Aquatic Life Ambient Water Quality Criteria for Ammonia –Freshwater

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Overview

- Provide a summary of the 2013 national recommended Clean Water Act 304(a) aquatic life ambient water quality criteria for ammonia in fresh water published in the Federal Register on August 22, 2013
  - The revised criteria include new toxicity data reflecting freshwater unionid mussel and non-pulmonate (gill-bearing) snail sensitivity
- Explain how toxicity data on freshwater mollusks was used in the 2013 revised criteria derivation
- Brief summary of supporting documents available for assisting States, Tribes, Territories considering adoption of the revised ammonia criteria

Ambient Water Quality Criteria & Water Quality Standards

- EPA publishes national recommended Ambient Water Quality Criteria (AWQC) for protection of human health and aquatic life
- States, Tribes, and Territories can set their water quality standards (WQS) based on the national AWQC or they can instead adopt other scientifically defensible WQS that differ from these recommendations
- EPA reviews changes or additions to state-adopted WQS
- Discharge permit limits are derived from the WQS for the state, not directly from the AWQC

History of Ammonia Criteria

- 1999 Update of the freshwater criteria included:
  - Consideration of pH and temperature effects and fish life stage on the criteria
  - Acute criteria for salmonids present and absent
- In 2003 toxicity data for freshwater unionid mussels were published indicating that glochidia or larval mussels and juvenile mussels are more sensitive to ammonia than the organisms in the 1999 dataset
- In 2005, an ASTM protocol for toxicity testing of glochidia and juvenile freshwater mussels was approved
- Draft updated criteria proposed in 2009
  - Reflected freshwater mussel sensitivity to ammonia
  - Bifurcated criteria for waters with mussels present or absent
  - New toxicity data (USGS 2009) for freshwater snails indicating that gill-bearing snails are sensitive to ammonia was also discussed

2013 Ammonia Aquatic Life Criteria Reflect Latest Science

- Scientifically acceptable freshwater snail and mussel data were included in the 2013 ammonia criteria
  - Updated literature review through October 2012
- One set of criteria applicable to all fresh water to protect the aquatic community as a whole, including sensitive mollusks which are present in nearly all fresh waters of the contiguous U.S.
  - Site-specific criteria recalculations are permitted for sites where mussels are absent, as appropriate
  - Recalculated site-specific values (e.g., for sites with mussels absent) are provided in Appendix N of the 2013 ammonia criteria document
- Several supporting documents developed to aid states considering adoption of the updated criteria

Freshwater Unionid Mussel Glochidia

- Glochidia (larval mussels) data included in 2013 acute dataset to calculate acute ammonia criteria based on new study/recommendation re: appropriate test duration (glochidia data not used in 2009 Draft criteria)
  - Require at least 90% control survival at the end of 24-hour exposure to accept test data for the 2013 ammonia criteria
  - Glochidia are not consistently more sensitive than juvenile mussels to ammonia
- Mussels are the 7 most sensitive genera in acute dataset

Juvenile Unionid Mussels

- Survival data from 28-day tests was used in derivation of chronic criteria – growth data was not used
- Mussel genera are the two most sensitive in the chronic dataset for ammonia

Non-Pulmonate Snails

- Toxicity studies in 2011 on freshwater non-pulmonate (gill-bearing) snails demonstrate they are also sensitive to ammonia
- New 28-day toxicity study on *Fluminicola sp.*, a species of pebblesnail (USGS 2011)
  - EPA externally peer reviewed the data
  - Used acceptable growth data in development of chronic criteria magnitude
- Pebblesnail genus mean chronic value or GMCV ranked #5 in chronic sensitivity

