



## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

### REGION 7

11201 Renner Boulevard  
Lenexa, Kansas 66219

SEP 27 2013

Ms. Sara Parker Pauley, Director  
Missouri Department of Natural Resources  
P.O. Box 176  
Jefferson City, Missouri 65102

Dear Ms. Pauley:

On December 1, 2011, the Missouri Department of Natural Resources proposed a number of changes to the state's water quality standards (36 MoReg 2521). A public hearing on the proposed changes was held in Jefferson City on January 4, 2012, and written comments on the proposed changes were accepted by the MDNR through January 18, 2012. The Missouri Clean Water Commission adopted six new or revised WQS provisions on March 9, 2012, but the final rule, published on May 31, 2012, included only five new or revised provisions. These included (1) sulfate and chloride criteria in Table A, (2) phenol criteria in Table A, (3) site-specific dissolved oxygen criteria in Table K, (4) stream use designation changes for whole body contact recreation and secondary contact recreation in Table H and (5) an amended compliance schedule authorizing provision at 10 CSR 20-7.031(10).

The revised WQS were submitted to the U.S. Environmental Protection Agency under a cover letter dated December 10, 2012. The EPA has acted upon the following parts of the submission, to date:

- On January 25, 2013, the EPA partially approved and partially disapproved Missouri's amended compliance schedule authorizing provision at 10 CSR 20-7.031(10);
- On May 10, 2013, the EPA disapproved the new site-specific DO criteria in Table K; and
- On September 27, 2013, the EPA partially approved and partially disapproved stream use designation changes for whole body contact recreation and secondary contact recreation in Table H.

In today's action, the EPA is (1) partially approving and partially disapproving Missouri's new and revised phenol criteria for the protection of aquatic life. Details on today's action are presented below.



## ACUTE AND CHRONIC PHENOL CRITERIA

Under Section 303(c) of the Clean Water Act (33 U.S.C. § 1313(c)) and Title 40, parts 131.20 and 131.21 of the Code of Federal Regulations, states must review their WQS at least every three years and submit any new or revised WQS to the EPA for review and approval or disapproval. Water quality standards submissions containing new or revised criteria must include the methodologies and analyses used to develop these criteria (40 CFR §§ 131.6(b) and 131.20(c)). Under Section 303(c), the EPA must determine whether the criteria are based on sound science and protect the applicable designated uses (40 CFR §§ 131.5(a), 131.6, 131.11 and 131.21(b)).

Aquatic life criteria establish numeric thresholds for allowable concentrations of particular chemicals (or other substances) in water bodies above which, studies indicate, aquatic life may be harmed. The criteria are intended to address unacceptable adverse effects from both short-term (acute) and long-term (chronic) exposure, with the objective of protecting aquatic life from lethal as well as sub-lethal effects (e.g., immobility, slower growth, reduced reproduction). For a given chemical, aquatic life criteria specify limits for the magnitude of a concentration, the duration (period of time) over which the concentration is averaged, and the frequency of exposure to the concentration.

Aquatic life criteria are estimates of concentrations of pollutants in ambient water that—if not exceeded—are expected to protect fish, invertebrates, and other aquatic life from adverse effects associated with exposure. Criteria should attempt to provide a reasonable and adequate amount of protection with only a small possibility of considerable overprotection or underprotection. It is not enough that a criterion be the best estimate that can be obtained using available data; rather, it is equally important that a criterion be derived only if adequate appropriate data are available to provide reasonable confidence that it is a good estimate.

Nationally recommended criteria, published by the EPA under Section 304(a) of the CWA, are expected to protect aquatic organisms from unacceptable effects assuming the following default exposures:

- **Acute** = Exposure to a 1-hour average concentration of the chemical does not exceed the criterion more than once every 3 years on average.
- **Chronic** = Exposure to a 4-day average concentration of the chemical does not exceed the criterion more than once every 3 years on average.

The derivation of criteria relies on two types of values from toxicity tests:

- **Median lethal concentration ( $LC_{50}$ )**. A specific concentration of a chemical that has been found to be lethal to 50 percent of individuals in a group of aquatic organisms exposed for 48 to 96 hours.
- **Median effective concentration ( $EC_{50}$ )**. A specific concentration of a chemical that has been found to cause a particular effect in 50 percent of individuals in a group of aquatic organisms exposed over a given time period (e.g., weeks or years).

Missouri's 2012 WQS submission at Table A included a newly adopted acute criterion for phenol (10,200 micrograms per liter) and a revised chronic criterion for phenol (2,560 µg/L). The state's previous chronic criterion was set at 100 µg/L. In developing the new and revised criteria, Missouri relied on the EPA's most recent publication addressing the effects of phenol on aquatic life (*Ambient Water Quality Criteria for Phenol-1980* (EPA 440/5-80-066)).

