Summary of North Carolina Surface Water Quality Standards 2007-2014

North Carolina Department of Environment and Natural Resources

Division of Water Resources

April 2015

Table of Contents

Part 1 –Background, Public Input Opportunities, State Rulemaking Process and Administrative Approval

Section 1: Background and Public Input Opportunities

During the period of time covering January 2007 to March of 2010, all North Carolina water quality standards were reviewed with the goal to fulfill the State's obligations under the Triennial Review process. From January 2007 to the fall of 2009, informal sessions were held throughout the state to inform industries, local governments, regulated parties, environmental groups and laboratories of the likely proposals, and to request any additional comments and suggestions. Based upon current scientific literature and federal guidance, several water quality standards were identified as being under-protective of human health and/or the environment. Numerous metal criteria were identified as being either over or under protective based upon the National Recommended Water Quality Criterion, as published during that time frame, while two elements were identified as being inappropriate water quality standards for North Carolina waters and were proposed for removal.

The NC Division of Water Resources (NC DWR), formerly, the Division of Water Quality (DWQ) obtained permission in March of 2010 from the Environmental Management Commission (EMC) to proceed to Public Hearing with numerous changes required to maintain its program consistent with Clean Water Act requirements. The State's Administrative Procedures Act (APA) process entails development of a Fiscal Note. The Fiscal Note analysis was initiated immediately following the EMC's approval to go out to public notice. This involved public solicitation (summer of 2010) of costs and/or benefits associated with the adoption of the proposals and began an extensive review of both ambient and wastewater data to review impacts to ambient monitoring, stormwater, National Pollutant Discharge Elimination System (NPDES) wastewater and water treatment permittees, groundwater remediation programs, etc. During the process of fiscal note development, staff from DWR continued with public outreach. (Attachment 1: Public Participation Process Record)

Significant revisions to NC General Statutes occurred during the initial review of water quality standards which affected the Division's ability to expedite adoption of the March 2010 EMC's proposals. These revisions included additional necessities and approval steps for development of the state's required fiscal notes and adoption requirements related to EMC approval. These modifications added to the length of time needed to adopt revised water quality standards.

Recognizing the significant time lapse, the revised state laws and pending legislation to readopt all rules (Session Law 2013-413; HB 74), new EMC members and new DENR management, the EMC approved DWR to proceed to public hearing to allow public review of all water quality standards regulations in Title 15A North Carolina Administrative Code (NCAC) 02B .0100-.0110, .0201-.0228, .0230-.0231 and .0300-.0317. The hearing was held on November 19th, 2013 in Raleigh, NC.

Mr. Steve Tedder, Chairman of the EMC's Water Quality Committee served as the appointed Hearing Officer for the proceedings. Approximately 100 people attended with ~ 30 offering oral comments. The public comment period was extended through January 3, 2014. Planned dates for public notice, comment period and hearings were all subject to the requirements of the State's Administrative Procedures Act (APA) as provided in NC General Statute §150B. (Attachment 2: NC Register Notice; November 1, 2013)

On March 13, 2014, Mr. Tedder presented recommendations to the EMC for NC DWR staff to evaluate as they drafted proposed changes to the surface water standards in 15A NCAC 02B regulations. The full report of that hearing and the recommendations can be found at the following link: http://portal.ncdenr.org/web/emc/march-13-2014.

Using the recommendations prepared by the Hearing Officer, proposed revisions to the 15A NCAC 02B regulations were drafted and presented, along with the accompanying fiscal note, to the Water Quality Committee and the Environmental Management Commission on May 7th and 8th, 2014, respectively.

A record of those proceedings is located at: http://portal.ncdenr.org/web/emc/may-7-2014-wqc and http://portal.ncdenr.org/web/emc/may-8-2014.

Following approval by the EMC on May 8th, 2014, in accordance with NC General Statutes, Chapter 143-214.1, 143-215.3(a) and 150B, a public notice, containing the proposed amendments and the accompanying fiscal note was published in the June 16, 2014 edition of the North Carolina Register. (Attachment 3: NC Register Notice; June 16, 2014)

Notices were sent to those who requested to be placed on the NC DWRs' rule-making e-mail notification list and additional notice to the public was also provided through the Department and Division's websites. A press release was issued by the Department of Environment and Natural Resources.

Following public notice, the first of two public hearings was conducted in Raleigh NC on July 15th, 2014. Approximately 70 individuals attended the public hearing, with 23 requesting to comment. The second public hearing was conducted in Statesville, NC on July 16th, 2014. Approximately 50 individuals attended the public hearing, with 12 requesting to make oral comments. Mr. Steve Tedder, Environmental Management Commission member and Chairman of the Water Quality Committee, served as the EMC appointed Hearing Officer for both public hearings.

Approximately 925 written comments were received. They included ~900 e-mails and letters from private citizens; 13 from business and industries, local governments, representatives of local governments and agricultural interests; 9 from non-governmental organizations; 3 from federal government representatives and 3 letters addressing water quality variances specifically (two supported retention of existing variances and one requested review to be concluded as soon as possible). A link to all written comments is available here: Public Comments Received wrt 2014 Public Hearings

Section 2: State Rule Making Process and Administrative Approval

Environmental Management Commission (EMC) Actions

On November 13th, 2014 the Environmental Management Commission, after a careful review of all public comments and recommendations made by the EMC appointed Hearing Officer, adopted amendments to 15A North Carolina Administrative Code (NCAC) 02B water quality standards regulations under the Clean Water Act required Triennial Review (http://www.epa.gov/lawsregs/laws/cwa.html).

Requirements to establish and/or amend these standards is authorized to the Environmental Management Commission (EMC) by NC General Statutes (NC GS §143-214.1 and 215.3(a)). Water quality standards are used in various ways including establishing NC's National Pollutant Discharge Elimination System (NPDES) permit limits and evaluating the conditions of the surface waters of the state per Clean Water Act Sections 303(d) and 305(b).

The EMC's Hearing Officer Report of Proceedings is located in Item 8. 14-42 linked here: http://portal.ncdenr.org/web/emc/november-13-2014

NC Administrative Procedures Act (APA)

Under NC General Statutes, (NC GS §150B), the EMC amended regulations must be submitted for review to the NC Office of Administrative Hearings (OAH)-Rules Review Commission (RRC), approved by the RRC and formally submitted for publication into the North Carolina Administrative Code (NCAC or Code) .

The OAH staff submitted numerous "technical changes" to the Division that were addressed prior to formal adoption into the Code. The effective date of the rules, January 1, 2015, appeared in the NC Administrative Code, January 26, 2015. The approved rule language is provided as Attachment 4: 15A NCAC 02B .0200 Regulations and result in updated NC criteria that reflect the potential toxicity to aquatic life and/or human health.

These amended water quality standards are not applicable under the Act until approval is made by the US EPA Administrator.

*****

As noted above, during the period of time covering January 2007 to March of 2010, all North Carolina water quality standards were reviewed for any needed amendments. Several water quality standards were identified as being either over or under protective based upon the National Recommended Water Quality Criterion, other current scientific literature and federal guidance. Two elements were identified as being inappropriate water quality criterion for North Carolina waters and were proposed for removal. The following Sections are designed to provide clarifying information and background on these decisions.

Section 1: Metals - Overview of Aquatic Life and Human Health Revisions

Consistent with the requirements of the Clean Water Act, North Carolina Water Quality Standards (WQS) are derived using the US Environmental Protection Agency (US EPA) National Guidelines for the protection of aquatic life. EPA has issued a federal guidance document used to calculate aquatic life standards (Stephan et al. (1985) - Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses: http://www.epa.gov/waterscience/criteria/library/85guidelines.pdf). North Carolina Division of Water Resources investigated a number of regulatory modifications to determine the most scientifically defensible, implementable mechanism for the control of metals in the aquatic environment.

A table summarizing these changes is provided as Attachment 5: NC WQS Metals Table 2015

Metals in the Water Column: Acute and Chronic Effects

In previous adoptions of water quality criteria, North Carolina regulations had language that implied that a concentration of a metal in the water column was a "never to exceed value" or a "maximum concentration". As these metals standards were calculated for protection of chronic (long term) impacts, the application of a "maximum" "never to exceed" value was incorrect.

In revising North Carolina's standards to address updated numerical criteria, NC DWR followed revisions to many 1980's and 1990's criteria documents that included both acute and chronic expressions of the numerical concentrations. To accurately capture the use of the newly adopted acute and revised chronic standards, language was added to 15A NCAC 02B 0211 (11) (e) that provides collection information in line with derivation of the criterion in accordance with Stephan at al. methodology. After public notice, review and approval by the EMC and RRC the following language was adopted into regulation:

> "Compliance with acute instream metals standards shall only be evaluated using an average of two or more samples collected within one hour. Compliance 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;"

To assure that implementation of the acute standard would/could be executed, language in 15A NCAC 02B .0206 (a) was modified to include permitting provisions as follows:

> "(3) Toxic substance standards to protect aquatic life from acute toxicity shall be protected using the 1Q10 flow;"

See additional discussion of implementing provisions in: "Application of Hardness Values in the NPDES Permit" below.

Metals in the Water Column: Dissolved, Particulate and Total Recoverable Metals

Two forms of a metal in the water column are relevant to aquatic life toxicity, dissolved metals and particulate metals. The US EPA operationally defines dissolved metals as the metal in a water sample which passes through a 0.45 µm or a 0.40 µm filter (US EPA Office Of Water: 1996 The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion. EPA 823-B-96-007 (4305)).

The free metal ion, which typically corresponds with the dissolved metal portion in the water column, is considered to be the most bioavailable form of a metal to aquatic organisms and therefore is considered the more toxic form of a metal. In basic terms, particulate metals account for metals that are bound to solids in the water column and are operationally defined by the US EPA as the total recoverable metal minus the dissolved metal. The term "total recoverable metals" accounts for all measurable metals, dissolved and particulate, present in a water sample.

These forms of a metal in the water column are not stable, and metals can cycle between the dissolved and particulate fractions. Metal form (dissolved/particulate) and speciation are dependent on water chemistry characteristics. Because water chemistry characteristics are constantly changing, the toxicity and bioavailability of metals are in a state of flux. Metals are transformed in the aquatic environment from one form and/or chemical species to another due to a variety of biological and chemical processes.

Previous North Carolina water quality standards for metals reflect total recoverable metal concentrations and were calculated to consider the toxic impact of all measurable forms of the specified metal present in the water column. The recently adopted rules change the aquatic life water quality standards for most metals to reflect the toxic impacts of the dissolved portion of the metals present in the ecosystem. Dissolved metals are currently understood to be the most important fraction to consider when looking at the toxic impacts of metals to aquatic organisms.

According to the US EPA, the particulate fraction, while not necessarily nontoxic, appears to produce substantially less toxic impacts than does the dissolved fraction. The adopted rules continue to incorporate the use of total recoverable metal measurements for mercury and selenium, as these are bioaccumulative metals.

Additionally, North Carolina water quality standards for metals calculated to protect human health (ex. arsenic) were not proposed for revision and will continue to be expressed as total recoverable metals concentrations. This is appropriate as human exposure to toxicity from metals would not be specific to the dissolved metal concentration but could come from all metal forms present in a water body.

Water Hardness

Many water chemistry parameters have been identified as being important influences on the toxicity of metals, such as water hardness, pH, dissolved organic carbon (DOC), and alkalinity. These parameters act in different ways to influence metal toxicity. Some parameters, such as DOC, can bind with metals thereby making them unavailable to aquatic organisms. Other parameters, such as water hardness, can provide for a competitive interaction with the metal ions present in the water column.