Threatened and Endangered (Federally-Listed) Species Protection

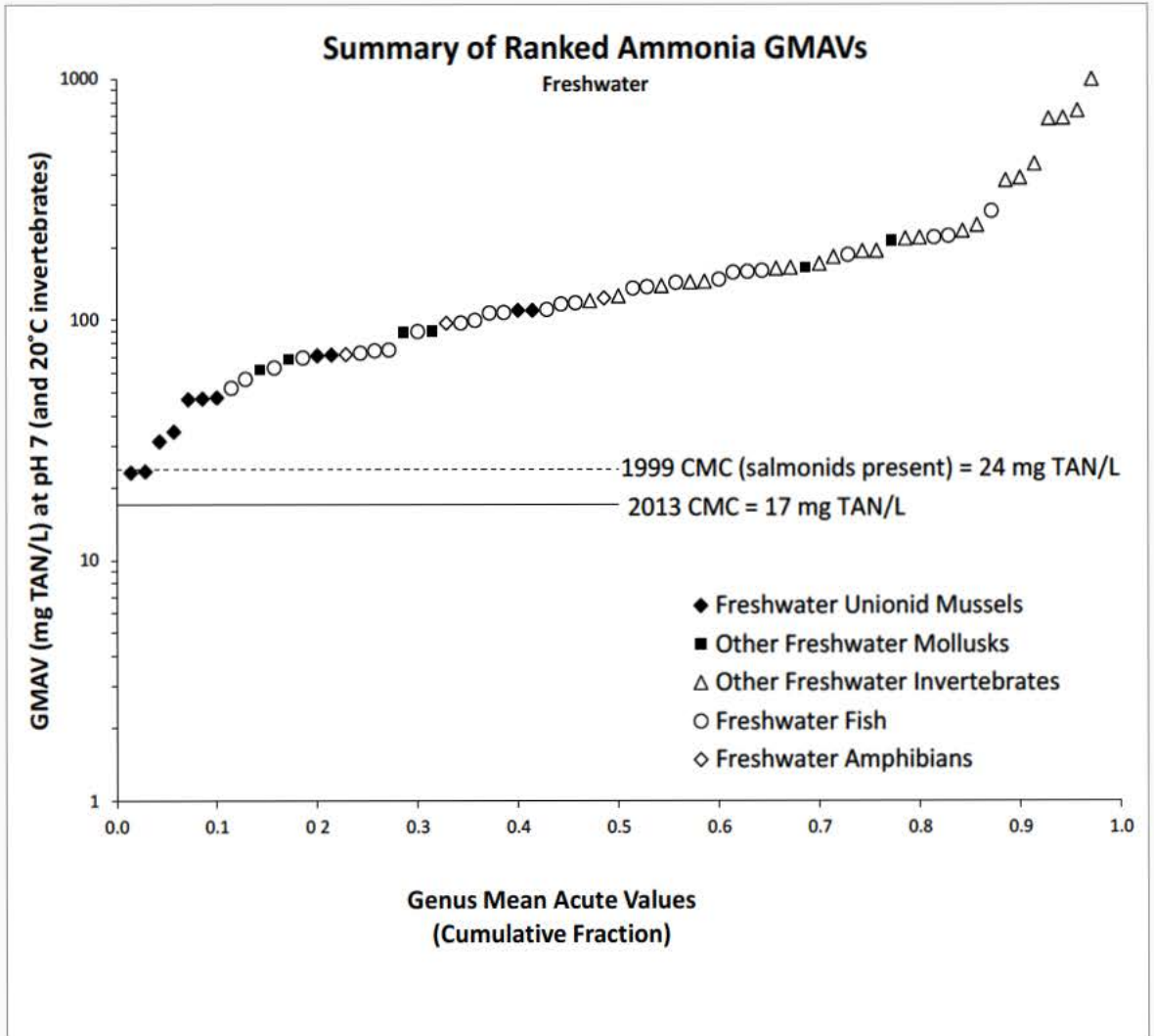
- First explicit analysis of Listed Species in a criteria document

- 14 Federally-listed species represented in 2013 ammonia criteria dataset
  - Includes 5 listed freshwater mussel species
    - In the U.S. there are 297 species of freshwater unionid mussels, 72 of which are Federally-listed
    - In the U.S. there are 650 species of freshwater snails, 25 of which are Federally-listed

Additional Minimum Data Requirements (MDRs) Fulfilled for 2013 Chronic Criterion (improvement over 2009 Draft)

- Fish
  - **Salmonid (*Oncorhynchus* sp.)** chronic data included to calculate GMCV
    - Fulfills chronic MDR #1
    - Ranked #9 GMCV in chronic sensitivity
- Benthic Crustacean
  - **Amphipod (*Hyalella azteca)*** now included in acute and chronic datasets based on new research re: water chemistry and feeding necessary for healthy test organisms
    - Fulfills chronic MDR #5
    - Ranked #13 GMCV in chronic sensitivity
- Insects
  - **Stonefly** chronic data included to calculate GMCV
    - Fulfills chronic MDR #6
    - Ranked #16 (least sensitive) GMCV in chronic sensitivity

