February 5, 2007

VIA ELECTRONIC MAIL (conard.shirley@azdeq.gov)

Shirley J. Conard
Water Quality Division
Arizona Department of Environmental Quality
1110 W. Washington Street, 5415A-1
Phoenix, AZ 85007

Re: *Arizona Chamber of Commerce and Industry and Greater Phoenix Chamber of Commerce Comments on Proposed Aquifer Water Quality Standards*

Dear Ms. Conard:

On behalf of their over 4,000 members, the Arizona Chamber of Commerce and Industry and the Greater Phoenix Chamber of Commerce (the "Chamber") hereby submit the following comments in response to the Arizona Department of Environmental Quality's ("ADEQ") proposed revision of its Aquifer Water Quality Standards ("AWQS"). Chamber members are often regulated under Arizona's Aquifer Protection Permit ("APP") program and other groundwater regulations, and are thus significantly impacted by the proposed AWQS. In addition, because violation of AWQS may result in both criminal and civil penalties, the adoption of reasonable AWQS is enormously important to the regulated community.[1] The Chamber's comments regarding the proposed AWQS regulations are set forth below and in the attached, more detailed, technical comments prepared by the Chamber's consultants, Exponent (the "Exponent Comments") and Savci Environmental Technologies, LLC ("SET") (the "SET Comments").

I. MCLs Are Not Always Appropriate as AWQS.

The U.S. Environmental Protection Agency ("EPA") establishes maximum contaminant levels ("MCLs") in connection with its regulation of public drinking water systems under the federal Safe Drinking Water Act ("SDWA"). 42 U.S.C. § 300 *et seq.* Under A.R.S. § 49-223(A), ADEQ establishes AWQS based on the EPA's drinking water MCLs, unless "substantial opposition is demonstrated in the rule making docket regarding a particular constituent."[2] If such substantial opposition is demonstrated to the AWQS for a particular constituent, ADEQ "may adopt for that constituent the maximum contaminant level as a drinking water aquifer water quality standard upon making a

[1] See A.R.S. § 49-263
[2] "Significant opposition" means information submitted to the director that explains with reasonable specificity why the maximum contaminant level is not appropriate as an aquifer water quality standard. A.R.S. § 49-223(A).

finding that this level is appropriate for adoption in Arizona as an aquifer water quality standard." A.R.S. § 49-223(A). In making such a finding, ADEQ "shall consider whether the assumptions about technologies, costs, sampling and analytical methodologies and public health risk reduction used by the administrator in developing and implementing the maximum contaminant level are appropriate for establishing a drinking water aquifer water quality standard." *Id.*

The AWQS statute thus allows ADEQ to deviate from the MCL in establishing the AWQS, thus providing the necessary flexibility to establish workable AWQS regulations. This flexibility is essential, as the MCLs and AWQS are set under different programs with different purposes, and serve different functions. As such, the AWQS statute itself clearly indicates that there will be instances where the levels should not be identical.

MCLs are set by the EPA in order to regulate public drinking water systems under the SDWA, whereas AWQS are designed to protect aquifer water quality for present and foreseeable future uses. MCLs apply to public water systems, which provide water to the public for "human consumption" and typically are applied after treatment. 40 C.F.R. § 141.2. In contrast, AWQS apply to natural, in-ground water before it is withdrawn for any use. The AWQS apply to many programs not considered by the EPA when revising the drinking water MCLs, including the APP program and state groundwater remediation requirements. The assumptions used to set MCLs for public drinking water systems do not always translate into reasonable standards for in-aquifer water. In-aquifer water will not necessarily raise the same health concerns as water treated for human consumption under the SDWA, since in-aquifer water may not be destined for human consumption, and may be incapable of being treated as required under the SDWA. MCLs also are set on a national basis using national data on available treatment technologies, contaminant background levels, and treatment costs, which may not be representative of Arizona hydrogeological conditions or the cost of treating Arizona aquifers to the MCLs.

Consistent with ADEQ's request for comments and with the flexibility built into the AWQS statute allowing for deviation from the MCL standard upon demonstration of substantial opposition, the Chamber submits these comments opposing certain portions of the proposed AWQS revisions, including the adoption of federal MCLs for certain AWQS constituents.

II. The Revised Federal Arsenic MCL is not Appropriate as an Arizona AWQS.

After substantial controversy regarding consideration of costs and potential health benefits, EPA established a revised MCL for arsenic at 0.01 mg/L in connection with its regulation of drinking water systems under SDWA. 40 C.F.R. § 141.11; 66 Fed. Reg. 6976 (January 22, 2001). Accordingly, pursuant to A.R.S. § 49-223(A), ADEQ has proposed that the AWQS for arsenic should also be 0.01 mg/L. The Chamber opposes the application of EPA's MCL for arsenic in Arizona because EPA's assumptions used in setting the MCL are inappropriate for Arizona.

First, as detailed in the attached Exponent Comments, recent developments regarding the human health effects of arsenic exposure no longer support the adoption of the revised arsenic MCL of 0.01 mg/L. In fact, it is questionable whether the revised arsenic drinking water standard continues to comply with the statutory mandate that EPA use the "best available" evidence when establishing drinking water standards, including MCLs. 42 U.S.C. § 300g-1(b)(3)(A). The Chamber is aware of recent efforts to revise the federal arsenic MCL upward as part of the pending six-year review of the federal drinking water standards required under 42 U.S.C. § 300g-1(b)(9). Consequently, the assumptions regarding potential human health impacts and resulting benefits used by EPA should no longer be considered valid and should not be used by ADEQ to support establishing an equivalent AWQS.

Second, the arsenic MCL does not reflect any consideration of the cost of treatment of Arizona aquifers. EPA estimated that five percent of community water systems in the U.S. have arsenic levels exceeding 0.01 mg/L[3], based on nationwide data. In Arizona, however, the percent of groundwater resources exceeding 0.01 mg/L is much higher, on the order of 30%, with 5% actually exceeding 0.05 mg/L.[4] Typical arsenic concentrations in Arizona groundwater range up to 0.05 mg/L, and the arsenic is generally naturally occurring, due in large part to Arizona's abundant, naturally occurring sulfide mineral deposits.[5] It would be prohibitively expensive to attempt to treat 30% of Arizona's groundwater in order to reduce natural arsenic levels, and totally inappropriate to set an AWQS for which 30% of the state's groundwater resources will immediately be in violation due to natural causes.

