# Health Consultation

Evaluation of Current and Future Fish Consumption from
Willow Springs Ponds

**SCHLAGE LOCK COMPANY**

**COLORADO SPRINGS, EL PASO COUNTY, COLORADO**

**EPA FACILITY ID: COD082657420**

**MAY 1, 2007**

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

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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:

The Colorado Department of Public Health and Environment
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

# Table of Contents

# Foreword

The Colorado Department of Public Health and Environment's (CDPHE) Environmental Epidemiology Section has prepared this health consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the US Department of Health and Human Services and is the principal federal public health agency responsible for the health issues related to hazardous waste. This health consultation was prepared in accordance with the methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful health effects resulting from exposure to hazardous substances in the environment. Health consultations focus on health issues associated with specific exposures so that the state or local department of public health can respond quickly to requests from concerned citizens or agencies regarding health information on hazardous substances. The Environmental Epidemiology Section (EES) evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur in the future, reports any potential harmful effects, and then recommends actions to protect public health. The findings in this report are relevant to conditions at the site during the time this health consultation was conducted and should not necessarily be relied upon if site conditions or land use changes in the future.

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# Purpose

The purpose of this health consultation is to evaluate additional fish tissue data collected from Willow Springs Ponds (WSP) in 2006 to determine if the ponds are safe to reopen to the general public. WSP have been closed to public fishing since September 1997. El Paso County, Colorado officials will be reopening the ponds to the public for recreational fishing in the near future (Summer of 2007). This document will serve as a tool for county and state health officials to make risk management decisions regarding the opening of WSP.

# Summary and Statement of Issues

WSP are spring-fed ponds located at the distal extent of a tetrachloroethene (PCE) plume that originates at the Schlage facility approximately 4 miles north and east of the ponds in Security, El Paso County, Colorado (Figure 1). WSP was a popular recreational fishing area that has been closed since September 1997, shortly after the contamination was initially discovered. Recently, El Paso County officials have decided to reopen WSP to the public for recreational fishing due to decreasing PCE concentrations in the water and fish tissue.

The Colorado Department of Public Health and Environment (CDPHE) conducted a health consultation on WSP in 2006 (CDPHE 2006) and determined that all past and current exposures posed no apparent public health hazard. Future exposures were classified as an indeterminate public health hazard because the PCE in fish tissue indicated that some groups of individuals might be at risk of carcinogenic health effects based on the last available data, collected in 2004. That document recommended that additional fish tissue be collected to determine the current levels of PCE in fish tissue for evaluating future exposures. Sediment data from WSP was also identified as a data gap and it was recommended that sediment data be collected to determine the potential adverse health effects from this pathway.

In November 2006, Schlage Lock Company (Schlage) collected additional fish tissue data from Willow Springs Ponds (WSP). This consultation evaluates the current and future health impacts from exposure to PCE contaminated fish, surface water, and sediment.

After evaluating the additional fish tissue, sediment, and surface water data, it was determined that current and future exposures represent no apparent public health hazard provided that anglers, particularly subsistence fishers, adhere to the fish consumption advisory issued by CDPHE. The fish advisory is designed to limit the amount and types of fish species taken from WSP and provide information to the public on “safe” fish consumption habits.

## Background

The background description of the site was included in the initial health consultation conducted in 2006 (CDPHE 2006). The following information summarizes and supplements the previously described background data. Please refer to the original health consultation for additional background information.

The Schlage Lock Company (Schlage), located at 3899 Hancock Expressway, Security, Colorado began operations manufacturing door locks and related hardware in August 1977. From late 1977 until mid 1992, Schlage used PCE as a metal cleaner and degreaser. In mid-July 1987, Schlage discovered PCE contamination in the subsurface soil on their property during excavation for plant expansion. A preliminary investigation, conducted in 1987, revealed that the PCE had leached down to groundwater beneath the site. It was later found that the contaminant had migrated into the Widefield Aquifer, the primary source of drinking water for the surrounding communities.

The PCE plume currently extends approximately 4 miles south-southwest from the Schlage facility to WSP (Figure 2). WSP are located within Fountain Creek Regional Park, which lies approximately 0.25 mile southeast of the Interstate 25 and CO Highway 16 intersection in El Paso County, Colorado (ESC 2003). The source water for these spring-fed ponds is the Widefield Aquifer.

Willow Springs Pond 1 is the northernmost and larger of the two ponds (Figure 3). Pond 1 was constructed approximately 30 years ago as a gravel pit. The pond is unlined and covers an area of approximately 5.6 acres with a maximum depth of 12 feet (ESC 2003). Willow Springs Pond 2 is located to the south of pond 1 and covers an area of approximately 1.8 acres. Pond 2 has a maximum depth of 5 feet. It was constructed in 1989 and is lined with bentonite. However, the integrity of the liner is unknown. Pond 2 receives water from Pond 1 via a screened connecting pipe located on the south end of Pond 1.

PCE was initially detected in Pond 1 on August 21, 1996 at an approximate concentration of 2.2 ppb. Additional environmental sampling indicated that PCE was also accumulating in fish tissue at levels of potential concern. Subsequently, the El Paso County Board of Commissioners closed the ponds to all fishing on September 10, 1997 pending further fish sampling and analysis. WSP remained closed at the time of this publication.

To restore water quality within WSP to an acceptable level, Schlage installed a 25-horsepower mechanical aerator on February 9, 1999. The original aerator was replaced on July 9, 2002 with another 25-horsepower aerator and a second 25-hp aerator was added on July 29, 2003. The PCE concentration in WSP Pond 1 water has been monitored on a monthly basis since the original aerator was installed. Overall, the PCE concentration appears to be decreasing. In addition, Schlage and El Paso County have recently reached a settlement agreement, which includes the installation of an upgradient sparge system designed to remove PCE from groundwater before it enters WSP.

WSP have served as valuable assets to the county in the past, and officials would like to see them returned to service as a functional recreational fishing area. Based on the decreasing concentration of PCE within the ponds and fish tissue, El Paso County Commissioners will be reopening Willow Springs Ponds to the public this summer. This health consultation evaluates current and future fishing exposures once WSP is reopened to the public.

### Demographics

The most frequent users of WSP are likely those individuals that live within a close proximity to Fountain Creek Regional Park. U.S. Census 2000 data for this area does not possess any striking demographic characteristics that would normally have an effect on this evaluation. However, El Paso County health officials have raised concerns that a substantial Asian population exists in the area that may have used WSP for subsistence fishing before the closure. The overall percentage of Asians within El Paso County is approximately 2.5 percent or 13,099 individuals (U.S. Census 2000, Population of one race, Asian alone). Moreover, some census tracts near WSP were in the highest tier of percent Asian of total tract population for all census tracts in El Paso County. Figure 4 is a geographic information system (GIS) graphic depiction of percent Asian population by census tract in El Paso County.

## Community Health Concerns

Community health concerns regarding the PCE contamination within the Widefield Aquifer were solicited and documented in the "Community Involvement and Health Issues Communication Plan" (CDPHE 2004). In addition, Schlage Lock and the Hazardous Waste and Waste Management Division (HWWMD) at CDPHE have also conducted public involvement activities in the affected communities. Their findings were documented in the "Community Involvement Plan for the Schlage Lock Company Site" (Schlage 2001). Community concerns from both documents are summarized below.

Previously Identified Community Concerns (Schlage 2001):

- Safety of the drinking water supply,
- Property Values,
- Progress on the Willow Springs Ponds remediation, and
- Testing of pumping wells west of U.S. Highways 85 and 87.