Ranked Freshwater Genus Mean Acute Values (GMAVs) with Criterion Maximum Concentrations (CMCs)

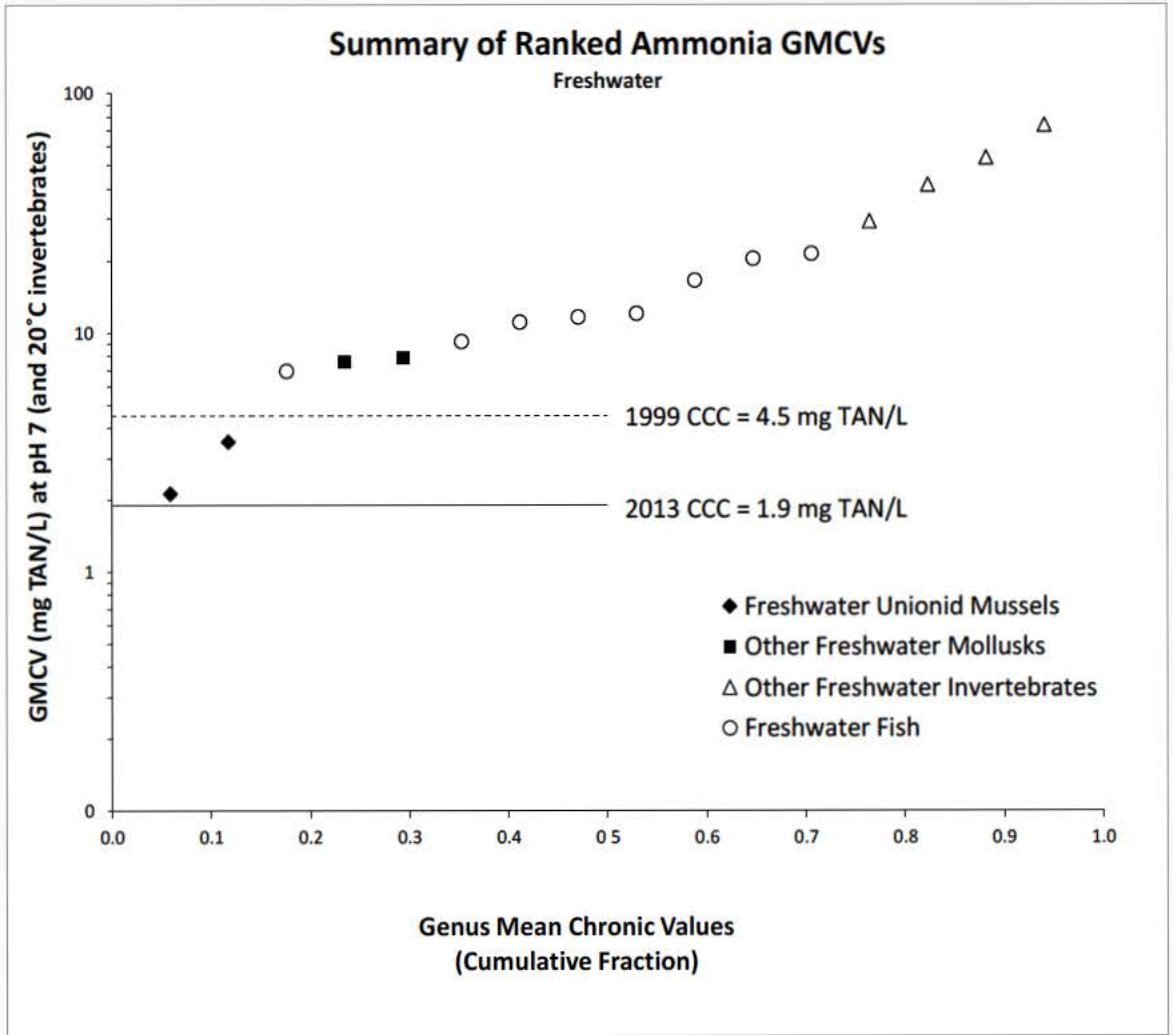


- 113 acute studies
- 69 Genera including:

11 mussel genera and
2 non-pulmonate snails

  - 52 invertebrate sp.
  - 44 fish sp.
  - 4 amphibian sp.

