Letter Health Consultation

Onsite Indoor Air Worker Health Evaluation

HAZEN RESEARCH INC.
GOLDEN, JEFFERSON COUNTY, COLORADO

Prepared by the
Colorado Department of Public Health and Environment

MARCH 11, 2010

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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LETTER HEALTH CONSULTATION

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LETTER HEALTH CONSULTATION

TO: ROBERT BEIERLE, PROJECT MANAGER, HMWMD/CDPHE
FROM: THOMAS SIMMONS, HEALTH ASSESSOR, CCPEHA/DCEED/CDPHE

SUBJECT: HAZEN RESEARCH, ONSITE INDOOR AIR EXPOSURES

DATE: 3/10/2010

Mr. Beierle,

This letter is in response to your request for assistance from the Colorado Cooperative Program for Environmental Health Assessments (CCPEHA) regarding a contaminated groundwater plume located in the Fairmont Neighborhood of Golden, Jefferson County, Colorado (Figure 1). The groundwater plume of concern appears to extend from the Hazen Research (Hazen) facility in a southeasterly direction and is bounded by the rail line to the north, 44th Ave. to the south, and Eldridge Road to the east. Previous work conducted by CCPEHA on this site includes evaluating the potential public health implications of the contaminated groundwater on residents living above the plume. The purpose of this letter is to evaluate the potential public health implications of contaminated ground water to Hazen employees through the vapor intrusion pathway.

BACKGROUND

In 2007, Hazen discovered a leaking drain in their onsite analytical laboratory, which was used to convey acidic wastewater from the lab to a treatment sump prior to discharge to the sanitary sewer. After discussions involving the Colorado Department of Public Health and Environment's (CDPHE) Hazardous Waste and Waste Management Division, Hazen voluntarily installed four groundwater monitoring wells around the perimeter of the analytical laboratory (Building 1, Figure 2) to determine the extent of contamination associated with the leak. Water samples were collected and submitted to Evergreen Analytical in Wheat Ridge, CO for analysis of metals, semi-volatile organic compounds (SVOCs), and volatile organic compounds (VOCs).

This round of sampling indicated the presence of tetrachloroethene, or PCE, at concentrations ranging from not detected to 1,200 micrograms per liter (μg/L) with a mean concentration of 436 μg/L over the 4 groundwater samples collected. All other analytes were either not detected or were found at a level below health concern. Following this discovery, additional monitoring wells were installed on Hazen property and sampled for PCE and other closely related compounds. PCE was again found at elevated concentrations in groundwater beneath the Hazen facility. Soil gas samples have also been collected and have shown the presence of PCE in soil gas. Other sampling that has been conducted off-site also indicated the presence of PCE and, to a lesser degree, other closely related compounds. For more information on previous sampling events and

results, both on and off site, refer to the Integrated Corrective Action Plan (ICAP)[a]. Because PCE belongs to a class of organic compounds that are known for their ability to migrate through soil from an underground source into overlying homes and buildings, exposure to PCE in air is a potential concern for Hazen personnel.

As part of the ICAP, Hazen contracted Envirogroup LLC to devise and execute an indoor air sampling event in 3 of Hazen's buildings located near where some of the highest concentrations of PCE in groundwater and soil gas have been found. Prior to sampling an indoor air survey was conducted to identify and/or exclude any potential sampling confounders that would produce undesired results. Indoor air samples were collected on the 1st floor using 6-liter passivated canisters fitted with regulators to sample air over an 8-hour period (length of a typical work day). Five samples were collected from Buildings 1, 2, and 6 including 1 duplicate sample collected from Building 1. The samples were sent to TestAmerica, an EPA certified analytical laboratory, located in Arvada, CO to be analyzed using EPA Method TO-15 in Selective Ion Monitoring (SIM) mode. Sample analytes include PCE, trichloroethene (TCE), 1,1-dichloroethene (1,1 DCE), 1,2-dichloroethene (1,2-DCE), and vinyl chloride (VC).

