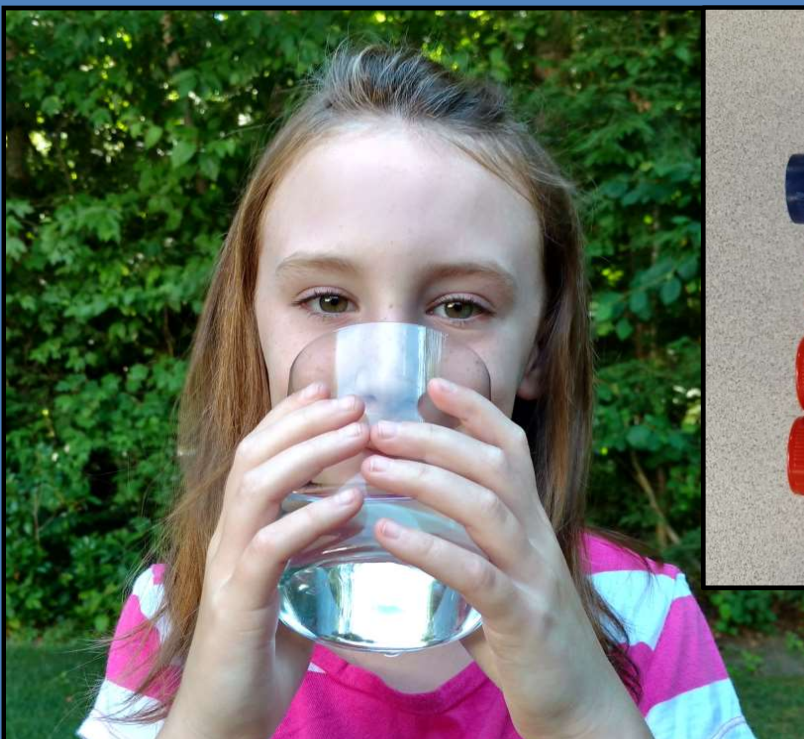
2019 NH Tracking and Assessment of Chemical Exposures (TrACE) Study



Summary Report

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Key Terms for this Report

95th and 50th percentiles: The 95th percentile is the value that 95% of participants tested below and only 5% of participants tested above. The 50th percentile is also referred to as the median. It is the value that 50% of participants tested below and 50% tested above.

Biomonitoring: Scientists test human blood, urine, or tissue to understand whether people have been exposed to environmental chemicals. If people have been exposed to these chemicals, then testing shows how much of the chemical or the breakdown products of the chemical is in their body.

Corrosivity: A measure of how likely the water is to dissolve the materials it comes into contact with, such as lead or copper in plumbing. Corrosive water may dissolve these metals from the plumbing allowing them to enter the water. The greatest risk for this occurs when the water sits stagnant or undisturbed for a long period of time (such as overnight).

Finished water: Water collected at the kitchen sink (or a similar faucet) after any treatment system. TrACE participants most likely used finished water for drinking and cooking. This water has traveled through the household plumbing.

Geometric mean: A special type of average value of the data that is less influenced by high values or outliers. It is a common way to determine the average value for environmental chemicals in human specimens.

Health limits: Values based on maximum contaminant levels (see maximum contaminant level definition) adopted by the US Environmental Protection Agency (EPA) or drinking water standards adopted by the NH Department of Environmental Services (NHDES).

Limit of detection (LOD): The lowest level that the laboratory can detect.

Maximum contaminant level (MCL): A standard set by the US EPA or the NHDES for drinking water quality. An MCL is the legal limit on the amount of a contaminant that is allowed in public water systems under the Safe Drinking Water Act or NH law. The limit is chosen based on what will protect human health and what public drinking water systems can achieve with their budget and available treatment options.

Micrograms per liter (µg/L): A unit of measurement that is sometimes referred to as parts per billion (ppb).

Milligrams per liter (mg/L): A unit of measurement that is sometimes referred to as parts per million (ppm).

N: The number of people or samples in a group.

Key Terms for this Report

Nanograms per liter (ng/L): A unit of measurement that is sometimes referred to as parts per trillion (ppt).

Picocuries per liter (pCi/L): A unit of measurement for radiological chemicals.

Private well water: Water from a private or shared well that gives access to groundwater to less than 25 people.

Public drinking water: Water from a public water system (PWS). A PWS has at least 15 service connections or serves at least 25 people for at least 60 days a year. This includes water from municipal water systems, mobile home parks, condominiums, and single-family developments.

Raw water: Water collected from the private well water storage tank (if present) are "raw" samples because this water is untreated and most similar to the groundwater. This water has not flowed through the home plumbing.

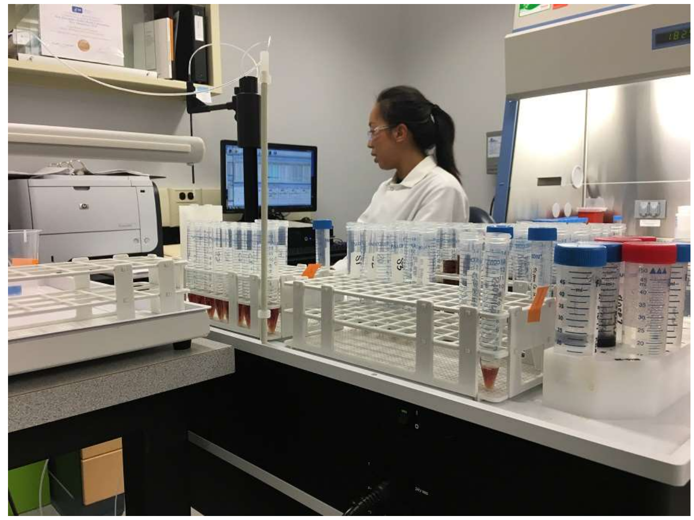
Screening levels: Values based on assessments conducted by US EPA or the US Geological Survey and are values below which adverse health effects are not anticipated from one-day or lifetime exposures.

Statistically significant: A statistically significant difference between groups (ex. males vs. females) means there is great confidence that the difference in levels between the groups is real and not due to chance or random variation. A statistically significant result is indicated by $P \leq 0.05$ or non-overlapping 95% confidence intervals.

US population: Comparison data for the US population came from the most recently available data from the Centers for Disease Control and Prevention National Report on Human Exposure to Environmental Chemicals at the time of TrACE Study (2019). The data in this report is compared to data from the US non-Hispanic white population as that is most similar to the population of New Hampshire.

Biomonitoring is the study of environmental chemicals in people. These chemicals may be natural, such as arsenic and uranium from groundwater. They may also be man-made, such as pesticides from agriculture.

OVERVIEW



Dr. Kimberly Aviado, BiomonitoringNH lead toxicologist, analyzes blood for metals.

The Tracking and Assessment of Chemical Exposures (TrACE) Study was conducted across NH, from Nashua to Pittsburg and everywhere in between.

Blood, serum, and urine from 336 people was tested for 50 chemicals.

Water from 274 households was tested for hundreds of chemicals.

PURPOSE

BiomonitoringNH conducted the TrACE Study for many reasons:

To see how the levels of chemicals in TrACE participants compare to the levels in the US population.

To identify which groups of people are most at risk for coming into contact with chemicals.

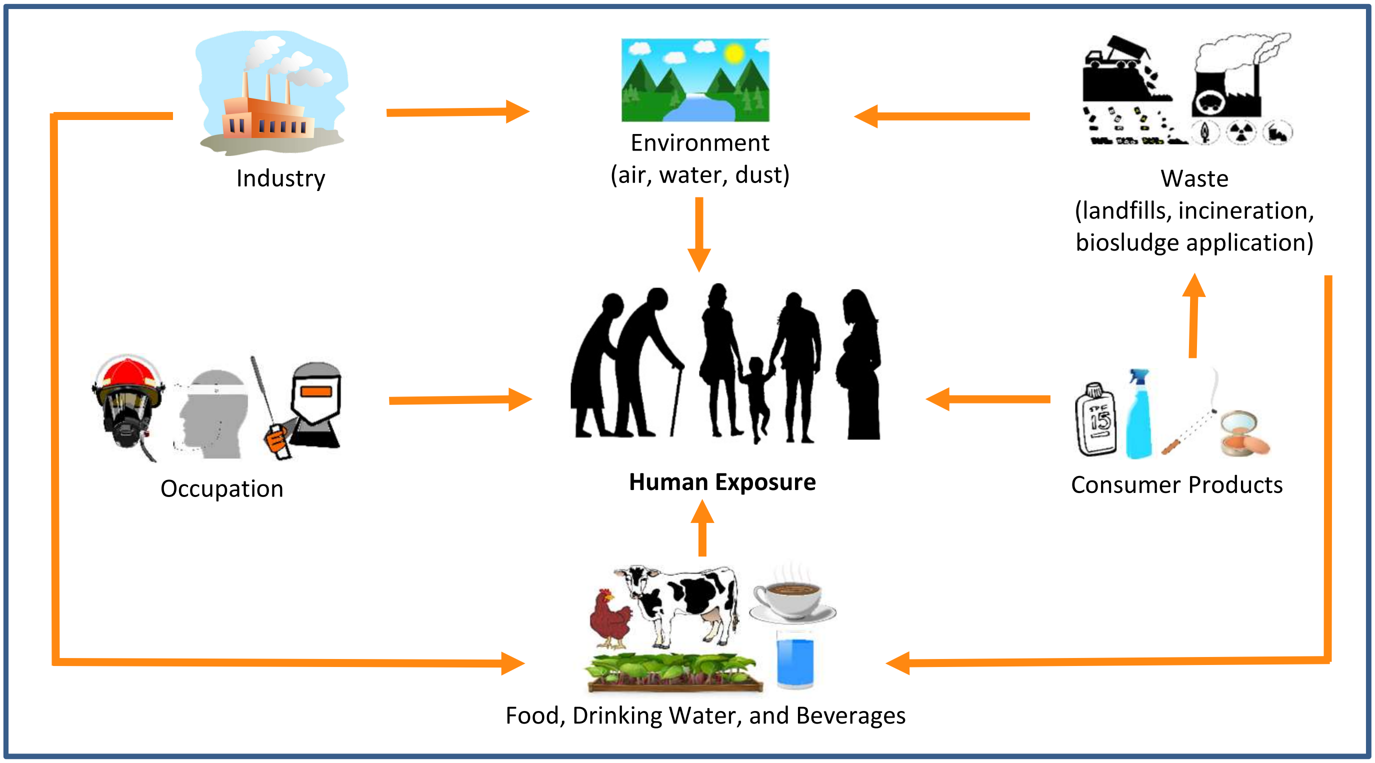
To educate NH residents on ways to reduce and/or eliminate their exposure to chemicals.

To build the capacity and capability of the NH Public Health Laboratories to conduct high quality biomonitoring science.

Biomonitoring is Testing for Natural and Man-made Chemicals in People

Biomonitoring is the assessment of chemicals or their breakdown products in human specimens such as urine, blood, or tissue. Biomonitoring is important because it gives information on whether people are coming into contact with environmental chemicals (also known as being exposed). People may be exposed to chemicals at work or from the foods and beverages they consume. They may also be exposed from the products they use and the activities they enjoy (Figure 1). **Biomonitoring results are useful because they can help people make decisions. For example, whether they should use less of, or completely stop using, a product. They also inform laws and help prioritize public health work.**

Figure 1. Examples of human exposure to chemicals.



The 2019 TrACE Study was NH's First Biomonitoring Surveillance Study

Surveillance means data is gathered in a controlled way so the information learned can be applied to a larger population. The TrACE Study was designed to measure the amount of fifty (50) chemicals in blood, serum (the clear part of blood), and urine specimens from NH residents. Some of these chemicals occur naturally in the environment, such as arsenic. Arsenic naturally exits NH's bedrock through normal wearing over time. It may enter the groundwater aquifer, which is a drinking water supply for many people.

Other chemicals tested for in TrACE Study participants are produced by humans, such as pyrethroids, a type of pesticide. The TrACE Study tested for a breakdown product of pyrethroids called 4F-3PBA. People may be exposed or come into contact with this chemical when they use pyrethroid-containing products like insect repellants.

BiomonitoringNH tested for arsenic, 4F-3PBA, and other chemicals in NH residents to learn how their levels compare to national data from the Centers for Disease Control and Prevention (CDC). The CDC has information on the levels of over 400 chemicals in US residents. That data is aggregated (combined) and cannot be broken down by state. NH residents may have different environmental exposures than people in other parts of the US, so the concentrations of chemicals in their bodies may not be the same. **The purpose of the 2019 NH TrACE Study was to see if NH residents had more, less, or similar amounts of chemicals in their bodies as the representative US population from the CDC National Report on Human Exposure to Environmental Chemicals (National Exposure Report).**

KEY FINDINGS

TrACE Participants Compared to the US Population

TrACE participants had significantly different levels of the following chemicals in their bodies when compared to the US population.

