Health Consultation

PEACH ORCHARD ROAD PCE GROUNDWATER PLUME SITE

AUGUSTA, RICHMOND COUNTY, GEORGIA

EPA FACILITY ID: GAN000407449

APRIL 27, 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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HEALTH CONSULTATION

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AUGUSTA, RICHMOND COUNTY, GEORGIA

EPA FACILITY ID: GAN000407449

Prepared by:

Georgia Department of Human Resources
Division of Public Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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Statement of Issues

The Peach Orchard Road PCE Groundwater Plume site was proposed for the National Priorities List (NPL) by the U.S. Environmental Protection Agency (EPA) and finalized in September 2005. Since 1986, the Agency for Toxic Substances and Disease Registry (ATSDR) has been required by law to conduct a public health assessment at each of the sites on the NPL. The aim of these evaluations is to find out if people have been exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. ATSDR requested that the Georgia Division of Public Health (GDPH) provide a health consultation to explore the potential human exposure to site-related contaminants in groundwater. GDPH has reviewed groundwater, and surface water monitoring data related to the site. The information in this health consultation is specifically designed to provide the community with information about the public health implications from exposure to hazardous substances at this site, and to identify populations for which further health actions are needed. It is not intended to serve the purpose or to influence any other environmental investigation such as a risk assessment, or to address liability, remediation, or other non-health issues.

Background

Site Description and History

The Peach Orchard Road PCE groundwater plume site (POR site area) is a tetrachloroethylene (PCE) groundwater plume that has impacted one of Augusta-Richmond Utilities Department (AUD) Well fields in the southern part of Augusta, Richmond County, Georgia. The POR site area is located on each side of Peach Orchard Road south of Rocky Creek; west of old Savannah Road (State Route 56); north of Windsor Spring Road, and east of Richmond Hill Road (Figure 1). In 1999, the POR site area included seven municipal wells and nine potential contaminant sources from both active and formerly active dry cleaning facilities located within residential and commercial areas [1].

The PCE groundwater contamination was first detected in trace amounts in one of the city's wells (Well No. 127) in June 1996 during routine monitoring of municipal well water. Since that time, the PCE has been detected in six additional municipal wells (Well Nos. 111, 119, 120, 121, 122, and 126) in the Peach Orchard Road Well Field and in numerous monitoring wells installed in and around the area. Subsequent sampling by the Georgia Environmental Protection Division (GEPD) showed that PCE concentrations were generally increasing over time. The PCE groundwater plume covers an estimated 350 acres of the 900-acre Well field (Figure 2). In October 1999, the city permanently closed Well No. 127 and designated five additional contaminated municipal wells as standby wells (Well Nos. 119, 120, 121, 122, and 126) in May 2001 [2, 3].

Between December 1999 and November 2000, GEPD conducted a three-phased investigation to identify facilities suspected of having contributed to the PCE groundwater contamination in the Peach Orchard Road Well Field. During Phase I of the investigation, GEPD installed five monitoring wells screened in the surficial aquifer. Analytical sampling results showed widespread PCE contamination in both municipal wells and monitoring wells. Trichloroethylene (TCE) and *cis* 1,2-dichlorethene (*cis* 1, 2-DCE) were also detected in several of the wells sampled [2, 3].

Phase II of the GEPD groundwater investigation involved groundwater sampling in various subsurface zones, and at locations not previously sampled. Analytical sampling results showed PCE contamination in both the surficial aquifer and the deeper Cretaceous aquifer. TCE and *cis* 1, 2-DCE were detected in the surficial aquifer [2, 3].

During Phase III of the investigation, GEPD installed seven additional monitoring wells screened in the surficial aquifer and ten monitoring wells screened in the Cretaceous aquifer (Figure 3). TCE, *cis* 1, 2-DCE, 1, 1, 1-trichloroethane (1, 1, 1-TCA), and vinyl chloride (all degradation products of PCE) were also detected in monitoring wells screened in the surficial aquifer [2, 3].

As part of the 1999-2000 investigation GEPD identified 26 active and former facilities, including dry cleaning facilities, gasoline service stations with service bays, auto salvage yards, and automotive repair shops as possible users of PCE. Of those facilities or former facilities investigated, four dry cleaners were noted as being likely sources of the PCE groundwater contamination based on the presence of PCE in groundwater underlying or downgradient from one of the facilities. These facilities include: K & D Dry Cleaners, former Taylor's Dry Cleaners, One-Hour Cleanerizing, and former Palmer's Cleaners. Four additional dry cleaners were identified during the pre-investigation screening process, but were not investigated. GEPD could not conclude from the investigation whether any other facilities may have contributed to the PCE contamination (Figure 3).

In August 2004, EPA's Superfund Technical Assessment and Response Team (START) conducted a private well survey within a two-mile radius of the approximated center of the PCE groundwater plume. The private well survey results are summarized as follows [4]:

- 10 private wells that were in use when the survey was conducted are confirmed to be located within 2 miles of the PCE groundwater plume
- 8 closed or abandoned private wells that are no longer used are confirmed to be located within 2 miles of the PCE groundwater plume
- 11 possible unconfirmed private wells may be located within a 2 miles of the PCE groundwater plume

In addition to surveying the area for private residential wells, an attempt was made to locate industrial wells for three large industries located between 1-2 miles of the PCE plume from an older GEPD map. One facility could not be found; another facility appeared to be abandoned, and the third facility (Thermal Ceramics) operated several industrial wells.