## UPDATED EVALUATION OF THE EPA 1980 PHENOL GUIDANCE VALUES

The 1980 guidance document states:

*"The available data for phenol indicate that acute and chronic toxicity to freshwater aquatic life occurs at concentrations as low as 10,200 and 2,560 µg/L, respectively, and would occur at lower concentrations among species that are more sensitive than those tested."*

These acute and chronic thresholds are based on the species mean acute value (SMAV) for the most sensitive species represented in the national database as of 1980. The method used to derive these thresholds is different than the method currently applied in establishing CWA §304(a)(1) national criteria, which is described in the EPA's 1985 *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection Of Aquatic Organisms and Their Uses* (EPA PB85-227049). The 1985 Guidelines are designed to protect both freshwater and saltwater organisms from the effects of acute and chronic exposure to potentially harmful chemicals. They are based, in part, on minimum data requirements, or MDRs, for the derivation of acute criteria (at least one tested animal species from each of eight or more different families) and chronic criteria (at least one tested animal species from each of three or more different families).

In reviewing Missouri's new and revised criteria for phenol, the EPA considered all available phenol toxicity data using the EPA AQUIRE (ECOTOX ) database. Although new data were available, MDRs established under the 1985 Guidelines were not met. Therefore, the EPA applied the method used to develop the 1980 thresholds to the new database, resulting in the use of a more sensitive species (*Ceriodaphnia dubia*).

Scientific Defensibility Evaluation of Currently Available Studies for Phenol – See Table 1 (enclosed).

### Summary Evaluation of Acute Value

Seven phenol toxicity studies with *C. dubia* were evaluated for test acceptability. Six met the procedural requirements set forth in the 1985 Guidelines, and collectively these yielded a total of seven acceptable 48 hr LC50s. Two of the LC50 values were from a study by Cowgill (1985) in which the investigator measured mortality at two test temperatures, 20° and 24°C. Because both of these temperatures are acceptable per the 1985 Guidelines, the geometric mean of the two studies was calculated and then combined with the values from the other studies to calculate a final species mean acute value (SMAV) using the five defensible 48 hr LC50 values. This resulted in a final SMAV of 5,293 µg/L. A second study by Cowgill (1991) was not accepted by the EPA, because *C. dubia* were fed during the toxicity tests. This study tracked the chronic effects of phenol over three generations of test organisms, and the 48 hr LC50 was measured only as an interim effect endpoint.

In conclusion, the *C. dubia* value presented in Table 1 is roughly half the previously reported SMAV, which was based on tests with rainbow trout. An additional rainbow trout study conducted by EPA (Spehar, 1989; 6082 µg/L [95% C.I. 5449-6789 µg/L]) was also available for evaluation and suggests that the previous SMAV reported for rainbow trout may not be sufficiently protective. Based on the available data, the EPA finds that an acute criterion concentration of 5,293 µg/L would be appropriately protective of aquatic life in Missouri waters.

### Summary Evaluation of Chronic Value

The 1980 chronic value of 2,560 µg/L was based on a single fathead minnow early life stage (ELS) test (Holcombe, et al. 1980) that produced an estimated maximum acceptable toxicant concentration (MATC) of 1,830 to 3,570 µg/L. The MATC is calculated from the geometric mean of the no observed effects concentration and the lowest observed effects concentration from a chronic toxicity test. It represents an “acceptable” chronic toxicity threshold, in keeping with the protection goals of the 1985 guidelines. The MATC is a chronic concentration value used in the calculation of the final chronic value, either through direct calculation (8 or more MDR’s met per the 1985 Guidelines) or by using an acute to chronic ratio when at least 3 chronic tests are available.

Available literature was evaluated by the EPA to determine whether the 1980 chronic value could still be considered protective of aquatic life. The study by Spehar (1989) yielded a chronic value of 157 µg/L (based on rainbow trout) and was deemed scientifically sound. Because no chronic criterion for phenol has been published by the EPA under CWA Section 304(a), and because no values lower than 2,560 µg/L were found in the available literature for warm water species, the EPA currently recommends that the chronic criterion concentration in warm waters be set at 2,560 µg/L and that the chronic criterion concentration in cool and cold waters be set at 157 µg/L.

## **SUMMARY FINDINGS**

Under 40 CFR § 131.11(a)(1), all criteria must be based on a sound scientific rationale and must protect the applicable designated uses. Based on its evaluation of currently available studies for phenol tests as described above, the EPA finds that the acute criterion concentration for phenol should not exceed 5,293 µg/L. As a result, the EPA is disapproving the higher acute criterion concentration for phenol (10,200 µg/L) adopted in the Missouri WQS.

