Health Consultation

PAYNE ROAD SOLVENTS

BESSEMER CITY, GASTON COUNTY, NORTH CAROLINA

SEPTEMBER 7, 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
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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:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Statement of Issues

During a conference call on August 1, 2006, the U.S. Environmental Protection Agency (EPA) requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate current groundwater data associated with the Bessemer City tetrachloroethene (PCE) plume site in Gaston County, North Carolina. In June 2006, EPA collected and analyzed water samples from 29 private wells for volatile organic compounds (VOCs). Private wells in this area provide water to homes, churches, businesses, and restaurants. EPA asked ATSDR to determine whether current exposures to VOC-contaminated groundwater are of public health concern.

Background

In February 2001, the North Carolina Department of Environment and Natural Resources (NCDENR) detected VOCs above EPA drinking water standards in a community well. NCDENR also detected VOCs in nearby wells serving churches and businesses. Filters were installed on a few of the wells at the expense of the well owners. Although the source of the VOC contamination is unknown, one suspected source is the Precision Metal Finishing site, which is currently closed.

In early May 2006, NCDENR reported to EPA that the filters were not maintaining VOC contaminants below EPA's drinking water standards. NCDENR also reported that there were no funds or plans to investigate the source or extent of the groundwater contamination. NCDENR requested EPA to conduct a field investigation of the groundwater plume (NCDENR 2006).

On May 25, 2006, EPA requested that ATSDR review the available groundwater data to determine whether current exposures were of health concern. Because the available data were from 2001, ATSDR determined that these data did not reflect current conditions. ATSDR asked EPA to assess current groundwater conditions; groundwater samples were accordingly collected on June 20, 2006. To determine the extent of VOC contamination, EPA collected the groundwater samples from area wells within a half-mile radius of the Precision Metal Finishing site.

VOCs were detected in five of the 29 sampled wells. The following text provides further information related to the five wells with VOC contamination.

- Well A currently supplies water to a trailer park comprised of 15 residences and a drive-inn movie theater. Area residents contact the well water during activities such as drinking, showering, bathing, cooking, and washing dishes. This well does not have a filter. EPA collected a sample of the water at the wellhead.

- Well B currently supplies water to two churches, a restaurant, and two businesses. Area residents contact the well water during activities such as drinking, cooking, hand washing, and washing dishes. This well has a filter—provided by the well owner—to remove VOC contaminants from the water. However, NCDENR reports the filter is not adequately maintained. EPA collected a sample of unfiltered water at the wellhead.

- Well C currently supplies water to a business. The water is for bathroom use (sink and toilet). It is not known if the water is used for drinking water, such as for a water fountain or small kitchen, but workers reported they drink bottled water. This well does not have a filter system. EPA collected a sample of the water from inside the business at the tap because the wellhead was inaccessible.

- Well D currently supplies water to a business. The water is for bathroom use (sink and toilet). It is not known if the water is used for drinking water, such as for a water fountain or small kitchen. This well does not have a filter system. EPA collected a sample of the water from inside the business at the tap.

- Well E currently supplies water to two businesses. The well supplies water only for bathroom use (sink and toilet). This well has a filter—provided by the well owner—to remove contaminants from the water. However, NCDENR reports the filter is not adequately maintained. EPA collected two samples of unfiltered water at the wellhead.

Although people are using the well water from the other 24 wells, EPA detected no VOC contamination in those wells. ATSDR is focusing our evaluation on the five wells with VOC contamination.

Discussion

The mission of ATSDR is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and disease related to toxic substances. For further information regarding the agency, please visit ATSDR's web site at http://www.atsdr.cdc.gov/.

ATSDR developed a method to evaluate the public health implications of exposures to environmental contamination. This method is called the *public health assessment* process. The purpose of the process is to find out whether people have been, are being, or may be exposed to hazardous substances and, if so, whether that exposure is harmful, or potentially harmful, and should therefore be stopped or reduced (ATSDR 2005). For additional information regarding the public health assessment process, readers can access ATSDR's Public Health Assessment Guidance Manual at http://www.atsdr.cdc.gov/HAC/PHAManual/index.html.

In this section, ATSDR evaluates the human exposure pathway factors and detected VOC levels for each of the five wells. ATSDR reviewed the VOC groundwater data summary to determine whether the detected VOC concentrations are above ATSDR health-based comparison values (CVs). ATSDR CVs are estimates of daily human exposure to a chemical that are not likely to result in adverse health effects over a specified duration of exposure. These values are developed for specific media (air, water, and soil) and for specific durations of exposure (acute, intermediate, and chronic). ATSDR's review also identified those chemicals with no relevant CV.

