**American Rivers ● Appalachian Voices ● Cape Fear River Watch ●
Carolina Wetlands Association ● Catawba Riverkeeper Foundation ●
Crystal Coast Waterkeeper ● Dan River Basin Association ● Haw River Assembly ●
MountainTrue ● NC Conservation Network ● NC League of Conservation Voters ●
River Guardian Foundation ● Sound Rivers ● Southern Environmental Law Center ●
Toxic Free NC ● Waterkeeper Alliance ● Whiteoak-New Riverkeeper Alliance ●
Winyah Rivers Foundation**

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Re: Triennial Review of North Carolina's Water Quality Standards

Dear Ms. Brower,

Thank you for the opportunity to offer comments on the NC Environmental Management Commission's (EMC) proposed changes to North Carolina's surface water quality standards during this triennial review. We submit these comments on behalf of American Rivers, Appalachian Voices, Cape Fear River Watch, Carolina Wetlands Association, Catawba Riverkeeper Foundation, Crystal Coast Waterkeeper, Dan River Basin Association, Haw River Assembly, NC Conservation Network, NC League of Conservation Voters, River Guardian Foundation, Sound Rivers, Southern Environmental Law Center, Toxic Free NC, Whiteoak-New Riverkeeper Alliance, Winyah Rivers Foundation, and Waterkeeper Alliance. Together, we represent thousands of North Carolinians who drink from and swim, fish, and paddle in the state's waters. We share a deep commitment to the implementation of the federal Clean Water Act in North Carolina and believe our water quality standards should be revised to better protect the designated uses of our precious water resources.

I. The Triennial Review

State water quality standards "play a central role in a State's water quality management program, which identifies the overall mechanism States use to integrate the various Clean Water Act quality control requirements into a coherent management framework."[1] Periodic review and revision by the EMC is critical to assure that our water quality standards reflect the latest science and respond to emerging threats to water quality in this state. The Clean Water Act requires states to "hold public hearings for the purpose of reviewing applicable water quality standards and, as

[1] EPA, Water Quality Standards Handbook: Second Edition Int-13 (1994) (hereinafter, "WQS Handbook").

appropriate, modifying and adopting standards."[2] The triennial review requirement is designed to ensure that state water quality standards are adequate "to protect the public health or welfare, enhance the quality of water and serve the purposes of" the Clean Water Act.[3]

We are concerned that, during the instant triennial review, the EMC has focused on meeting deadlines imposed by the North Carolina General Assembly and on resolving longstanding disputes with the U.S. Environmental Protection Agency (EPA) rather than conducting a meaningful review and revision of water quality standards. The combination of the triennial review hearings with rulemaking to comply with G.S. 150B-21.3A[4] suggests a focus on *re-adopting* existing water quality standards rather than considering new rules or substantive amendments. The few changes to water quality standards proposed as part of this triennial review are those needed to resolve EPA's objections to the 2007-2015 triennial review.

After the 2014 Triennial Review resulted in revisions to metals standards, EPA "strongly recommend[ed] that the State revise the criteria for these metals to delete the minimum hardness cutoff from the criteria equations so as not to be protective of North Carolina's many waters with low hardness."[5] EPA also expressed "substantial concerns that, although the State has added the updated metals criteria, it is simultaneously considering retaining and adding other provisions which may negate the use of the new criteria, specifically the 'biological trump' and 'action levels.'"[6] We support amendments proposed to resolve these concerns, particularly given that, as acknowledged by the EMC, current "state rules are not in agreement with how the state is required to implement National Pollutant Discharge Elimination System (NPDES) permits for regulated parties within the state."[7]

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[2] 33 U.S.C. § 1313(c)(1). Water quality standards include designated uses, water quality criteria to protect those uses, and antidegradation requirements. *See* 33 U.S.C. § 1313(c)(2)(A), (d)(4)(B); 40 C.F.R. § 131.12 (2013).

[3] *Id.* The Clean Water Act is a "comprehensive water quality statute designed to 'restore and maintain the chemical, physical, and biological integrity of the Nation's waters.'" *PUD No. 1 of Jefferson Cnty. V. Wash. Dep't of Ecology*, 511 U.S. 700, 704 (1994)(quoting 33 U.S.C. § 1251(a)). As such, the Clean Water Act is concerned not only with human health, but also "seeks to attain 'water quality which provides for the protection and propagation of fish, shellfish, and wildlife.'" *Id.* (quoting 33 U.S.C. § 1251(a)(2)).

[4] This statute required agencies to review the necessity of, and level of received or anticipated object to, existing rules, then readopt as though new rules all regulations deemed "necessary with substantive public interest. N.C. Gen. Stat. § 150B-21.3A. The EMC concluded that all of the rules in Subchapter 2B were "necessary with public interest," and the Rules Review Commission accordingly concluded the agency must readopt them all. EMC, G.S. 150B-21.3A Report for 15A NCAC Subchapter 02B, Surface Water and Wetland Standards (Oct. 20, 2014), *available at*, https://www.ncoah.com/rules/Final%20Reports%20Submitted%20to%20APO/15A%20NCAC%2002B%20Report%20with%20Comments%20and%20attachments.pdf. With limited exception, the deadline for readoption is October 31, 2019. *See* N.C. Rules Review Commission, *Periodic Review and Expiration of Existing Rules--Readoption Schedule*, https://www.ncoah.com/rules/HB%2074%20Readoption%20Schedule/Readoption%20Schedule.html (last visited July 11, 2018).

[5] Letter from James Giattina, EPA Region, to Tom Reeder, DWR, EPA Recommendations on the 2007-2014 NC Triennial Review 3 (Jan 03, 2016), *available at* https://files.nc.gov/ncdeq/documents/files/AppB_EPAComm.pdf. EPA also noted that North Carolina has a significant number of waters with a hardness below 25 mg/L $CaCO_3$. *Id.* EPA had previously instructed North Carolina to consider hardness-dependent toxicity of cadmium, chromium, copper, lead, nickel, silver, and zinc and stated "there must be a provision for the calculation of a more protective criteria" for waters with a lower hardness." Letter from Joanne Benante, EPA Region IV, to Alan Clark, DWQ (April 30, 2009), *available at* https://files.nc.gov/ncdeq/documents/files/AppB_EPAComm.pdf.

[6] Letter from James Giattina, EPA Region, to Tom Reeder, DWR, EPA Recommendations on the 2007-2014 NC Triennial Review 2 (Jan 03, 2016), *available at* https://files.nc.gov/ncdeq/documents/files/AppB_EPAComm.pdf.

[7] 32 N.C. Reg. 2411, 2412 (May 15, 2018).

Specifically, where metals toxicity is hardness-dependent, we support the proposals to remove the low-end cap of 25 mg/l hardness cap and use actual in-stream hardness, rather than median instream hardness values,[8] when deriving water quality standards. In addition, we support the removal of the biological confirmation requirement in 15A NCAC 2B .0211(11)(f). Water quality standards are supposed to prevent harm to aquatic health, not kick in only after a stream is degraded.

While we welcome the adoption of metals standards consistent with the requirements of the Clean Water Act, we lament the absence of necessary action on a host of other water quality standards in need of adoption or revision. North Carolina deserves a *real* triennial review. We urge the EMC to act swiftly to establish or revise water quality standards for numerous pollutants as outlined below and we appreciate your consideration of the following comments.

II. Establishing Adequately Protective Water Quality Standards

North Carolina law declares it is the public policy of the state to "provide for the conservation of" water resources[9] and "maintain, protect, and enhance water quality within North Carolina."[10] The N.C. General Assembly has empowered and directed the Commission to adopt water quality standards to promote that policy.[11] In doing so, the legislature was not solely aiming to implement state policy, but also to "qualify to administer federally mandated programs of environmental management" and "qualify to accept and administer funds from the federal government for such programs."[12]

To successfully administer federally mandated programs, the EMC must adopt water quality standards consistent with the mandate of the Clean Water Act. The objective of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[13] The goal is to achieve, "wherever attainable," "water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water."[14] As

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[8] We are particularly concerned by the provisions in current rules stating that "[c]ompliance with chronic instream metals standards shall only be evaluated using an average of a minimum of four samples taken on consecutive days, or as a 96-hour average." See 5A NCAC 02B .0211(11)(e) and 15A NCAC 02B .0220(9)(b)." EPA cautioned against such rules even before they were proposed in 2014, observing four year prior that "several states which have adopted similar provisions around the country have not been able to successfully carry out the strategy of monitoring on four consecutive days and can, therefore, never assess compliance with the water quality standard." Letter from Annie M. Godfrey, EPA Region IV, to Alan Clark, DENR-DWQ, at 6 (Aug. 20, 2010).

[9] N.C. Gen. Stat. § 143-211(a).

[10] N.C. Gen. Stat. § 143-211(b).

[11] N.C. Gen. Stat. § 143-214.1(a)(1).The same Article includes the following directive:

> Standards of water and air purity shall be designed to protect human health, to prevent injury to plant and animal life, to prevent damage to public and private property, to insure the continued enjoyment of the natural attractions of the State, to encourage the expansion of employment opportunities, to provide a permanent foundation for healthy industrial development and to secure for the people of North Carolina, now and in the future, the beneficial uses of these great natural resources.

N.C. Gen. Stat. § 143-211(c).

[12] N.C. Gen. Stat. § 143-211(c).

[13] 33 U.S.C. § 1251(a).

[14] *Id.* at § 1251(a)(2).

such, water quality standards "shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of" the Clean Water Act.[15]

The N.C. General Assembly recognized that the adoption of water quality standards should be the result of "proper study,"[16] but rather than cite such study as a justification for delaying water quality protection, urged the EMC to act "as rapidly as possible within the limits of funds and facilities available to it."[17] Today, owing in part to repeated draconian budget cuts, North Carolina has fallen behind in setting protective standards, and many existing standards no longer reflect the best available science. Fortunately, the EMC can draw on the expertise of its members and DEQ staff, as well as guidance from EPA.[18] We encourage the EMC to update North Carolina's surface water standards to reflect the growing depth of peer-reviewed science on toxicological mechanisms, ecological relationships, and the fate and transport of pollutants in our rivers and estuaries.

Establishing Standards to Protect Human Health

Protecting vulnerable populations. We encourage the EMC, when it sets out 'to protect human life,' to adopt standards that will protect vulnerable subpopulations, especially children and infants. Over the last two decades, scientists have documented multiple 'critical windows of development' during which exposures to even low levels of pollutants can have significant, long-term health impacts.[19] Water quality standards designed to protect human health should be set to avoid these exposures.[20] In addition to critical developmental windows, infants and children have distinct behaviors and pathways of exposure, such as drinking breast milk, drinking more water per pound of body weight than an adult, and having a greater surface area to volume ratio than an adult (which increases the relative dermal exposure to the same concentration of a pollutant in water).[21]

Similarly, increasing evidence suggests that, independent of age, some people are genetically more vulnerable to exposures of a given toxin than others. For example, a variety of

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[15] 33 U.S.C. § 11313(c)(2). "Serve the purposes of the Act" means that state water quality standards must, among other things, "include provisions for restoring and maintaining chemical, physical, and biological integrity of State waters" and "wherever attainable, achieve a level of water quality that provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water." WQS Handbook at Int-8 (Sept. 15, 1993) (emphasis added).

[16] N.C. Gen. Stat. § 143-214.1(a)(1); *see also* 15A N.C. Admin. Code 02B .0101(b)(2) (acknowledging the importance of "appropriate studies" to inform modification of water quality standards).

[17] N.C. Gen. Stat. § 143-214.1(a).

[18] EPA is statutorily obligated to update its recommendations for water quality standards so they reflect the "latest scientific knowledge" regarding the concentration and dispersal of pollutants and their effects on health and welfare as well as biological community diversity, productivity, and stability. 33 U.S.C. § 1314(a)(1).

[19] *See generally,* Michael Firestone et al, *Two Decades of Enhancing Children's Environmental Health Protection at the U.S. Environmental Protection Agency*, 124 Environmental Health Perspectives A214 (December 2016), *available at* https://ehp.niehs.nih.gov/EHP1040/; Jacqueline Moya et al, *A Life Stage Approach to Assessing Children's Exposures*, International Symposium on Children's Environmental Health (Jan. 30, 2004), *available at* https://www.env.go.jp/en/chemi/hs/health03/03.pdf.

