ATSDR

AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

ANNOUNCES THE RELEASE OF A

HEALTH CONSULTATION

For

Follow-up Report on the Health Implications of Farm Workers Exposed to 1, 2-DCA Contaminated Groundwater Adjacent to

CEDAR CHEMICAL CORPORATION
49 PHILLIPS ROAD 311
WEST HELENA, PHILLIPS COUNTY, ARKANSAS 72342

EPA FACILITY ID: ARD990660649

Enclosed is the Health Consultation for the Cedar Chemical Corporation Site in West Helena, Phillips County, Arkansas. This document, dated June 16, 2006, was prepared by the Arkansas Department of Health and Human Services under cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

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You Can Contact ATSDR Toll Free at
1-888-42ATSDR or
Visit our Home Page at: http://www.atsdr.cdc.gov

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Health Consultation

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JUNE 16, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

Arkansas Department of Health and Human Services
Division of Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
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STATEMENT OF ISSUES AND BACKGROUND

Cedar Chemical Corporation (CCC) manufactured insecticides, herbicides, and polymers used in the agricultural industry from 1986 until the company closed in 2002. Located in the Helena - West Helena Industrial Park, the plant's operation resulted in the contamination of groundwater south of the facility. The contaminant of concern was identified as 1,2-dichloroethane (1,2-DCA).

The highest level of 1,2-DCA (0.0271 grams per liter (g/L); or 27.1 parts per million (ppm)) was detected in groundwater samples collected by the Arkansas Department of Environmental Quality (ADEQ) in July 2004. The samples collected by ADEQ were from an agricultural irrigation well identified as AGI-1. The AGI-1 irrigation well is located on a tract of land approximately 240 yards south-southeast of the southern most point of the CCC property (Appendix A, Figure 1). The contaminant 1,2-DCA was also detected in another irrigation well (BHAGI-1) near the site, but at levels (0.000129 g/L; or 0.129 ppm) far below those detected in the AGI-1 well. Both wells are used for irrigating crops such as cotton and soybean.

In November 2004 the Arkansas Department of Health (now referred to as the Arkansas Division of Health (ADOH)) notified the AGI-1 irrigation well property owner/user of its recommendation that AGI-1 not be operated until such time that the concentration of 1,2-DCA is below levels of health concern. ADOH also sent a letter to the property owner of the BHAGI-1 agricultural irrigation well, recommending that the use of the well be conditional, pending review of future Environmental Protection Agency (EPA) sampling results. The property owner was informed that should future data indicate significant increases in the levels of 1,2-DCA for the BHAGI-1 well, that ADOH would then recommend discontinuing use of the well.

ADOH previously prepared a health consultation in August 2005, evaluating the potential health implications of farm workers exposed to groundwater from the agricultural irrigation wells near CCC [1]. For more detailed information about the initial health consultation, see the document entitled, "Health Implications of Farm Workers Exposed to Groundwater Adjacent to Cedar Chemical." The health consultation is available at the following web link: http://www.atsdr.cdc.gov/HAC/PHA/region_6.html#arkansas; or call ATSDR toll free at 1-888-42ATSDR to request a copy. Potential exposure pathways were evaluated, and all were excluded except for inhalation [1]. Without site-specific air dispersion modeling and/or air sampling results, health effects resulting from breathing 1,2-DCA could not be evaluated. In its final conclusion, ADOH found the AGI-1 irrigation well to represent an *Indeterminate Public Health Hazard* [1].

In the initial (August 2005) health consultation, ADOH made the following recommendations:

- The property owner and/or user of the irrigation well – identified as AGI-1 – should not operate it until such time that the concentration of 1,2-DCA is below levels of health concern.
- ADEQ and/or EPA should collect additional groundwater samples from the irrigation wells in the immediate area to better evaluate public health risk.

- ADEQ and/or EPA should conduct air sampling/modeling to assess field workers' inhalation exposure risk.

In May 2005, ADEQ and EPA personnel collected additional groundwater samples of the area agricultural irrigation wells. No samples were collected from the AGI-1 well because the farmer had removed the power source to comply with ADOH's recommendation not to use the well. The contaminant 1,2-DCA was again detected in the BHAGI-1 well (0.00039 g/L; 0.39 ppm); however, the well continues to be used solely for the purpose of irrigating crops and does not pose a health risk to the public.