Some of the CVs and health guidelines used by ATSDR scientists include ATSDR's minimal risk levels (MRLs), environmental media evaluation guides (EMEGs), reference dose media

evaluation guides (RMEGs), and cancer risk evaluation guides (CREGs). These ATSDR CVs and health guidelines represent conservative levels of safety; they are not thresholds of toxicity. Although concentrations at or below a CV may reasonably be considered safe, concentrations above a CV will not necessarily be harmful. To ensure that they will protect even the most sensitive populations (such as children or the elderly), ATSDR CVs are intentionally designed to be much lower, usually by two or three orders of magnitude, than the corresponding no-observed-adverse-effect-levels (NOAELs) or lowest-observed-adverse-effect-levels (LOAELs) on which the CVs were based. All ATSDR health-based CVs are non-enforceable.

Specifically, ATSDR's MRLs are estimates of daily human exposure to a chemical that are unlikely to be associated with any appreciable risk of noncancer effects over a specified duration of exposure. MRLs are calculated using data from human and animal studies and are reported for acute (≤14 days), intermediate (15–364 days), and chronic (≥365 days) exposures. MRLs for specific chemicals are published in ATSDR's toxicological profiles, which are available at http://www.atsdr.cdc.gov/toxpro2.html.

ATSDR's water EMEGs are contaminant concentrations calculated from ATSDR's MRLs by factoring in default body weights and ingestion rates. The default exposure assumptions account for variations in water ingestion between adults and children. An EMEG for a child is calculated assuming a daily water ingestion rate of 1 liter per day for a 10-kilogram (kg) child. For adults, a water EMEG is calculated assuming a daily water ingestion rate of 2 liters per day and a body weight of 70 kg (ATSDR 2005).

ATSDR's RMEGs are contaminant concentrations calculated from EPA's reference doses (RfDs) and default exposure assumptions. EPA's RfDs for specific chemicals are accessible through its Integrated Risk Information System (IRIS) database, which is available at http://www.epa.gov/iris/. ATSDR's RMEGs assume the same default exposure assumptions as those used for EMEGs.

ATSDR's CREGs are estimated contaminant concentrations expected to cause no more than one excess case of cancer in a million persons exposed over a lifetime. CREGs are calculated from EPA's cancer slope factors (CSFs), or cancer potency factors, using default values for exposure rates. Like RfDs, EPA's CSFs for specific chemicals are contained in IRIS at http://www.epa.gov/iris/. ATSDR derives CREGs for lifetime exposures, and therefore uses exposure parameters that represent exposures as an adult. An adult is assumed to ingest 2 liters a day of water and weigh 70 kg.

When reviewing the VOC groundwater data, ATSDR also screened the chemical data using EPA's maximum contaminant levels (MCLs). MCLs are legally enforceable drinking water standards set by EPA to control the level of contaminants in the nation's municipal (public) drinking water. Additional information regarding EPA's MCLs is available at http://www.epa.gov/safewater/mcl.html.

For each of the five wells, Table 1 (Attachment A) provides the levels of detected VOCs and their respective CVs. The following text outlines ATSDR's public health evaluation.

1,1,1-Trichloroethane

1,1,1-Trichloroethane (TCA) is a synthetic chemical that does not occur naturally in the environment. Although TCA was detected in four of the five wells (Wells A, B, C, and E), its concentrations were below all CVs, that is, levels considered safe for drinking water. Therefore, the levels of TCA detected in these four wells are not expected to cause harmful health effects in currently exposed residents.

1,1-Dichloroethane

1,1-Dichloroethane (1,1-DCA) is a colorless, oily liquid with a sweet odor that does not occur naturally in the environment. It evaporates from water rapidly into the air. It was detected in Well B at 6.7 micrograms per liter (µg/L) and in Well E at 11 µg/L. 1,1-DCA was not detected in any other wells. There are no CVs available for 1,1-DCA, but it is considered less toxic than 1,2-dichloroethane.

As stated previously, Well B supplies water to two churches, a restaurant, and two businesses. Because of inadequate filter maintenance on Well B, people are exposed to 1,1-DCA in their water. Routes of exposure are ingestion (drinking), inhalation of vapors (breathing), and dermal contact (skin contact) with the well water.

Well E supplies water to two businesses. Because of inadequate filter maintenance, people are exposed to 1,1-DCA during bathroom activities such as flushing the toilet (inhalation of vapors) and hand washing (inhalation and skin contact).