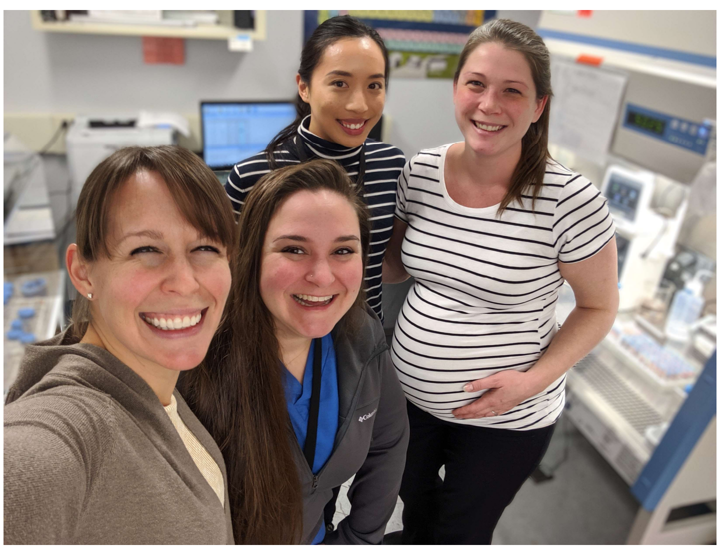
1. TrACE participants had higher levels of cadmium, cesium, lead, PFDA, PNP, total arsenic, and total mercury (see page 16 for results and Appendix A for full chemical names).
2. TrACE participants had lower levels of cobalt, manganese, PFHxS, PFOS, and selenium (see page 16).

Household Water Results

1. Raw private well water had higher levels of arsenic, manganese, radon, and uranium than finished private well water (see page 23 for results and Key Terms for raw and finished definitions).
2. Finished water from homes served by private wells had higher levels of arsenic, radon, strontium, uranium, stagnant lead, and stagnant copper than homes served by public drinking water (see page 24).

TrACE Participant Results with Household Water Quality

1. TrACE private well water users had higher levels of lead, PFOS, and uranium in their bodies than TrACE public drinking water users (see page 25).
2. TrACE public drinking water users had higher levels of PFOA in their bodies than TrACE private well water users (see page 25).
3. There was a trend of increasing levels of inorganic arsenic, lead, PFOA, and uranium in TrACE participants as the amount of those chemicals increased in home water (see page 29).



The BiomonitoringNH Team (from left to right): Amanda Cosser, Carleen Snow, Dr. Kimberly Aviado, and Melissa Josefiak.

Many factors go into whether a person will develop a health effect after being exposed to a chemical. Some of these include the person's genetics, overall health, how much and for how long they have been in contact with that chemical, how they were exposed, and if they are exposed to other chemicals at the same time. Much of the research scientists have done has involved people exposed to large amounts of chemicals at work, those who have misused the chemicals, or with animals. Scientists are conducting further studies to learn more about these chemicals and their effects on humans. For some chemicals, like lead, there is no known safe level in people. For others, limits have been set on how much a person can be exposed to (such as from drinking water) and still stay healthy. Additionally, it is important to remember that not all chemicals are bad for you. Some (like manganese) are essential nutrients and are needed in certain amounts for you to be healthy.

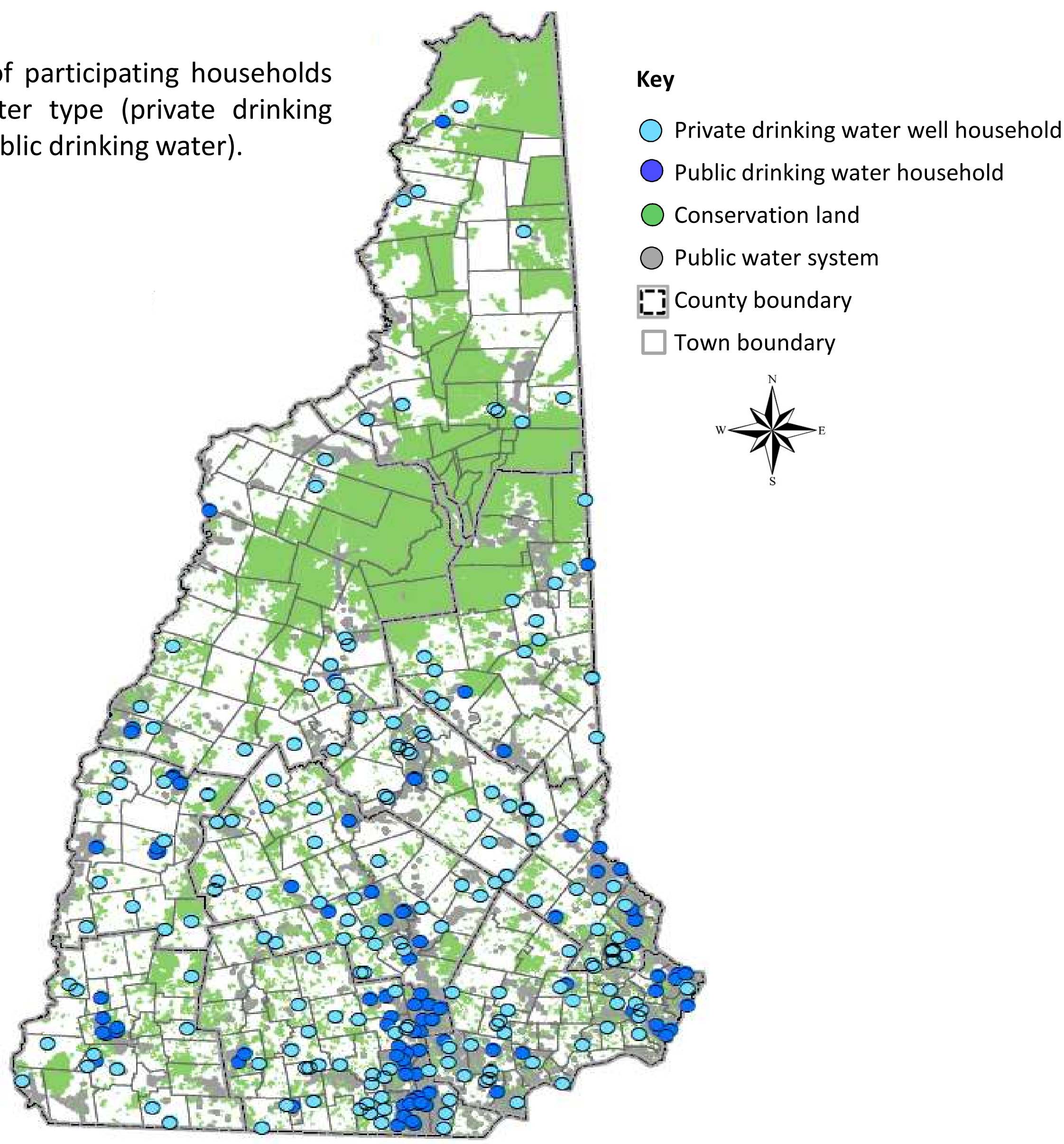
Everyone should consult with their healthcare provider about their contact with chemicals from their environment.

Participant Recruitment and Data Collection

Recruitment for the TrACE Study began in January 2017 when NH residents were randomly asked to complete the Behavioral Risk Factor Surveillance System (BRFSS) survey. Over the course of two years (2017-2018), residents were asked whether they would like to learn more about biomonitoring studies during the BRFSS survey. Those who were interested were added to a callback list. From June to September 2019, those residents and the people in their household were invited to participate in the TrACE Study. The only requirements were that they were at least six years old, they lived in NH at least half the year, they did not live in a mental health facility or prison, and they could understand the potential risks and benefits of participation.

A total of 336 participants from 276 households gave blood, serum, and urine specimens for biomonitoring. Participants from 274 households also supplied water samples for water quality testing (Figure 2). The test results were used to evaluate whether there was an association between the chemicals found in participant bodies and the chemicals detected in participant water. Both private well water and public drinking water were tested. All participants also completed an exposure survey to collect information on the ways they may come into contact with chemicals.

Figure 2. Map of participating households by drinking water type (private drinking water well or public drinking water).



Description of the TrACE Study Population

The TrACE Study aimed to recruit a study population with characteristics similar to the population of NH. This was done using information from the most recent census in 2010 and estimates in 2018. This was so the data was representative of NH which (among other differences) has an older population than the US average. To do this, BiomonitoringNH randomly recruited participants using the BRFSS survey and then restricted participation based on specific sex, age, and county goals. This recruitment strategy was used so the blood, serum, and urine results from the small study population could be a reflection of the levels of chemicals in NH residents across the state (see Study Limitations on page 12).

Table 1 describes the TrACE Study population compared to the population of NH.

Table 1. The 2019 NH TrACE Study population by sex, age, race, ethnicity, water source, and county.

Demographic		TrACE		Percent of NH Population[2] (%)
		Participants (#)	**Percent (%)**	
Sex	Females	194	57.7	50.4
	Males	139	41.4	49.6
	Other	3	0.9	---
Age	Under 18	9	2.7	19.0
	18 - 64	194	57.7	62.9
	65 and older	133	39.6	18.1
Race and ethnicity	Non-Hispanic white	320	95.2	90.0
	Other	16	4.8	10.0
Water source[1]	Private well water	216	64.3	42.0
	Public drinking water	120	35.7	58.0
County	Belknap	22	6.5	4.5
	Carroll	19	5.7	3.6
	Cheshire	23	6.8	5.6
	Coos	13	3.9	2.3
	Grafton	20	6.0	6.6
	Hillsborough	91	27.1	30.6
	Merrimack	40	11.9	11.1
	Rockingham	53	15.8	22.8
	Strafford	33	9.8	9.6
	Sullivan	22	6.5	3.2
Total participants		**336**		

[1]Two participants declined to have their water collected. Household water source estimates for NH Population using private well water as their primary source of home drinking water are from the BRFSS survey.
[2]Census Bureau estimates (7/1/2010) from https://www.census.gov/quickfacts/fact/table/NH/PST045218#PST045218 for demographics.
Note: Percentages may not equal 100% due to rounding.

Study Limitations

Almost all studies have limitations. These are characteristics of the study design or data analysis that may influence results. One of the best ways to be transparent with a study is to acknowledge those limitations. The results in this report should be interpreted while considering the following limitations.

Study Population

The study population is the participants in the study. Although every effort was made to recruit a population that was representative of NH, goals were not met for some groups such as children and those living in Rockingham County. It is thought that using a needle for blood collection may have prevented children from participating. Additionally, some counties may have a younger, working-age population with certain characteristics making it more difficult for them to participate in the clinical specimen or household water collection. BiomonitoringNH is exploring ways to meet recruitment goals for these populations in future studies such as by providing in-home, after-hours specimen collection services. Unfortunately, recruitment of children for biomonitoring studies is a well known limitation and an appropriate solution has yet to be identified.

Comparison Population

The comparison population is the group to whom TrACE participants were compared. The results presented in this report have been compared to the US non-Hispanic white population from the CDC National Exposure Report at the time of the study (2019). The non-Hispanic white population was chosen because it is closest to the overall population of NH. Participants who identify as anything other than non-Hispanic white may not find this information as useful. It must also be kept in mind that the lower age limit for the population in the National Exposure Report varies and may be different than the lower age limit for the TrACE Study. Information on National Exposure Report data, including other races, can be accessed at https://www.cdc.gov/exposurereport.

Additionally, laboratory methods vary and the lowest level of a chemical that they are able to detect may also differ. This makes comparing data from different sources difficult. One population may appear to have a higher average level of a chemical but that may only be because the laboratory does not have a method that can detect very low levels of the chemical. The impact of different method sensitivities (also called the limit of detection) is explained further later in the report (see page 20) and should be considered when interpreting these results.

Specimen Collection

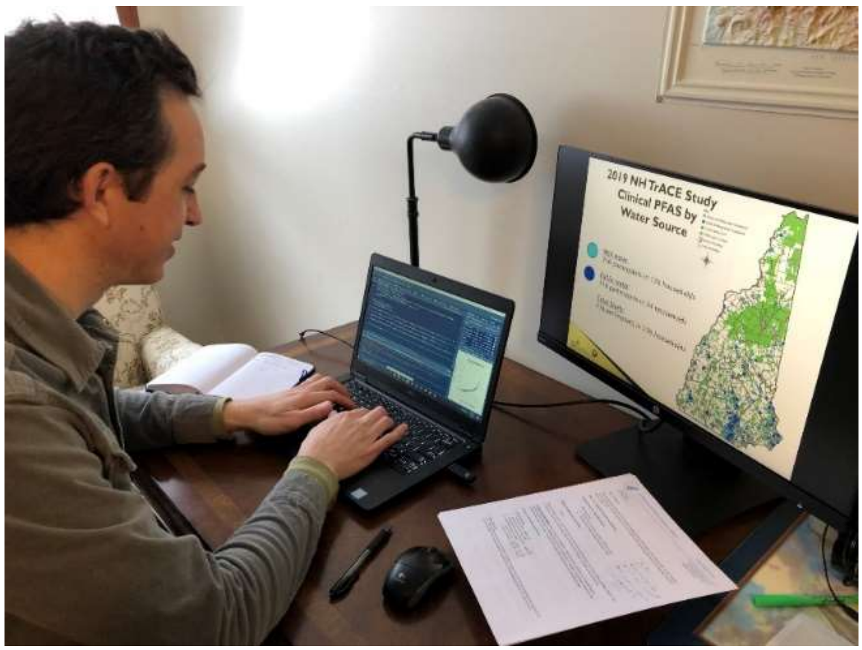
The specimens collected from participants were blood, serum (the clear part of the blood), and urine. The majority of the specimens were collected from June to September 2019 during which time participants may have had exposures specific to the season, such as increased seafood consumption or usage of insect repellants. This differs from the US population from the National Exposure Report where specimens were collected over two calendar years. Additionally, environmental contaminants are not spread equally across the state. Some areas have higher levels of certain chemicals due to natural occurrences (like geology) or human contamination. An example of this is the higher levels of some per- and polyfluoroalkyl substances (PFAS) in the environment near the Pease Tradeport and in southern NH. The TrACE specimen collection timeframe as well as the unequal distribution of environmental contaminants should be considered when interpreting these results.

