Health Consultation

PARADISE VALLEY WATER SYSTEM
North Indian Bend Wash Miller Road Treatment Facility

SCOTTSDALE, MARICOPA COUNTY, ARIZONA

EPA FACILITY ID: AZD980695969

AUGUST 22, 2008

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

PARADISE VALLEY WATER SYSTEM
North Indian Bend Wash Miller Road Treatment Facility

SCOTTSDALE, MARICOPA COUNTY, ARIZONA

EPA FACILITY ID: AZD980695969

Prepared By:

Arizona Department of Health
Under Cooperative Agreement with the
The U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Introduction

The North Indian Bend Wash (NIBW) Superfund site was added to the National Priorities List in 1983. As part of the remediation, the Miller Road Treatment Facility (MRTF) was built by the North Indian Bend Wash Participating Companies (PC's) to treat groundwater in order to reduce the levels of volatile organic compounds (VOCs) that have contaminated the aquifers. The MRTF was brought on-line in March 1997, and ownership was transferred to AAWC in December 1997. The MRTF processes the groundwater to remove the VOCs. Between January 15 – 17, 2008 trichloroethylene (TCE) was detected in the Paradise Valley Water System. Arizona American Water Company, who own and operate the Paradise Valley system, contacted the Arizona Department of Health Services (ADHS) and requested assistance in determining possible health risks from exposures related to this incidence. In response, the Arizona Department of Health Services reviewed existing data and performed a health consultation to evaluate the possibility of adverse health effects associated with this event.

Background

The Indian Bend Wash Superfund Site is located in Scottsdale and Tempe, Arizona in Maricopa County. The site is approximately 13 square miles and has been divided into North Indian Bend Wash and South Indian Bend Wash. The NIBW site is bounded by Chaparral Road on the north, the Salt River to the south, the Price Freeway (Loop 101) on the east, and Scottsdale Road on the west. The Miller Road Treatment Facility is located at 5975 North Miller Road at the intersection of Miller Road and McDonald Drive in Scottsdale, Arizona. In the area there are residences, manufacturing facilities, retail outlets, parks, open spaces, golf courses, and waterways. There are no schools, hospitals, churches, commercial day care facilities, or convalescent homes known to be located within 3,000 feet of the Miller Road Treatment Facility. The MRTF site is approximately 1.5 acres and is located just north of the northernmost tip of the contaminant plume (Appendix A).

Prior to the existence of our current environmental regulations, local industries improperly disposed of organic solvents directly onto the ground or into dry wells. Various industrial companies took advantage of this practice within the NIBW site up until the 1970's, a practice which subsequently contaminated all three levels of the aquifer. The solvents traveled through the soil matrix into the underlying aquifers, and contaminated the upper, middle, and lower aquifers with VOCs. The current levels of VOCs in the groundwater exceed the current water quality standard established by the US Environmental Protection Agency (EPA). Maximum Contaminant Levels (MCLs) are enforceable standards established by the EPA which are designed for use as a screening tool to look for potential health risks. Currently, three extraction wells supply water to the Miller Road Treatment Facility. These extraction wells are monitored on a monthly basis prior to treatment for trichloroethylene (TCE). Currently, only one of the wells (PCX-1) has TCE levels above the MCL for drinking water. The MCL for TCE is 5 parts per billion (ppb).
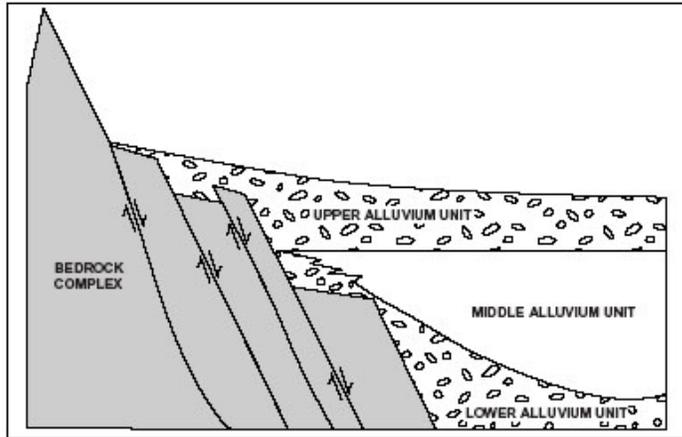
Figure 1. Components of Groundwater Aquifers