Water hardness is often expressed as the concentration of the minerals calcium and magnesium present in a water source. However, other minerals also contribute to water hardness. The calcium and magnesium ions that contribute to water hardness are known to lower the toxicity of some metals by competing with the dissolved metal ions for binding sites on an aquatic organism. Toxic impacts to aquatic organisms occur when the metal ions bind to these sites on the organism (such as on the gills of a fish). The higher the water hardness (indicating more hardness related ions are present) the lower the toxicity of some metals. The hardness ions are able to out-compete the metal ions for binding sites on the aquatic organisms; therefore, the organisms are ultimately exposed to less metal.

The opposite effect occurs in low hardness water, containing fewer hardness related ions. The competitive influence of hardness is absent or limited in these low hardness waters, increasing the likelihood that the metals will bind to sites on the organism, allowing toxicity to occur. However, the extent of this hardness effect varies by metal and by metal speciation. For example, water hardness affects the toxicity of chromium III but has no influence on chromium VI. Water type (fresh or salt) also affects the impact of water hardness on metal toxicity.

Ambient Application of Proposed Standards

Water hardness is a commonly studied parameter during aquatic toxicity testing for metals. Hardness can be varied, to a limited degree, in toxicity tests in order to characterize the effect, if any, on the toxicity of the metal being examined in the tests. Water hardness is also assumed by the US EPA to be a good surrogate for the influence of other water chemistry parameters on toxicity. To reflect this influence, the US EPA NRWQC are represented for some metals, referred to as hardness-dependent metals, as equations which allow the criteria to be modified to account for differences in ambient water hardness.

The previous NC water quality standards for these hardness-dependent metals were expressed as a single numeric concentration based upon a statewide application of 50 mg/l hardness. This was determined (at the time of that adoption) to be the statewide median hardness of waters across the state, but may have also included sites that were tidally influenced. Recognizing that the waters of the state may vary in hardness, the revised North Carolina regulations incorporate the current US EPA NRWQC hardness-dependent equations or, in the case of Cadmium, a modified NRWQC, as the water quality standards.

Measurement of hardness in an ambient water body is accomplished by collecting a sample to be analyzed in the laboratory along with the metals analysis. The adopted equations, shown in Appendix A, allow the collected ambient hardness of a water to be factored in creating a sample-to-sample standard that is then compared to the actual ambient sample reported result for assessment purposes. We remain confident that this approach will provide a much clearer idea of potential impacts to aquatic life.

Applicable Hardness Range

In determining an applicable hardness range to apply in the waters of the state, NC DWR reviewed the US EPA “National Recommended Water Quality Criteria-2002” (EPA-822-R-02-047) from the Office of Science and Technology, dated November 2002 for guidance on calculating hardness dependent metals standards. Additionally, we considered the actions of other states as provided to us in a summary table by the US EPA Region IV staff.

In the past, EPA recommended that when the hardness of fresh surface water is less than 25 mg/L, 304(a) criteria concentrations should be calculated as if the hardness is 25 mg/l. Today, US EPA expresses concern that the use of 25 mg/l hardness as a floor may not be fully protective. EPA-822-R-02-047 states that , "available toxicity data in this range for copper, zinc and cadmium (EPA 44015-84-03 1, EPA 44015-87-003, and EPA-822-R-01-001) are somewhat limited, and are quite limited for silver, lead, chromium III and nickel (EPA 44015-80-071, EPA 44015-84-027, EPA 44015-84-029 and EPA 44015-86-004). Even fewer data are available below 20 mg/l hardness for copper, zinc and cadmium and none are available for silver, lead, chromium 111 and nickel. EPA evaluated these limited data, available in the current metals' criteria documents, and determined that they are inconclusive."

NC DWR staff had concerns that lack of sufficient aquatic toxicity data at the lower hardness may be, in fact overly protective. Aquatic toxicity laboratories have a difficult time maintaining hardness in laboratory conditions below 25 mg/l so justification that the toxicity can be extrapolated to such levels will be a challenge. It is our desire to provide the protection that is intended by EPA's *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (EPA 822lR-85-100) or ''the Guidelines." Following that, we agree "If there is a state or tribal regulatory requirement that hardness be capped at 25 mg/l, or if there are any situation-specific questions about the applicability of the hardness-toxicity relationship, a Water Effect Ratio (WER) procedure should be used to provide the level of protection intended by the Guidelines." (EPA-822-R-02-047).

Our existing regulations were calculated using outdated formulas, and a baseline hardness of 50 mg/l across the entire state. The revised adopted criteria, calculated at either the ambient hardness or a minimum of 25 mg/l, is based upon scientifically protective criteria. The state has provided for the application of a WER if deemed necessary for additional protection. See the subsection below on WER for more information. After public notice, review and approval by the EMC and RRC the following language was adopted into regulation 15A NCAC 02B .0211 (c)(ii):

> "*…The minimum applicable instream hardness shall be 25 mg/l and the maximum applicable instream hardness shall be 400 mg/l, even when the actual median instream hardness is less than 25 mg/l and greater than 400 mg/l;"*

Application of Hardness Values in the NPDES Permit

The application of a hardness measurement in NPDES permits cannot vary from day-to-day. The permitting process requires that a uniform measurement of hardness be applied while determining both appropriately designed permit limits and the corresponding compliance with the permit.

NC DWR staff and the EMC recognized that a regionalized hardness value must be adopted for purposes of consistent NPDES permitting and to assure waters of the state were adequately protected at, or near, the discharge, and also downstream of the discharge. Many options were explored as to how to incorporate this concept into the rules. The chosen hardness policy needed to reflect the fact that water hardness values do vary across the state but also needed to make sure downstream uses were protected (per current 15A NCAC 02B regulations).

Data analysis suggested that allowing the use of the instream hardness value close to the discharge point (or a site specific hardness) may not be protective of downstream uses. Urban influences, such as stormwater runoff, and the effluent itself can cause an increase to be seen in the instream hardness

values around large cities and discharge outfalls and these artificially high hardness values weren't always reflective of the relatively unimpacted upstream or downstream hardness values.

While staff discussed that designing sampling studies for each discharger to determine applicable individual instream hardness would be ideal, completion of the task would be a significant increase in work load for which no staff or funding exists. Since the NC regulations currently contain provisions and mechanisms for site-specific derivation of water quality standards (should a specific discharger wish to investigate this mechanism), the concept of using Hydrologic Unit Code (HUC) hardness was developed to address both of these problems.

North Carolina has an extensive data set for hardness evaluation. As of our final appraisal of hardness data in STORET (6/6/1969 to 9/4/2013), NC DWR had 42,850 hardness samples from 1025 stations across the state. NC DWR sought to establish regulations that would represent this "location relevant" data evaluation (as opposed to the previously established single statewide number of 50 mg/l). See Attachment 6: Hardness by HUC 1969 to 2013

Starting with a 12 digit HUC, the scale was so small that only ~ 30 % of the 12 Digit HUCs have any sampling stations, making its use for all dischargers inappropriate. The 10 digit HUC scale offered better possibilities, as ~73% had at least one sampling station. Using an 8 digit HUC evaluation point, there are 53 HUCs (or, subbasin scale). When the data is broken into 8 digit HUCs, North Carolina had ~91 % with at least one station.

Ambient monitoring stations per subbasin ranged from 1 to 59, with an average of 16 stations per subbasin. The strength of data in each subbasin made it ideal for providing a more uniform, normalized assessment to be applied to our affected dischargers. The chosen hardness 8 Digit HUC reference point reflects localized waters (those directly downstream of a discharge), but, at the same time, may recognize the upstream and farther downstream hardness as well. So, in applying the 8-digit HUC hardness, we can address both of these issues.

The use of the HUC hardness allowed the incorporation of both the urban influenced hardness data as well as relatively unimpacted areas. Note that the NC DWR hardness data used to calculate the HUC hardness values was collected at the Division's ambient stations and that these stations originally were located in areas influenced by discharges or other pollutant sources in order to capture the impacts of these influences to surface waters. Due to the placement of ambient stations, it appears somewhat likely that the use of a smaller (12 or 10 digit) HUC hardness value would potentially reflect more of an "impacted" hardness situation than an "unimpacted" situation. Additionally, the use of calculated median 8 digit HUC hardness values allows for one hardness number to be applied for all dischargers in a particular subbasin without costly larger studies being undertaken.

After public notice, review and approval by the EMC and RRC the following language was adopted into regulations (15A NCAC 02B .0211 (c)(ii)):

> "Hardness-dependent metals in NPDES permitting: for NPDES permitting purposes, application of the equations in Table A: Dissolved Freshwater Standards for Hardness-Dependent Metals shall have hardness values (expressed as $CaCO_3$ or Ca+Mg) established *using the median of instream hardness data collected within the local US Geological Survey (USGS) and Natural Resources Conservation Service (NRCS) 8-digit Hydrologic Unit (HU)...*"

The language in 15A NCAC 02B .0206 and .0211 does not change any applications of Water Quality Based Effluent Limitations (WQBELs) in NPDES permitting. Water quality-based requirements in wastewater permits are, by their nature, specific to each discharge and its receiving stream. The Division performs separate Reasonable Potential Analyses (RPAs) for each permit and each parameter of concern to determine appropriate requirements. RPAs are conducted at each permit renewal, using the then-current characteristics of the discharger's effluent and the receiving stream. The RPA calculations are repeated for each metal of concern and each applicable standard (acute and chronic aquatic life, human health-water supply, human health-fish ingestion, trout), and a separate reasonable potential determination is made in each case.

Effluent limitations based on chronic standards (long-term impacts) are set as monthly average limits in the permit. Those based on acute standards (short-term impacts) are generally set as weekly average limits for publicly owned facilities and as daily maximum limits for private facilities. The NPDES program uses the same RPA methodology with all wastewater permits. The methodology has been approved by the US EPA as being consistent with its national guidance in the "Technical Support Document for Water Quality-Based Toxics Control", (EPA 505/2-90-001, March, 1991)

Non Hardness-Dependent Metals

To date, water hardness in freshwater environments has been observed to influence the toxicity of certain metals to aquatic life, but not others. NC DWR included in the adopted regulations a number of metals whose toxicity is not impacted by water hardness (in freshwaters): arsenic, beryllium, chromium VI and silver. Metals whose toxicity is not influenced by water hardness are still expressed as a single numeric value in the proposed rules and do not have an associated equation provided. Water hardness has not been found to affect the toxicity of metals to saltwater organisms in saltwater environments. The revised standards are adopted as provided by US EPA in the most recent issuance of the National Recommended Water Quality Criterion table. More information on each metal is found in Section 2, below.

Water Effects Ratio (WER)

The EMC wanted to provide that any interested stakeholder could seek and address the modifying effects of additional water quality parameters to metals toxicity. While current mechanisms exist in the 15A NCAC 02B regulation to develop a site specific standard, stakeholders and the EMC sought to place into rule the use of a Water Effect Ratio (WER).

The US EPA issued guidance in the early 1980s on the water-effect ratio (WER) method. The WER is "a biological method to compare bioavailability and toxicity in receiving waters versus laboratory test waters" (U.S. EPA, 1992). A WER is calculated by dividing the acute LC50 of the metal, determined in water collected from the receiving water of interest, by the LC50 of the metal determined in a standard laboratory water, after adjusting both test waters to the same hardness.

