

**Mission:**

To protect, promote & improve the health of all people in Florida through integrated state, county & community efforts.



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**Vision:** To be the **Healthiest State** in the Nation

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January 26, 2024

Jeffrey Smith  
Environmental Health Director  
Florida Department of Health in Osceola County  
1 Courthouse Square, Suite 1200  
Kissimmee, Florida 34741

Re: Letter Health Consultation: Narcoossee Dump [FDEP ID Eric\_17825]

Dear Mr. Smith:

The Florida Department of Health (Department), Public Health Toxicology Section is committed to assuring that people, who may be exposed to site-related contamination, have the best information available about the chemical contaminants and potential associated health risk.

We understand that the community surrounding the Narcoossee Dump (Site) is concerned that former activities at the Site may cause a potential health risk. Currently, the community is concerned about potential exposures to harmful chemicals in private, potable well (Well) water located at nearby residences. The Letter Health Consultation focuses on these concerns to ensure the health and safety of the community members.

Based on the review of available environmental data (groundwater) from ten Wells located on residences adjacent to the Site, the Department concludes that levels of arsenic (0.07 microgram per liter and greater [ $\mu\text{g/L}$ ]) and perfluorooctane sulfonate (PFOS) (0.023  $\mu\text{g/L}$  and greater) in some of the Wells could pose a health risk to residents, if they use the Well water for drinking and other consumption purposes including cooking and making baby formula. The Department recommends installation of special filters on the Wells of concern or using alternative clean water sources for drinking, cooking, and making baby formula.

While this investigation focuses on exposures from Well water, the Department recommends further evaluation of soil and groundwater at the Site prior to any new development as well as the evaluation of soil of adjacent residences. The following paragraphs describe the Site background, methodology, results and discussion, and full list of recommendations.

### Site Background

The Site is located at 0 Jones Road in Saint Cloud, Osceola County, Florida 34771 (Figure 1) and is surrounded by residences with Wells.

The Florida Department of Environmental Protection (FDEP) has no records of a registered dump operating at the Site [FDEP 2022]. Based on a lease agreement between the former owner of the Site and Osceola County, the Site is believed to have operated as a sanitary dump from 1964 to 1975.

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In addition, nearby residents have reported dumping of general garbage and construction debris at the Site during the same time period.

In 2022, FDEP conducted a Pre-CERCLA<sup>1</sup> Site Assessment (PSA) followed by a Preliminary Assessment/Site Investigation (PA/SI) [FDEP 2022]. The PA/SI found elevated chemical levels in soil and groundwater at the Site. In December 2022, the U.S. Environmental Protection Agency (EPA) decided not to consider the Site for listing on the National Priorities List and gave a No Further Remedial Action Planned (NFRAP) status. FDEP has recommended further site assessment under management of FDEP's Central District to define the extent of soil and groundwater contamination [FDEP 2022].

The Site has been vacant since dumping ceased, is currently covered by thick vegetation and has no constructions or buildings (Property Parcel 20-25-31-4260-0076-0010; Osceola County Property Appraiser 2023). Residential properties are located directly to the west, south, and east of the Site. In April 2020, the Site was purchased by a real estate company, who plans to build condominiums [FDEP 2022].

### **Environmental Data Collection**

In January 2022, the Florida Department of Health in Osceola County collected water samples from 10 of 18 Wells located within a quarter mile of the Site: Well IDs AAE8860, AAS0500, AAS0501, AAS0502, AAS0503, AAS0504, AAS0505, AAS0506, AAS0507, AAS0508 [FDOH 2022a]. The samples were tested for arsenic, metals, and trace elements, as well as volatile organic compounds (VOCs). In December 2022, the ten Wells were resampled and tested for per- and polyfluoroalkyl substances (PFAS) [FDOH 2023].

FDEP also investigated soil and groundwater contamination on the Site. Since the Site is currently vacant, no direct human exposure to on-site soil and groundwater contamination is expected. Therefore, this health consultation focuses on the Well water from nearby residences for which current human exposure is possible.

### **Health Risk Evaluation Methodology**

The Hazardous Waste Site Health Risk Assessment Program (Program) within the Public Health Toxicology Section completed this health risk evaluation under its cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). The Program follows ATSDR's public health assessment guidance.

### **Exposure Pathway Evaluation**

The exposure pathway evaluation determines the specific ways people could be exposed to harmful chemicals (another term is contamination). Contamination in the environment can only harm people's health if they have contact with those chemicals (exposure). Without contact or exposure, there is no harm to health from this contamination. If there is contact or exposure, risk of harm to people's health depends on how much of the chemical a person was in contact (concentration) with, how often (frequency) and for how long (duration) they were in contact with it, as well as how toxic the contamination is. Table 1 below defines the five elements considered by the Department using ATSDR's exposure pathway analysis as well as the Site-specific elements for this evaluation.

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<sup>1</sup> CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act. Also known as Superfund.

**Table 1: ATSDR’s 5 Elements of the Exposure Pathway Analysis.**

<b>ATSDR’s 5 Elements of the Exposure Pathway Analysis</b>	<b>Site-Specific Elements of the Exposure Pathway Analysis</b>
<b>Contaminant source</b>	Groundwater (to be determined)
<b>Environmental fate and transport</b>	Groundwater to private, potable well
<b>Exposure point</b>	Tap or shower
<b>Exposure route</b>	Ingestion of drinking water Skin contact with showering water
<b>Potentially exposed population</b>	Residents using contaminated private, potable well water

ATSDR defines exposure pathways as completed, potential, or eliminated. Exposure pathways are “completed” when all five elements of a pathway are present. Exposure pathways are “potential” when one or more elements of a pathway is missing, but information is not sufficient to eliminate or exclude the element. Exposure pathways are “eliminated” when one or more elements of a pathway is not present (i.e., exposure is not possible).

Completed and potential exposure pathways warrant further evaluation, but their identification does not necessarily mean the exposure will result in harmful health effects.

**Screening Analysis**

To evaluate the risk of harm to people’s health from site-related chemicals, the Department evaluates the chemical and its concentrations. The screening analysis involves comparing the maximum detected, site-specific chemical concentrations to environmental media<sup>2</sup>-specific ATSDR screening levels also called comparison values (CVs). CVs are specific environmental medium chemical concentrations that are not likely to cause harmful health effects to those exposed. Site-specific chemical concentrations at or below the CV are not considered for additional health risk evaluation. If a chemical concentration exceeds the CV, it warrants additional health risk evaluation (see next section on exposure calculations), but it does not mean adverse health effects will necessarily occur.

The Department used ATSDR’s Cancer Risk Evaluation Guide (CREG) for children and adults’ “chronic” exposure of 365 days or longer to screen the arsenic concentrations found in water of the Wells.

The Department also used ATSDR’s Environmental Media Evaluation Guides (EMEGs) for four PFAS: perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), perfluorononanoic acid (PFNA), and perfluorohexane sulfonate (PFHxS). This evaluation used the EMEGs for children’s “intermediate” exposure of 15 to 364 days. ATSDR’s Reference Dose Media Evaluation Guides (RMEGs) was used by the Department for four additional PFAS: perfluorohexanoic acid (PFHxA), perfluorobutyric acid (PFBA), perfluorobutane sulfonic acid (PFBS), and hexafluoropropylene oxide (HFPO) dimer acid. This evaluation used RMEG for children’s “chronic” exposure of 365 days or longer. Children are the most sensitive population. Therefore, screening against a children’s EMEG and RMEG will be protective for an adult as well.

All environmental (groundwater) chemical data collected from the ten Wells as well as their respective CVs are shown in Tables A-1 to A-10.

<sup>2</sup> Media = air, water, soil, and other environmental media.

## Exposure Calculations

When exposure pathways and chemicals of potential concern have been selected for further evaluation, chemical specific daily exposure doses are estimated to assess the potential risk of human health effects. A daily exposure dose is the amount of a chemical a person is exposed to in their surrounding environment in a day (in milligrams of chemical per kilogram body weight per day [mg/kg/day]). This evaluation calculated daily exposure doses for specific age groups using ATSDR's pre-defined body weights and intake rates, and the chemical concentrations found in the Well waters.

**Non-Cancer evaluation**—This evaluation assesses non-cancer health risk from estimated daily exposure doses using health guidelines called minimal risk levels (MRLs) and reference doses (RfDs). MRLs represent estimates of the daily human exposure to a specific chemical that, based on ATSDR evaluations, are not expected to cause non-cancer health effects during a specified exposure duration. RfDs represent estimates of daily oral exposures to a chemical not likely to have a noticeable risk of harmful effects to the general human population, including sensitive subgroups, during a lifetime<sup>3</sup> of exposure:

- For arsenic, the MRL was derived for chronic (365 days or longer) exposure durations.
- For PFOA, PFOS, PFNA, and PFHxS, MRLs were derived for intermediate (15 to 364 days) exposure durations.
- For PFHxA, PFBA, PFBS, and HFPO, RfDs were derived for chronic (365 days or longer) exposure durations.

We evaluate the potential for non-cancer health risk from exposure to a chemical by calculating a hazard quotient (HQ) (Equation 1). The HQ is calculated by dividing the maximum site- and media-specific chemical concentration by its respective MRL.:

- A HQ less than 1 indicates that a non-cancer health risk is unlikely.
- A HQ greater than 1 means there is an exceedance of the non-cancer health guideline, and a further in-depth toxicological effects analysis shall be conducted.

$$HQ = D/MRL$$

HQ = Hazard Quotient  
D = Exposure Dose (mg/kg/day)  
MRL = Minimal Risk Level (mg/kg/day)

*Equation 1: Hazard Quotient calculation*

Currently, the MRLs and RfDs for PFAS consider their toxicity as additive; meaning the individual PFAS have a combined potential to cause harmful health effects. Therefore, the PFAS risk is evaluated as a mixture—individual PFAS health effects are calculated and summed—using the Health Index (HI) approach. This approach evaluates the individual, non-cancer health risks associated with combining health risk effects of the mixture (Equation 2). The HI is calculated by adding the individual HQs for PFAS with the same critical endpoints<sup>4</sup> together:

- A HI less than 1 indicates that a non-cancer health risk is unlikely.
- A HI greater than 1 means there is an exceedance of the non-cancer health guideline, and a further in-depth toxicological effects analysis shall be conducted.

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<sup>3</sup> The Department used an average life expectancy of 78 years for adults (both males and females).

<sup>4</sup> A toxic endpoint is the result of a study conducted to determine how dangerous a substance is.

$$HI = HQ_{PFOA} + HQ_{PFOS} + HQ_{PFHxA}$$

*HI* = Hazard Index  
*HQ<sub>PFOA</sub>* = Hazard Quotient for PFOA  
*HQ<sub>PFOS</sub>* = Hazard Quotient for PFOS  
*HQ<sub>PFHxA</sub>* = Hazard Quotient for PFHxA

*Equation 2: Example of Hazard Index calculation*

**Note:** This mixture evaluation in this evaluation uses following eight PFAS for which ATSDR has developed CVs: PFOA, PFOS, PFNA, PFHxS, PFHxA, PFBA, PFBS, and HFPO. Additional PFAS were detected in the Well waters but could not be evaluated as part of this assessment due to missing information needed for a human health risk evaluation.