With respect to the chronic phenol criterion submitted by Missouri, the EPA is partially approving the value of 2,560 µg/L, as it can be used as the basis for WQS for warm waters only. Missouri’s WQS define separate designated uses for cold and cool water fisheries at 10 CSR 20-7.031(1)(C)(3) and (4), as stated below.

3. Cold-water fishery—Waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a naturally-reproducing or stocked trout fishery and other naturally-reproducing populations of recreationally-important fish species.
4. Cool-water fishery—Waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a sensitive, high-quality sport fishery (including smallmouth bass and rock bass) and other naturally-reproducing populations of recreationally-important fish species.

Because the EPA is recommending that a chronic value of 157 µg/L be used as the basis for WQS in waters that have a cold or cool water designated use, or where trout are present, the EPA inquired with the Missouri Department of Conservation for information on trout use in cool-water fishery waters. The MDC provided the following response<sup>1</sup>:

*“Most Missouri fish biologists consider rainbow trout in Missouri to be cold water species that use cool water reaches primarily during the winter months. According to Pflieger (1997), rainbow trout do best in waters that remain continuously below 70°F. They also spawn from early winter through late spring. Thus, conditions are suitable for trout to leave cold water reaches during winter to feed and spawn, and then return to cold water as summer warms water temperatures in cool water reaches. Some trout may also remain in cool water reaches throughout summer by sheltering in the small, in-channel spring upwellings that maintain water temperatures in the cool water range.”*

In order to remedy the disapproval actions identified above, and to adequately protect aquatic life from the toxic effects of phenol, the EPA encourages Missouri to adopt an acute criterion concentration of 5,293 µg/L for all waters and a chronic criterion concentration of 157 µg/L for cool and cold water fisheries. Alternatively, the EPA acknowledges that Missouri’s previous chronic criterion of 100 µg/L is protective of cool and coldwater fisheries and is still in effect for CWA purposes. The EPA appreciates the state’s continuing efforts to protect and restore water quality and its overall commitment to the triennial WQS review and revision process. We look forward to working with the MDNR, the Commission and interested stakeholders on future WQS revisions. Should you have any questions or comments regarding today’s action, please contact John DeLashmit, Chief, Water Quality Management Branch, at (913) 551-7821.

Sincerely,



Karen A. Flournoy  
Director  
Water, Wetlands and Pesticides Division

cc: John Madras, MDNR  
Corey Buffo, EPA HQ

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<sup>1</sup> 5/22/13 email from Karen Bataille, MDC.



**Table 1. Summary of acceptable studies for *Ceriodaphnia dubia* and rainbow trout (*Oncorhynchus mykiss*):**

The following table identifies the studies the EPA reviewed in its updated evaluation for phenol.

Author	Document Type	Species	Test Type	Endpoint Result w/95% C.I. where available (µg/L)	Comments
<b>Ceriodaphnia dubia studies</b>					
Soucek 2007	PRJ* Ecotoxicology	C. dubia	48h LC50	4340 (3880-4850)	
Lee et.al. 1997	PRJ Water Env. Research	C. dubia	48h LC50	13400	
Winner 1988	Memo to EPA ORD	C. dubia	48h LC50	3000 (1300-4100)	
**Cowgill 1985	PRJ Env Tox & Chem	C. dubia	48h LC50	13200 (11500- 15400)	@ 20°C
Cowgill 1985	PRJ Env Tox & Chem	C. dubia	48h LC50	4470 (3580-5410)	@ 24°C
			<b>GEOMEAN</b>	<b>7681</b>	
<b>** Cowgill 1985 – Same study – two temperatures – per 1985 Guidelines take GEOMEAN</b>					
Oris, 1991	PRJ Env Tox & Chem	C. dubia	48h LC50	3100	
			<b>GEOMEAN</b>	<b>5293 µg/L</b>	
<b>* PRJ = Peer Reviewed Journal Article</b>					
<b>Supplemental Data for Rainbow Trout</b>					
Spehar, 1989	EPA Internal Memo	O. mykiss	96h LC50	6082 (5449-6789)	Compare to 10,500 µg/L (Holcomb et al., 1987; fish were juvenile/smolt (15 wk; 370 mg) and likely not the most sensitive lifestage
<b>Unused Study – C. dubia</b>					
Cowgill, 1991	PRJ Arch Env Contam	C. dubia	48h LC50	20000 (16000-26000)	Daphnids fed during study, so 48 h LC50 results not comparable
<b>Chronic Studies</b>					
			NOEC	LOEC	
Spehar, 1989	EPA Internal Memo	O. mykiss	118	209	Chronic value (MATC) = 157 µg/L 90 day ELS - Mortality most sensitive endpoint