Current Community Concerns (CDPHE 2004):

- The possibility of PCE exposure causing brain cancer, lymphatic cancer, or other types of cancer,
- The possibility of PCE exposure resulting in respiratory problems, and
- The health of domestic dogs that have swam in Willow Springs Ponds.

The primary health concerns within the community from exposure to PCE appear to be cancer and other non-carcinogenic health effects, such as respiratory problems. The intent of this health consultation is to evaluate any potential adverse human health effects, including cancer, from exposure to PCE in contaminated fish tissue in WSP. Other pathways of exposure have been evaluated for carcinogenic risk in separate health consultations. Please see the "Public Health Action Plan" section of this document for a list of all other health consultations available on this site.

# Discussion

## Data Used

The data utilized for this assessment was collected from three primary environmental media including fish tissue, surface water, and sediment. The fish tissue data used in this assessment was collected in 2004 and 2006. Surface water data has been collected on a regular basis since 1996 and sediment data was collected on four separate occasions between 1997 and 2004. A brief description of each medium used in this assessment is provided below.

In September 2006, the Colorado Division of Wildlife collected additional fish samples from WSP to assess the current concentrations of PCE in fish tissue. Fish were collected using gill nets and were sent to GPL Laboratories in Frederick, Maryland for analysis by EPA Method 8260. A total of 12 fish were captured and analyzed including 6 Western White Suckers (WWS) and 6 Bass. The fish were weighed and their length measured prior to shipment to the laboratory. Edible fish fillet tissue was analyzed for 1, 2 dichloroethane, cis 1,2-dichloroethene, trans 1,2-dichloroethene, trichloroethene, and tetrachloroethene. The lipid percentage of each fillet was also quantified.

The 2006 fish data was analyzed for edible fish fillet only. Therefore, the 2004 data set for whole fish was used to evaluate exposure to whole fish. The general characteristics of the 2004 data collection and analysis are consistent with the most recent data collection characteristics outlined above. Twenty-five samples were collected in 2004, including 14 whole and 11 fillet fish tissue samples. Tables 1-3 contain the 2004 and 2006 fish tissue data by numbers of species and tissue type. In addition to bass and sucker species, edible catfish and green sunfish samples were also collected. Whole fish tissue data is available for suckers and European Rudd.

Surface water data was used to demonstrate a decreasing trend in PCE concentrations and to draw conclusions about its affect on the PCE concentration in fish tissue and sediment. However, a quantitative analysis was not conducted as dermal exposures to surface water in WSP was discussed in the previous health consultation and found to be a minor contributor to the overall health risk. (Note: Swimming is prohibited in WSP).

Schlage Lock and El Paso County collected the sediment data utilized in this assessment on four separate occasions between 1997 and 2004. A total 18 sediment samples were collected, primarily from the north pond (Pond #1). The samples were analyzed for PCE

and other volatile organic compounds (VOCs) by EPA method 8260B. The entire sediment data set is presented in Table 4.

## Exposure Evaluation

The initial steps of the assessment process involve screening the available environmental data for contaminants and then comparing this information to conservative, health-based environmental guidelines. Exposures to contaminated sources below the environmental guidelines are not expected to result in adverse or harmful health effects. If the concentration of a particular contaminant is above the chosen environmental guideline, the contaminant is normally retained for further analysis as a contaminant of potential concern (COPC). However, exceeding the screening value does not necessarily mean that the contaminant poses a public health hazard, only that further evaluation may be necessary. CDPHE's Environmental Epidemiology Section (EES) also consider sampling location, data quality, exposure probability, frequency and duration; and community health concerns in determining which contaminants to evaluate further.

If the contaminant is selected for extended evaluation, the next step is to identify pathways of probable exposure that could pose a hazard. Simply having the substance present in the environment does not necessarily mean that people will come into contact with it and subsequently experience adverse health effects. An exposure pathway consists of five elements: a source, a contaminated environmental medium, and transport mechanism, a point of exposure, a route of exposure, and a receptor population. Exposure pathways are classified as either complete, potential, or eliminated. Only complete exposure pathways can be fully evaluated and characterized to determine the public health implications. Site-specific contaminants of concern and completed exposure pathways are discussed further in the section below.

## Conceptual Site Model

Three primary routes of exposure can occur at a contaminated water body such as WSP including ingestion of contaminated fish, dermal contact with surface water while swimming/ wading (including incidental ingestion), and dermal contact with sediments while swimming/wading (including incidental ingestion). This assessment focuses on the ingestion of contaminated fish as well as dermal contact and incidental ingestion of sediments. As previously mentioned, dermal contact and incidental ingestion of surface water while swimming /wading was evaluated in the previous health consultation and was found to be an insignificant contributor to overall health risk due to the low concentrations of PCE in WSP. Therefore, surface water exposure pathways will not be quantitatively reevaluated in this consultation.

This evaluation of fish tissue focuses on current and future exposures to fishers based on the most recent data. Sediment data was identified as a data gap in the previous health consultation and historical sediment data was made available to the EES for this review.

## COPC Selection

Three sources of screening values were used in this assessment to evaluate exposures to PCE in fish tissue, surface water, and sediment. The Environmental Protection Agency's Region 3 Risk Based Concentration of 5.8 parts per billion (ppb) was used to screen fish tissue samples, EPA's Region 9 Preliminary Remediation Goal (PRG) of 480 ppb was used to screen sediment data, and the Colorado surface water quality standard was used to screen surface water data.

The EPA Region 3 RBC is a conservative screening value based on thirty years of fish consumption for the average adult consuming 54 grams of fish per day, 350 days per year. The maximum detected concentration of 19 ppb from the edible fish tissue samples exceeds the RBC. Ten of the 14 whole tissue samples exceed the screening value with a maximum concentration of 35.16 ppb. Higher concentrations of PCE are expected in whole fish tissue since PCE is a lipophilic compound, which tends to accumulate in the fatty tissues of the fish outside the fillet portion. All fish tissue will be carried forward to the next step of the evaluation process for PCE only and all other contaminants were not selected as COPCs (1, 2-dichloroethane, cis 1,2-dichloroethene, trans 1,2-dichloroethene, trichloroethene).

EPA Region 9 includes dermal contact, inhalation, and ingestion routes of exposure in the derivation of the PRG value for soils. The PRG value is considered a conservative screening value when used to identify potential health risks of exposure to contaminated sediments. All available sediment data is well below the PRG value for soil with a maximum detected concentration of 6.1 ppb (J-Qualified). The maximum detected concentration of PCE in sediments is nearly two orders of magnitude lower than the PRG of 480 ppb. Since the maximum detected concentration of PCE in sediments does not exceed the soil screening value for the residential use, it will not be carried further in the assessment. Contact with PCE in WSP sediments is not likely to result in adverse human health effects.

Surface water concentrations of PCE were screened against CDPHE's surface water quality standard for fish consumption and water ingestion of 0.69 ppb. Thirty-seven surface water samples were collected from WSP in 2006, and only 1 sample exceeded the screening value at a concentration of 0.78 ppb. The mean value of all surface water samples in 2006 was 0.30 ppb, less than half of the surface water standard for this body of water. Minor fluctuations in PCE concentrations are expected to occur in WSP as operators determine the optimal run cycles of the aerators throughout the year. The PCE concentrations in the surface water in WSP are not likely to result in adverse health effects and will not be quantitatively evaluated further in the assessment. Figure 6 is a graphic depiction of the PCE concentration trends in WSP over time.