Water Source

The water source was household water. This was either from a private well or from a public water system. Household water may expose people to chemicals. Private well water quality is not regulated by law. In NH, 42% of people rely on private wells as their primary source of home drinking water, however approximately 65% of the TrACE Study population uses a private well. This may mean the TrACE Study population had an increased risk of exposure to chemicals from their water, however it is not known for certain. Due to budgetary and time constraints, the TrACE Study did not restrict recruitment based on home water type. It was not a qualifier for participation in the 2019 TrACE Study although it may be a qualifier for the next TrACE Study (2024).

Outlier Analysis

Outliers are results that are very high or very low compared to the rest of the results. Including them when analyzing study results may influence summary information about the results, such as the 95th percentile. The 95th percentile is the level at which 95% of the study population tested below and only 5% of people tested higher (see Key Terms). An outlier analysis of the study results was conducted to determine the impact of very high values on the 95th percentile. A few high results increased the 95th percentile for some chemicals, however they were not eliminated from data analysis because they were actual participant results. These high values were kept in the analysis because TrACE participants with high results should be represented as part of the population.



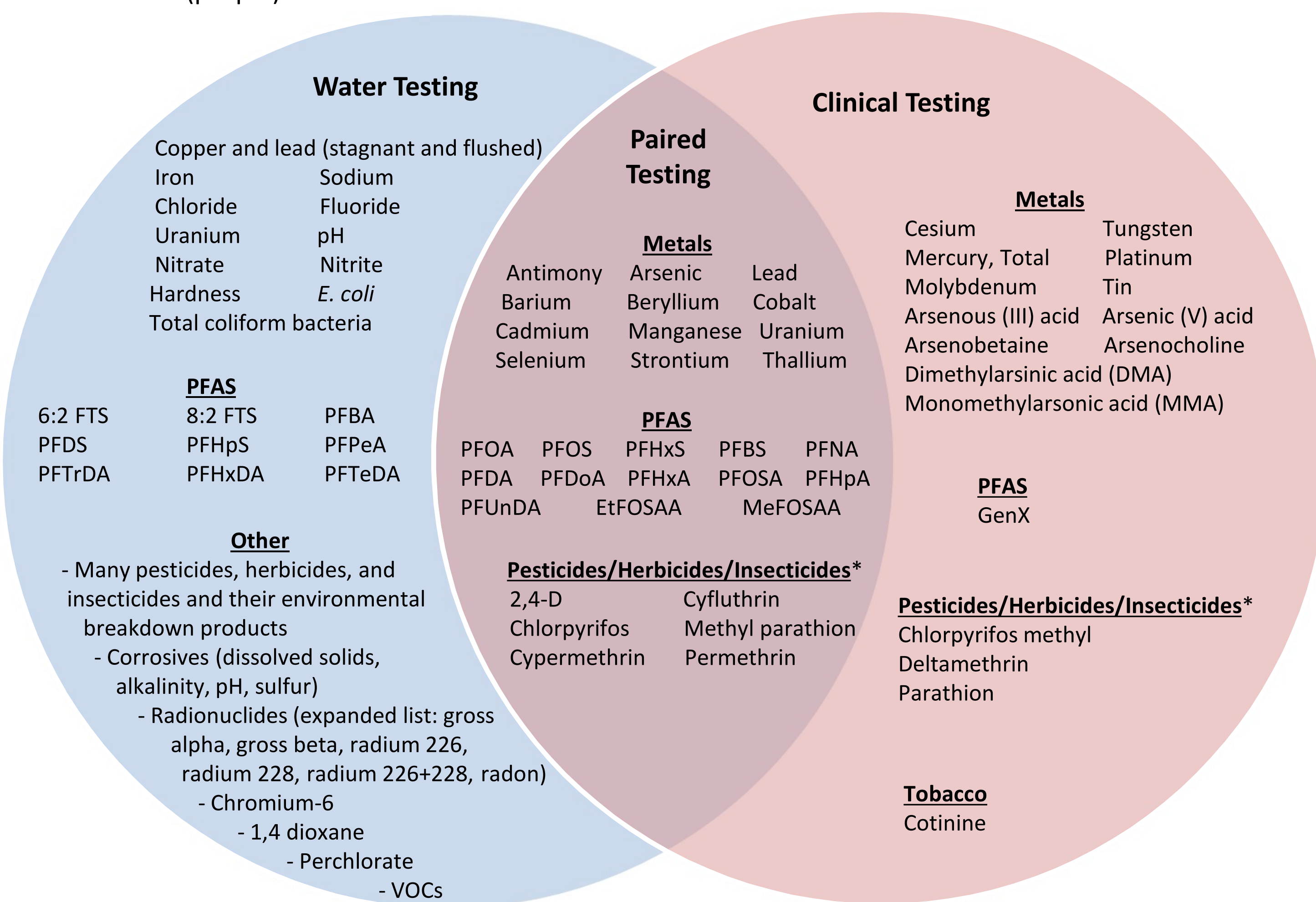
Nicholas Shonka, Environmental Health Data Analyst with the NH Environmental Public Health Tracking Program, analyzes results from the TrACE Study.

Chemicals Tested for in Participants and Home Water

The TrACE Study tested for 50 chemicals in participant blood, serum, and urine. These chemicals (shown in Figure 3 below under "Clinical Testing") were metals; PFAS; cotinine (an indicator of nicotine exposure); and pesticide, herbicide, and insecticide metabolites (breakdown products). See Appendix A on page 39 for the full names of the acronyms listed below.

The BiomonitoringNH Program worked closely with the NH Environmental Public Health Tracking Program and the NH Department of Environmental Services Drinking Water Quality Program to provide collection and testing of household water samples. The chemicals tested in water depended upon the type of water collected (private well vs. public drinking water) and where in the home it was collected (finished vs. raw) (see Key Terms and Appendix A). Hundreds of chemicals were tested for in household water with many of the same chemicals tested for in clinical specimens (this is referred to as "Paired Testing" in Figure 3). This allowed for the analysis of blood, serum, and urine results while considering the affect of water quality.

Figure 3. Household water (blue) and clinical testing (red) panels with the paired testing in the middle (purple).



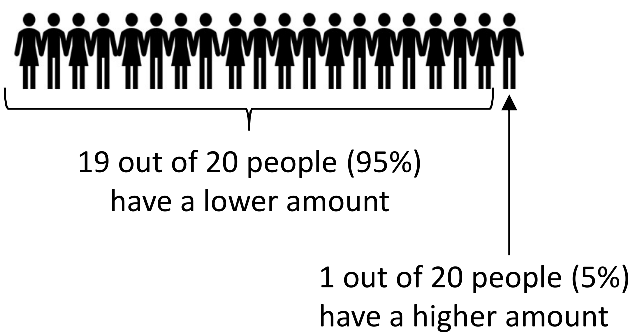
*BiomonitoringNH tested for the metabolites of the pesticides, herbicides, and insecticides listed here.

How Significant Findings Were Determined

Comparison Data

TrACE Study results were compared to data from the CDC National Exposure Report (https://www.cdc.gov/exposurereport) that was available in 2019. The National Exposure Report provides information on the levels of over 400 chemicals in a representative sample of US residents. This means the participants were recruited in a way that the information learned can be generally applied to everyone within each group listed. Examples of these groups are “non-Hispanic whites”, “females”, and “ages 12-19 years”. The CDC also presents the US data using various measurements such as the geometric mean (a special average measurement; see Key Terms) and 95th percentile (the value which 95% of people tested below; see Figure 4 and Key Terms). **The non-Hispanic white population from the National Exposure Report was used for comparison to TrACE participants because it is closest to the overall demographic of NH.**

Figure 4. Description of 95th percentile.



Analysis Methods

The geometric mean and 95th percentiles of chemicals in TrACE Study participants were compared to data from the National Exposure Report in order to determine if TrACE participants had significantly different levels of chemicals in their bodies. A significantly different level means there is great confidence that the difference in levels between the groups is real and not due to chance or random variation (see Key Terms). The geometric means of chemicals in TrACE participants using private well water and TrACE participants using public drinking water were also compared. This was done to see if there was a difference in the amount of chemicals in TrACE participants based on the type of water they use at home.

Why Geometric Mean and 95th Percentile Were Examined

Both the geometric mean and 95th percentile were evaluated because they give different information. Comparing the geometric means tells whether the average amount of a chemical in one group (like TrACE participants) is different from the average amount in another group (like the US population). Comparing the 95th percentiles helps describe whether the more extreme values are higher in one group. This means those most exposed to a chemical would have a higher exposure. The full set of aggregate (combined) results can be found in Appendix B on page 44. For the rest of the report “average” will be used in place of geometric mean.

The following pages present significant findings based on the average levels of chemicals in the TrACE Study and US populations. The levels of those most exposed were also compared.

Important Biomonitoring Results – Comparison of TrACE and US Averages

Comparison of TrACE Study Participant Averages to the US Population

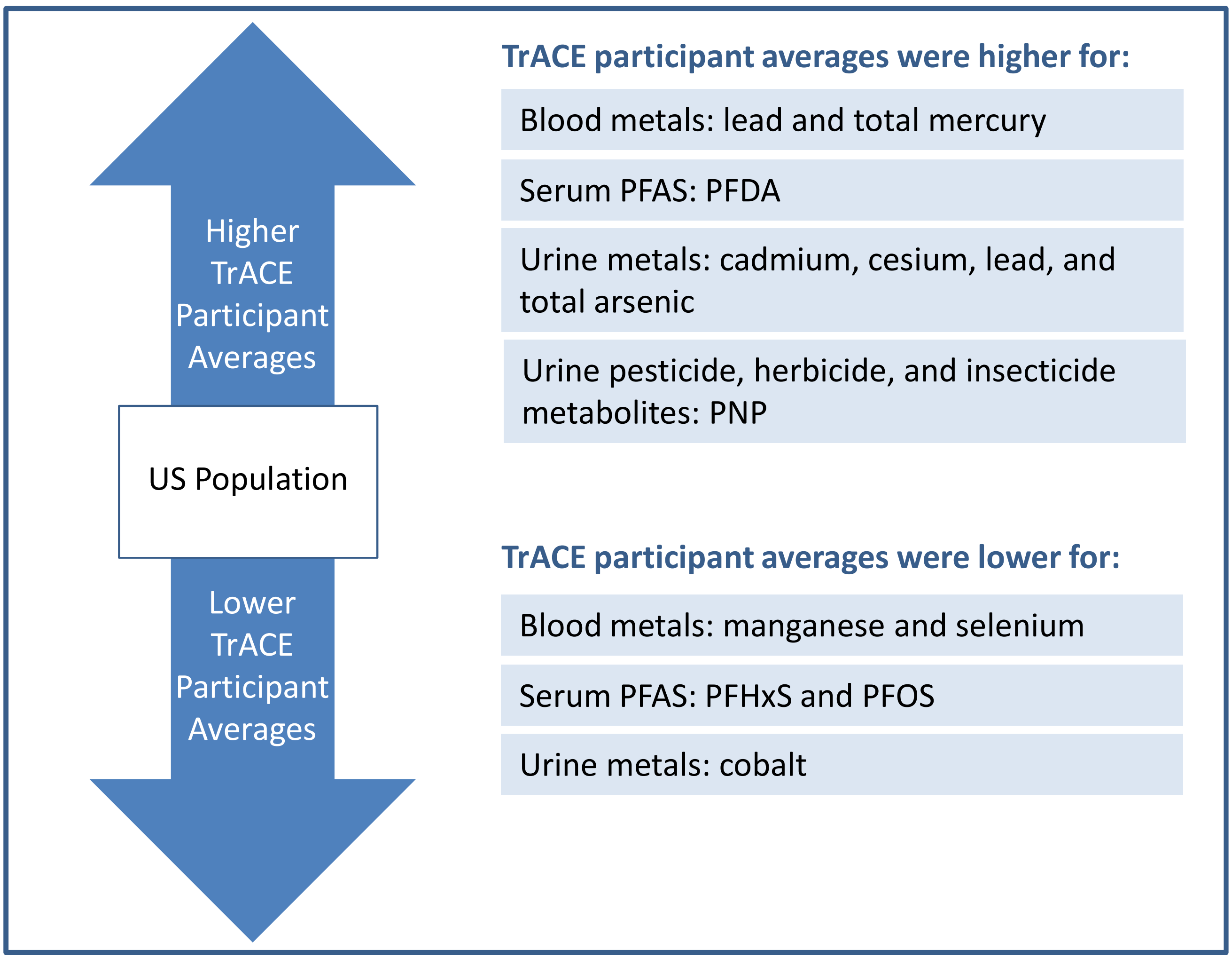
TrACE participants had significantly different averages of the following chemicals in their bodies when compared to the US Population (Figure 5). A significantly different average means there is great confidence that difference in averages between the groups is real and not due to chance or random variation.

- Blood metals: lead, manganese, selenium, and total mercury
- Serum PFAS: PFDA, PFHxS, and PFOS
- Urine metals: cadmium, cesium, cobalt, lead, and total arsenic
- Urine pesticide, herbicide, and insecticide metabolites: PNP

See Appendix A (page 39) for the complete names of these chemicals. A table with the average for each chemical can be found in Appendix B (see page 44).

Key Finding
TrACE Study participants had significantly different average levels of these chemicals in their bodies when compared to the US population (see Figure 5 below).

Figure 5. TrACE participant blood, serum, and urine average levels were significantly different for the following chemicals when compared to the US population. See page 20 for additional considerations.



