COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF POINT AND NON-POINT SOURCE MANAGEMENT

RATIONALE FOR THE DEVELOPMENT OF AMBIENT WATER QUALITY CRITERIA FOR THE PROTECTION OF

AQUATIC LIFE USE

Ambient water quality criteria are numeric values limiting the amount of chemicals present in our nation's waters. A water quality criterion is the highest concentration of a pollutant in water that is not expected to pose a significant risk to, or adversely impact, in this case, aquatic life. Water quality criteria are based solely on the best available scientific data and scientific judgments on pollutant concentrations and environmental or human health effects.

The following water quality criteria for aquatic life are being evaluated as part of this triennial review of water quality standards. They have been either recommended by EPA, or have been developed by the Department since the previous triennial review was finalized in April, 2010:

- Acrolein
- Nonylphenol
- Molybdenum

ACROLEIN

The Department is proposing that the PA Environmental Quality Board (EQB) adopt the EPA recommended freshwater aquatic life criteria for acrolein. (August 2009; EPA-822-F-09-004)

Acrolein is a priority pollutant and is currently listed in 25 PA Code, Chapter 93 Table 5. It is a widely used product and is used in the preparation of polyester resin, polyurethane, propylene glycol, and acrylic acid. It is also used as an herbicide to control submersed and floating weeds and algae in irrigation canals. In July, 2009 EPA published final aquatic life criteria for acrolein based on a 2007 data search that revealed new acute and chronic toxicological data. The updated aquatic life criteria were calculated using "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and their Uses" (Stephan et al. 1985).

In order to be consistent with the Federal recommendations, the Department is proposing to adopt the aquatic life criteria as stated in the EPA aquatic life document for Acrolein, August 2009, "Freshwater aquatic life and their uses should not be affected if the one-hour average concentration of acrolein does not exceed 3 ug/L more than once every three years on the average (acute criterion) and if the four-day average concentration of acrolein does not exceed 3

ug/l more than once every three years on the average (chronic criterion)." Upon adoption, the criteria will be placed in Chapter 93, Table 5 (relating to water quality standards for toxic substances).

NONYLPHENOL

The Department is proposing that the EQB adopt the EPA recommended freshwater aquatic life criteria for nonylphenol (EPA-822-F-05-003, Feb. 2006).

Nonylphenol is an organic chemical produced in large quantities in the United States, and is expected to be present in Pennsylvania surface waters. It is toxic to aquatic life, causing reproductive effects in aquatic organisms. Nonylphenol is moderately soluble and resistant to natural degradation in water.

Nonylphenol is one of the substances on Pennsylvania's list of emerging contaminates and is also on the National priority list of contaminates. Preliminary monitoring performed by USGS (2009) has detected nonylphenol in PA waters. It is used as a chemical intermediate in the processing of other chemicals and is often found in wastewater treatment plant effluent as a breakdown product from surfactants and detergents.

The chronic toxicity studies used by EPA to derive criteria for nonylphenol include assessments on growth and reproduction, including the estrogenic effects which have been shown to cause deformities in aquatic organisms. *Aquatic Life Ambient Water Quality Criteria – Nonylphenol,* (December 2005) "Freshwater aquatic life and their uses should not be affected if the one-hour average concentration of nonylphenol does not exceed 28 ug/L more than once every three years on the average (acute criterion) and if the four-day average concentration of nonylphenol does not exceed 6.6 ug/l more than once every three years on the average (chronic criterion)." Upon adoption, the criteria will be placed in Chapter 93, Table 5 (relating to water quality standards for toxic substances).

CRITERIA DEVELOPED BY THE DEPARTMENT

Other aquatic life use criteria for toxic substances to be included in this rational are for criteria that were developed by the Department. The calculated criteria were developed using the current best available toxicity data, scientific information, and methods described in "Guidelines for Deriving Numerical Water Quality Criteria for the Protection of Aquatic Life and Their Uses" (Stephan et al. 1985) (1985 Aquatic Life Criteria Guidelines). The compounds and the toxicity data used in the criteria derivation are as stated below:

MOLYBDENUM (Mo)

Molybdenum is a naturally occurring metal that is mobile and can enter the water ways in a variety of forms. Because there is more than one form of molybdenum found in PA waters, the Department is proposing to adopt aquatic life criteria for total molybdenum. Molybdenum is

actively mined and is used as an alloying agent to strengthen and harden steel. It is also used to increase wear and corrosion in alloy metals.