The standard laboratory water LC50 is used as the denominator to reflect that this LC50 is measured in test water that has water quality characteristics representative of the test waters used to develop the Water Quality Criteria (WQC) toxicity database, at least as a good approximation. The national hardness-based acute criterion concentration is then multiplied by this ratio (i.e., the WER) to establish a site-specific criterion that reflects the effect of site water characteristics on toxicity.

NC DWR modified regulations to allow for the WER multiplier to be one (1) until such time as the requestor could provide studies in accordance with Appendix L of the US EPA Water Quality Standards Handbook, *Interim Guidance on Determination and Use of Water-Effect Ratios for Metals* (EPA-823-B-94-001, February 1994) and the *Streamlined Water-Effect Ratio Procedure for the Discharge of Copper* (EPA-822-R-01-005, March 2001).

After public notice, review and approval by the EMC and RRC the following language was adopted into regulations at 15A NCAC 02B .0211 (11):

> (b) "With the exception of mercury and selenium, acute and chronic freshwater aquatic life standards for metals listed in this Subparagraph apply to the dissolved form of the metal and apply as a function of the pollutant's water effect ratio (WER). A WER expresses the difference between the measures of the toxicity of a substance in laboratory waters and the toxicity in site water. The WER shall be assigned a value equal to one unless any person demonstrates to the Division's satisfaction in a permit proceeding that another value is developed in accordance with the "Water Quality Standards Handbook: Second Edition" published by the US Environmental Protection Agency (EPA-823-B-12-002), free of charge, at http://water.epa.gov/scitech/swguidance/standards/handbook/ , hereby incorporated by reference including any subsequent amendments. Alternative site-specific standards may also be developed when any person submits values that demonstrate to the Commissions' satisfaction that they were derived in accordance with the "Water Quality Standards Handbook: Second Edition, Recalculation Procedure or the Resident Species Procedure", hereby incorporated by reference including subsequent amendments at http://water.epa.gov/scitech/swguidance/standards/handbook/..."

And,

> (d) "Alternatives: Acute and chronic freshwater aquatic life standards for metals listed in Table A apply to the dissolved form of the metal and apply as a function of the pollutant's water effect ratio (WER), which is set forth in Sub-Item (b) of this Rule. Alternative site-specific standards may also be developed as set forth in Sub-Item (b) of this Rule;"

Summary of Revisions to NC's Metal Criteria

With the exception of cadmium, North Carolina's proposed numeric changes to the water quality standards for metals are based on updated toxicity test data that has been added into the NRWQC calculations. The national data set refers to "Criteria Maximum Concentration" (CMC) which equals the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects. The CMC is referred to in North Carolina regulations as the "acute" criterion. The "Criteria Continuous Concentration" (CCC) equals the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects, referred to in NC regulations as the "chronic" criterion.

The calculation for cadmium is in direct response to the request (in 2006) for a modification and use of a recalculation study. Additional information on the cadmium calculations can be found in Section 2, below.

The discussions that follow do not include additional mention of the Water Effects Ratio (WER) and its use in standards. As noted above, the WER is one, until information to justify its inclusion is submitted and reviewed.

Section 2: Metals - Revisions for Individual Metals

The following were revised to reflect National Recommended Water Quality Criteria (NRWQC) or modifications to NRWQC:

ARSENIC (CASRN 7440-38-2)

Arsenic: Aquatic life

For protection of aquatic life in fresh and salt waters (Class C and SC, respectively), the previous NC water quality standard for arsenic (50 ug/l) was based upon the State of California's Water Quality Criteria; Second Edition (1963). The value first appears in the NC Water Quality Standards in March 1, 1977. However, this established value was intended, by California, to be used for the protection of domestic water supplies. Its location within the NC regulations offered protection for aquatic life that was lower than that recommended by the US EPA at the time and served a dual purpose of protecting water supplies as well.

The EMC and RRC, after the required public hearings and review, adopted the "1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water (EPA 820-B-96-001) (1995) for dissolved arsenic for the protection of aquatic life as follows:

Arsenic, Freshwater (Chronic): 150 ug/l
Arsenic, Freshwater (Acute): 340 ug/l
Arsenic, Saltwater (Chronic): 36 ug/l
Arsenic, Saltwater (Acute): 69 ug/l

Arsenic: Human health

Current arsenic water quality standards designed for the protection of human health in *all* waters of the state remains at 10 ug/l, measured as total recoverable arsenic. The DWR maintains this protective standard which is equivalent to the current National Drinking Water standard. (Reference: http://water.epa.gov/drink/contaminants/basicinformation/arsenic.cfm)

Arsenic, Human Health, all waters: 10 ug/l

BERYLLIUM (CASRN 7440-41-7)

Beryllium is a metal found in natural deposits as ores containing other elements, and in some precious stones such as emeralds and aquamarine. It is present in a variety of materials, such as rocks, coal and oil, soil, and volcanic dust. The greatest use of beryllium is in making metal alloys for nuclear reactors and the aerospace industry. Beryllium alloys are also used in automobiles, computers, sports equipment (golf

clubs and bicycle frames), and dental bridges. A key distinction among beryllium compounds is that some are soluble in water, but many are not.

North Carolina's chronic water quality standard for total recoverable beryllium is 6.5 ug/l based upon an assessment of beryllium toxicity performed by the US EPA (440/5-80024). In that report, the EPA indicated that insufficient data were available to develop a Final Acute Value according to US EPA guidelines. EPA determines that acute and chronic toxicity to aquatic life occurs at Beryllium concentrations as low as 130 ug/l and 5.3 ug/l, respectively. North Carolina's procedures for calculating aquatic-life based water quality standards for toxicants allows the application of a safety factor of 0.05 to the lowest 96 hour LC-50, in cases (like this one) where insufficient data exist for the development of a Final Acute Value.

The EMC and the RRC, after the required public hearings and review, determined that dissolved beryllium aquatic life protective standards in freshwater are 6.5 ug/l (chronic) and 65 ug/l (acute).

Beryllium, freshwater (Chronic): = Safety Factor X lowest LC50
= 0.05 X 130 ug/l
= 6.5 ug/l

Beryllium, freshwater (Acute): The acute standard was calculated in accordance with EPA convention:
=LC50/2
=130 ug/l / 2
= 65 ug/l

CADMIUM (CASRN 7440-43-9)

Cadmium is a relatively rare element that is a minor nutrient for plants at low concentrations, but is toxic to aquatic life at concentrations only slightly higher. In natural freshwaters, cadmium sometimes occurs at concentrations of less than 0.1 ug/l, however, in environments impacted by man, concentrations can be several micrograms per liter or greater. Cadmium can enter the environment from various anthropogenic sources, such as by-products from zinc refining, coal combustion, mine wastes, electroplating processes, iron and steel production, pigments, fertilizers, and pesticides. The impact of cadmium on aquatic organisms depends on a variety of possible chemical forms of cadmium, which can have different toxicities and bioconcentration factors.

Cadmium: Freshwater Criterion

North Carolina's previous water quality criterion of 2 ug/l (total recoverable) was based upon the guidance published in the "Ambient Water Quality Criteria for Cadmium – 1984" (EPA 440/5-84-032); January 1985). The calculated value was derived, using the published equations, for an assumed statewide hardness of 50 mg/l, and included recalculations for "trout" and "non-trout" waters. The adopted hardness dependent cadmium criterion is based, in part, on EPA's guidance in "2001 Update of Ambient Water Quality Criteria for Cadmium" (EPA-822-R-01-001; April 2001), this freshwater aquatic life protective standard was modified due to several factors including: addition of data for bull trout and rainbow trout, elimination of some data, and recalculation of species mean acute values for a few species.

After a failed attempt to adopt these during the 2004-2007 Triennial Review process, NC DWR was asked by a number of stakeholders to review modified (recalculated) versions of the cadmium equations that were developed by Chadwick Ecological Consultants, Inc. (CEC) at the request of the Association of Metropolitan Sewerage Agencies (AMSA).

(**NOTE:** During derivation of this cadmium report, AMSA changed its name to "National Association of Clean Water Agencies (NACWA)" and Chadwick Ecological Consultants, Inc. (CEC) changed its name to GEI Consultants- Chadwick Ecological Division (GEI-CED) and eventually to GEI Consulting Engineers and Scientists. The reader is advised that other documents relevant to this review may be located under these various names.)

The National Association of Clean Water Agencies (NACWA) funded a study by Chadwick Ecological Consultants (CEC) to review the EPA criterion in 2003. In this review and subsequent report (September 2004), CEC discovered several issues with EPA acute and chronic data and procedures for developing the national criteria. They also identified several additional sources of data to be added to the database for deriving the national criteria. CEC proposed alternative coldwater and warm water acute and chronic criteria. In December 2004, CEC published an addendum to its earlier review. While EPA took issue with several of the review points and suggestions by CEC, they ultimately accepted the water quality criteria modifications.

Upon receipt of the two GEI-CED reviews of the US EPA criterion for cadmium, which included additional studies published after the 2001 publication by the EPA, NC DWR staff began extensive research to validate the stakeholder proposal (North Carolina Pre-treatment Consortium) to formally adopt the recalculation, under the US EPA allowed recalculation procedure.

The following is a brief summary of actions based upon the GEI-CED recalculation (Attachment 7: (a) and (b) Cadmium Recalculation). These were implemented in the State of Colorado with the effective date of rule implementation, January 1, 2007.

GEI-CED removed one acute data set, for the African Claw frog, a species identified as having been introduced to the US, but currently not having any widespread habitat in the US. Their current North American habitat is limited to specific southwest locales. Additionally some data points were removed from the national data set which creates a slight modification to the Final Chronic Value. These changes have been deemed correct and in accordance with US EPA and NC protocol for development of water quality standards. As a result of the GEI-CED recalculation, the State of North Carolina will apply the recalculated dissolved criterion noted below as a hardness-dependent based criterion in all Class C waters. North Carolina retained Conversion Factors as published in Appendix A and B of the *"National Recommended Water Quality Criteria-Correction;* EPA 822-Z-99-001; April 1999, (cited as 62 FR 42160).