DISCUSSION

PCE was found in each indoor sample at a concentration range of 1.6 – 15 micrograms per cubic meter ($\mu g/m^3$). TCE and VC were also detected in some samples, but at much lower concentrations. 1,1-DCE and 1,2 DCE (*cis* and *trans*) were not detected in any sample. Sampling results are shown below in Table 1. These results were compared to residential screening values (ATSDR's Air Comparison Values and EPA's Regional Screening Levels) to determine contaminants of potential concern. This is considered a conservative screening approach since employees of Hazen are not likely to be exposed to contaminants found in indoor air to the same degree as a residential exposure scenario. Therefore, if the indoor air contaminant was found at a concentration below the residential screening value, it was not considered further in this evaluation because it is unlikely to result in any adverse non-cancer or cancer health effects for Hazen employees. As shown in Table 1, the only contaminant that exceeded the residential screening value was tetrachloroethene, or PCE. It should also be noted that there is no residential screening value available for *cis*-1, 2-DCE from ATSDR or the EPA. The value for *trans*-1,2-DCE was used as a reference point for *cis*-1,2-DCE since the compounds are similar.

The potential for adverse health effects to Hazen employees was evaluated by estimating the non-cancer and cancer doses based on the PCE concentrations found in indoor air at the facility and comparing these doses with health-based reference values. The estimated exposure doses were calculated using the standard default exposure factors for an industrial worker as established by the EPA. These exposure factors assume 250 days of exposure per year for a period of 25 years. A high and low-end inhalation rate was used to produce a potential risk range; however, a low-end rate seems to be more applicable to the type of work activities performed in the buildings that were sampled (laboratory and

[a] HWS Consulting Group, Inc. (HWS 2007). Integrated Corrective Action Plan for Hazen Research Inc, December 2007.

administrative workers). The high-end inhalation rate is more applicable to highly aerobic work activities including landscaping, consistently lifting heavy equipment, construction work, etc. The estimated non-cancer and cancer doses were then compared to health-based guidelines and the acceptable cancer risk range to determine the likelihood of adverse health effects. The results of the dose calculations are presented in Table 2 and the comparison of the estimated doses to the health reference values is presented in Table 3.

The estimated exposure dose results for cancer indicate a low level of cancer risk to Hazen employees that work in each building where indoor air sampling occurred. As shown in Table 3, the theoretical cancer risks at the lower inhalation rate range from a low of 1.0E-06 (1 excess cancer case per million exposed individuals) in the Building 1 laboratory to a high of 9.7E-06 (10 excess cancer cases per million exposed) in the Building 6 laboratory. At the higher inhalation rate, theoretical cancer risks range from a low of 2.2E-06 (2 excess cancer case per million exposed individuals) in the building 1 lab to a high of 2.1E-05 (21 excess cancer cases per million exposed individuals) in the Building 6 lab. This level of risk is well within the range of cancer risk that is generally considered acceptable, which is 1.0E-06 (1 excess cancer case per million exposed individuals) to 1.0E-04 (100 excess cancer cases per million exposed individuals). However, continued remediation is recommended to reduce contaminant levels in indoor air that would be consistent with CDPHE's target cancer risk level of 1 excess cancer case per million exposed individuals.

The non-cancer exposure doses that were estimated for Hazen employees were well below the health guidelines or "safe levels", which also indicates a low risk of developing non-cancer adverse health effects. As shown in Table 3, the estimated non-cancer hazards (i.e., Hazard quotient) for workers in each building sampled are well below the acceptable level of 1, which indicates that non-cancer adverse health effects are not likely to occur since the estimated dose is below the "safe" dose, or health–based guideline.

It is also important to note that there are inherent uncertainties associated with any risk assessment and indoor air sampling. Thus, the conclusions stated in this document could be under- or over-estimation of actual exposures and health risks for the following main reasons: 1) exposure assumptions used in this evaluation can over or underestimate the actual exposure, 2) toxicity values for PCE are being evaluated by the EPA and provisional toxicity values were used in this evaluation; and 3) sampling data is limited. In addition, regarding indoor air sampling uncertainties, the USEPA in the vapor intrusion guidance notes that concentrations of compounds found in indoor air are often subject to temporal and spatial variations, which may complicate estimates of exposure. In part, this means that levels of contaminants in indoor air will fluctuate by small margins depending upon the season and the types of activities occurring inside the building. Therefore, the year-round concentration of contaminants in the buildings is unknown.

CONCLUSIONS

Based on this review of the available data, CCPEHA and ATSDR have reached the following conclusion regarding exposure to indoor air at the Hazen Research facility:

Exposure to VOCs in the indoor air as a result of the vapor intrusion pathway is not expected to harm the health of Hazen employees. The reason for this is that the estimated theoretical cancer risks for long-term exposure to PCE in indoor air at the facility are well within the EPA's acceptable cancer risk range. Furthermore, Hazen employees are also unlikely to experience non-cancer health effects since the estimated non-cancer doses are below the levels of health concern and are considered "safe". Thus, the available data suggests that inhalation of PCE in the indoor air by workers is associated with a low increased risk of developing cancer and non-cancer health effects.

