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Re: Potential Risk of 1,2-Dibromo-3-Chloropropane (DBCP) in Private Domestic Wells

The Arizona Department of Health Services (ADHS) received your request to evaluate the potential health risks associated with 1,2-Dibromo-3-Chloropropane (DBCP) levels in three private domestic wells connected to three different residences located in Mesa, AZ. The wells were determined to contain DBCP levels below the Arizona Aquifer Water Quality Standard (AWQS) of 0.2 µg/L, but above the EPA Region 9 screening level of 0.00033 µg/L (EPA 2015). For two of the residences, the private wells are the sole source of domestic water, and may be used for drinking, cooking, bathing, irrigation, and swimming pools, among other uses. For the remaining residence, the private well is one of the sources of domestic water for the residence (the residence is also connected to the City of Mesa's water supply).

ADHS conducted an evaluation to determine whether the water can be used for drinking, cooking, bathing, irrigation, and swimming pools. The following summarizes our assessment results.

Background

The three private wells discussed in this report were sampled as part of a preliminary investigation by the Arizona Department of Environmental Quality (ADEQ) under the Water Quality Assurance Revolving Fund (WQARF). ADEQ does not regulate private wells, but requested permission from the owners of the wells to collect samples due to the concern of potential exposure to DBCP. These wells were installed in an area that had previously been a citrus grove. Prior to 1977, DBCP was legally applied as a pesticide to the citrus groves, and may have traveled into the groundwater via recharge of irrigation and natural waters.

Available Environmental Data

On November 6 and 7, 2015, water samples were collected from the three private domestic wells (ADWR Well #s: 55-206547, 55-208489, 55-596157). Wells #55-206547 and 55-596157 are the sole source of domestic water for their respective residences. Well #55-208489 is one of the sources of domestic water for its residence. Samples were collected by ADEQ and its contractor Hydro Geo Chem, Inc. The sample from Well #55-206547 was collected while the tank was refilling. A field duplicate was collected at Well #55-596157 and yielded a similar concentration

result. All samples were collected in volatile organic analysis (VOA) vials and kept on wet ice until delivery to the laboratory. The samples were analyzed by Trans West Analytical for DBCP by Microextraction and Gas Chromatography (EPA Method 504.1).

The DBCP concentration results were as follows:

ADWR Well #	**DBCP (µg/L)**
55-206547	0.0224
55-208489	0.0446
55-596157	0.0687

Exposure Pathway Analysis

Identifying exposure pathways is important in a health consultation because adverse health impacts can only happen if people are exposed to contaminants. The presence of a contaminant in the environment does not necessarily mean that people are actually coming into contact with that contaminant. Exposure pathways have been divided into three categories: completed, potential, and eliminated.

There are five elements considered in the evaluation of exposure pathways:

1) a source of contamination
2) a medium such as soil or groundwater through which the contaminant is transported
3) a point of exposure where people can contact the contaminant
4) a route of exposure by which the contaminant enters or contacts the body
5) a receptor population

Completed pathways exist when all five elements are present and indicate that exposure to a contaminant has occurred in the past and/or is occurring presently. In a potential exposure pathway, one or more elements of the pathway cannot be identified, but it is possible that the element might be present or might have been present. In eliminated pathways, at least one of the five elements is or was missing, and will never be present. Completed and potential pathways, however, may be eliminated when they are unlikely to be significant.

Typical potable water exposure to contaminants includes dermal and inhalation exposures from bathing and swimming, and ingestion exposures from drinking and using water for cooking. The ATSDR ToxFAQs states that exposure to DBCP occurs mainly from drinking water or eating food that contains the chemical (ATSDR 1995). ADHS further evaluated the completed exposure pathways to determine whether realistic exposures are sufficient in magnitude, duration or frequency to result in adverse health effects.

Exposure Pathway Elements					Time Frame	Type of Exposure Pathway
Source	Media	Point of Exposure	Route of Exposure	Estimated Exposed Population		
Private Domestic Well	Drinking Water	Residence tap	Ingestion, inhalation, dermal contact	Residents	Past	Potential
					Current	Completed
					Future	Potential

Description of Health-based Comparison Values

Health-based comparison values (CVs) are screening tools used to evaluate environmental data relevant to exposure pathways. The comparison values are quite conservative, and usually include uncertainty factors that account for the most sensitive populations. Adverse health effects are not expected to occur if an exposure concentration/dose is below a CV. However, an exposure concentration/dose at or above the CV does not mean adverse effects will occur. Rather, it means that there is a need to conduct a site-specific exposure scenario evaluation. The health risk for an individual depends on individual human factors (e.g. personal habits, occupation, and/or overall health), and site-specific environmental exposure factors (e.g. duration and amount of exposure). Therefore, CVs should not be used to predict the occurrence of adverse health effects without looking at site-specific conditions. CVs are only used to help determine if the contaminant needs to be evaluated in more detail.