EPA has specifically acknowledged that the arsenic MCL - directed at drinking water, including water monitored at its point of use - may not be appropriate for other federal or state regulatory programs. EPA does not even attempt to consider costs associated with other programs in formulating MCLs. In a September 23, 2002 letter (copy enclosed), EPA clarifies that the adoption of the revised arsenic MCL

> was made for the purposes of SDWA, based on the specific procedures prescribed in Section 1412 of SDWA for the purpose of setting drinking water standards [and that] [c]onsistent with SDWA, EPA did not quantify or consider the costs or other implications associated with the use of its revised MCL or MCLG (or the assumptions used to derive those values in any other Federal program or state non-SDWA program).

Based on this recognition, EPA warned that:

> where State regulators use the MCL... or the technical assumptions on which those values were based, in the implementation of non-SDWA programs, we would encourage them to confirm whether and the extent to which such use is appropriate, based on a review of the objections, requirements, and any site-

---

[3] U.S. EPA, "Arsenic in Drinking Water", 2007, EPA Website: http://www.epa.gov/safewater/arsenic/index.html. (hereinafter cited as "EPA 2007")
[4] John E. Spencer, "Arsenic in Groundwater", *Arizona Geological Survey*, Vol. 30, No. 3 (Fall, 2000) (hereinafter cited as "AGS 2000").
[5] *Id.*

specific risk assessment options applicable to the particular non-SDWA program at issue.

Third, the Chamber is concerned that ADEQ has not considered or evaluated the availability or cost of technologies for reduction of arsenic in potential discharges or in groundwater remediations; especially to the extent those technologies would differ from those used in the treatment of drinking water. Failure to carefully consider these issues, especially in light of the questionable benefits of the revised MCL outlined in the Exponent Comments, suggests that the revised arsenic MCL should not be adopted as an Arizona AWQS.

Based on the factors discussed above and in the Exponent Comments, the Chamber opposes the adoption of the arsenic MCL as an inappropriate standard to be adopted as an Arizona AWQS. The Chamber recommends that ADEQ retain the current 0.05 mg/L standard as a more appropriate AWQS for arsenic.[6]

III. The New Federal MCL for Uranium is Not Appropriate as an Arizona AWQS.

A similar concern applies to the AWQS for uranium. ADEQ simply adopts the new federal MCL for uranium (30 ug/L) as its proposed AWQS. However, as with arsenic, Arizona's unique geological conditions make application of a national SDWA-based standard inappropriate. As noted in the SET Comments, many parts of Arizona are underlain with rock types which contain high concentrations of uranium, including areas with hydrothermally mineralized rocks associated with copper-rich areas.[7] As such, many Arizona aquifers will be naturally high in uranium.

Additionally, the uranium MCL for drinking water is not an appropriate standard for in-aquifer uranium levels. EPA established MCL levels for uranium based on an "understanding of the risks associated with radionuclides in *drinking water*." 65 Fed. Reg. 76708 (December 7, 2000) [emphasis added]. One of the main reasons EPA established a uranium MCL is because uranium is a nephrotoxic metal (kidney toxicant). *Id.* Uranium's nephrotoxic properties would only be manifest if ingested. The SET Comments also note that the federal uranium MCL is applicable only to community water systems ("CWSs"). This limited application of the uranium MCL indicates EPA's intent that such a standard should apply only at the point of use, and not the source. As such, it is clear that the federal MCL for uranium was set to apply at the point of use, not at the source. ADEQ should adopt the federal uranium MCL consistent with EPA's intended application of that standard – i.e., only to community water systems providing water intended for human consumption.

Therefore, the Chamber opposes the proposed AWQS for uranium, because it fails to consider the naturally-occurring high levels of uranium in many Arizona aquifers. The Chamber recommends, consistent with the SET Comments, that ADEQ should

---

[6] This standard of 0.05 mg/L is based on the AGS 2000 study, which demonstrated that 0.05 mg/L represents the upper range of normal, naturally-occurring arsenic levels in Arizona aquifers.
[7] John T. Duncan and Jon E. Spencer, "Uranium and Radon in Southeastern Arizona", *Arizona Geological Survey Bulletin* 199, pp 40-42 (1993).

adopt a more appropriate AWQS based on the normal ambient uranium levels in a given aquifer, thereby giving proper consideration to Arizona's unique geological conditions while still preventing degradation of the aquifer.

IV. The Current AWQS for Barium is Not Appropriate.

In addition, the Chamber also opposes the current AWQS for barium. ADEQ based its AWQS for barium (2,000 ug/L) on the federal MCL for barium from 1991. However, in July of 2005, EPA updated its integrated risk information system ("IRIS") file for barium.[8] The reference dose ("RfD") for barium is now based on more recent studies, and is nearly three times higher than the old RfD. The Chamber recommends that the barium AWQS be modified to incorporate this more current scientific information and regulatory policy. Specifically, the barium AWQS should be calculated using the updated RfD of 0.2 mg/kg-day and assume a relative source contribution of 1.0, resulting in an AWQS of 7,000 ug/L.

ADEQ should take a similar approach going forward with all AWQS. As noted in this section, and above in Section II discussing arsenic, the scientific bases underlying many of the MCLs upon which AWQS is based have become antiquated and invalid following improved studies and more recent data. ADEQ should review and revise all existing AWQS as data shows current standards are unreasonably stringent and inappropriate for use as Arizona AWQS.