Ranked Freshwater Genus Mean Chronic Values (GMCVs) with Criterion Continuous Concentrations (CCCs)



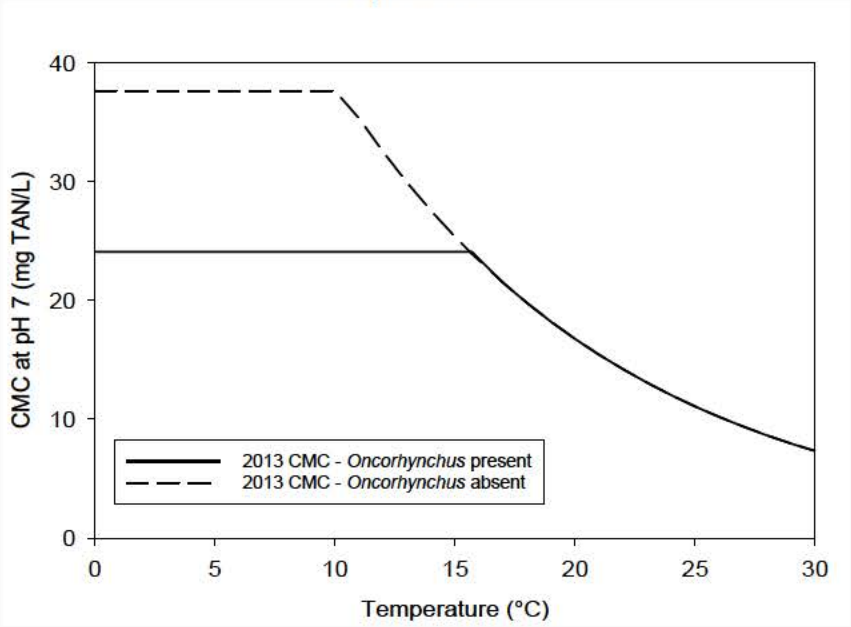
- 30 chronic studies
- 16 Genera including:

2 unionid mussel genera
1 non-pulmonate snail
- 10 invertebrate sp.
- 11 fish sp.

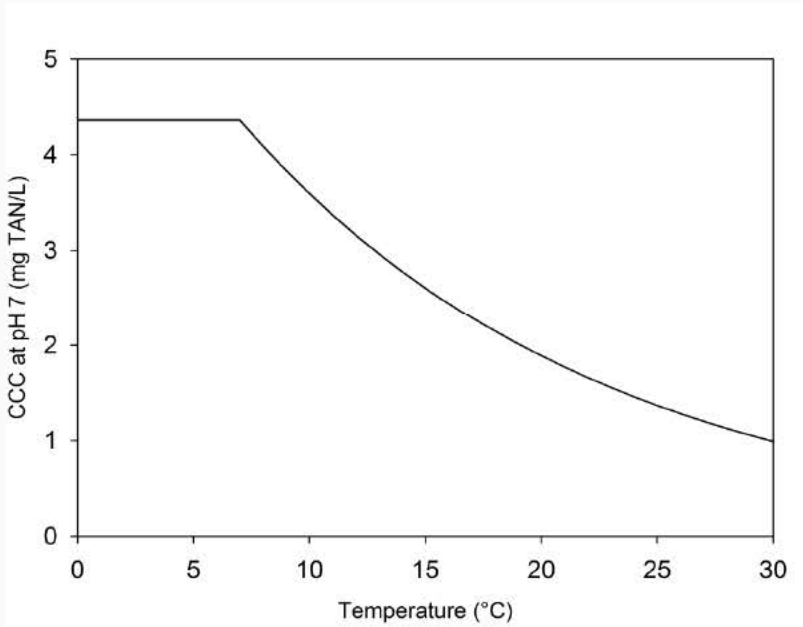
Criterion Duration	1999 AWQC Update Criteria Magnitude		2009 Draft AWQC Update Criteria Magnitude		2013 AWQC Update Criteria Magnitude
	pH 8.0, (mg TAN/L)	pH 7.0, T=20°C (mg TAN/L)	pH 8.0, T=25°C (mg TAN/L)	pH 7.0, T=20°C (mg TAN/L)	pH 7.0, T=20°C (mg TAN/L)
Acute (1-hr average)	5.6[a]	24	2.9	19	17
Chronic (30-d rolling average)	1.2	4.5	0.26	0.91	1.9*
*Not to exceed 2.5 times CCC or 4.8 mg TAN/L (at pH 7, 20°C) as a 4-day average within the 30-days, more than once in three years on average.					
Criteria frequency: Not to be exceeded more than once in three years on average.					