## Public Health Implications

To estimate exposure doses from ingestion of PCE contaminated fish when WSP are reopened to fishing, three distinct ingestion rate values were used to account for the wide variation in fish consumption across the exposed population. As previously mentioned,

there is some evidence to suggest that the potentially exposed population surrounding WSP may include subsistence fishers. Subsistence fishers will typically consume a much higher amount of fish per day than recreational fishers or members of the general population. To account for this possibility, the exposure doses must include a high-end ingestion rate for subsistence fishers. On the other hand, calculating exposure doses for subsistence fishers alone will highly overestimate the exposure to the general population. Thus, three values were utilized to calculate exposure doses for the 3 distinct subpopulations of interest: general population, recreational fishers, and subsistence fishers. The results of these calculations can be found in tables (Appendix Tables C1 and C2). For more information of the exposure dose assumptions and calculations, refer to Appendix C.

Generally speaking, edible fish tissue samples are preferred in health assessments over whole fish samples since most people only consume the fillet portion of the fish. However in this case, the subsistence population of interest, namely Asian Americans, may include whole fish in certain meals. Therefore, exposure doses were calculated for fish fillet and whole fish tissue.

Exposure to PCE can result in non-carcinogenic and carcinogenic adverse health effects. Carcinogenic adverse health effects are the most sensitive endpoint with non-cancer adverse health effects occurring at much higher doses. For example, the highest estimated dose in this assessment was 0.00005 mg/kg-day (when adjusted for non-cancer variables) and the EPA oral reference dose for non-cancer health effects is 0.01 mg/kg-day. Thus, no non-cancer adverse health effects are likely to occur from the exposures encountered in this assessment. Exposure doses are only discussed for carcinogenic risk because the highest exposures (for those who consume large amounts of fish) are well below a level of concern for non-cancer adverse effects. For more information on the health guidelines (or toxicity values) used in this assessment, please refer to Appendix B.

The estimated exposure dose results for the three categories of fish consumption rates range from $2.0 * 10^{-7} – 2.0 * 10^{-5}$ mg/kg-day, which results in a theoretical cancer risk range of $1.1 * 10^{-7} – 1.1 * 10^{-5}$, respectively. Thus, the highest estimated dose, which results from the ingestion of 142.4 grams of fish per day (subsistence fisher), 240 days per year for 30 years, would theoretically result in 11 excess cancer cases per million people. It should be noted that the exposure frequency of 240 days per year is based on the assumption of no consumption of locally caught fish during four months of winter.

EPA's acceptable theoretical cancer risk level range is $1 * 10^{-4}$- $1*10^{-6}$ depending on site-specific circumstances. CDPHE's risk management action level for fish consumption is $1 * 10^{-5}$ because of the potential health benefits from eating fish. Based on the consumption of locally caught fish during the eight warm weather months, the highest estimated exposure dose for consumption of whole fish exceeds CDPHE action level. However, based on the limited amount of information currently available on the historical use of WSP for fish consumption, subsistence ingestion rates and the subsequent exposure doses may overestimate or underestimate any actual exposures.

In addition, when the current fish tissue data is compared with the Cancer Risk Based Fish Consumption Limit Guidelines (FCLG) provided in Appendix Table C3, the cancer risks are above the cancer risk level of $1 * 10^{-5}$ for several categories of fish consumption (edible fillet as well as whole fish). FCLG tables are designed to enable risk assessors and risk managers to set acceptable, or "safe" take limits on fish. It should be noted that to be consistent with the CDPHE policy, FCLGs are based on the assumption of exposure throughout the year for a lifetime exposure duration of 70 years.

Schlage and their environmental contractor, WSP Environmental, have been remediating the ponds since 1999 and additional remedial actions are planned for the future. The PCE concentrations in water and fish have been decreasing over time and are expected to continue to decline in the future. In addition, Schlage has committed to stocking WSP with predator fish species to restore the ecosystem within the ponds and eliminate some of the remaining fish species that have traditionally been sampled. Moreover, the Colorado Division of Wildlife will be stocking the ponds with fresh trout, which have not been exposed to high levels of PCE in WSP. These actions are likely to decrease the overall PCE concentration in fish tissue available to anglers.

Overall, it appears that when WSP is reopened for recreational fishing, it would represent no apparent public health hazard with the following stipulations:

- The fish advisory, issued by the CDPHE, to limit the take and consumption of fish of fish from WSP is followed,
- The CDPHE fish advisory includes a warning regarding the consumption of whole fish tissue, and
- Health education and community outreach activities are carried out to inform community members of the fish advisory and proper cooking and preparation methods.

## Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health. For example, infants can be exposed to PCE that has been transferred into breast milk. Additionally, PCE can also cross the placenta. Therefore, the developing fetus and infants should be considered a susceptible population for exposure to PCE. It should be noted that fish also contains high quality proteins and other essential nutrients,

and are low in saturated fat and contain omega-3 fatty acids, which can contribute to children's proper growth and development (EPA 2004).

Child exposure estimates were calculated in this assessment. The estimated exposure doses for children do not indicate any increased risk of non-carcinogenic adverse health effects. No other special public health considerations are indicated for children in this consultation.

## Conclusions

Willow Springs Ponds were closed to anglers shortly after the PCE contamination was discovered in 1996. Past exposures (prior to 2006) were addressed in a previous health consultation. El Paso County officials will be reopening WSP due to decreasing PCE levels in fish tissue and surface water. The evaluation of available data showed that PCE is not a COPC for surface water and sediment and, therefore, no adverse health effects are likely to occur from contacting WSP sediments and surface water.

Based on the evaluation of additional fish tissue data, current and future exposures to PCE from consuming fish from WSP represent no apparent public health hazard. However, the CDPHE action level of $1 * 10^{-5}$ cancer risk is exceeded for various categories of fish consumption rates, based on the assumption of lifetime exposure duration of 70 years. Therefore, WSP can "safely" be reopened to recreational fishing without an appreciable risk to human health with limits on the consumption of fish as well as limits on the amount of certain types of fish that can be taken from the ponds (i.e. bass and sucker species). This will be accomplished through a formal fish advisory issued by CDPHE.

## Recommendations

To ensure that reopening WSP for recreational fishing remains "safe", the following recommendations have been made:

- El Paso County and the CDPHE will issue a formal fish consumption advisory to limit the amount of certain types of fish that can be taken from WSP. The fish advisory should include a statement regarding no consumption of whole fish.

- Schlage Lock and El Paso County should proceed with the remedial activities planned for WSP including:
    - the installation of an upgradient sparge system in Ceresa Park,
    - addition of predator species to restore the ecosystem in WSP,
    - and continued monitoring of fish tissue and water quality data for PCE.

- The appropriate community involvement activities should be conducted to enhance the effectiveness of the fish consumption advisory through awareness and health information.

## Public Health Action Plan

The Public Health Action Plan describes the activities necessary to alleviate and/or reduce adverse health effects from consuming fish from WSP. The PHAP includes activities that have been conducted, are currently in progress, and activities planned for the future.

**Completed Activities**

- The EES at CDPHE conducted an evaluation of fish consumption and dermal contact with PCE in WSP in a health consultation published in 2006. The health consultation examined the potential public health effects, identified data gaps, and recommended additional data collection (CDPHE, 2006).