The EMC and the RRC, after the required public hearings and review, determined that the dissolved cadmium aquatic life protective standards in freshwater are:

Cadmium, freshwater (Chronic) = (CF) · exp{mC [*ln*(hardness)]+ bC}

= {1.101672-[*ln* hardness](0.041838)} · *e*^{0.7998[*ln* hardness]-4.4451}

= 0.15 ug/l (@ 25 mg/l hardness)

Cadmium, freshwater (Acute) = (CF) · exp{mA [ln(hardness)]+ bA}

non-trout waters

= {1.136672-[*ln* hardness](0.041838)} · *e*^{0.9151 [*ln* hardness]-3.1485}

= 0.82 ug/l (@ 25 mg/l hardness)

Cadmium, *trout waters* (Acute) = (CF) · {exp{mA [ln(hardness)]+ bA}

= {1.136672-[*ln* hardness](0.041838)} · *e*^{0.9151[*ln* hardness]-3.6236}

= 0.51 ug/l (@ 25 mg/l hardness)

Cadmium: Saltwater

North Carolina's previous saltwater aquatic life criterion of 5 ug/l (total recoverable) was adopted in September 1979 based upon guidance from the US EPA, July 1976, "Quality Criteria for Water" (*The "Red Book").* Additional reviews of the saltwater criterion occurred in 1984 (EPA 440/5-80-025) and again in 1984 in response to the Federal Register notice 49(26); 1984 draft criterion of 12 ug/l cadmium (total recoverable), all with no proposed modification. The adopted saltwater chronic and acute standards are based on EPA's NRWQC *"2001 Update of Ambient Water Quality Criteria for Cadmium"* (EPA-822-R-01-001; April 2001), which are both expressed as dissolved metal. The US EPA derived the total cadmium acute and chronic concentrations (CMC and CCC, respectively) and converted them to a dissolved cadmium criterion using the 0.994 conversion factor determined experimentally by US EPA and published as Appendix A of the National Recommended Water Quality Criterion: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#D

The EMC and the RRC, after the required public hearings and review, determined that the dissolved cadmium aquatic life protective standards in saltwater are:

Cadmium, saltwater (Chronic) = 8.8 ug/l

Cadmium, saltwater (Acute) = 40 ug/l

CHROMIUM III (CASRN 16065831) and **CHROMIUM VI (CASRN 18540299)**

The previous NC criteria for total chromium was derived using recommendations for Chromium III in the "1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water" (EPA-820-B-96-001; September 1996) at an assumed statewide hardness of 50 mg/l. While it is not clear in the historical records, it is presumed that no standard was adopted for chromium III as no analytical method for the chromium III species existed, and a separate chromium VI criterion was (likewise) not established due to the limits of quantitation for chromium VI at the time. The previous saltwater standard of 20 ug/l total chromium is assumed to be from the US EPA "Quality Criteria for Water: 1986: EPA 440/5-86-001" (or, The "Gold Book") as derived using regulations in 15A NCAC 02B .0200:

Previous -Total Chromium, saltwater (Chronic) = Final Acute Value X Safety Factor
=2000 ug/l X 0.01
= 20 ug/l

(http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#gold)

After review of the guidance on chromium III and chromium VI issued in *"National Recommended Water Quality Criteria-Correction;* EPA 822-Z-99-001; April 1999, (62 FR 42160), North Carolina determined that adoption of speciated chromium values would more closely align with concerns over the toxicities of these in aquatic environments and would potentially eliminate any over-protectiveness that may occur with an evaluation of Total Recoverable Chromium (Cr III + Cr VI). These US EPA freshwater criterion (1999) were a modification of previously published 304(a) aquatic life criteria that were issued in the "*1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water*" (EPA-820-B-96-001, September 1996). The values were derived using GLI Guidelines (60FR15393-15399, March 23, 1995; 40CFR132 Appendix A).

CHROMIUM III (CASRN 16065831)

The toxicity of chromium III is hardness-dependent. After approval by the EMC and the RRC, required public hearings and review, the EMC determined that the dissolved chromium III aquatic life protective standards in freshwater are as follows:

Chromium III, freshwater (Chronic) =(CF) · {exp{mC [*ln*(hardness)]+ bC}
=0.860 · *e*^{0.8190[*ln* hardness]+0.6848}
= 24 ug/l @ 25 mg/l hardness

Chromium III, freshwater (Acute) = (CF) · {exp{mA [*ln*(hardness)]+ bA}
= 0.316 · *e*^{0.8190[*ln* hardness]+3.7256}
= 180 ug/l @ 25 mg/l hardness

No data were readily available to establish a criterion for Chromium III in saltwaters.

CHROMIUM VI (CASRN 18540299)

After approval by the EMC and the RRC, required public hearings and review, the EMC determined that the dissolved chromium VI aquatic life protective standards in freshwater are as follows:

Chromium VI, freshwater (Chronic) = 11 ug/l
Chromium VI, freshwater (Acute) = 16 ug/l

After approval by the EMC and the RRC, required public hearings and review, the EMC determined that the dissolved chromium VI aquatic life protective standards in saltwater are as follows:

Chromium VI, saltwater (Chronic) = 50 ug/l
Chromium VI, saltwater (Acute) = 1100 ug/l

COPPER (CASRN 7440508)

Copper is an abundant trace element found in the earth's crust and is a naturally occurring element that is generally present in surface waters. Copper is a micronutrient for both plants and animals at low

concentrations and is recognized as essential to virtually all plants and animals. However, it may become toxic to some forms of aquatic life at elevated concentrations. Thus, copper concentrations in natural environments, and its biological availability, are important. Mining, leather and leather products, fabricated metal products, and electric equipment are a few of the industries with copper-bearing discharges that contribute to anthropogenic inputs of copper to surface waters.

Copper: Freshwater

Over the past 20 years, the US EPA has published a number of guidance documents containing aquatic life criteria recommendations for copper (e.g., U.S. EPA 1980, 1985, 1986, and 1996). During this Triennial Review NC DENR adopted the published criterion from the *"National Recommended Water Quality Criteria-Correction;* EPA 822-Z-99-001; April 1999, (cited as 62 FR 42160) to be applicable in all fresh and saltwaters of the state. This US EPA freshwater criterion was a modification of previously published 304(a) aquatic life criteria that was issued in the "*1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water*" (EPA-820-B-96-001, September 1996). This value was derived using GLI Guidelines (60FR15393-15399, March 23, 1995; 40CFR132 Appendix A). For this rule, EPA updated freshwater aquatic life criteria contained in CWA section 304(a) criteria guidance first published in the early 1980's and later modified in the National Toxics Rule, as amended, for ten pollutants (including arsenic, cadmium, chromium (VI), copper, dieldrin, endrin, lindane (gamma BHC), nickel, pentachlorophenol, and zinc). The basis for this rule are explained more fully in the technical support document of 1995 and presents the derivation of each of the final CMCs and CCCs and the toxicity studies from which the updated freshwater criteria for the ten pollutants were derived.

In accordance with US EPA protocol, hardness-dependant metals' criteria may be calculated from the following formulas and incorporating factors listed as "Appendix B – Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent" (Reference: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#appendxb). These are the same factors which appear in the above referenced Federal Register notices.

The EMC and the RRC, after the required public hearings and review, determined that the dissolved copper aquatic life protective standards in freshwater are as follows:

Copper, freshwater (Chronic) = (CF) ·{exp{mC [*ln*(hardness)]+ bC}

= 0.960 · e^{0.8545[ln hardness]-1.702}

= 2.7 ug/l @ 25 mg/l hardness

Copper, freshwater (Acute) = (CF) X exp{mA [*ln*(hardness)]+ bA}

= 0.960 · *e*^{0.9422[*ln* hardness]-1.700}

= 3.6 ug/l @ 25 mg/l hardness

Copper: Saltwater

North Carolina's previous water quality standard for copper (October 1989) applicable to saltwaters was based upon the *"Ambient Water Quality Criteria for Copper-1984"* (EPA 440/5-84-031; January 1985). The adopted copper saltwater criterion value was derived in "*Ambient Water Quality Criteria Saltwater*

*Copper Addendum (*Draft, April 14, 1995) and was published in the *"National Recommended Water Quality Criteria-Correction;* EPA 822-Z-99-001; April 1999*"* as promulgated under the Interim final National Toxics Rule (60FR22228-222237, May 4, 1995).

The EMC and the RRC, after the required public hearings and review, determined that the dissolved copper aquatic life protective standards in saltwater are as follows:

Copper, saltwater (Chronic) = 3.1 ug/l

Copper, saltwater (Acute) = 4.8 ug/l

Copper: Biotic Ligand Model

Additionally, NC DENR recognized that EPA's latest criteria recommendations were based on the use of the copper biotic ligand model (BLM) and these recommendations would (or could) be useful to adequately update the freshwater criteria as needed. The US EPA developed the BLM for copper in "Aquatic Life Freshwater Quality Criteria – Copper 2007 Revision (EPA-822-R-07-001: February 2007) which produces a freshwater copper standard that takes into account the cumulative impacts of many relevant water chemistry parameters.

As copper speciation, bioavailability, and toxicity can vary due to various physicochemical characteristics of the water, including temperature, dissolved organic compounds, suspended particles, pH, and various inorganic cations and anions (including hardness and alkalinity). Many of these physicochemical factors affect copper speciation, and their effects on copper toxicity therefore could be due to effects on copper bioavailability. As the model requires numerous parameter inputs from site-specific ambient waters, the resulting standard is deemed to be site-specific. Inclusion of the ability to use the Copper BLM in NC rule provides a simple mechanism for a requestor to submit the information to the state and derive a site-specific criterion/resulting revised permit limits, where sufficient data is available. Private researchers and the US EPA are in the process of developing additional models for other metals, NC will continue to monitor EPA updates for potential inclusion into the water quality standards.

The EMC and the RRC, after the required public hearings and review, determined that the dissolved copper aquatic life protective standards in freshwater can be derived as follows in 15A NCAC 02B .0211 (11) Table A:

"Aquatic Life Ambient Freshwater Quality Criteria—Copper 2007 Revision" (EPA-822-R-07-001)

LEAD (CASRN 7439921)

North Carolina's water quality standard for lead was adopted in October 1989, and was based, in accordance with regulations in 15A NCAC 02B .0208, upon the use of a safety factor of 0.01 times the lowest LC50 for fresh and saltwater species for total lead. During this Triennial Review, the NC DWR adopted the published criterion from the "*Ambient Water Quality Criteria for Lead – 1984"* (EPA-440-5-84-027: January 1985). North Carolina retained "Conversion Factors" and "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent" as published in Appendix A and B of the "National Recommended Water Quality Criteria-Correction; EPA 822-Z-99-001; April 1999", (62 FR 42160).

(http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#appendxb).

The EMC and the RRC, after public notice and review, approved water quality standards for dissolved lead in fresh and saltwaters as follows:

Lead, freshwater (Chronic) = (CF) · {exp{mC [*ln*(hardness)]+ bC}

={1.46203-[*ln* hardness](0.145712)} · *e*^{1.273[*ln* hardness]-4.705}

= 0.54 ug/l @25 mg/l hardness

Lead, freshwater (Acute) = (CF) · {exp{mA [ln(hardness)]+ bA}

= {1.46203-[ln hardness](0.145712)} · e^{1.273[ln hardness]-1.460}

= 14 ug/l @ 25 mg/l hardness

Lead, saltwater (Chronic) = 8.1 ug/l

Lead, saltwater (Acute) = 210 ug/l

NICKEL (CASRN 7440020)

Over the past 20 years, the US EPA has published a number of guidance documents containing aquatic life criteria recommendations for Nickel (e.g., U.S. EPA 1980, 1986, 1995). During this Triennial Review the NC DENR adopted the published criterion from the *"National Recommended Water Quality Criteria-Correction;* EPA 822-Z-99-001; April 1999, (62 FR 42160) to be applicable in all fresh and salt waters of the state. This US EPA freshwater criterion was a modification of previously published 304(a) aquatic life criteria that was issued in the "*1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water*" (EPA-820-B-96-001, September 1996). This value was derived using GLI Guidelines (60FR15393-15399, March 23, 1995; 40CFR132 Appendix A). For this rule, EPA updated freshwater aquatic life criteria contained in CWA section 304(a) criteria guidance first published in the early 1980's and later modified in the National Toxics Rule, as amended, for ten pollutants (including arsenic, cadmium, chromium (VI), copper, dieldrin, endrin, lindane (gamma BHC), nickel, pentachlorophenol, and zinc). The basis for this rule are explained more fully in the technical support document of 1995 and presents the derivation of each of the final CMCs and CCCs and the toxicity studies from which the updated freshwater criteria for the ten pollutants were derived.
In accordance with US EPA protocol, hardness-dependant metals' criteria may be calculated from the following formulas and incorporating factors listed as "Appendix B – Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent" (Reference: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#appendxb). These are the same factors which appear in the above referenced Federal Register notices.