Notes: There was no significant difference in average levels for blood cadmium; serum PFNA and PFOA; and urine barium, molybdenum, strontium, thallium, tin, tungsten, uranium, 2,4-D, or TCPy. The average level could not be determined for the TrACE or US population when more than 40% of the results were below the limit of detection (LOD) for the test. This means the results were below the lowest level the lab could reliably detect and so the comparison analysis could not be done. A comparison of average levels for 3-PBA, DMA, and inorganic arsenic could not be conducted due to limits of the test method (see page 20). Average levels could not be calculated for the chemicals listed in Appendix A, but not mentioned above.

Biomonitoring Result Interpretation – Potential Exposures

TrACE participants had **significantly different and higher average** levels of blood lead and total mercury; serum PFDA (a type of PFAS); and urine cadmium, cesium, lead, total arsenic, and PNP (a pesticide metabolite) than the US population. The exact reason for these levels is unknown, but the following information describes the various ways people may come into contact with these chemicals.

Lead ⬆

- Lead was previously added to gasoline, paint, plumbing, pesticides, and solder for canned foods.
- The most common source of lead exposure in NH is old lead paint in homes that is flaking or creating dust.
- Lead was banned from paint in 1978, but many NH families live in homes built before that year which may still have lead paint.
- Others may be exposed from their household water if their home contains certain plumbing (or is connected to old public water supply plumbing) and they have corrosive water (see Key Terms).

Total Mercury ⬆

- Total mercury is the combination of all types of mercury (elemental, inorganic, and organic).
- For most people, their blood total mercury level is mainly methylmercury from eating fish and seafood. The TrACE Study was conducted during the summer months, a time when people may be more likely to consume these foods.
- Similarly, NH borders the Atlantic Ocean giving better access to fresh fish and seafood than other states.
- The Northeast also has higher rates of environmental mercury contamination from the burning of coal in the Midwest.

PFDA ⬆

- PFDA is a member of the PFAS family. PFAS have been used in many products due to their strong heat, water, stain, and grease resistant properties.
- Most people in the US have some level of PFAS in their body and are exposed by consuming contaminated food or water.
- PFDA has been found in semiconductor waste. People who work with or manufacture semiconductors (devices that help conduct electricity) may be exposed.
- A few studies have also found an association with ski wax, fishing, and firefighting.
- More research needs to be done to determine why TrACE participants had a higher average level of PFDA when compared to the US population.

Cadmium ⬆

- Most people come into contact with small amounts of cadmium from food (green leafy vegetables, potatoes, grains, peanuts, soybeans, sunflower seeds, some wild mushrooms, shellfish, and organ meats).
- The highest risk of exposure is when it is heated such as in welding or soldering.
- Tobacco smoke contains cadmium and smokers tend to have twice as much cadmium in their bodies as nonsmokers.
- Those who work in battery manufacturing, lead and copper refining, fossil fuel combustion, waste incineration, or with phosphate fertilizers may also be exposed.
- More research needs to be done to determine why TrACE participants had a higher average level of cadmium when compared to the US population.

Cesium ⬆

- Most people come into contact with small amounts of stable cesium from food.
- It is also present in drinking water and air.
- Some people take cesium chloride as a supplement.
- Others may be exposed through their jobs, especially those who produce photomultiplier and vacuum tubes, scintillation counters, infrared lamps, semiconductors, photographic emulsions, and high-power gas-ion devices.
- People may come into contact with cesium by consuming these foods or when using or working with these products.
- More research needs to be done to determine why TrACE participants had a higher average level of cesium when compared to the US population.

Total Arsenic ⬆

- Total arsenic is the combination of organic and inorganic arsenic.
- Organic arsenic mostly comes from fish and seafood. It is not thought to be toxic.
- Inorganic arsenic comes from contaminated drinking water, rice grown in contaminated water, the foods made from this rice, and smoking tobacco. Inorganic arsenic can negatively affect health.
- TrACE participants may have had a higher average level of total arsenic because they consumed a lot of fish and seafood (organic arsenic), foods that contain inorganic arsenic, and/or because of their drinking water. NH groundwater can be naturally contaminated with inorganic arsenic.

PNP ⬆

- A man-made chemical commonly used as a fungicide for crops (a chemical used to kill fungus). PNP is also a breakdown product of the chemical nitrobenzene and three insecticides (chemicals used to kill insects). These insecticides are methyl parathion, ethyl parathion, and EPN.
- It is unlikely that the general population will be exposed to large amounts of PNP or the parathion chemicals because their use is limited or restricted. People may be exposed to nitrobenzene or PNP at work or when near farms that recently used them.
- More research needs to be done to determine why TrACE participants had a higher average level of PNP when compared to the US population.

TrACE participants had **significantly different and lower average** levels of blood manganese and selenium; serum PFHxS and PFOS (types of PFAS); and urine cobalt than the US population. The exact reason for these levels is unknown, but the following information describes the various ways people may come into contact with these chemicals.

Manganese ⬇

- Most people come into contact with small amounts of manganese from food (grains, tea, and vegetables).
- It is an essential nutrient that is needed for bone and cartilage growth and healing.
- Some people may take manganese as a supplement.
- It is a natural contaminant in drinking water.
- Some people are exposed through their jobs, such as those who work with fireworks, in iron/steel production, welding, mining, or in coal-burning power plants.
- It is found in tobacco smoke, automobile exhaust, and some fertilizers and cosmetics.
- More research needs to be done to determine why TrACE participants had a lower average level of manganese when compared to the US population.

Selenium ⬇

- Most people come into contact with small amounts from food (meat, seafood, and plants).
- Some may take selenium as a supplement.
- It is a natural contaminant in drinking water and air.
- Some people are exposed through their jobs, such as those who work in coal-burning power plants, the metal and electronics industries, rubber and glass production, paint manufacturing, or selenium-recovery processes.
- More research needs to be done to determine why TrACE participants had a lower average level of selenium when compared to the US population.

PFHxS and PFOS ⬇

- PFHxS and PFOS are members of the PFAS family. PFAS have been used in many products due to their strong heat, water, stain, and grease resistant properties.
- Some of these include nonstick cookware, fast food and microwave popcorn packaging, stain resistant carpeting and clothing, shampoos, electronics, paints, and varnishes.
- Most people in the US have some level of PFAS in their body and are exposed by consuming contaminated food or water.
- Some people may be exposed through their jobs, such as those who have used certain firefighting foams, aviation hydraulic fluids, or those who work with heat-resistant machinery/products.
- Some NH residents living or working in specific areas of the state have higher levels of these chemicals in their bodies than the US population. This was seen in previous studies involving the Pease Tradeport and southern NH (https://wisdom.dhhs.nh.gov).
- The goal of the TrACE Study was to recruit a diverse population that was representative of NH as a whole and not just this known exposed population.
- The representative recruitment of NH may explain why on average TrACE participants had lower levels of PFHxS and PFOS in their bodies even though it is well known that some NH residents actually have higher levels of these chemicals.

Cobalt ⬇

- Most people come into contact with small amounts of cobalt from food. This is because plants transport it from the soil into their seeds, fruit, and grains.
- It is a natural contaminant in drinking water and air.
- Some people are exposed through their jobs, such as those who work in coal-fired power plants, waste incineration/recycling, mining, manufacturing, or with hard metal grinding tools, paints, or dyes.
- Cobalt may be used in some medical implants like joint and dental prostheses.
- It is an antidote for cyanide poisoning.
- More research needs to be done to determine why TrACE participants had a lower average level of cobalt when compared to the US population.

Important Data Analysis Considerations

A specialized instrument in the BiomonitoringNH lab tests blood for metals.

- The lowest level of a chemical a lab test is able to detect is called the limit of detection (LOD). BiomonitoringNH has a lower LOD than the CDC when testing for DMA, inorganic arsenic, 3-PBA, and trans-DCCA.
- When a participant result is very low, a substitution is made in order to use it in any calculations. This is because the lab test can never confidently report a person has a level of zero. The substitution uses the LOD of the lab test divided by the square root of two. This means the LOD of the lab test can affect the overall average of the group.
- The averages of all 50 chemicals were analyzed using the BiomonitoringNH LOD and then also with the CDC LOD to see if the results would change.
- When the BiomonitoringNH LOD was used, the average level was significantly different and lower in TrACE participants for DMA, inorganic arsenic, and 3-PBA when compared to the US population.
- When the CDC LOD was used, there was no significant difference in average levels between TrACE participants and the US population for these chemicals.
- It is important to keep in mind the limitation of the lab test LODs when comparing data tested by different labs.

Comparison of the Most Exposed TrACE Study Participants to the US Population

Another way to look at whether TrACE participants have a different amount of chemicals in their body than the US population is to compare the levels of the most exposed people in each group. If more than 5% of TrACE participants had a level higher than the US Population 95th percentile (see Key Terms), then they probably had more contact with those chemicals. **The most exposed TrACE participants had higher levels of the following chemicals (Figure 6).**

- Blood metals: lead and total mercury
- Serum PFAS: EtFOSAA, PFDoA, and PFUnDA
- Urine metals: arsenobetaine, cesium, cobalt, DMA, inorganic arsenic, lead, MMA, molybdenum, thallium, total arsenic, tungsten, and uranium
- Urine pesticide, herbicide, and insecticide metabolites: 2,4-D, 3-PBA, 4F-3PBA, cis-DCCA, PNP, TCPy, and trans-DCCA

It is important to note that although some people had very high levels of these chemicals, the chemicals were not always detected in TrACE participants. For example, only 19 TrACE participants had high enough levels of EtFOSAA to be analyzed. Of those 19 people, 5.7% were (or about 1 person was) above the US Population 95th percentile. This means only a very small percentage of TrACE participants are being described in this section. **More research needs to be done to determine why some TrACE participants are exposed to higher amounts of these chemicals than the US population.** See Appendix A for the complete names of these chemicals. A table with the 95th percentile for each chemical and the number of people with detectable levels can be found in Appendix B on page 44.

Key Finding

The most exposed TrACE participants had higher levels of these chemicals when compared to the US population (see Figure 6 below).

Figure 6. The most exposed TrACE participants had higher levels of the following chemicals in their bodies than the most exposed US population.

Some TrACE participants had very high levels of the following chemicals:

Blood metals: lead and total mercury

Serum PFAS: EtFOSAA, PFDoA, and PFUnDA

Urine metals: arsenobetaine, cesium, cobalt, DMA, inorganic arsenic, lead, MMA, molybdenum, thallium, total arsenic, tungsten, and uranium

Urine pesticide, herbicide, and insecticide metabolites: 2,4-D, 3-PBA, 4F-3PBA, cis-DCCA, PNP, TCPy, and trans-DCCA

Interpretation notes: A list of possible sources of exposure for these chemicals is not provided in this report, but can be found by searching for each chemical, parent chemical, or chemical family at https://www.cdc.gov/biomonitoring/biomonitoring_summaries.html.

Important Home Water Results

The TrACE Study evaluated the quality of participant home water because it is a way people are exposed to chemicals. Both public drinking water and private well water were tested. In New Hampshire, public water systems must follow strict guidelines for drinking water quality called health limits (drinking water standards). For chemicals, these are maximum contaminant levels (MCLs) or other enforceable health limits established by the US Environmental Protection Agency (US EPA) or the NH Department of Environmental Services (NHDES). Public water systems are required to test the water regularly and treat if necessary. Treatment is needed when the level of a contaminant (which could be naturally occurring or man-made) is above the health limit. Private wells are not regulated, however private well users are encouraged to follow the health limits in order to assure their water is safe to consume.

Finished water is water collected at the kitchen sink (or a similar faucet) after any treatment system. Finished water was tested from both public water system and private well water households. Raw water is water collected before any treatment in private well households. Raw water was also tested to evaluate the quality of water directly from the well. TrACE participants and the general public most likely use finished water (from their kitchen faucet) for drinking and cooking. See Appendix A for a complete list of the water test panels and full chemical names.

Hundreds of contaminants and water quality indicators were tested for in household water, however only some have health limits or screening levels. A health limit is chosen based on what will protect human health and what public drinking water systems can achieve with their budget and available treatment options. A screening level is set by the US EPA or US Geological Survey and is the value below which poor health effects are not expected from one day or lifetime exposure. **Out of the 146 contaminants tested for in this study that are regulated by health limits or screening levels, only 13 contaminants were found in TrACE participant water above these safety levels.** It is important to keep in mind that not all contaminants were tested for in each water type due to cost.

The tables on the following pages list these 13 contaminants and describe how water quality differs based on source (private well vs. public drinking water). Table 2 compares raw private well water with finished private well water. Table 3 compares finished public drinking water with finished private well water. The health limit or screening level is listed followed by the percent of TrACE household water samples with elevated results (those above health limits or screening levels). This is to help identify the most common TrACE Study water contaminants. Additional water results can be found in Appendix C on page 48.

Thomas Swenson, NHDES Environmentalist, collects raw water samples from a home with a private well.

Key Findings

Water treatment systems are working. Contaminants that may affect health are being removed.

Finished private well water had lower levels of arsenic, manganese, radon, and uranium than raw private well water.

Water health limits and screening levels are successful at improving water quality.

There were fewer contaminants in public drinking water than in private well water. People using private wells at home should treat their water, if indicated.

Table 2. Finished and raw private well water contaminants that exceeded health limits or screening levels.