- The responsible parties collected additional data to determine the current levels of PCE in fish tissue, surface water, and sediment. This data was evaluated by the EES to determine if it is "safe" to reopen WSP to public fishing and other recreational activities.

- EES conducted public outreach activities by posting the 2006 health consultation on the EES web site and providing copies in the local library.

- EES completed an evaluation of other exposure pathways through the various PCE contaminated media (e.g., indoor air, residential well drinking water, and municipal water supply) related to the Schlage Lock PCE plume. These health consultations are available at: http://www.cdphe.state.co.us/dc/ehs/

**Ongoing Activities**:

EES is preparing to conduct a number of activities in order to educate the nearby communities, anglers, and visitors to WSP regarding the findings of the 2006 health consultation as well as the fish consumption limit recommended by the CDPHE. These include:

- Community health education on the findings of the 2006 health consultation by holding a public information session prior to the reopening of WSP as well as by distributing educational materials.

- Health education on how to get the positive health benefits from eating fish by minimizing exposure to PCE. For example, explain the preferential

accumulation of PCE in fatty tissue and appropriate methods of fish preparation with special focus on site-specific subsistence fishers.

- Working with the HMWMD and WQCD to prepare outreach material regarding the CDPHE fish consumption limits recommendations (fish advisory).

**Future Activities:**

- Review any additional fish tissue data from Willow Springs Ponds at the request of El Paso County officials, other stakeholders, or Security-Widefield residents.

- Conduct community education and outreach activities to inform the public of the potential health risks from exposure to PCE within the Widefield Aquifer as well as methods that can be employed to reduce exposures to PCE, on an as needed basis.

- The responsible parties will continue to monitor fish tissue and water quality data for PCE in WSP.

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# Appendices

# Appendix A. Tables and Figures

**Table 1. 2004-2006 WSP Fish Tissue Data by Species and Tissue Type**

| Fish Species | 2004 | | 2006 |
|---|---|---|---|
| | Edible | Whole | Edible |
| Western White Sucker | 4 | 7 | 6 |
| European Rudd | - | 7 | - |
| Large Mouth Bass | 3 | - | 6 |
| Green Sunfish | 1 | - | - |
| Channel Catfish | 3 | - | - |

**Table 2. WSP Fish Fillet Tissue Data 2004-2006 (n = 23)**

| Species | Mean | Median | Minimum | Maximum | *n* |
|---|---|---|---|---|---|
| White Sucker | 4.99 | 3.75 | 2 | 10 | 10 |
| Bass | 6.70 | 3.5 | 1.37 | 19 | 9 |
| Channel Catfish | 3.28 | 3.33 | 2.13 | 4.37 | 3 |
| Green Sunfish | N/a | N/a | N/a | 0.98 | 1 |
| Combined | 5.26 | 3.5 | 0.98 | 19 | 23 |

**Table 3. WSP Whole Fish Tissue Data 2004-2006 (n = 14)**

| Species | Mean | Median | Minimum | Maximum | *n* |
|---|---|---|---|---|---|
| White Sucker | 13.11 | 8.52 | 2.48 | 35.16 | 7 |
| European Rudd | 12.29 | 13.11 | 3.66 | 18.77 | 7 |
| Combined | 12.70 | 11.40 | 2.48 | 35.16 | 14 |

**Table 4. WSP Sediment Data**

| September 8, 1997 | | |
|---|---|---|
| **Sample Number** | **Location** | **PCE (µg/kg** |
| 973638 | N. Pond | <4.0 |
| 973639 | N. Pond | <4.0 |
| 973640 | S. Pond | <4.0 |
| | | |
| September 17, 1997 | | |
| **Pond** | **Location** | **PCE (µg/kg)** |
| North Pond | North | <5.0 |
| | Central | <5.0 |
| | South | <5.0 |
| South Pond | North | <5.0 |
| | South | <5.0 |
| | | |
| May 7, 2002 | | |
| **Pond 1** | **PCE (µg/kg)** | |
| Sampling Location #1 | ND | |
| Sampling Location #2 | 6.1 J | |
| Sampling Location #3 | ND | |
| Sampling Location #4 | ND | |
| Sampling Location #5 | ND | |
| Sampling Location #6 | ND | |
| | | |
| September 28, 2004 | | |
| **Sample Number** | **Pond** | **PCE (µg/kg)** |
| WSP SED 1 | 1 | <3.4 (ND) |
| WSP SED 2 | 1 | <4.5 (ND) |
| WSP SED 3 | 1 | <5.0 (ND) |
| WSP SED 4 | 1 | <4.2 (ND) |