Image from EPA's Region 9 April 2001, North Indian Bend Wash North
Area Proposed Plan

The MRTF was built as a result of remedial actions to remove the contaminants from the lower alluvial groundwater. The project was established in 1997 and permitted by the Arizona Department of Environmental Quality. Three groundwater extraction wells provide the water to the treatment facility. There are three air stripper columns in the MRTF and each air stripper column was designed to remove the NIBW Contaminants of Concern (COCs) to below MCLs. Due to recent modifications to the system, a tower influent manifold allows water from two of the wells to be routed to either one of two air stripper columns. The third well, known as PCX-1, is routed to only one of the air stripper columns. Treated water from two of the wells is then directed to either the Arizona Canal or to the common clearwell which is pumped to the AAWC's distribution system. Well PCX-1 water is currently directed only to the Arizona Canal.

The facility runs 24 hours a day, and is currently manned on a 24-hour per day basis. There are safety systems which include alarms and a notification system in the event that the treatment facility fails or malfunctions. On the afternoon of January 15th, 2008, at which time the MRTF was manned only during the day, the operator left shortly before 3pm. When he arrived back at the facility early the following morning, he noticed that the air blower in the treatment tower had stopped working. He initially re-started the blower. He then contacted his superiors and started the procedures to shut down the system. By 9 am, on the 15th, the contaminated water was no longer entering the distribution system. The alarm and notification system had failed to warn the operator of the event. AAWC notified state and federal authorities of the failure. A reverse 911 notification system was implemented, and local news media was notified. Residents later criticized the reverse 911 system that was employed, because the system only used listed home telephone numbers, and many residents did not receive a notification directly from the water company to stop drinking the water. The TV news stations did run the health alerts notifying Paradise Valley residents to stop consuming water from the distribution system. The distribution system was flushed, and the contaminated well remained offline until authorities determined what course of action should be taken to ensure the public's health is protected. As part of the Participating Companies' agreement with EPA regarding the superfund site, the well is to remain online continuously. Continual pumping of well PCX-1 helps to keep the TCE plume from migrating. Therefore, authorities made efforts to get the well back online as soon as possible to protect public safety.[1]

Discussion

Data:

Water samples were collected at 18 locations throughout the distribution system on January 16, 17, 18, and 19, 2008. The results (detected concentration, sampling time) are listed in Table 1 (results are in parts per billion – ppb; ND: non-detected; detection limit 0.5 ppb).

Table 1: TCE Sample results from Paradise Valley Distribution System (0407056)

Sample Location	1/16/2008	1/17/2008	1/18/2008	1/19/2008
POE 004	22 ppb (09:19)	1.9 ppb (07:15)	ND	ND
	20 ppb (12:00)	0.8 ppb (15:30)	---	---
	18 ppb (15:08)	---	---	---
PV1	---	3.1 ppb (12:00)	ND	ND
	---	1.5 ppb (15:30)	---	---
PV2	---	3.1 ppb (12:00)	ND	1.9
	---	1.5 ppb (15:30)	---	---
PV3	---	1.6	ND	ND
PV4	---	5.6 ppb (12:00)	2.6	ND
	---	0.6 ppb (15:30)	---	---
PV5	---	1.3	ND	ND
PV6	---	1.4	2.2	ND
PV7	---	1.4	ND	ND
PV8	---	2.2 ppb (12:00)	0.7	ND
	---	1.4 ppb (15:30)	---	---
PV9	---	---	1.7	2
PV10	---	1.8	0.5	ND
HCBS	11	6.7	2.3	1.3
CWHBS	17	3.2	ND	ND
LBBS	20	3	0.6	ND
CCBS	21	2.4	ND	ND
GDBS	21	7.7	2.3	0.7
SCBS	23	2.4	ND	ND
SWPV	---	4.3	---	---

Exposure Pathways:

Identifying exposure pathways is important in a health consultation. Presence of a contaminant in the environment does not necessarily mean that people are actually coming into contact with that contaminant, thereby allowing the contaminant to be a threat to public health. Exposure pathways have been divided into three categories: Completed, Potential, and Eliminated. There are five elements to be considered when identifying exposure pathways: Source of Contamination, Environmental Medium through which chemicals travel, Point of Exposure, Route of Exposure, and Receptor Population. A completed exposure pathway is observed when all five elements are present. In a potential exposure pathway, one or more elements of the pathway cannot be identified, but it is possible that the element might be present or might have been present. In an eliminated exposure pathway, at least one element of the pathway is not present and either will never be present or is extremely unlikely to ever be present. Identifying an exposure pathway does not admit the presence or concentration of potential contaminants; it is simply a way of determining the possibility of exposure as if the contaminants were present in the medium. Table 2 shows the elements of the pathways.