V. Disinfection Byproducts are Not Relevant to AWQS

ADEQ proposes to establish, as AWQS, the MCLs for certain disinfection byproducts ("DBPs"), such as chlorite, bromate, trihalomethanes and haloacetic acids. DBPs occur as the result of a chemical reaction between a disinfectant and certain organic compounds in water. Where water has not been treated with a disinfectant, no meaningful concentrations of DBPs would be present. The reason EPA has established MCLs for DBPs is that public drinking water systems have water that has been treated with disinfectants, and thus would likely have potentially high levels of DBPs. Those MCLs have no application to water which has not been treated, such as aquifers. As such, ADEQ should remove the AWQS for DBPs, because such a standard has no relevance in the context of an aquifer in which no disinfection has taken place.

VI. ADEQ Should Retain the Option to Take a Confirmatory Sample for Coliforms.

Under the previous AWQS rules, taking a sample exceeding the total coliform AWQS resulted in the opportunity to take another sample to confirm the violation. R18-11-406(F). ADEQ now proposes to remove the option to take a confirmatory sample before the coliform level would be considered a violation of AWQS. Initial samples often result in false positives for total coliforms for various reasons, including human error or contamination that occurred within the laboratory. Historically, this has been a particular problem for coliform samples, which is why the provision was enacted in the first place. The confirmatory sample prevents false violations and the resulting expenditures where

---

[8] U.S. EPA "Integrated Risk Information System ("IRIS") (20007); http://epa.gov/iris/search.htm

there has been no actual violation. ADEQ should retain the language allowing for confirmatory samples to be taken in instances where the initial sample exceeds the AWQS for total coliforms.

VII. ADEQ Should Adopt More Reasonable AWQS for Remediation Purposes.

ADEQ has statutory authority to allow exceedances of AWQS for remediation purposes. Under A.R.S. § 49-282.06(D), ADEQ "may approve a remedial action that may result in water quality exceeding water quality standards after the completion of the remedy if the director finds that the remedial action meets the requirements of this section." As such, ADEQ may allow regulated parties to remediate aquifers to a concentration exceeding the AWQS for particular constituents, if such concentrations (i) assure the protection of public health and welfare and the environment; (ii) to the extent practicable, provide for the control, management or clean-up of the hazardous substances in order to allow the maximum beneficial use of the waters of the state; and (iii) are reasonable, necessary, cost-effective and technically feasible. A.R.S. § 49-282.06(A). Because remedial actions "shall be reasonable, necessary, cost-effective and technically feasible", ADEQ has discretion, if not a statutory obligation, to avoid adopting SDWA-based MCLs that fail to meet these mandatory remediation criteria.

This statutory backdrop, however, emphasizes the importance of adopting more reasonable AWQS than those now being proposed by ADEQ. For the reasons discussed above, the proposed AWQS for arsenic, uranium, barium and DBPs are unreasonable, unnecessary, not cost-effective or/and not technically feasible. These unreasonable AWQS will result in ADEQ having to apply its discretion in setting remediation standards under A.R.S. § 49-282.06(D) to establish more appropriate site-specific remediation standards or concentrations. However, the development of site-specific standards or concentrations for purposes of remediation only complicates matters. As noted in the Exponent Comments, use of background or some other site-specifically developed concentration is extremely problematic because site-specific concentrations vary widely from one area to another. Indeed, background concentrations, for example, vary within the same aquifer. Regulated parties would expend enormous resources in the potentially uncertain and technically infeasible pursuit of determining background or other more appropriate site-specific developed remediation concentrations. This would lead to ADEQ also expending its limited resources in determining what is "reasonable, necessary, cost-effective and technically feasible" for each remediation project. To avoid such difficult legal, technical and resource issues, the Chamber recommendations that ADEQ adopt more reasonable statewide AWQS's than the SDWA-based MCLs proposed in the rulemaking.

The Chamber appreciates ADEQ's consideration of these comments and anticipates working closely with ADEQ to develop reasonable AWQS. The Chamber respectfully requests that ADEQ revise the proposed AWQS in accordance with these comments.

Sincerely,

David P. Kimball, III
Chairman, Arizona Chamber of Commerce Environment Committee
Chairman, Greater Phoenix Chamber of Commerce Environment Committee

Enclosures

Exponent®
15375 SE 30th Pl, Suite 250
Bellevue, WA 98007

Technical Memorandum
February 5, 2007

Comments on Arizona Aquifer Water Quality Standards Proposed Rules

Exponent has reviewed the Arizona proposed aquifer water quality standards (AWQS) and is pleased to provide the following comments.

Applicability of MCLs as AWQS

The AWQS have historically been based on federal maximum contaminant levels (MCLs). However, A.R.S. 49-223(A) clarifies that federal MCLs should be used or adopted as AWQS only if the Arizona Department of Environmental Quality (ADEQ) finds that each federal MCL "is appropriate for adoption in Arizona as an [AWQS]" after consideration of whether the assumptions about technologies, costs, sampling and analytical methodologies and public health risk reduction used by EPA are appropriate for establishing an AWQS for Arizona. MCLs are federal standards that are applicable for water providers as defined by the federal drinking water regulations. As such, these values are developed based on an initial health-based calculation using default EPA assumptions for drinking water exposure (e.g., all your water consumption is from tap water, lifetime exposure) and conservative, health-protective criteria regarding the toxicity of the chemical. This health-based level is often then lowered to account for potential chemical exposure from other sources, such that the health-based drinking water level is multiplying by a percentage (e.g., 20 percent), called the relative source contribution (see comment below), even though such background exposures may not be relevant for all populations. Other factors considered include technical feasibility to achieve or measure the MCL and a cost-benefit analysis. Such factors are typically applied for chemicals considered to be carcinogenic, because the health-based goal for these chemicals is set at zero. The cost-benefit analysis is based on a nationwide review of current background levels in drinking water and the cost to lower these levels.

Higher background levels of constituents such as arsenic in Arizona groundwater than in nationwide averages for water supplies indicates that more treatment and hence higher cost would be involved in Arizona than for most water suppliers nationwide (see comment below). Use of mean statewide Arizona background levels for aquifer standards is also not a practical solution. Concentrations can vary widely across the state, and even within a single aquifer. Furthermore, unlike arsenic, background levels of most constituents have not been adequately characterized across the state. The amount of exposure to human populations for aquifers in Arizona is also very situation specific and may not necessarily involve any exposures. The risk analysis for a specific aquifer may be very different than the risk assumptions used to derive MCLs. Thus, neither the cost nor the benefit analysis based on nationwide drinking water supplier data is applicable for aquifers in Arizona. For this reason, MCLs are not well suited for use as a remediation standard in Arizona, one of the applications of AWQS.