			Private Wells Raw Water	Private Wells Finished Water
Chemical Class	**Chemical**	**Health Limit or Screening Level**	**Samples with Elevated Results (%)**	**Samples with Elevated Results (%)**
Metals	Arsenic (mg/L)	0.005	21.7	15.9
	Copper (stagnant) (mg/L)	1.3	Not Tested	8.0
	Lead (flushed) (mg/L)	0.015	No Exceedances	0.6
	Lead (stagnant) (mg/L)	0.015	Not Tested	4.0
	Manganese (mg/L)	0.3	7.2	0.6
	Strontium (mg/L)	1.5	Not Tested	1.2
PFAS	PFOA (ng/L)	12	2.8	Not Tested
	PFOS (ng/L)	15	1.1	Not Tested
Radiologicals	Radium 226 (pCi/L)	5	1.7	Not Tested
	Radon (pCi/L)	2000	49.7	37.5
	Uranium (µg/L)	30	3.9	2.8
	Uranium alpha (pCi/L)	20	3.9	Not Tested
VOCs	1,4-Dioxane (µg/L)	0.32	1.1	Not Tested

Interpretation of Raw vs. Finished Private Well Water Results

It is well known that NH groundwater may have high levels of arsenic and radon due to the granite bedrock. The data from TrACE Study water testing, in particular the finished private well water, shows that many TrACE participants using private wells may be coming into contact with water that has unhealthy levels of these contaminants. **Table 2 shows that 15.9% of TrACE private well participants are using finished water (kitchen faucet or similar) that contains arsenic above the health limit. Additionally, 37.5% of TrACE private well participants are using finished water that contains radon above the screening level.** Unhealthy levels of arsenic and radon have been shown to cause an increased risk of developing cancer, particularly bladder cancer (due to arsenic) and lung cancer (due to radon released to air). NH has very high rates of bladder and lung cancer when compared to the US population. Radon in household water is an indicator that radon gas may also be in the air in the home. Breathing radon gas that has entered the home either through cracks in the foundation or from running water (such as when showering) may increase the risk of lung cancer. **Assuring good home water quality by testing (and treating water, if indicated) may help reduce a person's risk of developing a health condition from coming into contact with these chemicals.** It is equally important to assess and address your home air quality for radon.

Of special interest in Table 2 is the smaller percentage of samples with elevated results in the finished private well water compared to the raw private well water (those above health limits or screening levels). **This means that at least some of the water treatment systems TrACE participants have in their homes are successful at removing or reducing the amount of the contaminant in their private well water.** For example, 21.7% of raw private well water samples had high levels of arsenic compared to 15.9% of finished private well water. Similarly, 49.7% of raw private well water samples had high levels of radon compared to 37.5% of finished private well water. Finally, 3.9% of raw private well water samples had high levels of uranium compared to 2.8% of finished private well water. **Although room for improving water quality exists, these data show that treatment systems are effective at removing contaminants. Treatment systems must be maintained in order to properly remove contaminants.**

There are multiple ways to address the water quality issues identified in this study. For more information on the chemicals described here as well as other common contaminants and treatment considerations, please review the NHDES drinking water fact sheets by searching by key word (such as "arsenic") at tinyurl.com/NHDESFactSheets and/or contact NHDES directly at DWGBinfo@des.nh.gov.

Table 3. Finished public water system and private well water contaminants that exceeded health limits or screening levels.

			Public Water System Finished Water	Private Wells Finished Water
Chemical Class	**Chemical**	**Health Limit or Screening Level**	**Samples with Elevated Results (%)**	**Samples with Elevated Results (%)**
Metals	Arsenic (mg/L)	0.005	4.3	15.9
	Copper (stagnant) (mg/L)	1.3	1.1	8.0
	Lead (flushed) (mg/L)	0.015	No Exceedances	0.6
	Lead (stagnant) (mg/L)	0.015	2.1	4.0
	Manganese (mg/L)	0.3	1.1	0.6
	Strontium (mg/L)	1.5	No Exceedances	1.2
PFAS	PFOA (ng/L)	12	Not Tested	Not Tested
	PFOS (ng/L)	15	Not Tested	Not Tested
Radiologicals	Radium 226 (pCi/L)	5	Not Tested	Not Tested
	Radon (pCi/L)	2000	4.3	37.5
	Uranium (µg/L)	30	No Exceedances	2.8
	Uranium alpha (pCi/L)	20	Not Tested	Not Tested
VOCs	1,4-Dioxane (µg/L)	0.32	Not Tested	Not Tested

Interpretation of Finished Public Water System vs. Finished Private Well Water Results

Public drinking water systems are legally required to test and treat (if indicated) the water they distribute. This does not mean that the water will be contaminant-free, only that the contaminant levels will be below the health limits. After leaving the facility, there are opportunities for contaminants to enter the water supply. These potential points of contamination may be older water distribution lines or certain types of household pipes and faucets.

The results in Table 3 show why it is important to test your home water even if you use water from a public water system. Chemicals in household plumbing and faucets can enter water depending on their manufacture date and the corrosivity of the water (see Key Terms). Table 3 shows that 4.0% of stagnant finished private well water and 2.1% of stagnant finished public water contained lead above the health limit. Additionally 8.0% of stagnant finished private well water and 1.1% of stagnant finished public water contained copper above the health limit. This may be because these households have certain plumbing and fixtures and more corrosive water allowing for chemicals to enter the water when it sits stagnant (still) for a long period of time, such as overnight. Residents may then consume these contaminants when they drink or cook with this water.

There is no health limit for radon, only a screening level. Table 3 shows that 37.5% of private well water contained radon above the screening level compared to 4.3% of public drinking water. There are no legal requirements to treat public drinking water when it exceeds the screening level. Private well water may have higher levels of radon because many wells are drilled deep into bedrock. Some public drinking water comes from the surface like lakes which are much less likely to have high levels of radon. **These results show the importance of testing your water for radon, regardless of whether your household uses a public water system or private well.**

Although 4.3% of the public drinking water samples had elevated arsenic results, this number reflects the new NHDES health limit which was not enforceable until July 1, 2021. Similarly, 1.1% of public drinking water samples had elevated manganese results, however the new health limit is not enforceable until July 1, 2022. This means those public water suppliers have until those dates to reduce the level of arsenic and manganese in those public water systems.

Water contaminants such as these can be removed. Read about specific contaminants and water treatment by searching by key word at tinyurl.com/NHDESFactSheets and/or contact NHDES directly at DWGBinfo@des.nh.gov.

Evaluation of Biomonitoring Results by Home Water Source

Out of the fifty chemicals evaluated in blood, serum, and urine, TrACE participants had significantly different and higher average levels than the US population for eight of them (see Figure 5 on page 16). These were blood lead and total mercury; serum PFDA; and urine cadmium, cesium, lead, total arsenic, and PNP. These were examined more closely in relation to finished water results by home water source (private well water vs. public water supply). **This was done to evaluate whether there was an association between water quality, home water source, and the amount of chemical in the body.**

The other PFAS of interest in NH (PFOA, PFOS, PFHxS, and PFNA) as well as common contaminants in the state (inorganic arsenic and uranium) were also evaluated. **The following information describes how TrACE private well users compared to TrACE public drinking water users for these chemicals.**

Key Findings

TrACE private well users had significantly different and higher average levels than public drinking water users for:

- Blood metals: lead
- Serum PFAS: PFOS
- Urine metals: uranium

TrACE public drinking water users had significantly different and higher average levels than private well users for:

- Serum PFAS: PFOA

People come into contact with chemicals in many ways and it is important to remember that exposures other than drinking water may contribute to these differences. These include occupation, product usage, recreational activities, and food and beverage consumption, to name a few. These differences were not controlled for in the following analyses.

Blood and Urine Lead Concentration by Home Water Source

TrACE Study participants had a significantly different and higher blood lead average concentration when compared to the US population. When looked at based on household drinking water source, TrACE Study private well users had a significantly different and higher blood lead average concentration than TrACE public drinking water users (P = 0.0009) (Table 4). In other words, TrACE private well users had more lead in their blood than public drinking water users. This means household drinking water may have contributed to the higher levels of lead in private well users and those residents may need to consider treating their water. The difference in urine lead concentrations by home water source was not significant (P = 0.0928).

Key Finding - Lead
TrACE Study private well users had more lead in their blood than public drinking water users.

Table 4. TrACE participant blood lead average level by household water source compared to the US population.

Chemical	Specimen	Water Source	NH TrACE Average (µg/dL)	US Average (µg/dL)
Lead	Blood	Private Well	1.12	0.835
		Public Water Supply	0.872	

Serum PFOS and PFOA Concentrations by Home Water Source

PFAS exposure reduction is of great importance to many NH residents and the NHDES has adopted drinking water health limits for four of them (PFOA, PFOS, PFHxS, and PFNA). The average PFOS concentration in serum was significantly different and lower in TrACE participants when compared to the US population. When looked at based on household drinking water source, TrACE Study private well users had a significantly different and higher serum PFOS concentration than TrACE public drinking water users ($P = 0.0312$) (Table 5). In other words, TrACE Study private well users had more PFOS in their serum than public drinking water users. This means household drinking water may be contributing to the higher levels of PFOS in private well users and those residents may need to consider treating their water. **It is important to note that specific areas of NH have very high levels of some PFAS in water and in people. This was seen in previous studies involving the Pease Tradeport and southern NH (https://wisdom.dhhs.nh.gov). This report analyzed data from across the state and not specific targeted areas, so serum results may be different in people living or working in areas with higher exposure.**

Key Finding – PFOS
TrACE Study private well users had more PFOS in their serum than public drinking water users.

The average concentration for PFOA in serum was not found to be significantly different in TrACE participants when compared to the US population. Results were then evaluated to determine whether there were differences in TrACE participants based on household drinking water source. TrACE Study public drinking water users had a significantly different and higher level of PFOA in their serum when compared to TrACE Study private well water users ($P = 0.0007$) (Table 5). In other words, TrACE Study public drinking water users had more PFOA in their serum than private well users. This means household drinking water may be contributing to the higher levels of PFOA in public drinking water users and those residents may need to consider treating their water.

Key Finding – PFOA
TrACE Study public drinking water users had more PFOA in their serum than private well users.

There are several ways people are exposed to PFAS chemicals. PFAS have been used in many products due to their strong heat, water, stain, and grease resistant properties. These other routes of exposure were not controlled for in this analysis. Additionally, public drinking water users did not receive PFAS water testing as part of this study because that information is available from the water distributor. The information presented here indicates there is a difference in the levels of these two PFAS in participants depending upon their home water source, however it does not mean that their home water is definitively the cause of their exposure. More detailed research would need to be done to determine the source of PFAS exposure because it is well known that PFAS are everywhere in our environment and people are exposed in many ways.

Table 5. TrACE participant serum PFOS and PFOA average level by household water source compared to the US population.

Chemical	Specimen	Water Source	NH TrACE Average (µg/L)	US Average (µg/L)
PFOS	Serum	Private Well	4.17	4.97
		Public Water Supply	3.51	
PFOA	Serum	Private Well	1.57	1.69
		Public Water Supply	1.93	

Urine Uranium Concentration by Home Water Source

Uranium exposure reduction is of great importance to many NH residents, so TrACE Study data were examined to see if there was a difference in urine levels based on household water source. TrACE Study private well users had a significantly different and higher urine uranium concentration than TrACE public drinking water users ($P = 0.0001$) (Table 6). In other words, TrACE private well users had more uranium in their urine than public drinking water users. This means household drinking water may be contributing to the higher levels of uranium in private well users and those residents may need to consider treating their water.

Key Finding - Uranium
TrACE Study private well users had more uranium in their urine than public drinking water users.

Table 6. TrACE participant urine uranium average level by household water source compared to the US population.

Chemical	Specimen	Water Source	NH TrACE Average (µg/L)	US Average (µg/L)
Uranium	Urine	Private Well	0.00768	0.005
		Public Water Supply	0.00480	

Additional Information

There was no significant difference between TrACE Study private well and public drinking water users for total mercury (in blood); PFDA, PFHxS, or PFNA (in serum); or cadmium, cesium, inorganic arsenic, lead, PNP, or total arsenic (in urine). A significant difference was seen between the TrACE participants and the US population for some of these chemicals, however a difference was not found within the TrACE population based on home water source. The comparison data can be found in Appendix B on page 44. Additionally, some chemicals, like PFAS can take many years to be cleared from the body. **People may be exposed in many ways (food, water, products, occupation, etc.) and although the results on the previous pages may show an association between a water source and levels in the participant, the amount of chemical in the participant may not be solely due to the water.** The data analysis did not control for other exposures.

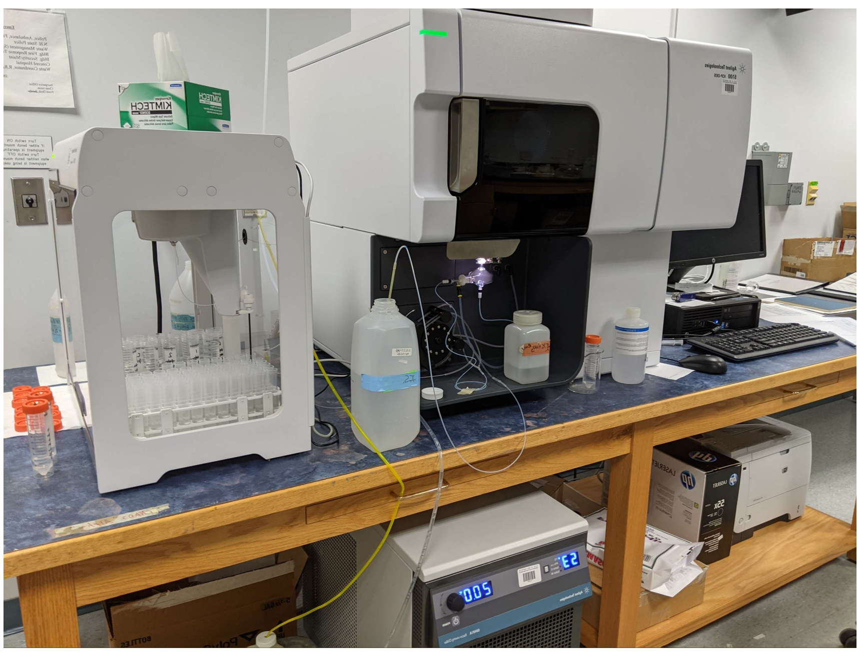
It is important to note that TrACE participants had a significantly different and higher urine total arsenic average level when compared to the US population. Total arsenic is the combination of two classes of arsenic: organic (usually from fish and seafood) and inorganic (most commonly from water and food grown in contaminated water). When examined in the context of home drinking water source, there was no significant difference in total arsenic levels between TrACE Study public drinking water users and TrACE Study private well water users ($P = 0.3569$).