The EMC and the RRC, after the required public hearings and review, determined that the dissolved nickel aquatic life protective standards in freshwater and saltwaters are as follows:

Nickel, freshwater (Chronic) = (CF) · exp{mC [*ln*(hardness)]+ bC}

= 0.997 · *e*^{0.8460[*ln* hardness]+0.0584}

= 16 ug/l @ 25 mg/l hardness

Nickel, freshwater (Acute) = (CF) · exp{mA [ln(hardness)]+ bA}

=0.998 · e^{0.8460[ln hardness]+2.255}

= 140 ug/l @ 25 mg/l hardness

Nickel, saltwater (Chronic) = 8.2 ug/l

Nickel, saltwater (Acute) = 74 ug/l

SILVER (CASRN 7440224)

A chronic NC water quality standard for silver was originally adopted in 1984 at 10 ug/l. Public records indicate that the silver standard was adopted due to the state's concerns with the presence of silver in wastewater discharges (mirror manufacturing plants). The standard was updated in 1989 to the current chronic standard of 0.06 ug/l. While the records indicate that this was derived using the "Ambient Water Quality Criteria for Silver, October 1980" (EPA 440/5-80-071), it also appears from public records that the 1989 revisions to the state's silver criterion were driven by 1987 Clean Water Act amendments requiring states to adopt numeric standards for any pollutant with a national criterion, including silver. The silver chronic criterion was calculated using the lowest LC50 for total recoverable silver of 1.2 ug/l and applying a safety factor of 0 .05 (in accordance with 15A NCAC .0208 provisions).

Previous -Total Silver, freshwater (Chronic) = LC50 X Safety Factor

= 1.2 ug/l x 0.05

= 0.06 ug/l

The current NC freshwater and saltwater chronic standards for silver have been proposed to remain unchanged due to the lack of any new data. While DWR acknowledges that there is currently no federal recommended chronic criterion for silver. Chronic criteria are meant to protect aquatic organisms from impacts such as reduced growth or reproduction due to long term exposure to low levels of a chemical while acute criteria establish the levels necessary to protect organisms from lethality due to an exposure to higher levels of a toxicant. DWR is concerned that the adoption of only a silver "acute" standard could potentially hinder the state in its efforts to protect for, and assess the harm to, aquatic populations from the more sensitive and long term exposure scenarios. NC DWR staff proposed the addition of acute standards for fresh and salt waters. The freshwater dissolved acute standard was calculated using EPA's equation for hardness-dependent metals. The saltwater acute standard was based on EPA's criterion, which is also expressed as dissolved. As silver continues to be present in some NC wastewater discharges, the state determined that it should not be removed from regulations governing aquatic life protection. In making this decision, a number of items were reviewed for relevance:

- In 1983, staff of NC DWR, then the Division of Environmental Management (NC DEM), reviewed the 1980 document for relevance to the state's waters, by examining a site specific location where two known dischargers were located. Applying conservative estimates of the stream located in Wilkes County, they applied a hardness factor of 21.5 mg/l (average hardness of that stream) to the published acute toxicity values and derived a 0.29 ug/l value. After further review, again looking at conditions surrounding these mountain streams, they derived an equation protective of rainbow trout, applied a safety factor of 0.1 (due to bioaccumulative potential) and estimated that chronic toxicity levels could be estimated at ~0.067 ug/l.

- The US EPA draft 1987 silver criteria (published in 1990) indicated a chronic criterion of 0.12 ug/l based on rainbow trout data. That information was reviewed by NC DEM, but was eliminated from consideration after the publication of the June 30, 1992 Tudor Davies memo indicated that the official EPA publication for silver criteria would be the "Ambient Water Quality Criteria for Silver, October 1980" (EPA 440/5-80-071) document.

- The US EPA continues to work on proposing a federal chronic standard for silver. However, in discussions with division staff at the US EPA Office of Water (Joe Beamon), it was indicated that new information has led the US EPA to believe that control of nanosilver may be a more urgent concern for federal regulation and resources may be shifted towards research of this form of silver over ionic silver. EPA staff indicated that the completion of the development of a chronic freshwater silver criterion was dependent on future resource allocations.

- NC's silver chronic standard is in line with another EPA Region 4 states' adopted chronic standard (Florida), as well as other states around the country that have chosen to calculate their own silver chronic standard. Florida's chronic silver standard of 0.07 ug/l has been challenged in court by the Florida Environmental Action Committee/ The Silver Coalition, which consisted of silver dischargers. Florida's silver chronic standard was upheld.

- North Carolina's current saltwater silver criterion value of 0.1 ug/l is believed to be similarly derived, but records are not clear. They appear to be from the 1980 published criterion ("Ambient Water Quality Criteria for Silver, October 1980" (EPA 440/5-80-071)) and based upon a safety factor of 0.05 applied to the 2.3 ug/l to equal 0.11 ug/l (rounded to 0.1 ug/l). As the EPA does not currently publish a conversion factor for saltwater application of the silver criterion it was presumed to be equal to "one".

After review of the above noted information it appeared that retention of the freshwater chronic criterion as calculated using either the 0.067 ug/l based on bioaccumulation or the LC50 X safety factor produced similar results and was warranted based upon detection of silver in some wastewaters. We also considered that the result was based upon a total recoverable calculation. Multiplication of the 0.067 ug/l by the presumed Conversion Factor of 0.85 produces a dissolved criterion of 0.057 ug/l (rounded to 0.06 ug/l) as developed in accordance with 15A NCAC 02B .0208 and appropriate factors listed as "Appendix B – Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent" (Reference: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#appendxb).

Therefore, it was the opinion of NC DWR that the US EPA could agree that removal of the chronic silver standards from the NC regulations was not warranted, and until further development of US EPA NRWQC, the standards would be retained as dissolved silver chronic concentrations. The acute criteria are

adopted using the "Ambient Water Quality Criteria for Silver, October 1980" (EPA 440/5-80-071) as published.

The EMC and the RRC, after the required public hearings and review, determined that the dissolved silver aquatic life protective standards in freshwater and saltwater are as follows:

Silver, freshwater (Chronic) = 0.06 ug/l

Silver, freshwater (Acute) = (CF) · exp{mA [ln(hardness)]+ bA}

=0.85 · *e*^{1.72[*ln* hardness]-6.59}

= 0.30 ug/l @ 25 mg/l hardness

Silver, saltwater (Chronic): = 0.1 ug/l

Silver, saltwater (Acute) = 1.9 ug/l

ZINC (CASRN 7440666)

The previous NC chronic criterion for zinc was adopted pursuant to the "Ambient Water Quality Criteria for Zinc"; October 1980 (EPA 440/5-80-79). The chronic zinc freshwater standard for this hardness-dependent metal was expressed as a single numeric concentration (calculated at 47 ug/l and rounded to 50 ug/l total recoverable zinc) and was based upon a statewide application of 50 mg/l hardness. This was determined (at the time of that adoption) to be the statewide median hardness of waters across the state.

As with other metals criteria, the US EPA has published a number of guidance documents containing aquatic life criteria recommendations for zinc (e.g., U.S. EPA 1980, 1986, 1987, 1995). During this Triennial Review the NC DWR adopted the published criterion from the *"National Recommended Water Quality Criteria-Correction;* EPA 822-Z-99-001; April 1999, (62 FR 42160) to be applicable in all fresh and salt waters of the state. This US EPA freshwater criterion was a modification of previously published 304(a) aquatic life criteria that was issued in the "*1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water*" (EPA-820-B-96-001, September 1996). This value was derived using GLI Guidelines (60 FR 15393-15399, March 23, 1995; 40 CFR 132- Appendix A). For this rule, EPA updated freshwater aquatic life criteria contained in CWA section 304(a) criteria guidance first published in the early 1980's and later modified in the National Toxics Rule, as amended, for ten pollutants (including arsenic, cadmium, chromium (VI), copper, dieldrin, endrin, lindane (gamma BHC), nickel, pentachlorophenol, and zinc). The basis for this rule are explained more fully in the technical support document of 1995 and presents the derivation of each of the final CMCs and CCCs and the toxicity studies from which the updated freshwater criteria for the ten pollutants were derived.

In accordance with US EPA protocol, hardness-dependent metals' criteria may be calculated from the following formulas and incorporating factors listed as "Appendix B – Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent" (Reference: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#appendxb). These are the same factors which appear in the above referenced Federal Register notices.

North Carolina's previous saltwater chronic criterion of 86 ug/l was adopted pursuant to "Ambient Water Quality Criteria for Zinc – 1987 (EPA 440/5-87-003; February 1987) as was also published (without modification) in *"National Recommended Water Quality Criteria-Correction;* EPA 822-Z-99-001; April 1999, (62 FR 42160). This criterion was retained and a conversion factor of 0.946 was applied to the published total recoverable criterion of 86 ug/l to achieve a freshwater criteria equal to81 ug/l (0.946 x 86 ug/l) and to 95 ug/l to achieve a saltwater criteria equal to 90 ug/l (95 ug/l X 0.946 = 89.9, rounded to 90 ug/l) .

The EMC and the RRC, after the required public hearings and review, determined that the dissolved zinc aquatic life protective standards in freshwater and salt waters are as follows:

Zinc, freshwater (Chronic)	= (CF) · exp{mC [*ln*(hardness)]+ bC}
	= 0.986 · *e*^{0.8473[*ln* hardness]+0.884}
	= 36 ug/l @ 25 mg/l hardness
Zinc, freshwater (Acute)	= (CF) · {exp{mA [ln(hardness)]+ bA}
	= 0.978 · *e*^{0.8473[*ln* hardness]+0.884}
	= 36 ug/l @ 25 mg/l hardness
Zinc, saltwater (Chronic):	= 81 ug/l
Zinc, saltwater (Acute)	= 90 ug/l

Section 3 – Removal of Iron and Manganese Criteria

The EMC and the RRC, after public notice and review, approved removal of the water quality standards for iron (freshwater aquatic life) and manganese (human health protection in Water Supply classified waters).

IRON (CASRN 7439965)

NC DWR reviewed the iron criterion of 1000 ug/L (1 mg/L) for aquatic life protection and examined stream data and groundwater monitoring data from across the state.

Iron in NC Surface Water

North Carolina surface water monitoring data indicates levels of iron that are quite often higher than the State's water quality criterion of 1 mg/l. Surface water monitoring results from NC DWR's basinwide assessment reports indicated exceedances of the iron criteria in every basin. Evaluations of elevated levels did not correlate with individual dischargers, urban settings nor mining operations, but instead show a generally increasing value from the Blue Ridge area through the Piedmont area and to the South Eastern Plain. As validated by a US EPA evaluation, the "differences in geochemistry, soils and topography represented in the ecoregions are likely responsible for this pattern." (Attachment 8: "Occurrence of Iron in North Carolina Surface Waters" 11/18/09).

Iron in NC Groundwater

As higher concentrations were seen in areas of the state predicted to be influenced by inflow of groundwater, an evaluation of groundwater quality data from research stations and ambient groundwater quality monitoring wells across North Carolina (2001-2007) was used to estimate the average concentration of iron in groundwater. The groundwater samples were taken primarily from dedicated groundwater quality monitoring wells, but a few samples from the coastal plain were obtained from private water supply wells. The data set included 125 wells located across the state. The average concentration of iron in NC groundwater is 1320 µg/l. The iron concentrations range from below detection limit (50 µg/l) to a maximum of 32,000 µg/l for a well located in the coastal plain. The average iron concentration in groundwater from the coastal plain is 2,715 µg/l, and for the NC piedmont and mountains it is 624 µg/l and 622 µg/l, respectively. To summarize, concentrations of iron in groundwater vary widely from one location to another and the data indicate that iron occurs naturally at significant concentrations in the groundwaters of NC.