Recommendation

We recommend that AWQS be calculated using health-based criteria, using realistic exposure assumptions for aquifers, not unrealistic MCL exposure assumptions.. The AWQS should take into account natural background levels in Arizona to the extent possible. Furthermore, AWQS should be applied based on the specific beneficial use of the aquifer.

The arsenic MCL is not a practical standard for Arizona waters

Effective January 23, 2006, EPA revised the arsenic MCL from 50 μg/L to 10 μg/L. Pursuant to A.R.S. 49-223(A), ADEQ initiated a revision to R18-11-406(B) lowering the arsenic AWQS to 10 μg/L. According to A.R.S. 49-223(A), ADEQ should "consider whether the assumptions about technologies, costs, sampling and analytical methodologies and public health risk reduction" assumed by EPA in developing the MCL are appropriate for an Arizona AWQS.

In setting the new arsenic MCL, EPA estimated that five percent of community water systems in the U.S. have arsenic levels exceeding 10 μg/L (U.S. EPA 2007). That estimate is based on nationwide data; in some areas of the country, including Arizona, the percent of groundwater resources exceeding 10 μg/L is much higher (AGS 2000). The Arizona Geological Survey reported that over 30 percent of 809 groundwater wells surveyed had arsenic levels greater than 10 μg/L, with nearly five percent exceeding 50 μg/L (AGS 2000). The report concludes that typical arsenic concentrations in Arizona groundwater range from 1 to 50 μg/L, and a significant percentage exceed 50 μg/L.

In most cases, groundwater arsenic levels in Arizona groundwater are naturally occurring, rather than the result of an anthropogenic source. Arsenic is present at low concentrations in virtually all rock and soil. The abundant, naturally occurring sulfide mineral deposits in Arizona may be a significant natural source of arsenic (AGS 2000). Treating drinking water to decrease chemical levels to an MCL can be an expensive undertaking, and in fact, the practicality of treatment is considered in the MCL derivation process along with the potential health benefits expected. For arsenic, EPA estimated that for community water systems with up to 10,000 users, the additional annual cost for treatment to reach the new arsenic MCL would range from $38 to $327 per household (U.S. EPA 2007). The cost would be less for systems serving more than 10,000 users. It follows that costs would be higher for systems with fewer users, although EPA does not provide those estimates because they only evaluated scenarios to which MCLs are meant to apply (i.e., community water systems serving at least 25 residents or 15 locations). Furthermore, the cost is affected by the arsenic concentration in the resource, and since the average concentration in Arizona groundwater is higher than the national average, the cost of treatment in Arizona would be higher per capita than the national average.

The importance of background levels and treatment costs have less influence in the decision making process if the evidence is clear that decreasing water concentrations to the MCL would provide a important public health benefit. However, the recent studies in populations (including in the U.S.) exposed to low levels of arsenic in drinking water (<100 μg/L) overall have not indicated increased cancer risks associated with arsenic.

The cancer risk estimates for arsenic exposure in drinking water are based on data derived from a Taiwanese population exposed to very high drinking water arsenic concentrations (>700 µg/L). However, there are a number of problems with the Taiwanese that limit their usefulness for estimating risk for U.S. populations, including extreme nutritional deficiency in the Taiwanese population which increases arsenic toxicity (Chen et al. 2001; Milton et al. 2004; Mitra et al. 2004; Gamble et al. 2005; Spallholtz et al. 2004; Yang et al. 2002; Miyazaki et al. 2005), exposure misclassification problems (Brown and Chen 1995; Brown and Ross 2002), and the association of elevated cancer risk with a certain well water source with possible other carcinogenic substances or confounding factors (Lamm et al. 2003; Lamm and Kruse 2005; Lamm et al. 2006). Furthermore, EPA used a linear mathematical model to estimate arsenic risk that assumes there is no threshold of exposure below which there would be no risk. This is despite considerable mechanistic toxicity (e.g., Schoen et al. 2004; Snow et al. 2005) and epidemiological data (below) at low doses that support a non-linear, threshold relationship.

On the other hand, several recent epidemiological studies indicate the arsenic cancer slope factor calculated from the Taiwan data is inconsistent with low-level exposures in nutritionally sufficient populations in the U.S. (Lewis et al. 1999; Steinmaus et al. 2003; Karagas et al. 2004; Lamm et al. 2004) and other countries (Kurttio et al. 1999; Michaud et al. 2004; Bates et al. 2004). These studies do not indicate that arsenic levels typically found in Arizona aquifers (e.g., <100 µg/L) would be associated with an increased risk of bladder cancer.

In summary, the cost, risk assessment, and treatment technology assumptions used in the development of the arsenic MCL are not applicable, realistic, or appropriate for establishing an AWQS that would be used for aquifer remediation and aquifer water quality compliance.

Recommendation

We recommend that ADEQ retain their previous arsenic AWQS for arsenic of 50 μg/L. It is a more realistic goal for Arizona aquifers, and still health protective for a drinking water beneficial use.

MCLs incorporate an overly conservative relative source contribution

MCLs typically incorporate a default relative source contribution (RSC) of 0.2. The RSC is intended to ensure that total exposure to a given chemical in a given water body does not exceed a threshold limit (i.e., the reference dose [RfD]) when combined with exposure to that chemical from sources other than that water body (e.g., diet). In this approach, the RSC is multiplied by the RfD under the assumption that background exposure to other sources could contribute up to 80 percent of the RfD, so the water source can contribute only 20 percent of the RfD in the water quality standard.

Thus, an MCL is calculated by EPA using the following general formula:

$$\text{DWS standard } (\mu g/L) = RfD \times RSC \times BW / IRw$$

where:

RfD	=	chemical-specific reference dose (μg/kg-day)
RSC	=	default relative source contribution of 0.2
BW	=	adult body weight of 70 kg
IRw	=	water ingestion rate of 2 L/day.