Inorganic arsenic is found in drinking water and it is well known that NH groundwater can have high levels of inorganic arsenic. In urine, inorganic arsenic is all of the inorganic arsenic species combined. This includes the naturally occurring species (AsV and AsIII) and those created through the metabolism or breakdown of inorganic arsenic in the body (DMA and MMA). There was no significant difference in urinary inorganic arsenic levels between TrACE Study public drinking water users and TrACE Study private well water users ($P = 0.4002$). **Exposure to arsenic from private well water is a significant risk to NH residents, however people are also exposed to arsenic in other ways such as from the foods they eat and smoking tobacco. These other exposures were not controlled for (evaluated) in this analysis and may explain this finding.**

Evaluation of Biomonitoring Results by Home Water Quality

The TrACE Study also examined the levels of certain chemicals in participants based on their water quality. Lead, PFOS, PFOA, and uranium were evaluated because private well users had significantly different biomonitoring (blood, serum, and urine) results from public drinking water users for these chemicals. Inorganic arsenic was also evaluated because it is a common contaminant in NH groundwater.

The bar charts on the following pages group the water concentration for each chemical by not detected (light blue), less than the health limit (MCL or NHDES adopted health limit) (medium blue), or greater than or equal to the health limit (dark blue) (see Key Terms). Water at or above the health limit should be treated to assure good water quality. The blood, serum, or urine levels in these charts are the average for the water concentration group. The water results are combined for both TrACE public water systems and TrACE private wells except for PFOS and PFOA which are only private well water results. PFAS were not tested for in public water samples due to budget restrictions and because that information is available from the water distributor. Additional information on biomonitoring results based on household water quality and amount of household water consumed per day can be found in Appendix D on page 58.



A specialized NH PHL chemistry instrument analyzes water samples for metals.

Lead

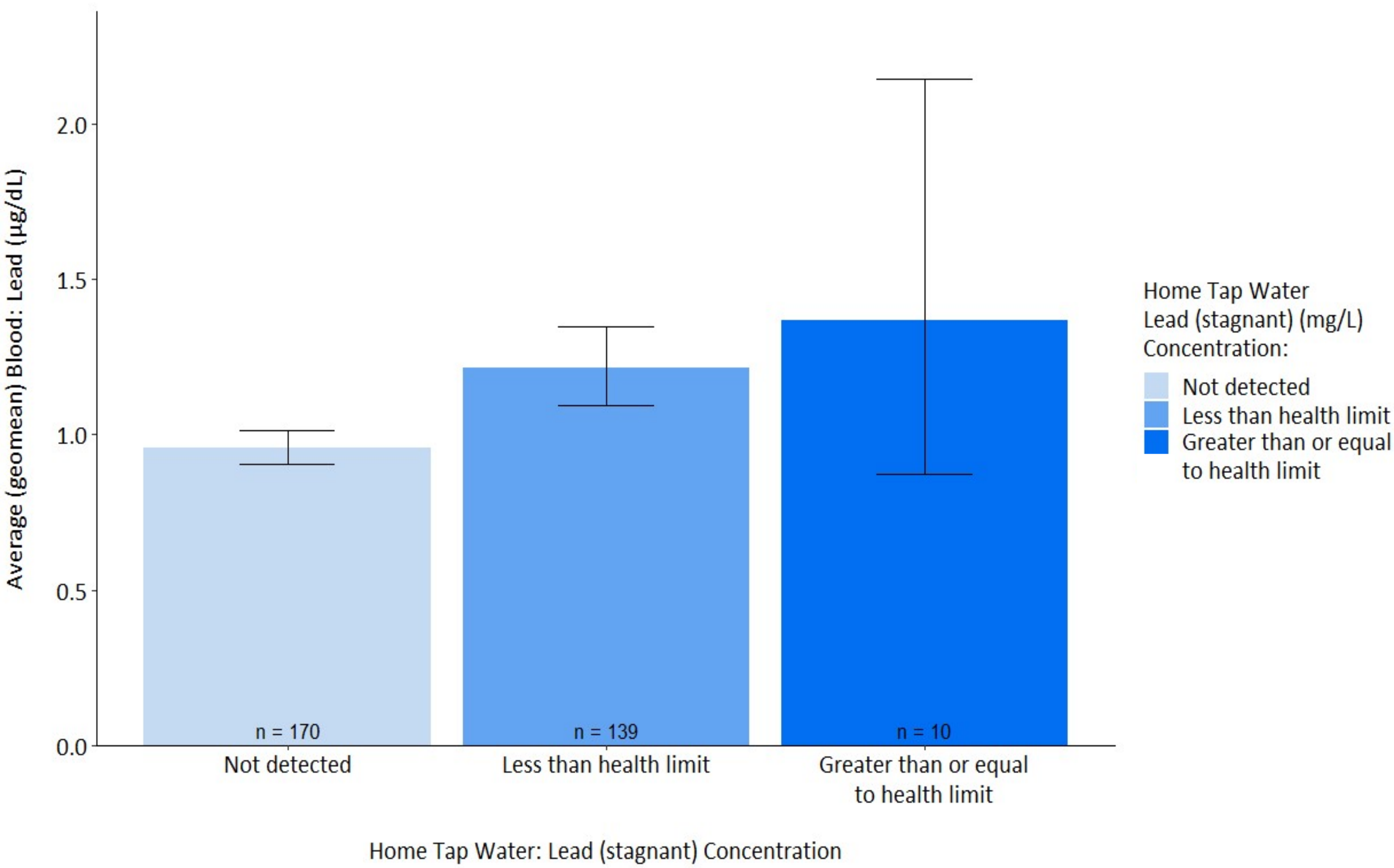
Stagnant water is water that has been sitting in household plumbing undisturbed for a long period of time, such as overnight or when away from the home for the workday. Water that is corrosive (see Key Terms) and sitting stagnant in the plumbing may allow metals like lead and copper to exit the plumbing and faucets and enter the water. Water that is used after sitting stagnant may have these metals. This is why a stagnant water sample should be collected and tested for lead and copper.

The TrACE Study found a trend of more lead in participant blood when there was more lead in home stagnant water (Figure 7). There was significantly different and more lead in the blood of people who drank water from homes with a stagnant lead result less than the health limit (medium blue) compared to people who drank water without lead (light blue). **This means home drinking water may be contributing to the higher levels of lead in their bodies and those residents may need to consider treating their water.** There was not a significant difference between the people who consumed water with a stagnant lead result less than the health limit (medium blue) compared to those who consumed water with a stagnant lead result at or above the health limit (dark blue). Only a small amount of people had household water at or above the health limit, so this may explain the lack of significance.

Key Finding - Lead

Participants who drank home water with a stagnant lead result less than the health limit had more lead in their blood than people who drank water without lead.

Figure 7. TrACE participant blood lead average levels grouped by water concentration of stagnant lead.

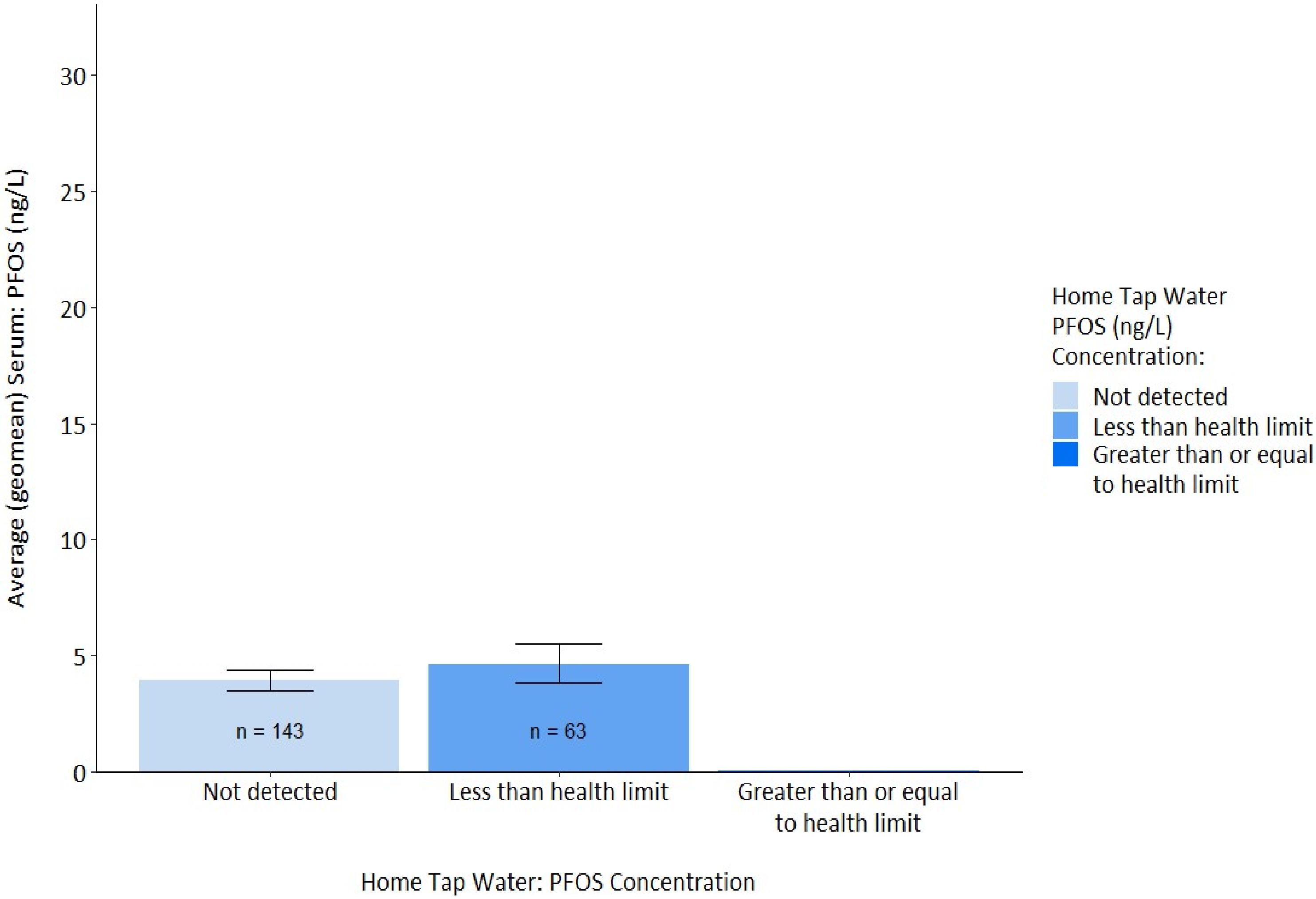


PFOS

Although the average amount of PFOS in participant serum increased when the water concentration of PFOS increased, these results were not significant (Figure 8). Additionally, there were not enough participants with a water concentration of PFOS greater than or equal to the health limit to share those results in the following figure. It is important to remember that people are exposed to PFOS in many ways and that water is only one potential source of exposure. Public water was not tested for PFOS (see page 29) and so TrACE participants using public water are not included in this particular analysis.

Key Finding - PFOS
No significant results.

Figure 8. TrACE participant serum PFOS average levels grouped by water concentration of PFOS.

