DECISION DOCUMENT ENCLOSURE

BACKGROUND

Statutory and Regulatory Background

Section 303(c) of the Clean Water Act (CWA, 33 U.S.C. 1313(c)) directs states to adopt WQS for their navigable waters. Section 303(c)(2)(A) and the EPA's implementing regulations at 40 C.F.R. § 131 require, among other things, that state WQS include the designated use or uses to be made of the waters and criteria that protect those uses. Water quality criteria "are elements of state WQS, expressed as constituent concentrations, levels or narrative statements, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use." 40 C.F.R. § 131.3(b).

States have a primary role in adopting WQSs. The EPA has an oversight role. In this role, the EPA must determine whether the state's WQS are consistent with the Act's requirements. CWA Section 303(c)(3). The EPA's review is based on "the requirements of Act as described in 40 C.F.R. §§ 131.5 and 131.6." 40 C.F.R. §131.21(b).

For water quality criteria, the EPA's review involves a determination of whether the state-adopted criteria are consistent with 40 C.F.R. § 131.11. 40 C.F.R. § 131.5(a)(2). Section 131.11(a)(1) provides that states shall "adopt those water quality criteria that protect the designated use" and that such criteria "must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use. "When adopting criteria, a state must "take into consideration the WQSs of downstream waters and shall ensure that its WQSs provide for the attainment and maintenance of the WQSs of downstream waters." 40 C.F.R. § 131.10(b).

The EPA also considers whether the state "followed applicable legal procedures for revisiting or adopting standards." 40 C.F.R. § 131.5(a)(6). This includes consideration of whether the state held a public hearing consistent with 40 C.F.R. § 131.20(b).

The EPA's regulations provide that the state must submit for review the new or revised water quality criteria, methods used and analyses conducted to support such criteria, and a certification that such criteria were duly adopted pursuant to state law. 40 C.F.R. § 131.6(b), (c), and (e).

If the EPA determines that the state's new or revised WQS is not consistent with the Act's requirements, it shall notify the state of the disapproval and "specify the changes to meet such requirements." CWA Section 303(c)(3).

Nutrient Criteria

Under CWA Section 304(a), the EPA periodically publishes criteria recommendations for use by states in setting water quality criteria for particular parameters to protect the designated uses for their surface

waters. States have the option of adopting water quality criteria based on the EPA's CWA Section 304(a) criteria guidance, section 304(a) criteria guidance modified to reflect site-specific conditions, or other scientifically defensible methods. (*See* 40 C.F.R. § 131.11(b)(1)). For nitrogen and phosphorus pollution, the EPA finalized in 2001-2002 numeric nutrient criteria recommendations (*i.e.*, total nitrogen, total phosphorus, chlorophyll *a*, and turbidity) for lakes and reservoirs, and for rivers and streams, for most of the aggregated Level III Ecoregions in the United States. These were based on the EPA's previously published series of peer-reviewed, water body specific technical guidance manuals regarding the development of numeric criteria for lakes and reservoirs (USEPA 2000a) and rivers and streams (USEPA 2000b). States are not required by the CWA to adopt numeric nutrient criteria, although many states have done so to address nutrient pollution.

The EPA has long recommended that states adopt numeric criteria for total nitrogen (TN) and total phosphorus (TP), nutrients that in excess can ultimately cause adverse effects on designated uses (USEPA 2000a and USEPA 2000b). For this reason, TN and TP are often referred to as "causal" parameters. However, the EPA recognizes that the specific levels of TN and TP that adversely affect designated uses, including harm to aquatic life as indicated by various measures of ecological responses, may vary from waterbody to waterbody, depending on many factors, including geomorphology and hydrology among others. As a result, the EPA has worked with several states as they developed a combined criterion approach that allows a state to further consider whether a waterbody is meeting designated uses when elevated TN and TP levels are detected. Under this approach, an exceedance of a causal variable acts as a trigger to consider additional physical, chemical and biological parameters that serve as indicators to determine protection or impairment of designated uses; these additional parameters are collectively termed "response" parameters. The EPA's articulation of this combined criterion approach[1] is intended to apply when states wish to rely on response parameters to determine whether a designated use is impaired (USEPA 2013). A combined criterion can include both numeric and narrative components, as long as they collectively protect the designated use.

Missouri 2009 Submission and the EPA's 2011 Disapproval

On November 5, 2009, the EPA received Missouri Department of Natural Resources' (MDNR) WQS submission for review. On August 16, 2011, the EPA disapproved most of the State's total phosphorus (TP), total nitrogen (TN) and chlorophyll *a* criteria for lakes and reservoirs because the criteria were not based on sound scientific rationale and failed to demonstrate how the criteria would protect the designated uses. The EPA's decision document specified the following changes pursuant to CWA Section 303(c)(3): "The state must revise the criteria to clearly indicate which designated uses the criteria is intended to protect as well as supporting documentation to indicate that the criteria in fact will fully support the associated use. Additionally, supporting documentation needs to include the raw data and resulting statistical analyses so that the EPA may evaluate the soundness of the scientific rationale and protectiveness of the criteria pursuant to the requirement found at 40 CFR 131.11(a)(1)." The EPA's 2011 disapproval also provided additional guidance to MDNR as it considered how to address the EPA's specified changes and recognized that the state may want to modify the criteria beyond the original framework that may require different supporting analyses (USEPA 2011, *See* page 28). In an

[1] This approach is sometimes referred to as a "bioconfirmation" approach despite the fact that response parameters may not all be "biological," although they typically do reflect biological activity.

April 18, 2014 letter to MDNR, the EPA noted a citation error in its August 16, 2011 disapproval letter. The EPA's April 18, 2014 letter explained that references in the August 16, 2011 letter to 10 CSR 20-7.031(**3**)(N) should have been 10 CSR 20-7.031(**4**)(N).

Lawsuit and Consent Decree

On February 24, 2016, the Missouri Coalition for the Environment (MCE) sued the EPA alleging that the EPA failed to perform its mandatory duty under the CWA Section 303(c) to propose criteria for Missouri following its disapproval. The EPA signed a consent decree with MCE setting deadlines for EPA to act. Under the terms of the consent decree entered by the court on December 1, 2016, the "EPA shall sign a notice of proposed rulemaking by December 15, 2017 that proposes new or revised WQSs addressing EPA's August 16, 2011 disapproval of 10 CSR 20-7.031(3) Specific Criteria (N) Nutrients and Chlorophyll (except for the lakes listed on Table M), as set forth in section 4.B found on pages 27-29 of the attachment to the August 16, 2011 Letter." The EPA signed a notice of proposed rulemaking on December 15, 2017, pursuant to the December 1, 2016 consent decree obligation. 82 Fed. Reg. 61,213 (December 27, 2017). Under Paragraph 6 of the consent decree, the EPA must sign a notice of final rulemaking on or before December 15, 2018, regarding its proposed rulemaking. The decree provides that "[t]he requirements of Paragraph 6 shall not apply if on or before December 15, 2018, the state of Missouri has submitted new or revised WQSs addressing EPA's August 16, 2011 disapproval of 10 CSR 20-7.031(4) Specific Criteria (N) Nutrients and Chlorophyll (except for the lakes listed on Table M), and EPA has approved such standards. Any such approval by EPA shall be in writing and signed by the EPA official with the authority to make such approval."

MDNR's Nutrient Criteria Submission

The State's rule was adopted by the Missouri Clean Water Commission on January 4, 2018. On April 13, 2018, MDNR submitted its WQS package to the EPA. The submission included: (1) memo from the Missouri Attorney General's Office certifying that the revised WQSs were duly adopted pursuant to State law, (2) copy of the October 16, 2017, Missouri Register containing the Proposed Rule amendment; (3) transcript of the public hearing held on November 21, 2017; (4) redline version of the proposed rule as adopted by the Missouri Clean Water Commission at its January 4, 2018, meeting; (5) copy of the March 15, 2018, Missouri Register containing the Order of Rulemaking; and (6) copies of the comments received during the public notice period of the proposed rule and additional data, information and reports in support of the WQS submittal. The EPA Region 7 office received the package on April 17, 2018, triggering review under CWA Section 303(c)(2)(A). The EPA also received supplemental information from the State after its initial submission. These items satisfy the requirements of 40 C.F.R. §§ 131.6(e), 131.20(b), 131.5(a)(6), 131.6(b), and 131.6(f) regarding certification by the State Attorney General that the WQS were duly adopted pursuant to State law, holding a public hearing when revising WQS, whether the State has followed applicable legal procedures, methods used and analyses conducted to support WQS revision, and information on general policies which may affect WQS application and implementation. The requirements of 40 C.F.R. § 131.6(c) regarding water quality criteria sufficient to protect the use are discussed below.

MDNR'S NUTRIENT CRITERIA APPROACH - 10 CSR 20-7.031(5)(N)

The state of Missouri's nutrient criteria applies to lakes and reservoirs that have an area of at least ten acres during normal pool conditions and are located outside the Big River Floodplain ecoregion. Missouri also submitted GIS shape files that define exactly where the nutrient criteria apply. These files show that the tributary arms and their polygons have the same waterbody identification number and waterbody name as the main lake and refer to Table G. Because the Lake of Ozarks and Table Rock Lake appear on Table G, MDNR's the nutrient criteria extend to the tributary arms Grand Glaze, Gravois and Niangua of the Lake of the Ozarks and tributary arms James River, Kings River and Long Creek of Table Rock Lake as provided by 10 CSR 20-7.031(5).

The state's lakes and reservoirs are impounded and have been assigned an aquatic life use of either: warm water habitat, cool-water habitat or cold-water habitat. Each subcategory is defined as "waters in which naturally-occurring water quality and habitat conditions allow [for] the maintenance of a wide variety of [warm, cool or cold water] biota."[2] Missouri's rule establishes three ecoregions and sets forth for each ecoregion chlorophyll *a* "response impairment thresholds" (which serve essentially as stand-alone criteria) above which waters would be deemed impaired, and a combination of TN, TP, and chlorophyll *a* "nutrient screening values" and five "response assessment endpoints" (*i.e.*, response parameters) where a waterbody would be deemed impaired if at least one nutrient screening value <u>and</u> at least one response assessment endpoint are exceeded in the same year. In pertinent part, the State's submission includes the following rule language (State rule language in italics; EPA commentary in regular text):

> *1. Definitions.*
>
> *A. For the purposes of these criteria, all lakes and reservoirs shall be referred to as "lakes."*
>
> *B. Lake ecoregions—Due to differences in watershed topography, soils, and geology, nutrient criteria for lakes and reservoirs will be determined by the use of four (4) major ecoregions based upon dominant watershed ecoregion. These regions were delineated by grouping the ecological subsections described in Nigh and Schroeder, 2002, Atlas of Missouri Ecoregions, as follows: (I) Plains: OP1 – Scarped Osage Plains; OP2 – Cherokee Plains; TP2—Deep Loess Hills; TP3—Loess Hills; TP4— Grand River Hills; TP5—Chariton River Hills; TP6—Claypan Till Plains; TP7—Wyaconda River Dissected Till Plains; TP8— Mississippi River Hills; (II) Ozark Border: MB2a—Crowley's Ridge Loess Woodland/Forest Hills; OZ11—Prairie Ozark Border; OZ12—Outer Ozark Border; OZ13—Inner Ozark Border; (III) Ozark Highland: OZ1—Springfield Plain; OZ2—Springfield Plateau; OZ3— Elk River Hills; OZ4—White River Hills; OZ5—Central Plateau; OZ6—Osage River Hills; OZ7—Gasconade River Hills; OZ8— Meramec River Hills; OZ9—Current River Hills; OZ10—St. Francois Knobs and Basins; OZ14—Black River Ozark Border; and (IV) Big River Floodplain: MB1—Black River Alluvial Plain; MB2b—Crowley's Ridge Footslopes and Alluvial Plains; MB3—St. Francis River Alluvial Plain; MB4, OZ16, TP9—Mississippi River Alluvial Plain; OZ15, TP1—Missouri River Alluvial Plain.*

[2] 10 CSR 20-7.031(1)(C)1.A.VI, B.V and C.V.