RECOMMENDATIONS

CCPEHA recommends that onsite remediation and monitoring of VOC contaminated groundwater continue at the Hazen facility to ensure a reduction in contaminant concentrations.

PUBLIC HEALTH ACTION PLAN

CCPEHA will review any additional data and information involving health concerns associated with groundwater contaminant plume stemming from the Hazen Research facility in Golden, CO.

Please feel free to contact me you have any questions or concerns regarding this evaluation.

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Tables and Figures

Table 1. Hazen Research Onsite Indoor Air Sampling Results

Sample Location	***Building 1 North (Laboratory)***	***Building 1 South (Office)***	***Building 1 South (Office) Duplicate***	***Building 2 (Sample Prep Lab)***	***Building 6 (Gravity Separation Lab)***	***Screening Value***		***COPC***
Sampling Date	4/25/2008	4/25/2008	4/25/2008	4/25/2008	4/25/2008	**EPA RSL[a]**	**ATSDR CV [b]**	
1,1 Dichloroethene	<0.04	<0.04	<0.04	<0.04	<0.04	210*	79*	
1,2 Dichloroethene (cis)	<0.2	<0.2	<0.2	<0.2	<0.2	NA	NA	
1,2 Dichloroethene (trans)	<0.04	<0.04	<0.04	<0.04	<0.04	63*	793*	
Tetrachloroethene	1.6	7.9	8.6	4.3	15	0.41**	271*	X
Trichloroethene	0.050	0.037	0.071	0.034	0.51	1.2**	537*	
Vinyl Chloride	<0.02	<0.02	0.021	<0.02	<0.02	0.16**	0.1**	

NOTES:
All concentrations in $\mu g/m^3$
"<" indicates the sample was below the practical quantitation limit (i.e. not detected)
NA: Not Available
[a]Environmental Protection Agency's Regional Screening Levels
[b]Agency for Toxic Substances and Disease Registry's Air Comparison Values
COPC = Contaminant of Potential Concern
* Value is based on a non-cancer health endpoint
** Value is based on a cancer health endpoint

Table 2. Onsite Indoor Air Estimated Exposure Doses

Non-Cancer Exposure Doses (in mg/kg-day)				
Location	HZLAB-1	HZOFFICE-1	HZBLDG2-1	HZBLDG6-1
Maximum Detected Concentration of PCE (in μg/m^3)	1.6	8.6	4.3	15
Low Inhalation Rate[a]	1.45E-04	7.81E-04	3.90E-04	1.36E-03
High Inhalation Rate[b]	3.13E-04	1.68E-03	8.41E-04	2.94E-03
Cancer Exposure Doses (in mg/kg-day)				
Location	HZLAB-1	HZOFFICE-1	HZBLDG2-1	HZBLDG6-1
Maximum Detected Concentration of PCE (in mg/m^3)	1.6	8.6	4.3	15
Low Inhalation Rate[a]	5.19E-05	2.79E-04	1.39E-04	4.86E-04
High Inhalation Rate[b]	1.12E-04	6.01E-04	3.01E-04	1.05E-03