Removal of Iron Criteria

The regulations at 40 CFR 131.11 state, in part, that States must adopt "those water quality criteria that protect the designated use." Further 40 CFR Part 122.44 requires that both numeric and narrative criteria be considered when establishing appropriate effluent limits. This standard (located in 15A NCAC 02B .0211) was originally derived using the National Recommended Water Quality Criteria for the protection of freshwater aquatic life as noted in the "Red Book" (EPA 440/9-76-023, July 1976). While the records indicate that NC adopted the criterion in March of 1977, it is challenging for the state to continue to defend it when the criterion was, and remains, based upon field data (1937) that observed healthy fish fauna at upwards of 10 mg/l.

The NRWQC for the non-priority pollutant also appears to have chosen the value based upon field observations and recognized the ameliorating effects ambient waters (alkalinity, pH, temperature and ligands) have on iron toxicity. A USGS study chose a number of water bodies to represent natural conditions across the state and found that iron values ranged from < 10 ug/l to 8900 ug/l, (Reference: Caldwell, W.S., 1993, Selected water-quality and biological characteristics of streams in some forested basins of North Carolina, 1985-88: U.S. Geological Survey Water-Resources Investigations Report 92-4129, 114 p.) Noting these values in "natural waters", the standard established at 1000 ug/l was determined to be unnecessary and potentially overly protective. NC further believes that removal of the standard from the current 15A NCAC 02B regulations will not cause any adverse effects on water quality and on any designated uses.

MANGANESE (CASRN 7439965)

Manganese is one of the most abundant metals in the Earth's crust and is prevalent in North Carolina waters. NC DWR reviewed the manganese criterion for human health protection, examined stream data and groundwater monitoring data for manganese from across the state, and evaluated the needs of the state in regulating potential manganese concentrations.

Manganese in NC Surface Water

North Carolina surface water monitoring data indicates levels of manganese that are quite often higher than the State's water quality criterion of 200 ug/l in Water Supply classified waters. In a USGS report entitled "Selected water-quality and biological characteristics of streams in some forested basins of North Carolina, 1985-88" (92-4129), the investigations confirmed that

> "Observed concentrations (of manganese) ranged from less than 10 to 380 ug/l….As in the case of iron and aluminum, these data indicate manganese concentrations are somewhat flow related, with greater concentrations usually occurring during storm runoff."

and,

> "Concentrations of total iron, total aluminum, and total manganese vary directly with stream flow conditions and are related to suspended-sediment concentrations. All mean concentrations of total iron and many mean concentrations of total manganese in stream water exceeded recommended limits for these constituents."

In a similar report of the "Water Quality of North Carolina Streams: U.S. Geological Survey Water-Supply Paper 2185-C", p. C15 (Table 7), the range of total manganese is listed as 30 -640 ug/l in waters of the French Broad. This information is noted as being "probably biased toward higher values" due to the fact that samples "were collected during periods of high flow when suspended sediment concentrations were also high" (p. C11).

In Section D of the same report, while discussing the conditions of the Neuse River, it was noted that

> "Only iron and manganese concentrations are consistently above levels suggested for domestic water supplies." (p. D8)

And also that,

> "Manganese concentrations are higher that the criterion level in all samples taken at Clayton and in 88 % of the samples collected at Kinston. The geology of the region is the primary cause for these high iron and manganese concentrations." (p. D16)

Manganese concentrations range from 70 – 2200 ug/l in samples taken on the Neuse river at Clayton, NC (Mean 430 ug/L) and 20 -450 ug/l (mean 120 ug/l) at Kinston. (See Table 4,p. D18).

Manganese in NC Groundwater

An evaluation of groundwater quality data from research stations and ambient groundwater quality monitoring wells across North Carolina (2001-2007) was used to estimate the average concentration of manganese in groundwater. The groundwater samples were taken primarily from dedicated groundwater quality monitoring wells, but a few samples from the coastal plain were obtained from private water supply wells. The data set included 125 wells located across the state.

This data shows that the average concentration of manganese in groundwater throughout the state is 102 µg/l. Regionally, the average manganese concentration in groundwater from the coastal plain is 41 µg/l, while the average manganese concentration for the piedmont and mountains is 221 µg/l and 44 µg/l, respectively.

To summarize, the data indicate that concentrations of manganese in groundwater vary widely throughout the state and that and that manganese occurs naturally at significant concentrations in the groundwater of NC.

Ingestion of Manganese via Consumption of Water and Fish

NC DWR staff reviewed manganese for "water and fish ingestion" human health protection. NC DWR staff recommended to the EMC that, after careful review, we could not determine that the standard provided any human health protective benefit and proposed to withdraw it from regulations. The following is a synopsis of staff review:

- The chemical is considered a non-priority pollutant by US EPA
- The current "water and fish ingestion" criterion published by EPA predates the 1980 methodology and therefore does not utilize fish ingestion bioconcentration factor (BCF) approaches. It is not based upon human health effects and the US EPA has not recommended a water and fish ingestion value for human health protection.
- The US EPA, under the Safe Drinking Water Act, has not published a Maximum Contaminant Level (MCL) for manganese.
- The US EPA, under the Safe Drinking Water Act, has published a Secondary Maximum Contaminant Level (MCL) for manganese of 50 µg/l. NC DWR believes that this guidance could be used by water suppliers, if ever warranted, to protect users from objectionable taste and/or staining of laundry.
- NC DWR has no evidence to conclude that discharges of manganese will impact any beneficial uses of NC's waters.
- North Carolina does not need a numeric manganese criterion to protect waters supplies based upon organoleptic effects. North Carolina has an applicable criterion in 15A NCAC 02B .0211 (12) that states: "Oils, deleterious substances, colored, or other wastes: only such amounts as shall not render the waters injurious to public health, secondary recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated uses…."
- The current manganese standard was a negotiated number with the US EPA (Adopted 1993) after consultation with NC Public Health officials. Records indicate that the state did not, even at that time, believe that ill effects from manganese were occurring and noted high naturally occurring levels of manganese.

Removal of Manganese Criteria

As NC DWR has no evidence to conclude that discharges of manganese will impact any beneficial uses of NC's waters. The EMC and the RRC, after public notice and review, approved removal of the water quality standards for both iron and manganese.

Section 4 – Non-metals

2, 4 –Dichlorophenoxyacetic acid (2,4-D) (CASRN 94-75-7)

Consistent with the requirements of the Clean Water Act, North Carolina Water Quality Standards (WQS) are derived using the EPA National Guidelines for developing human health protective concentrations.

EPA has published several risk assessment guidelines, including information to support both the identification of potential human carcinogens and the selection of procedures to characterize risk at low, environmentally relevant, exposure levels. Further advances in research have led to guidance in the areas of mutagenicity, developmental toxicity, neurotoxicity and established procedures for dealing more effectively with mixtures of toxic chemicals.

Many of these advances are incorporated in the EPA methodology documents: *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (Final, October 2000,* EPA 822-B-00-004), hereinafter referred to as the 2000 Human Health Methodology and the companion document, *National Recommended Water Quality Criteria, Human Health Calculation Matrix (November 2002,* EPA-822-R-02-012).

Applying the EPA 2000 Human Health Methodology, NC DWR has updated the water supply protective human health criteria equation based on the reference dose (RfD) published by the US EPA's Integrated Risk Information System (IRIS) for 2,4 –Dichlorophenoxyacetic Acid (2,4-D) (CAS # 94-75-7) obtained from: http://www.epa.gov/iris/subst/0150.htm

The US EPA IRIS information, with respect to the non-carcinogenic effects of 2, 4 D, has not been used to update the National Recommended Water Quality Criterion (NRWQC) for the protection of human health. Incorporation of the information results in a reduction in the water supply standard to 70 µg/l (previously 100 µg/l). See Attachment 9: 2, 4 D Calculation

The EMC and the RRC, after the required public hearings and review, determined that a human health standard for 2,4-D is established at 70 µg/l in Class WS waters.

Section 5: Biological Assessment and Biological Confirmation

North Carolina, like other states, is greatly concerned with maintaining protections for surface waters and making justifiable determinations that environmental impacts have occurred, or have not occurred, and that the extent of the impacts can be appraised in a clear and definitive manner. The same concerns and needs arise when attempting to demonstrate and validate improvements, or the need for improvements, to those same waters. In December 1986, the US EPA recognized that the needs of our water quality programs were changing and instituted investigations that led to a major study of the Agency's surface water monitoring activities. The resulting report, entitled "Surface Water Monitoring: A Framework for Change" (U.S. EPA 1987), emphasizes the restructuring of existing monitoring programs to better address the Agency's then current priorities, e.g., toxics, nonpoint source impacts, and documentation of "environmental results."

In response to these recommendations, the EPA Assessment and Watershed Protection Division developed the rapid bioassessment protocols designed to provide aquatic life data for water quality management purposes such as problem screening, site ranking, and trend monitoring. *Biological assessment* is defined here as an evaluation of the condition of a waterbody using biological surveys and other direct measurements of the resident biota in surface waters.

Additional modifications to the report, designed to assure sound management decisions, were issued in 1999: "Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic

Macroinvertebrates and Fish, Second Edition"; Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling; (EPA 841-B-99-002).

Reviewers of this document noted that it could "also be applied to other program areas, for example:

- Characterizing the existence and severity of impairment to the water resource
- Helping to identify sources and causes of impairment
- Evaluating the effectiveness of control actions and restoration activities
- Supporting use attainability studies and cumulative impact assessments
- Characterizing regional biotic attributes of reference conditions"

(Reference: Chapter 1, Section 1.1, Purpose)

As these guidance's for biocriteria have been developed by EPA, states have found these protocols useful as a framework for their monitoring programs, determining the most protective use classification, modifying criteria to protect sensitive species and making more refined management decisions. North Carolina is seeking to further its use of this knowledge in its decision making efforts.

North Carolina prides itself on its strong biological assessment protocols adapted to the waters of the state. The Biological Assessment Branch of NC DWR is charged with evaluating the water quality of streams and rivers using the biological communities that live there. The group is divided into two areas of expertise: fisheries, and benthic macroinvertebrates. These biological communities reflect both long and short-term environmental conditions given the variety of life cycles these organisms exhibit (from less than one to several years in duration).

NC DWR's biocriteria have been developed using the diversity, abundance, and pollution sensitivity of the organisms that inhabit lotic (flowing) waterbodies in NC. One of five bioclassifications are typically assigned to each water body sampled: *Excellent, Good, Good-Fair, Fair and Poor*. These bioclassifications, which have been developed for major ecoregions, are used to assess the various impacts of both point source discharges and nonpoint source runoff. The resulting information is used to document both spatial and temporal changes in water quality, and to complement water chemistry analyses, ambient toxicity data, and habitat evaluations.

In addition to assessing the effects of water pollution, biological information is also used to: refine use classifications and define High Quality or Outstanding Resource Waters, support enforcement of stream standards, and measure improvements associated with environmental management actions. The added language (noted below) is intended to place these current policies into regulation for a more transparent understanding of DENR programs.

Recognizing the utility of bioassessment in conjunction with chemical evaluation, the idea of bioconfirmation seeks to address challenges in making proper environmental decisions when quantifiably measuring the concentrations of metals may be at or near the limits of quantitation. NC DWR staff, working with the Hearing Officer and reviewing stakeholder comments on analytical reliability, proposed, and the EMC and RRC adopted, the following language in 15A NCAC 02B .0211 (similar language appears in .0220).