[20] Other State agencies have recognized the nuances of toxicity at different life stages when acting to protect human health. For instance, the N.C. Department of Health and Human Services, when issuing a fish consumption advisory in light of the toxic effects of eating fish containing mercury, set special standards for "women of childbearing age (15-44 years), Pregnant Women, Nursing Women, and Children under 15." NCDENR, *North Carolina Mercury TMDL* 8 (Sept. 2012), available at https://files.nc.gov/ncdeq/Water%20Quality/Planning/TMDL/FINAL%20TMDLS/Statewide/NCMercuryTMDL_EPASubmit.pdf.

[21] Alesia Ferguson, et al. *A Review of the Field on Children's Exposure to Environmental Contaminants: A Risk Assessment Approach*. 14 Int J Environ Res Public Health 265 (2017).

pollutants affect genetic males and genetic females differently.[22] Other genetic subpopulations are much smaller, and not sex-linked.[23] Where we can identify these subpopulations, water quality standards should be set to manage risks to their members. N.C. State University houses a resource, the Comparative Toxicogenomics Database, which may be helpful to agency staff seeking to incorporate this information.[24]

Mixtures of pollutants. A growing body of research also indicates that mixtures of pollutants can be far more harmful than exposures to single pollutants. A recently-published study found that rats exposed to a mixture of 18 compounds – all at no more than 20% of the 'lowest observed adverse effect level' (LOAEL) for the chemicals individually – showed developmental and reproductive harm.[25] Similar evidence of the potency of mixtures has been found in humans as well.[26] Most of the pollutants we are exposed to in drinking water (through ingestion) and in recreation (through ingestion and dermal absorption) are in mixtures. To a degree distinct from other comments offered in this section, this fact strikes at the foundation of our current process for setting water quality standards by abstracting 'no observable adverse effect levels' (NOAELs) or LOAELs from animal and epidemiological studies of individual chemicals. This concern cuts across media and regulatory programs; it applies to air and groundwater as well as surface water. We recommend that the EMC prepare itself to think creatively by scheduling presentations on the emerging science of the risks posed by mixtures, and consider ways to adapt existing regulatory authorities to that scientific reality.

Avoiding displacement of costs. Finally, water quality standards for water supply watersheds should be set to ensure that those waters are safe to drink without treatment beyond that needed to remove of pathogens. The Clean Water Act's legislative history and its regulations emphasize the responsibility of pollution control at the source.[27] In fact, EPA's policy guidance on setting the criteria that underpin state standards speaks to this directly:

> In consideration of the Agency's goals of pollution prevention, ambient waters should not be contaminated to a level where the burden of achieving health objectives is shifted away from those responsible for pollutant discharges and placed

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[22] C Torres-Rojas, et al. *Sex Differences in Neurotoxicogenetics*. 9 Front Genet.196 (2018), available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5996082/ (outlining a long list of ways men's and women's sex-linked genes create differential vulnerability to environmental toxics); Michael Edwards et al. *Our Environment Shapes Us: The Importance of Environment and Sex Differences in Regulation of Autoantibody Production*. 9 Frontiers in Immunology Art. 47B (2018)("In general, females when compared with their male counterparts, respond to pathogenic stimuli and vaccines more robustly, with heightened production of antibodies, pro-inflammatory cytokines, and chemokines").

[23] G Alam, *Toxicogenetics: in search of host susceptibility to environmental toxicants*. 5 Front Genet. 327 (2014), *available at* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4170107/ (noting gene-based differences in human vulnerability to pesticide exposures).

[24] Comparative Toxicogenomics Database, http://ctdbase.org/.

[25] JM Conley, et al, *Mixed "Antiandrogenic" Chemicals at Low Individual Doses Produce Reproductive Tract Malformations in the Male Rat* 164 Toxicol. Sci. 166-178 (2018).

[26] *See, e.g.*, Shanaz Dairkee et al. *A Ternary Mixture of Common Chemicals Perturbs Benign Human Breast Epithelial Cells More Than the Same Chemicals Do Individually*, Toxicological Sciences 2018, 1-14 (finding that a mixture of three structurally diverse and common pollutants - BPA, methylparaben (MP), and perfluorooctanoic acid (PFOA) - causes much greater disruption to healthy breast cells that exposure to a single pollutant would predict).

[27] *See*, Robert Glicksman & Matthew Batzell, *Science, Politics, Law, and the Arc of the Clean Water Act: The Role of Assumptions in the Adoption of a Pollution Control Landmark*, 32 Washington University Journal of Law & Policy (2010), at 118-121.

on downstream users to bear the costs of upgraded or supplemental water treatment.[28]

Inadequate standards do not just transfer costs downstream to drinking water utilities; they also transfer risk to all water users. EPA again: "[e]ven among the majority of water suppliers that do treat surface waters, existing treatments may not necessarily be effective for reducing levels of particular contaminants."[29] Moreover, the Safe Drinking Water Act requires utilities to treat not to the maximum contaminant level *goal* (set to protect health), but only to the maximum contaminant level (which relaxes protection based on the cost of treatment).[30] So, even for the limited subset of pollutants regulated under the Safe Drinking Water Act, the Clean Water Act envisions that state will set standards that fully protect users from toxic exposures and place responsibility on dischargers upstream.

Establishing Standards to Prevent Injury to Aquatic Life

Water quality standards for Class C waters, and for several of North Carolina's special supplemental categories, are designed to protect aquatic life. These standards recognize a distinction between "acute" and "chronic" impacts, defined in 15A NCAC 02B .0202. The rule defines acute toxicity as "lethality or other harmful effects" resulting from an exposure that lasts less than 96 hours. Chronic effects are those resulting from longer exposures. The state definitions - part of the set of rules proposed for readoption in the present rulemaking - reference EPA's guidance on how to set standards to protect aquatic life.[31]

<u>Updating references</u>. Unfortunately, EPA's guidance dates to 1985. As an EPA white paper noted in 2008, "[w]hile the Guidelines remain the primary instrument the Agency uses to meet its broad objectives for the development of [aquatic life criteria], there have been many advances in aquatic sciences, aquatic and wildlife toxicology, population modeling, and ecological risk assessment that are relevant to deriving ALC."[32] An EPA Science Advisory Board convened to review the white paper went further: "the derivation of aquatic life criteria needs to be more broadly risk-based, using a transparent and consistent framework that provides necessary flexibility not presently possible within the algorithm approach of the 1985 Guidelines."[33] The scientists recommended that EPA additionally rely on EPA's *1998 Guidelines for Ecological Risk Assessment* and the Science Advisory Board's 2007 *Advice to EPA on Advancing the Science and Application of Ecological Risk Assessment*. "In particular," the scientists added, "we urge EPA to include consideration of probable direct and/or indirect impacts on food webs, ecological processes and

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[28] EPA, *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* at 4-2 (2000) (hereinafter "2000 Human Health Methodology").
[29] 2000 Human Health Methodology, at 4-2.
[30] SDWA §300(f)(1)(C)(i); 40 CFR §141.2 (definitions).
[31] EPA, Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses (1985), *available at* https://www.epa.gov/sites/production/files/2016-02/documents/guidelines-water-quality-criteria.pdf.
[32] EPA, OW/ORD Emerging Contaminants Workgroup, *White Paper: Aquatic Life Criteria for Contaminants of Emerging Concern, Part I: Challenges and Recommendations* 5 (June 3, 2008), *available at* https://www.epa.gov/sites/production/files/2015-08/documents/white_paper_aquatic_life_criteria_for_contaminants_of_emerging_concern_part_i_general_challenges_and_recommendations_1.pdf.
[33] EPA Science Advisory Board, Advisory on Aquatic Life Water Quality Criteria for Contaminants of Emerging Concern, December 18, 2008, at ii and xv (hereafter "2008 SAB Advisory").

services, and endangered or unique species of special value or concern." In a letter the following spring, the agency itself affirmed the critique.[34]

Again in 2015, EPA recognized the inadequacy of the 1985 *Guidelines*, convening a set of scientists to compare the Guidelines to the standard-setting methods used in other developed nations, and examining specific shortcomings of relying on the *Guidelines* alone.[35] Ongoing scientific research documents a variety of these sublethal impacts. For example, sublethal exposures of tadpoles to glyphosate impair the tadpoles' movement and ability to evade predators.[36] Microcystin toxins have been shown to impair the health and reproductive potential of threadfin shad without killing them directly.[37] EPA based its 2016 decision to tighten the aquatic life criteria for selenium (discussed below) on research showing sublethal impairment of fish reproduction.[38] As exposures interfere with predator-prey interactions and reproduction, these sublethal effects add up over time to degrade aquatic health.

In fact, we know empirically that North Carolina rivers have levels of accumulated pollution with impacts that can only be understood with a focus on the food web and ecological relationships. A recent study of the Yadkin River found organochlorine pesticides in over 90% of biotic samples and mercury in 100%, as well as cadmium in river sediments at concentrations in excess of effect levels.[39]

EPA has not yet updated or revised the 1985 Guidelines. Fortunately, the EMC has all the authority it needs to update 15A NCAC .0202 and embrace lessons learned over the last three decades of ecotoxicological research. In particular, 02B .0202(1)(a) defines the Final Acute Value with reference to the 1985 Guidelines. We recommend that the EMC amend this subsection to read:

> (a) for specific chemical constituents or compounds, acceptable levels shall be equivalent to a concentration of one-half or less of the Final Acute Value (FAV) as determined according to "Guidelines for Deriving Numerical Water Quality Criteria for the Protection of Aquatic Life and its Uses" published by the Environmental Protection Agency and referenced in the Federal Register (50 FR 30784, July 29, 1985) <u>and "1998 Guidelines for Ecological Risk Assessment" published by the Environmental Protection Agency and referenced in the Federal Register (63 FR 26846, May 14, 1998).</u> ~~which is~~ <u>These documents are</u> hereby incorporated by reference including any subsequent ~~amendments.~~ amendments and editions.

<u>Acute toxicity - no lethality</u>. With respect to effluent, 02B .0202(1)(c) currently defines acceptable levels of acute toxicity as causing "no statistically measurable lethality." The proposed revision to this adds two alternative definitions, "<u>a LC50>100%, or a No Observed Adverse Effect</u>

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[34] Letter from Lisa Jackson, EPA Administrator to Deborah Swackhamer, SAB Chair, May 1, 2009.

[35] *See* Invited Expert Meeting on Revising U.S. EPA's Guidelines for Deriving Aquatic Life Criteria (September 2015) *at* https://www.epa.gov/wqc/invited-expert-meeting-revising-us-epas-guidelines-deriving-aquatic-life-criteria.

[36] H Moore et al. *Sub-lethal effects of Roundup on tadpole anti-predator responses.* 111 Ecotoxicol Environ Saf. 281-5 (2015).

[37] S Acuna. *Sublethal dietary effects of microcystin producing Microcystis on threadfin shad, Dorosoma petenense*. 60 Toxicon 1191-1202 (2012). While this research was conducted in the San Francisco Bay, the same species and toxins occur in North Carolina.

[38] EPA, Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater (2016). Note that in revising this criteria, EPA in fact did rely on the 1998 Guidelines for Ecological Risk Assessment, not just the 1985 Guidelines.

[39] TN Penland, et al. *Food web contaminant dynamics of a large Atlantic Slope river: Implications for common and imperiled species*. 633 Sci Total Environ. 1062-1077 (2018).

concentration," with a note that this would ratify current practice. If we understand 'LC50>100%' correctly, it means that when test organisms are exposed to the undiluted effluent, no more than half of them die. This is far weaker than the current standard, and weaker than a no observed adverse effect concentration; it certainly pays no attention to sublethal effects. In some circumstances, effluent will be rapidly diluted by the receiving waters, but that is already provided for in 02B .0204, Location of Sampling Sites and Mixing Zones. In some locations, effluent provides the bulk of streamflow in dry seasons, and aquatic life will be exposed at close to a 100% concentration. We recommend that the EMC strike the phrase 'a LC50> 100%,' from the current proposal.

Mixtures of pollutants. As with human exposures, aquatic life is often exposed to a mixture of pollutants. A 2017 study of 38 streams nationwide found hundreds of man-made toxic chemicals in them, including pesticide and pharmaceuticals.[40] Aquatic life downstream from wastewater discharge is especially likely to be continuously exposed to a mixture of biologically-active chemicals.[41] Federal scientists have known that chemicals with similar mechanisms of harm can have cumulative impacts.[42] As with mixtures that could harm human health, this presents a challenge for regulation.

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In addition to these general observations about the process of establishing water quality standards, we also offer comments below on specific pollutants and families of pollutants that need updated water quality standards to protect human health or aquatic life, or that present special challenges for the setting of standards and will require a creative approach.

