Appendix D:

Exposure Calculations

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Non-Cancerous:

Past Ingestion Exposure from PCE in public drinking water

The maximum level of PCE detected from city well No. 2 that users may have been exposed to for a period of time is considered to be 89 ppb.

$$\text{Ingestion Exposure Dose} = \frac{C \times IR \times EF}{BW}$$

where:
C = contaminant concentration (mg/L)
IR = ingestion rate
EF = Exposure Factor
BW = body weight

Adult: (89 ppb = 0.089 ppm = 0.089 mg/L)
This calculation assumes that an adult weighs 70 Kg and drinks 2 L of tap water per day.

$$\text{Ingestion Exposure Dose} = \frac{0.089 \text{ PCE mg/L} \times 2 \text{ L/day water} \times 1}{70 \text{ kg}}$$

Ingestion Exposure Dose = 0.0025 mg/Kg/day

Child:
This calculation assumes that a child weighs 10 Kg and drinks 1 L of tap water per day.

$$\text{Ingestion Exposure Dose} = \frac{0.089 \text{ PCE mg/L} \times 1 \text{ L/day water} \times 1}{10 \text{ Kg}}$$

Ingestion Exposure Dose = 0.0089 mg/Kg/day

Past Ingestion Exposure from PCE in private wells:

Users of PCE contaminated private wells are assumed to have been exposed to 210 ppb of PCE for a 12-year period of time. It is not likely that private well users were exposed at this level or for this period of time, but these assumptions are made to develop a worst-case exposure scenario.

Adult: (210 ppb = 0.210 ppm = .021 mg/L)

$$\text{Ingestion Exposure Dose} = \frac{0.210 \text{ PCE mg/L} \times 2 \text{ L/day water} \times 1}{70 \text{ Kg}} =$$

Ingestion Exposure Dose = 0.006 mg/Kg/day

Child:

$$\text{Ingestion Exposure Dose} = \frac{0.210 \text{ PCE mg/L} \times 1 \text{ L/day water} \times 1}{10 \text{ Kg}} =$$

Ingestion Exposure Dose = 0.021 mg/Kg/day

Total Past Exposure for PCE in Drinking Water (Ingestion and Inhalation Exposure)

Because the user of a PCE contaminated water supply would also have exposure through inhalation as PCE volatilizes into the air, inhalation exposure must be included as part of the exposure. Most of this inhalation exposure takes place during and after showering as time spent in the bathroom. To consider both pathways of exposure and their additive effect, we double the ingestion exposure dose for a conservative (more protective) value to include both pathways.

Total Past Public Drinking Water Exposure

Total Adult Exposure Dose: 0.0025 mg/Kg/day x 2 = 0.0050 mg/Kg/day

Total Child Exposure Dose: 0.0089 mg/Kg/day x 2 = 0.0178 mg/Kg/day

Total Past Private Well Exposure

Total Adult Exposure Dose: 0.006 mg/Kg/day x 2 = 0.012 mg/Kg/day

Total Child Exposure Dose: 0.021 mg/Kg/day x 2 = 0.042 mg/Kg/day

ATSDR's Acute (14 days or less) ingestion MRL for PCE = 0.05 mg/Kg/day.
ATSDR has not derived an intermediate (15-364 days) ingestion exposure MRL for PCE.
ATSDR has not derived a chronic (365 days or more) ingestion exposure MRL for PCE.

Cancer:

Using the assumption that PCE is carcinogenic, even though it is under review by EPA as to its carcinogenicity, the following calculation is used to approximate its theoretical risk if it would be determined to be carcinogenic in humans. Calculations assume that users of the New Haven public water supply were exposed at the maximum level of PCE contamination (89 ppb) for seven years.

Formula:

$$\text{Cancer Risk} = \frac{\text{Exposure dose x risk factor x years exposure}}{\text{70 years (lifetime)}}$$

Public Drinking Water Cancer Risk:

(Risk factor = 0.052 EPA's Oral Slope Factor)

$$\textbf{Adult Cancer Risk} = \frac{0.0050 \text{ mg/Kg/day} \times 0.052 \text{ (mg/Kg/day)}^{-1} \times 7 \text{ years}}{70 \text{ years}} =$$

Adult Cancer Risk = 0.000026 = 2.6 x 10^{-5}

$$\textbf{Child Cancer Risk} = \frac{0.0178 \text{ mg/Kg/day} \times 0.052 \text{ (mg/Kg/day)}^{-1} \times 7 \text{ years}}{70 \text{ years}} =$$

Child Cancer Risk = 0.000093 = 9.3 x 10^{-5}

Note : A child is considered a child for only 6 years so this cancer risk calculation overestimates the child's cancer risk.

Private Well Water Cancer Risk:

Calculations assume that private well users were exposed to PCE contaminated well water at a level of 210 ppb for a period of 12 years to develop a worst-case exposure scenario.

$$\textbf{Adult Cancer Risk} = \frac{0.012 \text{ mg/Kg/day} \times 0.052 \text{ (mg/Kg/day)}^{-1} \times 12 \text{ years}}{70 \text{ years}} =$$

Adult Cancer Risk = 0.00011 = 1.1 x 10^{-4}

$$\textbf{Child Cancer Risk} = \frac{0.042 \text{ mg/Kg/day} \times 0.052 \text{ (mg/Kg/day)}^{-1} \times 12 \text{ years}}{70 \text{ years}} =$$

Child Cancer Risk = 0.00037 = 3.7 x 10^{-4}

Note : A child is considered a child for only 6 years so this cancer risk calculation overestimates the child's cancer risk.