

# Selenium Overview

## I. HISTORY

EPA's 1980 Water Quality Criteria for Selenium were based on a direct toxic effects database. "Direct toxic effects" refers to the effects of waterborne selenium taken up directly from the water rather than exposure by way of both elevated dietary and waterborne selenium. In 1986 Colorado based their aquatic life standards on the 1980 EPA Criteria document, with some limited new data. The Colorado Water Quality Commission adopted the 1980 Criteria with two modifications: 1) The Commission applied EPA's revised 1985 criteria guidelines, and 2) the Commission used a final acute-chronic ratio of 16 instead of 7.5 used in deriving the 1980 EPA criteria. This was adopted in an interim standard pending the release and availability of new research findings. The values were set at:

acute criterion = 135  $\mu\text{g/l}$   
chronic criterion = 17  $\mu\text{g/l}$

In 1987 EPA revised its selenium criteria recommendations. The criteria were amended in two respects: 1) direct toxicity based criteria were derived for both selenite (selenium IV) and selenate (selenium VI) using EPA's 1985 criteria guidelines, and 2) criteria were derived based on effects to aquatic organisms due to elevated dietary selenium ( a food web exposure pathway). The 1987 document was based on field data that suggested that the food based pathway was more important to use to define the appropriate selenium toxicity thresholds. The consequence of the food pathway was demonstrated at the Kesterson Wildlife Refuge in the mid-1980's. The primary field data used was based on the effects of selenium on the fish community in Belews Lake, North Carolina that allowed the identification of selenium levels in unaffected areas of the lake and affected areas of the lake. At 10  $\mu\text{g/l}$  the fish population was affected and at 5  $\mu\text{g/l}$  the fish population was not affected. The criteria were set at:

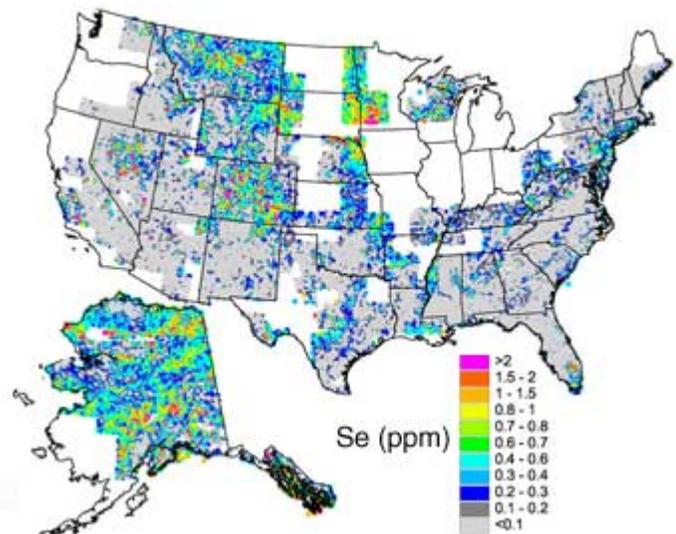
acute criterion = 20  $\mu\text{g/l}$   
chronic criterion = 5  $\mu\text{g/l}$

## II. COLORADO CRITERIA

In October 1995 Colorado adopted the 1987 EPA selenium criteria of:

acute criterion = 18.4  $\mu\text{g/l}$   
chronic criterion = 4.6  $\mu\text{g/l}$

The numbers adopted by Colorado are slightly lower than the EPA criteria because compliance in Colorado is based on the dissolved form.



Appropriate site-specific standards may be different than these table value numbers. Bioaccumulation may occur at higher or lower water column concentrations of selenium depending on a variety of factors. Nutrient enrichment, selenium speciation (different forms of selenium have different levels of toxicity), and acclimation (many areas of Colorado have natural sources of selenium that have existed for thousands of years). This determination would require extensive studies.

### III. PROPOSED CRITERIA

December 2004, EPA proposed a draft revised water quality criteria for selenium (<http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/selenium/>). The revised criteria reflected a new approach to measuring bioaccumulative pollutants in the aquatic environment. EPA published this draft to seek scientific data, information, and views on the draft revised ambient water quality criteria, which will then be considered by EPA before issuance of new final criteria for selenium.

