page 4, WDNR states "...we find that the deficiency in the coldwater fishery habitat is not clearly driven by phosphorus." Later WDNR states "Because current levels of phosphorus are not clearly driving the habitat deficiency, setting a more-stringent SSC



- than 15 µg/L is not appropriate for the main basins of Lac Courte Oreilles.” The WDNR appears to place a very high reliance on assessments of correlations between data on phosphorus and chlorophyll *a*, HOD, or the OLT. However, WDNR relied on annual averages to assess correlations between phosphorus and HOD. In a large lake system such as LCO, we would not necessarily expect strong annual correlations between phosphorus and HOD. HOD will be impacted by historical accumulation of organic matter in the sediment and, therefore, historical levels of phosphorus. WDNR is wrong to conclude that HOD is not correlated to phosphorus levels in LCO based on their assessment of correlations between annual values. WDNR’s regressions of annual total phosphorus (TP) to HOD show consistently positive correlations in the East and Central basins, including a statistically significant correlation in the East basin (Figure 16). However, for unclear reasons, WDNR discounted the more robust assessment of HOD using a calculated depth for the thermocline, and instead opted for a simplified assumption of the thermocline depth of 10 meters where the test of statistical significance was not met. Statistical significance is difficult to obtain for regressions where the independent variable only spans a small range, and WDNR acknowledges that the variability in TP is relatively small. Also, WDNR appears to discount widely accepted scientific understanding that concludes that a change in phosphorus loadings and in-lake phosphorus concentrations in a phosphorus-limited lake system will impact algae growth. Subsequently, algae growth results in algae death, decay, and oxygen consumption, whether in the water column or in the sediment. Therefore, HOD is linked to phosphorus in any phosphorus-limited lake. WDNR is wrong to conclude that HOD is not linked to TP in LCO.
10. DNR hinges much of its argument on the lack of a correlation between HOD and TP within Lac Courte Oreilles. DNR uses only a single statistical test to evaluate whether such a correlation exists, and this test lacks scientific merit. The test simply evaluates the existence of a linear relationship between a given year’s mean summer TP and the same year’s estimated HOD. HOD, as described by DNR, is impacted by several potential demands in the lake. Notably, these demands include the degradation of organic matter produced in the water column and degradation of organic matter in the sediment. Organic matter in the water column is a combination of primary production and external loading, while organic matter in the sediment is an accumulation of primary production and external loading settled out of the water column over time. By testing for HOD dependence exclusively on summer mean TP, however, DNR does not factor in the long-term impact of TP and primary production that has settled into the sediments.
 11. DNR hinges much of its argument on the lack of a correlation between HOD and TP within Lac Courte Oreilles. DNR uses only a single statistical test to evaluate whether such a correlation exists, and this test lacks statistical merit. The level of significance established by DNR ($p < 0.05$) inherently requires a considerable number of data points in order to detect a relationship and overcome the risk of a false negative (Type II) error. This is known as ‘statistical power’, which DNR does not address in its technical review. The sample sizes in East, Central, and West Basins, have the statistical power of 0.85, 0.49, and 0.49 to assess linear relationships (based on a moderate effect size equal to



- 0.3). Conventionally, a statistical test is only considered adequate if its statistical power is greater than 0.8, which is not the case in the Central and West Basins. DNR chose to accept the flawed results for these basins despite insufficient data to detect significant trends with reasonable likelihood. Conversely, in the East Basin, which is the only basin where there is sufficient statistical power for the chosen test, DNR did in fact detect a significant relationship but chose to dismiss it for other anecdotal reasons.
12. DNR's overall statistical strategy is dependent upon the p-value of each test being less than a predetermined threshold of 0.05. While this is a conventional approach, there are experts in the field of statistics who caution against conclusions drawn solely based on statistical significance. In a recently published editorial titled Moving to a World Beyond "p < 0.05" in *The American Statistician*, Ronald Wasserstein and his coauthors state, "Don't believe that an association or effect is absent just because it was not statistically significant." and cautioned against arbitrary p-value thresholds⁶. Perhaps more importantly, the authors also asserted, "Don't conclude anything about scientific or practical importance based on statistical significance (or lack thereof).", which is what DNR did by refuting scientific knowledge about the known relationship between TP and HOD.
 13. WDNR states on page 6 that "more than half of total HOD comes from aerobic decomposition of organic matter in the sediment. This means that less than half of HOD comes from decomposing organic matter in the water column." However, WDNR does not highlight the ultimate sources of HOD in the sediment, of which a significant component may be algae. WDNR should consider the reductions in HOD in response to reductions in TP from both water column degradation of algae and reduced organic matter in the sediment.
 14. WDNR states on page 6 that the Chapra and Canale (1991) model used by LimnoTech to relate phosphorus to HOD is not appropriate for LCO because a "relationship observed across lakes as in the Chapra and Canale study will not necessarily hold true within a single lake." WDNR states that because their analysis of correlations between TP and HOD in LCO did not demonstrate a significant correlation, that the Chapra and Canale model should not be used. However, we disagree with WDNR's approach to correlating annual TP with annual HOD. We also strongly disagree with WDNR on the appropriateness of using empirical models to inform decision-making in the environmental sciences field. The use of empirical models should be done with careful thought, but is a long-standing and commonly used approach. WDNR makes use of empirical models in much of its decision-making to link phosphorus to algal productivity, such as the BATHTUB model in numerous TMDLs, or the Jensen model in the draft Wisconsin River TMDL. WDNR also compares LCO to eutrophic lakes from a study by Muller et al, 2012 when assessing Areal Hypolimnetic Mineralization (AHM), and based on that comparison suggests reduced substances could account for 50%-75% of the AHM, even though LCO is not considered a eutrophic lake. Therefore, WDNR's objection to the use of the Chapra and Canale model but comparison of LCO to the Muller study is