III. Contaminants of Emerging Concern

This triennial review comes at a time of heightened interest in North Carolina's water quality. Even the N.C. General Assembly, despite years of weakening DEQ and slashing its budget, has constituted House and Senate Select Committees on North Carolina River Quality. Much of this unprecedented attention is due to the evolving realization that we simply do not know what pollutants are in our waters or at what concentrations. While much of the state's attention to date has focused on GenX, in reality the problem facing North Carolina's waters is much larger, and demands a statewide response.

Persistent toxics narrative standard

Among the various categories of contaminants of emerging concern, persistent bioaccumulating toxics (PBTs) stand out. These chemicals are persistent in the environment, bioaccumulate in exposed organisms (and, in some cases, biomagnify through food webs), and are toxic. Because they do not break down easily, they will continue to increase as an environmental

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[40] Paul Bradley et al. *Expanded Target-Chemical Analysis Reveals Extensive Mixed-Organic-Contaminant Exposure in USA Streams,* 51 Environ Sci Technol 4792–4802 (2017), *available at* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5695041/pdf/nihms916453.pdf

[41] *See, e.g.,* Larry Barber. *Effects of biologically-active chemical mixtures on fish in a wastewater-impacted urban stream*. 409 Science of The Total Environment 4720-4728 (2011)(finding over 100 chemicals in water samples downstream from Chicago WWTPs, and biological responses in exposed male fish).

[42] 2008 SAB Advisory, at xv.

threat as long as they are produced and discharged into the environment. For this reason, the European Union has set as a policy that PBTs shall not be discharged at any concentration.[43] In the United States, Washington state has shown strong leadership since 2000, setting out criteria to recognize PBTs, developing a list of them, and drafting plans to monitor for and reduce discharges of a series of prominent PBTs.[44] Pollutants with plans include mercury, PDBE flame retardants, lead, polyaromatic hydrocarbons (PAH), polychlorinated biphenals (PCBs), and (ongoing) per- and polyflouroalkyl substances (PFASs).[45] Not surprisingly, this includes chemicals of long-standing concern, as well as some of emerging concern in North Carolina.

More recently, scientists have identified a related category of persistent mobile toxics (PMT). These are typically strongly hydrophilic and therefore do not accumulate in the body fat of organisms, but spread much faster through groundwater and through surface aquatic environments. Short-chain perfluoroalkyl substances (PFAS), including GenX and perfluorobutylsulfonate (PFBS), are PMTs. Because they are purged from the body more quickly, they have been marketed as less damaging than PBTs. But because PMTs are persistent, they will not go away, and because they are mobile, they will keep circulating – and the more of them that are released into the environment, the greater the ongoing base level of exposure for everyone in North Carolina, even if individual molecules are purged as others are ingested. For that reason, PMTs also have essentially no assimilative capacity in the water cycle as a whole.

Counting bioaccumulating and mobile compounds, there are thousands of persistent organic toxics. No state regulatory process will be able to derive and adopt water quality standards for more than a fraction of these on a chemical-by-chemical basis. Moreover, a numeric standard could present a challenge for implementation, since many persistent toxics are already ubiquitous at low levels in our rivers, and therefore in intake waters and effluent. The critical goal for policy should be to prevent concentrations from increasing. For that reason, we recommend that the EMC adopt a new narrative standard that calls for no increase in persistent toxics - bioaccumulating or mobile - in North Carolina waters.

One way to accomplish this is to add the following subsection to 02B .0208, Standards for Toxic Substances and Temperature:

> (c) Persistent organic toxic substances: Persistent organic toxic substances may not be introduced at levels that increase their total loading to waters of the state.

and then to add a new definition to 02B .0202, Definitions:

> (#) Persistent organic toxic means a toxic substance or toxicant that is carbon-based and that when released into the environment remains intact for a period of years or longer.

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[43] European Parliament & Council of the European Union, Regulation No. 850 (April 29, 2004), *available at* https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32004R0850&from=EN; European Commission, Commission Regulation No. 756, 223 Journal of the European Union 20 (Aug. 24, 2010), *available at* https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010R0756&from=EN; European Commission,, Commission Regulation No. 757, 223 Journal of the European Union 29 (Aug. 24, 2010), *available at* https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010R0757&from=EN.

[44] Washington Administrative Code 173-333 (governing "Persistent Bioaccumulative Toxins"); *see also*, Washington Dept. of Ecology, Implementation Plan for the Adoption of Chapter 173-333 (2006), *available at* https://fortress.wa.gov/ecy/publications/documents/0607010.pdf.

[45] *See* Washington Department of Ecology, Addressing Priority Chemicals, https://ecology.wa.gov/Waste-Toxics/Reducing-toxic-chemicals/Addressing-priority-toxic-chemicals (last visited July 11, 2018).

Other changes to 02B .0208, toxic substances

North Carolina's existing rule on standards for toxic substances, 02B .0208, has a number of strengths, including detailed direction on how to set various kinds of standards. However, in comparison with some other states, it has some gaps. For example, Oregon has a toxics substance narrative standard that explicitly prohibits release of pollutants that "accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare or aquatic life, wildlife or other designated beneficial uses."[46] This is notable for its explicit mention of sediments, as well as the prohibition on discharge of bioaccumulating toxics. Further, in the absence of an adopted water quality standard, Oregon's state agency may set "permit or other regulatory limits" based on "public health advisories, and published scientific literature. DEQ may also require or conduct bio-assessment studies to monitor the toxicity to aquatic life of complex effluents, other suspected discharges or chemical substances without numeric criteria."[47]

> We recommend that the EMC revise the first paragraph of 02B .0208 to read:
> "(a) Toxic Substances: the concentration of toxic substances, either alone or in combination with other wastes, in surface waters shall not render waters injurious to aquatic life or wildlife, recreational activities, public health, or impair the waters for any designated uses; and shall not accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare or aquatic life, wildlife or other designated uses. Specific standards for toxic substances to protect freshwater and tidal saltwater uses are listed in Rules .0211 and .0220 of this Section, respectively. Procedures for interpreting the narrative standard for toxic substances and numerical standards applicable to all waters are as follows:"

PFAS class standard

Ultimately, North Carolina needs a narrative standard curtailing discharges of persistent toxics; but in the meantime, we recommend that the EMC adopt a numeric class standard for PFAS. EPA's Chemical Dashboard, drawing on a list created by the Swedish Chemicals Agency, includes 2370 different per- and polyfluorinated substances; that is an underestimate of PFAS in the stream of commerce.[48] At the current rate of standard setting, it would take centuries to adopt water quality standards for each of these compounds. Instead, the EMC should echo the approach it has already taken successfully with polyaromatic hydrocarbons (PAHs), setting a single, relatively low concentration for all PFAS *and their precursors* measured together. The inclusion of precursors in the standard is critical, as research has indicated that a number of precursors break down into PFAS in the environment, after discharge.[49] We appreciate that, depending on the test method used, the

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[46] OAR 340-041-0033(1).
[47] OAR 340-041-0033(4).
[48] EPA Chemical Dashboard, *available at* https://comptox.epa.gov/dashboard/chemical_lists/SFISHFLUORO, quoting Kemi. Occurrence and use of highly fluorinated substances and alternatives (2015), appendix 2, *available at* https://www.kemi.se/en/global/rapporter/2015/report-7-15-occurrence-and-use-of-highly-fluorinated-substances-and-alternatives.pdf. Kemi estimates that there are over 3000 PFAS on the market worldwide. *Ibid*, at 27.
[49] *See e.g.,* C Dassuncao, et al. *Temporal Shifts in Poly- and Perfluoroalkyl Substances (PFASs) in North Atlantic Pilot Whales Indicate Large Contribution of Atmospheric Precursors.* 51 Environ Sci Technol. 4512 (2017)(using pilot whales, which cannot metabolize the precursors, to demonstrate that most mammal body burdens must reflect exposure both to PFAS and to PFAS precursors).

standard may be framed as something other than a simple concentration, but we recommend that it equate to a concentration of 10 to 30 parts per trillion (ppt) for a sample composed entirely of PFOS or PFOA. That is not as stringent as the PFOS and PFOA standards recommended by the Agency for Toxic Substances & Disease Registry (ATSDR) or in the process of adoption by the State of New Jersey, but is more protective than EPA's health advisory level for PFOS and PFOA combined, reflecting our evolving estimates of the toxicity of PFAS.[50]

No low dose threshold/ non-monotonic dose response

For years, a rule of thumb among many practicing toxicologists was that most toxics have a linear dose-response curve. That is, when concentrations of the toxic drop, so should observed effects. A related idea was the notion that at a low enough dose, observed effects should stop altogether. These two assumptions have formed a critical framework for the way regulators have set standards, including water quality standards: animal studies could be used to identify a "no adverse effect level" (NOAEL), below which exposures are "safe." Further, once the slope of the dose-response curve was identified, one could scale the estimated risk based on the size of the exposure.

Increasingly, research has found compounds and categories of compounds for which these assumptions are false. For example, some endocrine disrupting chemicals appear to have no NOAEL; This means that, even at very dilute concentrations, they still lead to changes in cells and metabolic processes. Some endocrine disruptors even appear to cause worse impacts at relatively lower concentrations, a pattern described as 'non-monotonic dose-response.'[51] This is not merely a theoretical problem; endocrine disrupting chemicals that show non-monotonic dose response have been found widely distributed across North Carolina, from both point- and non-point sources.[52] Other states have addressed this; for example, since 2003, New York's rules deal explicitly with carcinogens that exhibit nonlinear dose-response by incorporating additional safety factors.[53] To begin to address this in North Carolina, we recommend that the EMC hear presentations on the science of toxics with no NOAEL and those with a non-monotonic dose response curve, because the policy problem of how to manage these within current regulatory authorities will keep cropping up across the EMC's programs.

Pesticides

The majority of pesticides currently monitored by state regulators are no longer registered for use in North Carolina; similarly, most of the pesticides for which EPA established human health criteria in 2015 are prohibited here. Meanwhile, modern pesticides used in massive volumes go unmonitored and lack water quality standards. As previously observed by DWR, "pesticides are widely used each year in North Carolina to control insects, and other organisms" and pesticides

[50] ATSDR, Toxicological Profile for Perfluoroalkyls: Draft for Public Comment (June 2018)(the draft lists a reference dose that would translate to a concentration of 7 ppt for PFOS and 11 ppt for PFOA); New Jersey: website: Contaminants of Emerging Concern, available at https://www.nj.gov/dep/srp/emerging-contaminants/ (13 ppt for PFOS, 14 ppt for PFOA); EPA, Lifetime Health Advisories and Health Effects Support Documents for Perfluorooctanoic acid and Perfluorooctane Sulfonate (2016), at 81 Fed. Reg. 33250 (70 ppt individually or combined for PFOS and PFOA).
[51] Laura Vandenberg. *Non-monotonic dose responses in studies of endocrine disrupting chemicals: bisphenol a as a case study*. 12 Dose Response 259 (2013), *available at* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4036398/pdf/drp-12-259.pdf.
[52] Dana Sackett et al. *Sources of Endocrine-Disrupting Compounds in North Carolina Waterways: A Geographic Information Systems Approach*. 34 Environmental Toxicology and Chemistry 437–445 (2015), at 443.
[53] 6 CRR-NY 702.4(d)(2),(3).

"continue to enter North Carolina streams from application, atmospheric deposition, and erosion of soils contaminated from past use."[54] Several pesticides of particular concern include atrazine, chlorpyrifos, and the family of neonicotinoid pesticides.

Atrazine. Atrazine and chlorpyrifos were among the ten most commonly-found man-made organic pollutants found in sampling of streams nationwide in 2017.[55] A draft risk assessment published by EPA in 2016 found that:

> Atrazine is moderately toxic to freshwater and estuarine/marine fish, highly toxic to freshwater aquatic invertebrates and very highly toxic to estuarine/marine aquatic invertebrates on an acute exposure basis. Chronic exposure studies for freshwater and estuarine/marine fish, aquatic phase amphibians and aquatic invertebrates resulted in significant effects on survival, growth or reproduction, with freshwater fish having the most sensitive reported chronic endpoint due to reproductive effects.[56]

The assessment also found that, based on monitoring, rivers in North Carolina already experience concentrations of atrazine in excess of the chronic levels of concern for fish.[57] Based on tests on medaka (Japanese rice fish, *Oryzias latipes*), EPA has identified 5 ug/L as a no adverse effect level (NOAEL) for aquatic vertebrates.[58] North Carolina already identifies a protective value for atrazine in drinking water supplies of 680 ug/L, but the state lacks a water quality standard. We recommend that the EMC adopt a standard for atrazine for class C waters of 5 ug/L; that would make the question of a standard for water supply watersheds moot.