On March 10, 2010, EPA approved molybdenum aquatic life criteria for the state of Nevada. The Department conducted a literature search to collect all relevant molybdenum toxicity data for aquatic life. The review included:

- EPA's ECOTOX database
- Aquatic Life Water Quality Criteria for Molybdenum. Prepared for Nevada Division of Environmental Protection by Tetra Tech, Inc. July 9, 2009
- EURAS (2008), International Molybdenum Association (IMOA). Freshwater effects assessment of molybdenum: data evaluation and PNEC-deviation.

After a thorough review of the available toxicological data, the Department determined that the studies used to calculate the criteria approved by EPA for the State of Nevada contained biological species that are representative of biological species found in PA ambient waters, and are relevant for the aquatic life criteria determination in PA.

The Department excluded the PNEC study by EURAS due to the lack of acute data. The prescribed 1985 Guideline methodology cannot be performed without the acute data and no acute to chronic ratio (ACR) can be generated using the data provided in this report. In addition some of the species used in the report were not species found in the U.S.

Below are the acute and chronic data sets used by Pennsylvania to calculate the aquatic life criteria for molybdenum. The Department reviewed acute test data (Aquatic Life Water Quality Criteria for Molybdenum) developed for the Nevada Division of Environmental Protection by Tetra Tech, Inc., 2008. The aquatic life organisms used in the Nevada data sets were applicable to organisms found in Pennsylvania. The acute data set used by Pennsylvania is the same as the Nevada data set, with the exception of Oncorhynhus nerka and Catostomus latipinnis which are not found in Pennsylvania waters. The effect levels for the species in the genus Oncorhynhus were averaged. The genus level toxicity data (GMAV's) were used to calculate the aquatic life criteria. All currently available toxicity data from the above reviews was considered in the molybdenum aquatic life criteria determination. The acute criterion calculated by Pennsylvania is the same as that developed by Nevada, rounded to two significant figures. (Acute – 6000 ug/L)

Acute Test Data

Rank	Species	Common Name	Acute Effect Level mg/L
1	Tubifex tubifex tubificid	worm	28.9100
2	Euglena gracilis	protistan	72.3000
3	Pimephales promelas	fathead minnow	253.8110
4	Oncorhynchus tshawytscha	chinook salmon	1,000.0000
	Oncorhynchus kisutch	coho salmon	1,000.0000
5	Ceriodaphnia dubia	cladoceran	1,015.0000
6	Girardia dorotocephala	flatworm	1,225.6000

	Catostomus latipinnis	flannelmouth sucker	1,940.0000
7	Catostomus commersoni	white sucker	2,000.0000
	Oncorhynchus nerka	kokanee salmon	2,000.0000
8	Daphnia magna	cladoceran	2,218.0871
	Oncorhynchus mykiss	rainbow trout	2,269.4034
9	Crangonyx pseudogracilis	isopod	2,650.0000
10	Gammarus fasciatus	scud	3,940.0000
11	Lepomis macrochirus	bluegill	6,790.0000
12	Chironomus tentans	midge	7,533.3000
13	Ictalurus punctatus	channel catfish	10,000.0000

Most sensitive species	GMAV
4. Ceriodaphnia dubia	1015.
3. Pimephales promelas	253.8
2. Euglena gracilis	72.3
1. Tubifex tubifex	28.9

FAV = 12.36
CMC = 6.12 (6000 ug/L)

The chronic data set used by Pennsylvania was also obtained from Aquatic Life Water Quality Criteria for Molybdenum, developed for the Nevada Division of Environmental Protection by Tetra Tech, Inc.

After incorporating the species prevalent in Pennsylvania waters, the chronic criterion is calculated at 1900 ug/L. The chronic data for Catostomus commersoni was excluded because the average chronic ratio (ACR) is outside of 10% of the other ACR's for the data set. Also, if a species mean ACR is less than 2.0, the final ACR is assumed to be 2.0. These requirements are found in the EPA, "Guidelines for Deriving Numerical Water Quality Criteria for the Protection of Aquatic Life and Their Uses" (1985). The calculated chronic criterion is slightly less stringent than the chronic criterion proposed by the Nevada DEP, based on a final acute-chronic ratio of 6.69.