> *(f) Metals criteria shall be used for proactive environmental management. An instream exceedence of the numeric criterion for metals shall not be considered to have caused an adverse*

impact to the instream aquatic community without biological confirmation and a comparison of all available monitoring data and applicable water quality standards. This weight of evidence evaluation shall take into account data quality and the overall confidence in how representative the sampling is of conditions in the waterbody segment before an assessment of aquatic life use attainment, or non-attainment, shall be made by the Division. Recognizing the synergistic and antagonistic complexities of other water quality variables on the actual toxicity of metals, with the exception of mercury and selenium, biological monitoring will be used to validate, by direct measurement, whether or not the aquatic life use is supported;

As noted in previous sections of this report, the state of North Carolina is "data rich" both in ambient water quality monitoring data and in biological assessment data. Using biology to assess ambient stream conditions is a sensible and scientifically sound route as noted by the scientific works discussed above. Macroinvertebrates and fish can provide an enormous wealth of information relating to the ultimate toxicity of the metals in question. Thus, chemical data used in conjunction with biological data can produce excellent examinations of the quality of the water.

In circumstances where the calculated water quality standard(s) derived by the equations listed in 15A NCAC .0200 are at, or near, the limits of analytical capability using methods required by 15A NCAC 02B .0103, an instream exceedance may inaccurately indicate that a water is unsuitable for the uses described in 15A NCAC 02B .0211. In these circumstances, and in other instances, a comprehensive evaluation of the biological integrity (as defined in 15A NCAC 02B .0202) will be undertaken to assure that a balanced and indigenous population of aquatic organism exists. If, after evaluation, the waterbody is rated *excellent to good*, it may be determined that the water body is supporting its designated use. If the water body is rated good-fair or poorer, the waters shall be assessed as unsuitable for aquatic life propagation and maintenance of biological integrity. Where it is not feasible to determine the biological integrity due to site conditions, the situation will be fully examined and assessed for the need to initiate additional monitoring and/or further evaluation.

NC DWR intends that the "weight of evidence" approach contains careful and thoughtful examination of any and all of the following, where data is available.

- Data quality:
    - Is the reported data sufficiently above the field blanks or other analytical blanks to assure that the measurement is sound?
- Overall confidence in representative sampling:
    - Were conditions at the time of collection unusual for the stream?
    - Where samples are collected for a chronic event, was any data point so statistically different from the rest as to cause concern about collection, contamination or other factors?
- Antagonistic complexities of water quality variables:
    - Were samples particularly turbid?
    - Where the biological classification is less than desirable, are naturally occurring situations the cause of the low rating and perhaps not due to the detection of a single exceedance of a metal? (examples: extremely low flow, no flow, low pH, low DO, oligotrophic conditions, the occurrence of anakeesta rock, the occurrence of naturally high conductivity in groundwater, etc.)

- Downstream protection
    - Examinations of impacts from exceedances of the standard will also include an assessment of downstream impacts to assure compliance with 02B regulations.

The above considerations help focus the Division's attention on specific water bodies and will enable NC DWR to target additional monitoring and comprehensive evaluations to maximize and prioritize efforts under expected budget constraints. These evaluations will provide a more consistent assessment of aquatic resource condition and allow us to set clearer aquatic life protection and restoration goals. Like other programs related to holistic approaches, most notably the Biological Condition Gradient (BCG) and Tiered Aquatic Life Uses (TALU), it requires us to look at ecological information more critically in making assessments.

NC DWR strongly believes that, using its robust chemical knowledge base and incorporating scientifically sound biological monitoring methodology assessments of waterbody health will provide us with strong legal foundations on which to: base Section 303 (d) listing decisions; enable revised standards to be more readily defended; fortify management goals; and, provide additional information to protect the designated uses. All of these are in keeping with the goals of the Clean Water Act.

*****

Part 3 – Implementation of Water Quality Standards in NPDES Permits

A number of modifications to the 15A NCAC 02B regulations surrounding control of toxic metals are not water quality standards, but are related to implementation of the established criterion. A request for clarity in how the standards are implemented was notably expressed by stakeholders during the public comment period, both in written statements, requested meetings with staff, Directors, the Secretary of DENR and, of course, EPA staff and management. Of concern to the regulated parties was having a straightforward and unambiguous design for implementation of the various changes (total to dissolved, hardness dependent, addition of acute standards, etc.). A great deal of work and effort on the part of all of the above mentioned parties and the appointed Hearing Officer went into making sure that fears were relieved by stating our intentions clearly and providing numerous spreadsheets and meetings to discuss implementation. With this accomplished, NC DWR strongly believes that nothing in these implementing provisions alters the purpose of the adopted instream water quality standards, which is to provide protection of, and maintenance of, the waters for their designated uses.

Section 1: Modifications to 15A NCAC 02B Implementing Regulations

The following 15A NCAC 02B regulations have modifications related to the implementation of water quality criteria:

15A NCAC 02B .0206 (a) (3):

> "Toxic substance standards to protect aquatic life from acute toxicity shall be protected using the 1Q10 flow;"

15A NCAC 02B .0211 (11) (c) (2):

> "*Hardness-dependent metals in NPDES permitting: for NPDES permitting purposes, application of the equations in Table A: Dissolved Freshwater Standards for Hardness-Dependent Metals shall have hardness values (expressed as $CaCO_3$ or Ca+Mg) established using the median of instream hardness data collected within the local US Geological Survey (USGS) and Natural Resources Conservation Service (NRCS) 8-digit Hydrologic Unit (HU).* The minimum applicable instream hardness shall be 25 mg/l and the maximum applicable instream hardness shall be 400 mg/l, even when the actual median instream hardness is less than 25 mg/l and greater than 400 mg/l;…."

15A NCAC 02B .0211 (22)

> *Action Levels for Toxic Substances Applicable to NPDES Permits*:
> (a) Copper, dissolved, chronic: 2.7 ug/l;
> (b) Silver, dissolved, chronic: 0.06 ug/l;
> (c) Zinc, dissolved, chronic: 36 ug/l; and
> (d) Chloride: 230 mg/l;
>
> The hardness-dependent freshwater action levels for copper and zinc, provided here for illustrative purposes, corresponds to a hardness of 25 mg/l. Copper and zinc action level values for other instream hardness values shall be calculated per the chronic equations specified in Item (11) of this Rule and in Table A: Dissolved Freshwater Standards for Hardness-Dependent Metals. If the action levels for any of the substances listed in this Item (which are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics or associated waste characteristics) *are determined by the waste load allocation to be exceeded in a receiving water by a discharge under the specified 7Q10 criterion for toxic substances*, the discharger *shall monitor the chemical or biological effects of the discharge;*

efforts shall be made by all dischargers to reduce or eliminate these substances from their effluents. Those substances for which action levels are listed in this *Item shall be limited as appropriate in the NPDES permit if sufficient information (to be determined for metals by measurements of that portion of the dissolved instream concentration of the action levels parameter attributable to a specific NPDES permitted discharge) exists to indicate that any of those substances may be a causative factor resulting in toxicity of the effluent.*

Section 2: Establishment of NPDES Limits

The revisions to the metals standards (15A NCAC 02B .0211 and .0220) will not alter the conceptual approach to setting metals limitations: water quality-based limits will be based on Reasonable Potential Analyses designed to maintain instream water quality standards. However, the proposed formula-based standards will require additional calculations of discharge-specific standards in evaluating water quality-based effluent limitations for the affected metals prior to the RPAs. The following paragraphs briefly describe potential changes in the permitting process based upon the *numerous* changes to the water quality standards for metals.

NC DWR expects that one or both of the following steps will be routinely required prior to conducting RPAs. Both steps would be required in the case of discharges to freshwater; only the second step is required for discharges to saltwater.

Step #1: Calculate the Hardness-Dependent Maximum Allowable Metal (Dissolved) in Receiving Stream for Permitting Purposes (freshwater only)

The modified rules express freshwater standards for cadmium, chromium III, copper, lead, nickel, and zinc as hardness-dependent equations (15A NCAC 02B .0211 (11) (e), Table A). The hardness value used for permitting purposes will be the combined hardness of the effluent and receiving stream downstream of the discharge (see 15A NCAC 02B (11) (c)(ii), above).

Whenever possible, NC DWR will use actual effluent to calculate combined hardness values for permitting of the wastewater discharges. If sufficient effluent hardness data are not available for a facility, a default value of 25 mg/l will be used. Instream hardness values for permitting purposes shall be established using the median of available hardness data according to the revised rule. Our database for this estimation of the median value is quite robust. See additional supporting information for the use of this hardness value in Part 2, Section 1, Application of Hardness Values in the NPDES Permit above. The result from the dissolved standards equations for each metal will be called the *Maximum Allowable Metal (dissolved)* value *or MAM-dissolved*.

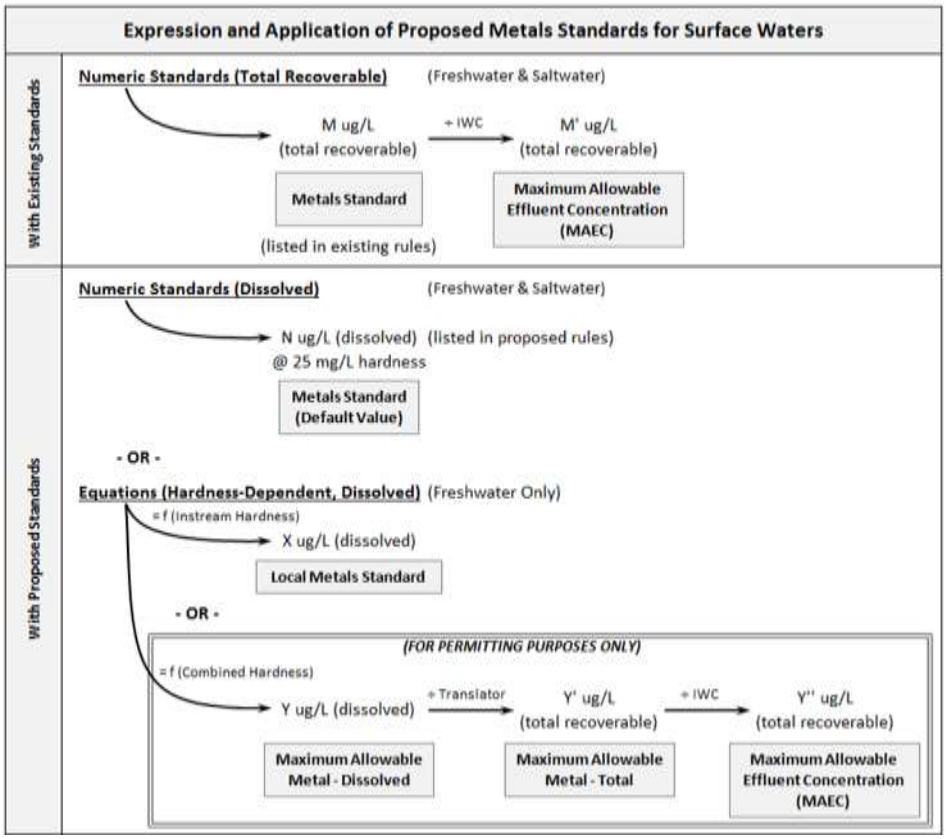
Step #2: Calculate the Maximum Allowable Metal (Total) in Receiving Stream for Permitting Purposes

Federal regulation (40 CFR 122.45(c)) requires that NPDES permit limitations be expressed as total recoverable metals. A translator for each metal must be used to convert between the dissolved water quality standard for the metal and total forms of the metal for permitting purposes. NC DWR will employ freshwater translators developed by the US EPA. The translators can be located here: http://water.epa.gov/scitech/datait/models/upload/2009_03_26_models_guidance_pdf.pdf. So, for each metal of interest, the *MAM-dissolved* value from *Step #1* must be translated, using EPA approved mechanisms, to the total recoverable form. The result is the *Maximum Allowable Metal (total)* value *or MAM-total.*

For permitting purposes, *MAM-total* for each metal is the discharge-specific, *total recoverable expression* of the dissolved standard that *remains protective of the dissolved instream water quality standard*. It is

calculated using the applicable dissolved surface water quality standards and the facility's Instream Wastewater Concentration (IWC). The IWC is the portion of the total downstream flow that comes from the wastewater discharge and is calculated using the full permitted flow of the facility and the statistical low flow of the receiving stream. Both of these are conservative assumptions and are deemed appropriate to correspond to the exposure periods associated with the standards: 1-day low flows with acute exposure and 7-day low flows with chronic exposure. This value will be used to represent the *dissolved* standard in the ensuing Reasonable Potential Analyses process.