⁶ Ronald L. Wasserstein, Allen L. Schirm & Nicole A. Lazar (2019) Moving to a World Beyond "p < 0.05", *The American Statistician*, 73:sup1, 1-19, DOI: 10.1080/00031305.2019.1583913



- a clear contradiction. LimnoTech continues to assert that the Chapra and Canale model is a reasonable tool to link TP to HOD in LCO. Other models, such as BATHTUB, could be also be applied to LCO to in the same manner as we applied the Chapra and Canale model to demonstrate the same type of cause-and-effect relationship between TP and HOD. WDNR has widely applied BATHTUB to inform TMDLs and establish phosphorus targets for lakes and phosphorus wasteload and load allocations.
15. On page 6, WDNR states “If future studies determine the organic matter mostly comes from algal production in the lake, then reducing phosphorus concentrations would reduce the influence of organic matter decomposition on HOD over time.” We agree with WDNR’s recognition that organic matter in the sediment can be a result of algal production in the lake, and that reducing phosphorus concentrations would reduce HOD over time. If WDNR’s position is that reductions in algal production should only be made if it is the majority share of the HOD, then we strongly disagree. Effective TMDLs and water resource management efforts do not restrict themselves to management efforts targeting only sources that are the majority of the load. TMDLs are required to evaluate all sources, and may even target sources that are not the majority load, especially those for which controls are most feasible or regulatory agencies have a means to enforce load reductions. WDNR should establish a TP SSC for LCO that reduces TP levels which will lead to reductions in HOD, from both reduced algae decay in the water column and reduced decomposition of organic matter in the sediment.
 16. WDNR states on page 6 that reducing phosphorus would not be effective if sediment organic matter mostly comes from land. We disagree. Organic matter from land also contains phosphorus. Setting lower phosphorus criteria in the lake is also a means of reducing organic matter loads from land. Sediment organic matter containing phosphorus, no matter the source, may release phosphorus from the sediment. WDNR acknowledges the high rates of phosphorus release measured from LCO sediments, which are in the range of eutrophic lakes suggesting that phosphorus dynamics in LCO are changing and additional protections are needed.
 17. WDNR concludes that Musky Bay should not be listed as impaired and does not require a TP SSC. WDNR does not acknowledge that phosphorus in Musky Bay sediment has increased significantly since the 1970s. WDNR does not acknowledge that the higher concentrations of phosphorus in Musky Bay impact West Basin and the rest of LCO. WDNR does not acknowledge that recent trends of potentially lower phosphorus concentrations in Musky Bay may be a result of one of the cranberry bogs switching to a closed loop system. Musky Bay continues to be a large and continuing source of TP to the rest of the lake. Therefore, a TP SSC is appropriate for Musky Bay to restore and protect designated uses.

Conclusion

It is clear from the TSD that WDNR appears to explain all possible aspects of oxygen consumption in LCO *except* for those processes linked to decomposition of algal matter (i.e. autochthonous material). WDNR appears to dispute well-established limnological principles that



algal productivity will increase with increased phosphorus in a P-limited system. WDNR offers multiple options to further investigate the magnitude of HOD from the various mechanisms (e.g. oxidation of reduced substances diffusing from the sediments). However, WDNR does not offer alternative studies or measurements to strengthen the linkage between phosphorus, algal productivity and oxygen consumption in LCO. By only offering alternative studies and measurements to strengthen their hypotheses of the major factors degrading oxythermal habitat in LCO, and ignoring long-standing, and tested, limnological theory, WDNR is exhibiting bias in avoiding phosphorus as the source of impairment and degradation of LCO.