MDNR should consider a regulatory revision to Table G that would reflect the ecoregion to which each lake is classified so citizens of the state can easily determine which criteria applies to particular lakes. Online access to Nigh and Schroeder's Atlas of Missouri Ecoregions appears to require downloading a large zip file and may not be possible with a standard personal computer.

> *C. Nutrient Criteria—Nutrient criteria represent the desired condition for a water body necessary to protect the designated uses assigned in rule.*
> *(I) Lake Ecoregion Criteria—A decision framework that integrates causal and response parameters into one WQS that accounts for uncertainty in linkages between causal and response parameters.*
> *(a) Response Impairment Thresholds—Maximum ambient concentrations of chlorophyll-a (Chl-a) that are based on annual geometric means of samples collected May through September with an allowable exceedance frequency of one in three (1-in-3) years for lakes that have not been assigned site-specific criteria.*
> *(b) Nutrient Screening Thresholds—Maximum ambient concentrations of total phosphorus (TP), total nitrogen (TN), and Chl-a that are based on the annual geometric mean of samples collected May through September. Nutrient screening thresholds represent causal and response parameter concentrations, above which an exceedance in any one year warrants further evaluation of Response Assessment Endpoints.*
> *(c) Response Assessment Endpoints—Narrative and numeric biological response endpoints that link directly to designated use impairment.*
> *(II) Lake Site-Specific Criteria— Maximum Ambient Concentrations of TP, TN, or Chl-a that are based on the geometric mean of a minimum of three (3) years of data and the characteristics of the waterbody.*
>
> *2. This rule applies to all lakes that are waters of the state and have an area of at least ten (10) acres during normal pool condition. Big River Floodplain lakes shall not be subject to these criteria.*
>
> *3. Response Impairment Thresholds are listed in Table L. Nutrient Screening Thresholds are listed in Table M. Lake Site-Specific Criteria for TP, TN, and Chl-a are listed in Table N. Additional lake site-specific criteria may be developed in accordance with subsection (5)(S) to account for the unique characteristics of the waterbody that affect trophic status, such as lake morphology, hydraulic residence time, temperature, internal nutrient cycling, or watershed contribution from multiple ecoregions.*

Section (5)(S) referenced in the above provision is existing language within the state's WQS. The remainder of this provision references the location of the tables which contain the values for Response Impairment Thresholds and the Nutrient Screening Thresholds, as well as Site Specific Criteria which the EPA previously approved in 2011. The EPA previously approved the Site-Specific Criteria found in Table N which has simply been renamed from the version the EPA previously approved in 2011 as 10 CSR 20-7.031 (4) Specific Criteria (N) Nutrients (3), Table M. The EPA is approving the renaming of this table as a non-substantive change (USEPA 2012a).

> *4. All TP, TN, and Chl-a concentrations must be calculated as the geometric mean of a minimum of four (4) representative samples per year for one (1) year for purposes of*

comparison to lake ecoregion criteria thresholds. All samples must be collected from the lake surface, near the outflow of the lake, and during the period May 1 – September 30.

The above provision (4) refers to a geometric mean calculation and a seasonality component, both of which are attributes of a WQS as duration and frequency components of a water quality criterion. However, these aspects are already described in the definitions above in provision (1)(C)[3]. What's left in provision (4) is a requirement for four representative samples per year and sample collection location specification, neither of which is a component of a water quality criterion that describes the desired condition or instream level of protection (see USEPA 2012a for a discussion of how the EPA generally evaluates whether provisions of State law are new or revised WQS requiring EPA review under the CWA). As such, provision (4) is not a WQS applicable for CWA purposes. It may apply for State law purposes.

5. Lakes with water quality that exceed Response Impairment Thresholds or Lake Site-Specific Criteria identified in Tables L and N are to be deemed impaired for excess nutrients.

6. Lakes are to be deemed impaired for excess nutrients if any of the following Response Assessment Endpoints are documented to occur within the same year as an exceedances of Nutrient Screening Thresholds in Table M. The department shall collect information on Response Assessment Endpoints concurrently with collection of Nutrient Screening Threshold parameters. The department shall determine attainment of Nutrient Criteria during the biennial assessment of Missouri waters.

The sentence, "The department shall collect information on Response Assessment Endpoints concurrently with collection of Nutrient Screening Threshold parameters" ensures that the combined nutrient criteria are designed so that a determination of attainment of WQS, the desired condition, will be based on a full set of information. The EPA thus concludes that this sentence is a component of the new WQS. (See USEPA 2012a for a discussion of how the EPA generally evaluates whether provisions of state law are new or revised WQS requiring EPA review under the CWA.) The following sentence, "The department shall determine attainment of Nutrient Criteria during the biennial assessment of Missouri waters" is merely an expression of the State's commitment to the biennial assessment and is not itself an expression of desired condition of level of protection, and thus is not considered a WQS under the CWA.

MDNR's rule also provides Response Assessment Endpoints, Response Impairment Threshold Values and Nutrient Screenings Threshold Values as follows:

1. Occurrence of eutrophication-related mortality or morbidity events for fish and other aquatic organisms;

2. Epilimnetic excursions from dissolved oxygen or pH criteria;

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[3] For the Lake Ecoregion Criteria, the Response Impairment Thresholds have an annual duration, from which a seasonal geometric mean is calculated, and the frequency is no more than one exceedance of the magnitude and duration (which is annual) over a three-year period. The Nutrient Screening Thresholds likewise have an annual duration, above which an exceedance in any one year warrants further evaluation of Response Assessment Endpoints.

3. Cyanobacteria counts in excess of one hundred thousand (100,000) cells per milliliter (cells/mL);

4. Observed shifts in aquatic diversity attributed to eutrophication; and

5. Excessive levels of mineral turbidity that consistently limit algal productivity during the period May 1 – September 30.

Table L: Lake Ecoregion Chl-a Response Impairment Threshold Values (µg/L)

Lake Ecoregion	Chl-a Response Impairment Thresholds
Plains	30
Ozark Border	22
Ozark Highland	15

Table M: Lake Ecoregion Nutrient Screening Threshold Values (µg/L)

Lake Ecoregion	Nutrient Screening Thresholds		
	TP	TN	Chl-a
Plains	49	843	18
Ozark Border	40	733	13
Ozark Highland	16	401	6

BASIS FOR THE EPA'S APPROVAL OF THE WQS IN 10 CSR 20-7.031(5)(N)

The EPA's review of Missouri's nutrient criteria involved a unique circumstance where MDNR was engaged in its rulemaking process to adopt nutrient criteria and the EPA issued a proposed rule (pursuant to the consent decree) and sought public comments during the same period. The EPA's December 2017 proposal requested comments on two alternatives, including one alternative that reflected the Missouri's October 2017 proposal under consideration by MDNR at the time. 82 Fed. Reg. at 61,213. The EPA also included another alternative that used a different methodology to derive the criteria values and a few other distinguishing features. 82 Fed. Reg. at 61,220-25. Importantly, the EPA acknowledged that "the alternatives in the current proposal are not the only possible options that EPA could promulgate or Missouri could adopt to address the 2011 disapproval action" and took comments on additional alternative approaches that were considered. 82 Fed. Reg. at 61,225. The nutrient criteria MDNR ultimately adopted were similar to its October 2017 proposal with a few changes.

Given this unique circumstance, the EPA reviewed and considered the documents submitted by MDNR, including public comments submitted during its rulemaking and the public comments the EPA received in response to its December 27, 2017 proposed rule notice in making today's decision. The EPA's discussion below and attached appendix addresses the significant issues raised in these documents and

public comments and the basis for the EPA's determination that MDNR's nutrient criteria satisfy all applicable CWA requirements. MDNR submitted sufficient information to evaluate their criteria as required by 40 C.F.R. §§ 131.5 and 131.6. As described below, MDNR relied primarily on scientific literature and established correlations between chlorophyll *a* and TN and TP. Because MDNR elected not to use a reference condition or modeling approach in its final submittal, it was not required to address the request to submit raw data and resulting statistical analyses described in the EPA's 2011 disapproval letter. The Missouri's 2018 submission for its nutrient criteria satisfied the EPA's requirement to submit "methods used and analyses conducted" so that the EPA could ultimately determine whether the resulting criteria are based on a sound scientific rationale.

The EPA's 2011 disapproval specified that the "[s]tate must revise the criteria to clearly indicate which designated uses the criteria is intended to protect as well as supporting documentation to indicate that the criteria in fact will fully support the associated use." MDNR submitted nutrient criteria for all classified lakes and reservoirs (hereafter "lakes") in Missouri that (1) are listed in Table G of the state's WQS regulations and the Missouri Use Designation Dataset (10 CSR 20-7.031(2)(E)) with respect to use designations, (2) equal or exceed ten acres, (3) are located outside of the Big River Flood Plain Ecoregion, and (4) are not already listed in Table M of the state's WQS regulations. MDNR also submitted a supporting rationale document, entitled *Rationale for Missouri Lake Numeric Nutrient Criteria, December 2017* (hereafter "Rationale document").[4] MDNR structured its nutrient criteria as a combined criterion approach applied on an ecoregional basis to three ecoregions: the Plains, Ozark Border and Ozark Highland. In the Rationale document, Missouri explains that its criteria are intended to protect the aquatic life use, deciding "that the focus of the current effort would be AQL [aquatic life] criteria." This addresses the issue of which designated use Missouri is intending to protect. Although MDNR's WQSs indicate that nutrient criteria "represent the desired condition for a water body necessary to protect the designated uses assigned in rule," it is clear from MDNR's record of adoption that the specific derivation and protections provided are with respect to aquatic life uses. As described below, applicable general criteria in narrative format remain in place to protect drinking water supply and recreational designated uses.

All lakes in Missouri are designated for aquatic life protection and recreation, and a subset of lakes are also designated for drinking water supply. The EPA's regulations at 40 C.F.R. § 131.11(a) require that criteria support the most sensitive use. The EPA's regulations at 40 C.F.R. § 131.11(b) specify that states should establish criteria as 1) numerical values and 2) narrative criteria where numerical criteria cannot be established or to supplement numerical criteria.