The RSC in this case assumes that 80 percent of the RfD is contributed by non-water sources and so the water body to which the MCL is being applied can contribute only up to the remaining 20 percent. This fractional approach considers only an assumed ratio of background exposure of a chemical through water ingestion to total background exposure.

There are two primary problems with this approach. First, the default value of 0.2 is overly conservative for most chemicals. U.S. EPA (2000) guidance recommends use of an RSC in the range of 0.2 to 0.8 for drinking water and fish ingestion when applying the fractional approach.

However, EPA has yet to update current national MCLs or ambient water quality criteria (AWQC) to incorporate RSCs specific to each chemical, using this approach. U.S. EPA (2000) indicates that "States and authorized Tribes have the flexibility to make alternative exposure and RSC estimates based on local data, and EPA strongly encourages this." The State of California has used a range of chemical-specific RSC's in setting water quality Public Health Goals (OEHHA 2005). For example, California uses RSCs as high as 1.0 (e.g., for barium and fluoride), whereas, they use the low-end default value of 0.2 for some other chemicals.

Second, the fractional approach for applying the RSC is inherently flawed. Although use of an RSC is particularly important for chemicals that are ubiquitous in the environment **and** for which background exposure may approach the RfD, it is overly conservative for chemicals for which exposure to the general public would be negligible outside the specific water body in question. It is particularly important to consider the ramifications of this approach when applying it to drinking water standards such as MCLs and, by adoption, AWQS. An MCL assumes that an individual's entire drinking water ingestion (i.e., 2 L/day) comes from the water body in question, and none from other water sources. This implies that the RSC for chemicals for which exposure occurs primarily through water should be 1.0, or close to it, because there is assumed to be no other water source to which a person is exposed. Further, this method includes an inherent assumption that background exposures are at or near the RfD, which is typically not the case.

In reality, intake of many chemicals would not approach their RfD. The typical source contribution from water expressed, as a simple percent (as is done with the fractional method), is irrelevant to the question of how close one's exposure is to the RfD. In fact, U.S. EPA (2001) used a different approach altogether in its water quality criteria for methylmercury. In revising the AWQC for methylmercury, EPA applied a "subtraction" method, whereby background exposures are subtracted from the RfD and the remaining portion of the RfD is used to calculate the water quality criteria. The subtraction method is a more appropriate method of accounting for RSC because it takes into account the actual amount of typical background exposure, and relates that amount to the RfD. This method was endorsed by U.S. EPA (2002) in the *Human*

Health Criteria Calculation Matrix for the water quality criteria program, was used by EPA in developing the AWQC for human health for methylmercury (U.S. EPA 2001), and has been proposed in EPA's draft toxicological review of cadmium (U.S. EPA 1999).

This subtraction approach is a more practical and scientifically appropriate methodology in that it considers the actual magnitude of background exposure relative the RfD. The approach uses available data from the scientific literature, summarized by federal and state environmental and health agencies. In the subtraction approach, an RSC-adjusted RfD (RfD_{RSC}) is derived by subtracting non-water sources of exposure from the RfD:

$$RfD_{RSC} = RfD - \text{Non-drinking water background dose}$$

An AWQS standard would then be calculated using the RfD_{RSC}

$$AWQS\ (\mu g/L) = RfD_{RSC} \times BW / IRw$$

As an example, the proposed inorganic mercury AWQS is 2 μg/L. This value is based on the MCL, which was derived using the equation and default fractional RSC presented above, along with the inorganic mercury RfD of 0.3 μg/kg-day.

$$MCL\ (\mu g/L) = 0.3\ \mu g/kg\text{-}day \times 0.2 \times 70\ kg / 2\ L/day$$

$$= 2\ \mu g/L$$

The federal mercury MCL was promulgated in 1987, prior to more recent EPA guidance supporting use of a more chemical specific approach to RSC (U.S. EPA 2001, 1998, 2002). Data summarized in the *Toxicological Profile for Mercury* (ATSDR 1999) indicate that a typical background exposure to inorganic mercury is 4.3 μg/day, or 0.06 μg/kg-day assuming a 70 kg adult. The diet provides almost 99 percent of background inorganic mercury exposure, with water ingestion providing the remaining 1 percent. Ambient air is an insignificant source of inorganic mercury exposure. Even with the significant contribution from diet to overall exposure, total background exposure still does not approach the RfD. Thus, the fractional approach overestimates the contribution of non-water sources to overall exposure.

For inorganic mercury, the RfD_{RSC} would be calculated as follows:

$$RfD_{RSC}\ (\mu g/kg\text{-}day) = RfD\ (\mu g/kg\text{-}day) - \text{food exposure}\ (\mu g/kg\text{-}day)$$

$$= 0.3\ \mu g/kg\text{-}day - 0.06\ \mu g/kg\text{-}day$$

$$= 0.24\ \mu g/kg\text{-}day$$

The AWQS would then be calculated as follows:

$$\text{DWS standard}\ (\mu g/L) = RfD_{RSC}\ (\mu g/kg\text{-}day) \times BW\ (kg)\ /\ IRw\ (L/day)$$

$$= 0.24\ \mu g/kg\text{-}day \times 70\ kg\ /\ 2\ L/day$$

$$= 8.4\ \mu g/L$$

The resulting mercury AWQS of 8.4 μg/L would be health protective, account for background exposure, and incorporate a relative source background component that is consistent with EPA guidelines.

Recommendation

Most federal MCLs are obsolete, using a methodology and data that are 20 years old. Application of these MCLs as AQWS is overly conservative and does not consider the available science and more recent guidance. We recommend that ADEQ recalculate AWQS and use chemical-specific information and a subtraction method in accounting for relative source contribution rather than multiplying by a default RSC, which has no connection with actual intake.