**Figure 1. Aerial Overview Map**


**Source: Google Earth**

**Figure 2. Approximation of the Schlage Lock PCE Plume (based on 2002 data)**

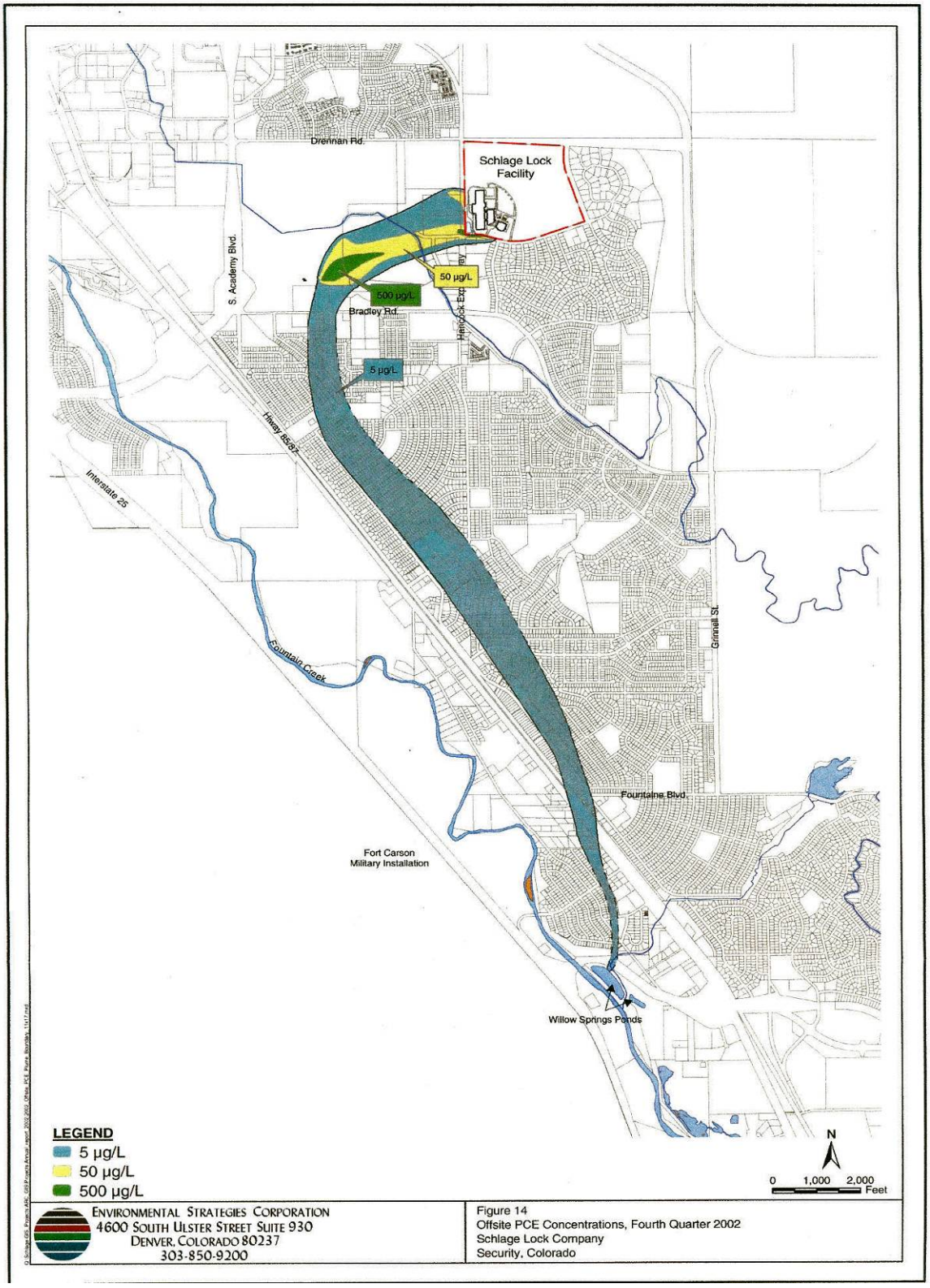


**Figure 3. Willow Springs Ponds**

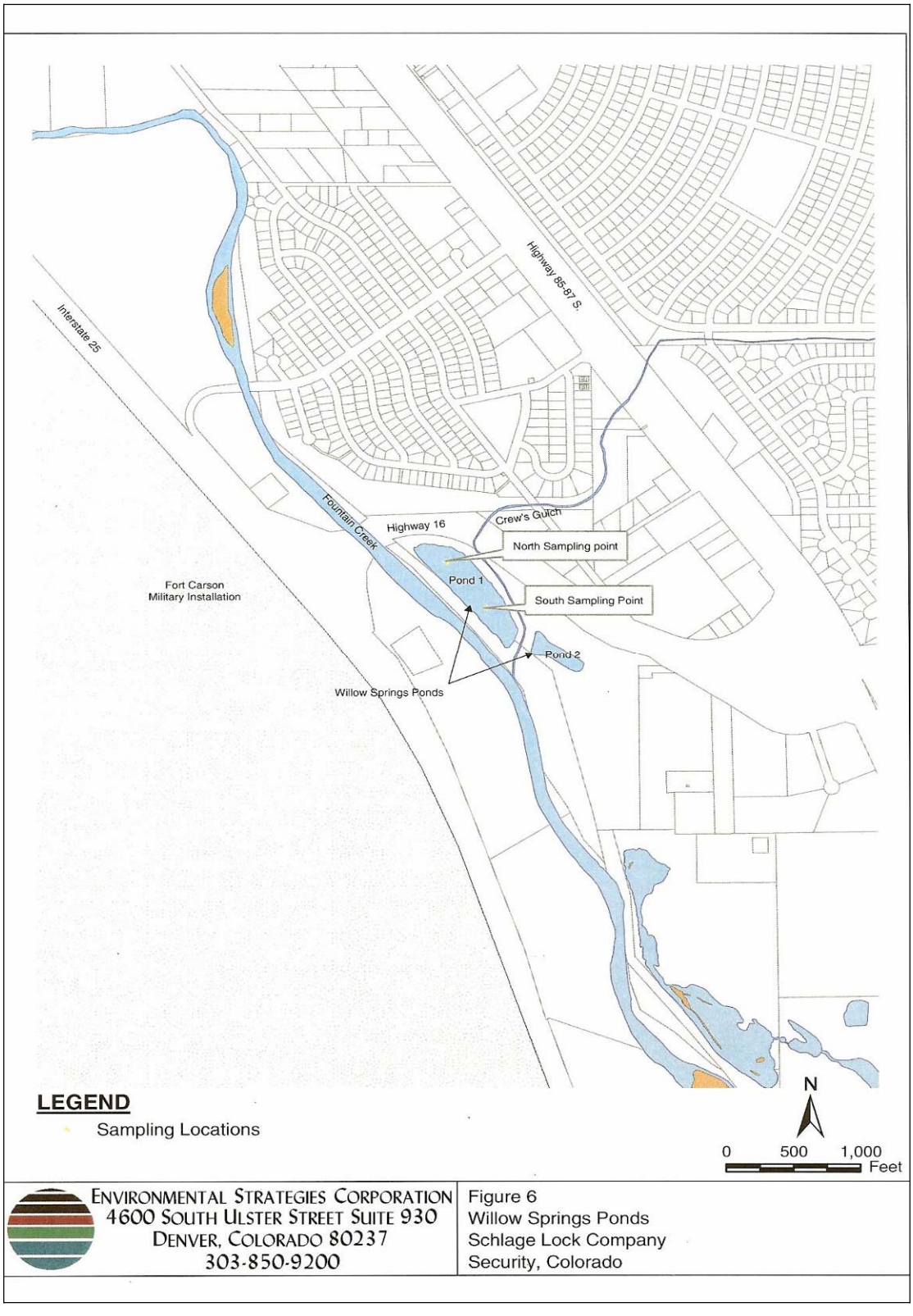


**Figure 4. Percent Asian American of Total Population by Census Tract, El Paso County, Colorado**

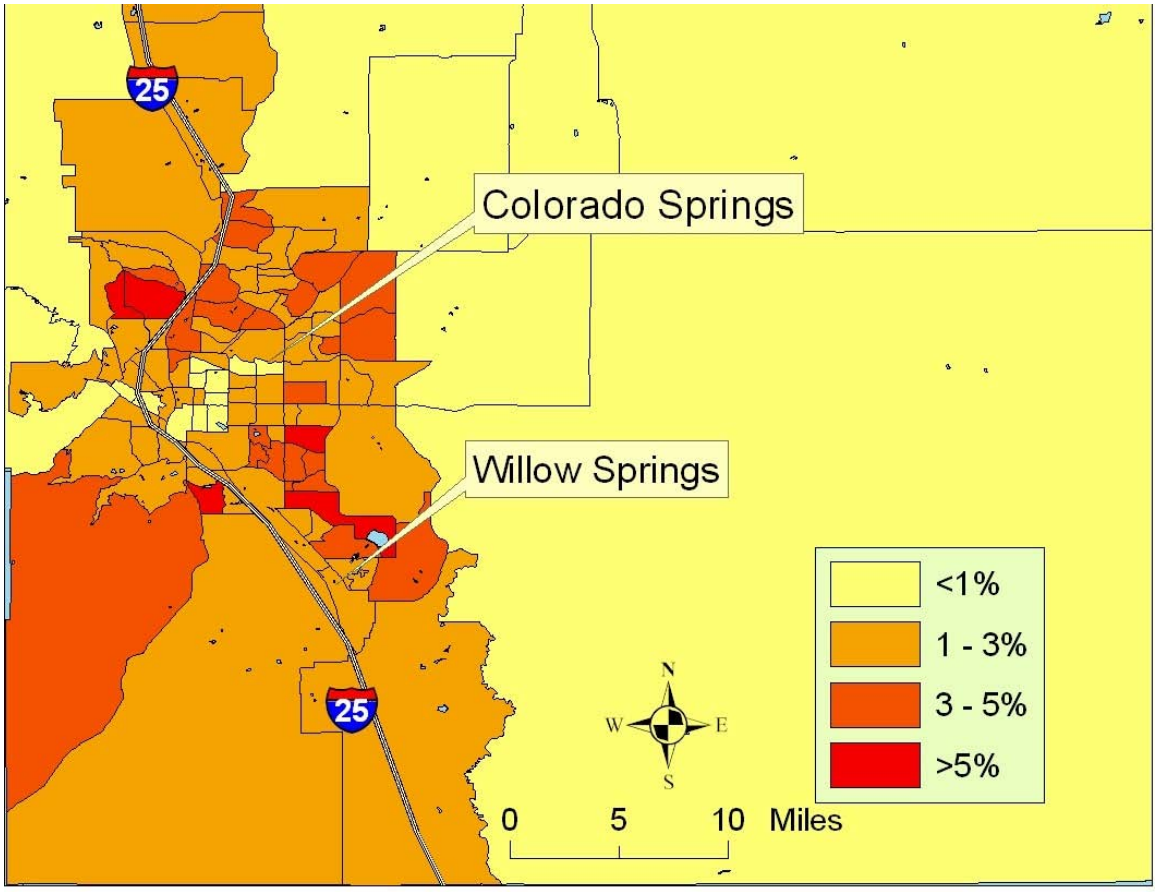


**Figure 5. 2004 and 2006 Edible Fish Tissue Sample Means**

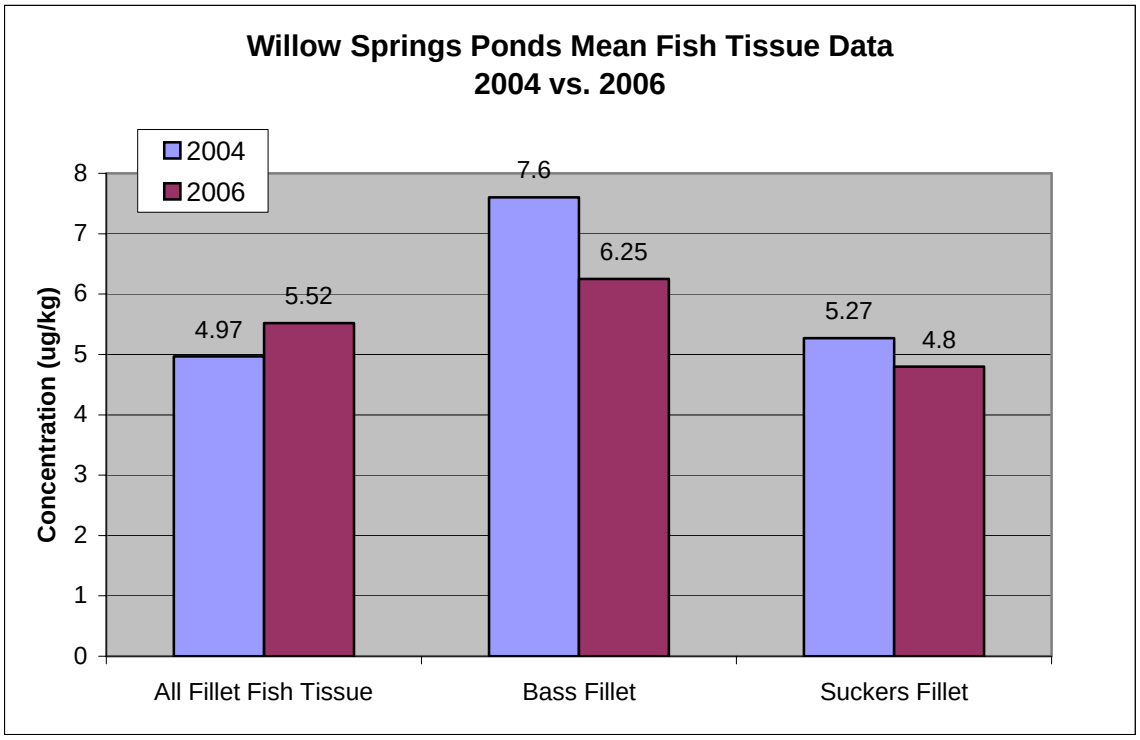
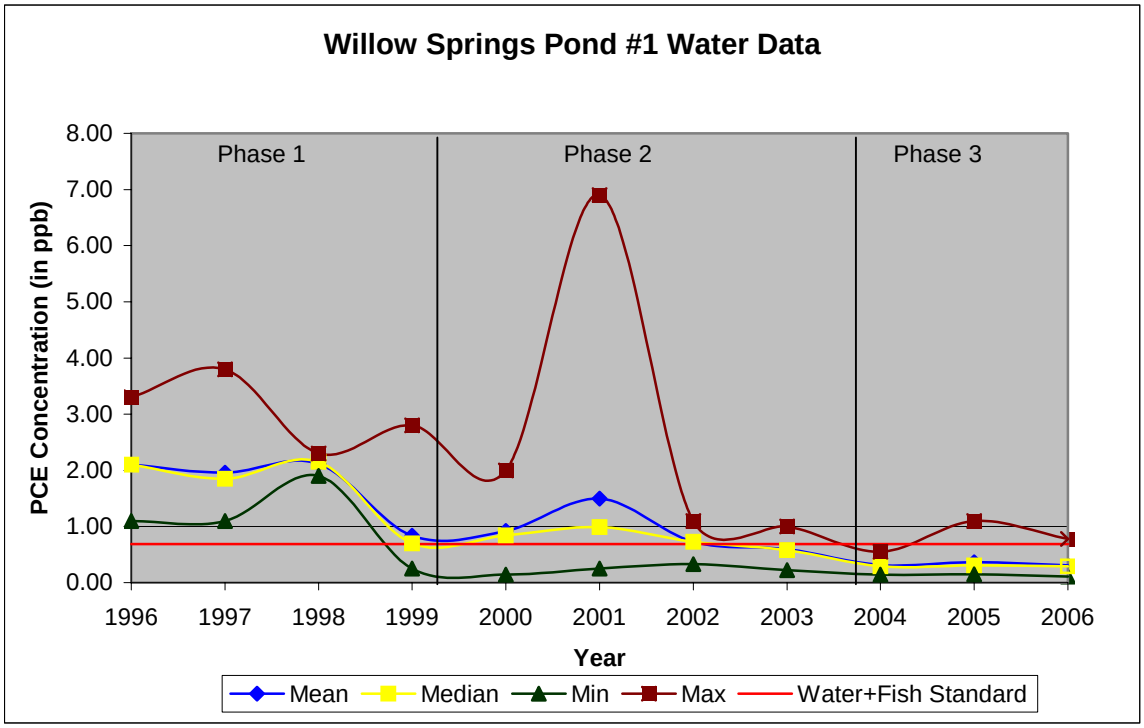



**Figure 6. WSP PCE Concentration, 1996-2006**



# Appendix B. Toxicological Evaluation

The basic objective of a toxicological evaluation is to identify what adverse health effects a chemical causes, and how the appearance of these adverse effects depends on dose. In addition, the toxic effects of a chemical frequently depend on the route of exposure (oral, inhalation, dermal) and the duration of exposure (acute, subchronic, chronic or lifetime). In general, acute and chronic neurological changes, and liver and kidney toxicity, have been observed in humans and animals exposed to PCE (See Appendix… for PCE health effect fact sheet). It is important to note that estimates of human health risks may be based on evidence of health effects in humans and/or animals depending upon the availability of data.

The toxicity assessment process is usually divided into two parts: the cancer effects and the non-cancer effects of the chemical. This two-part approach is employed because there are typically major differences in the time-course of action and the shape of the dose-response curve for cancer and non-cancer effects.