<u>MDNR's Criteria Support the Most Sensitive Use and Downstream WQSs</u>

When evaluating whether a state's new or revised criteria protect the most sensitive use for purposes of 40 C.F.R. § 131.11(a), the EPA interprets and implements its regulation at 40 C.F.R. § 131.11(a) to consider whether "criteria" are holistically protective. In other words, the set of adopted criteria, which may include both numeric and narrative criteria, are taken as a whole to protect the most sensitive use.

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[4] Missouri Department of Natural Resources. *Rationale for Missouri Lake Numeric Nutrient Criteria*. December 2017. Available at: https://dnr.mo.gov/env/wpp/rules/docs/mo-lake-nnc-rationale-dec-2017-final.pdf

For example, the EPA recommends that states adopt separate criteria for individual pollutants to protect aquatic life itself and to protect people when consuming the aquatic life (in operation, these endpoints may be encompassed in the same aquatic life use or, as Missouri does,[5] may be separated into distinct aquatic "habitat" and "human health protection" uses). Taken together, these criteria collectively protect the most sensitive use (either aquatic life itself or consumption of aquatic life by people), but their relative stringency may differ markedly. For many pollutants, there are insufficient data to derive criteria for both aquatic life and human health protection. The EPA does not consider the lack of consideration of one endpoint (*e.g.*, aquatic life or human health) in a numerical criterion to be a violation of 40 C.F.R. § 131.11(a) with respect to protecting the most sensitive use. Rather, the EPA would consider other elements of WQSs, such as narrative criteria, to provide the necessary protection of designated uses.

The Fourth Circuit in *Natural Resource Defense Council v. U.S. EPA* upheld the EPA's interpretation and implementation of its regulations to consider narrative and numeric criteria holistically when evaluating whether criteria together protect the most sensitive use. 16 F.3d 1395, 1404-05 (4th Cir. 1993). The court considered the term "criteria" in the statute and regulations and concluded that "where multiple uses are designated for a body of water, there may be multiple criteria applicable to it, as long as the criteria support the most sensitive use of that particular body of water." *Id.* at 1405. In that case, the court upheld the EPA's approval of numeric dioxin criteria for both Virginia and Maryland where the EPA evaluated whether the numeric criteria would protect the states' intended human health use, acknowledged that dioxin may have adverse effects on aquatic life, and concluded that the application of the states' "existing, separate narrative criteria protecting such aquatic life and wildlife could require more stringent controls in some cases than would be required through use of the human health criteria alone." *Id.* The court rejected the claim that "[s]tates have an obligation under the CWA or its accompanying regulations to adopt a single numeric criterion to protect against all identifiable effects to human health, aquatic life and wildlife." *Id.*

Consistent with its interpretation of 40 C.F.R. § 131.11(a), the EPA advised MDNR during its initial development of numeric nutrient criteria that "MDNR needs to consider all uses for which Missouri's lakes are designated and to develop criteria that are protective for all uses for which *adequate data and scientific information exist*" (USEPA 2016) (emphasis added). Under the EPA's regulations, a state's numeric criteria may be based on the EPA's 304(a) guidance or "other scientifically defensible methods." 40 C.F.R. § 131.11(b). For numeric nutrient criteria, the EPA recognizes that states have options when deciding what methodology to use and recognizes that a state's selected methodology may require different information and data. *See* 82 Fed. Reg. at 61,216-17.

Here, MDNR's drinking water supply use is defined as "Maintenance of a raw water supply which will yield potable water after treatment by public water treatment facilities." 10 CSR 20.7.031(1)(C)(6). The EPA advised MDNR during its initial development of numeric nutrient criteria that the department should evaluate "(a) available scientific reports addressing the effects of eutrophication on the prevalence of disinfection byproducts and taste/odor producing compounds in finished drinking water, and (b) the potential effects of algal toxins on sensitive human subpopulations (*e.g.*, children under six of age)" (USEPA 2016). This type of information is necessary for purposes of deriving criteria to protect Missouri's drinking water supply use because harmful algal blooms (*e.g.*, cyanobacteria that produce

[5] *See* Missouri Code of State Regulations 10 CSR 20-7.031(1)(c)

cyanotoxins) can endanger drinking water supply first by potentially contaminating improperly-treated drinking water with cyanotoxins and second, by increasing the amount of organic matter that can cause elevated levels of disinfection byproducts when treated in the drinking water facility (Falconer and Humpage 2005; Zamyadi et al. 2012).

In response, MDNR had considered developing a numerical criterion for protecting drinking water, provisionally considering a value of 25 μg/L for chlorophyll *a* based on analyses of available microcystin data in Missouri's lakes and a review of disinfection byproducts information from Missouri drinking water treatment plants. However, as explained in its Rationale document, MDNR considered the existing information relating to microcystin (a type of cyanotoxin) and determined that the existing information was inadequate for purposes of deriving nutrient criteria (MDNR 2017). MDNR is in the process of collecting additional data, including data for additional toxins other than microcystin, and believes that "additional data will help clarify the extent of algal toxins in Missouri's lakes, and combined with continued improvements in our understanding of both the factors that drive toxin production and the efficiencies of treatment in removing algal toxins from source water, will allow the state to better address drinking water protection during a future rulemaking." *Id.* Because EPA has not published 304(a) recommended criteria, nor provided specific guidance tailored to protect a drinking water supply use, the Agency supports Missouri's position that it needs to collect more data and conduct further analysis before establishing numeric expressions for nutrients in their WQSs. This is a matter of evolving science. As indicated in a recent document developed by the Interagency Working Group on the Harmful Algal Bloom and Hypoxia Research and Control Act, the EPA is itself "developing, in collaboration with states, Lake Numeric Nutrient Criteria that will inform how phosphorus and nitrogen concentrations contribute to HABs and drinking and recreational water criteria and swim advisories" (D'Anglada et al. 2018).

Missouri's whole-body contact use is defined as "[a]ctivities involving direct human contact with waters of the state to the point of complete body submergence. The water may be ingested accidentally and certain sensitive body organs, such as the eyes, ears, and the nose, will be exposed to the water. Although the water may be ingested accidentally, it is not intended to be used as a potable supply unless acceptable treatment is applied. Waters so designated are intended to be used for swimming, water skiing, or skin diving." 10 CSR 20.7.031(1)(C)(2)(A). The kind of information that are needed to derive numeric nutrient criteria specific to protect recreational uses may include studies on the effects of cyanotoxins on recreational uses. MDNR reviewed the existing information regarding recreational uses and determined that "[r]esearch and information continue to develop at the national level with respect to nutrient impacts and criteria for the protection of recreational uses. Missouri intends to pursue numeric nutrient criteria for recreational designated uses during a future rulemaking. This effort will allow studies currently underway by EPA and others on the effects of cyanotoxins on recreational uses to mature, and for the state to conduct user perception surveys of algae by the recreating public" (MDNR 2017).

After considering the relevant data and its record, the EPA has determined that MDNR's decision to focus its numeric nutrient criteria on the protection of applicable aquatic life uses at this time and defer development of numeric criteria specifically tailored to protect recreation and drinking water supply is reasonable. Given the circumstances here (*i.e.*, that the nutrient criteria are intended to implement what a "wide variety of biota" means for manmade lakes, and the lack of data and information relating to other

designated uses), it is difficult to definitively identify the most sensitive use. That said, the EPA has determined that to the extent aquatic life uses are the most sensitive use, the numeric nutrient criteria will provide sufficient protection, and to the extent it becomes evident that water supply or recreational uses are the most sensitive use, MDNR can rely on their existing general criteria.

Importantly, Missouri has existing general criteria in narrative form that can be interpreted to prevent harm to the drinking water supply and whole body contact recreational uses should conditions warrant in the interim. Scum, floating surface debris, unsightly color, turbidity and offensive odor are characteristics associated with blooms of cyanobacteria, which are a response to elevated levels of nutrients. As described above, the presence of cyanobacterial blooms can endanger the drinking water supply designated use first by producing cyanotoxins that may potentially contaminate improperly-treated drinking water, and second, by increasing the amount of organic matter that can cause elevated levels of disinfection byproducts when treated in the drinking water facility. The presence of cyanobacterial blooms may also pose a threat to recreational designated uses, as the cyanotoxins that can be produced by cyanobacteria can have serious human health impacts.

Missouri's adopted specific narrative criterion to protect lakes with a drinking water use provides that "the taste- and odor-producing substances shall be limited to concentrations that will not interfere with the production of potable water by reasonable water treatment processes." 10 CSR 20-7.031(5)(E). In addition, Missouri has numerous general narrative criteria that can be interpreted to protect either the applicable drinking water use and recreational use to prevent the potential harms discussed above. In particular, Missouri's General Criteria at 10 CSR 20-7.031(4) states [emphasis added]:

> *(A) [W]aters shall be free from substances in sufficient amounts to . . . prevent full maintenance of beneficial uses;*
> *(B) Waters shall be free from oil,* ***scum,*** *and* ***floating debris*** *in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses; and*
> *(C) Waters shall be free from substances in sufficient amounts to cause* ***unsightly color*** *or* ***turbidity, offensive odor,*** *or prevent full maintenance of beneficial uses.*
> *(D) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal, or aquatic life; and*
> *(E) There shall be no significant human health hazard from incidental contact with the water.*

For these reasons, MDNR's existing narratives sufficiently address the types of harm excess nutrients may present to lakes designated for drinking water supply and recreational uses and are available to MDNR if site-specific numeric translations become necessary to protect such uses beyond the protection provided by 10 CSR 20-7.031(5)(N). As is the case with all states, the EPA is available to work with Missouri, as additional data and information become available, to support state efforts to develop numeric nutrient criteria for recreation and drinking water supply uses.

Missouri WQSs also include a general criterion addressing protection of downstream waters: "Waters shall maintain a level of water quality at their confluences to downstream waters that provides for the attainment and maintenance of the WQSs of those downstream waters, including waters of another state." 10 CSR 20-7.031(4)(E). This provision is available to MDNR if site-specific numeric translations

become necessary to protect downstream standards beyond the protection provided by 10 CSR 20-7.031(5)(N). This provision addresses the requirements of 40 C.F.R. § 131.10(b) regarding downstream protection. It is comparable to the narrative provisions the EPA suggests states use for this purpose (*See* https://www.epa.gov/wqs-tech/templates-narrative-downstream-protection-criteria-state-water-quality-standards).

MDNR's Nutrient Criteria Protect the Aquatic Life Uses and are based on Sound Scientific Rationale

The EPA's regulations at 40 C.F.R. § 131.11(a) specify that criteria must be based on a sound scientific rationale and must protect the designated use. In establishing designated uses, states are directed to consider the use and value of water for, among others, aquatic life uses consistent with "protection and propagation of fish, shellfish, and wildlife." 40 C.F.R. § 131.10; 80 Fed. Reg. 51020, 51024 (August 21, 2015). States have significant latitude in how they may specify and describe their designated uses (USEPA 2012b). Through its criteria development methodologies, EPA generally recommends that states consider protection of a broad spectrum of species that are expected to occur in their waters (USEPA 2017a).