EPA began a preliminary assessment of the POR site area in January 2004. The area was proposed for the National Priority List (NPL) on April 27, 2004 and accepted as an NPL site September 14, 2005. In order to gather representative data necessary to address data gaps which currently prevent a complete evaluation of the nature and extent of contamination at the POR site area, EPA began a Remedial Investigation/Feasibility Study (RI/FS) in early 2005. Initially, extensive groundwater sampling was conducted on all existing monitoring wells, as part of a phased approach to specifically evaluate the current nature and extent of PCE/TCE related (PCE, TCE, *cis* 1, 2-DCE, *trans* 1, 2-DCE, vinyl chloride) groundwater contamination at the POR site area. Future phases of investigation will include an assessment of the current extent of soil and surface water contamination at the POR site area.

Natural Resources Use

In 1999, the City of Augusta/Richmond County obtained water from the Savannah River and two well fields, one of which is partially within the POR site area. The northern part of the Peach Orchard Road Well Field is between Peach Orchard Road and Rocky Creek. There were a total of 14 municipal wells in the entire well field. Seven of the City's wells were in the POR site area. The wells in the Peach Orchard Road Well Field typically range from depths of 82 feet to 130 feet with well pumping capacities ranging from 375 gallons per minute (gpm) to 1,032 gpm. The average capacity of both well fields is 562 gpm. The total capacity of the well field is rated at 7,899 gpm or 11.35 million gallons per day (mgd). Excluding well 127, which was permanently abandoned by the City in October 1999, and wells 119,120,121, and 122, which were taken off-line in May 2001, the total capacity is 7.3 mgd. The wells draw from the Cretaceous aquifer, which underlies the surficial aquifer in the Peach Orchard Well Field [1].

Rocky Creek is located along the northern and eastern boundary of the POR site area. The stream receives surface water run-off from intermittent streams and groundwater discharge from the POR site area and outside the POR site area [1].

Site Geology and Hydrogeology

The POR site area is located south of Augusta, Georgia in the Coastal Plain Physiographic Province. In the general vicinity of Augusta, the Coastal Plain has flat to gently rolling topography and is composed of unconsolidated sands, clays, and gravel of the Oconee Group.

Two aquifers are present throughout the POR site are: a shallow, surficial aquifer and a deeper, more productive Cretaceous aquifer. Both of these aquifers are composed of sands, silts, clays, and gravels. The surficial, water table aquifer consists of alternating and discontinuous layers of sand, silt and clay with occasional thin layers of gravel and layers of peat/organic material. The surficial aquifer extends from the water table to the top of the sands and gravel that form the Cretaceous aquifer. Flow direction of the surficial aquifer is generally east towards Rocky Creek. Rocky Creek normally flows year-round and maintains stream flows during periods of low rainfall, implying that groundwater discharges into the stream [1].

The prolific Cretaceous aquifer is comprised of the lower portion of the Gaillard Formation and underlies the surficial aquifer in the POR site area. The Cretaceous aquifer consists of a relatively thick and uniform sequence of sand with lesser amounts of gravel and fine-grained material. The city withdraws water from this aquifer in the Peach Orchard Road Well Field. City wells 126 and 127 fully penetrated the Cretaceous aquifer and entered the crystalline bedrock beneath the aquifer. The Cretaceous aquifer thickness in Well No. 127 is 58 feet, and the well penetrated 6 feet into the crystalline rock. Elevation contours for the Cretaceous aquifer show that the flow direction is east-southeast [1]. Hydrogeologic conditions show a significant hydraulic connection between the surficial and Cretaceous aquifer at or near the well field, indicating that the wells pumping from the Cretaceous aquifer also draw water from the surficial aquifer over the well field and from the area near the well field, including the locations of the dry cleaning facilities [1].

Demographics

The population within one mile of the POR site area is approximately 20,776 people. Using 2000 U.S. Census data, the Agency for Toxic Substances and Disease Registry (ATSDR) calculated population information for individuals living within a 1-mile radius of the POR (Figure 4).

Community Health Concerns

Health Outcome Data

In March 2006, the GDPH Cancer Control Section analyzed current (1999-2002) cancer incidence data available for the 30906 zip code (south Augusta). Zip code areas are the smallest geographic units for which data are available. Analysis of a distribution of cancer cases in the 30906 zip code show that no cancer clusters and no significant numbers of cancer cases have been reported (Appendix A). No other health outcome data such as mortality or birth defects were evaluated. No site-specific health outcome data related to this site exists.

Discussion

Environmental Sampling Data

Ongoing investigations have been conducted at the POR site area since 1999 to characterize the extent of contamination released to environmental media (groundwater and surface water) from the site. Available data include groundwater samples collected from shallow surficial monitoring wells in the area and deeper Cretaceous monitoring and municipal wells in the area (Figures 5, 6). Surface water samples were collected from streams that traverse the Peach Orchard Well Field at 5 locations and from 6 locations along Rocky Creek (Figure 3).