**Cancer evaluation**—ATSDR calculates a population’s exceeded cancer risk estimate for cancer-causing chemicals using available cancer risk values published by EPA. EPA cancer risk values include oral cancer slope factors (CSFs) and inhalation unit risks (IURs). In general, the Departments health risk evaluation uses EPA’s approach for estimating a theoretical exceeded risk of developing cancer in the exposed population by multiplying a chemical-specific CSF by the estimated daily exposure dose (Equation 3).

$$CR = CFS \times D$$

*CFS* = Cancer Slope Factor  
*CR* = Cancer Risk  
*D* = Exposure Dose (mg/kg/day)

*Equation 3: Cancer Risk calculation*

### **In-Depth Toxicological Effect Analysis**

This analysis involves a closer examination of what health effects have been observed for the chemical of concern and how the estimated daily exposure doses for that chemical compare to observed-health effect levels in the published literature (mostly in animal studies). The in-depth analysis helps evaluate if the exposure scenario is likely to lead to adverse health effects.

## **Results and Discussion**

### **Exposure Pathways**

Residents with Wells could be exposed to chemicals in the Well water via ingestion of the water through drinking and dermal contact when showering. The Department was informed (personal communication) that at least some residents currently choose to use alternative water for drinking and cooking. Therefore, this evaluation considers exposure via ingestion and showering separately, as well as combined.

### **Screening Analysis**

The Well water samples were analyzed for arsenic, metals and trace elements, VOCs, and PFAS (PFOA, PFOS, PFNA, PFHxS, PFHxA, PFBA, PFBS, and HFPO). Sample results for arsenic, metals, trace elements and PFAS, as well as their respective CVs are shown in Tables A-1 to A-10.

Arsenic concentrations exceeded the respective drinking water CV in six of the ten Wells. PFOS concentration exceeded the respective drinking water CVs in three of the ten Wells (Tables A-1 to A-3, A-7 to A-8, and Table A-10).

Based on the exceedances, arsenic and PFOS are considered chemicals of potential concern for drinking water of these Wells and were further evaluated for their potential health risks.

PFOA, PFNA, PFHxS, PFHxA, PFBA, PFBS, and HFPO did not exceed the respective ATSDR CV and are not of concern in drinking water from the Wells.

*Note: Per ATSDR's recommendation, PFAS are evaluated as a mixture and if one PFAS exceeds their respective CV, all detected PFAS need to be further evaluated (see note about mixture evaluation). Therefore, PFOA, PFHxS, PFHxA, PFBA, and PFBS were further evaluated for exposure via both drinking and showering water. PFNA and HFPO, were not evaluated because their concentration levels were below the detection level for all.*

VOCs were below the method detection limit in all Well water samples and are not considered further for this assessment.

### **Estimated Exposures and Health Risk**

The Department used parameters identified in Tables B-1 to B-2 to evaluate potential health impacts.

#### **Arsenic**

Residents of all ages who come in contact with arsenic contaminated drinking water from Well IDs AAE8860, AAS0500, AAS0501, AAS0505, AAS0506, and AAS0508 could be at an excess risk of developing cancer (Tables C-1, C-2A, C-3, C-4A, C-5 and C-6A). Chronic arsenic exposures have been linked to increasing the risk of cancers of the lung, skin, kidney, and bladder [FDOH 2022b].

Water collected from Well ID AAS0505 contains the maximum concentration of arsenic 0.48 ug/L (Table C-4A) which results in an estimated excess cancer risk over a period of 33 years<sup>5</sup> of approximately 2.1 in a hundred thousand ( $0.000021$  or  $2.1 \times 10^{-5}$ ).

To put this into context, the American Cancer Society estimates that one out of every two men (or 50,000 in 100,000) and one out every three women (or 33,333 in 100,000) will develop some type of cancer in their lifetime. Adding the excess cancer risk from exposure to the highest level of arsenic in the Well water would increase the cancer incidence for men from 50,000 in 100,000 to 50,002 in 100,000 and for women from 33,333 in 100,000 to 33,335 in 100,000.

The maximum resident arsenic dose ( $6.6 \times 10^{-5}$  mg/kg/day)<sup>6</sup> is less than ATSDR's chronic MRL ( $3 \times 10^{-4}$  mg/kg/day). Thus, resident who ingests drinking water from Wells at the site with the highest arsenic levels is unlikely to develop non-cancer illnesses. (Table C-4A).

#### **PFAS**

Based on the CV screening results, PFOS is of potential concern in drinking water from Well IDs AAS0500, AAS0505, and AAS0508.

Health risk evaluation with PFOS concentration in water from these Wells resulted in an HQ and/or HI > 1 for children from birth to 11 years, as well as breastfeeding woman, and could be leading to an increased risk of developing non-cancer health risks when drinking water from these Wells:

AAS0500	Birth to less than 2 year	(Table C-2B)
AAS0505	Between birth and less than 11 years, breastfeeding woman	(Table C-4B)
AAS0508	Birth to less than 1 year	(Table C-6B)

Based on predictions from animal studies, the estimated daily exposure doses for children between birth to less than 1 year who are drinking water from Well IDs AAS0500 and AAS0505 were similar to levels predicted to cause immunotoxicity.

<sup>5</sup> The Department used a reasonable maximum exposure residential occupancy period of 33 years.

<sup>6</sup>  $10^{-5}$  is the number 0.00001 expressed using scientific notation.

Residents, including pregnant and breastfeeding women, who shower with water from Wells surrounding the Site containing increased levels of PFOS are not likely to experience non-cancer illnesses from PFOS exposure via showering alone.

PFOA and PFHxS, PHxA, PFBA and PFBS concentrations are not a concern to cause harmful health effects when using the water for drinking or showering.

### Conclusions and Recommendations

The results of this health risk evaluation indicate that Well water of some residents surrounding the Site containing arsenic and PFOS could potentially lead to exceeded cancer risk and increased non-cancer health effects. Showering exposure alone is not of concern, however when combined with drinking exposure there is an increased health risk.

Well water from all sampled Wells (10 out of 18) surrounding the Site is contaminated with levels of arsenic that could cause exceeded cancer risk if someone is directly drinking the water over a lifetime<sup>3</sup>.

Water from Wells containing PFOS concentration of 0.023µg/L or greater (Well IDs AAS0500, AAS0505, and AAS0508) could cause non-cancer health effects (mainly immunotoxicity) if someone is directly drinking it.

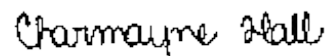
The Department recommends the following:

- Installation of special filters on the contaminated wells of concern or use of an alternative water source for drinking and other consumption, including cooking for residents with PFOS contaminated water from Well IDs AAS0500, AAS0505, and AAS0508.
- An in-depth investigation of water contamination to determine the source and extent of contamination at the Site.
- Conducting soil sampling at the Site and adjacent residences for further evaluation prior to any new development at the Site.

If requested, the Department will consider evaluation of additional data.

If you have any questions or comments concerning this letter, please contact Charmayne Hall at 1-877-798-2772 or at [PHToxicology@FLHealth.gov](mailto:PHToxicology@FLHealth.gov).

Sincerely,



Charmayne Hall  
Health Risk Assessor

### Enclosure

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**Letter Health Consultation Preparation**

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## Potable Well Water Concentrations

Table A-1: Concentrations of metals, metalloids, HFPO, PFBA, PFBS, PFOA, PFOS, PFNA, PFHxA, and PFHxS in well water collected in 2022 [Well ID AAE8860].

Chemical Contaminant	Concentration in Well Water (µg/L)	Comparison Value [CV] (µg/L)		CV type
		Drinking water CV	Shower CV	
<b>Metals and metalloids</b>				
Aluminum	6.7i	7,000	7,900,000	Chronic/int. EMEG for children
Antimony	0.05U	2.8	470	Chronic RMEG for children
Arsenic	<b>0.13i</b>	<b>0.016</b>	9.1	Chronic CREG for children and adults
Barium	1U	1,400	110,000	Int. EMEG for children, chronic EMEG/RMEG for children
Beryllium	0.02i	14	110	Chronic EMEG/RMEG for children
Cadmium	0.02U	0.7	20	Chronic EMEG for children
Chromium	0.4U	100	NA	MCL, primary (for total chromium)
Iron	30U	300	NA	MCL, secondary for taste and color
Lead	0.97	15	NA	MCL, primary
Mercury	0.1U	2	NA	MCL, primary
Nickel	1.5i	140	31,000	Chronic RMEG for children
Selenium	0.2U	35	39,000	Chronic EMEG/RMEG for children
Thallium	0.1U	2	NA	MCL, primary
<b>Per- and polyfluoroalkyl substances (PFAS)</b>				
PFOA	0.002U	0.021	8.4	Int. EMEG for children
PFOS	0.002U	0.014	2.5	
PFNA	0.002U	0.021	4.2	
PFHxS	0.0008U	0.140	48	
PFHxA	0.002U	3.5	5,000	RMEG for children
PFBA	0.004U	7	30,000	
PFBS	0.0004U	2.1	1,400	
HFPO	0.004U	0.021	25	

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **CREG** = cancer risk evaluation guide [ATSDR]; **Int.** = intermediate exposure duration of 15 to 364 days; **EMEG** = environmental media evaluation guide [ATSDR]; **FDEP** = Florida Department of Environmental Protection; **MCL** = maximum contaminant level [FDEP]; **MCL, primary** = enforceable primary drinking water standard to protect public health; **MCL, secondary** = non-enforceable secondary drinking water standard for aesthetic issues (color, taste, odor); **NA** = not available; **HFPO** = hexafluoropropylene oxide dimer acid; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxA** = perfluorohexanoic acid; **PFHxS** = perfluorohexane sulfonate; **PFNA** = perfluorononanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RMEG** = reference dose media evaluation guide.

i = estimated value, detected below the reporting limit; U = analyzed for but not detected above method detection limit; µg/L = micrograms per liter.

Shaded Water concentrations at or above CV warrant further evaluation, but exceedance of CV does not necessarily mean there is a health risk.

Table A-2: Concentrations of metals, metalloids, HFPO, PFBA, PFBS, PFOA, PFOS, PFNA, PFHxA, and PFHxS in well water collected in 2022 [Well ID AAS0500].

Chemical Contaminant	Concentration in Well Water (µg/L)	Comparison Value [CV] (µg/L)		CV type
		Drinking water CV	Shower CV	
<b>Metals and metalloids</b>				
Aluminum	221C	7,000	7,900,000	Chronic/int. EMEG for children
Antimony	0.05U	2.8	470	Chronic RMEG for children
Arsenic	<b>0.34</b>	<b>0.016</b>	9.1	Chronic CREG for children and adults
Barium	7.5	1,400	110,000	Int. EMEG for children, chronic EMEG/RMEG for children
Beryllium	0.01i	14	110	Chronic EMEG/RMEG for children
Cadmium	0.02U	0.7	20	Chronic EMEG for children
Chromium	0.5i	100	NA	MCL, primary (for total chromium)
Iron	680C	300	NA	MCL, secondary for taste and color
Lead	0.89	15	NA	MCL, primary
Mercury	0.1U	2	NA	MCL, primary
Nickel	0.5U	140	31,000	Chronic RMEG for children
Selenium	0.2U	35	39,000	Chronic EMEG/RMEG for children
Thallium	0.1U	2	NA	MCL, primary
<b>Per- and polyfluoroalkyl substances (PFAS) [Two samples collected. Maximum concentration shown]</b>				
PFOA	0.012	0.021	8.4	Int. EMEG for children
PFOS	<b>0.023*</b>	<b>0.014</b>	2.5	
PFNA	0.002U	0.021	4.2	
PFHxS	0.0052	0.140	48	
PFHxA	0.01	3.5	5,000	RMEG for children
PFBA	0.012i	7	30,000	
PFBS	0.0068	2.1	1,400	
HFPO	0.004U	0.021	25	

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **CREG** = cancer risk evaluation guide [ATSDR]; **Int.** = intermediate exposure duration of 15 to 364 days; **EMEG** = environmental media evaluation guide [ATSDR]; **FDEP** = Florida Department of Environmental Protection; **MCL** = maximum contaminant level [FDEP]; **MCL, primary** = enforceable primary drinking water standard to protect public health; **MCL, secondary** = non-enforceable secondary drinking water standard for aesthetic issues (color, taste, odor); **NA** = not available; **HFPO** = hexafluoropropylene oxide dimer acid; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxA** = perfluorohexanoic acid; **PFHxS** = perfluorohexane sulfonate; **PFNA** = perfluorononanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RMEG** = reference dose media evaluation guide.