Ammonia Toxicity

- Ammonia toxicity is affected by pH and temperature
  - As pH increases, organisms are more sensitive to ammonia
  - As temperature increases, invertebrates only are more sensitive to ammonia
    - Consequently the criteria (expressed as total ammonia nitrogen or TAN) vary as a function of pH and temperature based on an equation



Acute criteria across temperature gradient (pH 7)



Chronic criteria across temperature gradient (pH 7)

Example Table from Criteria Document Showing Temperature and pH-Dependent Values of the CCC (Chronic Criterion Magnitude)

pH	Temperature (°C)													
	0-7	8	9	10	11	12	13	14	15	16	17	18	19	20
6.5	4.9	4.6	4.3	4.1	3.8	3.6	3.3	3.1	2.9	2.8	2.6	2.4	2.3	2.1
6.6	4.8	4.5	4.3	4.0	3.8	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1
6.7	4.8	4.5	4.2	3.9	3.7	3.5	3.2	3.0	2.8	2.7	2.5	2.3	2.2	2.1
6.8	4.6	4.4	4.1	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.1	2.0
6.9	4.5	4.2	4.0	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0
7.0	4.4	4.1	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.2	2.0	1.9
7.1	4.2	3.9	3.7	3.5	3.2	3.0	2.8	2.7	2.5	2.3	2.2	2.1	1.9	1.8
7.2	4.0	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7
7.3	3.8	3.5	3.3	3.1	2.9	2.7	2.6	2.4	2.2	2.1	2.0	1.8	1.7	1.6
7.4	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5
7.5	3.2	3.0	2.8	2.7	2.5	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4
7.6	2.9	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.6	1.5	1.4	1.4	1.3
7.7	2.6	2.4	2.3	2.2	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1
7.8	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0
7.9	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.95	0.89
8.0	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.94	0.88	0.83	0.78

External Peer Review & Public Comment

- EPA conducted an external peer review of the 2009 draft ammonia criteria document
  - The 2013 criteria document reflects edits based on 2009 draft peer review
  - Response to comments document available online
- EPA received public comment on the 2009 draft ammonia criteria document
  - Approximately 50 comments were received in docket for the 2009 draft generally concerning science policy and implementation issues
  - 2013 criteria document addresses the comments
  - Response to comments document available online
- EPA conducted external peer review of snail studies
  - Response to comments document for this peer review available online

Supporting Documents

- Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria
- Flexibilities for States Applying the EPA's Ammonia Criteria Recommendations
- Technical Support Document for Conducting and Reviewing Freshwater Mussel Occurrence Surveys for the Development of Site-specific Water Quality Criteria for Ammonia

Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria

- Developed by EPA to take into account relevant differences between the sensitivities of lab-tested surrogate aquatic organisms used to develop the National criteria and the sensitivities of species that occur at the site.
- Intended to provide flexibility to States to tailor criteria development to the aquatic life that occur at a particular site.
- Designed to ensure that each species (and higher taxa levels) that occur at a site but not in the National toxicity dataset is represented in the site-specific dataset by at least one species most closely related to it from the National dataset
- Revision addresses a previous incongruity in the step-by-step process – i.e., eliminates the possibility of unintended results at the order, class and phylum levels.

Potential Application of Deletion Process of the Recalculation Procedure

- Where a state can demonstrate, on a site-specific basis, that mussels are not present (and that there are no related species of similar sensitivity for which mussels serve as a surrogate), the Recalculation Procedure may be used to delete mussel species from the national criteria dataset to better represent the species at the site.
- The recommended procedure allows deletion of nonresident tested species if and only if they are not appropriate surrogates of resident untested species – based on taxonomy.