Disinfection byproducts are not relevant to the AWQS

Disinfectants are commonly used in community water systems in order to reduce the levels of microorganisms, such *E. coli*, in accordance with the MCLs for microorganisms. Disinfection byproducts occur when the halogenated compounds used as disinfectants break down in the water. However, these byproducts are also associated with their own health risks. Therefore, in 2001 EPA promulgated a new set of standards for disinfectants and disinfectant byproducts (U.S. EPA 2001). The intent is to protect a community water system in which treatment for microorganisms has been conducted.

The proposed Arizona AWQS incorporate MCLs for four disinfection byproducts: bromate, chlorite, haloacetic acid, total trihalomethanes. However, these standards have no relevance in the context of an aquifer in which no disinfection has taken place.

Recommendation

We recommend that ADEQ remove the standards for the disinfection byproducts bromate, chlorite, haloacetic acid, total trihalomethanes.

AWQS for barium

The AWQS for barium of 2,000 μg/L is based on the MCL promulgated in 1991. In July 2005, U.S. EPA (2007b) updated its IRIS file for barium. The RfD for barium is now based on a study showing kidney effects in mice after 2 years of exposure to barium in drinking water, rather than the more tenuous relationship with blood pressure on which the previous RfD was based. The new RfD is 0.2 mg/kg-day, nearly 3-fold higher than the old RfD of 0.07 mg/kg-day. Even retaining the original assumption regarding relative source contribution, a revised MCL would increase nearly 3-fold to 5,600 μg/L. However, because background sources of barium are not significant, it is appropriate to use assume a RSC of 1.0, consistent with the value used by California in setting their water quality Public Health Goal for barium (OEHHA

2005). Assuming an RSC of 1.0 and the updated RfD of 0.2 mg/kg-day, the AWQS for barium would be 7,000 µg/L.

The case of barium is illustrative of a flaw in rule making process for AWQS. The statute indicates, "Within one year after the administrator establishes additional primary drinking water maximum contaminant levels, the director shall open a rule making docket pursuant to section 41-1021 for adoption of those maximum contaminant levels as drinking water aquifer water quality standards." In practice, EPA only revises MCLs to account for new science when an MCL would be lowered. The MCL rule revision process is so time-consuming and expensive, that there is little impetus to initiate the process in order to raise an existing MCL. The EPA's charge is to protect public health, so the focus is on areas where they feel public health is not already adequately protected. Thus, even though EPA has, by revising the barium RfD, acknowledged that newer science shows barium to be less potent than previously thought, there is little impetus to revise the barium MCL consistent with that updated RfD; the current barium MCL is already protective. However, ADEQ cannot simply follow suit. In fact, the applicable statutory language (see A.R.S. 49-223(A)) dictates that ADEQ is compelled to revise an AWQS when the science indicates it should be lowered, and when the science indicates the AWQS should be higher.

Recommendation

As required by A.R.S. 49-223(A), the barium AWQS must be modified to incorporate scientific information and regulatory policy. Specifically, the barium AWQS should be calculated using the updated RfD of 0.2 mg/kg-day and assume a relative source contribution of 1.0, resulting in an AWQS of 7,000 μg/L.

References

ATSDR. 1999. Toxicological profile for mercury. Agency for Toxic Substances and Disease Registry.

Bates, M.N., O.A. Rey, M.L. Biggs, C. Hopenhayn, L.E. Moore, D. Kalman, C. Steinmaus, and A.H. Smith. 2004. Case-control study of bladder cancer and exposure to arsenic in Argentina. Am. J. Epidemiol. 159(4):381–389.

Brown, K.G., and C-J. Chen. 1995. Significance of exposure assessment to analysis of cancer risk for inorganic arsenic in drinking water in Taiwan. Risk Anal. 15:

Brown, K.G., and G.L. Ross. 2002. Arsenic, drinking water, and health: A position paper of the American Council on Science and Health. Regul. Toxicol. Pharmacol. 36:162–174.

Chen, C-J., Y-M. Hsueh, M-P. Tseng, Y-C. Lin, L-I. Hsu, W-L. Chou, H-Y. Chiou, I-H. Wang, Y-L. Chou, C-H. Tseng, and S-H. Liou. 2001. Individual susceptibility to arseniasis. pp. 135–143. In: Proc. Fourth Annual International Conference on Arsenic Exposure and Health Effects. June 18–22, 2000. W.R. Chappell, C.O. Abernathy, and R.L. Calderon (eds). Elsevier Science Ltd.

Gamble, M.V., X. Liu, H. Ahsan, J.R. Pilsner, V. Ilievski, V. Slavkovich, F. Parvez, D. Levy, P. Factor-Litvak, and J.H. Graziano. 2005. Folate, homocysteine, and arsenic metabolism in arsenic-exposed individuals in Bangladesh. Environ. Health. Perspect. 113(12):1683–1688.

Karagas, M.R., T.D. Tosteson, J.S. Morris, E. Demidenko, L.A. Mott, J. Heaney, and A. Schned. 2004. Incidence of transitional cell carcinoma of the bladder and arsenic exposure in New Hampshire. Cancer Causes Control 15(5):465–472.

Kurttio, P., E. Pukkala, H. Kahelin, A. Auvinen, and J. Pekkanen. 1999. Arsenic concentrations in well water and risk of bladder and kidney cancer in Finland. Environ. Health Perspect. 107(9):705–710.

Lamm, S.H., A. Engel, C.A. Penn, R. Chen, and M. Feinleib. 2006. Arsenic cancer risk confounder in southwest Taiwan data set. Environ. Health Perspect. 114(7):1077-82.

Lamm, S.H., A. Engel, M.B. Kruse, M. Feinleib, D.M. Byrd, S. Lai, and R. Wilson. 2004. Arsenic in drinking water and bladder cancer mortality in the United States: An analysis based on 133 U.S. counties and 30 years of observation. J. Occup. Environ. Med. 46(3):298–306.

Lamm, S.H., and M.B. Kruse. 2005. Arsenic ingestion and bladder cancer mortality – what do the dose-response relationships suggest about mechanism? Hum. Ecol. Risk. Assess.11:433.

Lamm, S.H., D.M. Byrd, M.B. Kruse, M. Feinleib, and S.H. Lai. 2003. Bladder cancer and arsenic exposure: Differences in the two populations enrolled in a study in southwest Taiwan. Biomed. Environ. Sci. 16(4):355–368.