The USEPA IRIS (EPA, 1988) has established an oral reference dose (RfD) of 0.01 mg/kg/day for non-cancer effects. The RfD is based on liver toxicity in mice and weight gain in rats. An RfD is the daily dose in humans (with uncertainty spanning perhaps an order of magnitude), including sensitive subpopulations, that is likely to be without an appreciable risk of noncancer adverse health effects during a lifetime exposure.

The USEPA has not established in the EPA IRIS an inhalation reference concentration as well as a carcinogenicity assessment for lifetime exposures to PCE. However, in the absence of relevant values in the EPA IRIS, the USEPA Office of Solid Waste and Emergency Response (OSWER) recommends using the Cal EPA oral slope factor of 0.54 per mg/kg/day for PCE (EPA, 2003, OSWER Directive No. 9285.7-75). The Cal EPA classifies PCE to be an animal carcinogen and a possible human carcinogen. This classification is based on the observed increased incidence of hepatocellular carcinoma in male and female mice exposed orally to PCE. Additionally, human epidemiological studies suggest that PCE is possibly carcinogenic in humans. The most consistent tumor sites in humans are the esophagus and lymphatic system, but the available information is insufficient to quantify cancer risks. Therefore, quantitative estimates of the potential of PCE to induce human cancer are inferred from animal data. Additionally, estimating the cancer slope factor is often complicated by the fact that observable increases in cancer incidence usually occur only at relatively high doses. Therefore, it is necessary to use mathematical models to extrapolate from the observed high dose data to the desired slope at low dose. In order to account for the uncertainty in this extrapolation process, EPA typically chooses to employ the upper 95th confidence limit of the slope as the Slope Factor. That is, there is a 95% probability that the true cancer potency is lower than the value chosen for the Slope Factor.

ATSDR has derived an acute-duration oral minimal risk levels (MRLs) for PCE of 0.05 mg/kg/day. The acute MRL is based on an increase in total spontaneous activity

(locomotion and rearing) in mice. An MRL is the dose of a compound that is an estimate of daily human exposure that is likely to be without an appreciable risk of adverse noncancerous effects of a specified duration of exposure. The acute MRL addresses short-term exposures of 14 days or less. ATSDR has not established intermediate- and chronic-duration oral MRLs for PCE.

# Appendix C. Exposure Dose Calculation Equations and Results

### C1. Fish Ingestion Exposure Dose Calculations (ATSDR 2005)

Fish Ingestion exposure doses were calculated in the following manner:

$$\text{Dose (mg/kg or ppm)} = \frac{\mathbf{C * IR * AF * EF}}{\mathbf{BW}}$$

$$\text{Where EF} = \frac{\mathbf{F * ED}}{\mathbf{AT}}$$

| Variable | Units | Description | Adult | Child |
|---|---|---|---|---|
| $C_E$ | mg/kg | Edible Fish Tissue EPC | 0.019 | 0.019 |
| $C_W$ | mg/kg | Whole Fish Tissue EPC | 0.03516 | 0.03516 |
| $IR_1$ | kg/day | Ingestion Rate #1 | 0.0075 | 0.0028 |
| $IR_2$ | kg/day | Ingestion Rate #2 | 0.08712 | 0.04563 |
| $IR_3$ | kg/day | Ingestion Rate #3 | 0.1424 | 0.06153 |
| AF | unitless | Bioavailability Factor | 1 | 1 |
| F | days/year | Frequency of Fish Consumption | 240 | 240 |
| ED | years | Exposure Duration | 30 | 6 |
| $AT_c$ | days | Averaging Time for Cancer | 25,550 | 25,550 |
| BW | kg | Body Weight | 70 | 14.5 |

## Table C1. Potential theoretical cancer risks for adult fish consumption exposures

| Description of Applicable Population | Ingestion Rate (grams/day) | Fish Fillet Exposure Dose for Carcinogenic Health Effects (mg/kg-day) | Estimated Excess Cancer Risk | Whole Fish Exposure Dose for Carcinogenic Health Effects (mg/kg-day) | Estimated Excess Cancer Risk |
|---|---|---|---|---|---|
| **Represents the mean fish consumption of individuals 18 and older living in the United States.** | 7.5[a] | $5.7 * 10^{-7}$ mg/kg-day | $3.1 * 10^{-7}$ (3.1 excess cancer cases / 10,000,000 individuals) | $1.0 * 10^{-6}$ mg/kg-day | $5.7 * 10^{-7}$ (5.7 excess cancer cases / 10,000,000 individuals) |
| **Represents the upper limit of the 90 % estimate on the mean for "Consumers Only" individuals 18 and over living in the U.S.** | 87.12[b] | $6.6 * 10^{-6}$ mg/kg-day | $3.6 * 10^{-6}$ (3.6 excess cancer cases / 1,000,000 individuals) | $1.2 * 10^{-5}$ mg/kg-day | $6.6 * 10^{-6}$ (6.6 excess cancer cases / 1,000,000 individuals) |
| **Represents the default value for a subsistence population living in the U.S.** | 142.4[c] | $1.1 * 10^{-5}$ mg/kg-day | $5.8 * 10^{-6}$ (5.8 excess cancer cases / 1,000,000 individuals) | $2.0 * 10^{-5}$ mg/kg-day | $1.1 * 10^{-5}$ (11 excess cancer cases / 1,000,000 individuals) |

[a] This value represents EPA's mean value for the general population group (Age 18 and Older) (EPA, 2002, *Per Capita Fish Ingestion Rate, Table 4 - Freshwater/Estuarine Fish, p. 5-6*).

[b] This value represents the EPA's value of 87.12g/day that represents the 90th percentile upper bound interval on the mean for "Consumers Only" (Age 18 and Older) (EPA, 2002, *Per Capita Fish Ingestion Rate, Table 4-Freshwater/Estuarine Fish, p. 5-43*).

[c] This value is within the 90% confidence interval on the 99th percentile of 125.27 – 156.84 g/day for the general population group (Age 18 and Older) (EPA, 2002, *Per Capita Fish Ingestion Rate, Table 4 - Freshwater/Estuarine Fish, p. 5-6*).

## Table C2. Potential theoretical cancer risk from Child fish consumption exposures

| Description of Applicable Population | Ingestion Rate (grams/day) | Fish Fillet Exposure Dose for Carcinogenic Health Effects (mg/kg-day) | Estimated Excess Cancer Risk | Whole Fish Exposure Dose for Carcinogenic Health Effects (mg/kg-day) | Estimated Excess Cancer Risk |
|---|---|---|---|---|---|
| **Represents mean fish consumption rate of the general U.S. population (Ages 3-5)** | 2.8[a] | $2.0 * 10^{-7}$ mg/kg-day | $1.1 * 10^{-7}$ (1.1 excess cancer cases / 10,000,000 individuals) | $3.8 * 10^{-7}$ mg/kg-day | $2.0 * 10^{-7}$ (2.0 excess cancer cases / 10,000,000 individuals) |
| **Represents the upper confidence limit on the 90% estimate of the mean fish consumption for Consumers Only (Ages 3-5)** | 45.63[b] | $3.3 * 10^{-6}$ mg/kg-day | $1.8 * 10^{-6}$ (1.8 excess cancer cases / 1,000,000 individuals) | $6.2 * 10^{-6}$ mg/kg-day | $3.3 * 10^{-6}$ (3.3 excess cancer cases / 1,000,000 individuals) |
| **Represents the upper confidence limit on the 90% estimate of the 99th percentile of fish consumption for the general U.S. population (ages 3-5)** | 61.53[c, d] | $4.5 * 10^{-6}$ mg/kg-day | $2.4 * 10^{-6}$ (2.4 excess cancer cases / 1,000,000 individuals) | $8.4 * 10^{-6}$ mg/kg-day | $4.5 * 10^{-6}$ (4.5 excess cancer cases / 1,000,000 individuals) |

[a] This value is similar to the 90th percentile upper bound interval value of 2.58 g/day on the mean for children ages 3 to 5 (EPA, 2002, *Per Capita Fish Ingestion Rate, Table5-Freshwater/Estuarine Fish , p. 5-7*).