"Resident Species" or "Occur at the Site"

- Usually present
- Present only seasonally due to migration
- Present intermittently because they periodically return to or extend their ranges into the site
- Were present in past, are not currently present due to degraded conditions, but are expected to return when conditions improve
- Are present in nearby waterbodies, not currently present at site, but expected to be present when conditions improve

Site-Specific Criteria for Ammonia

- Appendix N of the 2013 ammonia criteria document provides Site-Specific Criteria (SSC) for four "general" scenarios:
  - Unionid Mussels Absent and Oncorhynchus spp. Present
  - Unionid Mussels Absent and Oncorhynchus spp. Absent
  - Unionid Mussels Absent, Fish Early Life Stage (ELS) Protection Necessary
  - Unionid Mussels Absent, Fish Early Life Stage (ELS) Protection Not Necessary
- What's the difference between Appendix N SSC and developing SSC using the Recalculation Procedure?
  - Appendix N SSC are based on the faunal list used to derive the National recommended criteria, whereas some taxa may not occur at a site

Technical Support Document for Conducting and Reviewing Freshwater Mussel Occurrence Surveys for the Development of Site-specific Water Quality Criteria for Ammonia

- Provides a basic overview of mussel survey techniques, sampling methods, data sources, and additional information for individuals without mussel survey experience. Specifically, the purpose is two-fold:
  - To assist state and tribal staff in determining whether freshwater mussels in the Order Unionoida are present or absent (i.e., do not occur) at a site.
  - To assist EPA staff in reviewing state and tribal water quality standards submissions that contain site-specific criteria for ammonia and a demonstration that mussels are absent (i.e., do not occur) at the site.
- Provides a general, phased approach to determining mussel occurrence.
- Provides additional information on accessing data in the NatureServe database as well as example surveys.

General Approach to Mussel Presence/Absence Determinations

- Phase 1: Delineate the site (study area) and define presence and absence.
- Phase 2: Check databases, literature, and reports for mussel survey records (historical and recent).
- Phase 3: If no records of mussel presence are available, conduct mussel survey(s) at the site.
  - Includes a checklist of key elements to consider when choosing a suitable protocol.

General Approach to Mussel Presence/Absence Determinations

- Phase 4: If after steps 1-3 mussels are still not detected, develop site-specific criteria using the Recalculation Procedure.
- Phase 5: Re-evaluate the site-specific criteria as needed but at least once every three years in conjunction with the state or tribe's triennial water quality standards review process.

Flexibilities for States Applying EPA's Ammonia Criteria Recommendations

- Describes some of the flexibilities that states and tribes may consider in adopting and applying the ammonia criteria.
  - Flexibilities are the same for all criteria.
- Provides a framework to show when each flexibility can be used individually or in combination in the water quality standards adoption and application processes.

Flexibilities for States Applying EPA's Ammonia Criteria Recommendations – Water Quality Standards Related

- **Recalculation procedure for site-specific criteria derivation**

- **Variances:** May be appropriate where a state or tribe determines that the designated use cannot be attained for a period of time because the discharger cannot immediately meet a water quality-based effluent limit, which is written to meet a particular water quality standard, or a waterbody/waterbody segment cannot immediately meet the criteria to protect the designated use.

- **Revision to Designated Uses:** 40 CFR 131.10(g) provides that "[s]tates may remove a designated use… or establish sub-categories of a use if the [s]tate can demonstrate that attaining the designated use is not feasible…" because of at least one of the six specified factors.

Flexibilities for States Applying the EPA's Ammonia Criteria Recommendations – NPDES Permit Related

- **Dilution Allowances:** A dilution allowance is typically expressed as the flow of a river or stream, or a portion thereof, that is allowed to mix with and dilute effluent before water quality criteria must be met.

- **Compliance Schedules:** May be appropriate for ammonia where the permitting authority determines that the discharger can ultimately meet its new ammonia effluent limits by a date certain in the future (as soon as possible) but requires time to install treatment technology or implement other controls necessary to meet the new limits.

Conclusion

- 2013 Ammonia Aquatic Life Criteria reflect the latest science including data on freshwater mollusks
  - Unionid mussels are the most sensitive species in both the acute and chronic datasets, non-pulmonate snails are also sensitive
  - One set of criteria applicable to all fresh water to protect the aquatic community as a whole, including sensitive mollusks which are present in nearly all fresh waters of the contiguous U.S.
- EPA has provided supporting materials to assist in applying the ammonia criteria recommendation

Thank you!

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