Exposure Pathway Elements					Time	Type of Exposure Pathway
Source	**Media**	**Point of Exposure**	**Route of Exposure**	**Estimated Exposed Population**		
Contaminated Groundwater	Tap Water	Tap	Ingestion	4,751 Households and Businesses	Past	Potential
					Current	Completed
					Future	Potential
Contaminated Groundwater	Tap Water	Shower	Incidental ingestion; Inhalation; Dermal contact	4,444 Households	Past	Potential
					Current	Completed
					Future	Potential

Health Effects Evaluation:

A completed exposure pathway has been identified; however, people can be harmed only if they contact a chemical over time at levels high enough to cause adverse health effects. To determine whether residents in the vicinity of the MRTF were being exposed to contaminants over time and at levels high enough to cause adverse health effects, existing data was reviewed.

The first step (after identifying exposure pathways) is to determine if the contaminants are present at concentrations that are of concern (above the comparison values). If a contaminant is above the comparison value, it is selected for further analysis. However, if a contaminant is above the comparison value, it does not mean that the contaminant *will* cause adverse health effects. Comparison values are simply used as a screening tool to identify chemicals of interest

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which should be looked at more closely to determine if there *may* be any adverse health effect risks.

On January 16th, the TCE concentrations ranged from 11 ppb to 23 ppb. On January 17th, the TCE concentration ranged from 0.6 to 5.6 ppb. The Maximum Contaminant Level (MCL) for TCE is 5 ppb. MCLs are drinking water standards set by EPA in accordance with the Safe Drinking Water Act. MCLs are not health-based threshold levels. Instead, the MCLs include a substantial margin of safety to account for uncertainties in health studies and technology. Therefore, people ingesting chemicals at or slightly above MCLs will not experience any illness or other adverse health effects. For more information on MCLs and the EPA standard setting process, visit the EPA website at: http://www.epa.gov/safewater/mcl.html. On January 18th and 19th (after the contaminated well was taken off line) all samples were below the MCL. ADHS selected TCE as a chemical of interest.

If a contaminant is selected as a chemical of interest, a "dose" is calculated according to the specific exposure scenario surrounding the event or site. The dose is then compared to a health based guideline (HBGL). The HBGL used in this document is ATSDR's oral minimal risk level (MRL). MRLs are an estimate of the daily human exposure to a substance that is not likely to result in adverse health effects during a specific exposure scenario. (Table 1)

TCE is a colorless liquid which has been used as a solvent for cleaning metal parts. It has also been an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers. Breathing small amounts may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. Drinking small amounts for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women. Drinking or breathing high levels of TCE may cause nervous system effects, liver and lung damage, abnormal heartbeat, and coma. ADHS evaluated TCE exposure scenarios in adults, children, and infants. The results are summarized in the table entitled *Exposure Evaluation*.

Adults

In order to calculate a dose for adults, ingestion, inhalation, and dermal contact was considered. The calculated dose for adults was 0.002004 mg of TCE per kilogram (kg) of body weight per day. The Health Based Guidance Level is 0.2 mg of TCE per kg of body weight per day. The estimated dose is nearly 100 times lower than (1/100th) the Health Based Guidance Level. Based on this analysis, an acute exposure (less than 2 weeks) to TCE in this exposure scenario poses No Apparent Public Health Hazard to adults.

Children

In order to calculate a dose for children, ingestion, inhalation, and dermal contact was considered. The calculated dose for children was 0.0056 milligram (mg) of TCE per kilogram (kg) of body weight per day. The Health Based Guidance Level is 0.2 mg of TCE per kg of body weight per day. The estimated dose is 36 times lower than (1/36th) the Health Based Guidance Level. Based on this analysis, an acute exposure to TCE in this exposure scenario poses No Apparent Public Health Hazard to children.