Pathway Analysis

GDPH identifies pathways of human exposure by identifying environmental and human components that might lead to contact with contaminants in environmental media (e.g., air, soil, groundwater, and surface water). A pathways analysis considers five principle elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and a receptor population. Completed exposure pathways are those in which all five elements are present, and indicate that exposure to a contaminant has occurred in the past, is presently occurring, or will occur in the future. GDPH regards people who come into contact with contamination as exposed. For example, people who reside in an area with contaminants in air, or who drink water known to be contaminated, or who work or play in contaminated soil are considered to be exposed to contamination. Potential exposure pathways are those for which exposure seems possible, but one or more of the elements is not clearly defined. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future. However, key information regarding a potential pathway may not be available. It should be noted that the identification of an exposure pathway does not imply that health effects will occur. Exposures may, or may not be substantive. Thus, even if exposure has occurred, human health effects may not necessarily result [5].

GDPH reviewed the site's history and available environmental sampling data. Based on this review, GDPH identified an exposure pathway that warranted consideration. The completed and potential exposure pathways identified for the POR site area are discussed in the following sections.

Evaluation Process

For each environmental medium (in this case) groundwater; GDPH examines the types and concentrations of contaminants of concern (COCs). In preparing this document, GDPH used the ATSDR comparison values, and other agencies' reference values, to screen contaminants that may warrant further evaluation. Comparison values (CVs) are concentrations of contaminants that can reasonably (and conservatively) be regarded as harmless, assuming default conditions of exposure. The CVs generally include ample safety factors to ensure protection of sensitive

populations. Because CVs do not represent thresholds of toxicity, exposure to contaminant concentrations above CVs will not necessarily lead to adverse health effects. CVs and the evaluation process used in this document are described in more detail in Appendix B. GDPH then considers how people may come into contact with the contaminants. Because the level of exposure depends on the route and frequency of exposure and the concentration of the contaminants, this exposure information is essential to determine if a public health hazard exists.

The contaminants identified for the completed exposure pathway are discussed in the following sections and presented in Table 2. Other contaminants not exceeding CVs were reviewed, but not selected for additional evaluation in this assessment. The tables also include the chemical-specific CVs, which GDPH considered in the selection process.

Exposure to site related contaminants at the POR site area could occur through three routes: ingestion, inhalation, and dermal adsorption of petroleumcontaminated groundwater. Ingestion is defined as *direct ingestion* or actively drinking water. However, it is important to note that the other routes of exposure; inhalation of vapors into the lungs, and direct skin contact (dermal absorption) through bathing activities, may contribute additional exposure to contaminants at this site.

At the POR site area, exposure to contaminated groundwater and surface water are the only exposure pathways that encompasses the five principal elements of a completed exposure pathway: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and a receptor population.

Exposure Pathways

Completed Exposure Pathway

Table 1: Completed Exposure Pathways

Pathway	Exposure Pathway Elements					Time
	Source	Transport	Point of Exposure	Route of Exposure	Exposed Population	
Drinking water	Movement of contaminants from the surficial to Cretaceous aquifer from various sources	Cretaceous aquifer	Residential taps served by municipal well water	Ingestion, Inhalation, Dermal	Residents using municipal well water as water supply source	Past
Rocky Creek and Intermittent Streams	Movement of contaminants from the surficial aquifer to Rocky Creek	Surface water	Contact with water from Rocky Creek	Dermal		Past, current

Municipal Wells

Prior to June 1996, PCE was not detected in Well No. 127 during two years of previous sampling, nor was it detected in the other municipal wells in the POR Well Field. In September 1999, PCE was detected in Well Nos. 119, 120, and 122. In November 1999, PCE was also detected in Well Nos. 121 and 126. However, all historical detections of PCE in Well Nos. 120,

122, and 126 have been below the Maximum Contaminant Level[1] (MCL) for PCE. TCE and *cis* 1, 2-DCE were also found in Well No. 121 at levels below the MCL in November 2000.

Table 2 summarizes historical sampling data for all municipal wells in which exposure occurred in the past.

Table 2: Summary of municipal well water sampling results

Municipal Well No.	Contaminant	No. of Samples	Range of Concentrations (ppb)	Health-Based Comparison Value (ppb)	Type of CV
119	**tetrachloroethylene**	**5**	**4.3 to 10**	**5**	**MCL**
120	tetrachloroethylene	5	1.6 to 2.5	5	MCL
121	**tetrachloroethylene**	**4**	**2.3 to 7.8**	**5**	**MCL**
121	*cis* 1, 2-dichloroethylene	4	ND to 1.4	70	MCL
121	trichloroethylene	4	ND to 0.94	5	MCL
122	tetrachloroethylene	5	0.62 to 1.3	5	MCL
126	tetrachloroethylene	4	0.56 to 0.66	5	MCL
127	**tetrachloroethylene**	**10**	**1.06 to 36**	**5**	**MCL**

Bold denotes wells where contaminants were found above a comparison value
ND: non-detect
ppb: parts per billion
MCL: Maximum Contamination Level
Source: ATSDR Drinking Water Comparison Values

The Augusta Utilities Department (AUD) currently comprises three well fields and a surface water intake located on the Augusta Canal, off the Savannah River. The well fields include Peach Orchard Road Well Field, Bush Well Field, and the Little Spirit Creek Well Field. Peach Orchard Road Well Field presently comprises eight full time production wells and five standby wells used for emergency purposes (Figure 5). AUD currently provides potable water to 66, 070 connections with water obtained from one surface water intake and 28 groundwater wells from the three Well Fields described (including the 5 standby wells maintained for emergency purposes). Based on the 2000 U.S. Census Bureau's persons per household value (2.55) for Richmond County, Georgia, AUD provides potable water to approximately 168,479 persons. Water from all water sources is blended prior to final distribution. Based on individual well and intake pumping capacities provided by AUD, the surface water intake presently contributes approximately 76 percent of the total water supply. The 28 groundwater wells contribute the remaining 24 percent of the total water supply [3].