MDNR's Aquatic Life Uses Defined

Missouri defines its applicable aquatic life uses as "waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a wide variety of [warm, cool or cold water] biota," depending on the specific habitat use.[6] There are no lakes designated as cool water habitat and only four designated as cold water habitat, all in the Ozark Highlands ecoregion: Lake Taneycomo, Bull Shoals Lake, East Arrowhead Lake and West Arrowhead Lake. The rest of the lakes covered by MDNR's nutrient criteria are designated for warm water habitat aquatic life use. Missouri WQSs describe warm water habitat as "waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a wide variety of warm-water biota" and cold-water habitat as "waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a wide variety of cold-water biota. These waters can support a naturally reproducing or stocked trout fishery and populations of other cold-water species." 10 CSR 20-7.031(1)(C)1.C. Missouri WQSs also contain special protections for Lake Taneycomo: "An especially stringent antidegradation policy will be observed in the development of effluent rules, discharge permits, and nonpoint-source management plans and permits to assure that the high visual quality and aquatic resources are maintained." 10 CSR 20-7.031(10).

Neither Missouri in their rulemaking nor EPA in its proposed rule made a distinction in the expression of nutrient criteria among warm, cool and cold-water habitat designated uses for aquatic life protection. Both MDNR and EPA lack specific data to evaluate whether different or additional protections are needed to protect cold water species in these Missouri lakes. The EPA does not have data that would indicate that Missouri's nutrient criteria would not protect cold water habitat.

[6] Missouri Department of Natural Resources. WQSs Regulations. 10 CSR 20-7.031(1)(C)1.A.VI, B.V and C.V.

MDNR's Nutrient Criteria Approach for Manmade Reservoirs Aligns with the Applicable Aquatic Life Use Definitions

In Missouri, all lakes are manmade reservoirs created by dams on river channels. In past correspondence with MDNR, the EPA has recommended a "reference condition" approach to developing nutrient criteria for Missouri's lakes and EPA proposed an alternative that used that approach. In its Rationale document, MDNR explains that "use of reference conditions is better suited for natural lakes than man-made reservoirs because Missouri's reservoirs were built long after large scale land-cover changes occurred on the landscape." MDNR further says: "Reservoirs are highly managed for purposes that may or may not be well aligned with expectations for a pristine, natural lake" and "[f]urthermore, nutrients in reservoirs are driven by human decisions such as dam height and watershed size, which depend on where the dam is built within the river valley."

Reservoirs that are created by damming rivers tend to have larger watersheds than natural lakes of comparable water surface area (Chapman 1996; Thornton et al. 1981). Because a reservoir typically has one major river inflow, and may also experience periodic withdrawals, the variable water levels may impede the development of a littoral zone (transition zone between open water and land where rooted aquatic plants tend to grow and provide habitat for fish and other aquatic animals) (Chapman 1996; Wetzel 1990 as cited in USGS 2018). As a result, reservoirs generally experience greater nutrient and sediment loading, and greater rates of sedimentation (Thornton et al. 1981; Maavara et al. 2016). These factors may lead reservoirs to have less biological diversity than natural lakes of the same region and comparable size (Wetzel 1990 as cited in USGS 2018; Logez et al. 2016; Schallenberg et al. 2013; Northcote and Atagi 1997).

Although the EPA has recommended a reference condition approach for lakes and reservoirs (USEPA 2000a) and proposed such an approach for Missouri's lakes and reservoirs, the Agency has also recommended other approaches (USEPA 2010a) and acknowledged that Missouri may pursue other approaches. USEPA 2011; 82 Fed. Reg. at 61,225. Missouri has discretion to choose an alternative sound scientific rationale for developing protective criteria, and it is reasonable for Missouri to consider an alternative to a reference condition approach. 40 C.F.R. § 131.11(b).

In its submission and supporting rationale, MDNR made clear it "considers the status of the recreational fishery as an indicator of the reservoir's suitability for aquatic life" for manmade lakes and that its "findings show the health of sport fish populations can be interpreted as an indicator of overall ecosystem health and the presence of a 'wide variety' of aquatic biota, as defined in the existing regulation."[7] After considering the relevant science, MDNR determined that the protection of a healthy sport fish population is an appropriate management endpoint for Missouri's manmade lakes for the protection of aquatic life uses from excess nutrients. MDNR reasoned that sport fish are apex predators, and that water quality and habitat conditions that maintain a healthy sport fish population in manmade lakes would necessarily maintain a wide-variety of warm water, cool, or cold-water biota that serve as a food web community for those fish populations. This reasoning would hold regardless of habitat type, warm or cold.

[7] *See* Missouri Department of Natural Resources, Rationale for Missouri Reservoir Nutrient Criteria Development, November 2016, Section 6.1, pages 33 – 39.

Scientific literature abounds with studies indicating that increased levels of nutrients and primary production (algal growth) measured by chlorophyll *a* are associated with increased biomass of fish, with different levels of productivity favoring certain types of species over others in many cases depending on many other factors affecting habitat (Allen et al. 1988; Bachmann et al. 1996; Bayne et al. 1994; Brucet et al. 2013; Downing et al. 1990; Elliott et al. 1996; Hoyer and Canfield 1996; Maceina & Bayne 2001; Persson et al. 1991; Plante and Downing 1993; Randall et al. 1996; Walker et al. 2007). In its Rationale document, MDNR indicated it considered many of these studies. Both natural and manmade lakes are considered in these studies, but the general findings with respect to productivity are applicable to manmade lakes. Researchers have also described that there are likely limits to lake productivity (meaning algal growth that leads to increased fish biomass), and that at some point increased enrichment (nutrient loading or eutrophication) may lead to loss of productivity as water quality conditions such as dissolved oxygen levels deteriorate[8]; however, these levels appear to be quite high, higher than the levels Missouri has established for either their Response Impairment Thresholds or Nutrient Screening Thresholds (Allen et al. 1999; Bachmann et al. 1996; Bayne et al. 1994; Egertson and Downing 2004; Michaletz et al. 2012; Ney 1996). The upper end of the chlorophyll *a* range in the first five studies cited above were 40, 241, 34, >100, and 114 μg/L, respectively, with no reported limit of productivity reached. Less certain is the effect of increased productivity on species diversity. In general, the literature includes many studies that point to a different mix of species present at different levels of overall productivity.

- Bachmann et al. (1996) studied the growth of fish in 65 Florida lakes that ranged from oligotrophic through hypereutrophic lakes (chlorophyll *a* concentrations 1–241 μg/L). The authors found total standing fish crops of fish positively correlated with chlorophyll *a*, TN, and TP. In this study, increases in trophic state did not result in a decrease in the number of fish species per lake. The recreationally important centrarchids (*e.g.*, largemouth bass, bluegill, crappies) as a group increased in biomass, with only a couple individual species exhibiting lower standing crops or lower proportions with higher trophic states. The authors characterize the results as "centrarchids did not show important changes with trophic state."

- Allen et al. (1998) studied the relationship of increasing productivity and largemouth bass populations in Alabama reservoirs (chlorophyll *a* concentrations ranging 8–40 μg/L). Increased chlorophyll *a* was positively correlated with an increase in juvenile shad (the prey fish) and juvenile largemouth bass.

- Downing et al. (1990) synthesized previously published literature on fish biomass in lakes covering a wide range of geographic areas and trophic status. They found fish production to be closely correlated with phytoplankton production and TP. The authors did not find any break point in chlorophyll *a* or TP where fish production dramatically increases or decreases.

- Bayne at al. (1994) studied the response of fish and zooplankton to trophic gradient in reservoirs in the southeastern U.S., with chlorophyll *a* ranging from 2-34 μg/L. Rotifer and zooplankton increase

[8] Increased nutrient loading (*i.e.*, eutrophication) leads to algal growth that could eventually exceed the needs of a growing fish population and then decay and use up available dissolved oxygen, which in turn could adversely affect sport fish to the point that a healthy population could not be maintained.

with increasing trophic status, but crustacean zooplankton did not. Fish abundance and biomass was positivity correlated to trophic state. Species composition varied by lake (*e.g.*, mesotrophic lakes had mostly sunfish, minnows, shad; eutrophic lakes had mostly shad).

- Elliott et al. (1996) examined fish population density in a natural lake that had experienced nutrient enrichment both before and after phosphorus effluent concentrations were reduced. When there was increasing eutrophication, charr populations declined and brown trout became more abundant. The abundance of each species varied by lake depth and time of day (possibly related to temperature and dissolved oxygen concentrations).

- Ney (1996) examined published literature and concludes that available evidence indicates that maximum sport fish biomass would occur at TP concentrations >100 μg/L, and states that it is intuitive that productivity would subsequently peak (and then fall off) in reservoirs as hypolimnetic oxygen depletion or excessive vegetative cover degrades habitat.

- Robillard and Fox (2006) saw a shift in species composition among piscivorous fish in shallow Canadian lakes—from walleye to bass—after declines in phosphorus concentration and increased water clarity. The authors cite additional pressures such as introduction of exotic species and other anthropogenic stressors as possibly influencing species abundance.

- Maceina and Bayne (2006) identified shifts in species composition among sportfish associated with reductions in waterbody nutrient concentrations. A decrease in chlorophyll *a* concentrations from > 40 μg/L (in 1987–1988) to 9–17 μg/L (in 1998–1999) resulted in a decline in largemouth bass recruitment as well as growth rates. An increase in spotted bass recruitment was seen as chlorophyll *a* levels decreased. Overall, there was a shift toward smaller spotted bass and fewer, smaller, and less robust largemouth bass with lower concentrations of chlorophyll *a*.

- Walker et al. (2007) summarized a number of studies on nutrient concentrations appropriate for sport fish in lakes and reservoirs. Cited studies showed that the chlorophyll *a* concentrations at which peak abundance of sport fish occurred varies by species, and were dependent on other conditions. The authors point out that there are differences in how one would manage a lake to maintain sport fisheries, depending upon the desired fish species. The authors note that generally, fish populations in small lakes and reservoirs are more subject to influence by non-nutrient factors (*e.g.*, suspended sediments, physical features, and structural elements) than fish populations in large lakes and reservoirs.

- Persson et al. (1991) built on previous studies that found that substantial changes to fish species composition take place with increasing productivity. The authors found a change in fish species present with increasing productivity in Swedish lakes, and that fish biomass of each species peaks at different levels of productivity. For instance, in lakes with medium productivity, proportion of piscivores in the total fish biomass peaked. With increasing productivity, there was a general shift from a dominance by salmonids to percids (perch) to cyprinids (minnows).

- Jeppesen et al. (2000) studied 71 mainly shallow Danish lakes along a TP gradient of 2 to 990 μg/L and found a significant decline in species richness of zooplankton and submerged macrophytes as TP

increases, and an increase in species richness for fish, phytoplankton, and floating-leaved macrophytes, all peaking at 100-400 μg/L. The authors also report a shift from piscivorous fish (particularly perch) to planktic-benthivorous cyprinids (roach, in this case) with TP.

- Egertson and Downing (2004) examined 32 lakes in Iowa (a mix of impoundments and natural lakes) with chlorophyll *a* spanning from approximately 10 to 100 μg/L and found that total fish and sport fish (defined as crappie, bluegill, and channel catfish) biomass increased with lake trophic status. However, sport fish, and bluegill in particular, declined significantly as a fraction of total catch, while benthivores (defined as carp and black bullhead) increased significantly as a fraction of total catch. This study did not identify a specific break point for chlorophyll *a* associated with each species and did not include specific data for each species for analysis.