Infants

In order to calculate a dose for infants, ingestion (mixing formula), inhalation, and dermal contact was considered. The calculated dose for infants was 0.00509 milligram (mg) of TCE per kilogram (kg) of body weight per day. The Health Based Guidance Level is 0.2 mg of TCE per kg of body weight per day. The estimated dose is 39 times lower than (1/39th) the Health Based Guidance Level. Based on this analysis, an acute exposure to TCE in this exposure scenario poses No Apparent Public Health Hazard to infants.

Table 1			
	Exposure Dose (mg/kg/day)	**Health Based Guidance Level** (mg/kg/day)	**Exceed the HBGL?**
Adults	0.0020		No
Children	0.0056	0.2	No
Infants	0.0051		No

These calculations were based on an acute exposure. An acute exposure is a short term exposure. Health effects from acute exposures generally show up immediately (within days to a few weeks). ADHS concludes that exposure to TCE during this event should not be an acute public health hazard.

Conclusions

Based on the data presented in this report, ADHS concludes that this short term event posed **no apparent public health hazard.**

Recommendations

The Arizona Department of Health Services has the following recommendation:

- Ensure that proper notification and emergency systems are in place to deal with emergency events.

- Perform routine testing to ensure that these systems work.

Public Health Action Plan

- The Arizona Department of Health Services will continue to review and evaluate data provided for this site

- The Arizona Department of Health Services will notify the property owners in the area of the findings of this health consultation.

References

1. **Personal Communications.** Information gathered from communications with Vice President of Arizona American Water, the Arizona Department of Environmental Quality Project Manager for the site, and the Scottsdale Operations Manager / Vice President with Errol L. Montgomery & Assoc., Inc., the firm representing the North Indian Bend Wash participating companies.

2. **Arizona American Water.** Memorandum to the Water Quality Division of the Arizona Department of Environmental Quality regarding "Arizona American Water Company – Paradise Valley Public Water System 04-07056, January 2008." February 6, 2008.

3. **ATSDR.** ToxFaqs for Trichlorothylene. Agency for Toxic Substances and Disease Registry. July 2003. http://www.atsdr.cdc.gov/tfacts19.pdf

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Cooperative Agreement and Program Evaluation Branch

Cooperative Agreement Program

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Certification

This Paradise Valley Water System, North Indian Bend Wash, Miller Road Treatment Facility Health Consultation was prepared by the Arizona Department of Health Services under cooperative agreement with the Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and procedures existing at the time the exposure investigation report was begun.
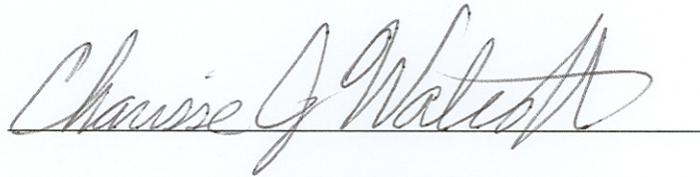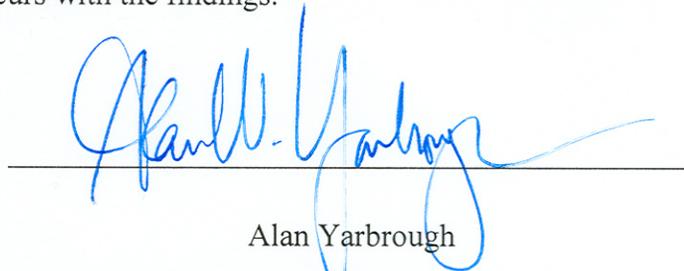
Charisse J Walcott

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Technical Project Officer

CAT, CAPEB, DHAC, ATSDR

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

Alan W. Yarbrough

Alan Yarbrough

Team Leader-Cooperative agreement Program

CAT, CAPEB, DHAC, ATSDR

Appendix A
Calculations

Adults

Ingestion (from drinking and cooking):

$$D_i = \frac{CW \times IR}{BW} \qquad D_i = \frac{.023 \times 2}{70} = 0.00066$$

- D_i = Dose from ingestion of water from drinking and cooking – milligrams per kilogram per day (mg/kg/day)
- CW = Concentration of TCE in the water – .023 milligrams per L (mg/L), the highest detected level of TCE
- IR = Ingestion Rate – 2 Liters/Day
- BW = Bodyweight – 70 kilograms (kg)

Showering (inhalation & dermal contact):

$$CA = \frac{CW \times F \times WF \times T}{V} \qquad CA = \frac{0.023 \times 1 \times 12 \times 10}{10} = 0.276$$