**C** = exceeds MCL, secondary for color/taste; **i** = estimated value, detected below the reporting limit; **U** = analyzed for but not detected above method detection limit; **µg/L** = micrograms per liter.

\*CV is exceeded in one of two samples.

**Shaded** Water concentrations at or above CV warrant further evaluation, but exceedance of CV does not necessarily mean there is a health risk.

Table A-3: Concentrations of metals, metalloids, HFPO, PFBA, PFBS, PFOA, PFOS, PFNA, PFHxA, and PFHxS in well water collected in 2022 [Well ID AAS0501].

Chemical Contaminant	Concentration in Well Water (µg/L)	Comparison Value [CV] (µg/L)		CV type
		Drinking water CV	Shower CV	
<b>Metals and metalloids</b>				
Aluminum	5U	7,000	7,900,000	Chronic/int. EMEG for children
Antimony	0.05U	2.8	470	Chronic RMEG for children
Arsenic	<b>0.09i</b>	<b>0.016</b>	9.1	Chronic CREG for children and adults
Barium	7	1,400	110,000	Int. EMEG for children, chronic EMEG/RMEG for children
Beryllium	0.01U	14	110	Chronic EMEG/RMEG for children
Cadmium	0.02U	0.7	20	Chronic EMEG for children
Chromium	0.4U	100	NA	MCL, primary (for total chromium)
Iron	1,070C	300	NA	MCL, secondary for taste and color
Lead	0.39i	15	NA	MCL, primary
Mercury	0.1U	2	NA	MCL, primary
Nickel	0.5U	140	31,000	Chronic RMEG for children
Selenium	0.2U	35	39,000	Chronic EMEG/RMEG for children
Thallium	0.1U	2	NA	MCL, primary
<b>Per- and polyfluoroalkyl substances (PFAS)</b>				
PFOA	0.002U	0.021	8.4	Int. EMEG for children
PFOS	0.002U	0.014	2.5	
PFNA	0.002U	0.021	4.2	
PFHxS	0.0008U	0.140	48	
PFHxA	0.002U	3.5	5,000	RMEG for children
PFBA	0.004U	7	30,000	
PFBS	0.0004U	2.1	1,400	
HFPO	0.004U	0.021	25	

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **CREG** = cancer risk evaluation guide [ATSDR]; **Int.** = intermediate exposure duration of 15 to 364 days; **EMEG** = environmental media evaluation guide [ATSDR]; **FDEP** = Florida Department of Environmental Protection; **MCL** = maximum contaminant level [FDEP]; **MCL, primary** = enforceable primary drinking water standard to protect public health; **MCL, secondary** = non-enforceable secondary drinking water standard for aesthetic issues (color, taste, odor); **NA** = not available; **HFPO** = hexafluoropropylene oxide dimer acid; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxA** = perfluorohexanoic acid; **PFHxS** = perfluorohexane sulfonate; **PFNA** = perfluorononanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RMEG** = reference dose media evaluation guide.

**C** = exceeds MCL, secondary for color/taste; **i** = estimated value, detected below the reporting limit; **U** = analyzed for but not detected above method detection limit; **µg/L** = micrograms per liter.

**Shaded** Water concentrations at or above CV warrant further evaluation, but exceedance of CV does not necessarily mean there is a health risk.

Table A-4: Concentrations of metals, metalloids, HFPO, PFBA, PFBS, PFOA, PFOS, PFNA, PFHxA, and PFHxS in well water collected in 2022 [Well ID AAS0502].

Chemical Contaminant	Concentration in Well Water (µg/L)	Comparison Value [CV] (µg/L)		CV type
		Drinking water CV	Shower CV	
<b>Metals and metalloids</b>				
Aluminum	5U	7,000	7,900,000	Chronic/int. EMEG for children
Antimony	0.05U	2.8	470	Chronic RMEG for children
Arsenic	0.05U*	0.016	9.1	Chronic CREG for children and adults
Barium	6.5	1,400	110,000	Int. EMEG for children, chronic EMEG/RMEG for children
Beryllium	0.01U	14	110	Chronic EMEG/RMEG for children
Cadmium	0.02U	0.7	20	Chronic EMEG for children
Chromium	0.4U	100	NA	MCL, primary (for total chromium)
Iron	1,580C	300	NA	MCL, secondary for taste and color
Lead	0.2U	15	NA	MCL, primary
Mercury	0.1U	2	NA	MCL, primary
Nickel	0.5U	140	31,000	Chronic RMEG for children
Selenium	0.2U	35	39,000	Chronic EMEG/RMEG for children
Thallium	0.1U	2	NA	MCL, primary
<b>Per- and polyfluoroalkyl substances (PFAS)</b>				
PFOA	0.002U	0.021	8.4	Int. EMEG for children
PFOS	0.002U	0.014	2.5	
PFNA	0.002U	0.021	4.2	
PFHxS	0.0008U	0.140	48	
PFHxA	0.002U	3.5	5,000	RMEG for children
PFBA	0.004U	7	30,000	
PFBS	0.0004U	2.1	1,400	
HFPO	0.004U	0.021	25	

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **CREG** = cancer risk evaluation guide [ATSDR]; **Int.** = intermediate exposure duration of 15 to 364 days; **EMEG** = environmental media evaluation guide [ATSDR]; **FDEP** = Florida Department of Environmental Protection; **MCL** = maximum contaminant level [FDEP]; **MCL, primary** = enforceable primary drinking water standard to protect public health; **MCL, secondary** = non-enforceable secondary drinking water standard for aesthetic issues (color, taste, odor); **NA** = not available; **HFPO** = hexafluoropropylene oxide dimer acid; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxA** = perfluorohexanoic acid; **PFHxS** = perfluorohexane sulfonate; **PFNA** = perfluorononanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RMEG** = reference dose media evaluation guide.

**C** = exceeds MCL, secondary for color/taste; **U** = analyzed for but not detected above method detection limit; **µg/L** = micrograms per liter.

\*The method detection limit exceeds the CV. We do not know if arsenic was present in the water or at which concentration.

Table A-5: Concentrations of metals, metalloids, HFPO, PFBA, PFBS, PFOA, PFOS, PFNA, PFHxA, and PFHxS in well water collected in 2022 [Well ID AAS0503].

Chemical Contaminant	Concentration in Well Water (µg/L)	Comparison Value [CV] (µg/L)		CV type
		Drinking water CV	Shower CV	
<b>Metals and metalloids</b>				
Aluminum	5U	7,000	7,9000,000	Chronic/int. EMEG for children
Antimony	0.05U	2.8	470	Chronic RMEG for children
Arsenic	0.05U*	0.016	9.1	Chronic CREG for children and adults
Barium	15.8	1,400	110,000	Int. EMEG for children, chronic EMEG/RMEG for children
Beryllium	0.01U	14	110	Chronic EMEG/RMEG for children
Cadmium	0.02U	0.7	20	Chronic EMEG for children
Chromium	0.4U	100	NA	MCL, primary (for total chromium)
Iron	230	300	NA	MCL, secondary for taste and color
Lead	0.2U	15	NA	MCL, primary
Mercury	0.1U	2	NA	MCL, primary
Nickel	0.5U	140	31,000	Chronic RMEG for children
Selenium	0.2U	35	39,000	Chronic EMEG/RMEG for children
Thallium	0.1U	2	NA	MCL, primary
<b>Per- and polyfluoroalkyl substances (PFAS)</b>				
PFOA	0.002U	0.021	8.4	Int. EMEG for children
PFOS	0.002U	0.014	2.5	
PFNA	0.002U	0.021	4.2	
PFHxS	0.0008U	0.140	48	
PFHxA	0.002U	3.5	5,000	RMEG for children
PFBA	0.004U	7	30,000	
PFBS	0.0004U	2.1	1,400	
HFPO	0.004U	0.021	25	

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **CREG** = cancer risk evaluation guide [ATSDR]; **Int.** = intermediate exposure duration of 15 to 364 days; **EMEG** = environmental media evaluation guide [ATSDR]; **FDEP** = Florida Department of Environmental Protection; **MCL** = maximum contaminant level [FDEP]; **MCL, primary** = enforceable primary drinking water standard to protect public health; **MCL, secondary** = non-enforceable secondary drinking water standard for aesthetic issues (color, taste, odor); **NA** = not available; **HFPO** = hexafluoropropylene oxide dimer acid; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxA** = perfluorohexanoic acid; **PFHxS** = perfluorohexane sulfonate; **PFNA** = perfluorononanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RMEG** = reference dose media evaluation guide.

**U** = analyzed for but not detected above method detection limit; **µg/L** = micrograms per liter.

\*The method detection limit exceeds the CV. We do not know if arsenic was present in the water or at which concentration.

Table A-6: Concentrations of metals, metalloids, HFPO, PFBA, PFBS, PFOA, PFOS, PFNA, PFHxA, and PFHxS in well water collected in 2022 [Well ID AAS0504].

Chemical Contaminant	Concentration in Well Water (µg/L)	Comparison Value [CV] (µg/L)		CV type
		Drinking water CV	Shower CV	
<b>Metals and metalloids</b>				
Aluminum	5U	7,000	7,9000,000	Chronic/int. EMEG for children
Antimony	0.05U	2.8	470	Chronic RMEG for children
Arsenic	0.05U*	0.016	9.1	Chronic CREG for children and adults
Barium	18.8	1,400	110,000	Int. EMEG for children, chronic EMEG/RMEG for children
Beryllium	0.01U	14	110	Chronic EMEG/RMEG for children
Cadmium	0.02U	0.7	20	Chronic EMEG for children
Chromium	0.4U	100	NA	MCL, primary (for total chromium)
Iron	300	300	NA	MCL, secondary for taste and color
Lead	0.2U	15	NA	MCL, primary
Mercury	0.1U	2	NA	MCL, primary
Nickel	0.5U	140	31,000	Chronic RMEG for children
Selenium	0.2U	35	39,000	Chronic EMEG/RMEG for children
Thallium	0.1U	2	NA	MCL, primary
<b>Per- and polyfluoroalkyl substances (PFAS)</b>				
PFOA	0.002U	0.021	8.4	Int. EMEG for children
PFOS	0.002U	0.014	2.5	
PFNA	0.002U	0.021	4.2	
PFHxS	0.0008U	0.140	48	
PFHxA	0.002U	3.5	5,000	RMEG for children
PFBA	0.004U	7	30,000	
PFBS	0.0004U	2.1	1,400	
HFPO	0.004U	0.021	25	

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **CREG** = cancer risk evaluation guide [ATSDR]; **Int.** = intermediate exposure duration of 15 to 364 days; **EMEG** = environmental media evaluation guide [ATSDR]; **FDEP** = Florida Department of Environmental Protection; **MCL** = maximum contaminant level [FDEP]; **MCL, primary** = enforceable primary drinking water standard to protect public health; **MCL, secondary** = non-enforceable secondary drinking water standard for aesthetic issues (color, taste, odor); **NA** = not available; **HFPO** = hexafluoropropylene oxide dimer acid; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxA** = perfluorohexanoic acid; **PFHxS** = perfluorohexane sulfonate; **PFNA** = perfluorononanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RMEG** = reference dose media evaluation guide.