EPA used the highest level of 1,2-DCA (0.0271 g/L; 27.1 ppm) detected in the AGI-1 well as their source data in performing air dispersion modeling on the Industrial Source Complex Short Term Version 3 (ISCST3) program during September 2005. For modeling purposes, it was assumed that no degradation of 1,2-DCA would occur. Other modeling assumptions included the well pump rate of 8,994,240 liters per day (L/day), and 1,2-DCA loading of 243,741 grams per day (g/day) onto 20-acre irrigation plots. Appendix B provides a summary of the values considered in the modeling program and the exposure calculations.

Farm worker exposures were evaluated using the National Institute of Occupational Safety and Health (NIOSH) recommended exposure limit (REL) of 50 ppm for 1,2-DCA. RELs are time-weighted average (TWA) concentrations for up to a 10-hour workday during a 40-hour workweek that health scientists have determined will not cause adverse health effects [2].

EPA's air dispersion modeling output indicates that evaporated 1,2-DCA dissipates rapidly as one travels away from the application area (tract of land irrigated by AGI-1). Modeled air acute concentrations of 50, 150, and 750 meters were estimated at 6.4, 2.2, and 0.2 ppm, respectively. Concentration of 1,2-DCA within the application area was calculated to be 16.9 ppm, which is about 3 times lower than the worker exposure limit of 50 ppm (this calculation includes consideration of potential occupational cancer risk). ISCST3 dispersion modeling is reported to give results that overestimate downwind concentrations by factors of 2.5 or greater [3]. Therefore, the concentrations obtained through modeling may be much less than predicted.

DISCUSSION

As shown in Table 1, the detected contaminant does not exceed its respective health comparison value and as a result does not pose a public health hazard. The health comparison value presented in Table 1 is the NIOSH REL. NIOSH sets RELs to protect workers against the health effects of exposure to hazardous substances. RELs are recommended limits on the amount or concentration of a substance in the air. RELs can be defined in two different ways:

1. **Ceiling values** - at no time should this exposure limit be exceeded.
2. **Time Weighted Average (TWA)** - an average value of exposure for up to a 10-hour workday during a 40-hour workweek.

TWA levels are usually lower than ceiling values. Thus, a worker may be exposed to a level higher than the TWA for part of the day (but still lower than the ceiling value) as long as the total 10-hour exposure does not exceed the TWA [2].

Table 1. Comparison of estimated contaminant concentration to National Institute of Occupational Safety and Health (NIOSH) recommended exposure limits (REL)

Contaminant	Highest Calculated Concentration	Comparison Value	
		REL†	Ceiling Value‡
1,2-dichloroethane	16.9 ppm*	50 ppm	100 ppm

* ppm: parts per million
† Recommended exposure limits (REL): time-weighted average (TWA) concentrations for up to a 10-hour workday during a 40-hour workweek that health scientists have determined will not cause adverse health effects.
‡ Ceiling value: any substance whose level must not be exceeded during any part of the workday.

COMMUNITY HEALTH CONCERNS

Citizens that we talked with during our investigation presented no health concerns. However, ADEQ initially requested ADOH review the groundwater sampling data that were collected off site of CCC because of possible health risk associated with exposure to 1,2-DCA above the health comparison value for drinking water.

CHILD HEALTH CONCERNS

ADOH and ATSDR recognize that infants and children may be more vulnerable to exposures than adults when faced with contamination of air, water, soil, or food. Critical periods exist during development, particularly during early gestation, but also throughout pregnancy, infancy, childhood and adolescence [4]. This vulnerability is a result of the following factors:

- Children are more likely to play outdoors and bring food into contaminated areas.
- Children are shorter and their breathing zone is closer to the ground, resulting in a greater likelihood of breathing dust, soil, and heavy vapors.
- Children are smaller and receive higher doses of chemical exposure per body weight.
- Children's developing body systems are more vulnerable to toxic exposures, especially during critical growth stages in which permanent damage may be incurred.

Children are not expected to play in the field surrounding the irrigation well because of the site's limited proximity to any residential area. Additionally, EPA's air modeling calculations for residential exposures were estimated to be below health risk values.

CONCLUSIONS

Evaluation of groundwater sampling data and site-specific air dispersion modeling, completed in 2005, revealed levels of 1,2-DCA below its respective health comparison values and poses *No Apparent Public Health Hazard* to exposed individuals. (This category is used for sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.) On the basis of these data and modeling output, the AGI-1 agricultural irrigation well can be returned to normal operation. Furthermore, the conditional use of the BHAGI-1 agricultural irrigation well imposed by ADOH in a letter dated July 2005, is hereby removed.