- CA = Concentration of TCE in the air in milligrams per cubic meter (mg/m^3)
- CW = Concentration of TCE in water in milligrams per liter (mg/L)
- F = Fractional volatilization rate (no units)
- WF = Water flow rate in liters per minute (L/min)
- V = Bathroom volume in cubic meters (m^3)

    A. inhalation during shower

$$D_{si} \frac{CA \times IR \times T}{AT \times BW} \qquad D_{si} \frac{0.276 \times 15 \times 10}{1440 \times 70} = 0.00041$$

- D_{si} = Dose from inhalation in shower – milligrams per kilogram per day (mg/kg/day)
- CA = Concentration of TCE in the air
- IR = Inhalation Rate – 15 cubic meters per day (m^3/Day)
- T = Time spent taking shower – 10 minutes (min)
- AT = Averaging time – 1440 minutes per day (min/day)
- BW = Bodyweight – 70 kilograms (kg)

Appendix A
Calculations

B. dermal contact while showering

$$D_{ds} = D_{si} = \frac{CW \times IR}{AT \times BW} \qquad D_{ds} = D_{si} = \frac{0.276 \times 15 \times 10}{1440 \times 70} = 0.00041$$

D_{ds} = Dose from dermal contact while showering – milligrams per kilogram per day (mg/kg/day)

D_{si} = Dose from inhalation in shower – milligrams per kilogram per day (mg/kg/day)

CW = Concentration of TCE in the air
IR = Inhalation Rate – 15 cubic meters per day (m^3/Day)
T = Time spent taking shower – 10 minutes (min)
AT = Averaging time – 1440 minutes per day (min/day)
BW = Bodyweight – 70 kilograms (kg)

C. inhalation during time spent in bathroom after shower

$$D_{ib} = \frac{CA \times IR \times T}{AT \times BW} \qquad D_{ib} = \frac{0.276 \times 15 \times 15}{1440 \times 70} = .00062$$

D_{ib} = Dose from inhalation in bathroom after shower – milligrams per kilogram per day (mg/kg/day)
CA = Concentration of TCE in the air
IR = Inhalation Rate – 15 Liters/Day
T = Additional time spent in bathroom – 15 minutes (min)
AT = Averaging time – 1440 minutes per day (min/day)
BW = Bodyweight – 70 kilograms (kg)

Total Adult Dose = D_i + D_{si} + D_{ds} + D_{ib} = 0.002 mg/kg/day

Appendix A
Calculations

Children

Ingestion (from drinking and cooking):

$$D_i = \frac{CW \times IR}{BW} \quad D_i = \frac{.023 \times 1}{16} = 0.0014$$

D_i = Dose from ingestion of water from drinking and cooking – milligrams per kilogram per day (mg/kg/day)

CW = Concentration of TCE in the water – .023 milligrams per L (mg/L), the highest detected level of TCE

IR = Ingestion Rate – 1 Liters/Day

BW = Bodyweight – 16 kilograms (kg)

Showering (inhalation & dermal contact):

$$CA = \frac{CW \times F \times WF \times T}{V} \quad CA = \frac{0.023 \times 1 \times 12 \times 10}{10} = 0.276$$

CA = Concentration of TCE in the air in milligrams per cubic meter (mg/m^3)

CW = Concentration of TCE in water in milligrams per liter (mg/L)

F = Fractional volatilization rate (no units)

WF = Water flow rate in liters per minute (L/min)

V = Bathroom volume in cubic meters (m^3)

    A. inhalation during shower

$$D_{si} \frac{CA \times IR \times T}{AT \times BW} \quad D_{si} \frac{0.276 \times 10 \times 10}{1440 \times 16} = 0.0012$$

D_{si} = Dose from inhalation in shower – milligrams per kilogram per day (mg/kg/day)

CA = Concentration of TCE in the air

IR = Inhalation Rate – 10 cubic meters per day (m^3/Day)

T = Time spent taking shower – 10 minutes (min)

AT = Averaging time – 1440 minutes per day (min/day)

BW = Bodyweight – 16 kilograms (kg)

Appendix A
Calculations

B. dermal contact while showering

$$D_{ds} = D_{si} = \frac{CW \times IR}{AT \times BW} \qquad D_{ds} = D_{si} = \frac{0.276 \times 10 \times 10}{1440 \times 16} = 0.0012$$

D_{ds} = Dose from dermal contact while showering – milligrams per kilogram per day (mg/kg/day)