The analytical results were compared to the following CV: Minimal Risk Level (MRL) developed by the Agency for Toxic Substances and Disease Registry (ATSDR). A MRL is an estimate of daily human exposure to a substance that is likely to be without noncarcinogenic health effects during a specified duration of exposure based on ATSDR evaluations. The MRL for DBCP is 0.002 mg/kg/day, which is based on reproductive effects in rabbits (EPA 2000).

ATSDR has not developed a Cancer Risk Evaluation Guide (CREG) for DBCP. However, EPA has calculated an oral cancer slope factor of 1.4 per mg/kg/day for DBCP (EPA 2000). Cancer slope factors are used to estimate the risk of cancer associated with exposure to a carcinogenic substance, and are usually developed using data from animal experiments or public health studies.

Public Health Implications: *This section will provide general toxicological information and site-specific exposure evaluation.*

Overview: 1,2-Dibromo-3-Chloropropane (DBCP) was formerly used as a soil fumigant and nematocide on crops. DBCP was banned from use in 1979 by the US EPA, following discovery of its deleterious health effects on humans. It is no longer used except as an intermediate in the synthesis of organic chemicals. Acute inhalation exposure to DBCP in humans results in moderate depression of the central nervous system and pulmonary congestion, and acute oral exposure results in gastrointestinal distress and pulmonary edema. Chronic exposure to DBCP in humans causes male reproductive effects, such as decreased sperm counts. High incidences of tumors of the nasal tract, tongue, adrenal cortex, and lungs of rodents were reported in a National Toxicology Program (NTP) inhalation study (EPA 2000). The International Agency for Research on Cancer (IARC) has classified DBCP as a Group 2B agent, meaning that it is possibly carcinogenic to humans.

Non-Cancerous Health Effects

In order to make comparisons to the MRL for DBCP of 0.002 (2×10^{-3}) mg/kg/day, the DBCP concentration results must be converted to drinking water ingestion doses (see Appendix A for the equation). The concentration results were converted to doses for an adult (ingestion rate = 2 L/day, body weight = 80 kg) and a child less than 1 year of age (ingestion rate = 1 L/day, body weight = 7.8 kg). The exposure duration was assumed to be 33 years (reasonable maximum exposure duration based on ATSDR guidance) for 365 days a year. The doses are shown below:

ADWR Well #	DBCP (µg/L)	Adult Dose (mg/kg/d)	Child <1 Year Dose (mg/kg/d)
55-206547	0.0224	5.6×10^{-7}	2.87×10^{-6}
55-208489	0.0446	1.12×10^{-6}	5.72×10^{-6}
55-596157	0.0687	1.72×10^{-6}	8.81×10^{-6}

The DBCP doses in both adult and children are well below the MRL for DBCP at all three residences. Therefore, ADHS does not expect to see non-cancerous adverse health effects among the exposed population via the ingestion, inhalation, or dermal pathways.

Cancerous Health Effects

Cancer risks are explained in terms of the likelihood that an additional case of cancer will occur in a population. For example, one additional cancer case in 1,000,000 exposed individuals indicates that there is a very low cancer risk. EPA has established a target risk range of between 1 additional cancer risk in 1,000,000 exposed individuals to 1 excess cancer risk in 10,000 exposed individuals (10^{-6} to 10^{-4}) for hazardous sites.

EPA has calculated an oral cancer slope factor of 1.4 per mg/kg/day for DBCP. Doses are calculated slightly differently for cancer risk estimation than for non-cancer risk estimation due to the consideration of lifetime exposure (78 years) in the development of cancerous health effects. The calculations of estimated excess lifetime cancer risk for each well are shown below:

ADWR Well #	DBCP (µg/L)	Adult Dose (mg/kg/d)	Child <1 Year Dose (mg/kg/d)	Adult Excess Lifetime Cancer Risk	Child <1 Year Excess Lifetime Cancer Risk
55-206547	0.0224	2.37×10^{-7}	1.21×10^{-6}	3.32×10^{-7}	1.69×10^{-6}
55-208489	0.0446	4.74×10^{-7}	2.42×10^{-6}	6.64×10^{-7}	3.39×10^{-6}
55-596157	0.0687	7.28×10^{-7}	3.73×10^{-6}	1.02×10^{-6}	5.22×10^{-6}

The estimated excess lifetime cancer risk in both adult and children at all three residences is below or within EPA's target risk of 10^{-6} to 10^{-4} for hazardous sites. Therefore, ADHS does not expect to see cancerous adverse health effects among the exposed population via the ingestion, inhalation, or dermal pathways.

Conclusion

ADHS does not expect to see any noncancerous or cancerous health effects at any of the three residences due to the current DBCP concentrations.

If you have any questions, please contact Kaleb Tsang by e-mail at Kaleb.Tsang@azdhs.gov or call (602) 364-3847.

REPORT PREPARATION

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Appendix A

Chronic Daily Intake from Water

$$ED_{water} = \frac{Conc. \times IR \times EF}{BW}$$

ED_{water}: chronic daily exposure via water ingestion (mg/kg/day)
Conc.: chemical concentration in water (mg/L)
IR: water ingestion rate (L/day)
EF: exposure factor (unitless)
BW: body weight (kg)