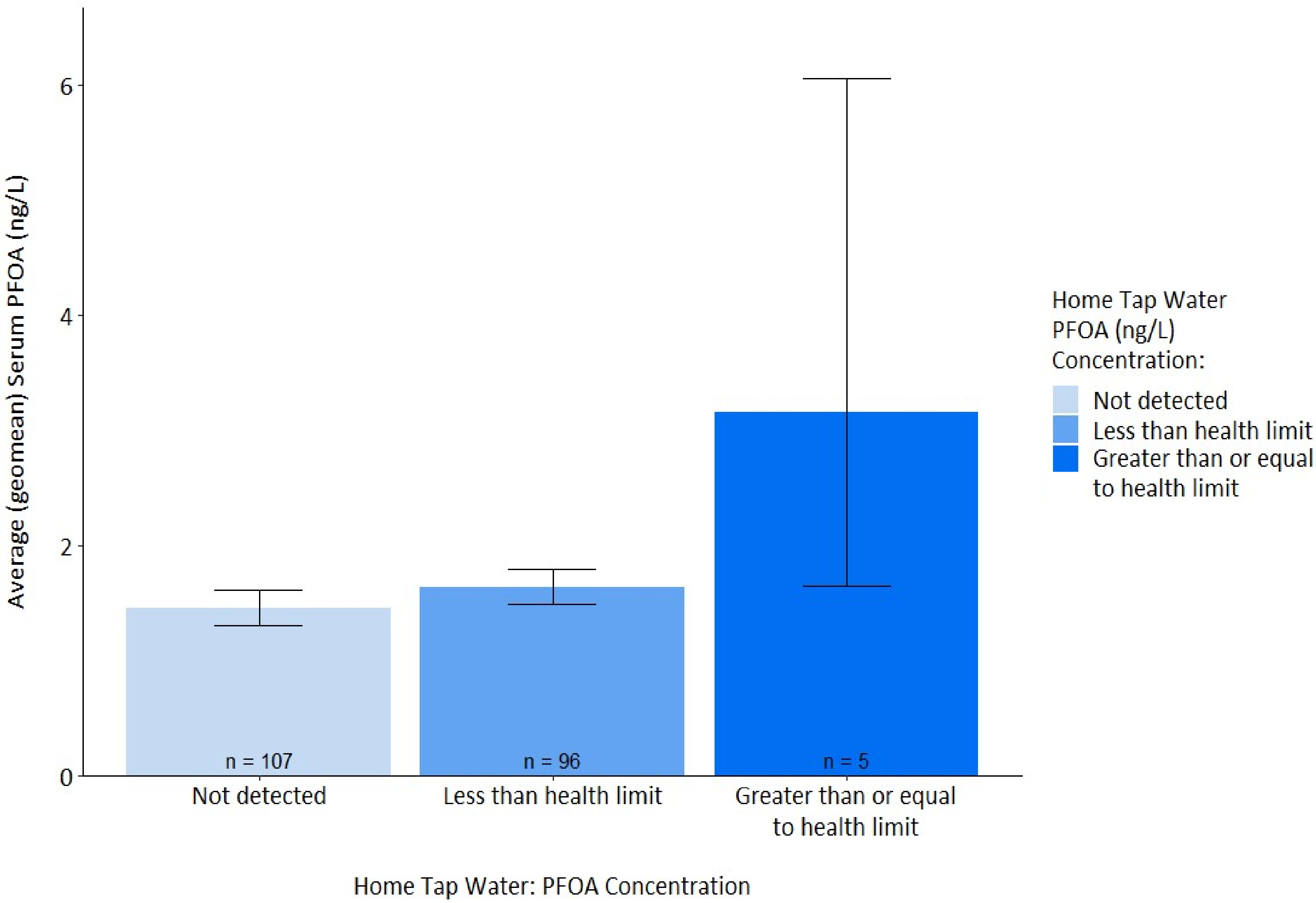


PFOA

The TrACE Study found a trend of more PFOA in participant serum when there was more PFOA in private well water (Figure 9). These results were not significant. It is important to remember that people are exposed to PFOA in many ways and that water is only one potential source of exposure. Public water was not tested for PFOA (see page 29) and so TrACE participants using public water are not included in this particular analysis.

Key Finding - PFOA
No significant results, however there was a trend of more PFOA in the body when there was more PFOA in home water.

Figure 9. TrACE participant serum PFOA average levels grouped by water concentration of PFOA.



Inorganic Arsenic

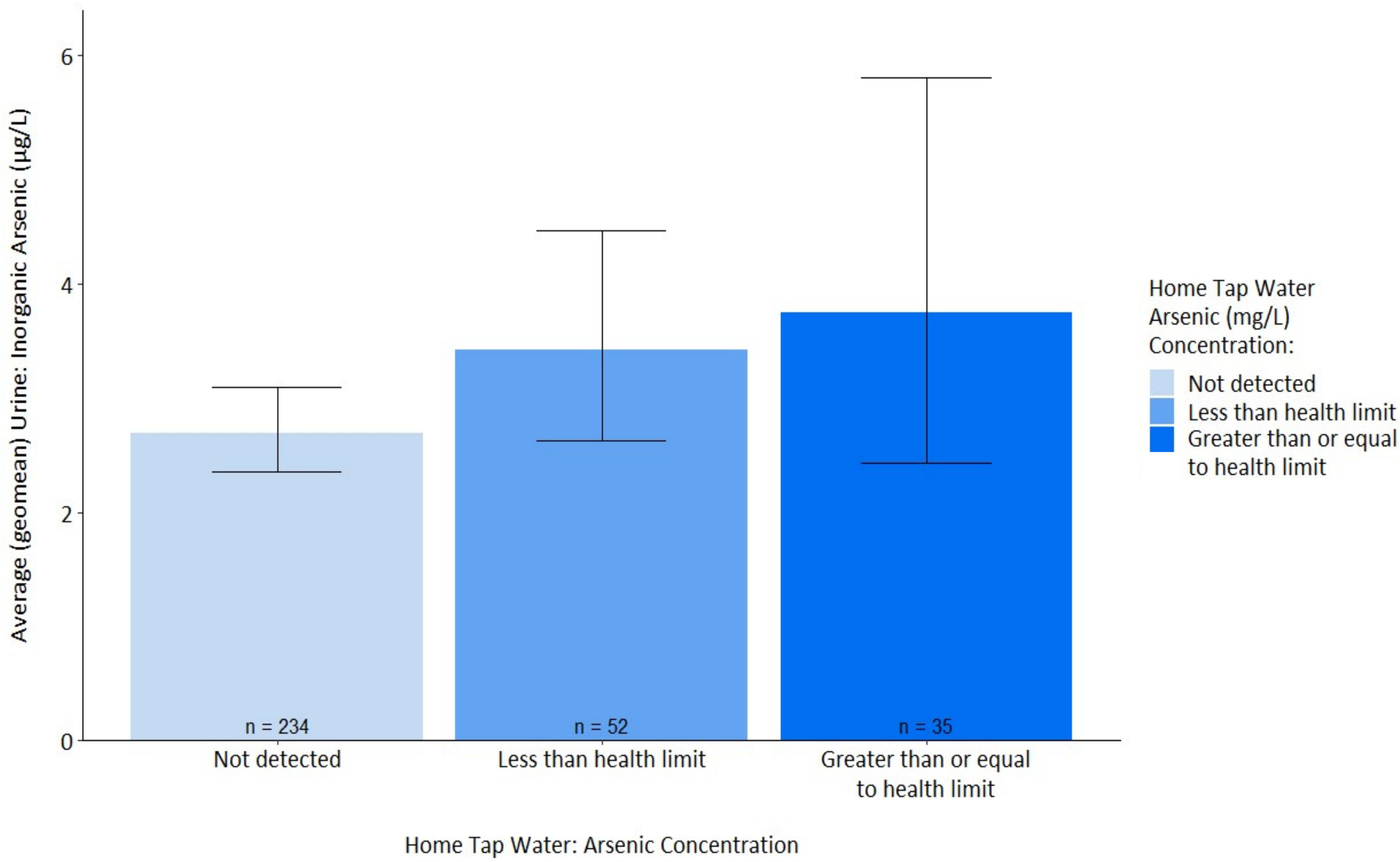
There are many ways a person may be exposed to inorganic arsenic. Some of them are drinking or cooking with contaminated water, eating rice grown in contaminated water or the foods made from this rice, drinking contaminated fruit juice, and smoking tobacco. These various exposures were not taken into account (controlled for) when analyzing the study data. **The following information must be considered with the potential for the influence (confounding) of these other exposures.**

There was a trend of more inorganic arsenic in participant urine as the amount of arsenic in home water increased (Figure 10). These results were not significant, however the relationship between arsenic in water and inorganic arsenic in the body is well known. Anyone with arsenic in their home water should consider treating their water. This is because the US EPA has set a health goal of zero arsenic in drinking water.

Key Finding - Inorganic Arsenic

No significant results, however there was a trend of more inorganic arsenic in the body when there was more arsenic in home water.

Figure 10. TrACE participant urine inorganic arsenic average levels grouped by water concentration of arsenic.



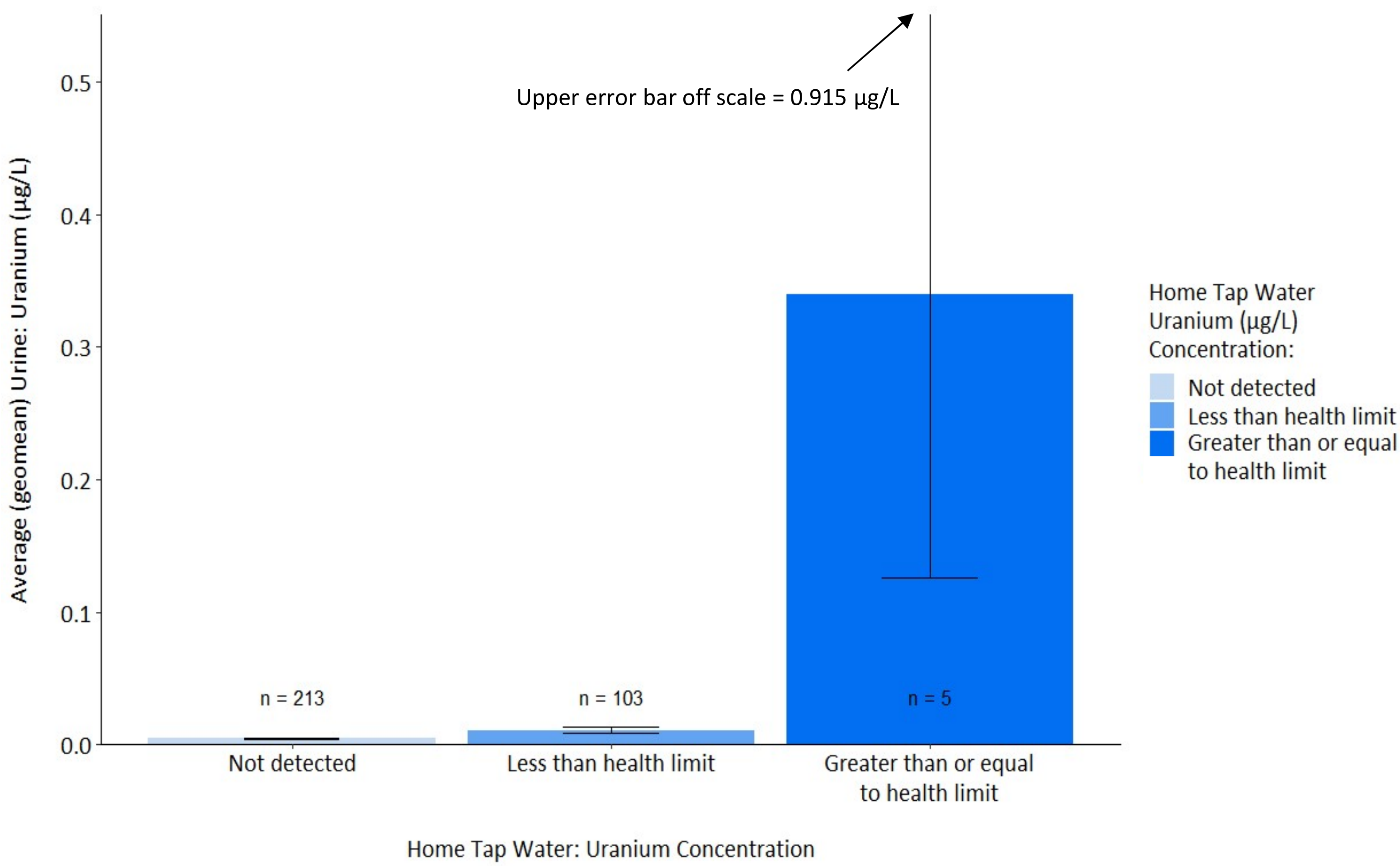
Uranium

The TrACE Study found more uranium in participant urine when there was more uranium in home water (Figure 11). There was significantly different and more uranium in the urine of people who drank water from homes with uranium less than the health limit (medium blue) compared to people who drank water without uranium (light blue). There was also significantly different and more uranium in the urine of people who drank water from homes with uranium greater than or equal to the health limit (dark blue) compared to people who drank water with uranium less than the health limit (medium blue). **This means home drinking water may be contributing to the higher levels of uranium in their bodies.** Anyone with uranium in their home water should consider treating their water. This is because the US EPA has set a health goal of zero uranium in drinking water.

Key Finding - Uranium

Participants who drank home water with uranium had more uranium in their urine than people who drank water without uranium. As the amount of uranium in home water increased, so did the amount of uranium in urine.

Figure 11. TrACE participant urine uranium average levels grouped by water concentration of uranium.



Summary of Important Findings by Chemical

The majority of specimens for the TrACE Study were collected from June to September 2019 during which time participants may have had exposures specific to the season. Examples of these are increased seafood consumption or usage of insect repellants. This differs from the US population from the National Exposure Report where specimens were collected over two calendar years. Additionally, environmental contaminants are not spread equally across the state. Some areas have higher levels of certain chemicals due to natural occurrences (like geology) or human contamination. An example of this is the higher levels of some PFAS in the environment near the Pease Tradeport and in southern NH. The TrACE specimen collection timeframe as well as the unequal distribution of environmental contaminants due to natural differences and local exposures should be considered when interpreting these results. No important results were found for the chemicals not mentioned in this section.

Arsenic

- TrACE participants had a significantly different and higher average level of total arsenic in their body when compared to the US population (see page 16).
- Raw private well water had higher levels of arsenic than finished private well water (see page 23).
- Finished private well water had higher levels of arsenic than finished public drinking water (see page 24).
- There was a trend of more inorganic arsenic in participant urine as the amount of arsenic in home water increased (see page 33).

Cadmium

- TrACE participants had a significantly different and higher average level of cadmium in their body when compared to the US population (see page 16).

Cesium

- TrACE participants had a significantly different and higher average level of cesium in their body when compared to the US population (see page 16).

Cobalt

- TrACE participants had a significantly different and lower average level of cobalt in their body when compared to the US population (see page 16).