Chlorpyrifos. This organophosphate insecticide kills its targets by breaking down neurotransmitters. As with other toxics, impacts to aquatic ecosystems depend on the duration and magnitude of exposure. Chlorpyrifos enters the aquatic environment several ways: in run-off, via erosion of soil particles, and - to a lesser extent - via drift of sprays and deposition from the atmosphere.[59] The insecticide is acutely toxic to freshwater fish and invertebrates; toxicity increases with temperature and pH, meaning that conditions in North Carolina's eutrophying lakes and reservoirs could intensify risks.[60] Chlorpyrifos is also highly toxic to estuarine and marine

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[54] DWR, Fact Sheet: Bioaccumulation in North Carolina Fish 2 (Sept. 2016), *available at* https://files.nc.gov/ncdeq/Water%20Quality/Environmental%20Sciences/ISU/DWR%20Fish%20Bioaccumulation%20Fact%20Sheet%20Sept%202016.pdf.

[55] Paul Bradley et al., *Expanded Target-Chemical Analysis Reveals Extensive Mixed-Organic-Contaminant Exposure in USA Streams*, 51 Environ Sci Technol 4792–4802 (2017), *available at* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5695041/pdf/nihms916453.pdf

[56] EPA, *Refined Ecological Risk Assessment for Atrazine* (2016), at 29, *available at* https://www.regulations.gov/contentStreamer?documentId=EPA-HQ-OPP-2013-0266-0315&contentType=pdf.

[57] *Id*. at 442.

[58] *Id.* at 186.

[59] Jeffrey Giddings et al. *Risks to Aquatic Organisms from Use of Chlorpyrifos in the United States*. 231 Reviews of environmental contamination and toxicology 119 (2014), *available at* https://www.researchgate.net/publication/261604745_Risks_to_Aquatic_Organisms_from_Use_of_Chlorpyrifos_in_the_United_States?_sg=UgwtRxXgVYAdf62NdjEw3IZYn8_AbfCLWgbvJSK7RK7xZ85THOoXkVQ5PlZvX6d3Kzv62q1w7g.

[60] John Carriger and Gary Rand. *Aquatic Risk Assessment of Pesticides in Surface Waters in and Adjacent to the Everglades and Biscayne National Parks: I. Hazard Assessment and Problem Formulation*. 17 Ecotoxicology 660 (2008) at 668, *available at* http://chm.pops.int/Portals/0/docs/Responses_on_Annex_E_information_for_endosulfan/UnitedStates_090113_2008 July - Vol. I - Aquatic risk assessment of pesticides.pdf.

organisms.[61] EPA has established human health criteria for chlorpyrifos, 0.083 ug/l acute and 0.041 ug/l chronic, as well as an aquatic life standard for saltwater, 0.011 ug/l acute and 0.0056 ug/l chronic. We are concerned that EPA's method does not account for movement of pesticides adsorbed to organic carbon in the soil, and the organisms used to calculate lethal doses are not the most sensitive. Nonetheless, in the absence of a more robust method, we recommend that the EMC adopt the EPA's recommended aquatic life criteria for all fresh- and salt-waters in the state to protect invertebrates.

Neonicotinoids. Also dubbed 'neonics,' neonicotinoids are the most commonly used insecticides around the world; the most commonly-applied neonic in the U.S. is imidacloprid. Only 5% of the active ingredient neonicotinoid is taken up by the roots, while the other 95% disperses into the wider environment.[62] Because neonics are water soluble, they travel easily into the aquatic environment. Neonicotinoids have not yet been documented as a direct cause of fish kills, but they do kill aquatic invertebrates. "[B]ecause aquatic invertebrates are a rich food source for many species of fish, depletion and disappearance of this source in waters contaminated with neonicotinoids could affect fish stocks in freshwater ecosystems."[63] As another 2015 study concluded, "[d]espite large knowledge gaps and uncertainties, enough knowledge exists to conclude that existing levels of pollution with neonicotinoids and fipronil resulting from presently authorized uses frequently exceed the lowest observed adverse effect concentrations and are thus likely to have large-scale and wide ranging negative biological and ecological impacts on a wide range of non-target invertebrates in terrestrial, aquatic, marine and benthic habitats."[64]

In fact, EPA has calculated aquatic life benchmark values, the concentrations below which pesticides are not expected to harm aquatic life, for several neonics. We encourage the EMC to adopt these for all waters in the state to protect fresh- and salt-water invertebrates.

Table 1. Recommended aquatic life standards for neonicotinoids.[65]

Neonicotinoid	Year updated	Acute	Chronic
Imidacloprid	2017	0.385 ug/L	0.01 ug/L
Thiamethoxam	2017	17.5 ug/L	no data
Clothianidin	2016	11 ug/L	1.1 ug/L

[61] M.A. Kamrin, Pesticide Profiles Toxicity, Environmental Impact, and Fate (1997), at 147- 152.
[62] Thomas James Wood, and Dave Goulson. *The Environmental Risks of Neonicotinoid Pesticides: A Review of the Evidence Post 2013*. Advances in Pediatrics. 2017. Accessed July 20, 2018. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5533829/.
[63] Francisco Sanchez-Bayo et al. *Contamination of the Aquatic Environment with Neonicotinoids and Its Implication for Ecosystems*. 4 Frontiers in Environmental Science (November 2, 2016), *available at* https://www.farmlandbirds.net/sites/default/files/2017-04/Sanchez-Bayo et al 2016.pdf.
[64] L.W. Pisa et al, *Effects of neonicotinoids and fipronil on non-target invertebrates* 22 Environ Sci. Pollut Res Int 68 at 69, 92 (2015).
[65] EPA, Aquatic Life Benchmarks and Ecological Risk Assessments for Registered Pesticides (multiple dates), available at https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-and-ecological-risk.

IV. Ammonia

According to EPA, ammonia is "one of the most important pollutants in the aquatic environment."[66] Despite this, the EMC has repeatedly declined to adopt an ammonia standard and does not propose one now. We strongly encourage the EMC to adopt an ammonia standard reflecting the best available science.

A constituent of nitrogen pollution, ammonia enters the aquatic environment in a variety of ways, including "direct means such as municipal effluent discharges and the excretion of nitrogenous wastes from animals, and indirect means such as nitrogen fixation, air deposition, and runoff from agricultural lands"[67] Ammonia is highly toxic to aquatic life. Freshwater mussels, of which there are seven endangered species in North Carolina, are particularly sensitive to ammonia.[68] Impacts of chronic exposure on bivalves include reduction of respiration and feeding, depleted carbohydrate stores, and altered metabolism.[69] Acute impacts include mortality.[70]

As scientific support for an ammonia standard has grown, so have calls for the adoption of water quality criteria to protect aquatic life. EPA first recommended water quality criteria for ammonia in 1976. EPA published revised ambient water quality criteria for ammonia in 1985 and provided additional information about ammonia criteria in 1989, 1992, 1996, and 1998.[71] In 1999, EPA recommended revised ammonia standards to protect aquatic life.[72]

As research continued, datasets available to inform water quality standards included species that previously had not been tested, including sensitive freshwater mussels. During North Carolina's 2003 triennial review, the U.S. Fish and Wildlife Service (USFWS) urged the EMC to consider the toxicity of ammonia on freshwater mussels; in 2006, the USFWS repeated this call for action and

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[66] EPA, Final Aquatic Life Ambient Water Quality Criteria for Ammonia- Freshwater 2013, 78 Fed. Reg. 52191 (August 22, 2013), *available at* https://www.gpo.gov/fdsys/pkg/FR-2013-08-22/pdf/2013-20307.pdf.

[67] *Id*. One of the biggest sources of ammonia emissions is animal agriculture. Globally, domestic animals reportedly contribute 50% of ammonia emissions; in the United States, as much as 80% of ammonia emissions originate from livestock waste. EPA National Risk Management Research Laboratory, Review of Emission Factors and Methodologies to Estimate Ammonia Emissions From Animal Waste Handling, EPA-600/R-02-017 (April 2002), *available at* https://files.nc.gov/ncdeq/Air%20Quality/inventory/industry/animal/rpt_200208.pdf.

[68] *See, e.g.*, Augspurger T, et al, *Water quality guidance for protection of freshwater mussels (Unionidae) from ammonia exposure*, 22 Environmental Toxicology and Chemistry 2569-2575 (2003); Bartsch MR, et al., *Effects of pore-water ammonia on in situ survival and growth of juvenile mussels (Lampsilis cardium) in the St. Croix Riverway, Wisconsin, USA*, 22 Environmental Toxicology and Chemistry 2561-2568 (2003); Mummert AK, et al, *Sensitivity of juvenile freshwater mussels (Lampsilis fasciola, Villosa iris) to total and un-ionized ammonia*, 22 Environmental Toxicology and Chemistry 2545-2553 (2003); Newton, TJ, *The effects of ammonia on freshwater unionid mussels*, 22 Environmental Toxicology and Chemistry 2543-2544 (2003); Newton, TJ, et al, *Effects of ammonia on juvenile unionid mussels (Lampsilis cardium) in laboratory sediment toxicity tests* 22 Environmental Toxicology and Chemistry 2554-2560 (2003).

[69] Mummert AK, et al, *Sensitivity of juvenile freshwater mussels (Lampsilis fasciola, Villosa iris) to total and un-ionized ammonia*, 22 Environmental Toxicology and Chemistry 2545-2553 (2003).

[70] Newton, TJ, et al, *Effects of ammonia on juvenile unionid mussels (Lampsilis cardium) in laboratory sediment toxicity tests* 22 Environmental Toxicology and Chemistry 2554-2560 (2003); Augspurger T, et al, *Water quality guidance for protection of freshwater mussels (Unionidae) from ammonia exposure*, 22 Environmental Toxicology and Chemistry 2569-2575 (2003).

[71] EPA, 1999 Update of Ambient Water Quality Criteria for Ammonia, EPA Doc. No. 822-R-99-014 (Dec. 1999), *available at* https://nepis.epa.gov/Exe/ZyPDF.cgi/20003O3L.PDF?Dockey=20003O3L.PDF.

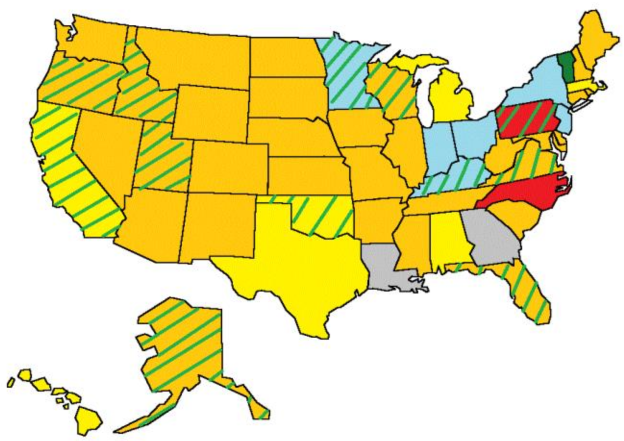
[72] EPA, 1999 Update of Ambient Water Quality Criteria for Ammonia, EPA Doc. No. 822-R-99-014 (Dec. 1999), *available at* https://nepis.epa.gov/Exe/ZyPDF.cgi/20003O3L.PDF?Dockey=20003O3L.PDF.

noted "[t]here is ample data for developing a standard for this common pollutant;"[73] The EMC expressed gratitude for data, but made no effort to change water quality standards.