In 1999, when GEPD detected PCE in Well No. 127 above MCL levels, AUD provided 64,397 connections to approximately 164,212 persons. In 1999, according to AUD, surface water intake contributed approximately 80 percent of the water supply while the remaining wells contributed the remaining 20 percent. Well No. 127 had the capacity to provide 128 gallons per minute (GPM), or 0.184 percent of the total AUD water supply of 69,393 gpm [3].

According to 2004 AUD Water System Capacity, Well No. 119 provides 500 gpm, or 0.686 percent of AUD's total potable water capacity. Well No. 121 provides 250 gpm, or 0.343 percent of AUD's total potable water capacity. The apportioned population that potentially receives potable water from Well No. 121 is 578 people. However, both Well Nos. 119 and 121,

[1] Maximum Contaminant Level (MCL) – The highest level of a contaminant that is allowed in drinking water. MCLs are enforceable standards. http://www.epa.gov/OGWDW/mcl.html#mcls

which had PCE concentrations above the MCL in the past are now standby wells maintained by AUD for emergency purposes only.

Surface Water

Eleven surface water samples were collected within the POR site area during the 2000 investigation. Sampling locations SW-1 through SW-5 were collected from streams that traverse the Peach Orchard Road Wells Field (Figure 3). Sampling locations SW-6 through SW-11 were collected from Rocky Creek, located near the northeastern site of the well field as illustrated in Figure 3. PCE was detected in 7 of 11 locations. The SW-3 sample location, obtained from an intermittent stream 50 feet south of One-Hour Cleanerizing, was the only concentration detected that exceeded the PCE surface water quality standard of 8.85 ug/l for Georgia streams. The PCE concentration was 20 ug/l. Although it is likely that people can come into contact with PCE only from infrequent exposure to intermittent streams and Rocky Creek, dermal absorption is the route of most concern with surface water. Ingestion of surface water is possible, but the likelihood of swallowing water from Rocky Creek and intermittent streams that traverse the POR site area in volumes large enough to be of concern is not very high. The actual contribution to exposure dose via dermal absorption would be minuscule, therefore; this dose is negligible for the purpose of estimating exposure doses in this health consultation.

Potential Exposure Pathways

Surficial Aquifer

Extensive groundwater sampling of existing monitoring wells screened in the surficial aquifer was conducted in April 2005 (Figures 6, and 7). Volatile organic compounds (VOCs), semivolatile organic compounds, metals, pesticides, and PCBs (polychlorinated biphenyls) were analyzed for. VOCs were detected in 17 of the 22 monitoring wells. The MCL for PCE was exceeded in six monitoring wells at concentrations ranging from 5.1 ug/l to 5000 ug/l. The MCL for TCE was exceeded in 3 monitoring wells at concentrations ranging from 5.9 ug/l to 14 ug/l. The MCLs for *cis* 1, 2-DCE (70 ug/l) and *trans* 1, 2-DCE (100ug/l) were not exceeded in these 3 monitoring wells. Vinyl chloride (VC) was not detected in any of the groundwater samples taken in April 2005; however, VC was detected in one monitoring well below the MCL (2 ug/l) at a concentration of 1.2 ug/l in November 2000.

Other VOCs were detected but did not exceed their respective MCL levels. Semivolatile organic compounds were also detected in 10 of the 22 monitoring wells; however, none exceeded their respective MCLs. It must be noted that potable water in the POR site area is not drawn from the surficial aquifer but with the known interconnectivity between the surficial and Cretaceous aquifers, migration of surficial aquifer contaminants to the Cretaceous aquifer will occur with time.

Private Wells

Ten private wells were confirmed to be located within 2 miles of the POR site area; however, these wells are not primary drinking water wells and are used for irrigation purposes only [3]. An industrial company called Thermal Ceramics, located on old Savannah Road, near the POR site area, operates several industrial wells. Some of these wells are used for employee showering, but are not used for drinking water. Samples of the industrial well water are collected periodically by Thermal Ceramics to ensure that the water is of potable quality. The

last sampling event was conducted in 2001, and PCE was not detected. Also, no VOCs were detected in sampling conducted in 2000 [4].

Soil

To date, surface and subsurface soil sampling has not been conducted at the POR site area. However, a subsurface soil investigation is planned at a later date in Phase II of the RI/FS.