**U** = analyzed for but not detected above method detection limit; **µg/L** = micrograms per liter.

\*The method detection limit exceeds the CV. We do not know if arsenic was present in the water or at which concentration.

Table A-7: Concentrations of metals, metalloids, HFPO, PFBA, PFBS, PFOA, PFOS, PFNA, PFHxA, and PFHxS in well water collected in 2022 [Well ID AAS0505].

Chemical Contaminant	Concentration in Well Water (µg/L)	Comparison Value [CV] (µg/L)		CV type
		Drinking water CV	Shower CV	
<b>Metals and metalloids</b>				
Aluminum	511C	7,000	7,900,000	Chronic/int. EMEG for children
Antimony	0.05U	2.8	470	Chronic RMEG for children
Arsenic	<b>0.48</b>	<b>0.016</b>	9.1	Chronic CREG for children and adults
Barium	44.7	1,400	110,000	Int. EMEG for children, chronic EMEG/RMEG for children
Beryllium	0.03i	14	110	Chronic EMEG/RMEG for children
Cadmium	0.02U	0.7	20	Chronic EMEG for children
Chromium	0.44i	100	NA	MCL, primary (for total chromium)
Iron	1,710C	300	NA	MCL, secondary for taste and color
Lead	0.2U	15	NA	MCL, primary
Mercury	0.1U	2	NA	MCL, primary
Nickel	0.5U	140	31,000	Chronic RMEG for children
Selenium	0.2U	35	39,000	Chronic EMEG/RMEG for children
Thallium	0.1U	2	NA	MCL, primary
<b>Per- and polyfluoroalkyl substances (PFAS)</b>				
PFOA	0.0059i	0.021	8.4	Int. EMEG for children
PFOS	<b>0.049</b>	<b>0.014</b>	2.5	
PFNA	0.002U	0.021	4.2	
PFHxS	0.013	0.140	48	
PFHxA	0.0037i	3.5	5,000	RMEG for children
PFBA	0.0048i	7	30,000	
PFBS	0.0078	2.1	1,400	
HFPO	0.004U	0.021	25	

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **CREG** = cancer risk evaluation guide [ATSDR]; **Int.** = intermediate exposure duration of 15 to 364 days; **EMEG** = environmental media evaluation guide [ATSDR]; **FDEP** = Florida Department of Environmental Protection; **MCL** = maximum contaminant level [FDEP]; **MCL, primary** = enforceable primary drinking water standard to protect public health; **MCL, secondary** = non-enforceable secondary drinking water standard for aesthetic issues (color, taste, odor); **NA** = not available; **HFPO** = hexafluoropropylene oxide dimer acid; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxA** = perfluorohexanoic acid; **PFHxS** = perfluorohexane sulfonate; **PFNA** = perfluorononanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RMEG** = reference dose media evaluation guide.

**C** = exceeds MCL, secondary for color/taste; **i** = estimated value, detected below the reporting limit; **U** = analyzed for but not detected above method detection limit; **µg/L** = micrograms per liter.

**Shaded** Water concentrations at or above CV warrant further evaluation, but exceedance of CV does not necessarily mean there is a health risk.



Table A-8: Concentrations of metals, metalloids, HFPO, PFBA, PFBS, PFOA, PFOS, PFNA, PFHxA, and PFHxS in well water collected in 2022 [Well ID AAS0506].

Chemical Contaminant	Concentration in Well Water (µg/L)	Comparison Value [CV] (µg/L)		CV type
		Drinking water CV	Shower CV	
<b>Metals and metalloids</b>				
Aluminum	2,820C	7,000	7,900,000	Chronic/int. EMEG for children
Antimony	0.05U	2.8	470	Chronic RMEG for children
Arsenic	<b>0.15i</b>	<b>0.016</b>	9.1	Chronic CREG for children and adults
Barium	157	1,400	110,000	Int. EMEG for children, chronic EMEG/RMEG for children
Beryllium	0.06	14	110	Chronic EMEG/RMEG for children
Cadmium	0.1	0.7	20	Chronic EMEG for children
Chromium	0.4U	100	NA	MCL, primary (for total chromium)
Iron	420C	300	NA	MCL, secondary for taste and color
Lead	1.81	15	NA	MCL, primary
Mercury	0.1U	2	NA	MCL, primary
Nickel	0.5U	140	31,000	Chronic RMEG for children
Selenium	0.2U	35	39,000	Chronic EMEG/RMEG for children
Thallium	0.1U	2	NA	MCL, primary
<b>Per- and polyfluoroalkyl substances (PFAS)</b>				
PFOA	0.0061i	0.021	8.4	Int. EMEG for children
PFOS	0.0026U	0.014	2.5	
PFNA	0.0026U	0.021	4.2	
PFHxS	0.0035	0.140	48	
PFHxA	0.0026U	3.5	5,000	RMEG for children
PFBA	0.0053U	7	30,000	
PFBS	0.0021	2.1	1,400	
HFPO	0.0053U	0.021	25	

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **CREG** = cancer risk evaluation guide [ATSDR]; **Int.** = intermediate exposure duration of 15 to 364 days; **EMEG** = environmental media evaluation guide [ATSDR]; **FDEP** = Florida Department of Environmental Protection; **MCL** = maximum contaminant level [FDEP]; **MCL, primary** = enforceable primary drinking water standard to protect public health; **MCL, secondary** = non-enforceable secondary drinking water standard for aesthetic issues (color, taste, odor); **NA** = not available; **HFPO** = hexafluoropropylene oxide dimer acid; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxA** = perfluorohexanoic acid; **PFHxS** = perfluorohexane sulfonate; **PFNA** = perfluorononanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RMEG** = reference dose media evaluation guide.

**C** = exceeds MCL, secondary for color/taste; **i** = estimated value, detected below the reporting limit; **U** = analyzed for but not detected above method detection limit; **µg/L** = micrograms per liter.

**Shaded** Water concentrations at or above CV warrant further evaluation, but exceedance of CV does not necessarily mean there is a health risk.

Table A-9: Concentrations of metals, metalloids, HFPO, PFBA, PFBS, PFOA, PFOS, PFNA, PFHxA, and PFHxS in well water collected in 2022 [Well ID AAS0507].

Chemical Contaminant	Concentration in Well Water (µg/L)	Comparison Value [CV] (µg/L)		CV type
		Drinking water CV	Shower CV	
<b>Metals and metalloids</b>				
Aluminum	5.2i	7,000	7,900,000	Chronic/int. EMEG for children
Antimony	0.05U	2.8	470	Chronic RMEG for children
Arsenic	0.05U*	0.016	9.1	Chronic CREG for children and adults
Barium	17.9	1,400	110,000	Int. EMEG for children, chronic EMEG/RMEG for children
Beryllium	0.01U	14	110	Chronic EMEG/RMEG for children
Cadmium	0.02U	0.7	20	Chronic EMEG for children
Chromium	0.4U	100	NA	MCL, primary (for total chromium)
Iron	1,370C	300	NA	MCL, secondary for taste and color
Lead	0.2U	15	NA	MCL, primary
Mercury	0.1U	2	NA	MCL, primary
Nickel	0.5U	140	31,000	Chronic RMEG for children
Selenium	0.2U	35	39,000	Chronic EMEG/RMEG for children
Thallium	0.1U	2	NA	MCL, primary
<b>Per- and polyfluoroalkyl substances (PFAS)</b>				
PFOA	0.002U	0.021	8.4	Int. EMEG for children
PFOS	0.002U	0.014	2.5	
PFNA	0.002U	0.021	4.2	
PFHxS	0.0008U	0.140	48	
PFHxA	0.002U	3.5	5,000	RMEG for children
PFBA	0.004U	7	30,000	
PFBS	0.0004U	2.1	1,400	
HFPO	0.004U	0.021	25	

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **CREG** = cancer risk evaluation guide [ATSDR]; **Int.** = intermediate exposure duration of 15 to 364 days; **EMEG** = environmental media evaluation guide [ATSDR]; **FDEP** = Florida Department of Environmental Protection; **MCL** = maximum contaminant level [FDEP]; **MCL, primary** = enforceable primary drinking water standard to protect public health; **MCL, secondary** = non-enforceable secondary drinking water standard for aesthetic issues (color, taste, odor); **NA** = not available; **HFPO** = hexafluoropropylene oxide dimer acid; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxA** = perfluorohexanoic acid; **PFHxS** = perfluorohexane sulfonate; **PFNA** = perfluorononanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RMEG** = reference dose media evaluation guide.

**C** = exceeds MCL, secondary for color/taste; **i** = estimated value, detected below the reporting limit; **U** = analyzed for but not detected above method detection limit; **µg/L** = micrograms per liter.

\*The method detection limit exceeds the CV. We do not know if arsenic was present in the water or at which concentration.

Table A-10: Concentrations of Metals, Metalloids, HFPO, PFBA, PFBS, PFOA, PFOS, PFNA, PFHxA, and PFHxS in well water collected in 2022 [Well ID AAS0508].

Chemical Contaminant	Concentration in Well Water (µg/L)	Comparison Value [CV] (µg/L)		CV type
		Drinking water CV	Shower CV	
<b>Metals and metalloids</b>				
Aluminum	804C	7,000	7,900,000	Chronic/int. EMEG for children
Antimony	0.05U	2.8	470	Chronic RMEG for children
Arsenic	<b>0.07i</b>	<b>0.016</b>	9.1	Chronic CREG for children and adults
Barium	23.7	1,400	110,000	Int. EMEG for children, chronic EMEG/RMEG for children
Beryllium	0.03i	14	110	Chronic EMEG/RMEG for children
Cadmium	0.02U	0.7	20	Chronic EMEG for children
Chromium	0.52i	100	NA	MCL, primary (for total chromium)
Iron	1,890C	300	NA	MCL, secondary for taste and color
Lead	0.2U	15	NA	MCL, primary
Mercury	0.1U	2	NA	MCL, primary
Nickel	0.5U	140	31,000	Chronic RMEG for children
Selenium	0.2U	35	39,000	Chronic EMEG/RMEG for children
Thallium	0.1U	2	NA	MCL, primary
<b>Per- and polyfluoroalkyl substances (PFAS)</b>				
PFOA	0.013	0.021	8.4	Int. EMEG for children
PFOS	<b>0.017</b>	<b>0.014</b>	2.5	
PFNA	0.002U	0.021	4.2	
PFHxS	0.0041	0.140	48	
PFHxA	0.002U	3.5	5,000	RMEG for children
PFBA	0.004U	7	30,000	
PFBS	0.0019	2.1	1,400	
HFPO	0.004U	0.021	25	

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **CREG** = cancer risk evaluation guide [ATSDR]; **Int.** = intermediate exposure duration of 15 to 364 days; **EMEG** = environmental media evaluation guide [ATSDR]; **FDEP** = Florida Department of Environmental Protection; **MCL** = maximum contaminant level [FDEP]; **MCL, primary** = enforceable primary drinking water standard to protect public health; **MCL, secondary** = non-enforceable secondary drinking water standard for aesthetic issues (color, taste, odor); **NA** = not available; **HFPO** = hexafluoropropylene oxide dimer acid; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxA** = perfluorohexanoic acid; **PFHxS** = perfluorohexane sulfonate; **PFNA** = perfluorononanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RMEG** = reference dose media evaluation guide.

