

HEALTH CONSULTATION

OLD PAYSON DRY CLEANERS PAYSON, GILA COUNTY, ARIZONA

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Office of Environmental Health
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BACKGROUND

The Arizona Department of Health Services (ADHS), Office of Environmental Health, has been requested by the Arizona Department of Environmental Quality (ADEQ) to evaluate the potential health effects of [exposure](#) to private well water contaminated with tetrachloroethylene (PCE), for domestic uses other than drinking. The well in question serves a 19-unit trailer park, and the contamination was discovered during routine groundwater monitoring of the Old Payson Dry Cleaners state [superfund](#) site in May of 1998.

The town of Payson is located in the central mountainous region of Arizona. It is approximately 65 miles northeast of Phoenix, and has a population of 8,377. The primary area of contamination is a commercial site located at the intersection of Aero Drive and South Meadow Street, where the highest levels of PCE were detected in monitoring wells during ADEQ's initial characterization of the site. The suspected source of the contamination is the Old Payson Dry Cleaners, which was located at 906 South Beeline Highway when it was in operation during the late 1970's and early 1980's.

The Old Payson Dry Cleaners site is an Arizona Water Quality Assurance Revolving Fund (WQARF) site currently undergoing interim remediation actions. ADEQ sampled private wells and monitoring wells down gradient of the site, the Old Payson Dry Cleaners, during routine monitoring. The trailer park well three months earlier had shown PCE at a level of 6 ug/L, but had now increased to a level of 16 ug/L, again exceeding the EPA Maximum Contaminant Level (MCL) of 5 µg/L for PCE in drinking water.

The trailer park well serves 19 units, and falls short of the 25 unit requirement for classification as a semi-public well, and is therefore not regulated by the drinking water section of ADEQ. However, upon receiving the sampling results, the owner of the contaminated well was immediately advised by the WQARF program at ADEQ to stop using the well for drinking water purposes. All the residents of the trailer park are currently being supplied bottled water by ADEQ. However, residents are still using the contaminated water for other domestic uses. There are twenty three people living at the trailer park who range in age from children to the elderly.

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DISCUSSION

Studies have shown that inhalation exposure from residential uses of VOC contaminated water may equal or exceed those of ingestion. According to the EPA, the greatest risk posed by halogenated hydrocarbons, such as PCE, from indoor water activities occurs in the shower, when the volatilization from water to air is at a maximum [Wiley, 1991]. Furthermore, bathroom activities account for nearly two-thirds of the total daily per capita domestic water usage [Andelman, et. al, 1990]. A well studied model shows that the inhalation dose from a shower exposure for a 70 kg man taking a fifteen minute shower at a efflux rate of 10 L/minute once a day is equivalent to a two liter ingestion exposure [McKone and Knezovich, 1991]. The model applies standard residential exposure assumptions.

Inhalation intakes were calculated based on this McKone and Knezovich model. The daily exposure dose for a 16 kg child is 0.001 mg/kg/day and 0.00046 mg/kg/day for a 70 kg adult. Acute inhalational minimal risk levels (MRL) is 0.213 mg/kg/day for a 16 kg child taking a 15 minute shower, and 0.097 for a 70 kg adult. Chronic MRL is 0.042 mg/kg/day for a 16 kg child exposed to PCE in the shower, and 0.02 mg/kg/day for an adult. The MRL's account for an uncertainty factor of 100 (10 for the use of a LOAEL, and 10 for cross species extrapolation)[ATSDR Toxicological Profile for PCE, Sept. 1997]. The hazard quotient, an index reflective of relative risk from a given pathway, is calculated to be 0.005 for acute exposure and 0.023 for chronic inhalational exposure. Since the risk is found to be less than one, it is considered minimal.

As stated previously, Andelman, et. al. report that bathroom activities account for two-thirds of residential usage. Drinking water is the other main residential use. Therefore, the remaining domestic uses such as cooking, laundry, and dishwashers all combined contribute much less than one third of total water usage and are individually insignificant factors in exposure.

Ingestion is not a potential pathway of exposure since trailer park residents are being provided bottled drinking water.

The dermal dose for a 70 kg adult with an estimated body surface area of 20,000 cm² is calculated to be 0.000055 mg/kg per fifteen minute shower. For a 16 kg child, with an estimated body surface area of 9,000 cm², we estimate an absorption of approximately 0.00011 mg/kg PCE for each fifteen minute shower. No animal or human studies were available in the toxicological profiles with known systemic toxic effects from specific dermal doses. Therefore, no reference dose exists. The hazard quotient, 0.022 for a child, and 0.011 for an adult, is extrapolated from the oral reference dose assuming a 10% absorption efficiency for organics [PEA, Cal EPA, 1994].

The same subpopulations are subjected to both dermal and inhalation exposure, and thus the combined exposure must also be considered. The hazard index is reflective of multiple pathway exposure for the trailer park residents, and is calculated by adding the individual hazard quotients from each of the dermal and inhalation exposures. The hazard indexes indicate no risk, as they are below one for both acute (HI=0.016) and chronic exposure (HI=0.034).

CHILD HEALTH ISSUES

The hazard indexes for children are 0.027 for acute and 0.046 for chronic exposure, again less than one, so there is no cumulative risk posed at the concentration of PCE present in the trailer park well. Sensitive subpopulations tend to be children whose systems are still developing, and elderly people who may be immune compromised, but at these calculated daily doses, even the most sensitive populations are unlikely to be affected. There are no known, observed health effects from exposure to PCE at the daily doses that the Payson trailer park residents are being exposed to from their private well water.

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CONCLUSION

Based upon the calculated total daily dose of PCE for the trailer park residents, the contaminated groundwater uses in cooking and showering is unlikely to cause any adverse health effects in either adults or children. Although exposure to PCE is occurring, at the doses calculated, the exposure would pose no apparent public health hazard.

Inhalation exposure from the McKone and Knezovich model makes several assumptions. The model is unable to account for variability in VOC concentrations in shower stalls that depend upon the water flow characteristics, and we assume in our calculations that there is a constant flow and dispersion of PCE in the water and air.

We lack an exposure factor to estimate the exposure from volatilization of PCE during cooking alone. Also, the lack of scientific data to support a dose-based NOAEL for dermal exposure poses a data gap. Dermal uptake can also vary due to physiological and anatomical factors such as % skin fat, and % blood fat.

RECOMMENDATIONS

Recommendations for the trailer park residents whose well is currently impacted by PCE at a level greater than MCL:

1. ADHS recommends that citizens continue to use the bottled drinking water that is being temporarily supplied to impacted private well owners by ADEQ until a comprehensive remedy is finalized. ADEQ has encouraged the owner to obtain municipal water or an alternative water supply to ensure a PCE-free water supply.
2. ADHS should continue to provide health education materials about PCE contamination to impacted well owner and trailer park residents, and otherwise assist the community as needed.

SITE TEAM & AUTHORS

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CERTIFICATION

The Old Payson Dry Cleaners: Contaminated Trailer Park Well Health Consultation was prepared by the Arizona Department of Health Services 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 initiated.

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

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