RECOMMENDATIONS

No further recommendations are indicated at this time.

PUBLIC HEALTH ACTION PLAN

The purpose of the Public Health Action Plan (PHAP) is to ensure that this health consultation not only identifies any public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. The PHAP implemented by ADOH for the Cedar Chemical Corporation site is as follows:

Completed Actions

- ADEQ and EPA collected additional groundwater data from agricultural wells in May 2005, as recommended by ADOH.
- ADOH prepared a groundwater data health consultation in August 2005.
- EPA Region 6 personnel performed site-specific air dispersion modeling in September 2005, as recommended by ADOH, to assess risk of inhaling volatized 1,2-DCA.

Future Activities

- ADOH will continue to review any new data provided by ADEQ and/or EPA, and update health recommendations as necessary.
- ADOH will conduct health education in the community, as needed and/or requested.
- ADOH will mail letters and a copy of this finalized health consultation to the well owners/users, and other stakeholders.
- ADOH will update the community needs assessment.

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CERTIFICATION

This health consultation for Cedar Chemical Corporation was prepared by the Arkansas Division of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodology and procedure existing at the time the health consultation was initiated. Editorial review was completed by the cooperative agreement partner.

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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

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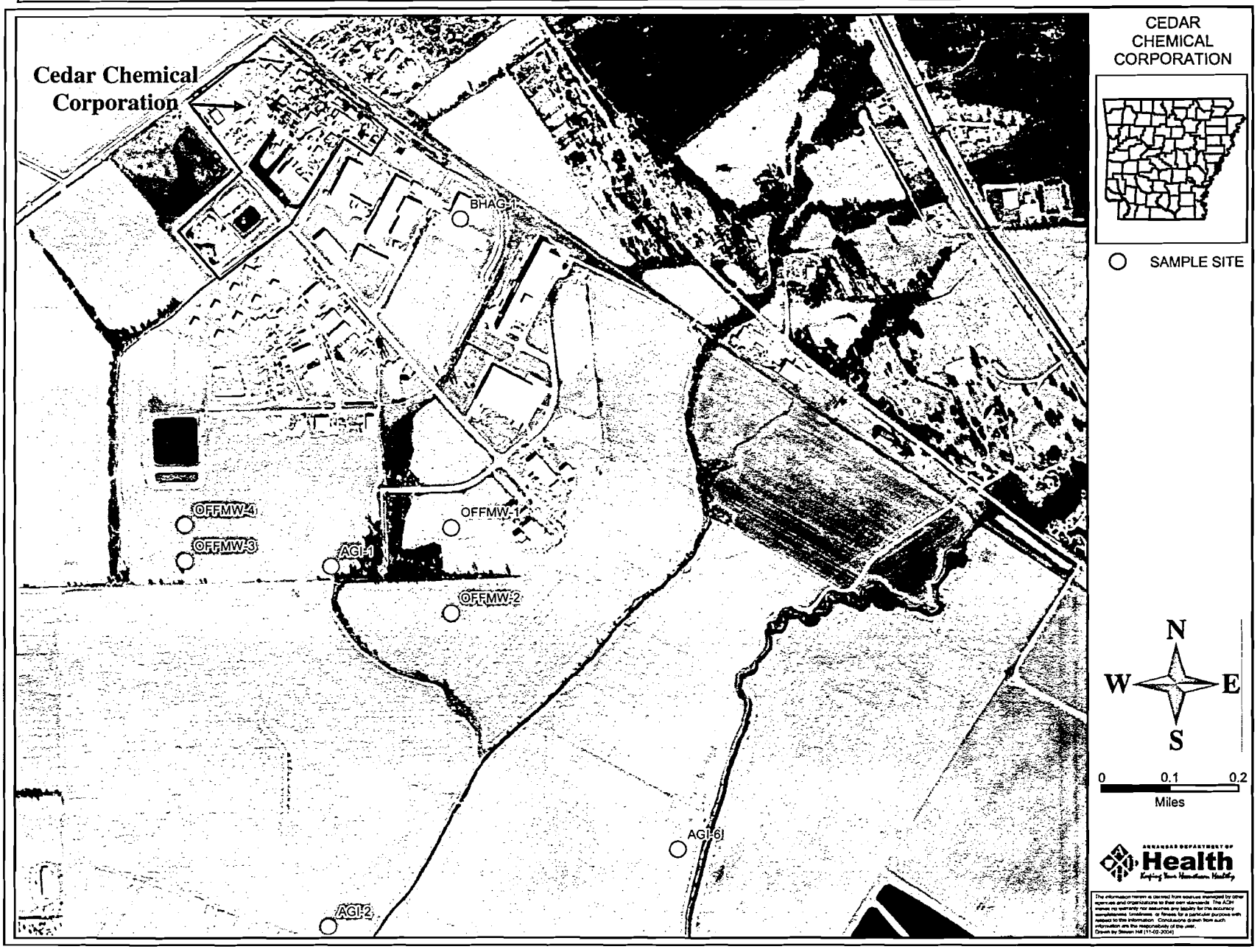
REFERENCES