D_{si} = Dose from inhalation in shower – milligrams per kilogram per day (mg/kg/day)

CW = Concentration of TCE in the air

IR = Inhalation Rate – 10 cubic meters per day (m^3/Day)

T = Time spent taking shower – 10 minutes (min)

AT = Averaging time – 1440 minutes per day (min/day)

BW = Bodyweight – 16 kilograms (kg)

C. inhalation during time spent in bathroom after shower

$$D_{ib} = \frac{CA \times IR \times T}{AT \times BW} \qquad D_{ib} = \frac{0.276 \times 10 \times 15}{1440 \times 16} = .0018$$

D_{ib} = Dose from inhalation in bathroom after shower – milligrams per kilogram per day (mg/kg/day)

CA = Concentration of TCE in the air

IR = Inhalation Rate – 10 cubic meters per day (m^3/Day)

T = Additional time spent in bathroom – 15 minutes (min)

AT = Averaging time – 1440 minutes per day (min/day)

BW = Bodyweight – 16 kilograms (kg)

Total Child Dose = D_i + D_{si} + D_{ds} + D_{ib} = 0.0056 mg/kg/day

Appendix A
Calculations

Infants drinking formula

Ingestion (from drinking formula):

$$D_i = \frac{CW \times IR}{BW} \quad D_i = \frac{.023 \times 1}{10} = 0.0023$$

D_i = Dose from ingestion of water from drinking and cooking – milligrams per kilogram per day (mg/kg/day)

CW = Concentration of TCE in the water – .023 milligrams per L (mg/L), the highest detected level of TCE

IR = Ingestion Rate – 1 Liters/Day

BW = Bodyweight – 10 kilograms (kg)

Showering (inhalation & dermal contact):

$$CA = \frac{CW \times F \times WF \times T}{V} \quad CA = \frac{0.023 \times 1 \times 12 \times 10}{10} = 0.276$$

CA = Concentration of TCE in the air in milligrams per cubic meter (mg/m^3)

CW = Concentration of TCE in water in milligrams per liter (mg/L)

F = Fractional volatilization rate (no units)

WF = Water flow rate in liters per minute (L/min)

V = Bathroom volume in cubic meters (m^3)

    A. inhalation during shower

$$D_{si} \frac{CA \times IR \times T}{AT \times BW} \quad D_{si} \frac{0.276 \times 4.5 \times 10}{1440 \times 10} = 0.00086$$

D_{si} = Dose from inhalation in shower – milligrams per kilogram per day (mg/kg/day)

CA = Concentration of TCE in the air

IR = Inhalation Rate – 4.5 cubic meters per day (m^3/Day)

T = Time spent taking shower – 10 minutes (min)

AT = Averaging time – 1440 minutes per day (min/day)

BW = Bodyweight – 10 kilograms (kg)

Appendix A
Calculations

B. dermal contact while showering

$$D_{ds} = D_{si} = \frac{CW \times IR}{AT \times BW} \qquad D_{ds} = D_{si} = \frac{0.276 \times 4.5 \times 10}{1440 \times 10} = 0.00086$$

D_{ds} = Dose from dermal contact while showering – milligrams per kilogram per day (mg/kg/day)

D_{si} = Dose from inhalation in shower – milligrams per kilogram per day (mg/kg/day)

CW = Concentration of TCE in the air

IR = Inhalation Rate – 4.5 cubic meters per day (m^3/Day)

T = Time spent taking shower – 10 minutes (min)

AT = Averaging time – 1440 minutes per day (min/day)

BW = Bodyweight – 10 kilograms (kg)

C. inhalation during time spent in bathroom after shower

$$D_{ib} = \frac{CA \times IR \times T}{AT \times BW} \qquad D_{ib} = \frac{0.276 \times 4.5 \times 15}{1440 \times 10} = .0013$$

D_{ib} = Dose from inhalation in bathroom after shower – milligrams per kilogram per day (mg/kg/day)

CA = Concentration of TCE in the air

IR = Inhalation Rate – 4.5 cubic meters per day (m^3/Day)

T = Additional time spent in bathroom – 15 minutes (min)

AT = Averaging time – 1440 minutes per day (min/day)

BW = Bodyweight – 10 kilograms (kg)

Total Infant Dose = D_i + D_{si} + D_{ds} + D_{ib} = 0.005 mg/kg/day