The new data suggest that, while selenium occurs naturally and is nutritionally essential, it is toxic to both aquatic life and wildlife where concentrations are excessive. The draft revised criteria for selenium reflect not only the new data but also presented a method for monitoring selenium based on its presence in fish tissue. The proposed revised criteria contains recommended safe levels for selenium exposure over the short-term and long-term and for both fresh water and salt water. A special monitoring trigger is also included.

This criterion, was not adopted by EPA due to extensive comments. EPA has collect additional scientific studies and revised the criterion. It is expected that a new draft will be proposed in 2013. When EPA publishes the final criteria document it will be considered for adoption in Colorado. If more stringent requirements are adopted by Colorado the City of Pueblo Water Reclamation Facility will have to meet these requirements. This additional cost has to be passed on to the rate payers.

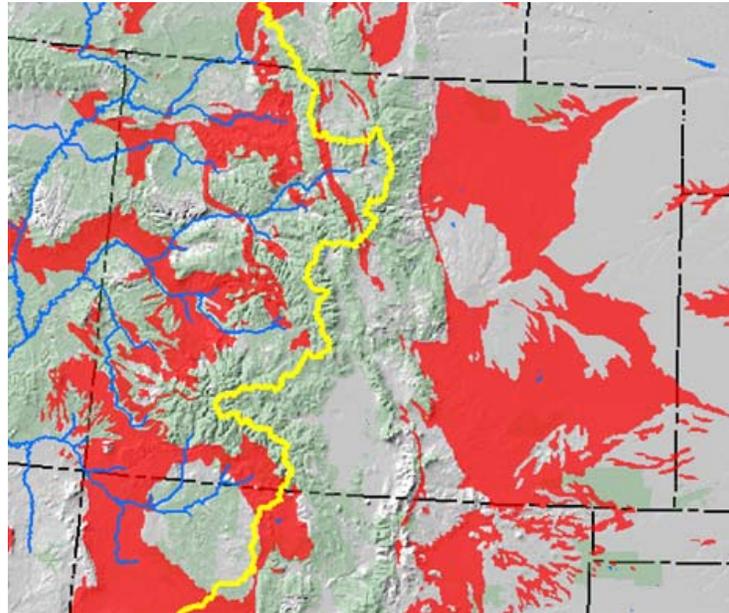
### IV. IMPACT ON PUEBLO WATER RECLAMATION FACILITY

Pierre Shale and the Niobrara Formations of shale are high in selenium. These shale formations are common throughout the Pueblo area. Several studies indicate that selenium concentrations are high in the sediments in the Pueblo vicinity with locations where selenium in plants are some of the highest concentrations found in the Great Plains. Ground water in the Pueblo vicinity is often high in selenium.



As documented by the Water Quality Control Commission in the Statement of Basis and Purpose for the September 1998 Regulation #32 for the Arkansas Basin Rulemaking hearing, the discharge from the Pueblo Water Reclamation Facility periodically contains concentrations of selenium and sulfate far in excess of levels in the receiving water, and the primary source of these high levels of selenium and sulfate is intercepted groundwater in the Pierre Shale formation that is discharged to the sanitary sewer system through basement sump pumps. Industrial sources are described as “virtually nil” compared to the basement source. On the basis that high groundwater conditions will continue to occur in these urbanized areas and result in basement sump pump discharges to the sanitary sewer system, which would result in discharges from the facility far in excess of the adopted site specific standards. This segment has feasibility-based site specific standards for selenium and sulfate. These standards were derived based on a compilation of the data from four monitoring stations located within the segment, using periods of records ranging from 1998 through 2001 (oldest) to 2005 through 2006 (most recent).

Red indicates areas in Colorado that have underground shale formations that contribute to high concentrations of selenium in the ground water and surface water.



If more stringent requirements are adopted by Colorado the City of Pueblo Water Reclamation Facility will have to determine what is necessary to meet these requirements. If construction of treatment facilities is necessary the additional cost has to be passed on to the rate payers.