Chronic Test Data - NV

Rank	Species	Common Name	Chronic Effect Level mg/L
1	Catostomus commersoni	white sucker	1.7000
2	Ceriodaphnia dubia	cladoceran	60.4380
3	Daphnia magna	cladoceran	97.0183
4	Pimephales promelas	fathead minnow	163.5427
5	Oncorhynchus mykiss	rainbow trout	866.0254

Species	**Average Acute**	**Average Chronic**	**ACR**	**Species Mean ACR**

	Value mg/L	Value mg/L		
Oncorhynchus mykiss	**2269.4034**	**866.0254**	**2.6**	**2.6**
Pimephales promelas	**253.8110**	**163.5427**	**1.6**	**2.0**
Daphnia magna	**2218.0871**	**97.0183**	**22.9**	**22.9**
Ceriodaphnia dubia	**1015.**	**60.438**	**16.8**	**16.8**
Catostomus commersoni	**2000.**	**1.7**	**NA**	
Final ACR				**6.69**

ACR = 6.69
CCC = 1.85 (1900. ug/L)

Based on the best available toxicological data, the Department is proposing a molybdenum acute ambient water quality criterion of 6000 ug/L and a chronic criterion of 1900 ug/L for the protection of the aquatic life use.

SULFONATE COMPOUNDS AND RESORCINOL

The Department is proposing aquatic life criteria for the sulfonate compounds and resorcinol:

- meta-benzene disulfonic acid (m-BDSA)
- benzene monosulfonic acid (BSA)
- p-phenol sulfonic acid (p-PSA)
- resorcinol

Sulfonates are present in the environment as a result of the widespread use of detergents in industry, agriculture, coal mining drilling fluid additives and formulations for oil recovery operations. Because water quality criteria had not been developed for the sulfonates or resorcinol by either the Department or the U.S. EPA, AMEC Earth & Environmental (AMEC), a consulting company, used the U.S. EPA's national guidelines to develop aquatic life water quality criteria (Stephan, et al., 1985) in accordance with 25 Pa. Code § 16.22. (AMEC. April 2008).

The AMEC studies included a comprehensive review of relevant literature and existing toxicity data. These studies also required that a series of acute and chronic toxicity tests be conducted since there was insufficient existing toxicity data available to meet U.S. EPA's established minimum data requirements for aquatic life criteria development. AMEC used a variety of U.S. EPA and/or ASTM approved methods and protocols for conducting the different series of biotoxicity tests, depending on what was determined to be appropriate for the particular species being tested.

The Department reviewed AMEC's documentation. U.S. EPA performed an informal review of this documentation, and the process used by AMEC. Based on comments forwarded to the Department from the U.S. EPA's Health and Ecological Criteria Division in the EPA Office of Science and Technology, it was determined that AMEC followed the U.S. EPA National Guidelines on toxicity testing and criteria development. However, based on a more thorough review of the calculations and data tables, U.S. EPA provided additional recommendations to

correct errors found in some reported values. AMEC revised its ambient water quality report and updated the report titled "Development of Ambient Water Quality Criteria for Benzene Metadisulfonic Acid, Benzene Monosulfonic Acid, p-Phenol Sulfonic Acid and Resorcinol" (AMEC. 2008). This updated report, dated April 3, 2008, incorporates revisions based on recommendations provided by the U.S. EPA and the Department.

Summary of Criteria Development

Based on the results of the studies presented by AMEC, the Department is proposing that the EQB adopt the following ambient water quality criteria for the sulfonates and resorcinol.

Compound	CAS Number	Acute AWQC Criterion Maximum Concentration (ug/l)	Chronic AWQC Criterion Continuous Concentration (ug/l)	Health Effect
Benzene Metadisulfonic Acid	00098486	2600000	1600000	
Benzene Monosulfonic Acid	00098113	2000000	1200000	
p-Phenol Sulfonic Acid	00098679	3500000	1400000	
Resorcinol	01084603	28000	7200	

Upon approval these criteria will be placed in 25 Pa. Code Chapter 93, Table 5 (relating to water quality criteria for toxic substances).

REFERENCES USES IN THIS EVALUATION:

1. **Stephen, Charles, et al. (1985).** ***Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*****.**
2. **Nonylphenol, Dec. 2005, Aquatic Life Ambient Water Quality Criteria –US EPA (EPA-822-F-05-005).**
3. **Molybdenum, 2008, Aquatic Life Water Quality Criteria for Molybdenum developed for the Nevada Division of Environmental Protection (Tetra Tech, Inc..)**
4. **AMEC Earth & Environmental 2008. Development of Ambient Water Quality Criteria for Benzene Metadisulfonic Acid, Benzene Monosulfonic Acid, p-Phenol Sulfonic Acid and Resorcinol (AMEC April 3, 2008).**
5. **INDSPEC Chemical Corporation (May 2004).** ***Data Analysis and Test Plan for Resorcinol.***