- Weber and Brown (2011) examined fish populations in 81 lakes in eastern South Dakota along with various physicochemical characteristics. The authors found inverse relationships in relative abundances between common carp and native fishes, and that lakes with greater carp abundance also had larger surface areas and watersheds and higher dissolved solids and chlorophyll *a* and lower secchi depth based on multivariate statistical analysis. The authors do not identify any water quality thresholds.

- Michaletz et al. (2012) examined fish populations in 89 small (<400 ha) impoundments in Missouri with chlorophyll *a* spanning from 2 to 114 μg/L and found that variables associated with predation, competition, and lake fertility were most important in explaining variation among sport fish populations. The authors discuss the negative impacts of common carp on relative abundance of largemouth bass, but do not identify specific water quality levels where these impacts occur. The authors note that apparently few of the study lakes contained nutrient levels high enough to allow negative effects on sport fish populations.

- Brucet et al. (2013) analyzed a large dataset in an attempt to distinguish the relative contributions of natural and anthropogenic local factors on patterns of fish diversity in European lakes at different geographical scales. They concluded that local fish species richness and diversity were related mainly to morphometric and (bio)geographical/climatic variables. In general, there was greater species richness and diversity in larger and deeper lakes in warm areas. They also found that fish density was related mainly to productivity. After controlling for the natural factors, productivity had a positive effect on fish species richness and diversity, whereas it negatively influenced fish size.

The studies summarized above demonstrate that, as a general matter, as nutrient levels increase in a lake system, algal growth and fish biomass also increase, with increasing abundance of most, if not all, fish species. At the same time, as overall productivity increases there can be a shift in the relative proportion of species present in a lake, with benthivore species (*e.g.*, catfish, carp) more able to exploit the increased energy and food sources than piscivore species (*e.g.*, largemouth bass, bluegill, crappie) at some point in the process. The available scientific literature does not identify a universal point on this spectrum of algal growth, measured by chlorophyll *a*, where meaningful shifts in populations would occur in lakes. Rather, the shifts can occur at different levels depending on many other biotic and abiotic factors. The particular mix of species that is desired for a manmade lake is more a matter of preference and judgment than a matter of science.

As explained below, the key to MDNR's combined criterion approach is the protectiveness of the "Response Impairment Threshold" for chlorophyll *a* in the three ecoregions. For natural systems, such as rivers and lakes formed by glaciers or other natural processes for example, it is more feasible to identify an expected level of productivity and mix of species with respect to nutrient levels (*i.e.*, an expected trophic state) to serve as a target for nutrient criteria development, but this exercise is more difficult for reservoirs, which are highly managed systems[9]. The question becomes more a matter of what do naturally occurring water quality and habitat conditions mean for manmade lakes and what mix of sport fish species does a state wish to manage these systems to maintain. In its selection of Response Impairment Thresholds for chlorophyll *a*, MDNR has identified what the scientific literature would generally describe as eutrophic conditions (highly enriched) to represent the upper bound for their Plains Ecoregion lakes (Jones et al. 2008a and Nürnberg 1996, as cited in MDNR 2017). For the Ozark Highland and Ozark Border Ecoregions, MDNR identified targets closer to the boundary with the mesotrophic range. *Id.*

In a letter from Mr. Brian Canaday, Fisheries Division Chief of the Missouri Department of Conservation, to Mr. Chris Weiburg, Water Protection Program Director of the Missouri Department of Natural Resources, dated June 18, 2018, Mr. Canaday writes:

> The Department effectively manages fish populations in Missouri's major reservoirs for a sport fish combination of black bass spp., bluegill, crappie and catfishes. Those populations are self-sustaining and managed through effective regulation and enforcement. Supplemental stocking for these primary species is not needed.
>
> Additionally, those reservoirs also have strong populations of non-sportfish that are self-sustaining and managed through effective regulation and enforcement. Again, supplemental stocking is not needed to maintain these populations.[10]

In its Nutrient Criteria Implementation Plan dated July 27, 2018, the Missouri Department of Natural Resource discusses the Response Assessment Endpoint of "Observed shifts in aquatic diversity attributed to eutrophication" (10 CSR 20-7.031(5)(N)6.D):

> Relative abundances of fish at the various levels of the food chain can be surveyed to see if it is in balance. High nutrient inputs along with high levels of suspended solids can cause a decrease in the number of sight-feeding predators and an increase in the number of the prey that the predators are unable to catch. More numerous prey put a strain on the resources available, resulting in smaller prey and smaller, less numerous predators. This imbalance in the number and/or size of fish, or a shift to less sight-feeding fish in favor of bottom-feeding fish such as carp, due to eutrophication is a cause for concern. (MDNR 2018).

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[9] Management actions could include licensing, hydrology alteration, dam operation, physical habitat enhancement, and other actions.

[10] Mr. Canaday goes on to say that the Department stocks additional fish species to provide a "bonus" or "specialty" sport fishing opportunity, including but not limited to paddlefish, rainbow trout, brown trout, striped bass, hybrid striped bass, walleye, and muskellunge.

Taken together, these statements indicate Missouri is most interested in maintaining a healthy sport fishery of black bass species (*e.g.*, largemouth bass, smallmouth bass), other sunfish such as bluegill and crappie (which are also "sight feeding" piscivores), and catfish, but wishes to avoid an "imbalance" or shift to bottom-feeding fish such as carp. Missouri does not elaborate further on what constitutes an "imbalance" or "shift." One study (Egertson and Downing 2004), cited by both MDNR in its Rationale document and commenters, suggests that the decreasing proportion of total catch of sport fish (defined in the study as crappie, bluegill, and channel catfish) and increasing proportion of total catch of benthivores (defined in the study as carp and black bullhead) occur as a continuum over a range of chlorophyll *a* from approximately 10 to 100 µg/L, but the benthivore group does not overtake the sport fish group in proportion of catch until approximately 70 µg/L (*See* Figure 4 of the cited document), which is well above the numeric values in MDNR's nutrient criteria. The same study indicates that the biomass of sport fish remains constant or increases slightly over the same chlorophyll *a* range (*See* Figure 3of the cited document). It will be a matter of state implementation as to how it will specifically identify what constitutes "observed shifts in aquatic diversity attributed to eutrophication" (10 CSR 20-7.031(5)(N)6.D) related to protection of a wide variety of biota.

MDNR's Nutrient Criteria are Based on a Sound Scientific Rationale and Protect the Aquatic Life Uses as Applied to Missouri's Manmade Reservoirs

The EPA supports a "combined criterion" approach that integrates causal (nitrogen and phosphorus) and response parameters and has provided Guiding Principles (USEPA 2013) for their development and construction. EPA recognizes that the specific levels of TN and TP that adversely affect designated uses, including harm to aquatic life as indicated by various measures of ecological responses, may vary from waterbody to waterbody, depending on many factors, including geomorphology and hydrology among others. As a result, EPA has worked with several states as they developed a combined criterion approach that allows a state to determine that a waterbody is meeting designated uses despite elevated TN and TP levels where there is evidence to confirm that the designated uses are in fact not impaired from excess nutrients. The physical, chemical, and biological parameters that serve as evidence to confirm protection of designated uses are collectively termed "response" parameters. EPA's articulation of this combined criterion approach is intended to apply when states wish to rely on response parameters to indicate that a designated use is protected, even though a nitrogen and/or phosphorus level is/are above an adopted threshold. As with any criteria, states should make clear when a waterbody is meeting and not meeting its designated use.

MDNR's combined criterion approach includes three components: Response Impairment Thresholds for chlorophyll *a* which represent a "ceiling" above which a lake is considered impaired (not meeting its aquatic life designated use); Nutrient Screening Thresholds for chlorophyll *a*, TP, and TN which represent a "floor" below which a lake is considered to be attaining its aquatic life designated use; and a set of five Response Assessment Endpoints to determine attainment status in between.

1. Response Impairment Thresholds Components

MDNR adopted chlorophyll *a* criteria for the Plains, Ozark Border and Ozark Highland of 30 µg/L, 22 µg/L, and 15 respectively called "Response Impairment Thresholds." In its Rationale document, MDNR describes a process of literature review and discussion with fishery management professionals for

selecting Response Impairment Thresholds (MDNR 2017). MDNR specifically refers to the "sport fish biomass peak" near 100 µg/L identified in Ney (1996) and its correlation to approximately 36 µg/L chlorophyll *a* in the Plains ecoregion (using the regression equations appearing on Figure 5-3 of the Rationale document), observing that the selected threshold of 30 µg/L is "more conservative" (MDNR 2017). Given the range of chlorophyll *a* from studies summarized above (*i.e.*, at least between 10 µg/L and 100 µg/L) concurrent with observed abundances of fish species identified by MDNR as their target sport fish, and the reasons MDNR summarizes on pages 26-27 of their Rationale document (MDNR 2017), the EPA considers the selection of 30 µg/L for the Plains to be reasonable with respect to protecting a wide variety of biota and maintaining a healthy sport fish population as Missouri defines it.

In its Rationale document, MDNR describes the chlorophyll *a* threshold of 15 µg/L for the Ozark Highlands as reflective of the "regional pattern of reservoir fertility associated with the different physiographic regions of the state" and the threshold of 22 µg/L for the Ozark Border as an intermediate value representing a transition zone between the Plains and Ozark Highlands. It is evident from the data displayed in Figures 5-2 and 5-3 of the Rationale document that the overall distributions of chlorophyll *a* and nutrient levels differ among the three ecoregions, with higher productivity in the Plains, intermediate productivity in the Ozark Border, and lower productivity in the Ozark Highlands. The EPA observes that the 75th percentile of growing season chlorophyll *a* geometric means (presented on Figure 5-2 of the Rationale document) of 31 µg/L, 27 µg/L, and 13 µg/L for the Plains, Ozark Border, and Ozark Highlands, respectively closely approximate MDNR's selected thresholds (30 µg/L, 22 µg/L, and 15 µg/L for the Plains, Ozark Border, and Ozark Highlands, respectively). As discussed above, MDNR's adopted value for the Plains is protective of MDNR's aquatic life use and therefore the 75th percentile of growing season chlorophyll *a* geomeans for the Ozark Border and Highlands represent protective values. The value adopted for the Ozark Border, 22 µg/L, is more conservative than the 75th percentile value of 27 µg/L. The difference between the value adopted for the Ozark Highlands, 15 µg/L, as compared to 75th percentile value, 13 µg/L, are comparable. Because of the different physiographic features, lakes in the Ozark Border and Ozark Highlands do not exhibit as high a level of productivity (or "reservoir fertility" as MDNR phrases it) as lakes in the Plains. As such, establishing lower thresholds for chlorophyll *a* reflects these differences in terms of expectations for the associated mix of species that define the aquatic habitat use in each ecoregion. The EPA has determined that this rationale supports MDNR's establishment of differing Response Impairment Thresholds for each ecoregion and for establishing the specific values MDNR selected. Furthermore, it is reasonable to use these regional boundaries based on their demonstrated differences in nutrient enrichment.