Figure #1, below, illustrates the generalized process for determining *Maximum Allowable Metal (total)* values for permitting purposes and illustrates the differences between the use of the former and revised dissolved hardness dependent standards.



Section 3: Implementation of Copper, Zinc, Silver and Chloride in NPDES Permits

In 1984, North Carolina adopted water quality standards for copper, zinc, iron, and silver. These standards were developed to be applicable instream standards with a specialized action level implementation policy for NPDES dischargers. When these instream standards were initially adopted, US EPA was initiating a number of notable changes to its water quality standards recommendations for metals: total recoverable criteria to dissolved criteria, single numerical concentrations to equation based concentrations, hardness-dependent criteria, and water effects ratio derivations, scientific analytical testing methods for acid

soluble metals, and observations and inclusion of bioaccumulation potential. *North Carolina has not made these adjustments, until now, to adopt these factors.*

As this report was being developed, it was noted that the Division, throughout the 30 + years of successfully using an "action level" policy has consistently placed the word "standard" in the expression of, and explanation of, these procedures. We found this enlightening and realize that we have been perhaps defending "a standard" when in fact we were going above and beyond the established water quality instream standard to examine the actual toxic effects of the metal in the effluent, plus any other toxic effects that related to combined influences of other constituents. This NC procedure did not eliminate, nor change, the evaluation of the instream water quality standards for any parameter.

As noted above, the RPA process must change to be consistent with the adoption of dissolved standards; likewise the implementation of action levels will be modified to address the revised regulations, *the policy will not alter the instream water quality standards, nor compliance of the instream water quality standard.*

NC DWR remains firm in our belief that an additional examination of the Water Quality Based Effluent Limitation is warranted to assure that the limitations are neither under protective – nor overprotective. The objective of the whole effluent toxicity limits placed into an NPDES permit is to add an additional mechanism to assess and prevent discharge of toxic substances in amounts likely to cause chronic or acute toxicity to wildlife in the receiving stream. Measurement of the WET is not to be considered as "in place of" numeric criterion, it represents a feasible and reliable method of evaluating the combined effects of complex waste streams, *in addition to* instream assessments. Toxicity testing limits exist in over 647 permits in North Carolina. The compliance rate of these facilities not under Special Order by Consent (SOC) is 95% for the last five years. North Carolina's investigators and others have demonstrated the predictive ability of whole effluent toxicity tests with respect to instream impacts of wastewater discharges. (Reference: "Comparison of Instream Biological Responses with Responses Predicted by Ceriodaphnia Chronic Toxicity Tests"; Eagleson, KW, DR Lenat, L. Ausley, and F. Winborne. Env. Toxicology and Chem. 9:1019-28, and U.S. Environmental Protection Agency. 1991. Technical Support Document For Water Quality-Based Toxics Control. EPA/505/2-90-001. Office of Water, Washington, DC, p. 21.)

North Carolina maintains that they have adopted revised ambient water quality criteria that are in alignment with CWA Section 303 (c) (3) which requires numeric criteria to be developed for priority toxic pollutants. Further, we strongly believe that the actions taken by the state to develop revised numeric criterion, with an accompanying sampling instream mechanism to measure compliance using appropriate chemical testing is a positive step towards maintaining the waters of the state and protecting the designated uses of the water bodies. The Action Level policy *will not* and *does not* infer that the adopted numeric criterion listed in 15A NCAC 02B .0211 and .0220 are replaced and/or ignored.

*****

Part 4 – Water Quality Variances

As part of the Triennial Review, North Carolina is required to notice and review all water quality standard variances. There are three of these variances in effect: one for color and two for chloride. Additionally, there are thermal variances issued by the US EPA under its Section 316 (a) program.

Color Variance

A color variance for Evergreen Packaging (doing business as, Blue Ridge Paper Products, and formerly Champion International Corporation, Permit Number NC0000272),) was required to reduce color in their effluent discharge. Following the required public hearing in January 2010, the NPDES permit was renewed in May of 2010 and subsequently the color variance was approved, after review, by the EMC's NPDES Committee (July 2010) and the US EPA (December 2010). Comments received during this Triennial Review will be noted and reviewed by the NPDES Committee of the Environmental Management Commission and the US EPA at the next permit renewal.

Chloride Standard Variances

Variances from the state surface water quality standard for chloride (230 mg/L) were granted to Mount Olive Pickle Company (Permit Number NC0001074) and the Dean Pickle-Faison Plant (Permit Number NC0001970) in 1996. The elevated chloride concentrations at these facilities are due to the salt (sodium chloride) used in processing pickles. High concentrations of chloride are potentially detrimental to freshwater organisms. Both permits were renewed in June 2011 and the EMC and US EPA approval was given to continue with the existing variances in March 2011 and September 2011 respectively. Comments received during this Triennial Review will be noted and reviewed by the NPDES committee of the Environmental Management Commission and the US EPA at the next permit renewal.

Section 316(a) Thermal Variances

Thermal wastewater discharges in North Carolina are subject to effluent limitations under North Carolina Administrative Code Section: 15A NCAC 02B .0211 (3) (j). This rule limits thermal discharges to 2.8 degrees C (5.04 degrees F) above the natural water temperature and includes further restrictions based on geographic regions of the state. Exceptions to these limits are allowed under the temperature variance provisions of the Clean Water Act under Section 316(a). Under this provision permittees must demonstrate that the variance for the thermal component of the discharge assures the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in the receiving water.

The NPDES permit holders listed below have requested continuance of thermal variances, which allow for site by site limitations based upon studies conducted by the permittee and submitted to NC DENR. NC DWR has determined that these studies submitted by the permittees comply with Section 316(a) of the Clean Water Act. On the basis of North Carolina Administrative Code Section: 15A 02B .0208 (b), and other appropriate lawful standards and regulations, NC DWR proposed to continue the 316(a) variance in conjunction with the renewal of the following National Pollutant Discharge Elimination System (NPDES) permits:

North Carolina 316(a) Thermal Variances		
Permit Number	Facility	County
NC0000272	Evergreen Packaging, d/b/a Blue Ridge Paper Products, Inc.	Haywood
NC0000396	Duke Energy Progress - Asheville Steam Electric Power Plant	Buncombe
NC0003468	Duke Energy Carolinas, LLC – Dan River Steam Station	Rockingham
NC0004774	Duke Energy Carolinas, LLC –Buck Steam Station	Rowan
NC0004961	Duke Energy Carolinas, LLC – Riverbend Steam Station	Gaston
NC0004979	Duke Energy Carolinas, LLC – Allen Steam Station	Gaston
NC0004987	Duke Energy Carolinas, LLC – Marshall Steam Station	Catawba
NC0005088	Duke Energy Carolinas, LLC – Cliffside Steam Station	Rutherford
NC0024392	Duke Energy Carolinas, LLC – McGuire Steam Station	Mecklenburg

*****

Part 5 – Consultation with US EPA and US Fish & Wildlife Service

Pursuant to revisions to the water quality standards regulation promulgated in April of 2000 (*the "Alaska" rule*), new or revised water quality standards become effective for purposes of the Clean Water Act upon EPA approval. The Division maintains communication with the US EPA Region IV office (Atlanta, GA) to solicit input to potential issues affecting the waters of our state. Our contact persons there are:

- Ms. Lisa Perras-Gordon (Region IV NC Standards coordinator),
- Mr. Joel Hansel (coastal bacteria issues),
- Mr. Fritz Wagener (Endangered Species Act coordinator) (recently retired), and
- Ms. Eve Zimmerman (Native American affairs).

EPA approval of a new or revised water quality standard is considered a federal action that may be subject to the Section 7 consultation requirements of the Endangered Species Act (ESA). Section 7 of the ESA requires federal agencies to protect endangered species and threatened species and prohibits actions "likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined to be critical..."

Accordingly, ongoing discussion and consultation with the U.S. Department of the Interior, Fish and Wildlife Service is an important part of NC and EPA's water quality standards approval process. Comments, received from the US Fish and Wildlife Service, are included in the hearing officers "Report of Proceedings" (A record of those proceedings is located at: http://portal.ncdenr.org/web/emc/may-7-2014-wqc and http://portal.ncdenr.org/web/emc/may-8-2014.)

For information regarding the US Fish and Wildlife Service consultation process, please contact:
Tom Augspurger, US Fish and Wildlife Service, 551-F Pylon Drive, Raleigh NC 27606, phone: 919-856-4520 (x 21).

*****

Part 6 – Looking to the Future

In conjunction with examination of the standards as identified in March of 2010, NC DWR is appraising the following for the next Triennial Review:

- The "2012 Recreational Water Quality Criteria" (bacteriological) published in the Federal Register (77 FR 71191) on November 29, 2012 (EPA 820-F-12-058),
- the "Aquatic Life Ambient Water Quality Criteria for Ammonia-Freshwater; April 2013, EPA 822-R-13-001" ; published August 22, 2013 (78 FR 52192),
- the "Draft Aquatic Life Ambient Water Quality Criterion for Selenium--Freshwater 2014"; EPA-822-P-14-001" published May 14, 2014 (79 FR 27601-27604), and the
- "Draft: Updated National Recommended Water Quality Criteria - Human Health" (79 FR 27303-27304) published May 13, 2014.

These constituents, along with other current water quality standards will be included in the next Triennial Review cycle, and /or Rules Review as required under North Carolina Session Law 2013-413 (HB74).

Session Law 2013-413 reviews are already well underway with one meeting occurring on March 24, 2015 and additional meetings scheduled through the following weeks.

*****

Part 7 – Attachments

1. Public Participation Process Record

Attachment 1.docx

2. NC Register Notice (November 1, 2013)

Attachment 2.pdf

3. NC Register Notice (June 16, 2014)

Attachment 3.pdf

4. 15A NCAC 02B .0200 Regulations

Attachment 4.pdf

5. NC WQS Metals Table 2015

Attachment 5.docx

6. Hardness by HUC 1969 to 2013

Attachment 6.xls

7. (a) and (b) Cadmium Recalculation

Attachment 7(a).pdf

Attachment 7(b).pdf

8. Occurrence of Iron in NC Surface Waters

Attachment 8.pdf

9. 2,4 D Calculation

Attachment 9.xls

10. Certification of Adoption of Modifications to North Carolina's Surface Water Quality Criteria

Attachment_10.pdf

To Table of Contents