After the 2007 triennial review, the EMC rejected calls to adopt an ammonia standard, justifying delay by noting pending EPA studies of ammonia's toxicity on freshwater mussels as well as EPA's anticipated decision on whether or not to revise the aquatic life standard.[74] The EMC stated, "After EPA makes its decision, we will reexamine the standard . . . and determine an appropriate course of action."[75]

In 2013, EPA published revised ammonia recommendations.[76] In 2014, EPA noted the absence of, and encouraged the EMC to adopt, an ammonia standard to protect aquatic life in North Carolina.[77] Again, the EMC failed to adopt, or even propose, a water quality standard for ammonia. During its review of the 2014 review triennial review package, EPA again encouraged the State to adopt an ammonia standard "during this current triennial review" and sent additional material directly to North Carolina to inform adoption of ammonia criteria.[78] After the 2014 triennial review, DENR noted it was "appraising" EPA's 2013 recommendations "for the next Triennial Review."[79]

Figure 1. Status of ammonia water quality standards, July 2018



Legend

Red	1984 EPA formula
Orange	1999 EPA formula
Green	2013 EPA adopted
Stripe	2013 EPA in process
Yellow	Narrative standard
Blue	State-specific WQS
Gray	N/A or no standard

Yet, when the current triennial review arrived, no action was proposed. Instead, the EPA's 2013 recommended ammonia standards were added to a list of items to be "carefully reviewed and

[73] Letter from Tom Augspurger, USFWS, to Connie Brower, DWQ (Sept. 1, 2006).
[74] NCDENR, "Report of Proceedings on the Proposed Changes to the Surface Water Quality Standards and Classifications Rules for the Triennial Review," (July 2006), *available at* https://files.nc.gov/ncdeq/documents/files/TriennialReview2006_0.pdf
[75] *Id.*
[76] EPA, *Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater 2013* x (2013), *available at* https://www.epa.gov/sites/production/files/2015-08/documents/aquatic-life-ambient-water-quality-criteria-for-ammonia-freshwater-2013.pdf.
[77] Letter from James Giattina, EPA Region IV, to Tom Reeder, NCDENR 2 (Feb. 4, 2014).
[78] Letter from James Giattina, EPA Region IV, to Tom Reeder, DWR *EPA Recommendations on the 2007-2014 NC Triennial Review* 1 (Jan. 3, 2016), *available at* https://files.nc.gov/ncdeq/documents/files/AppB_EPAComm.pdf
[79] DENR, *Summary of Surface Water Quality Standards 2007-2014* 39 (April 2015), *available at* https://files.nc.gov/ncdeq/documents/files/Summary%20of%20NC%20standards_Tri%20Rev%20Report_May_4_2015.pdf.

prioritized for inclusion in the next cycle of the Triennial Review."[80] North Carolina today has one of the most obsolete ammonia standards in the nation (figure 1). It is time for the EMC to adopt EPA's 2013 formula. Once the state water quality standard is adopted, the EMC and DEQ can consider how best to manage discharge limits over time; but updating the standard to reflect the best available science is well past due.

V. Bacteria

North Carolina currently uses fecal-coliform as a pathogen indicator to measure the suitability of freshwaters for recreational use.[81] This standard is similar to, but less stringent than, that recommended in 1968 by the National Technical Advisory Committee (NTAC).[82] We urge the EMC to adopt standards for freshwater pathogen indicators – specifically *Escherichia coli* (*E. coli*) and *enterococci* – based on more recent epidemiological data and EPA recommendations.

In 1972, in response to objections regarding the fecal coliform standard recommended by the NTAC, EPA conducted a series of studies to better assess the relationship between gastrointestinal illnesses and recreational use of sewage-contaminated waters.[83] These studies demonstrated that *enterococci* are good predictors of gastrointestinal illnesses (GI) in marine and fresh recreational waters; *E. coli* are good predictors of GI illnesses in fresh waters; and fecal coliforms are poor predictors of GI illness. In other words, we knew nearly 50 years ago that basing recreational water quality standards on fecal coliform was not aligned with the best available science.

In 1986, EPA formally recommended that *E. coli* or *enterococci* replace fecal-coliform bacteria in state water quality standards.[84] EPA's 1986 criteria were designed to protect people from swimming-related gastrointestinal illness. At the time EPA recognized it would "take a period of at least one triennial review and revision period for States to incorporate the new indicators into State

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[80] DEQ, 32 N.C. Reg. 2411, 2412-13 (May 15, 2018), *available at* https://www.ncoah.com/rules/register/Volume%2032%20Issue%2022%20May%2015,%202018.pdf.

[81] 15A N.C. Admin. Code 2B .0219(3)(b) ("Organisms of coliform group: fecal coliforms not to exceed geometric mean of 200/100 ml (MF count) based on at least five consecutive samples examined during any 30-day period and not to exceed 400/100 ml in more than 20 percent of the samples examined during such period."); *see also* 15A N.C. Admin. Code 2B .0211 (stating the standards for Class C waters). The Clean Water Act defines a "pathogen indicator" as "a substance that indicates the potential for human infectious disease." 33 U.S.C. § 1362(23).

[82] EPA, Bacteriological Ambient Water Quality Criteria for Marine and Fresh Recreational Waters 2 (1986). The NTAC recommended as follows:

> Fecal coliforms should be used as the indicator bacteria for evaluating the microbiological suitability of recreation waters. As determined by the multiple-tube fermentation or membrane filter procedures and based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content of primary contact recreation waters shall not exceed a log mean of 200/100 ml, nor shall more than 10 percent of total samples during any 30-dy period exceed 400/100 ml.

Id. North Carolina's standard allows up to 20 percent exceedance of the 400/100 mL threshold.

[83] EPA, Bacteriological Ambient Water Quality Criteria for Marine and Fresh Recreational Waters 3 (1986). Diarrheal diseases can be associated with bacteria and other pathogens. In addition, ear, nose, throat, skin and respiratory infections are associated with recreating in contaminated waters.

[84] EPA, Bacteriological Ambient Water Quality Criteria for Marine and Fresh Recreational Waters (1986). The 1986 EPA recommendations suggested using *enterococci* for marine and fresh recreational waters (a GM of 33 *enterococci* cfu per 100 mL in fresh water and 35 *enterococci* cfu per 100 mL in marine water) and *E. coli* for fresh recreational waters (a GM of 126 E. coli cfu per 100 mL). The presence of these bacteria, which inhabit the intestinal tract of warm-blooded animals, is a direct indication of fecal contamination.

Water Quality Standards and start to accrue experience with the new indicators at individual water use areas."[85] Over 30 years later, North Carolina has not adopted either standard for fresh water.

In 2000, the Beaches Environmental Assessment and Coastal Health Act (BEACH Act) amended the federal Clean Water Act (CWA) to better protect water quality in states with coastal recreation waters. For such coastal waters, the BEACH Act required states to adopt water quality standards for pathogens and pathogen indicators based on EPA criteria established under § 1314 of the CWA.[86] The law also allowed the EPA to promulgate bacteria standards to protect coastal recreation in states that failed to adopt the standards and criteria required under the BEACH Act. In 2004, after years of EMC inaction, North Carolina was one of 21 states for which EPA issued such regulations.[87] Today, in coastal recreation areas, North Carolina has an *enterococci* standard consistent with the requirements of the BEACH Act.[88] But for freshwaters, our standards remain stuck in the last century.

In light of scientific advances since 1986, and given the significant use of North Carolina's freshwater resources for primary recreation, we urge the EMC to adopt the bacteriological water quality standards more recently recommended by the EPA. In 2012, EPA published recommended Recreational Water Quality Criteria "for the protection of primary contact recreation in both coastal and non-coastal waters, based upon consideration of all available information relating to the effects of fecal contamination on human health, including the studies conducted under CWA §104(v)."[89] These recommendations were based in part on National Epidemiological and Environmental Assessment of Recreational Water data collected during investigations of U.S. beaches between 2003 and 2009.[90]

The 2012 recommendations resolved some concerns and difficulties associated with the 1986 guidance. First, the recommendations for freshwater and marine water were no longer based on different illness rates.[91] Second, the recommendations no longer included different criteria for different intensities of use.[92] In addition, the 2012 recommendations consist of both a geometric mean and a statistical value threshold for *E. coli* and *enterococci* bacteria and include limits on the magnitude, duration, and frequency of excursions. The recommendations include two sets of values designed around two illness rates: 32 and 36 illnesses per 1000 swimmers.[93] In addition, EPA

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[85] EPA, Bacteriological Ambient Water Quality Criteria for Marine and Fresh Recreational Waters 8 (1986).
[86] 33 U.S.C. § 1313 et seq.
[87] The federal standard remained in place until North Carolina adopted an acceptable marine pathogen indicator standard.
[88] *Enterococci* standards for coastal waters were adopted after the 2006 triennial review and, combined with Coastal Recreational Waters Monitoring Evaluation codified at 15A NCAC 18A .3400, these rules were deemed to satisfy the BEACH Act requirements. Letter from James Giattina, EPA Region IV, to Colleen Sullins, DWQ (Nov. 26, 2007), *available at* https://files.nc.gov/ncdeq/documents/files/2006_TrRev_EPA_response.pdf.
[89] EPA, Recreational Water Quality Criteria (2012), *available at* https://www.epa.gov/sites/production/files/2015-10/documents/rwqc2012.pdf.; *see also* 33 U.S.C. § 1314(a)(9) (obligating EPA to publish revised water quality criteria for pathogens and pathogen indicators for the purpose of protecting recreation in coastal waters.
[90] "The NEEAR study enrolled 54,250 participants, encompassed nine locations, and collected and analyzed numerous samples from a combination of freshwater, marine, tropical, and temperate beaches." *Id.* at 3; *see also id.*at 10.
[91] *Id.* at 6.
[92] The 1986 standard included different confidence limits to distinguish waters at a designated bathing beach and waters for which use for bathing was moderate, light, or infrequent. EPA, Bacteriological Ambient Water Quality Criteria for Marine and Fresh Recreational Waters 16 (1986).
[93] "Based on the EPA's analysis of the available information, either set of thresholds protects the designated use of primary contact recreation and, therefore, protects the public from the risk of exposure to harmful levels of pathogens

recommended Beach Action Values (BAVs) - defined as the 75th percentile of the water quality distribution of values of *E. coli* and *enterococcus* spp. in the epidemiological studies - to assist state notification programs.

In 2017, EPA conducted a five-year review of the 2012 recommendations.[94] After re-analyzing the scientific support for the 2012 recommendations, evaluating new scientific developments, and considering perceived barriers to state adoption, the federal agency decided not to amend the 2012 recommendations.[95] We encourage the EMC to adopt the 2012 EPA Recommended Water Quality Criteria to prevent unnecessary human health impacts stemming from recreational use of the state's freshwaters and ensure that waters classified for public recreation are not those in which "water pollution could result in a hazard to public health."[96]

Notably, the current *enterococci* standard for SB waters, written as a geometric mean based upon samples collected within a 30 day period, uses the same threshold – 35 *enterococci* per 100 mL – as that recommended by EPA based on the 36 illnesses/1000 swimmers guidance.[97] We encourage consideration of the threshold – 30 *enterococci* per 100 mL – based on a lower frequency of illnesses.[98] More importantly, we urge the EMC to adopt the recommended statistical threshold value to protect recreational users from uncommonly high levels of bacteria. In addition to updating the criteria for salt waters, we especially encourage the EMC to consider adoption of updated *E. coli* and *enterococci* standards for freshwaters.

We make these recommendations while observing that scientific inquiry is ongoing, and more study will likely improve our understanding of the predictive capacity of pathogen indicators. For instance, EPA studies note that when swimming, children ingest more water than adults and are also more susceptible to swimming-related gastrointestinal illnesses.[99] As such, future research may indicate ways to better protect these vulnerable populations

In addition, though we urge the EMC to revise its water quality standards to better protect recreational uses, we acknowledge that North Carolina agencies devote considerable time and energy to assessing and mitigating the impact of pathogens in our coastal waters. The N.C. Recreational Water Quality Program of DEQ's Division of Marine Fisheries tests selected coastal recreational waters (e.g., beaches, sounds, bays, and estuarine rivers) for *enterococci* bacteria and notifies the public whenever bacteriological levels in the water exceed levels deemed safe by the EMC.[100] Currently, the state monitors 240 sites in the coastal region, with increased monitoring

from fecal contamination." EPA, 2017 Five-Year Review of the 2012 Recreational Water Quality Criteria 5 (May 4, 2018), *available at* https://www.epa.gov/sites/production/files/2018-05/documents/2017-5year-review-rwqc.pdf.

[94] EPA, 2017 Five-Year Review of the 2012 Recreational Water Quality Criteria (May 4, 2018), *available at* https://www.epa.gov/sites/production/files/2018-05/documents/2017-5year-review-rwqc.pdf.

[95] *Id.* at xi.

[96] *See* 15A N.C. Admin. Code 02B .0106.

[97] 15A N.C. Admin. Code 02B .0222(3)(c).

[98] EPA, Recreational Water Quality Criteria at 6 (2012) (recommending *enterococci* standards based on 32 illnesses per 100 swimmers that include a 30 day geometric mean of 30 cfu/100 mL and a statistical threshold value of 100 cfu/100 mL)

[99] *Id.* at 12.