**C** = exceeds MCL, secondary for color/taste; **i** = estimated value, detected below the reporting limit; **U** = analyzed for but not detected above method detection limit; **µg/L** = micrograms per liter.

**Shaded** Water concentrations at or above CV warrant further evaluation, but exceedance of CV does not necessarily mean there is a health risk.

**Population-Specific Input Parameters**

Table B-1. Input parameters and exposure factors used to calculate drinking water exposure estimates for residents.

Exposure Group	Body Weight (kg)	Age-Specific Exposure Duration (years)	Intake Rate* (L/day)
Birth to < 1 year	7.8	1	1.11
1 to < 2 years	11.4	1	0.893
2 to < 6 years	17.4	4	0.977
6 to < 11 years	31.8	5	1.4
11 to < 16 years	56.8	5	1.98
16 to < 21 years	71.6	5	2.44
Adult	80	33	3.09
Pregnant Women	73	NA	2.59
Breastfeeding Women	73	NA	3.59

Duration	Days	Weeks	Years	Non-Cancer Exposure Factor	<b>EF cancer:</b> EF non-cancer x Age-Specific Exposure Duration (years)/78 years
Acute				1	
Intermediate	7	50		1	
Chronic	7	50	33	0.96	

**Acute** = exposure duration of 14 days or less; **chronic** = exposure duration of 365 days and longer; **EF** = exposure factor; **intermediate** = exposure duration of 15 to 364 days; **kg** = kilogram; **L/day** =liters per day; **NA** = not applicable.

\*Reasonable maximum intake rates were used that are intended to assess higher than average, yet realistic exposures.

**Residents Private, Potable Well Water Exposure**

Table B-2. Input parameters and exposure factors used to calculate residential exposure estimates for showering and other non-consumption household water use\*.

Exposure Group	Body Weight (kg)	Skin Area (cm <sup>2</sup> )		Breathing Rate (L/min)		Average Daily Exposure (min/day)	
		Hand Surface Area	Total Skin Surface Area	Shower	Main House	Bathroom Stay <sup>‡</sup>	Main House
<b>Birth to &lt; 1 year</b>	7.8	211	3,992	7.60	3.75	20	1420
<b>1 to &lt; 2 years</b>	11.4	300	5,300	12.00	5.56	20	1420
<b>2 to &lt; 6 years</b>	17.4	348	7,225	11.25	6.81	20	1420
<b>6 to &lt; 11 years</b>	31.8	510	10,800	11.00	8.33	20	1420
<b>11 to &lt; 16 years</b>	56.8	720	15,900	13.00	10.56	20	1420
<b>16 to &lt; 21 years</b>	71.6	830	18,400	12.00	11.32	20	1420
<b>Adult</b>	80	980	19,650	12.34	10.53	20	1420
<b>Pregnant Women</b>	73	890	18,160	15.47	15.47	20	1420
<b>Breastfeeding Women</b>	73	890	18,160	15.47	15.47	20	1420

Duration	Days	Weeks	Years	Non-Cancer Exposure Factor	<b>EF cancer:</b> EF non-cancer x Age-Specific Exposure Duration (years)/78 years
<b>Acute</b>				1	
<b>Intermediate</b>	7	50		1	
<b>Chronic</b>	7	50	33	0.96	

**Acute** = exposure duration of 14 days or less; **chronic** = exposure duration of 365 days or longer; **cm<sup>2</sup>** = square centimeters; **intermediate** = exposure duration of 15 to 364 days; **kg** = kilogram; **L/min** = liters of air breathed per minute

\*ATSDR's Shower and Household Water-Use Exposure Model Version 3.0.0 was used.

<sup>‡</sup>The model assumes a person spends 15 minutes in the shower and 5 minutes in the bathroom afterwards.

Table C-1. Estimated chronic duration exposure doses, non-cancer health risk (hazard quotients), and excess cancer risk for residents exposed to **ARSENIC** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAE8860].

Exposure Group	Drinking Water (Ingestion)			Shower/Household (Dermal)			Drinking & Shower/Household (Total)		
	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk
<b>Arsenic (Water Concentration: 0.00013 mg/L; Chronic MRL: 0.0003 mg/kg/day)</b>									
Birth to < 1 year	1.8E-05	0.059	2.4E-6*	1.7E-08	5.8E-05	4.5E-9*	1.8E-05	0.059	2.4E-6*
1 to < 2 years	9.8E-06	0.033		1.6E-08	5.3E-05		9.8E-06	0.033	
2 to < 6 years	7.0E-06	0.023		1.4E-08	4.7E-05		7.0E-06	0.023	
6 to < 11 years	5.5E-06	0.018		1.1E-08	3.8E-05		5.5E-06	0.018	
11 to < 16 years	4.3E-06	0.014		9.4E-09	3.1E-05		4.3E-06	0.014	
16 to < 21 years	4.3E-06	0.014		8.6E-09	2.9E-05		4.3E-06	0.014	
Adult	4.8E-06	0.016	3.1E-6*	8.3E-09	2.8E-05	5.3E-9*	4.8E-06	0.016	3.1E-6*
Pregnant Women	4.4E-06	0.015	NC	8.4E-09	2.8E-05	NC	4.4E-06	0.015	NC
Breastfeeding Women	6.1E-06	0.020	NC	8.4E-09	2.8E-05	NC	6.1E-06	0.020	NC
Birth to 33 years (at same residence)‡			3.7E-6*			6.7E-9*			3.7E-6*

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **mg/L** = milligram contaminant per liter of water; **mg/kg/day** = milligram contaminant per kilogram body weight per day; **MRL** = ATSDR's minimal risk level. **NC** = not calculated: excess cancer risk is not calculated for pregnant and breastfeeding women whose cancer risks are expected to be similar to an adult woman exposed for 33 years.

\*Excess cancer risk is calculated using an arsenic cancer slope factor of 1.5 (mg/kg/day)<sup>-1</sup>.

‡ATSDR's default estimate for children who continue to live at their childhood home as adults.

Shaded Excess cancer risk (i.e., excess cancer risk is greater than 1.0E-6).

Table C-2A. Estimated chronic duration exposure doses, noncancer health risk (hazard quotients), and excess cancer risk for residents exposed to **ARSENIC** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0500].

Exposure Group	Drinking Water (Ingestion)			Shower/Household (Dermal)			Drinking & Shower/Household (Total)		
	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk
<b>Arsenic (Water Concentration: 0.00034 mg/L; Chronic MRL: 0.0003 mg/kg/day)</b>									
Birth to < 1 year	4.7E-05	0.16	6.3E-6*	4.5E-08	0.00015	1.2E-8*	4.7E-05	0.16	6.4E-6*
1 to < 2 years	2.6E-05	0.085		4.2E-08	0.00014		2.6E-05	0.085	
2 to < 6 years	1.8E-05	0.061		3.7E-08	0.00012		1.8E-05	0.061	
6 to < 11 years	1.4E-05	0.048		3.0E-08	0.00010		1.4E-05	0.048	
11 to < 16 years	1.1E-05	0.038		2.5E-08	8.2E-05		1.1E-05	0.038	
16 to < 21 years	1.1E-05	0.037		2.3E-08	7.5E-05		1.1E-05	0.037	
Adult	1.3E-05	0.042	8.0E-6*	2.2E-08	7.2E-05	1.4E-8*	1.3E-05	0.042	8.0E-6*
Pregnant Women	1.2E-05	0.039	NC	2.2E-08	7.3E-05	NC	1.2E-05	0.039	NC
Breastfeeding Women	1.6E-05	0.053	NC	2.2E-08	7.3E-05	NC	1.6E-05	0.053	NC
Birth to 33 years (at same residence) ‡			9.6E-6*			1.8E-8*			9.7E-6*

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **mg/L** = milligram contaminant per liter of water; **mg/kg/day** = milligram contaminant per kilogram body weight per day; **MRL** = ATSDR's minimal risk level. **NC** = not calculated: excess cancer risk is not calculated for pregnant and breastfeeding women whose cancer risks are expected to be similar to an adult woman exposed for 33 years.

\*Excess cancer risk is calculated using an arsenic cancer slope factor of 1.5 (mg/kg/day)<sup>-1</sup>.

‡ATSDR's default estimate for children who continue to live at their childhood home as adults.

Shaded Excess cancer risk (i.e., excess cancer risk is greater than 1.0E-6).

Table C-2B. Estimated chronic and intermediate duration exposure doses, noncancer health risk (hazard quotients), and hazard index (HI) for residents exposed to **PFOA, PFOS, and PFHxA** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0500].

Exposure Group (years)	PFOA		PFOS		PFHxA		HI
	Conc.: 1.2 x 10 <sup>-5</sup> mg/L MRL: 3 x 10 <sup>-6</sup> mg/kg/d		Conc.: 2.3 x 10 <sup>-5</sup> mg/L MRL: 2 x 10 <sup>-6</sup> mg/kg/d		Conc.: 1.0 x 10 <sup>-5</sup> mg/L RfD: 0.0005 mg/kg/d		
	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	
<b>Drinking Water (Ingestion)</b>							
Birth to < 1 y	1.7E-06	0.57	3.3E-06	1.6	1.4E-06	0.0027	2.2
1 to < 2 y	9.4E-07	0.31	1.8E-06	0.90	7.5E-07	0.0015	1.2
2 to < 6 y	6.7E-07	0.22	1.3E-06	0.65	5.4E-07	0.0011	< 1
6 to < 11 y	5.3E-07	0.18	1.0E-06	0.51	4.2E-07	0.00085	< 1
11 to < 16 y	4.2E-07	0.14	8.0E-07	0.40	3.3E-07	0.00067	< 1
16 to < 21 y	4.1E-07	0.14	7.9E-07	0.39	3.3E-07	0.00065	< 1
Adult	4.6E-07	0.15	8.9E-07	0.44	3.7E-07	0.00074	< 1
Pregnant Women	4.3E-07	0.14	8.2E-07	0.41	3.4E-07	0.00068	< 1
Breastfeeding Women	5.9E-07	0.20	1.1E-06	0.57	4.7E-07	0.00094	< 1
<b>Shower/Household (Dermal)</b>							
Birth to < 1 y	4.7E-09	0.0016	2.0E-08	0.0099	1.0E-09	2.1E-06	< 1
1 to < 2 y	4.3E-09	0.0014	1.8E-08	0.0091	9.6E-10	1.9E-06	< 1
2 to < 6 y	3.7E-09	0.0012	1.6E-08	0.0078	8.2E-10	1.6E-06	< 1
6 to < 11 y	3.0E-09	0.0010	1.3E-08	0.0064	6.7E-10	1.3E-06	< 1
11 to < 16 y	2.5E-09	0.00082	1.0E-08	0.0052	5.5E-10	1.1E-06	< 1
16 to < 21 y	2.3E-09	0.00075	9.6E-09	0.0048	5.0E-10	1.0E-06	< 1
Adult	2.2E-09	0.00074	9.3E-09	0.0047	4.9E-10	9.8E-07	< 1
Pregnant Women	2.2E-09	0.00074	9.4E-09	0.0047	4.9E-10	9.9E-07	< 1
Breastfeeding Women	2.2E-09	0.00074	9.4E-09	0.0047	4.9E-10	9.9E-07	< 1
<b>Drinking &amp; Shower/Household (Total)</b>							
Birth to < 1 y	1.7E-06	0.57	3.3E-06	1.7	1.4E-06	0.0027	2.3
1 to < 2 y	9.4E-07	0.31	1.8E-06	0.91	7.5E-07	0.0015	1.2
2 to < 6 y	6.8E-07	0.23	1.3E-06	0.65	5.4E-07	0.0011	< 1
6 to < 11 y	5.3E-07	0.18	1.0E-06	0.51	4.2E-07	0.00085	< 1
11 to < 16 y	4.2E-07	0.14	8.1E-07	0.41	3.3E-07	0.00067	< 1
16 to < 21 y	4.1E-07	0.14	7.9E-07	0.40	3.3E-07	0.00066	< 1
Adult	4.7E-07	0.16	9.0E-07	0.45	3.7E-07	0.00074	< 1
Pregnant Women	4.3E-07	0.14	8.3E-07	0.41	3.4E-07	0.00068	< 1
Breastfeeding Women	5.9E-07	0.20	1.1E-06	0.57	4.7E-07	0.00094	< 1