The EPA recognizes that lakes in Missouri currently reflect a mix of trophic state conditions, and that the optimal selection of an upper bound depends in part upon the desired mix of aquatic life species and desired relative and absolute abundance. The EPA further recognizes Missouri has discretion to establish this intended level of protection given the variable habitat conditions of manmade lakes and the subjective nature of the term "wide variety" with respect to manmade managed systems. The EPA also recognizes that this degree of productivity expressed as chlorophyll *a* is consistent with similar CWA Section 303(c) WQS approval actions for comparable subsets of lakes in other states, such as in Minnesota (Heiskary and Wilson 2008) and Virginia (Zipper et al. 2005; Walker et al. 2007).

As discussed above, Missouri broadly defines its aquatic life as "wide variety of biota," and has explicitly determined that sport fish can be interpreted as an indicator of a sufficiently "wide variety of

biota" in their waters. Based on its review of available information cited above, EPA has concluded that Missouri's Response Impairment Thresholds will protect a general target of sport fish populations and are therefore based on sound scientific rationale and protective of the aquatic life use. EPA acknowledges that in its proposed rule, it identified chlorophyll *a* criteria values in its "Alternative 1" as "ceiling" values (above which impairment is determined) that are more stringent than MDNR's Response Impairment Thresholds. This difference in values is a result of the fact that for "Alternative 1," the EPA interpreted Missouri's aquatic life uses (and other uses) as protected where conditions are "least disturbed," whereas MDNR interprets their aquatic life uses as a highly productive sport fishery. As discussed above, EPA recognized in its proposal that Missouri could choose to address EPA's disapproval using a variety of approaches and MDNR's adopted nutrient criteria for manmade reservoirs aligns with its aquatic life use definitions.

2. Nutrient Screening Thresholds Components

Missouri's nutrient criteria include not just the chlorophyll *a* Response Impairment Thresholds, but also Nutrient Screening Thresholds and Response Assessment Endpoints that work in conjunction to provide additional protection of aquatic life uses. When a Nutrient Screening Threshold is exceeded, a Response Assessment Endpoint may confirm that aquatic life uses are not protected.

As documented in its Rationale document, MDNR derived the Nutrient Screening Thresholds for chlorophyll *a* as the 50th percentile of the distribution of growing season data for each ecoregion (*See* Figure 5-2 of the Rationale document) and for TP and TN using the regression relationships presented in Figure 5-3. These values closely approximate the values the EPA had calculated as protective under "Alternative 1" of the federal proposal from December 2017. The EPA derived these using the 75th percentile of reference conditions from least disturbed watersheds in Missouri (USEPA 2017b). For the Plains, the EPA proposed TP, TN and chlorophyll *a* nutrient protection values of 44, 817, and 14 µg/L, respectively.[11] For the Plains, MDNR established TP, TN, and chlorophyll *a* Nutrient Screening Thresholds of 49, 843, and 18 µg/L, respectively. These are comparable values because the differences between them are small (*i.e.*, 44 versus 49, 817 versus 843, and 15 versus 18) considering the range of measured variability of these parameters (*e.g.*, *See* 5-3 in MDNR 2017) and such differences are not significant in terms of when a shift in biology generally would be expected (*e.g.*, *See* Table 5-1 of MDNR 2017). Likewise, the proposed values for a combined Ozarks ecoregion that are between the values MDNR established for Ozark Border and Ozark Highlands. The values in the EPA proposal "Alternative 1" and the values MDNR established as Nutrient Screening Thresholds have the same purpose: to establish a floor below which lakes are presumed to support designated uses they are intended to protect. Although the EPA and MDNR derived these values using different methods, they are nonetheless comparable in magnitude (factoring in that the EPA chose to combine the Ozark ecoregion and thus identified higher productivity levels for the Ozark Highland lakes and lower productivity levels for the Ozark Border lakes than did MDNR, above which to examine effects). The EPA remains confident that the reference condition-derived values for "Alternative 1" reflect an appropriate floor below which adverse impacts from nutrient enrichment should not occur, and thus the EPA is likewise confident that MDNR's Nutrient Screening Thresholds are appropriate for the same function because these sets of values closely approximate each other.

3. Response Assessment Endpoint Components

[11] Subsequent to the proposal, the EPA found the correct calculation for chlorophyll *a* to be 15 µg/L, not 14 µg/L.

The potential adverse responses are articulated in a combination of narrative and quantitative Response Assessment Endpoints. Response Assessment Endpoints are related to biological (fish mortality, cyanobacteria, and shifts in aquatic diversity) and chemical (dissolved oxygen and pH) responses to elevated levels of TN, TP, or chlorophyll *a*. A fifth Response Assessment Endpoint relates to a physical attribute (excess turbidity that can limit productivity during certain times and thus mask potential impairments).

a) **Occurrence of eutrophication-related mortality or morbidity events for fish and other aquatic organisms.** This endpoint is related to water quality that may not be protective of the aquatic habitat designated use. In its Implementation document, MDNR indicates it will review individual and annual fish kill reports from the Missouri Department of Conservation (MDC) and determine impairment if there are more than one fish kill within 10 years or one large fish kill (>100 fish covering more than 10 percent of the lake area) caused by dissolved oxygen excursions, pH, algal blooms, or the toxins associated by algal blooms. The EPA approves MDNR's adoption of this Response Assessment Endpoint because such an event would be evidence of aquatic life use impairment.

b) **Epilimnetic excursions from dissolved oxygen or pH criteria.** This endpoint addresses ecosystem function parameters (USEPA 2013). The processes of photosynthesis and respiration fueled by nutrients can affect both dissolved oxygen and pH level throughout the lake, potentially causing wide daily variation. In its Implementation document, MDNR includes a lengthy description (page 13-15) of thermal stratification and why this should limit application of this endpoint to the epilimnion (the endpoint would apply to the entire lake depth in the absence of stratification, and thus no discernible epilimnion). In Missouri WQS, dissolved oxygen and pH criteria are not qualified in this manner[12], as MDNR elected to do in the context of this component of nutrient criteria. The presence of stratification and its impact on dissolved oxygen (and pH) levels is not in dispute between MDNR and the EPA. Although the EPA recognizes the effects of stratification, in its proposed rule the EPA elected not to limit the applicability of dissolved oxygen and pH criteria to the epilimnion to be consistent with the expression of those criteria in Missouri WQS. The EPA approves the combined criterion aspect that exceeding the dissolved oxygen or pH criterion in the epilimnion (or whole lake in the absence of stratification) in the same year as a Nutrient Screening Threshold is exceeded would constitute an aquatic habitat impairment. MDNR could consider developing an appropriate approach for evaluating dissolved oxygen and pH protection of aquatic habitat within the hypolimnion as other states have done.

c) **Cyanobacteria counts in excess of one hundred thousand (100,000) cells per milliliter (cells/mL).** This endpoint is related to primary productivity in the form of cyanobacteria at levels that are indicative of the potential production of cyanotoxins creating a harmful algal bloom. While the Response Impairment Thresholds reflect the primary response parameter addressing excess primary production of chlorophyll *a*, the cyanobacteria endpoint can function as a useful supplement. In its Implementation document, MDNR explains that algal toxins can be harmful to aquatic life as well as human health and pets. MDNR cites cost concerns with routine monitoring of cell counts and describes a program of monitoring algal toxins and evaluating them as a surrogate. MDNR indicates its intention to use thresholds for

[12] This action does not alter the EPA's prior approval of these criteria in Missouri WQS.

four specific algal toxins used by the Oregon Health Authority (which are themselves based on draft EPA health advisory information), explaining that those levels are "associated with a total toxigenic algal species cell count greater than or equal to 100,000 cells/mL." The EPA recognizes this is an evolving area of science and there remains uncertainty concerning levels of cyanobacteria that specifically harms aquatic life. This endpoint is reasonable for informing MDNR of an impairment condition related to a response to elevated levels of TN, TP, and chlorophyll *a*.

d) **Observed shifts in aquatic diversity attributed to eutrophication.** This endpoint directly addresses the desired mix of species that is inherent in MDNR's derivation of Response Impairment Thresholds. As described above, MDNR has expressed in its Implementation document that an "imbalance in the number and/or size of fish, or a shift to less sight-feeding fish in favor of bottom-feeding fish such as carp due to eutrophication is a cause for concern" (page 16). In the same document, MDNR describes the regular fish population monitoring and annual reporting conducted by MDC, and MDNR's intention to use this information to evaluate this endpoint. The EPA supports use of this information in the context of evaluating this endpoint and encourages MDNR to continue to develop approaches that specifically identify- and facilitate management interventions to avoid - shifts that do not reflect desired aquatic diversity conditions in Missouri lakes. The EPA approves MDNR's endpoint because observed shifts in aquatic diversity along with exceedances of a Nutrient Screening Threshold will identify potential aquatic life use impairment.

e) **Excessive levels of mineral turbidity that consistently limit algal productivity during the period May 1 – September 30.** This endpoint relates to reduced water column transparency that can suppress levels of chlorophyll *a* despite high levels of nutrients. In its Implementation document, MDNR explains the purpose of this endpoint to ensure that periodic suppression of excess primary production that nonetheless manifests itself at other times does not go unassessed. In the same document, MDNR describes several approaches to monitor mineral turbidity and transparency with some quantitative thresholds for specific types of measures. The specific secchi depth thresholds provided are consistent with or more protective than the thresholds suggested by the EPA in its Technical Support Document in support of "Alternative 1" of the proposed federal rule. The EPA approves inclusion of this endpoint in the combined criterion approach as an additional protection measure.

The EPA has stated that "all causal and response parameters should be expressed numerically" in a combined criterion approach (EPA 2013). Each of MDNR's Response Assessment Endpoints are quantitative in some respect if the further articulation in MDNR's Implementation Plan (MDNR 2018) is considered, except for the observed shifts in aquatic diversity, which is not conducive to quantification at this point. Key indicators of nutrient pollution include measures of primary productivity, measures of the algal assemblage, and measures of ecosystem function as biological response parameters (EPA 2013). MDNR's combined criterion approach includes numerical expressions for chlorophyll *a* (primary production), cyanobacteria (algal assemblage), and dissolved oxygen and pH (ecosystem function) as response endpoints. Because MDNR's approach includes all these measures, the EPA considers the suite of response parameters included in MDNR's combined criterion approach to be sufficiently numeric. For the reasons articulated in this and the previous section, the EPA has determined that MDNR's Nutrient Screening Thresholds and Response Assessment Endpoint are based on sound science and protective of the aquatic life use.

4. Duration and Frequency

Missouri specified that the Response Assessment Endpoints and Nutrient Screening Thresholds have a one-year duration and frequency and are to be evaluated within the same year. In contrast, in "Alternative 1" of the federal proposal, the EPA provided a three-year window. The EPA's intent was to ensure that sufficient data would be available, that is, effects within this window could reflect effects that occur within the same year but went unassessed. MDNR's final rule requires data for the Response Assessments Thresholds shall be collected at the same time as Nutrient Screening Thresholds are assessed, which should limit instances of inadequate information and unassessed waterbodies. 10 CSR 20-7.031(5)(N)6.