[100] DEQ, *The Facts: Recreational Water Quality Monitoring in North Carolina*, http://portal.ncdenr.org/c/document_library/get_file?uuid=89ecc697-deb0-4e2c-a18d-5e1609242628&groupId=38337 (last visited July 5, 2018).

frequency at many sites from April to September, and collects roughly 6,000 samples per year. [101] These efforts are important. But their utility would increase if the applicable standards were revised to reflect the latest science. Moreover, recreational use of North Carolina's waters is not limited to the coastal region and North Carolinians swimming in the mountains and the piedmont deserve no less protection than those recreating at the beach. Even if the state lacks resources to increase its monitoring efforts to protect recreational users of North Carolina's waters, establishing an *E. coli* standard for fresh waters would better equip local advocates to inform residents when bacteria levels exceeded those set by the state.[102]

VI. Metals

As previously mentioned, most of the substantive amendments proposed as part of this triennial review pertain to metals standards and stem from EPA guidance recommending revision thereof. We are discouraged to see the EMC disregard additional EPA guidance meant to inform the adoption of protective metals standards. Instead, without proposing any changes, the EMC has merely solicited input regarding recent EPA guidance regarding a number of metals, including selenium, cadmium, copper, and aluminum. The first three are considered toxic pollutants.[103] We encourage the EMC to adopt water quality standards for all four metals that are consistent with the most current EPA recommendations.

Selenium

In 2016, EPA recommended new ambient water quality criteria for selenium to protect aquatic life.[104] Selenium is a bioaccumulative chemical previously observed by DWR in North Carolina fish.[105] Selenium bioaccumulation occurs at concentrations too low to trigger acute effects; instead, toxicity transfers to eggs and harms reproduction. To combat this, the agency recommended new chronic criteria for concentrations in fish tissue and in the water column.[106]

EPA did not recommend a one-size-fits-all approach, instead observing that "[b]ecause the factors that determine selenium bioaccumulation vary among aquatic systems, site-specific water column criterion element values may be necessary at aquatic sites with high selenium bioaccumulation to ensure adequate protection of aquatic life."[107] We urge the EMC to consider the need for site-specific selenium standards where high rates of bioaccumulation, especially in lentic

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[101] DEQ, *The Facts: Recreational Water Quality Monitoring in North Carolina*, http://portal.ncdenr.org/c/document_library/get_file?uuid=89ecc697-deb0-4e2c-a18d-5e1609242628&groupId=38337 (last visited July 5, 2018).
[102] This past spring, Waterkeepers throughout North Carolina conducted bacteriological monitoring in multiple subwatersheds to evaluate impacts of upstream animal agriculture operations. In the absence of a state standard, they could only inform the public how *E. coli* measurements compared to the federal recommendations for freshwaters. https://waterkeeper.org/north-carolina-water-sampling-reveals-high-bacteria-levels-near-industrial-animal-farms/
[103] 40 C.F.R. § 401.15 (listing toxic pollutants).
[104] EPA, Aquatic Life Ambient Water Quality Criteria for Selenium- 2016 (June 2016), *available at* https://www.epa.gov/sites/production/files/2016-07/documents/aquatic_life_awqc_for_selenium_-_freshwater_2016.pdf.
[105] DWR, Fact Sheet: Bioaccumulation in North Carolina Fish 1 (Sept. 2016), *available at* https://files.nc.gov/ncdeq/Water%20Quality/Environmental%20Sciences/ISU/DWR%20Fish%20Bioaccumulation%20Fact%20Sheet%20Sept%202016.pdf.
[106] EPA, Aquatic Life Ambient Water Quality Criteria for Selenium- 2016 xiii (June 2016).
[107] *Id.* at xiii.

aquatic systems, suggest the need for additional protection. We support the EPA recommendations and urge the EMC to adopt the recommended standard to protect aquatic life from chronic exposure to selenium.

Cadmium

We also support adoption of water quality standards for cadmium that are consistent with recent EPA recommendations.[108] Cadmium primarily enters the aquatic environment through human activity; per the EPA, "human sources, such as mining and urban processes, are responsible for contributing approximately 90 percent of the cadmium found in surface waters."[109] EPA revised its 2001 cadmium criteria after reviewing toxicity studies of the effect of cadmium on 75 species (49 genera).[110] Studies informing the new recommendations included those examining the cadmium toxicity on yellow perch,[111] a predatory species commonly found in North Carolina's waters.[112] The 2016 recommendations include slightly lower (more stringent) acute criteria in both freshwater and saltwater, as well as chronic criteria in saltwater, but slightly less stringent for chronic freshwaters.[113] We support EPA's recommendations and encourage the EMC to revise North Carolina water quality standards for cadmium reflecting the underlying advances in scientific understanding of aquatic life toxicity.

Copper

During the 2014 triennial review, the EMC proposed allowing the use of the Biotic Ligand Model (BLM), rather than hardness equations, to calculate Class C water quality standards for copper. This proposal stemmed from the observation that the toxicity of copper was influenced by water hardness in addition to a host of other input parameters – "temperature, pH, dissolved organic carbon, major geochemical cations (calcium, magnesium, sodium, and potassium), dissolved inorganic carbon (DIC, the sum of dissolved carbon dioxide, carbonic acid, bicarbonate, and carbonate), and other major geochemical anions (chloride, sulfate)" – considered in the BLM.[114] At the time, water quality advocates expressed two primary concerns about using the BLM: (1) to work, it required data rarely collected in North Carolina's waters; and (2) it was ill-suited to inform a standard to protect aquatic life from chronic copper exposure. Indeed, the latter concern had been expressed by EPA itself, which conceded in the 2007 revision of its copper standards, that "further development [of the BLM] is required before it will be suitable for use to evaluate . . . Criterion Continuous Concentration or chronic value (freshwater or saltwater) WQC."[115] Notwithstanding this, the EMC authorized, as an alternative to using hardness equations, use of the "Aquatic Life

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[108] *See*, EPA, Aquatic Life Ambient Water Quality Criteria Cadmium- 2016 at 1 (March 2016), *available at* https://www.epa.gov/sites/production/files/2016-03/documents/cadmium-final-report-2016.pdf.
[109] EPA, Fact Sheet, Aquatic Life Ambient Water Quality Criteria Update for Cadmium - 2016 at 2 (March 2016), available at https://www.epa.gov/sites/production/files/2016-03/documents/cadmium-final-factsheet.pdf.
[110] *Id.*
[111] *See*, EPA, Aquatic Life Ambient Water Quality Criteria Cadmium- 2016 at 1 (March 2016), *available at* https://www.epa.gov/sites/production/files/2016-03/documents/cadmium-final-report-2016.pdf.
[112] DWR, Fact Sheet: Bioaccumulation in North Carolina Fish 1 (Sept. 2016), *available at* https://files.nc.gov/ncdeq/Water%20Quality/Environmental%20Sciences/ISU/DWR%20Fish%20Bioaccumulation%20Fact%20Sheet%20Sept%202016.pdf.
[113] *Id.*
[114] EPA, Aquatic Life Ambient Freshwater Quality Criteria--Copper 2007 Revision, EPA-822-R-07-001, at 12 (Feb. 2007), *available at* https://nepis.epa.gov/Exe/ZyPDF.cgi/P1000PXC.PDF?Dockey=P1000PXC.PDF
[115] EPA, Aquatic Life Ambient Freshwater Quality Criteria--Copper 2007 Revision, EPA-822-R-07-001, at 10-11 (Feb. 2007), *available at* https://nepis.epa.gov/Exe/ZyPDF.cgi/P1000PXC.PDF?Dockey=P1000PXC.PDF

Ambient Freshwater Quality Criteria - Copper 2007 Revision (EPA-822-R-07-001)" to set both acute and chronic criteria for copper.[116]

Notably, in 2016, EPA drafted technical guidance to assist states in the use of the BLM to protect aquatic life from the toxic effects of copper.[117] Here, EPA essentially acknowledged the validity of concerns about the dearth of data necessary to inform use of the BLM to derive copper standards. To overcome this lack of data, EPA developed and recommended "default values for water quality parameters used in the Freshwater Copper BLM when data are lacking."[118]

Ultimately, we support the use of recent scientific developments to inform copper standards. We believe the BLM should only be used where the necessary data inputs are either provided based on sampling or available in EPA's technical guidance. However, while we support this qualified use of the BLM to establish acute copper standards, we remain opposed to using the BLM to establish chronic copper standards, as "further development" of the model remains necessary for that purpose.

Aluminum

Unlike selenium, cadmium and copper, North Carolina has no water quality standards for aluminum.[119] EPA first recommended ambient water quality criteria for aluminum in 1988.[120] Last year, EPA issued draft ambient water quality criteria for aluminum based on recent studies regarding the toxicity of aluminum to aquatic life.[121] We urge the EMC to correct decades of inaction and adopt freshwater aluminum water quality criteria consistent with the latest EPA recommendations.[122]

VII. Cyanotoxins

Many North Carolina rivers, lakes, and sounds receive too much nitrogen and phosphorus, leading to algal blooms. Some species of algae produce cyanobacterial toxins that can kill fish, harm swimmers, and significantly increase the cost of treating drinking water. Worse, recent studies suggest that climate change may accelerate eutrophication of North Carolina's waterways and cause more frequent toxic algal blooms.[123]

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[116] 15A N.C. Admin. Code 2B .0211(11)(d).
[117] EPA, Draft Technical Recommended Estimates for Missing Water Quality Parameters for Application in EPA's Biotic Ligand Model (March 2016), *available at* https://www.epa.gov/sites/production/files/2016-02/documents/draft-tsd-recommended-blm-parameters.pdf
[118] *Id.* at v.
[119] *But see* 15A N.C. Admin. Code 2B .0406(incorporating by reference effluent limitations promulgated by EPA for industrial dischargers engaged in aluminum forming).
[120] EPA, Ambient Water Quality Criteria for Aluminum- 1988 (August 1988), https://nepis.epa.gov/Exe/ZyPDF.cgi/2000M5FC.PDF?Dockey=2000M5FC.PDF
[121] EPA, Draft Aquatic Life Ambient Water Quality Criteria-Aluminum - 2017 (July 2017), *available at* https://nepis.epa.gov/Exe/ZyPDF.cgi/P100SFQ1.PDF?Dockey=P100SFQ1.PDF
[122] "Like the 1988 AWQC for aluminum, there are still insufficient data to fulfill the MDRs as per the 1985 Guidelines, such that no estuarine/marine criteria can be recommended at this time." *Id.* at xiv.
[123] Paerl, H.W. & Huisman, J., *Climate change: A catalyst for global expansion of harmful cyanobacterial blooms,* 1 Environ. Microbiol. Rep. 27-37 (2009); O'Neil et al, *The rise of harmful cyanobacteria blooms: The potential roles of eutrophication and climate change*, 14 Harmful Algae 313–334 (2012); Paerl, H.W et al, *Mitigating cyanobacterial harmful algal blooms in aquatic ecosystems impacted by climate change and*

Currently, North Carolina lacks numeric water quality criteria for algal toxins, and the EMC has not proposed any such standards during this triennial review. We recommend that the EMC adopt a standard based on the best available science as described below.

EPA has provided ample guidance on the subject. First, in 2015, EPA issued health advisory levels[124] for microcystins and cylindrospermopsin in drinking water.[125] Both toxins can be produced by various cyanobacteria. Cylindrospermopsin can adversely affect liver and kidney function.[126] Microcystins primarily impact the liver.[127] EPA has concluded that adverse health effects are not anticipated to occur over a 10-day exposure to cyanobacteria in drinking water at the following concentrations or below: microcystin, 0.3 µg/L for infants and 1.6 µg/L for children and adults; and cylindrospermopsin, 0.7 µg/L for infants and 3 µg/L for children and adults.[128]

Cyanotoxins can also harm people who are exposed while swimming or boating in or near cyanobacterial blooms. In 2016, EPA issued draft criteria to protect human health in waters designated for swimming and other recreational use.[129] The proposal makes a convincing case that criteria that protect children, ages 5 to 11, playing in the water, will also protect adults, and will protect people subject to a variety of other exposures, including breathing aerosol droplets thrown up by jet ski motors, or accidentally ingesting toxins or absorbing them through the skin while swimming, diving, or otherwise recreating. Based on the totality of the evidence, EPA proposes a recreational criterion for microcystin of 4 micrograms/liter (µg/L), and for cylindrospermopsin, 8 µg/L.