Overall, very limited information is available about the effects of 1,1-DCA on human health. Some animal studies have shown that it can cause kidney disease after long-term, high-level exposure in the air. 1,1-DCA caused cancer in animals given very high oral doses for a lifetime. Delayed growth was observed in the offspring of animals who breathed high concentrations of 1,1-DCA during pregnancy (ATSDR 1990).

These harmful health effects were observed in animals at very high doses. At this time, there is no information to indicate that these effects occur in humans. The 1,1-DCA levels detected in Wells B and E water would result in doses many orders of magnitude below the animal doses that resulted in harmful health effects. Therefore, the levels of 1,1-DCA detected in these two wells are not expected to harm exposed residents. Nevertheless, efforts to reduce exposure to potential chemical carcinogens are considered prudent public health practice.

1,1-Dichloroethene

1,1-Dichloroethene (1,1-DCE) is an industrial chemical that is not found naturally in the environment. It is a colorless liquid with a mild, sweet smell. Most 1,1-DCE evaporates quickly. 1,1-DCE was detected in four of the five wells (Wells A, B, C, and E). 1,1-DCE was detected above its MCL in two wells (Wells B and E).

Available information indicates that prolonged inhalation of high levels of 1,1-DCE can induce adverse neurological effects and is possibly associated with liver and kidney damage in people. At this time, no information exits concerning health effects in people who drink water containing

1,1-DCE. Animals fed food that contained 1,1-DCE developed liver and kidney disease (ATSDR 1994).

1,1-DCE was detected in Well B at 55 µg/L. As stated previously, because of inadequate filter maintenance, people are exposed via oral, inhalation, and dermal contact with Well B water. The 1,1-DCE concentration in Well B is below ATSDR's chronic environmental media evaluation guides (c-EMEGs) for children and adults. Concentrations below ATSDR's chronic EMEGs are unlikely to be associated with noncancer effects over a lifetime of exposure. ATSDR therefore considers that exposure to 1,1-DCE in Well B water is unlikely to result in harmful noncancer health effects.

The 1,1-DCE concentration in Well E (130 µg/L) is above the c-EMEG for children but below the c-EMEG for adults. NCDENR reported that four adult workers are exposed to Well E water during bathroom activities. Because (a) children are not exposed to Well E water and (b) the 1,1-DCE concentration is below its adult CV, harmful noncancer health effects are unlikely.

1,1-DCE concentrations were below all CVs in Wells A and C, that is, levels considered safe for drinking water. However, the 1,1-DCE concentrations in Wells B and E are above EPA's MCL. MCLs are the maximum allowable concentration for specific chemicals in public drinking water. MCLs are based partially on the ability of public water systems to detect and remove contaminants, given present technology and resources. ATSDR considers them as a guide because like c-EMEGs, they are considered protective of public health over a lifetime of exposure. Although ATSDR determined that harmful noncancer health effects are unlikely to occur, efforts to reduce exposure are considered prudent public health practice when chemical levels are above an EPA MCL.

We do not know whether coming into contact with 1,1-DCE increases the risk of cancer in people. The U.S. Department of Health and Human Services (DHHS) has not classified 1,1-DCE with respect to carcinogenicity (ATSDR 1994). The EPA has determined that data for 1,1-DCE are inadequate to assess human carcinogenic potential by the oral route (IRIS 2006). Several studies examined the possibility that 1,1-DCE may increase the risk of cancer in animals. One of these studies indicated that mice breathing 1,1-DCE for 1 year developed kidney cancer, but the particular type of mouse used may be especially sensitive to 1,1-DCE (ATSDR 1994). Given the information currently available, ATSDR considers that exposures to 1,1-DCE in water from Wells B and E are unlikely to result in harmful cancer health effects. However, efforts to reduce exposure to potential chemical carcinogens are considered prudent public health practice.

1,2-Dichloroethane

1,2-Dichloroethane (1,2-DCA) is a manufactured chemical that is not found naturally in the environment. It is a clear liquid and has a pleasant smell and sweet taste. 1,2-DCA was detected in only one well (Well E). Its concentration was below all noncancer CVs. Therefore, the level of 1,2-DCA detected in Well E is not expected to cause harmful noncancer health effects.

The Well E level of 1,2-DCA exceeded ATSDR's cancer risk evaluation guide (CREG). The CREG is based on ingesting 2 liters of water, every day, for life. However, 1,2-DCA was detected in a well currently used for bathroom activities (toilet flushing and hand washing) by four adults. The routes of current exposure are dermal contact and inhalation of vapors rather than ingestion. ATSDR therefore considers that exposure to 1,2-DCA in Well E is unlikely to

result in harmful cancer health effects. As stated previously, efforts to reduce exposure to potential chemical carcinogens are considered prudent public health practice.

