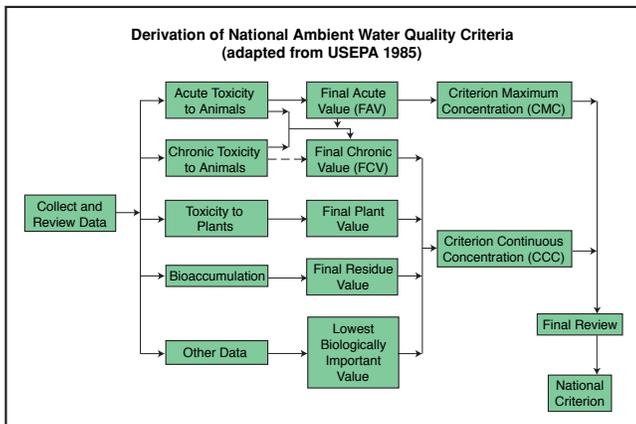


Extant Criteria Evaluation

EPA's National Ambient Water Quality Criteria (AWQC) are used as the basis for state water quality regulations, including protection of beneficial uses and derivation of NPDES discharge permit levels. These set maximum threshold concentrations of contaminants for both freshwater and marine environments. Numeric AWQC are derived using a well-defined process that relies on the collection of mostly laboratory-derived toxicity data which are then used to calculate both an acute and a chronic criterion. Narrative AWQC criteria are created for constituents that are not appropriate to this process (e.g., pH, temperature, total dissolved solids).



Arid West Issues

One major difficulty in applying AWQC to surface waters in the arid West is that they are derived chiefly from standardized toxicity tests using aquatic species that may not be representative of aquatic biota in this region. Furthermore, the physical and chemical characteristics of surface waters in the arid West differ substantially from those in more mesic regions. AWQC thus may not provide an appropriate or consistent level of protection for aquatic ecosystems in arid regions which are subject to these unique environmental conditions.

Study Objectives

The objectives of the Extant Criteria Evaluation (ECE) project were to (1) examine the appropriateness of AWQC for arid Western ecosystems, (2) identify potential weaknesses in the AWQC (or their derivation methods) for these systems, and (3) recommend future research to address any identified potential weaknesses.

Study Results Summary

The goal of the ECE was to evaluate the relevance of selected USEPA ambient water quality criteria (AWQC) to ephemeral and effluent-dependent watercourses in the arid West. More emphasis was placed on considering modifications to AWQC duration and frequency periods to better reflect the biotic and hydrologic conditions encountered in these systems. To test this approach, four AWQC were evaluated as "models" for several important contaminant classes of interest to dischargers in the arid West:

- **Copper** represents metals for which accumulation at the biotic ligand best predicts toxicity. Other important metals in this category include silver, zinc, nickel, and cadmium.
- **Selenium** is an example of an inorganic element for which bioaccumulation or dietary intake are important to toxicity. Another example in this category is mercury.
- **Diazinon** an organic pesticide, represents contaminants which are primarily toxic to invertebrates, rather than fishes.
- **Ammonia** is an example of a constituent for which criteria are derived on the basis of pH and water temperature.

AWQC Magnitudes—Changes in default national AWQC magnitudes are probably warranted to maximize the accuracy by which they represent concentrations which are protective of aquatic life in these systems. For the most part, existing site-specific



Las Vegas Wash
Las Vegas, Nevada

criteria modification methods (i.e., recalculation procedure, water-effect ratio procedure, and resident species procedure) may adequately address these changes, and so a “regional” approach may not be necessary in many cases. The extent to which methods for site-specific magnitude modification may be applied on a regional scale depends mostly upon the ability to generalize the composition of biotic assemblages for use with a Recalculation Procedure. In particular, the presence vs. absence of planktonic cladocerans needs better confirmation owing to the importance of these taxa to criteria derivation for many criteria chemicals.

AWQC Duration and Frequency—Criteria implementation also depends upon the duration (i.e., averaging period) and frequency (i.e., period between criteria excursions that still allows for recovery of aquatic communities) components of an AWQC. Because default duration values are based entirely on laboratory toxicology and toxicokinetics data, it is not possible to suggest modifications on the basis of conditions unique to the arid West. However, recent laboratory evidence suggests that these default duration values may be overly conservative (i.e., too short) in some cases. Increasing duration values would significantly increase design flows for NPDES permit calculations, and so is an important avenue of future study.

The relevance of the default 3-yr recovery period to arid West biotic assemblages was evaluated not only as a function of community recovery from disturbance, but also as a function of hydrologic disturbance frequency. The analysis suggests that the frequency and duration of hydrologic events in ephemeral streams of the arid West have the potential to be of similar importance to biotic communities as is exposure to toxics. The frequency of hydrologic disturbance to ephemeral and effluent-dependent streams certainly is high enough to suggest that these ecosystems could be disturbed more frequently than once every three years. In contrast, the biotic assemblages of ephemeral and effluent-dependent streams may still require longer time periods (e.g., 3 yrs) to recover from disturbance even if a substantial number of endemic species still remain. This suggests that it may be environmentally conservative to retain the default 3-yr frequency of allowed excursions except, perhaps, for relatively unmodified ephemeral streams. Frequency values also can have a significant impact on derivation of NPDES permit design flows, and so a closer examination of the 3-yr default frequency—at least in the case of ephemeral streams—deserves closer attention.

Copper Hardness – Toxicity Study

The mitigating effect of increasing hardness on metal toxicity is reflected in USEPA water quality criteria, but are limited to a hardness range of 25 – 400 mg/L (as CaCO₃). However, waters in the arid West

frequently exceed 400 mg/L hardness, and the applicability of hardness-toxicity relationships in these waters are unknown. Thus in a companion study to the copper AWQC evaluation, acute toxicity tests with *Ceriodaphnia dubia* were conducted at hardness levels ranging from ca. 300 to 1000 mg/L using reconstituted waters that mimic two kinds of natural waters with elevated hardness (Las Vegas Wash, NV, and a CaSO₄-treated mining effluent in CO). The moderately-alkaline EPA synthetic hard water was also included for comparison. Although copper toxicity still decreased with increasing hardness at levels > 400 mg/L, the hardness-toxicity relationships differed with ion composition. In particular, increas-



Ceriodaphnia dubia

ing alkalinity, magnesium, or sodium concentrations explained decreases in copper toxicity better than did either hardness or calcium concentrations. Therefore, further study is needed to determine whether simple hardness-based metals criteria are appropriate for use in the arid West, or whether more complex approaches are warranted.

Final Report

A limited number of final report copies have been distributed by Pima County; additionally, the report will be published by the Society of Environmental Toxicology and Chemistry (SETAC). An Executive Summary may be downloaded from the AWWQR website.

Additional Project Information

Arid West Water Quality Research Project
Pima County Wastewater Management
201 N. Stone Avenue, 8th Floor
Tucson, AZ 85701-1207
(520) 740-6500
e-mail: wqrp@wwm.pima.gov
Website: www.pima.gov/wwm/wqrp