1. Agency for Toxic Substances and Disease Registry. Health Implications of Farm Workers Exposed to Groundwater Adjacent to Cedar Chemical Corporation. Atlanta: U.S. Department of Health and Human Services; August 1, 2005.
2. CDC. National Institute for Occupational Safety and Health Pocket Guide To Chemical Hazards. Atlanta: U.S. Department of Health and Human Services. 1997.
3. Hagenstein, P. Plocchini, R. Air Emissions from Animal Feeding Operations: Current Knowledge, Future Needs (2003). National Academies Press. Available at: http://darwin.nap.edu/books/0309087058/html/255.html. Accessed March 8, 2006
4. U.S. Environmental Protection Agency. Strategy for research on environmental risks to children. Washington, DC: U.S. Environmental Protection Agency, Office of Research and Development. 2000. EPA/600/R-00/068, Section 1.2.

APPENDICES

Appendix A – Figure

Figure 1. Aerial photo of monitoring well and agricultural well sampling sites



CEDAR CHEMICAL CORPORATION
WEST HELENA, PHILLIPS COUNTY, ARKANSAS

Appendix B – Calculations

Assumptive values in Table 2 were used to estimate exposure levels within the application area. These assumptions were intended to represent the worst-case scenario.

Table 2. Parameters used by EPA to evaluate human health effects

Parameter	Default Units	Units
Exposure Parameters - General		
Average Farmer Height	1.83	meters (m)
Surface Area	80,937	square meters (m^2)
Volume (surface area times height)	148,018	cubic meters (m^3)
1,2-DCA Concentration	0.0271	grams per liter (g/L)
Irrigation Assumptions		
Irrigation Well Pumping Rate	8,994,240	liters per day (L/day)
1,2-dichloroethane Loading	10,156	grams per hour (g/hr)
Unit Conversion Factors		
1 part per million (ppm) = 4.05 milligram per cubic meter (mg/m^3)		
1,000 milligrams = 1 gram		

EPA used a very conservative volume-based approach to determine the potential concentration of 1,2-DCA within the air column above the application site (i.e. area being irrigated). Several of the key assumptions in this approach included: **1)** the volume was determined using the application site surface area (20 acres) and the height (1.83 m) of a farm worker, **2)** that 1,2-DCA concentrations were uniform throughout the volume rather than graduated with highest concentrations at the groundwater surface and lower concentrations as you move higher in the column to breathing height (6 feet), **3)** that there was no potential removal of 1,2-DCA from the volume by wind or other mechanisms, and **4)** irrigation is conducted at daily intervals for 20 acre irrigation plots.

The concentration of 1,2-DCA in the volume of air directly above the application site was calculated. The volume of air was determined by taking the surface area of the 20 acre plot 80,937 m^2 and multiplying it by the average farm worker height, resulting in a volume of 148,018 m^3.

EPA utilized the concentration of 1,2-DCA in the groundwater (0.0271 g/L), assuming no chemical degradation to develop the potential DCA mass loading during irrigation application. Utilizing pump rate and irrigation information provided by the property owner, a potential groundwater application of 8,994,240 liters per day (L/day) and a corresponding 1,2-DCA mass loading was calculated. The product of this operation is 243,744 g/day or 10,156 g/hr. By dividing the hourly product value (10,156 g/hr) by the volume (148,018 m^3) a simplified volume exposure estimate of 0.0686 grams per cubic meter (g/m^3) or 68.6 milligrams per cubic meter (mg/m^3) is obtained.

To convert the exposure estimate (68.6 mg/m^3) to ppm a conversion factor of 4.05 mg/m^3 to 1 ppm is used. The exposure estimate result is 16.9 ppm. The concentration of 1,2-DCA within the application area was calculated to be 16.9 ppm, which is about 3 times lower than the worker exposure limit of 50 ppm (this calculation includes consideration of potential occupational cancer risk).