Lewis, D.R., J.W. Southwick, R. Ouellet-Hellstrom, J. Rench, and R.L. Calderon. 1999. Drinking water arsenic in Utah: A cohort mortality study. Environ. Health Perspect. 107(5):359–365.

Michaud, D.S., M.E. Wright, K.P. Cantor, P.R. Taylor, J. Virtamo, and D. Albanes. 2004. Arsenic concentrations in prediagnostic toenails and the risk of bladder cancer in a cohort study of male smokers. Am. J. Epidemiol. 160(9):853–859.

Milton, A.H., Z. Hasan, S.M. Shahidullah, S. Sharmin, M.D. Jakariya, M. Rahman, K. Dear, and W. Smith. 2004. Association between nutritional status and arsenicosis due to chronic arsenic exposure in Bangladesh. Int. J. Environ. Health Res. 14(2):99–108.

Mitra, S.R., D.N. Guha Mazumder, A. Basu, G. Block, R. Haque, S. Samanta, N. Ghosh, M.M. Hira Smith, O.S. von Ehrenstein, and A.H. Smith. 2004. Nutritional factors and susceptibility to arsenic-caused skin lesions in West Bengal, India. Environ. Health Perspect. 112(10):1104–1109.

Miyazaki, K., C. Watanabe, K. Mori, K. Yoshida, and R. Ohtsuka. 2005. The effects of gestational arsenic exposure and dietary selenium deficiency on selenium and selenoenzymes in maternal and fetal tissues in mice. Toxicology 208(3):357–365.

OEHHA. 2005. Water – Public Health Goals (PHGs). Office of Environmental Health Hazard Assessment. http://www.oehha.ca.gov/water/phg/index.html.

Schoen, A., B. Beck, R. Sharma, and E. Dube. 2004. Arsenic toxicity at low doses: epidemiological and mode of action considerations. Toxicol Appl Pharmacol. 198(3):253-67.

Snow, E.T., P. Sykora, T.R. Durham, and C.B. Klein. 2005. Arsenic, mode of action at biologically plausible low doses: What are the implications for low dose cancer risk? Toxicol. Appl. Pharmacol. 207:S557–S564.

Spallholtz, J.E., L.M. Boylan, and M.M. Rhaman. 2004. Environmental hypothesis: Is poor dietary selenium intake an underlying factor for arsenicosis and cancer in Bangladesh and West Bengal, India? Sci. Total Environ. 323(2004):21–32.

Steinmaus, C., Y. Yuan, M.N. Bates, and A.H. Smith. 2003. Case-control study of bladder cancer and drinking water arsenic in the western United States. Am. J. Epidemiol. 158(12):1193–1201.

U.S. EPA. 1998. Ambient water quality criteria derivation methodology human health, technical support document. Final Draft, Washington, DC: Office of Science and Technology. EPA/822/B-98/005.

U.S. EPA. 1999. Toxicological review, cadmium and compounds. External Review Draft, Washington, DC: Office of Research and Development. March 4, 1999.

U.S. EPA. 2000. Methodology for deriving ambient water quality criteria for the protection of human health. Washington, DC: Office of Science and Technology. EPA/822/B-00/004.

U.S. EPA. 2001a. Water quality criterion for the protection of human health: methylmercury. Final, Office of Science and Technology, EPA-823-R-01-001

U.S. EPA. 2002. Human health criteria calculation matrix. National Recommended Water Quality Criteria. EPA-822-R-02-012. U.S. Environmental Protection Agency, Office of Water.

U.S. EPA. 2007a. Arsenic in Drinking Water. EPA website: http://www.epa.gov/safewater/arsenic/index.html.

U.S. EPA. 2007b. Integrated risk information system (IRIS). http://www.epa.gov/iris/search.htm.

Yang, L., W. Wang, S. Hou, P.J. Peterson, and W.P. Williams. 2002. Effects of selenium supplementation on arsenism: An intervention trial in Inner Mongolia. Environ. Geochem. Health 24:359–374.

S.E.T.
S A V C I
ENVIRONMENTAL
TECHNOLOGIES, LLC

SAVCI ENVIRONMENTAL TECHNOLOGIES, L.L.C.
10288 West Chatfield Avenue, Suite 301. Littleton, Colorado 80127
Phone (720) 981-4077 Fax: (720) 981-4082 www.savci-env.com

February 5, 2007
S.E.T. Project No. 07-100
Set07-100-020507_AWQSpRule.doc

Ms. Shirley J. Conard
Water Quality Division
Arizona Department of Environmental Quality
1110 W. Washington Street, 5415A-1
Phoenix, AZ 85007

RE: TECHNICAL COMMENTS ON ARIZONA AQUIFER WATER QUALITY STANDARD FOR URANIUM – PROPOSED RULES

Dear Ms. Conard:

On April 7, 2006, the Arizona Department of Environmental Quality (ADEQ) published a proposed rule (A.A.R. § Vol. 12, Issue 14 – 18.A.A.C.11, Article 4), to incorporate the U.S. Environmental Protection Agency's (EPA) new safe drinking water regulations related to uranium, arsenic and disinfection byproducts. On December 7, 2000, the EPA established a new Maximum Contaminant Level (MCL) of 30 ug/L for uranium (65 FR 76708, dated December 7, 2000, which became effective on December 8, 2003). This letter-report provides technical comments related to the ADEQ's proposed rule to incorporate the Federal uranium MCL as an Arizona Water Quality Standard (AWQS) in Arizona. Our comments are developed on-behalf of the Arizona Chamber of Commerce and Industry.

ADEQ's adoption of the EPA's MCL for uranium as an AWQS is inconsistent with the EPA's intended use and requirements for the uranium MCL [(1)] [(2)] [(3)] [(4)]. In addition, the ADEQ's proposed rulemaking does not take into account Arizona's unique geological conditions wherein naturally occurring uranium levels in groundwater systems can be several orders of magnitude higher than that of the EPA's MCL for uranium[(5)] [(6)]. Therefore, we oppose the application of the EPA's MCL for uranium as an AWQS in Arizona.