**chronic duration exposure** = exposure duration of 365 days or longer; **Conc.** = concentration in well water; **intermediate duration exposure** = exposure duration of 15 to 364 days; **HI** = hazard index; **mg/L** = milligram contaminant per liter of water; **mg/kg/d** = milligram contaminant per kilogram body weight per day; **MRL** = minimal risk level; **PFHxA** = perfluorohexanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RfD** = reference dose.

**Shaded** Potential non-cancer health risk. Hazard Quotients and/or HI's greater than 1 warrant further evaluation but does not mean health effects will occur.



Table C-2C. Estimated chronic and intermediate duration exposure doses, noncancer health risk (hazard quotients), and hazard index (HI) for residents exposed to **PFHxS, PFBA, and PFBS** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0500].

Exposure Group (years)	PFBA		PFBS		PFHxS		HI
	Conc.: $1.2 \times 10^{-5}$ mg/L RfD: 0.001 mg/kg/d		Conc.: $6.8 \times 10^{-6}$ mg/L RfD: 0.0003 mg/kg/d		Conc.: $5.2 \times 10^{-6}$ mg/L MRL: $2 \times 10^{-5}$ mg/kg/day		
	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	
<b>Drinking Water (Ingestion)</b>							
Birth to < 1 y	1.6E-06	0.0016	9.3E-07	0.0031	7.4E-07	0.037	< 1
1 to < 2 y	9.0E-07	0.00090	5.1E-07	0.0017	4.1E-07	0.020	< 1
2 to < 6 y	6.5E-07	0.00065	3.7E-07	0.0012	2.9E-07	0.015	< 1
6 to < 11 y	5.1E-07	0.00051	2.9E-07	0.00096	2.3E-07	0.011	< 1
11 to < 16 y	4.0E-07	0.00040	2.3E-07	0.00076	1.8E-07	0.0090	< 1
16 to < 21 y	3.9E-07	0.00039	2.2E-07	0.00074	1.8E-07	0.0089	< 1
Adult	4.4E-07	0.00044	2.5E-07	0.00084	2.0E-07	0.010	< 1
Pregnant Women	4.1E-07	0.00041	2.3E-07	0.00077	1.8E-07	0.0092	< 1
Breastfeeding Women	5.7E-07	0.00057	3.2E-07	0.0011	2.6E-07	0.013	< 1
<b>Shower/Household (Dermal)</b>							
Birth to < 1 y	4.2E-10	4.2E-07	1.5E-09	5.1E-06	2.3E-09	0.00012	< 1
1 to < 2 y	3.8E-10	3.8E-07	1.4E-09	4.8E-06	2.2E-09	0.00011	< 1
2 to < 6 y	3.3E-10	3.3E-07	1.2E-09	4.1E-06	1.9E-09	9.3E-05	< 1
6 to < 11 y	2.7E-10	2.7E-07	1.0E-09	3.3E-06	1.5E-09	7.6E-05	< 1
11 to < 16 y	2.2E-10	2.2E-07	8.1E-10	2.7E-06	1.2E-09	6.2E-05	< 1
16 to < 21 y	2.0E-10	2.0E-07	7.5E-10	2.5E-06	1.1E-09	5.7E-05	< 1
Adult	2.0E-10	2.0E-07	7.3E-10	2.4E-06	1.1E-09	5.5E-05	< 1
Pregnant Women	2.0E-10	2.0E-07	7.4E-10	2.5E-06	1.1E-09	5.6E-05	< 1
Breastfeeding Women	2.0E-10	2.0E-07	7.4E-10	2.5E-06	1.1E-09	5.6E-05	< 1
<b>Drinking &amp; Shower/Household (Total)</b>							
Birth to < 1 y	1.6E-06	0.0016	9.3E-07	0.0031	7.4E-07	0.037	< 1
1 to < 2 y	9.0E-07	0.00090	5.1E-07	0.0017	4.1E-07	0.020	< 1
2 to < 6 y	6.5E-07	0.00065	3.7E-07	0.0012	2.9E-07	0.015	< 1
6 to < 11 y	5.1E-07	0.00051	2.9E-07	0.00096	2.3E-07	0.012	< 1
11 to < 16 y	4.0E-07	0.00040	2.3E-07	0.00076	1.8E-07	0.0091	< 1
16 to < 21 y	3.9E-07	0.00039	2.2E-07	0.00074	1.8E-07	0.0089	< 1
Adult	4.4E-07	0.00044	2.5E-07	0.00084	2.0E-07	0.010	< 1
Pregnant Women	4.1E-07	0.00041	2.3E-07	0.00077	1.9E-07	0.0093	< 1
Breastfeeding Women	5.7E-07	0.00057	3.2E-07	0.0011	2.6E-07	0.013	< 1

**chronic duration exposure** = exposure duration of 365 days or longer; **Conc.** = concentration in well water; **intermediate duration exposure** = exposure duration of 15 to 364 days; **HI** = hazard index; **mg/L** = milligram contaminant per liter of water; **mg/kg/d** = milligram contaminant per kilogram body weight per day; **MRL** = minimal risk level; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxS** = perfluorohexane sulfonate; **RfD** = reference dose.

Table C-3. Estimated chronic duration exposure doses, noncancer health risk (hazard quotients), and excess cancer risk for residents exposed to **ARSENIC** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0501].

Exposure Group	Drinking Water (Ingestion)			Shower/Household (Dermal)			Drinking & Shower/Household (Total)		
	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk
<b>Arsenic (Water Concentration: 0.00009 mg/L; Chronic MRL: 0.0003 mg/kg/day)</b>									
Birth to < 1 year	1.2E-05	0.041	1.7E-6*	1.2E-08	4.0E-05	3.1E-9*	1.2E-05	0.041	1.7E-6*
1 to < 2 years	6.8E-06	0.023		1.1E-08	3.7E-05		6.8E-06	0.023	
2 to < 6 years	4.8E-06	0.016		9.7E-09	3.2E-05		4.9E-06	0.016	
6 to < 11 years	3.8E-06	0.013		7.9E-09	2.6E-05		3.8E-06	0.013	
11 to < 16 years	3.0E-06	0.010		6.5E-09	2.2E-05		3.0E-06	0.010	
16 to < 21 years	2.9E-06	0.0098		6.0E-09	2.0E-05		3.0E-06	0.0098	
Adult	3.3E-06	0.011	2.1E-6*	5.7E-09	1.9E-05	3.6E-9*	3.3E-06	0.011	2.1E-6*
Pregnant Women	3.1E-06	0.010	NC	5.8E-09	1.9E-05	NC	3.1E-06	0.010	NC
Breastfeeding Women	4.2E-06	0.014	NC	5.8E-09	1.9E-05	NC	4.2E-06	0.014	NC
Birth to 33 years (at same residence)†			2.6E-6*			4.7E-9*			2.6E-6*

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **mg/L** = milligram contaminant per liter of water; **mg/kg/day** = milligram contaminant per kilogram body weight per day; **MRL** = ATSDR's minimal risk level. **NC** = not calculated: excess cancer risk is not calculated for pregnant and breastfeeding women whose cancer risks are expected to be similar to an adult woman exposed for 33 years.

\*Excess cancer risk is calculated using an arsenic cancer slope factor of 1.5 (mg/kg/day)<sup>-1</sup>.

†ATSDR's default estimate for children who continue to live at their childhood home as adults.

Shaded Excess cancer risk (i.e., excess cancer risk is greater than 1.0E-6).

Table C-4A. Estimated chronic duration exposure doses, noncancer health risk (hazard quotients), and excess cancer risk for residents exposed to **ARSENIC** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0505].

Exposure Group	Drinking Water (Ingestion)			Shower/Household (Dermal)			Drinking & Shower/Household (Total)		
	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk
<b>Arsenic (Water Concentration: 0.00048 mg/L; Chronic MRL: 0.0003 mg/kg/day)</b>									
Birth to < 1 year	6.6E-05	0.22	8.9E-6*	6.4E-08	0.00021	1.7E-8*	6.6E-05	0.22	9.0E-6*
1 to < 2 years	3.6E-05	0.12		5.9E-08	0.00020		3.6E-05	0.12	
2 to < 6 years	2.6E-05	0.086		5.2E-08	0.00017		2.6E-05	0.086	
6 to < 11 years	2.0E-05	0.068		4.2E-08	0.00014		2.0E-05	0.068	
11 to < 16 years	1.6E-05	0.053		3.5E-08	0.00012		1.6E-05	0.053	
16 to < 21 years	1.6E-05	0.052		3.2E-08	0.00011		1.6E-05	0.052	
Adult	1.8E-05	0.059	1.1E-5*	3.1E-08	0.00010	1.9E-8*	1.8E-05	0.059	1.1E-5*
Pregnant Women	1.6E-05	0.054	NC	3.1E-08	0.00010	NC	1.6E-05	0.055	NC
Breastfeeding Women	2.3E-05	0.075	NC	3.1E-08	0.00010	NC	2.3E-05	0.076	NC
Birth to 33 years (at same residence)†			1.4E-5*			2.5E-8*			1.4E-5*

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **mg/L** = milligram contaminant per liter of water; **mg/kg/day** = milligram contaminant per kilogram body weight per day; **MRL** = ATSDR's minimal risk level. **NC** = not calculated: excess cancer risk is not calculated for pregnant and breastfeeding women whose cancer risks are expected to be similar to an adult woman exposed for 33 years.

\*Excess cancer risk is calculated using an arsenic cancer slope factor of 1.5 (mg/kg/day)<sup>-1</sup>.

†ATSDR's default estimate for children who continue to live at their childhood home as adults.

Shaded Excess cancer risk (i.e., excess cancer risk is greater than 1.0E-6).

Table C-4B. Estimated chronic and intermediate duration exposure doses, noncancer health risk (hazard quotients), and hazard index (HI) for residents exposed to **PFOA, PFOS, and PFHxA** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0505].