Available data on algal blooms, although complaint driven and therefore far from comprehensive, shows that both microcystin and cylindrospermopsin threaten the recreational use of North Carolina's waters. In recent years, cyanobacteria have been identified at counts above 100,000 cells/mL in the Pasquotank River (2012), Albemarle Sound (2012, 2015), Pamlico River (2012, 2015, 2016), and Waterville Lake in the French Broad basin (2015). Cyanobacteria have been identified at counts between 20,000 and 100,000 cells/mL in the Tar-Pamlico basin (2012, 2014, 2015, 2016), the Neuse basin (2014, 2015), the Lower Cape Fear (2016), and lakes in the Yadkin basin (2012, 2016). *Cylindrospermopsis* have been identified in the Roanoke basin (2014), Albemarle Sound (2013), the Tar-Pamlico basin (2014, 2015, 2016), the Neuse basin (2015), the

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anthropogenic nutrients, 54 Harmful Algae 213–222 (2016).

[124] EPA may issue health advisories for contaminants that are not subject to national primary drinking water regulations. 42 U.S.C. § 300 g– 1(b)(1)(F).

[125] 80 Fed. Reg. 34637, *available at* https://www.federalregister.gov/documents/2015/06/17/2015-14936/availability-of-health-effects-support-documents-and-drinking-water-health-advisories-for In preparing the health advisories, EPA compiled information on relevant health effects, analytical methods, and treatment technologies. EPA also produced a support document to assist states trying to address cyanotoxins in drinking water supplies.

[126] EPA, Drinking Water Health Advisory for Cyanobacterial Toxin Cylindrospermopsin, EPA Doc. No. 820R15101 (June 15, 2015), *available at* https://www.epa.gov/sites/production/files/2017-06/documents/cylindrospermopsin-report-2015.pdf.

[127] EPA, Drinking Water Health Advisory for Cyanobacterial Microcystin Toxins, EPA Doc. No. 820R15100 (June 15, 2015), *available at* https://www.epa.gov/sites/production/files/2017-06/documents/microcystins-report-2015.pdf.

[128] 80 Fed. Reg. 34637, *available at* https://www.federalregister.gov/documents/2015/06/17/2015-14936/availability-of-health-effects-support-documents-and-drinking-water-health-advisories-for

[129] EPA, *Draft Human Health Recreational Ambient Water Quality Criteria and/or Swimming Advisories for Microcystins and Cylindrospermopsin* 81 Fed. Reg. 91929 (Dec. 19, 2016), *available at* https://www.federalregister.gov/documents/2016/12/19/2016-30464/request-for-scientific-views-draft-human-health-recreational-ambient-water-quality-criteria-andor

Lower Cape Fear basin (2013, 2016), and the middle Cape Fear (2014).[130] *Cylindrospermopsis raciborskii* has also been identified in several Piedmont lakes by academic researchers.[131]

The data on exposures to toxins is also not systematic. The state Division of Public Health (DPH) in the NC Department of Health and Human Services (DHHS) collects data on a complaint-driven basis, and only on the edges of lakes or rivers (that is, not in deep water). Between 2005 and 2012, the agency collected records of 67 algal bloom events, skewed strongly to counties with large populations and concentrated recreational use close to agency offices. Of the reported events, 80% were tested for algal toxins; cyanobacterial toxins were found in 74% of tested events, and in all but one of these (38 out of 39), microcystins were detected.[132] Ultimately, if algal toxins are present often enough to have generated this record solely through complaints, it seems likely that many more blooms are happening, and that many more people have been exposed without notifying state or local authorities.

Yet, without the adoption of applicable water quality standards, the State is unlikely to systematically sample or analyze concentrations of cyanobacteria or their toxins. North Carolina splits up responsibility for detecting and responding to algal blooms among several agencies. State management focuses on four different impacts: ecological harms; recreational exposures; consequences for drinking water treatment; and the safety of fish and shellfish for human consumption. Four distinct state programs are charged to address these distinct concerns. Each program has its own statutory authority, and they all respond to blooms independently of one another. As a result, in the absence of a clear mandate, the State rarely obtains data on cell concentrations and ambient toxin concentrations from the same event, and never simultaneously. More importantly, DEQ's ambient water quality monitoring program collects only cell concentrations, creating a disconnect between Clean Water Act toxin-based criteria and the State's regulatory infrastructure. Absent improved monitoring and analysis driven by numeric water quality standards, it will be difficult for North Carolina to impose whatever effluent limitations may be needed to reduce algal blooms to safe levels. As such, we encourage the EMC to adopt standards to protect both drinking water resources and recreation.

In adopting standards, the EMC should adopt cell count standards as well as concentration standards for specific toxins, for three reasons. First, as noted above, North Carolina's ambient monitoring already collects cell counts. Second, cyanobacteria of different strains produce various microcystin congeners, but sampling to measure microcystin concentrations tends to focus on just one: microcystin-LR.[133] Blooms are often composed of more than one species, and sometimes several genera. Because a cell count standard picks up all the cells, it implicitly protects against the full range of congeners, not just microcystin LR. Finally, separate from the toxins, cyanobacteria cells can cause inflammatory and allergic reactions. The World Health Organization (WHO) anticipates a 'moderate' probability of adverse health impacts at 100,000 cells/ mL.

[130] NC Dept. of Environmental Quality, Division of Water Resources, *Annual Reports of Algal Blooms, 2012-2016*.
[131] Laura Fondario Grubbs, *Quantification of Select Cyanobacteria and Cyanotoxins in Piedmont North Carolina Lakes using Real-Time PCR*, 2014.
[132] NC Department of Health & Human Services, *Algal Bloom Events, 2005-2012 Report*. The agency has more recent data for years since 2012, but has sequestered it pending publication in an academic journal.
[133] EPA, Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin- Draft, EPA Doc. No. 822-P-16-002 (Dec. 2016), *available at* https://www.epa.gov/sites/production/files/2016-12/documents/draft-hh-rec-ambient-water-swimming-document.pdf

So, we urge the EMC to adopt a drinking water standard for chronic exposures that protects the most vulnerable (infants), 0.3 µg/L for microcystin and 0.7 µg/L for cylindrospermopsin. For class B and C waters, we urge the EMC to adopt both concentration and cell count standards, 4 micrograms/liter (µg/L), and for cylindrospermopsin, 8 µg/L, and a cell count standard of 100,000 cells/mL.

Finally, we recommend that the EMC consider adopting an algal toxin standard specifically for SA waters and their tributaries. Recent research indicates that oysters and mussels can absorb toxins in particulate or dissolved form and then hold them for weeks. One experiment found that mussels exposed to varying levels of microcystin for 24 hours retained it for up to 8 weeks; oysters cleaned themselves somewhat faster.[134] *Cylindrospermopsin* can also bioaccumulate in shellfish and fish tissues.[135] This suggests that shellfish can serve as a filter for toxins produced by blooms further upstream in the watershed over a period of weeks or months. The EMC should examine whether a special standard based on shellfish consumption is needed for SA waters in North Carolina.

VIII. 2015 EPA update for 94 Human Health Criteria

In 2015, EPA finalized new human health criteria for 94 pollutants.[136] Federal law requires states conducting triennial reviews to either adopt these criteria as water quality standards or explain why they have not.[137] In our review of the criteria, it appears to us that roughly one-third are significantly more protective than North Carolina's current state standards (for water supply watershed, recreational, or Class C waters). However, many of these pollutants may not actually be discharged into North Carolina waters. At least eight are legacy pesticides that were banned years ago and are unlikely to appear in our surface waters unless they are leaking from contaminated soil or groundwater.[138]

We are aware that updating water quality standards for these 94 pollutants could absorb agency resources needed to update or develop standards for other pollutants that, by any objective measure, pose a greater risk to public health or the aquatic environment. We imagine that assessment of fiscal impacts for these pollutants could be especially time consuming. To simplify that, we recommend that the EMC or DEQ specifically request public comment on the occurrence and use of the 94 compounds, including discharge to water, by any person in North Carolina. The EMC's notice for the current triennial review implicitly invites such information, but a separate notice and request for public comment could be more explicit. Then, if no member of the public identifies a given chemical as one they use or discharge, the EMC may conclude that it is not in use and that updating the state standard should have no fiscal impact.

Ultimately, the EMC must adopt such changes to the standards for these 94 pollutants as are necessary to stay in compliance with the federal act. Yet, we urge the EMC to prioritize attention

[134] Corinne Gibble, et. al. *Evidence of freshwater algal toxins in marine shellfish: Implications for human and aquatic health*. 59 Harmful Algae 59–66 (2016).
[135] Susan Kinnear. 2010. Cylindrospermopsin: A Decade of Progress on Bioaccumulation Research. *Mar. Drugs* 8, 542-564.
[136] EPA, 80 Fed. Reg. 36986 (June 29, 2015).
[137] 40 CFR 131.20(a).
[138] These include Aldrin, alpha-Hexachlorocyclohexane (HCH), Chlordane, Dieldrin, DDD, DDT, Endosulfan Sulfate, and Hexachlorobenzene. Alpha-Endosulfan and beta-endosulfan also appear to be in the process of being phased-out.

and resources to pollutants that are actually a threat to water quality in North Carolina, whether or not they have an EPA-established human health criterion (for example, the pesticides and emerging contaminants discussed above).

IX. Flow

To protect the many designated uses of North Carolina's waters, the EMC should adopt water quality standards to ensure necessary stream flow to protect ecological integrity. Aquatic life, primary and secondary recreation, drinking water, industrial and agricultural water use, and other designated uses depend on appropriate flow in streams and rivers. These uses warrant protections through the development and adoption of narrative and numeric flow standards. Federal courts have upheld minimum stream flow requirements necessary to enforce designated uses of state waters as part of the states' authority under the Clean Water Act.[139]

Absent an explicit flow standard, efforts to achieve the designated uses of water bodies tend to focus on the chemical component of water quality, with limited consideration of how decisions will impact the physical and biological integrity of water bodies. It makes little sense, however, to deem a waterbody "protected for primary recreation which includes swimming"[140] because it meets chemical standards if there is inadequate water volume in the waterbody to swim or otherwise recreate therein. Recreational use of our waters is not the only designated use that would be better protected by the adoption of flow standards. For instance, some waters are designated for use as drinking water supplies, yet water can become unfit for consumption or industrial processes when there is inadequate flow to assimilate nutrients and other pollutants. This is explicitly demonstrated by algal blooms on the Cape Fear River, which tend to only happen during low flows in during the growing season.[141]

EPA Region 4 has continued to recommend that State agencies develop flow standards as part of the triennial review process and has provided state agencies with guidance. In the Southeast, Kentucky, Virginia, and Tennessee have already adopted flow protections in their water quality standards, allowing for the protection of flows for aquatic life and recreation. In 2017, the USGS and EPA released a final technical report on the process to protect aquatic life from the effects of hydrologic alteration.[142] This guidance can further aid the EMC in developing standards that explicitly protect designated uses including aquatic life and recreation. North Carolina should follow this guidance and develop flow protection standards.

We encourage the EMC to adopt flow standards developed using a 'natural flow paradigm'[143] that recognizes the importance of seasonal, intra-annual, and inter-annual variable flow patterns necessary to sustain designated uses during a wide range of annual precipitation patterns. One method that is useful when site-specific flow data is lacking is the Percent-of-Flow

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[139] *PUD No. 1 of Jefferson Cnty. v. Washington Dept. of Ecology*, 511 U.S. 700, 723 (1994).

[140] 15A N.C. Admin. Code 2B .0101(c).

[141] Presentation to NC WRRI Annual Conference 2017, Hall, Nathan and al, "Unraveling dual influences of increasing nutrients and changing flow regimes on bloom potential along the middle Cape Fear" https://wrri.ncsu.edu/wp-content/uploads/2017/04/Hall.pdf (visited 7/30/18)

[142] EPA Report 822-R-16-007/USGS Scientific Investigations Report 2016-5164, which recognizes that too much or too little flow can have major negative consequences on aquatic life.

[143] N.L. Poff, J.D. Allan, et al. *The natural flow regime: A paradigm for river conservation and restoration*. 47 BioScience 769-784 (1997).

(POF) approach or "presumptive standard." The presumptive standard "explicitly recognizes the importance of natural flow variability and sets protection standards by using allowable departures from natural conditions, expressed as percent alternation."[144] We caution against adopting a flow standard based on default measures like 7Q10, which mimic the most severe drought conditions and are inadequate to protect aquatic life or many other uses.