Cis-1,2-Dichloroethene

There are two forms of 1,2-dichloroethene; *cis*-1,2-dichloroethene (*cis*-1,2-DCE) and *trans*-1,2-dichloroethene. DCE is a highly flammable, colorless liquid with a sharp, harsh odor. *Cis*-1,2-DCE was detected in two wells (Wells B and E). However, the concentrations were below all CVs, that is, levels considered safe for drinking water. Therefore, the levels of *cis*-1,2-DCE detected in these two wells are not expected to cause harmful health effects in currently exposed residents.

Methyl Tert-Butyl Ether

MTBE is the common name for a synthetic chemical called methyl *tert*-butyl ether, a flammable liquid made from combinations of chemicals like isobutylene and methanol. It has a distinctive odor that most people find disagreeable. Although MTBE was detected in one well (Well C), its concentration was below all CVs, that is, levels considered safe for drinking water. Therefore, the level of MTBE detected in Well C is not expected to cause harmful health effects in currently exposed residents.

Tetrachloroethene

Tetrachloroethene (PCE) is a nonflammable liquid at room temperature. It evaporates easily into the air and has a sharp, sweet odor. PCE was detected in four of the five wells (Wells A, B, D, and E). It was above its MCL in two wells (Wells B and E).

When in high concentrations in closed and poorly ventilated areas, PCE can cause dizziness, headache, sleepiness, confusion, nausea, and other adverse effects. The health effects of breathing air or drinking water with low levels of PCE are not known. Animal studies using much greater amounts than those to which most people are exposed, show that PCE can cause liver and kidney damage. The relevance of these animal studies to people is unclear (ATSDR 1997a).

PCE was detected in Well B at 6.9 µg/L and in Well E at 53 µg/L. As stated previously, because of inadequate filter maintenance, people are exposed via oral, inhalation, and dermal contact with Well B water. Adult workers are exposed to Well E water during bathroom activities. However, PCE concentrations in both wells are below ATSDR's reference dose media evaluation guides (RMEGs) for children and adults. Concentrations below ATSDR's RMEGs are unlikely to be associated with noncancer effects over a lifetime of exposure. ATSDR therefore considers that exposures to PCE in water from Wells B and E are unlikely to result in harmful noncancer health effects.

However, the PCE concentrations in Wells B and E are above EPA's MCL. As stated previously, efforts to reduce exposure are considered prudent public health practice when chemical levels are above an EPA MCL.

DHHS has determined that PCE may reasonably be anticipated to be a human carcinogen. High-dose animal studies show that long-term exposure to PCE causes liver cancer in mice and monocellular leukemia and kidney cancers in rats (ATSDR 1997a). However, humans may respond to PCE differently than mice and rats. Given presently available information, ATSDR

considers that exposures to PCE in water from Wells B and E are unlikely to result in harmful cancer health effects. However, efforts to reduce exposure to potential chemical carcinogens are considered prudent public health practice.

Trichloroethene

Trichloroethylene (TCE) is a nonflammable, colorless liquid at room temperature with a somewhat sweet odor and a sweet, burning taste. TCE was detected in three of the five wells (Wells B, C, and E). It was detected above its MCL in two wells (Wells B and E).

Exposure to TCE produces harmful effects, primarily to the liver, kidneys and nervous system. People who breathe TCE have reported health effects when exposed to levels at which its odor is noticeable. Effects have also occurred at much higher levels. Studies suggest that more birth defects may occur when mothers drink water containing TCE (ATSDR 1997b).

TCE was detected in Well B at 12 µg/L and in Well E at 15 µg/L. Because of inadequate filter maintenance, people are exposed via oral, inhalation and dermal contact with Well B water. Adult workers are exposed to Well E water during bathroom activities. Levels of TCE in Wells B and E are orders of magnitude below the lowest NOAELs and LOAELs reported in ATSDR's Toxicological Profile for Trichloroethene (ATSDR 1997a). Therefore, ATSDR considers that exposures to TCE in water from Wells B and E are unlikely to result in harmful noncancer health effects.

However, the TCE concentrations in Wells B and E are above its MCL. As stated previously, efforts to reduce exposure are considered prudent public health practice when chemical levels are above an EPA MCL.

There is no clear evidence that TCE alone in drinking water can cause leukemia or any other type of cancer in humans. As part of the National Exposure Subregistry, ATSDR compiled data on 4,280 residents of three states (Michigan, Illinois, and Indiana) who had environmental exposure to TCE. An increase of respiratory cancer was noted in older men, but this was thought to result from smoking rather than TCE exposure. A study in New Jersey found an association between leukemia in women and exposure to TCE in the drinking water. A study in Massachusetts found that exposure was associated with leukemia in children. Overall, though, ATSDR found no definitive evidence for an excess of cancers from TCE exposure (1997b). Given the information presently available, ATSDR considers that exposures to TCE in water from Wells B and E are unlikely to result in harmful cancer health effects. However, efforts to reduce exposure to potential chemical carcinogens are considered prudent public health practice.