Toxicological Evaluation

When a contaminant exceeds a CV, the toxicological evaluation presented requires a comparison of calculated site-specific exposure doses (e.g., amount of the contaminant believed to enter the body at the person's body weight for an estimated duration of time) with an appropriate health guideline. The health guidelines are health-protective values that have incorporated various safety factors to account for varying human susceptibility. These guidelines are developed using human exposure data when it is available and animal data when human exposure data is not available. Health guidelines used are ATSDR's Minimal Risk Levels (MRLs). MRLs are described in more detail in Appendix B. Usually little or no information is available for a site to know exactly how much exposure is actually occurring, so in some cases, health assessors assume worse case scenarios where someone received a maximum dose. As a result, actual exposure is likely much less than the assumed exposure. In the event that the calculated, site-specific exposure dose for a chemical is greater than the established health guideline, it is then compared to exposure doses from individual studies documented in the scientific literature that have reported health effects. If a contaminant has been determined to be cancer-causing (carcinogenic), a cancer risk is also estimated [5] (Appendix B).

Using residential well sample results from the POR site area, exposures were evaluated to determine the likelihood of adverse health effects. Estimated exposure doses were calculated for adults and children based on the highest concentrations of PCE found above the health-based comparison value for PCE detected the municipal wells. This is considered the most conservative approach to estimating exposure levels. However, as is true with most sites, assuming use of the maximum concentration is not reasonable; therefore, any conclusions based on a highly exposed person should be viewed as an overestimation of true risk.

For the purpose of this health consultation, exposures were assumed to occur seven days a week. Adults were assumed to drink two liters of water per day, and children were assumed drink one liter of water per day. Bathing was also assumed to be a daily activity, so GDPH assumed that exposure doses for dermal contact and for inhalation were equal to those from ingestion of contaminants in water. Potential adverse health effects from chronic exposure will be considered in this discussion.

The only contaminant of concern detected in municipal wells was PCE. Levels of other chemicals were detected below MCLs and are, therefore; not of public health concern. Using the above assumptions, calculated exposures doses resulting from ingestion, inhalation, and dermal contact with PCE from the Peach Orchard Road Well Field are presented in Table 3.

Table 3: Calculated doses from exposure to bedrock groundwater contaminated with PCE

Contaminant	Total Estimated Dose mg/kg/day	Health Guideline* mg/kg/day	Numeric Cancer Risk
Tetrachloroethylene Well No. 119	Adult: 0.0006 Child: 0.0008	0.01	Not applicable
Tetrachloroethylene Well No. 121	Adult: 0.0004 Child: 0.0006	0.01	Not applicable
Tetrachloroethylene Well No. 127	Adult: 0.002 Child: 0.003	0.01	Not applicable

* RfD: U.S. EPA's chronic reference dose value

Non-cancer Health Effects

Well No. 119

The site-specific child and adult exposure doses calculated using the highest (10 ppb) PCE concentration measured in drinking water 0.0008 and 0.0006 milligrams per kilogram per day (mg/kg/day), respectively. Estimated exposure doses for children and adults are approximately 12 to 17 times lower than the health guideline of 0.01 mg/kg/day. Furthermore, it must be noted that drinking water containing this concentration was not consumed directly, but in a blend of potable water that contained a 0.686 percent contribution of water from Well No. 119. Therefore, the actual concentration of PCE (contributed by Well No. 119) consumed by people belonging to the AUD was diluted over 99 times with potable water from other sources within the AUD. Because this dilution lowers any actual exposure dose almost 100 times, health consequences will not evaluated further. GDPH concludes that adverse (non-cancer) health effects are not likely in children and adults exposed to the highest PCE concentration detected in this municipal well water.

Well No. 121

The site-specific child and adult exposure doses calculated using the highest (7.8 ppb) PCE concentration measured in drinking water 0.003 and 0.002 milligrams per kilogram per day (mg/kg/day), respectively. Estimated exposure doses for children and adults are approximately 17 to 25 times lower than the health guideline of 0.01 mg/kg/day. Furthermore, it must be noted that drinking water containing this concentration was not consumed directly, but in a blend of potable water that contained a 0.343 percent contribution of water from Well No. 121. Therefore, the actual concentration of PCE (contributed by Well No. 121) consumed by people belonging to the AUD was diluted over 99 times with potable water from other sources within the AUD. Because this dilution lowers any actual exposure dose almost 100 times, health consequences will not evaluated further. GDPH concludes that adverse (non-cancer) health effects are not likely in children and adults exposed to the highest PCE concentration detected in this municipal well water.

Well No. 127

The site-specific child and adult exposure doses calculated using the highest (36 ppb) PCE concentration measured in drinking water 0.0003 and 0.0002 milligrams per kilogram per day (mg/kg/day), respectively. Although the estimated exposure doses for children and adults are

only 3 to 5 times lower than the health guideline of 0.01 mg/kg/day, it must be noted that drinking water containing this concentration was not consumed directly, but in a blend of potable water that contained a 0.18 percent contribution of water from Well No. 127. Therefore, the actual concentration of PCE (contributed by Well No. 127) consumed by people belonging to the AUD was diluted over 99 times with potable water from other sources within the AUD. Because this dilution lowers any actual exposure dose almost 100 times, health consequences will not evaluated further. GDPH concludes that adverse (non-cancer) health effects are not likely in children and adults exposed to the highest PCE concentration detected in this municipal well water.

Cancer Risk

The International Agency for Research on Cancer [6] considers PCE to be probably carcinogenic to humans based on sufficient evidence in animals, while the National Toxicology Program considers PCE as reasonably anticipated to be a human carcinogen. PCE has been shown to cause liver tumors in mice and kidney tumors in male rats [7].