Exposure Group (years)	PFOA		PFOS		PFHxA		HI
	Conc.: $5.9 \times 10^{-6}$ mg/L MRL: $3 \times 10^{-6}$ mg/kg/d		Conc.: $4.9 \times 10^{-5}$ mg/L MRL: $2 \times 10^{-6}$ mg/kg/d		Conc.: $3.7 \times 10^{-6}$ mg/L RfD: 0.0005 mg/kg/d		
	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	
<b>Drinking Water (Ingestion)</b>							
Birth to < 1 y	8.4E-07	0.28	7.0E-06	3.5	5.1E-07	0.0010	3.8
1 to < 2 y	4.6E-07	0.15	3.8E-06	1.9	2.8E-07	0.00056	2.1
2 to < 6 y	3.3E-07	0.11	2.8E-06	1.4	2.0E-07	0.00040	1.5
6 to < 11 y	2.6E-07	0.087	2.2E-06	1.1	1.6E-07	0.00031	1.2
11 to < 16 y	2.1E-07	0.068	1.7E-06	0.85	1.2E-07	0.00025	< 1
16 to < 21 y	2.0E-07	0.067	1.7E-06	0.84	1.2E-07	0.00024	< 1
Adult	2.3E-07	0.076	1.9E-06	0.95	1.4E-07	0.00027	1.0
Pregnant Women	2.1E-07	0.070	1.7E-06	0.87	1.3E-07	0.00025	< 1
Breastfeeding Women	2.9E-07	0.097	2.4E-06	1.2	1.7E-07	0.00035	1.3
<b>Shower/Household (Dermal)</b>							
Birth to < 1 y	2.3E-09	0.00076	4.2E-08	0.021	3.8E-10	7.7E-07	< 1
1 to < 2 y	2.1E-09	0.00071	3.9E-08	0.019	3.5E-10	7.1E-07	< 1
2 to < 6 y	1.8E-09	0.00061	3.3E-08	0.017	3.0E-10	6.1E-07	< 1
6 to < 11 y	1.5E-09	0.00049	2.7E-08	0.014	2.5E-10	4.9E-07	< 1
11 to < 16 y	1.2E-09	0.00040	2.2E-08	0.011	2.0E-10	4.0E-07	< 1
16 to < 21 y	1.1E-09	0.00037	2.0E-08	0.010	1.9E-10	3.7E-07	< 1
Adult	1.1E-09	0.00036	2.0E-08	0.010	1.8E-10	3.6E-07	< 1
Pregnant Women	1.1E-09	0.00036	2.0E-08	0.010	1.8E-10	3.7E-07	< 1
Breastfeeding Women	1.1E-09	0.00036	2.0E-08	0.010	1.8E-10	3.7E-07	< 1
<b>Drinking &amp; Shower/Household (Total)</b>							
Birth to < 1 y	8.4E-07	0.28	7.0E-06	3.5	5.1E-07	0.0010	3.8
1 to < 2 y	4.6E-07	0.15	3.9E-06	1.9	2.8E-07	0.00056	2.1
2 to < 6 y	3.3E-07	0.11	2.8E-06	1.4	2.0E-07	0.00040	1.5
6 to < 11 y	2.6E-07	0.087	2.2E-06	1.1	1.6E-07	0.00031	1.2
11 to < 16 y	2.1E-07	0.069	1.7E-06	0.86	1.2E-07	0.00025	< 1
16 to < 21 y	2.0E-07	0.067	1.7E-06	0.85	1.2E-07	0.00024	< 1
Adult	2.3E-07	0.076	1.9E-06	0.96	1.4E-07	0.00027	1.0
Pregnant Women	2.1E-07	0.070	1.8E-06	0.88	1.3E-07	0.00025	1.0
Breastfeeding Women	2.9E-07	0.097	2.4E-06	1.2	1.7E-07	0.00035	1.3

**chronic duration exposure** = exposure duration of 365 days or longer; **Conc.** = concentration in well water; **intermediate duration exposure** = exposure duration of 15 to 364 days; **HI** = hazard index; **mg/L** = milligram contaminant per liter of water; **mg/kg/d** = milligram contaminant per kilogram body weight per day; **MRL** = minimal risk level; **PFHxA** = perfluorohexanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RfD** = reference dose.

**Shaded** Potential non-cancer health risk. Hazard Quotients and/or HI's greater than 1 warrant further evaluation but does not mean health effects will occur.

Table C-4C. Estimated chronic and intermediate duration exposure doses, noncancer health risk (hazard quotients), and hazard index (HI) for residents exposed to **PFBA, PFBS, and PFHxS** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0505].

Exposure Group (years)	PFBA		PFBS		PFHxS		HI
	Conc.: $4.8 \times 10^{-6}$ mg/L RfD: 0.001 mg/kg/d		Conc.: $7.8 \times 10^{-6}$ mg/L RfD: 0.0003 mg/kg/d		Conc.: $1.3 \times 10^{-5}$ mg/L MRL: $2 \times 10^{-5}$ mg/kg/day		
	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	
<b>Drinking Water (Ingestion)</b>							
Birth to < 1 y	6.6E-07	0.00066	1.1E-06	0.0036	1.9E-06	0.093	< 1
1 to < 2 y	3.6E-07	0.00036	5.9E-07	0.0020	1.0E-06	0.051	< 1
2 to < 6 y	2.6E-07	0.00026	4.2E-07	0.0014	7.3E-07	0.036	< 1
6 to < 11 y	2.0E-07	0.00020	3.3E-07	0.0011	5.7E-07	0.029	< 1
11 to < 16 y	1.6E-07	0.00016	2.6E-07	0.00087	4.5E-07	0.023	< 1
16 to < 21 y	1.6E-07	0.00016	2.6E-07	0.00085	4.4E-07	0.022	< 1
Adult	1.8E-07	0.00018	2.9E-07	0.00096	5.0E-07	0.025	< 1
Pregnant Women	1.6E-07	0.00016	2.7E-07	0.00088	4.6E-07	0.023	< 1
Breastfeeding Women	2.3E-07	0.00023	3.7E-07	0.0012	6.4E-07	0.032	< 1
<b>Shower/Household (Dermal)</b>							
Birth to < 1 y	1.7E-10	1.7E-07	1.8E-09	5.9E-06	5.9E-09	0.00029	< 1
1 to < 2 y	1.5E-10	1.5E-07	1.6E-09	5.5E-06	5.4E-09	0.00027	< 1
2 to < 6 y	1.3E-10	1.3E-07	1.4E-09	4.7E-06	4.6E-09	0.00023	< 1
6 to < 11 y	1.1E-10	1.1E-07	1.1E-09	3.8E-06	3.8E-09	0.00019	< 1
11 to < 16 y	8.8E-11	8.8E-08	9.3E-10	3.1E-06	3.1E-09	0.00015	< 1
16 to < 21 y	8.0E-11	8.0E-08	8.6E-10	2.9E-06	2.8E-09	0.00014	< 1
Adult	7.9E-11	7.9E-08	8.4E-10	2.8E-06	2.8E-09	0.00014	< 1
Pregnant Women	7.9E-11	7.9E-08	8.4E-10	2.8E-06	2.8E-09	0.00014	< 1
Breastfeeding Women	7.9E-11	7.9E-08	8.4E-10	2.8E-06	2.8E-09	0.00014	< 1
<b>Drinking &amp; Shower/Household (Total)</b>							
Birth to < 1 y	6.6E-07	0.00066	1.1E-06	0.0036	1.9E-06	0.093	< 1
1 to < 2 y	3.6E-07	0.00036	5.9E-07	0.0020	1.0E-06	0.051	< 1
2 to < 6 y	2.6E-07	0.00026	4.2E-07	0.0014	7.3E-07	0.037	< 1
6 to < 11 y	2.0E-07	0.00020	3.3E-07	0.0011	5.8E-07	0.029	< 1
11 to < 16 y	1.6E-07	0.00016	2.6E-07	0.00087	4.6E-07	0.023	< 1
16 to < 21 y	1.6E-07	0.00016	2.6E-07	0.00085	4.5E-07	0.022	< 1
Adult	1.8E-07	0.00018	2.9E-07	0.00097	5.1E-07	0.025	< 1
Pregnant Women	1.6E-07	0.00016	2.7E-07	0.00089	4.6E-07	0.023	< 1
Breastfeeding Women	2.3E-07	0.00023	3.7E-07	0.0012	6.4E-07	0.032	< 1

**chronic duration exposure** = exposure duration of 365 days or longer; **Conc.** = concentration in well water; **intermediate duration exposure** = exposure duration of 15 to 364 days; **HI** = hazard index; **mg/L** = milligram contaminant per liter of water; **mg/kg/d** = milligram contaminant per kilogram body weight per day; **MRL** = minimal risk level; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxS** = perfluorohexane sulfonate; **RfD** = reference dose.

Table C-5. Estimated chronic duration exposure doses, noncancer health risk (hazard quotients), and excess cancer risk for residents exposed to **ARSENIC** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0506].

Exposure Group	Drinking Water (Ingestion)			Shower/Household (Dermal)			Drinking & Shower/Household (Total)		
	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk
<b>Arsenic (Water Concentration: 0.00015 mg/L; Chronic MRL: 0.0003 mg/kg/day)</b>									
Birth to < 1 year	2.1E-05	0.068	2.8E-6*	2.0E-08	6.7E-05	5.2E-9*	2.1E-05	0.068	2.8E-6*
1 to < 2 years	1.1E-05	0.038		1.8E-08	6.1E-05		1.1E-05	0.038	
2 to < 6 years	8.1E-06	0.027		1.6E-08	5.4E-05		8.1E-06	0.027	
6 to < 11 years	6.4E-06	0.021		1.3E-08	4.4E-05		6.4E-06	0.021	
11 to < 16 years	5.0E-06	0.017		1.1E-08	3.6E-05		5.0E-06	0.017	
16 to < 21 years	4.9E-06	0.016		9.9E-09	3.3E-05		4.9E-06	0.016	
Adult	5.6E-06	0.019	3.5E-6*	9.6E-09	3.2E-05	6.1E-9*	5.6E-06	0.019	3.5E-6*
Pregnant Women	5.1E-06	0.017	NC	9.7E-09	3.2E-05	NC	5.1E-06	0.017	NC
Breastfeeding Women	7.1E-06	0.024	NC	9.7E-09	3.2E-05	NC	7.1E-06	0.024	NC
Birth to 33 years (at same residence)†			4.3E-6*			7.8E-9*			4.3E-6*

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **mg/L** = milligram contaminant per liter of water; **mg/kg/day** = milligram contaminant per kilogram body weight per day; **MRL** = ATSDR's minimal risk level. **NC** = not calculated: excess cancer risk is not calculated for pregnant and breastfeeding women whose cancer risks are expected to be similar to an adult woman exposed for 33 years.

\*Excess cancer risk is calculated using an arsenic cancer slope factor of 1.5 (mg/kg/day)<sup>-1</sup>.

†ATSDR's default estimate for children who continue to live at their childhood home as adults.

Shaded Excess cancer risk (i.e., excess cancer risk is greater than 1.0E-6).

Table C-6A. Estimated chronic duration exposure doses, noncancer health risk (hazard quotients), and excess cancer risk for residents exposed to **ARSENIC** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0508].