MDNR specifies that its Response Impairment Thresholds for chlorophyll *a* and its Nutrient Screening Thresholds for chlorophyll *a*, TN and TP reflect a seasonal geometric mean. This is appropriate because (1) the seasonality reflects the period of time when concern for excess primary production occurs (*i.e.*, the spring and summer months when algal production is at its peak) and (2) the geometric mean reflects a standard way to represent the central tendency and variability of data that typically occur as a log-transformed normal distribution and to guard against the statistical distortions created by unusually high or low values (*e.g.*, Jones et al. 2008b). The Response Impairment Thresholds include a no more than one in three-year return frequency allowance, which is typical of independently applied numeric criteria for pollutant parameters which are intended to reflect long-term conditions and where the aquatic ecosystem has some ability to recover from short-term impacts (USEPA 2010b[13]). Shorter term impacts (*i.e.*, those manifesting themselves in a single year) are addressed with the combination of Nutrient Screening Thresholds and Response Assessment Endpoints, which are applied on an annual basis for duration and frequency. The duration and frequency aspects of MDNR's combined criterion components are based on sound scientific rationale and protective of their aquatic life designated uses.

MDNR's Nutrient Criteria Components Operate to Protect the Aquatic Life Uses

Missouri's nutrient criteria are structured as an integrated or combined criterion that consists of stand-alone criteria for chlorophyll *a* (Response Impairment Threshold); separate TN, TP and chlorophyll *a* values (Nutrient Screening Thresholds); and five response parameters (Response Assessment Endpoints) for three ecoregions. Exceeding the Response Impairment Threshold indicates the criterion is not met. Water quality below the Response Impairment Thresholds, but above any of the Nutrient Screening Thresholds will be examined for observations of Response Assessment Endpoints. If any of the Response Assessment Endpoints are observed, the lake is not meeting the criterion. If none are observed, the lake would be meeting the criterion. If data are lacking for the Response Assessment Endpoints, the lake would be deemed unassessed until the data are collected.

EPA recognizes that MDNR's combined criteria approach differs from EPA's 2013 Guiding Principles in a number of ways. Like all agency guidance documents, the Guiding Principles provide recommendations to states and stakeholders, but the agency cannot mandate any specific action, outcome or requirement through guidance. As described below, EPA has determined that despite some differences, MDNR's criteria are based on a sound scientific rationale and are designed to protect the aquatic life uses.

[13] See discussion on pages 108-110.

Missouri's construction of its combined criterion is unusual in the EPA's limited experience because it includes a chlorophyll *a* Nutrient Screening Threshold in the typical position of a "causal" parameter rather than a "response" parameter, whereby a Response Assessment Endpoint would need to occur to determine that the criterion is not met, regardless of whether the chlorophyll *a* Nutrient Screening Threshold is exceeded. Without any other provision, this construction would be problematic because chlorophyll *a* could exceed any level as long as there is not a Response Assessment Endpoint exceedance. This is contrary to long standing science that documents the central role that elevated primary productivity (measured by chlorophyll *a*) plays in protecting aquatic life uses in lakes from adverse effects of nutrient enrichment (USEPA 2000a; USEPA 2013). However, Missouri also includes a separate Response Impairment Threshold for chlorophyll *a*, which operates as a stand-alone criterion. Thus, the protectiveness of the Response Impairment Threshold for chlorophyll *a* is a critical component to the protectiveness of Missouri's combined nutrient criterion. EPA has explained above why the stand-alone chlorophyll *a* Response Impairment Thresholds protects the applicable aquatic life uses for lakes in the three ecoregions.

The Guiding Principles also state that "[i]f a causal parameter is not exceeded but an applicable response variable is exceeded, then the criterion is not met and the waterbody is not meeting its designated uses." The response variables addressing critical elements of primary productivity and ecosystem function do function independently from causal variables, consistent with the Guiding Principles. For lakes, and with respect to aquatic life uses as MDNR has articulated them, the EPA considers this to be sufficient because the reference to algal assemblage in the Guiding Principles was principally in reference to streams.

Under MDNR's rule, in a situation where a lake or reservoir exceeds Missouri's Nutrient Screening Thresholds and data are unavailable for any of the Response Impairment Thresholds, the waterbody would not be considered as impaired. The EPA's 2013 Guiding Principles document recommends that in this situation, the combined criterion make clear that the criterion is not met, and the waterbody is not meeting the intended designated uses (USEPA 2013). Consistent with this approach, the EPA's December 2017 proposed rule "Alternative 1" required that water quality not exceed protective TN or TP values unless each of the response parameters are evaluated and none occur within the same three-year rolling average period. 82 Fed. Reg. at 61229. The EPA explained that it "included this presumption to address potential for data gaps for response variables." *Id.* at 61221. To address this issue of potential data gaps for response parameters, MDNR's rule requires data for the Response Assessments Endpoints to be collected at the same time as Nutrient Screening Thresholds are assessed, which should limit instances of inadequate information and unassessed waterbodies. 10 CSR 20-7.031(5)(N)6. In its Implementation document, MDNR describes its monitoring efforts and cooperative agreement with the university of Missouri (pages 6-7), as well as relevant monitoring efforts conducted by MDC (pages 17-18). While MDNR's approach differs in some respects from the 2013 Guiding Principles, the EPA has determined that MDNR's rule provides a reasonable approach to achieve the same objective (*i.e.*, address the data gap issue). As a result, MDNR's approach results in a criterion that protects the applicable aquatic life uses because it provides that if there is information demonstrating that TN, TP and chlorophyll *a* Nutrient Screening Thresholds are exceeded there will also be information available to evaluate regarding the Response Assessment Endpoints.

Although implementation is not within the scope of the EPA's WQS approval action, the EPA's Guiding Principles discusses implementation and state that the TN and TP values should be available to support assessment and provide a target for source control implementation (*e.g.*, NPDES permitting and TMDL development). Missouri's TN and TP Nutrient Screening Thresholds are available to serve this function. In addition to these values, MDNR would also have available direct translations of the Response Impairment Thresholds for chlorophyll *a* to TN and TP using the regression equations provided in their Rationale document (see Figure 5-3). The difference between these translations is that the former set is based on the Nutrient Screening Thresholds for chlorophyll *a* and the latter set is based on the Response Impairment Thresholds for chlorophyll *a*. As such, it may be appropriate to use the Nutrient Screening Thresholds where there is concern for effects described by the Response Assessment Endpoints at levels of chlorophyll *a* below the Response Impairment Thresholds, whereas it may be appropriate to use translations using the Response Impairment Thresholds where this additional level of protection does not appear necessary. In its Implementation document, MDNR states that: "TMDLs developed to meet applicable numeric nutrient criteria will consider targets appropriate for attaining chlorophyll-a response impairment thresholds with consideration given to other causal and response parameter concentrations to ensure WQSs are met and maintained" (page 24). With respect to permitting, MDNR states in the same document: "Because exceedance of the numeric Chl-a criteria is a response to excess TN and/or TP in the water body, regional correlations between nutrients and algal biomass will be used to set in-lake nutrient targets" (page 29). The EPA considers these statements to be consistent with the Guiding Principles with respect to source control and demonstrate that Missouri's numeric nutrient criteria contain sufficient elements to implement source control programs.

ESA CONSULTATION

The EPA initiated consultation with the U.S. Fish and Wildlife Service under Section 7(a)(2) of the ESA, 16 U.S.C. §1536, regarding the effects of the EPA approving a change to Missouri's WQS for numeric nutrient criteria on November 21, 2017. The EPA sent a letter to Karen Herrington, Field Supervisor, Missouri Ecological Field Services Office on October 1, 2018, to continue informal consultation with FWS with a specific focus on the EPA's proposed action on Missouri's WQS for numeric nutrient criteria for lakes and reservoirs. The EPA requested verification of the current species list on October 23, 2018. The EPA completed and submitted to FWS a Biological Evaluation on November 5, 2018, conveying the EPA's evaluation that the proposed approval of Missouri's new numeric nutrient criteria for Missouri's lakes and reservoirs is not likely to adversely affect listed species and designated critical habitat. On November 26, 2018, FWS confirmed it had reviewed the EPA's BE and based on the analysis of effects to listed species and critical habitat provided in the BE, FWS concurred with the EPA's determination of not likely to adversely affect pursuant to the ESA. This concluded ESA consultation.

CONCLUSION

MDNR submitted revised regulations including provisions for numeric nutrient criteria for manmade lakes for the EPA's review under section 303(c) of the CWA. These criteria include three components: Response Impairment Thresholds for chlorophyll *a* which represent a "ceiling" above which a lake is considered impaired (not meeting its aquatic life designated use); Nutrient Screening Thresholds for chlorophyll *a*, TP and TN which represent a "floor" below which a lake is considered to be attaining its

aquatic life designated use; and a set of five Response Assessment Endpoints to determine attainment status in between. These provisions appear in Missouri regulations at 10 CSR 20-7.031(5)(N). The EPA is approving these provisions in their entirety, except for (1) the provisions of (N)1.C.II, (N)3, and Table N which refer to Lake Site-Specific Criteria which EPA has previously approved; and (2) the provision at (N)4 which the EPA determined is not a new or revised WQS. The approved provisions are based on sound scientific rationale and are protective of the designated uses for which they are developed to protect and therefore address EPA's 2011 disapproval.

MDNR derived Response Impairment Thresholds for chlorophyll *a* consistent with eutrophic conditions in Plains lakes and mesotrophic/eutrophic boundary conditions in Ozarks lakes. Although the EPA derived protective chlorophyll *a* levels from the 75th percentile of reference conditions for least disturbed lakes that reflect levels more in line with the mesotrophic/eutrophic boundary for Plains lakes and the oligotrophic/mesotrophic boundary for Ozarks lakes, it is within Missouri's discretion to adopt a value associated with a higher level of productivity and overall biomass because Missouri's aquatic life use is broadly defined as "wide variety of biota"; these waters are manmade, highly managed systems; and Missouri has explicitly determined that sport fish can be interpreted as an indicator of a sufficiently "wide variety of biota" in their manmade lakes. Missouri's criteria would support a healthy sport fish population.

MDNR adopted Nutrient Screening Thresholds that are comparable to values EPA derived for least disturbed reference conditions and thus suitable as a "floor" below which attainment of aquatic life uses can be presumed. The Response Assessment Endpoints address conditions that are sensitive to nutrients and reflect protective quantitative or narrative expressions associated with primary production, ecosystem function, fish species survival and diversity, and mineral turbidity that could mask excessive algal production. Either the Nutrient Screening Thresholds for TN and TP or translations of the Response Impairment Thresholds using available regression relationships could be used as WQS elements to support NPDES permitting and TMDL development. MDNR retains sufficient general criteria provisions in narrative form to protect drinking water supply and recreational designated uses while MDNR continues to collect data and information and develop approaches for future numeric nutrient criteria for those uses.

Although not related to the EPA WQS review, the EPA recognizes that the level of protection established by MDNR's combined criterion approach for lakes represents incremental progress in controlling nutrient loadings. Many lakes in Missouri will likely be considered impaired that had not been, and the EPA anticipates there would be costs incurred and benefits realized from implementing corresponding controls to meet the newly adopted criteria. The EPA recognizes that many lakes in Missouri currently have chlorophyll *a* levels much lower than levels specified by the Response Impairment Thresholds. The EPA recommends that Missouri consider further sub-classification of lakes and consider whether lakes currently achieving conditions of a lower trophic state (*e.g.*, Plains lakes currently achieving chlorophyll *a* of 15 μg/L) should be expressly maintained at that level and have criteria set accordingly.