X. Methylmercury

North Carolina currently has a water quality standard for mercury in Class C waters, but lacks a standard for methylmercury, the mercury compound most toxic to aquatic life. Notably, "[w]henever a State reviews water quality standards . . ., or revises or adopts new standards . . ., such State shall adopt criteria for *all toxic pollutants* listed pursuant to section 1317(a)(1) of this title . . . ," and "[s]uch criteria shall be specific numeric criteria for such toxic pollutants."[145] The list of toxic pollutants include "mercury and compounds."[146]

The amount of mercury released into the environment has increased throughout the industrial age, and North Carolina's power plants continue to be a substantial source of mercury emission in North Carolina.[147] After a series of chemical transformations caused by microbial activity, mercury becomes methylmercury, a harmful neurotoxin with the highest chronic toxicity of any tested mercury compound.[148]

Methylmercury is absorbed into the tissue of fish, where it bioaccumulates and bio-magnifies in the food chain, so predator fish and older fish typically have high concentrations of methylmercury.[149] As observed by DWR, "[m]ercury is by far the most common metal detected in

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[144] B.D. Richter, M.M. Davis, et al. *Short Communication: A presumptive standard for environmental flow protection*. River Research Applications (2011). DOI: 10.1002/rra.1511.

[145] 33 U.S.C. § 1313(c)(2)(B) (emphasis added).

[146] 40 C.F.R. § 401.15 (listing toxic pollutants).

[147] NCDENR, *North Carolina Mercury TMDL* 8 (Sept. 2012), available at https://files.nc.gov/ncdeq/Water%20Quality/Planning/TMDL/FINAL%20TMDLS/Statewide/NCMercuryTMDL_EPASubmit.pdf. As previously observed by the State,

> Approximately 80% of the mercury released from human activities is elemental mercury released to the air, primarily from fossil fuel combustion, mining, and smelting, and from solid waste incineration. Coal-burning power plants are the largest man-made source of mercury emissions to the air in the United States, accounting for over 50% of all domestic human-caused mercury emissions. About 15% of the total is released to the soil from fertilizers, fungicides, and municipal solid waste (for example, from waste that contains discarded batteries, electrical switches, or thermometers). Discharges of industrial wastewater account for an additional 5% of mercury released to surface waters.

Id. at 12.

[148] EPA, Quality Criteria for Water 172 (May 1, 1986), *available at* http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#gold.

[149] EPA, Water Quality Criterion for the Protection of Human Health: Methylmercury, EPA-823-R-01-001 (Jan. 2001), available at http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/methylmercury/document.cfm.; *see also* Dana Sackett et al, *The Influence of Fish Length on Tissue Mercury Dynamics: Implications for Natural Resource Management and Human Health Risk*, 10 INT'L. J. ENVTL. RESEARCH & PUB. HEALTH 638-59 (Feb. 2013), *available at* http://www.mdpi.com/1660-4601/10/2/638.

North Carolina fish.[150] According to EPA studies, nearly 100% of the mercury that bioaccumulates in predatory fish is methylmercury.[151]

Humans are exposed to methylmercury by eating fish that contain methylmercury. Such exposure is particularly problematic to pregnant women and women of childbearing age due to the adverse effects of methylmercury on childhood development. "Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage."[152]

Mercury-related fish consumption advisories issued by the N.C. Department of Health and Human Services caution against consumption of largemouth bass, blackfish, black crappie, catfish, jack fish, warmouth, yellow perch, almaco jack, banded rudderfish, cobia, Crevalle jack, greater amberjack, South Atlantic grouper, king mackerel, ladyfish, little tunny, marlin, orange roughy, shart, Spanish mackerel, swordfish, tilefish, and Albacore tuna.[153] Those advisories offer more stringent precautions for vulnerable populations like children under 15 and women of childbearing age. However, fish consumption advisories are no substitute for water quality standards.[154]

In 2001, EPA recommended a water quality criterion for methylmercury (0.3 mg/kg of fish tissue), reasoning that such a standard was preferable to a water column-based criterion because it integrates spatial and temporal complexity that affects methylmercury bioaccumulation.[155] In 2010, EPA issued guidance for implementing that recommendation.[156] We urge the EMC to adopt a methylmercury standard that is at least as protective as the EPA recommendation.[157]

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[150] DWR, Fact Sheet: Bioaccumulation in North Carolina Fish (Sept. 2016), *available at* https://files.nc.gov/ncdeq/Water%20Quality/Environmental%20Sciences/ISU/DWR%20Fish%20Bioaccumulation%20Fact%20Sheet%20Sept%202016.pdf.

[151] Dana Sackett et al, *The Influence of Fish Length on Tissue Mercury Dynamics: Implications for Natural Resource Management and Human Health Risk*, 10 Int'l J. Envtl Research & Pub. Health 638-59 (Feb. 2013),

[152] Agency for Toxic Substances & Disease Registry ("ATSDR"), Mercury, Cas# 7439-97-6 (Apr. 1999), *available at* http://www.atsdr.cdc.gov/tfacts46.pdf.

[153] NCDENR, *North Carolina Mercury TMDL* 9 (Sept. 2012).

[154] Catherine E. LePrevost, *Need for Improved Risk Communication of Fish Consumption Advisories to Protect Maternal and Child Health: Influence of Primary Informants*, 10 Int'l J. Envtl Research & Pub. Health 1720-34 (Apr. 2013) (noting that fish consumption advisories often do no reach the population most at risk from bioaccumulated mercury), *available at* www.mdpi.com/1660-4601/10/5/1720/pdf.

[155] EPA, Water Quality Criterion for the Protection of Human Health: Methylmercury, EPA 823-R-10-001 (January 2001).

[156] EPA, Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion, EPA 823-R-10-001 (April 2010).

[157] Research into the human microbiome suggests bacteria in the human gut may convert methylmercury back into the highly toxic inorganic mercury, suggesting support for a more stringent standard. K.S. Betts, *A Study in Balance: How Microbiomes Are Changing the Shape of Public Health*, 119(8) Envtl Health Persp., 340, 343 (2011); Liebert, C.A., et al., *Phylogeny of Mercury Resistance (mer) operons of Gram-Negative Bacteria Isolated from the Fecal Flora of Primates*, 63 Applied & Envtl Microbiology 1006-1076 (Mar. 1977) (discussing ability of intestinal bacteria to demthylate methyl mercury), *available at* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC168397/pdf/631066.pdf.

XI. High Quality Waters changes

In addition to the narrative and numeric standards for various pollutants, the proposed readoption package contains the rules defining North Carolina's suite of designated uses, and describing the process the state will follow in assigning or reclassifying uses. For the most part, the EMC proposes to readopt these rules without substantive change, while moving some existing language to new locations. However, the package does include a significant substantive revision to the definition of 'High Quality Waters' (HQWs) that may have harmful consequences and appears to violate federal rules.

The current definition of HQWs is located at 15A NCAC 02B .0101(e)(5):

> High Quality Waters (HQW): waters which are rated as excellent based on biological and physical/chemical characteristics through Division monitoring or special studies, native and special native trout waters (and their tributaries) designated by the Wildlife Resources Commission, primary nursery areas (PNA) designated by the Marine Fisheries Commission and other functional nursery areas designated by the Marine Fisheries Commission, all water supply watersheds which are either classified as WS-I or WS-II or those for which a formal petition for reclassification as WS-I or WS-II has been received from the appropriate local government and accepted by the Division of Water Quality and all Class SA waters.

The proposed rule package moves much but not all of this language to 15A NCAC 02B .0224:

> (a) High Quality Waters (HQW) are a subset of ~~waters~~ "waters with quality higher than the standards" ~~standards and are as described by 15A NCAC 2B .0101(e)(5)~~ as defined in Rule .0202 (59) of this Section. The ~~following~~ procedures in this rule shall be implemented in order to ~~implement~~ meet the requirements of Rule .0201(d) of this Section.
>
> (b) All water supply watersheds which are classified as WS I or WS II, and all waters classified as Class SA waters are HQW. The Commission may classify, if case by case reclassification proceedings are conducted, any surface waters of the state as High Quality Waters (HQW) upon finding that such waters are:
>
> (1) rated excellent based on biological and physical/chemical characteristics through monitoring or special studies, or
>
> (2) primary nursery areas (PNA) and other functional nursery areas designated by the Marine Fisheries Commission or the Wildlife Resources Commission.
>
> …

In the process of the move, the package makes three substantive changes, two of which are of concern.

First, the proposed new .0224 drops any reference to the designation of 'native and special native trout waters', formerly applied by the Wildlife Resources Commission (WRC) but abolished some years ago. The WRC designation reportedly was not aligned with the supplemental classification of 'trout waters,' which is already defined, proposed for consolidation in .0202 (55), and referenced throughout the numeric standards. We do not object to this change.

Second, the proposed new .0224 removes waters that have been petitioned for reclassification to WS-I or WS-II from the list of automatic HQWs. A staff note on the draft claims that this is necessary to avoid a conflict with the state Administrative Procedures Act, without further explanation. We think that misreads the impact of the existing provision. The EMC clearly has the authority, in this readoption (as it did when it first adopted .0101(e)(5)), to say that when a petition is filed, that water will be temporarily treated as an HQW, with all the management measures that implies, until the petition is resolved. There are strong policy reasons to retain this: when a segment is under consideration for reclassification to WS-I or WS-II – the most pristine watersheds – projects that are inconsistent with HQW measures can irreversibly damage the segment. Temporary protection is appropriate, and will expire if the reclassification fails.

Most problematically, the proposed revision of .0224 strips the self-executing designation of a primary nursery area (PNA) "or other functional nursery area" as an HQW. Staff have explained that their intent is for this section to apply prospectively, so that all PNAs designated until now would remain HQWs, but future PNAs would need to be reclassified separately as HQWs by the EMC. This seems needlessly convoluted. We urge the EMC to make the policy decision now (as the current wording of .0101(e)(5) does) that waters identified in the future as a PNA by the NC Marine Fisheries Commission should automatically receive HQW protections.

In any event, the proposed revision of .0224 is *not* merely prospective. In eliminating automatic HQW status for PNAs 'and other functional nurseries', the proposed language strips HQW status from any PNA that has not been independently listed as an HQW in the pages and pages of designated uses laid out in the 2B .0300 rules. To make the proposed change to .0224 without stripping HQW status from these waters, the EMC would need to review all of the PNAs designated to date, compare them to the designated uses in the current .0300 rules, and then propose and adopt HQW status for all the PNAs 'and other functional nurseries' that are not already so identified.[158] Moreover, under 40 CFR 131.10(j), North Carolina cannot remove the HQW classification from any of these waters without first conducting a time-consuming and potentially expensive use attainability analysis.[159]

For these reasons, we recommend that the EMC instead adopt a revised .0224 along these lines:

(a) High Quality Waters (HQW) are a subset of ~~waters~~ "waters with quality higher than the standards" ~~standards and are as described by 15A NCAC 2B .0101(e)(5)~~ as defined in Rule .0202 (59) of this Section. The ~~following~~ procedures in this rule shall be implemented in order to ~~implement~~ meet the requirements of Rule .0201(d) of this Section.

(b) All water supply watersheds which are classified as WS I or WS II, all waters classified as Class SA waters, and all primary nursery areas (PNA) and other functional nursery areas designated by the Marine Fisheries Commission or the Wildlife Resources Commission are HQW. The Commission may classify, if case by case reclassification proceedings are conducted, any surface waters of the state

[158] Maps of the PNAs and other functional nursery areas identified to date by the Marine Fisheries Commission are available at http://portal.ncdenr.org/web/mf/primary-nursery-areas and comprise large stretches of North Carolina's coastal waters.

[159] 40 CFR 131.10(j): "A State must conduct a use attainability analysis … whenever: …(2) The State wishes to remove a designated use that is specified in section 101(a)(2) of the Act, to remove a sub-category of such a use, or to designate a sub-category of such a use that requires criteria less stringent than previously applicable."

as High Quality Waters (HQW) upon finding that such waters are rated excellent based on biological and physical/chemical characteristics through monitoring or special studies. When a water has been petitioned for reclassification as WS-I or WS-II, it shall temporarily, pending a final adoption or rejection of the petition by the Commission, be managed under the provisions of this section.

XII. Conclusion

Despite numerous updates of EPA recommendations and considerable advances in the scientific understanding of water pollution and its effects, North Carolina has failed to make improvements to its water quality standards necessary to protect the State's waters. Given the EMC's acknowledgment of many such recommendations and advances, we are discouraged by its failure to act. However, we urge the EMC to conduct a substantive and meaningful triennial review process and, when doing so, make the long-overdue changes recommended in these comments.

Sincerely,

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