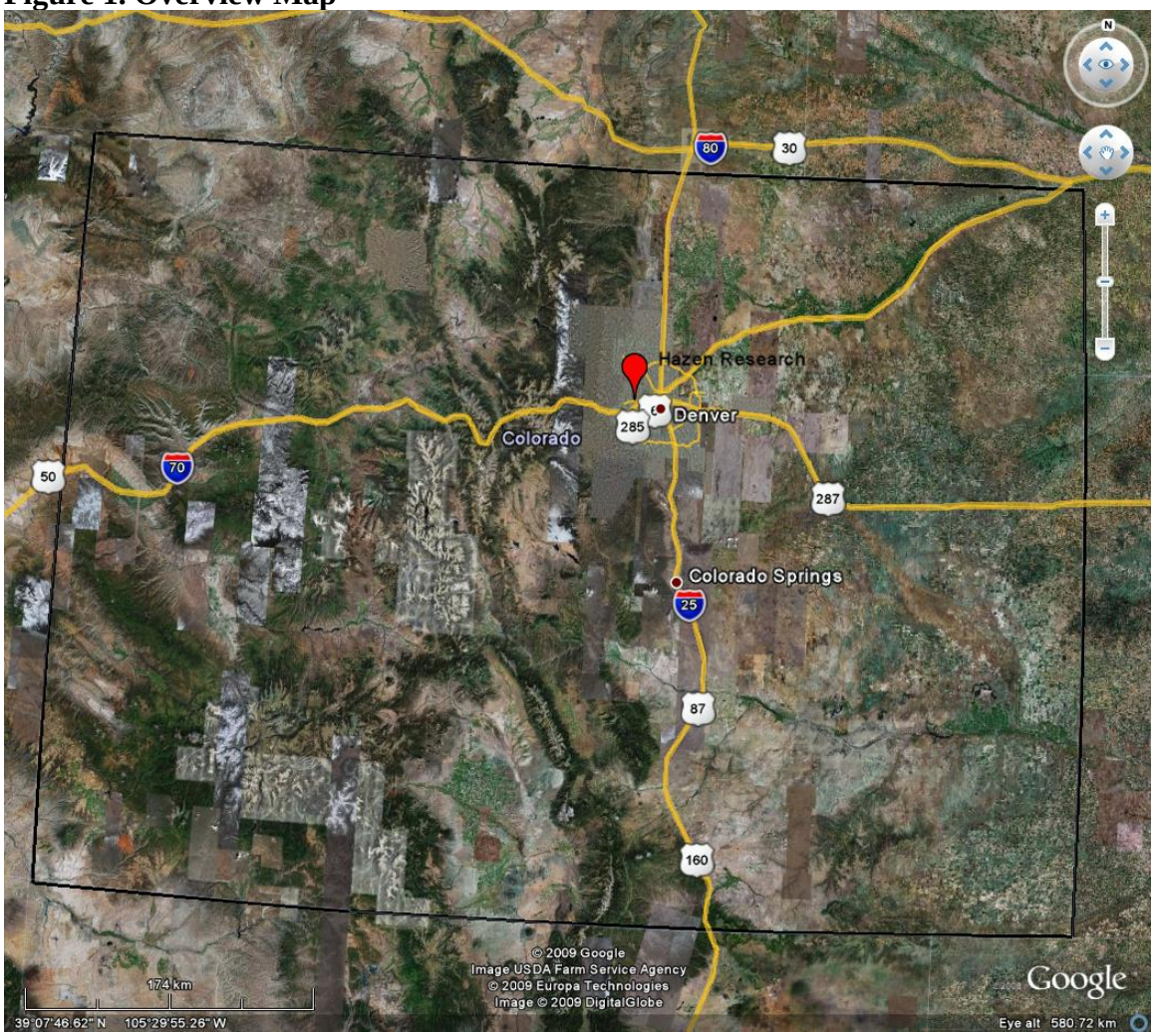
NOTES:
[a] Low inhalation rate = 1.16m^3 per hour
[b]High inhalation rate = 2.5m^3 per hour

Table 3. Onsite Indoor Air Non-cancer Hazards and Theoretical Cancer Risks

Non-Cancer Hazard Quotients				
Location	HZLAB-1	HZOFFICE-1	HZBLDG2-1	HZBLDG6-1
Low Inhalation Rate[a]	1.45E-02	7.81E-02	3.90E-02	1.36E-01
High Inhalation Rate[b]	3.13E-02	1.68E-01	8.41E-02	2.94E-01
Theoretical Cancer Risks				
Location	HZLAB-1	HZOFFICE-1	HZBLDG2-1	HZBLDG6-1
Low Inhalation Rate[a]	1.04E-06	5.58E-06	2.79E-06	9.73E-06
High Inhalation Rate[b]	2.24E-06	1.20E-05	6.01E-06	2.10E-05

NOTES:
Hazard Quotients are calculated by diving the estimated exposure dose by the non-cancer health based guideline (EPA Inhalation Reference Dose of 1.00E-02 mg/kg/day).
Theoretical Cancer Risks are calculated by multiplying the estimated cancer dose by inhalation cancer slope factor (for PCE = 2.10E-02 mg/kg-day^{-1})

Figure 1. Overview Map



SOURCE: Google Earth

Figure 2. Aerial Image of Hazen Research Inc.

SOURCE: Google Earth

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CERTIFICATION

This Health Consultation was prepared by the Colorado Department of Public Health and Environment under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement partner.

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

Alan Yarbrough
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CAT, CAPEB, DHAC, ATSDR