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Decision Document Enclosure Appendix

As mentioned in the decision document enclosure, the EPA's review of Missouri's nutrient criteria involved a unique circumstance where MDNR was engaged in its rulemaking process to adopt nutrient criteria during the same time period as the EPA issued a proposed federal rule (pursuant to the consent decree) and sought public comments on two alternatives: MDNR's proposed rule (Alternative 2) as well an alternative developed by the EPA (Alternative 1). During their respective rulemakings both the EPA and MDNR received comments on each of the issues discussed below, except for the last one (Truman Lake and downstream protection) which was only submitted as a comment during MDNR's rulemaking. The EPA's decision document approving Missouri's criteria directly or indirectly addresses the significant public comments as they relate to the EPA's approval. The EPA is approving Missouri's numeric nutrient criteria and is therefore no longer pursuing its proposed federal rule; however, the purpose of this appendix is to respond to comments that are relevant to the EPA's approval action, but not directly addressed in the EPA's decision document.

Some public comments expressed concern that the "Response Assessment Endpoints" identified in MDNR's final rule are too subjective. This is relevant because the EPA is approving MDNR's Response Assessment Endpoints as part of the submitted combined criterion for nutrients. First, the EPA considers that key response endpoints, such as chlorophyll *a* (as a Response Impairment Threshold) and dissolved oxygen and pH, do have objective thresholds for determining protection. In fact, EPA noted in the preamble to its proposed rule that it considered limiting the Response Assessment Endpoints to just dissolved oxygen and pH but instead chose to include in the federal proposed rule the additional Response Assessment Endpoints that MDNR included in its proposed rule. 82 Fed. Reg. 61213, 61225 (December 17, 2017). The additional Response Assessment Endpoints in MDNR's final rule relate to fish mortality, cyanobacteria cell counts and turbidity and have objective assessment approaches described in supplemental materials provided by MDNR to the EPA. The Response Assessment Endpoint related to shifts in aquatic diversity retains a certain degree of subjectivity, although Missouri's supplemental materials submitted to the EPA and correspondence between Missouri departments indicate broad management objectives. This degree of subjectivity is likely by design and may prove beneficial as MDNR develops approaches to evaluate potential shifts and their early indication signals.

Some public comments expressed concern that the criteria proposed by MDNR and EPA are reactive and only address water quality after it is identified as impaired, with a particular concern for application to discharge permits. These comments are relevant because the EPA is approving these criteria components. The EPA considers all the criteria components in MDNR's final rule to be set at protective levels. Furthermore, the EPA describes in the decision document (see pages 26-27) how the combined criterion approach includes both causal and response parameters, and how protective thresholds for the causal parameters are available for source control targets (permitting) regardless of impairment status. MDNR described in its Implementation document some initial approaches for permitting on a watershed basis, noting that "all permitting will be consistent with federal and state requirements."[1] MDNR also

[1] See page 26 of Missouri Department of Natural Resources (MDNR). 2018. *Nutrient Criteria Implementation Plan*. July 27, 2018. https://dnr.mo.gov/env/wpp/rules/documents/nutrient-implementation-plan-final-072618.pdf

implements a Nonpoint Source Management Program (NPSMP) with a stated goal to protect and improve the quality of the Missouri's water resources using a collaborative, statewide watershed approach.

Comments expressed concern that in its proposed federal rule, EPA changed its position since the May 2016 letter EPA sent to Missouri. In this letter, the EPA stated that "The MDNR needs to consider all uses for which Missouri's lakes are designated and to develop criteria that are protective for all uses for which adequate data and scientific information exist." As discussed in the decision document, MDNR's submission adequately describes its focus on aquatic life uses and presents a supportable basis for deferring development of numeric nutrient criteria for recreation and drinking water uses (see pages 9-12). In the May 2016 letter, the EPA also expressed concern that MDNR's thresholds "focus on the identification of waters already requiring restoration and would do little to protect designated uses" and that MDNR's approach "appears to offer no protection beyond that provided under the state's long-standing general (narrative) water quality criteria." Upon review of MDNR's complete submission and as explained in EPA's decision document, the EPA has determined that MDNR's rule is protective of MDNR's aquatic life use as applied to manmade lakes and that protective TN and TP values are available for use as source control targets. Many lakes in Missouri will likely be considered impaired that had not been, and the EPA anticipates there would be costs incurred and benefits realized from implementing corresponding controls to meet the newly adopted criteria. The EPA also described in the decision document that Missouri's long-standing general (narrative) water quality criteria continues to protect designated uses such as recreation and drinking water supply. In response to other concerns the EPA raised in its May 2016 letter, Missouri has incorporated TN and TP causal parameter thresholds in its combined criterion approach and each component of the combined criterion approach is based on a sound scientific rationale.

Some public comments expressed concern about the perceived intent by MDNR to ignore federal permitting regulations and include nutrient permit limits only if a water is first identified as impaired. The MDNR's WQS include the necessary components for implementation of CWA assessment, permitting, and TMDL programs (and other source control efforts). From a WQS perspective, protection of aquatic life uses as described by MDNR is provided by the Response Impairment Thresholds for chlorophyll *a* and the combination of Nutrient Screening Thresholds and Response Assessment Endpoints. As described in the decision document, MDNR has the means to identify corresponding protective TN and TP thresholds (which could be the Nutrient Screening Thresholds themselves). Adequate implementation is a matter of EPA oversight other than CWA 303(c) review, which focuses on the uses and criteria applicable to surface waters. Implementation programs have additional relevant components, such as the "reasonable potential" analysis that goes into determining the need for discharge permit limits.

Some public comments expressed concern that nutrient criteria adopted by other states do not support a conclusion that the criteria proposed by MDNR or the EPA are protective. Other states may interpret their designated uses differently, may have elected to address other designated uses in the numeric nutrient criteria, and may take alternative approaches to establishing protective criteria. The EPA reviews state criteria individually to determine whether CWA requirements are met. We would note that Missouri's NNC do not stand apart from all other states. In the decision document, the EPA noted the similarity to the criteria for chlorophyll *a* for a subset of lakes in Minnesota, and the similarity in aquatic life interpretation for lakes in Virginia (with comparable chlorophyll *a* magnitude values for some lake categories as well).

Some public comments expressed concern about the removal of Missouri's proposed rule language regarding use of the Nutrient Screening Thresholds as targets for TMDL development. These comments referenced the Missouri's response to comments, which the EPA has also reviewed and are consistent with MDNR's Rationale and Implementation documents. Missouri's removal of this language provides Missouri a degree of flexibility to implement the criteria in a manner that is allowable under the CWA. The EPA concurs with MDNR's approach that it may not be appropriate to use the Nutrient Screening Thresholds in all cases for TMDL development or source control. As described in the decision document, there are at least two choices for protective TN and TP levels: Nutrient Screening Thresholds and translations of the Response Impairment Thresholds for chlorophyll *a*, which are available now and could be refined as more information becomes available or more applicable site-specific information is available. The selection would involve ensuring that adverse Response Assessment Endpoints and Response Impairment Thresholds are not exceeded. Given the variability in nutrient levels and responses (which several commenters also noted), this degree of flexibility is warranted and beneficial with respect to protection of designated uses.

Some public comments expressed concern that the Response Impairment Thresholds are overly protective of sport fish and that research data supports the fact that harmful effects on sports fish populations only occur at higher levels of chlorophyll *a*. This comment relates to the Missouri's rationale for its rule. As discussed in the decision document, the EPA did not find studies that specifically document harm to sport fish at high levels of chlorophyll *a*. However, many studies point to shifts in relative proportion of populations of specific types of sport fish. Missouri has described a preference for maintaining a healthy sport fishery of black bass species (*e.g.*, largemouth bass, smallmouth bass), other sunfish such as bluegill and crappie (which are also "sight feeding" piscivores), and catfish, but wishes to avoid an "imbalance" or shift to bottom-feeding fish such as carp. Given this preference, it makes sense to establish the thresholds with the caution with which Missouri has exercised.

Some public comments expressed concern that there should not be a one in three-year exceedance frequency of exceeding the Response Impairment Thresholds because it could allow extremely high levels of chlorophyll *a* in some years. This is relevant because the EPA is approving this exceedance frequency. The studies MDNR relied upon to support the Response Impairment Thresholds (and summarized in the decision document) were typically based on several years of data and thus represent long term averages. Knowlton and Jones (2006) found that "Seasonal mean values based on a single summer misclassified 15-17% of Missouri reservoirs with respect to the status of their long-term averages (8 or more seasons)" and advise that "Given this level of temporal variation, numeric criteria determined from average conditions in reference lakes should be applied only to long-term averages in target lake" and "Rules for assessing compliance with nutrient standards should be framed with anticipation of the widely varying conditions in individual lakes".[2] Given this phenomenon, a one in three year exceedance frequency is appropriate.

Some public comments expressed concern that the EPA's proposed "nutrient protection values" under EPA's "Alternative 1" should have been based on the 50th percentile reference concentrations for the Plains ecoregion because the region as a whole has experienced a high degree of land cover disturbance. This is relevant to this approval because the EPA cites back to the Alternative 1 values as evidence that

[2] Knowlton, M.F. and J.R. Jones. 2006. Natural variability in lakes and reservoirs should be recognized in setting nutrient criteria. *Lake and Reserv. Manage.* 22(2): 16 1-166.

the comparable Nutrient Screening Thresholds reflect an appropriate floor below which adverse impacts from nutrient enrichment should not occur. The EPA considered using the 50th percentile to develop nutrient protection values for the Plains ecoregion under "Alternative 1" of the EPA proposed rule. In developing the set of reference condition waters, the EPA screened out lake watersheds with greater than 20 percent cropland and urban land. The EPA applied this screen (and other screens) to all ecoregions and then set nutrient protection values equal to the 75th percentile of the set of reference conditions approach for all ecoregions (see pages 13-14 of the Technical Support Document for the proposed rule). In the EPA's view, it does not matter if there is relatively more land disturbance in the Plains ecoregion in general because all reference watersheds for each ecoregion must contain less than 20 percent cropland and urban land to be considered part of the reference population.

Some public comments on MDNR's proposal expressed concern that it does not make sense for Truman Lake to have less stringent nutrient criteria than Lake of the Ozarks since Truman Lake feeds into Lake of the Ozarks. This is relevant because WQS as a whole must ensure protection of downstream waters. The EPA is aware of the geographic proximity of these two lakes. The EPA concurs with MDNR's response to that public comment on their proposed rule, which states in pertinent part: "Although water from Truman Lake does eventually discharge into Lake of the Ozarks, some settling and nutrient attenuation is expected. Additionally, because the criteria are expressed as geometric means, any individual measurements greater than the numeric criteria values do not in and of themselves indicate an excursion of water quality standards. Further protection of Lake of the Ozarks will be implemented as a result of added general criteria at 10 CSR 20-7.031(4)(E), which requires that waters shall maintain a level of water quality at their confluences to downstream waters that provides for attainment and maintenance of the water quality standards of those downstream waters."