Child Health Considerations

To protect the health of the nation's children, ATSDR has implemented an initiative to guard children from exposure to hazardous substances. In communities faced with contamination of the water, soil, air, or food, ATSDR and GDPH recognize that the unique vulnerabilities of infants and children demand special emphasis. Due to their immature and developing organs, infants and children are usually more susceptible to toxic substances than are adults. Children are more likely to be exposed because they play outdoors and they often bring food into contaminated areas. They are also more likely to encounter dust, soil, and contaminated vapors close to the ground. Children are generally smaller than adults, which results in higher doses of chemical exposure because of their lower body weights relative to adults. In addition, the developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages.

At the POR site area, children may have been exposed to contaminants in groundwater if they consumed contaminated municipal drinking water. It is not known whether PCE exposure affects the developing fetus in pregnant women. However, animal studies have shown behavioral changes in the offspring of rats that breathed high levels of PCE while they were pregnant. It must be noted, however, that high levels of PCE in air were not present at the POR site area because the medium of contamination is potable municipal water, and because AUD's water is blended from all sources, the past PCE concentration was highly diluted. Based on the highly diluted concentrations found in contaminated municipal wells, bathing activities are not likely to generate high levels of PCE in the air.

Conclusions

GDPH developed the following conclusions and assigned a public health hazard category to the site. A description of public health hazard categories is provided in Appendix C.

Based on the data evaluated, GDPH considers this site to pose **no apparent past or current public health hazard**. Specifically:

1. Exposure to PCE above health guidelines has not occurred for Augusta residents consuming municipal water from the Peach Orchard Road Well Field. For the purposes of this health consultation, the maximum concentration of PCE measured at each municipal was used as a conservative measure for estimating the highest exposure doses one could have received. Children and adults exposed to the maximum concentration of PCE from Well Nos. 119, 121, and 127 are likely not at any increased risk for non-cancer health effects. The actual concentrations of PCE that residents were exposed to are likely to be many times less than the maximum concentrations found because drinking water containing these concentrations was not consumed directly, but in a blend of potable water that contained very small percentages of water from the contaminated wells. Therefore, the actual concentrations of PCE consumed by people belonging to the AUD were highly diluted with potable water from other sources within the AUD.

2. Current and future exposure to potable water from municipal wells having past PCE is unlikely. Well No. 127 was permanently abandoned in October 1999, and Well Nos. 119,120,121, and 122, which were taken off-line in May 2001 and now serve for emergency capacity purposes only.

Recommendations

1. EPA should continue monitoring the surficial and Cretaceous aquifer plumes in an effort to determine the vertical and horizontal extent of PCE contamination, as well as continue their efforts to determine the extent of contamination in subsurface soils, surface water, and sediments in the POR site area.
2. Once EPA completes the remedial investigation/feasibility study in the POR site area, appropriate remediation measures should be undertaken along with continual monitoring of the effectiveness of such remediation actions.

Public Health Action Plan

Actions Completed

- In October 1999, the AUD permanently abandoned Well No. 127, which historically had the highest PCE detection in the AUD municipal well system.
- In May 2001, Well Nos. 119,120,121, and 122, which were taken off-line in May 2001 and now serve for emergency capacity purposes only.
- The final NPL listing for the POR site area was completed in September 2005. This paves the way for remediation of the POR site area.

Actions Planned

- EPA will complete their remediation investigation/feasibility study of the POR site area. The total extent of POR site area contamination will be determined.
- Once EPA decides on a remedial solution for the POR site area, remediation of the site will begin
- If additional data become available, the information will be reviewed by GDPH and appropriate actions will be taken at that time.
- GDPH will respond to all requests for information regarding health issues associated with the POR site area.

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REFERENCES

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2. Georgia Environmental Protection Division, *Preliminary Assessment for Peach Orchard Road PCE Groundwater Contamination, Augusta, Richmond County, Georgia,* December 15, 2003.

3. Weston Solutions, Inc, *Preliminary Assessment for Peach Orchard Road PCE Groundwater Contamination and Site Investigation,* April 2005.

4. Weston Solutions, Inc, *Peach Orchard Road PCE Groundwater Plume – Private Well Survey letter Report,* November 30, 2004.

5. Agency for Toxic Substances and Disease Registry. *Public Health Assessment Guidance Manual (Update).* U.S. Department of Health and Human Services. Public Health Service. Atlanta, Georgia. March 2002.

6. International Agency for Research on Cancer (IARC). Available at http://www.iarc.fr/.

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CERTIFICATION

This Peach Orchard Road PCE Groundwater Plume site health consultation was prepared by the Georgia Division of Public Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial Review was completed by the Georgia Division of Public Health.