[b] This value represents the 90% UCL on the mean fish consumption rate for children ages 3-5, "Consumers Only" (EPA, 2002, *Per Capita Fish Ingestion Rate, Table5-Freshwater/Estuarine Fish , p. 5-44*).

[c] This value represents the 90% UCL on the 99th percentile for children ages 3 to 5 (EPA, 2002, *Per Capita Fish Ingestion Rate, Table5-Freshwater/Estuarine Fish , p. 5-7*).

[d] No subsistence fishing rate was available for children in the EPA Guidance. Therefore, the 90% upper confidence limit on the 99th percentile was used as a surrogate for this subpopulation. This value is consistent with the default subsistence rate for adults.

**Table C3. Theoretical Cancer Risk-Based Fish Consumption Limit Guidelines (FCLGs) for PCE provided as Number of Meals/Month (or Per Week) and the Corresponding Fish Tissue Levels for the General Population, Including Children***

| Frequency of Fish Meals [a] | Daily Fish Intake Rates for adults | | Concentration of Fish Tissue (in parts per billion, wet weight) per Theoretical Cancer Risk Level | | |
|---|---|---|---|---|---|
| **Meals Per Month/ Meals Per Week** | **grams/day** | **kg/day** | **1x10 $^{-4}$** | **1x10 $^{-5}$** | **1x10 $^{-6}$** |
| 30 | 227.0 | 0.227 | 0-57 | 0-5.7 | 0-0.57 |
| 28<br>7 meals/ week | 211.9 | 0.212 | >57-61 | >5.7-6.1 | >0.57-0.61 |
| 24<br>6 meals/ week | 181.6 | 0.182 | >61-71 | >6.1-7.1 | >0.61-0.71 |
| 20<br>5 meals/ week | 151.3 [b] | 0.151 | >71-86 | >7.1-8.6 | >0.71-0.86 |
| 16<br>4 meals/ week | 121.1 | 0.121 | >86-107 | >8.6-10.7 | >0.86-1.07 |
| 12<br>3 meals/ week | 90.8 [c] | 0.091 | >107-143 | >10.7-14.3 | >1.07-1.43 |
| 8<br>2 meals/ week | 60.5 | 0.060 | >143-214 | >14.3-21.4 | >1.43-2.14 |
| 4<br>1 meal/ week | 30.3 | 0.030 | >214-428 | >21.4-42.8 | >2.14-4.28 |
| 3 | 22.7 | 0.023 | >428-571 | >42.8-57.1 | >4.28-5.71 |
| 2 | 15.1 | 0.015 | >571-857 | >57.1-85.7 | >5.71-8.57 |
| 1 | 7.6 [d] | 0.008 | >857-1713 | >85.7-171.3 | >8.57-17.13 |
| **No Consumption Recommended** | **NA** | **NA** | **>1713** | **>171.3** | **>17.13** |

***For children, the meal size must be reduced to account for the smaller portions generally consumed by children (See notes below).**

[a] The assumed meal size for a person weighing 70 kg is a default value of 227g (8 oz portion of uncooked fish). (EPA, 2000; *Guidance for risk assessment and fish consumption limits, Volume 2*).

[b] This value is within the 90% confidence interval on the 99$^{th}$ percentile of 125.27 – 156.84 g/day for the general population group (Age 18 and Older) (EPA, 2002, *Estimated Per Capita Fish Consumption in the U.S., Table 4 - Freshwater/Estuarine Fish, p. 5-6*). This value is also similar to the EPA screening-level default consumption rate of 142.4 g/day for subsistence fishers.

[c] This value is similar to EPA's value of 87.12g/day, which represents the upper bound of the 90% confidence interval on the mean for "Consumers Only" (Age 18 and Older) (EPA, 2002, *Estimated Per Capita Fish Consumption in the U.S., Table 4-Freshwater/Estuarine Fish, p. 5-43*).

[d] This value represents EPA's mean value for the general population group (Age 18 and Older) (EPA, 2002, *Estimated Per Capita Fish Consumption in the U.S., Table 4 - Freshwater/Estuarine Fish, p. 5-6*).

## FCLG Table Notes:

1. The FCLG is a concentration of tetrachloroethylene (PCE) in fish that is designed to prevent consumers from being exposed to a theoretical cancer risk level greater than the acceptable cancer risk level, for example, $1x10^{-5}$ or $1x10^{-6}$. It is assumed that no other PCE-contaminated fish is being eaten and all fish will be prepared and consumed as skin-off fillet to reduce contaminants levels to the maximum extent possible. Additionally, FCLGs do not take into account PCE loss during the cooking process. The FCLG developed for carcinogenic health effects in the general population is based on:

    - EPA recommended body weight value of 70 kg (EPA, 2000, Table 2-2)
    - California EPA Oral Cancer Slope Factor (CSF) for PCE = 0.54 $mg/kg*day^{-1}$
    - Lifetime Exposure Duration of 70 yrs.
    - Relative Source Contribution (RSC) of fish to total exposure = 1. This means that other sources of PCE to the total body burden are not taken into account in deriving FCLGs.
    - Cooking Reduction Factor =1. This is a conservative assumption because organic contaminants in fish are generally reduced by at least 30%.
2. The fish consumption limits described above are also protective of non-cancer adverse health effects.
3. Monthly limits are based on the total allowable dose over a 1-month period (30 days) based on the CSF and theoretical cancer risk. When monthly limit is consumed in a few large meals (bolus dose), in less than a month, the daily dose may exceed the recommended carcinogenic risk levels described above. Therefore bolus doses should be avoided.
4. Fish Tissue Level = [(RL / CSF) * BW] / Mean Fish Consumption Rate averaged over 70 yrs (kg/day) (EPA 2000, Vol. 1 Ch. 5, p. 5-4).
5. The low-dose extrapolation procedure for carcinogenic health effects used in this assessment provides an upper 95 percent bound risk estimate. This is considered by some to be a conservative estimate of cancer risk (EPA 2000, Vol. 1 Ch. 5, p. 5-3).
6. Fish Intake Rate (g/day) = Monthly frequency of meals (Number of meals per month) x Meal size (227 g) / 30 days.
7. **For children it is important to adjust meal size to body weight**. Meal sizes can be adjusted by using a general guide of 0.20 oz per kg body weight for children. For example, a meal size for a child weighing 10 kg is a two-ounce serving (uncooked fish weight).
8. For adults, meal sizes can be adjusted by using a general guide of 0.114 oz per kg body weight. For example, a meal size for a person weighing 88 kg is a ten-ounce serving (uncooked fish weight).

**It is important to note that the recommended consumption in the above table may be an underestimate for some highly exposed subpopulations such as Native American subsistence fishers.**

# CERTIFICATION

This Willow Springs Ponds Health Consultation was prepared by the Colorado Department of Public Health and Environment under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement partner.

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

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