Child Health Considerations

Children could be at greater risk than adults are after certain kinds of exposure to hazardous substances. A child's lower body weight results in a greater dose of hazardous substance per unit of body weight. Children also are more active and have higher heart and respiratory rates, causing them to have higher peak and mean exposures. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. ATSDR considers that current exposures to VOC-contaminated groundwater would not be likely to result in harmful health effects in children (see Discussion section).

Conclusions

EPA asked ATSDR *to determine whether current exposures to VOC-contaminated groundwater are of public health concern*. EPA detected VOCs in five area wells. ATSDR concludes that current exposures to VOCs in well water are unlikely to cause harmful health effects in exposed residents. However, because some VOC concentrations exceed their respective MCLs and some VOCs are potential chemical carcinogens, ATSDR considers it a prudent public health measure to reduce exposures to the VOC-contaminated groundwater.

Recommendations

1. Actions taken to reduce exposures to VOC-contaminated groundwater should continue.
2. Installed filters should be adequately maintained.
3. Monitoring potentially affected wells should continue, with filters added when VOC concentrations exceed MCLs.
4. Monitoring newly installed wells in areas of suspected contamination should occur, with filters added when VOC concentrations exceed MCLs.
5. A more permanent, long-term remedy for well users should be sought (i.e., public water line extension).

Public Health Action Plan

The purpose of the public health action plan is to ensure that this evaluation not only identifies potential and ongoing 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. ATSDR will mail this health consultation to the appropriate personnel at EPA and NCDENR to ensure that they are aware of ATSDR's public health conclusions and recommendations.

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[IRIS] Integrated Risk Information System. 2006. TOXNET, National Library of Medicine. Available at: http://toxnet.nlm.nih.gov/. Files accessed August 2006: 1,1-dichloroethylene.

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Attachment A

Table 1. Summary of Groundwater Data*

Contaminant	Well A Conc. (µg/L)	Well B Conc. (µg/L)	Well C Conc. (µg/L)	Well D Conc. (µg/L)	Well E Conc.† (µg/L)	CV (µg/L)	Type of CV
1,1,1-Trichloroethane	0.6 A	13 A	0.6 A	U	79 A	200,000	i-EMEG (child)
						700,000	i-EMEG (adult)
						200	MCL
1,1-Dichloroethane	U	6.7 A	U	U	11 A	NA	NA
1,1-Dichloroethene	2.2 A	55 A	2.2 A	U	130 A	90	c-EMEG (child)
						300	c-EMEG (adult)
						7	MCL
1,2-Dichloroethane	U	U	U	U	3.9 A	0.4	CREG
						2,000	i-EMEG (child)
						7,000	i-EMEG (adult)
						5	MCL
cis-1,2-Dichloroethene	U	3.4 A	U	U	8.9 A	3,000	i-EMEG (child)
						10,000	i-EMEG (adult)
						70	MCL
Methyl *tert*-butyl ether	U	U	12 A	U	U	3,000	i-EMEG (child)
						10,000	i-EMEG (adult)
Tetrachloroethene	2.1 A	6.9 A	U	0.74 A	53 AJ	100	RMEG (child)
						400	RMEG (adult)
						5	MCL
Trichloroethene	U	12 A	0.68 A	U	15 A	5	MCL

* Source: Agency for Toxic Substances and Disease Registry. 2006. Summary of volatile organic compounds data (excel file: 06_061summary.xls). Groundwater data provided via email by Greg Zarus to the ATSDR Strike Team on July 17, 2006. Atlanta: US Department of Health and Human Services.

† EPA collected two samples from Well E. The reported concentration is the maximum level detected.

A	contaminant analyzed in replicate – reported value is 'average' of replicates
ATSDR	Agency for Toxic Substances and Disease Registry
Conc.	concentration
CV	comparison value
EPA	U.S. Environmental Protection Agency
c-EMEG	chronic environmental media evaluation guide (child or adult)
i-EMEG	intermediate environmental media evaluation guide (child or adult)
J	identification of contaminant is acceptable – reported value is an estimate
MRL	minimal risk level
NA	none available
RMEG	reference dose media evaluation guide (child or adult)
µg/L	micrograms per liter
U	contaminant not detected at or above reporting limit