Technical Project Officer, CAT, SPAB, DHAC

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

Team Lead, CAT, SPAB, DHAC, ATSDR

FIGURES

APPENDICES

APPENDIX A: CANCER INCIDENCE, 1999-2002

(Source: GDPH, Cancer Control Section)

Age-Adjusted Cancer Incidence Rates for Zip Code 30906, GA, 1999-2003

Site	Total		Male		Female	
	Cases	Rate	Cases	Rate	Cases	Rate
All Sites	1060	414.9	518	497.6	542	367.3
Oral Cavity	21	8.1	16	~	5	~
Esophagus	7	~	***	~	<5	~
Stomach	11	~	6	~	5	~
Colon and Rectum	137	54.6	77	74.1	60	41.6
Liver	10	~	***	~	<5	~
Pancreas	20	8.0	7	~	13	~
Larynx	18	~	***	~	<5	~
Lung and Bronchus	216	83.7	122	119.2	94	62.1
Bone and Joints	<5	~	<5	~	<5	~
Melanoma	21	7.5	11	~	10	~
Breast	--	--	--	--	171	115.1
Uterine Cervix	--	--	--	--	19	~
Uterine Corpus	--	--	--	--	28	18.4
Ovary	--	--	--	--	12	~
Prostate	--	--	119	107.4	--	--
Testis	--	--	<5	~	--	--
Kidney and Renal Pelvis	36	14.1	23	20.1	13	~
Bladder (Incl in situ)	38	16.7	29	30.7	9	~
Brain and Other Nervous System	14	~	<5	~	***	~
Thyroid	19	~	5	~	14	~
Hodgkin Lymphoma	6	~	<5	~	<5	~
Non-Hodgkin Lymphoma	39	15.9	19	~	20	13.3
Multiple Myeloma	12	~	6	~	6	~
Leukemias	21	9.1	12	~	9	~

Average annual rate per 100,000, age-adjusted to the 2000 US standard population.

Rates highlighted in yellow are significantly lower than the state rate (p<.05).

Rates highlighted in orange are significantly higher than the state rate (p<.05).

Georgia Comprehensive Cancer Registry (1999-2003), Georgia Department of Human Resources, Division of Public Health, February 2006.

Data Summary

All Cancer Sites

- 1060 new cancer cases were diagnosed in Zip Code 30906 from 1999 to 2003, an average of 212 new cases per year.
- It is expected that about 104 males and 108 females will be diagnosed with cancer every year in Zip Code 30906.
- The overall age-adjusted cancer incidence rate in Zip Code 30906 is 414.9 per 100,000 population. This is significantly lower than the rate for Georgia (463.3 per 100,000).
- Males are 35% more likely than females to be diagnosed with cancer in Zip Code 30906.

Males

- The overall age-adjusted cancer incidence rate for males in Zip Code 30906 is 497.6 per 100,000 population. This is significantly lower than the rate for Georgia males (570.4 per 100,000).
- Prostate, lung, and colorectal are the top cancer sites among males in both Zip Code 30906 and the State of Georgia.
- The age-adjusted prostate cancer incidence rate is significantly lower for males in Zip Code 30906 (107.4 per 100,000) than for Georgia males (166.4 per 100,000).
- The age-adjusted lung cancer incidence rate is higher for males in Zip Code 30906 (119.2 per 100,000) than for Georgia males (109.0 per 100,000), but this difference is not statistically significant.
- The age-adjusted colorectal cancer incidence rate is higher for males in Zip Code 30906 (74.1 per 100,000) than for Georgia males (61.7 per 100,000), but this difference is not statistically significant.

Females

- The overall age-adjusted cancer incidence rate for females in Zip Code 30906 is 367.3 per 100,000 population. This is lower than the rate for Georgia females (393.6 per 100,000), but this difference is not statistically significant.
- Breast, lung and colorectal are the top cancer sites among females in both Zip Code 30906 and the State of Georgia.
- The age-adjusted breast cancer incidence rate is lower for females in Zip Code 30906 (115.1 per 100,000) than for Georgia females (124.0 per 100,000), but this difference is not significant.
- The age-adjusted lung cancer incidence rate is higher for females in Zip Code 30906 (62.1 per 100,000) than for Georgia females (52.9 per 100,000), but this difference is not statistically significant.
- The age-adjusted colorectal cancer incidence rate is lower for females in Zip Code 30906 (41.6 per 100,000) than for Georgia females (43.8 per 100,000), but this difference is not statistically significant.

APPENDIX B: Explanation of Evaluation Process

Step 1--The Screening Process

In order to evaluate the available data, GDPH used comparison values (CVs) to determine which chemicals to examine more closely. CVs are contaminant concentrations found in a specific environmental media (for example: air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, soil, or water that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. The CV is used as a screening level during the health consultation process where substances found in amounts greater than their CVs might be selected for further evaluation. CVs are not intended to be environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factors for ingestion exposure, or inhalation risk units for inhalation exposure. Non-cancer CVs are calculated from ATSDR's minimal risk levels, EPA's reference doses, or EPA's reference concentrations for ingestion and inhalation exposure. When a cancer and non-cancer CV exist for the same chemical, the lower of these values is used as a conservative measure. The chemical and media-specific CVs used in the preparation of this health consultation are listed below:

An **Environmental Media Evaluation Guide (EMEG)** is an estimated comparison concentration for exposure that is unlikely to cause adverse health effects, as determined by ATSDR from its toxicological profiles for a specific chemical.

A **Reference Dose Media Evaluation Guide (RMEG)** is an estimated comparison concentration that is based on EPA's estimate of daily exposure to a contaminant that is unlikely to cause adverse health effects.

A **Cancer Risk Evaluation Guide (CREG)** is an estimated comparison concentration that is based on an excess cancer rate of one in a million persons exposed over a lifetime (70 years), and is calculated using EPA's cancer slope factor.