---

(1) 65 FR 76708, Vol. 65, No. 236/Thursday, December 7, 2000 – National Primary Drinking Water Regulations: Radionuclides; Final Rules.

(2) U.S. EPA. 2001, "Radionuclides Rule: A Quick Reference Guide" – Office of Water (4606), EPA 816-F-01-003.

(3) U.S. EPA. 2002, "Implementation Guidance for Radionuclides" – Office of Groundwater and Drinking Water (4606M), EPA 816-F-00-002."

(4) U.S. EPA. 2006. "Technical Fact Sheet: Final Rule for (Non-radon) Radionuclides in Drinking Water (last updated on September 19, 2006), EPA Website: http://www.epa.gov/safewater/radionuclides/regulation_techfactsheet.html

(5) John T. Duncan and Jon E. Spencer. 1993, "Uranium and Radon in Southeastern Arizona", Arizona Geological Survey Bulletin 1999, pp. 40-42.

(6) Savci Environmental Technologies, LLC. 2005, "Determining Alert Levels and Aquifer Quality Limits for Point of Compliance wells, Sierrita Mine Site Aquifer Protection Permit", dated September 22, 2005 and submitted to ADEQ on September 23, 2005.

As stated by the EPA in EPA 2001, 2002 and 2006, the Federal uranium MCL of 30 ug/L is **only applicable to community water systems** (CWSs) [7]. The MCL is intended to regulate radionuclide water quality "*at each point to a CWS's distribution system to ensure that every customer's water meets the MCLs for radionuclides – (page I-3 of EPA 2002)*". Clearly the EPA's radionuclide MLCs, including uranium did not intend to regulate and set standards for in-aquifer uranium levels (e.g., not intended for point of compliance wells for facilities licensed under the Aquifer Protection Permit [APP] program or under the guidance of Water Quality Assurance Revolving Fund (WQARF) program in Arizona).

The major objective of the EPA's MCL for uranium is to protect the CWS users at the point of use, not at the source (i.e., in-aquifer). The EPA's goal was to reduce cancer risk caused by exposure to uranium (due to radiotoxicity) and to reduce the potential kidney effects of uranium (due to chemical toxicity). These effects are related to ingestion at the point of entry at the CWSs. By implementation of the uranium MCL for the CWSs, the EPA estimated that nationwide reduction in exposure to uranium would be 620,000 persons (~0.25% of the US population; and slightly less than 1% of CWSs) (EPA 2001). EPA also estimated that the national annual compliance costs for CWSs would be $81 million (based on total of 795 CWSs, ranging from $9,000 annually for the smaller CWSs to over $500,000 annually for larger systems).

Due to the natural occurrences of elevated uranium in Arizona, the percentage of effected population from the CWSs is approximately four times higher (~1% of Arizona's population – or - ~52,000 persons) than the national average (~2% of Arizona drinking water supplies from groundwater sources are expected to be higher than EPA's uranium MCL – [8]). The annual mitigation costs of ~$7 million for the Arizona CWSs are anticipated.

However, if the EPA's uranium MCL is adopted as an AWQS, then an additional 8% of non-drinking groundwater wells in Arizona may be required to comply with the new uranium AWQS [9]. As demonstrated in ADEQ 2005 (page VII-9 and VII-10), Spencer 1992[10] and Duncan and Spencer 1993, the elevated uranium concentration in the majority of these groundwater wells occurs naturally due to unique geologic formations of Arizona containing high levels of uranium (e.g., granitic rock units around Kingman, Prescott, Bagdad and Tucson areas – for example the Lawler Peak Granite in Central Arizona contains up to ~550 ppm uranium – Spencer 1992). The naturally occurring uranium concentrations in Arizona's non-drinking groundwater wells are observed to be as high as 1,200 ug/L (e.g., in aquifer waters from Ruby Star Granodiorite near Green Valley, Arizona – S.E.T. 2005).

---

(7) Community Water Systems (CWS) are water systems that serve at least 15 service connections or 25 residents regularly year round.

(8) Holbert, K.E., Steward B.D., Eshraghi, P. 1995. "Measurement of radioactivity in Arizona groundwater using improved analytical techniques for samples with high dissolved solids" Health Physics, Vol. 68(2), p. 185-194".

(9) ADEQ. 2005, "The Status of Water Quality in Arizona – 2004. Arizona's Integrated 305(d) Assessment and 303(d) Listing Report – Reissued July 2005 to include EPA revisions.

(10) Spencer, John E. 1992, "Radon Gas – A Geological Hazard in Arizona", Arizona Geological Survey.

The application of the EPA's MCL for uranium as an AWQS would be inconsistent with EPA's intention to reduce uranium's radiological and chemical toxicity at the point of use through an ingestion pathway (e.g., at the point of entry at the CWSs, but not at the source or in-aquifer). The new uranium AWQS, if finalized, would require compliance not only for the Arizona CWSs but for all other groundwater well systems, for example for wells under APP and WQARF programs, and all other non-community water systems. These types of locations would not have a direct ingestion pathway between the water and the end-users (public); therefore, implementation of the proposed uranium AWQS would not provide additional benefit for reducing uranium's toxicity for the end-users. In addition, the mitigation efforts to meet the 30ug/L uranium AWQS for the groundwater wells with naturally occurring uranium would not be technically feasible.

Therefore, it is our opinion that the EPA's uranium MCL of 30 ug/L, which was **intended to apply only at the point of use**, is not an appropriate standard to regulate in-aquifer uranium levels, as proposed by ADEQ. If adopted, the EPA's uranium MCL should only be applicable to Arizona's CWSs, and the water quality issues related to non-drinking water systems should consider normal ambient uranium levels in a given aquifer, thereby given proper consideration to Arizona's unique geological conditions while still preventing degradation of the aquifer.

We appreciate ADEQ's consideration of these comments.

Sincerely,

SAVCI ENVIRONMENTAL TECHNOLOGIES, LLC

GultekinSavci

Gültekin Savci, Ph.D.
Principal