Exposure Group	Drinking Water (Ingestion)			Shower/Household (Dermal)			Drinking & Shower/Household (Total)		
	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk	Dose (mg/kg/day)	Hazard Quotient	Cancer Risk
<b>Arsenic (Water Concentration: 0.00007 mg/L; Chronic MRL: 0.0003 mg/kg/day)</b>									
Birth to < 1 year	9.6E-06	0.032	1.3E-6*	9.4E-09	3.1E-05	2.4E-9*	9.6E-06	0.032	1.3E-6*
1 to < 2 years	5.3E-06	0.018		8.5E-09	2.8E-05		5.3E-06	0.018	
2 to < 6 years	3.8E-06	0.013		7.5E-09	2.5E-05		3.8E-06	0.013	
6 to < 11 years	3.0E-06	0.0099		6.2E-09	2.1E-05		3.0E-06	0.0099	
11 to < 16 years	2.3E-06	0.0078		5.1E-09	1.7E-05		2.3E-06	0.0078	
16 to < 21 years	2.3E-06	0.0076		4.6E-09	1.5E-05		2.3E-06	0.0077	
Adult	2.6E-06	0.0086	1.6E-6*	4.5E-09	1.5E-05	2.8E-9*	2.6E-06	0.0087	1.6E-6*
Pregnant Women	2.4E-06	0.0079	NC	4.5E-09	1.5E-05	NC	2.4E-06	0.0080	NC
Breastfeeding Women	3.3E-06	0.011	NC	4.5E-09	1.5E-05	NC	3.3E-06	0.011	NC
Birth to 33 years (at same residence)‡			2.0E-6*			3.6E-9*			2.0E-6*

ATSDR = Agency for Toxic Substances and Disease Registry; **chronic** = exposure duration of 365 days or longer; **mg/L** = milligram contaminant per liter of water; **mg/kg/day** = milligram contaminant per kilogram body weight per day; **MRL** = ATSDR's minimal risk level. **NC** = not calculated: excess cancer risk is not calculated for pregnant and breastfeeding women whose cancer risks are expected to be similar to an adult woman exposed for 33 years.

\*Excess cancer risk is calculated using an arsenic cancer slope factor of 1.5 (mg/kg/day)<sup>-1</sup>.

‡ATSDR's default estimate for children who continue to live at their childhood home as adults.

Shaded Excess cancer risk (i.e., excess cancer risk is greater than 1.0E-6).

Table C-6B. Estimated chronic and intermediate duration exposure doses, noncancer health risk (hazard quotients), and hazard index (HI) for residents exposed to **PFOA, PFOS, and PFHxA** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0508].

Exposure Group (years)	PFOA		PFOS		PFHxA		HI
	Conc.: $1.3 \times 10^{-5}$ mg/L MRL: $3 \times 10^{-6}$ mg/kg/d		Conc.: $1.75 \times 10^{-5}$ mg/L MRL: $2 \times 10^{-6}$ mg/kg/d		Conc.: $2.0 \times 10^{-6}$ mg/L RfD: 0.0005 mg/kg/d		
	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	
<b>Drinking Water (Ingestion)</b>							
Birth to < 1 y	1.9E-06	0.62	2.4E-06	1.2	2.7E-07	0.00055	1.8
1 to < 2 y	1.0E-06	0.34	1.3E-06	0.67	1.5E-07	0.00030	1.0
2 to < 6 y	7.3E-07	0.24	9.5E-07	0.48	1.1E-07	0.00022	< 1
6 to < 11 y	5.7E-07	0.19	7.5E-07	0.38	8.5E-08	0.00017	< 1
11 to < 16 y	4.5E-07	0.15	5.9E-07	0.30	6.7E-08	0.00013	< 1
16 to < 21 y	4.4E-07	0.15	5.8E-07	0.29	6.5E-08	0.00013	< 1
Adult	5.0E-07	0.17	6.6E-07	0.33	7.4E-08	0.00015	< 1
Pregnant Women	4.6E-07	0.15	6.0E-07	0.30	6.8E-08	0.00014	< 1
Breastfeeding Women	6.4E-07	0.21	8.4E-07	0.42	9.4E-08	0.00019	< 1
<b>Shower/Household (Dermal)</b>							
Birth to < 1 y	5.0E-09	0.0017	1.5E-08	0.0073	2.1E-10	4.1E-07	< 1
1 to < 2 y	4.7E-09	0.0016	1.4E-08	0.0068	1.9E-10	3.8E-07	< 1
2 to < 6 y	4.0E-09	0.0013	1.2E-08	0.0058	1.6E-10	3.3E-07	< 1
6 to < 11 y	3.3E-09	0.0011	9.4E-09	0.0047	1.3E-10	2.7E-07	< 1
11 to < 16 y	2.7E-09	0.00089	7.7E-09	0.0038	1.1E-10	2.2E-07	< 1
16 to < 21 y	2.4E-09	0.00081	7.1E-09	0.0035	1.0E-10	2.0E-07	< 1
Adult	2.4E-09	0.00080	6.9E-09	0.0035	9.8E-11	2.0E-07	< 1
Pregnant Women	2.4E-09	0.00080	7.0E-09	0.0035	9.9E-11	2.0E-07	< 1
Breastfeeding Women	2.4E-09	0.00080	7.0E-09	0.0035	9.9E-11	2.0E-07	< 1
<b>Drinking &amp; Shower/Household (Total)</b>							
Birth to < 1 y	1.9E-06	0.62	2.4E-06	1.2	2.7E-07	0.00055	1.8
1 to < 2 y	1.0E-06	0.34	1.3E-06	0.67	1.5E-07	0.00030	1.0
2 to < 6 y	7.3E-07	0.24	9.7E-07	0.48	1.1E-07	0.00022	< 1
6 to < 11 y	5.8E-07	0.19	7.6E-07	0.38	8.5E-08	0.00017	< 1
11 to < 16 y	4.5E-07	0.15	6.0E-07	0.30	6.7E-08	0.00013	< 1
16 to < 21 y	4.5E-07	0.15	5.9E-07	0.29	6.6E-08	0.00013	< 1
Adult	5.0E-07	0.17	6.6E-07	0.33	7.4E-08	0.00015	< 1
Pregnant Women	4.6E-07	0.15	6.1E-07	0.30	6.8E-08	0.00014	< 1
Breastfeeding Women	6.4E-07	0.21	8.4E-07	0.42	9.4E-08	0.00019	< 1

**chronic duration exposure** = exposure duration of 365 days or longer; **Conc.** = concentration in well water; **intermediate duration exposure** = exposure duration of 15 to 364 days; **HI** = hazard index; **mg/L** = milligram contaminant per liter of water; **mg/kg/d** = milligram contaminant per kilogram body weight per day; **MRL** = minimal risk level; **PFHxA** = perfluorohexanoic acid; **PFOA** = perfluorooctanoic acid; **PFOS** = perfluorooctane sulfonate; **RfD** = reference dose.

**Shaded** Potential noncancer health risk. Hazard Quotients and/or HI's greater than 1 warrant further evaluation but does not mean health effects will occur.



Table C-6C. Estimated chronic and intermediate duration exposure doses, noncancer health risk (hazard quotients), and hazard index (HI) for residents exposed to **PFBA, PFBS, and PFHxS** in potable well water via drinking water (ingestion) and shower and other non-consumption household use (dermal contact) [Well ID AAS0508].

Exposure Group (years)	PFBA		PFBS		PFHxS		HI
	Conc.: $4.0 \times 10^{-6}$ mg/L RfD: 0.001 mg/kg/d		Conc.: $1.9 \times 10^{-6}$ mg/L RfD: 0.0003 mg/kg/d		Conc.: $4.1 \times 10^{-6}$ mg/L MRL: $2 \times 10^{-5}$ mg/kg/d		
	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	Dose (mg/kg/d)	Hazard Quotient	
<b>Drinking Water (Ingestion)</b>							
Birth to < 1 y	5.5E-07	0.00055	2.6E-07	0.00087	5.9E-07	0.029	< 1
1 to < 2 y	3.0E-07	0.00030	1.4E-07	0.00048	3.2E-07	0.016	< 1
2 to < 6 y	2.2E-07	0.00022	1.0E-07	0.00034	2.3E-07	0.012	< 1
6 to < 11 y	1.7E-07	0.00017	8.0E-08	0.00027	1.8E-07	0.0091	< 1
11 to < 16 y	1.3E-07	0.00013	6.3E-08	0.00021	1.4E-07	0.0071	< 1
16 to < 21 y	1.3E-07	0.00013	6.2E-08	0.00021	1.4E-07	0.0070	< 1
Adult	1.5E-07	0.00015	7.0E-08	0.00023	1.6E-07	0.0079	< 1
Pregnant Women	1.4E-07	0.00014	6.5E-08	0.00022	1.5E-07	0.0073	< 1
Breastfeeding Women	1.9E-07	0.00019	9.0E-08	0.00030	2.0E-07	0.010	< 1
<b>Shower/Household (Dermal)</b>							
Birth to < 1 y	1.4E-10	1.4E-07	4.3E-10	1.4E-06	1.8E-09	9.2E-05	< 1
1 to < 2 y	1.3E-10	1.3E-07	4.0E-10	1.3E-06	1.7E-09	8.5E-05	< 1
2 to < 6 y	1.1E-10	1.1E-07	3.4E-10	1.1E-06	1.5E-09	7.3E-05	< 1
6 to < 11 y	8.9E-11	8.9E-08	2.8E-10	9.3E-07	1.2E-09	6.0E-05	< 1
11 to < 16 y	7.3E-11	7.3E-08	2.3E-10	7.6E-07	9.7E-10	4.9E-05	< 1
16 to < 21 y	6.7E-11	6.7E-08	2.1E-10	6.9E-07	8.9E-10	4.5E-05	< 1
Adult	6.6E-11	6.6E-08	2.0E-10	6.8E-07	8.7E-10	4.4E-05	< 1
Pregnant Women	6.6E-11	6.6E-08	2.1E-10	6.9E-07	8.8E-10	4.4E-05	< 1
Breastfeeding Women	6.6E-11	6.6E-08	2.1E-10	6.9E-07	8.8E-10	4.4E-05	< 1
<b>Drinking &amp; Shower/Household (Total)</b>							
Birth to < 1 y	5.5E-07	0.00055	2.6E-07	0.00087	5.9E-07	0.029	< 1
1 to < 2 y	3.0E-07	0.00030	1.4E-07	0.00048	3.2E-07	0.016	< 1
2 to < 6 y	2.2E-07	0.00022	1.0E-07	0.00034	2.3E-07	0.012	< 1
6 to < 11 y	1.7E-07	0.00017	8.1E-08	0.00027	1.8E-07	0.0091	< 1
11 to < 16 y	1.3E-07	0.00013	6.4E-08	0.00021	1.4E-07	0.0072	< 1
16 to < 21 y	1.3E-07	0.00013	6.2E-08	0.00021	1.4E-07	0.0070	< 1
Adult	1.5E-07	0.00015	7.1E-08	0.00024	1.6E-07	0.0080	< 1
Pregnant Women	1.4E-07	0.00014	6.5E-08	0.00022	1.5E-07	0.0073	< 1
Breastfeeding Women	1.9E-07	0.00019	9.0E-08	0.00030	2.0E-07	0.010	< 1

**chronic duration exposure** = exposure duration of 365 days or longer; **Conc.** = concentration in well water; **intermediate duration exposure** = exposure duration of 15 to 364 days; **HI** = hazard index; **mg/L** = milligram contaminant per liter of water; **mg/kg/d** = milligram contaminant per kilogram body weight per day; **MRL** = minimal risk level; **PFBA** = perfluorobutyric acid; **PFBS** = perfluorobutane sulfonic acid; **PFHxS** = perfluorohexane sulfonate; **RfD** = reference dose.

Figure 1: Narcoossee Dump, Saint Cloud, Osceola County—site location.