Step 2--Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific scenarios, using assumptions regarding an individual's likelihood of accessing the site and contacting contamination. A brief explanation of the calculation of estimated exposure doses used in this health consultation are presented below. Calculated doses are reported in units of milligrams per kilogram per day (mg/kg/day).

Ingestion of contaminants present in drinking water

Exposure doses for ingestion of contaminants present in groundwater were calculated using the average detected concentrations of contaminants in milligrams per liter (mg/kg [mg/kg = ppm]). The following equation is used to estimate the exposure doses resulting from ingestion of contaminated groundwater:

$$ED_w = \frac{C \times IR \times EF}{BW} * 2$$

where;

ED_w = exposure dose water (mg/kg/day)
C = contaminant concentration (mg/kg)

IR = intake rate of contaminated medium (based on default values of 2 liters/day for adults, 1 liter/day for children)
EF = exposure factor (based on frequency of exposure, exposure duration, and time of exposure). The exposure factor used for CPC is 1.0 based on 24 hour day, 7 days a week.
BW = body weight (based on average rates: for adults, 70 kg; children, 25 kg).
* 2 = dose was multiplied by 2 to account for inhalation and dermal absorption during bathing avtivities.

Non-cancer Health Risks

The doses calculated for exposure to individual chemicals are then compared to an established health guideline, such as an ATSDR minimal risk level (MRL) or an EPA reference dose (RfD), in order to assess whether adverse health impacts from exposure are expected. Health guidelines are chemical-specific values that are based on available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice to derive health guidelines is to identify, usually from animal toxicology experiments, a no observed adverse effect level (NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The known toxicological values are doses derived from human and animal studies that are summarized in ATSDR's *Toxicological Profiles (www.atsdr.cdc.gov/toxpro2.html).* The NOAEL is modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (e.g., children, pregnant women, the elderly), extrapolation from animals to humans, and the completeness of the available data. Thus, exposure doses at or below the established health guideline are not expected to cause adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies.

For non-cancer health effects, the following health guidelines were used in this health consultation:

Minimal Risk Levels (MRLs) are developed by ATSDR for contaminants commonly found at hazardous waste sites. The MRL is developed for ingestion and inhalation exposure, and for lengths of exposures: acute (less than 14 days); intermediate (between 15-364 days), and chronic (365 days or greater). ATSDR has not developed MRLs for dermal exposure (absorption through skin).

Reference Doses (RfDs) EPA developed chronic RfDs for ingestion and RfCs for inhalation as estimates of daily exposures to a substance that are likely to be without a discernable risk of deleterious effects to the general human population (including sensitive subgroups) during a lifetime of exposure.

If the estimated exposure dose to an individual is less than the health guideline value, the exposure is unlikely to result in non-cancer health effects. If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the health consultation. A direct comparison of site-specific exposures and doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur.

It is important to consider that the methodology used to develop health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer risk evaluation is necessary for potentially cancer-causing contaminants detected at this site.

Cancer Risks

Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated risk for developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific doses by EPA's chemical-specific cancer slope factors (CSFs) available at *www.epa.gov/iris*. This calculation estimates a theoretical excess cancer risk expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated risk of 1×10^{-6} predicts the probability of one additional cancer over background in a population of 1 million. An increased lifetime cancer risk is not a specified estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime in his or her lifetime following exposure to a particular contaminant under specific exposure scenarios. For children, the theoretical excess cancer risk is not calculated for a lifetime of exposure, but from a fraction of lifetime; based on known or suspected length of exposure, or years of childhood.

Because of conservative models used to derive CSFs, using this approach provides a theoretical estimate of risk; the true or actual risk is unknown and could be as low as zero. Numerical risk estimates are generated using mathematical models applied to epidemiologic or experimental data for carcinogenic effects. The mathematical models extrapolate from higher experimental doses to lower experimental doses. Often, the experimental data represent exposures to chemicals at concentrations orders of magnitude higher than concentrations found in the environment. In addition, these models often assume that there are no thresholds to carcinogenic effects--a single molecule of a carcinogen is assumed to be able to cause cancer. The doses associated with these estimated hypothetical risks might be orders of magnitude lower that doses reported in toxicology literature to cause carcinogenic effects. As such, a low cancer risk estimate of 1×10^{-6} and below may indicate that the toxicology literature supports a finding that no excess cancer risk is likely. A cancer risk estimate greater than 1×10^{-6}, however, indicates that a careful review of toxicology literature before making conclusions about cancer risks is in order.

APPENDIX C: ATSDR Public Health Hazard Conclusion Categories

ATSDR Public Health Hazard Categories
Depending on the specific properties of the contaminant, the exposure situations, and the health status of individuals, a public health hazard may occur. Using data from public health assessments and consultations, sites are classified using one of the following public health hazard categories:

Category 1: Urgent Public Health Hazard
Sites that pose a serious risk to public health as the result of short-term exposures to hazardous substances.

Category 2: Public Health Hazard
Sites that pose a public health hazard as the result of long-term exposures to hazardous substances.

Category 3: Potential/Indeterminate Public Health Hazard
Sites for which no conclusions about public health hazard can be made because data are lacking.

Category 4: No Apparent Public Health Hazard
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.

Category 5: No Public Health Hazard
Sites for which data indicate no current or past exposure or no potential for exposure and therefore no health hazard.