Copper

- Finished private well water had higher levels of stagnant copper than finished public drinking water (see page 24).

Lead

- TrACE participants had a significantly different and higher average level of lead in their blood when compared to the US population (see page 16).
- Finished private well water had higher levels of stagnant lead than finished public drinking water (see page 24).
- Private well users had a higher level of lead in their blood than public drinking water users (see page 26).
- Participants with home stagnant water containing lead less than the health limit had more lead in their blood than participants with home stagnant water without lead (see page 30).
- There was a trend of more lead in participant blood when there was more lead in home stagnant water (see page 30).

Manganese

- TrACE participants had a significantly different and lower average level of manganese in their bodies when compared to the US population (see page 16).

Mercury

- TrACE participants had a significantly different and higher average level of total mercury in their blood when compared to the US population (see page 16).

PFAS

- TrACE participants had a significantly different and higher average level of PFDA in their bodies when compared to the US population (see page 16).
- TrACE participants had a significantly different and lower average level of PFHxS and PFOS in their bodies when compared to the US population (see page 16).
- Private well users had a higher level of PFOS in their bodies than public drinking water users (see page 27).
- Public drinking water users had a higher level of PFOA in their bodies than private well users (see page 27).
- There was a trend of more PFOA in participant serum when there was more PFOA in home water (see page 32).

PNP

- TrACE participants had a significantly different and higher average level of PNP in their bodies when compared to the US population (see page 16).

Radon

- Raw private well water had higher levels of radon than finished private well water (see page 23).
- Finished private well water had higher levels of radon than finished public drinking water (see page 24).

Selenium

- TrACE participants had a significantly different and lower average level of selenium in their bodies when compared to the US population (see page 16).

Uranium

- Raw private well water had higher levels of uranium than finished private well water (see page 23).
- Finished private well water had higher levels of uranium than finished public drinking water (see page 24).
- Private well users had a higher level of uranium in their bodies than public drinking water users (see page 28).
- There was more uranium in participant urine when there was more uranium in home water (see page 34).

Recommendations

1. **Talk with your Healthcare Provider**
   It is important to be aware of how you are exposed to chemicals in your environment (see Figure 1 on page 7). The data contained in this report represents both body burden and water quality at the time of collection. Blood, serum, and urine levels fluctuate based on exposure and groundwater quality changes over time. **TrACE Study participants are encouraged to share their clinical and water results with their healthcare providers to determine whether they should take steps to reduce their exposure to chemicals.**

2. **Explore Your Potential for Health Effects from Chemicals**
   It is important to remember that many factors go into whether a person will develop a health effect after being exposed to a chemical. Some of these include the person's genetics, overall health, how much and for how long they have been in contact with that chemical, how they were exposed, and if they are exposed to other chemicals at the same time. Much of the research scientists have done has involved people exposed to large amounts of these chemicals at work, those who have misused the chemicals, or with animals. Scientists are conducting further studies to learn more about these chemicals and their effects on human health. Additionally, it is important to remember that not all chemicals are bad for your health. Some (like manganese) are essential nutrients and are needed in certain amounts to be healthy. **Everyone should consult with their healthcare provider about their contact with chemicals in their environment.** Consider your contact with chemicals from drinking water, food, air, work, recreational activities, and the products you use during these conversations.

3. **Continue Testing Your Water, Install a Treatment System (if indicated), and Maintain it**
   The NHDES recommends standard and radiological analysis testing of private well water every three to five years and yearly testing for bacteria and nitrate. Public drinking water users are encouraged to test their water for stagnant lead and copper every three to five years. Public water system operators test and treat public drinking water for contaminants with enforceable health limits. Everyone should test their water for any contaminant for which they are concerned. The NH Public Health Laboratories (NH PHL) provides water testing for a fee. For test kits, visit tinyurl.com/OrderWaterTestKit or call 603-271-3445. For more information about water testing and water treatment options, please contact the NHDES at 603-271-2513, DWGBinfo@des.nh.gov, or visit tinyurl.com/NHDESWaterTesting. **There are multiple ways to address the water quality issues identified in this study.** For more information about common water contaminants and treatment considerations, please review the NHDES drinking water fact sheets at tinyurl.com/NHDESFactSheets.

4. **Test Your Home Air for Radon and Install a Mitigation System (if indicated)**
   The greatest risk to health from radon is from breathing it in. Radon is released into home air by cracks in the walls or foundation. It is also released into the air when using contaminated water, such as when showering or washing dishes. High levels of radon in water are an indicator of the potentially high levels of radon in air. However, low levels of radon in the water do not mean low levels of radon in the air. Everyone should test their home air for radon at each level below the third floor and install a mitigation system (if necessary). Home water should also be tested every 3-5 years and treated if indicated (see more information at tinyurl.com/NHDESWaterTesting).

Additional Information

Testing

Blood, serum, and urine testing was performed at the NH Public Health Laboratories (NH PHL). The NH PHL is certified by the Clinical Laboratory Improvement Amendments (CLIA) for the testing of human specimens. This means all procedures undergo strict quality control and assurance and testing is completed by trained scientists. Water testing was performed by the NH PHL and through contract with ChemServe Environmental Analysts, Nelson Analytical Lab, TestAmerica Laboratories, and Weck Analytical Environmental Services. These water testing labs are accredited by the National Environmental Laboratory Accreditation Program (NELAP) or state-based environmental laboratory accreditation programs. This means they also have rigorous quality control and assurance procedures as well as trained scientists to complete the testing.

Funding

Funding and technical assistance for clinical testing was provided by cooperative agreement with the CDC Division of Laboratory Sciences at the National Center for Environmental Health (RFA EH14140202). The contents of these pages do not necessarily represent the official views of the CDC. Funding for water testing was provided by the NH Drinking Water and Groundwater Trust Fund, the NHDES MtBE Remediation Bureau, and the NH Environmental Public Health Tracking (EPHT) Program. Household water samples were collected with in-kind support by the NHDES Drinking Water Quality Program. Data analysis was a collaborative effort between these groups and largely supported by the NH EPHT Program. The two year effort cost approximately $2,331,845. It was funded primarily by the BiomonitoringNH Program through cooperative agreement with the CDC ($1,891,100) and the NHDES and Drinking Water and Groundwater Trust Fund ($376,346) with a mini-grant from the NH EPHT ($64,398).

Contact Information

Data and information from the 2019 NH TrACE Study will be presented on the NH Health WISDOM website at https://wisdom.dhhs.nh.gov. Additional information about this study and the BiomonitoringNH Program is available at tinyurl.com/BiomonitoringNH. Email BiomonitoringNH@dhhs.nh.gov or call 603-271-4611 with questions.

Affiliations

BiomonitoringNH is a member of the National Biomonitoring Network and operates within the Chemistry Program at the NH PHL. Both the NH PHL and the NH EPHT are programs of the NH Division of Public Health Services, NH Department of Health and Human Services. The NHDES is a separate department; both departments worked closely together on the 2019 NH TrACE Study.

Biomonitoring New Hampshire

NH DIVISION OF Public Health Services Department of Health and Human Services

NEW HAMPSHIRE ENVIRONMENTAL PUBLIC HEALTH TRACKING NH.GOV/EPHT

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Appendix A
TrACE Clinical and Water Testing Lists

Clinical Testing
Whole blood, serum, and urine

Whole blood	Serum	Urine	
		Metals	Pesticide, Herbicide, and Insecticide Metabolites
Cadmium	Cotinine	Antimony	2,4-D
Lead	PFBS	Arsenic, Total	3-PBA
Manganese	PFDA	Arsenic (V) acid	4F-3PBA
Mercury, Total	PFDoA	Arsenobetaine	*cis*-DBCA
Selenium	PFHpA	Arsenocholine	*cis*-DCCA
	PFHxS	Arsenous (III) acid	*trans*-DCCA
	PFNA	DMA	PNP
	PFOA	MMA	TCPY
	PFOS	Barium	
	PFOSA	Beryllium	
	EtFOSAA	Cadmium	
	MeFOSAA	Cesium	
	PFUnDA	Cobalt	
	PFHxA	Lead	
	GenX	Manganese	
		Molybdenum	
		Platinum	
		Strontium	
		Thallium	
		Tin	
		Tungsten	
		Uranium	

Clinical Testing Acronym Descriptions

Per- and polyfluoroalkyl substances (PFAS)
PFBS: Perfluorobutane sulfonic acid
PFDA: Perfluorodecanoic acid
PFDoA: Perfluorododecanoic acid
PFHpA: Perfluoroheptanoic acid
PFHxS: Perfluorohexane sulfonic acid
PFNA: Perfluorononanoic acid
PFOA: Perfluorooctanoic acid
PFOS: Perfluorooctane sulfonic acid
PFOSA: Perfluorooctane sulfonamide
EtFOSAA: 2-(N-ethyl-perfluorooctane sulfonamido) acetic acid
MeFOSAA: 2-(N-methyl-perfluorooctane sulfonamido) acetic acid
PFUnDA: Perfluoroundecanoic acid
PFHxA: Perfluorohexanoic acid
GenX: Tetrafluoro-2-(heptafluoropropoxy) propanoic acid

Arsenic metabolites
DMA: Dimethylarsinic acid
MMA: Monomethylarsonic acid

Herbicide metabolite
2,4-D: 2,4-dicholorophenoxyacetic acid

Organophosphorus insecticide metabolites
PNP: para-Nitrophenol
TCPY: 3,5,6-trichloro-2-pyridinol

Pyrethroid insecticide metabolites
3-PBA: 3-phenoxybenzoic acid
4F-3PBA: 4-fluoro-3-phenoxybenzoic acid
***cis*-DBCA**: *cis*-3-(2,2-dibromovinyl)-2,2- dimethylcyclopropane carboxylic acid
***cis*-DCCA**: *cis*-3-(2,2-dichlorovinyl)-2,2- dimethylcyclopropane carboxylic acid
***trans*-DCCA**: *trans*-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid

Water Testing

Finished public water, raw and finished private well water

Public Water System Testing List (finished water)		
Metals	**Radiologicals**	**Other**
Antimony	Radon	*E. coli* bacteria
Arsenic	Uranium	Hardness
Barium		pH
Beryllium		Total coliform bacteria
Cadmium		VOCs (see page 42)
Chloride		
Cobalt		
Copper (stagnant and flushed)		
Fluoride		
Iron		
Lead (stagnant and flushed)		
Manganese		
Selenium		
Sodium		
Strontium		
Thallium		
Uranium		

Private Well Water Testing List (finished water)		
Metals	**Radiologicals**	**Other**
Antimony	Radon	*E. coli* bacteria
Arsenic	Uranium	Hardness
Barium		Nitrate
Beryllium		Nitrite
Cadmium		pH
Chloride		Total coliform bacteria
Cobalt		VOCs
Copper (stagnant and flushed)		
Fluoride		
Iron		
Lead (stagnant and flushed)		
Manganese		
Selenium		
Sodium		
Strontium		
Thallium		

Private Well Water Testing List (raw water)			
Metals	**Radiologicals**	**Other**	**Per- and Polyfluoroalkyl Substances (PFAS)**
Arsenic	Analytical Gross Alpha	1,4-Dioxane	6:2 FTSA
Chloride	Analytical Gross Beta	Corrosivity	8:2 FTSA
Copper (flushed)	Compliance Gross Alpha	*E. coli* bacteria	NEtFOSAA
Fluoride	Radium 226	Hardness	NMeFOSAA
Iron	Radium 228	Hexavalent chromium	PFBA
Lead (flushed)	Radium 226 + 228	Nitrate	PFBS
Manganese	Radon	Nitrite	PFDA
Sodium	Uranium	Perchlorate	PFDoA
		pH	PFDS
		Total coliform bacteria	PFHpA
		VOCs (see page 4)	PFHpS
			PFHxA
			PFHxDA
			PFHxS
			PFNA
			PFOA
			PFOS
			FOSA
			PFPeA
			PFTEA
			PFTRA
			PFUNA

PFAS Acronym Descriptions

6:2 FTSA: fluorotelomer sulfonate 6:2
8:2 FTSA: 8:2 fluorotelomer sulfonate
NEtFOSAA: 2-(N-ethyl-perfluorooctane sulfonamido) acetic acid
NMeFOSAA: 2-(N-methyl-perfluorooctane sulfonamido) acetic acid
PFBA: perfluorobutanoic acid
PFBS: perfluorobutane sulfonic acid
PFDA: perfluorodecanoic acid
PFDoA: perfluorododecanoic acid
PFDS: perfluorodecane sulfonate
PFHpA: perfluoroheptanoic acid
PFHpS: perfluoroheptane sulfonate
PFHxA: perfluorohexanoic acid
PFHxDA: perfluorohexadecanoic acid
PFHxS: perfluorohexane sulfonic (or perfluorohexylsulfonic) acid
PFNA: perfluorononanoic acid
PFOA: perfluorooctanoic acid
PFOS: perfluorooctane sulfonic (or perfluorooctylsulfonic) acid
FOSA: perfluorooctane sulfonamide
PFPeA: perfluoropentanoic acid
PFTEA: perfluorotetradecanoic acid
PFTRA: perfluoro-n-tridecanoic acid
PFUNA: perfluoroundecanoic acid

Private Well Water Testing List: Pesticides and pesticide metabolites (raw water)		
1,2,3-TCP	Diazinon oxon	Metribuzin DADK
2,4,5-T	Dicamba	Metribuzin DK
2,4,5-TP	Dichlorprop	Metsulfuron-methyl
2,4-D	Dicrotophos	Myclobutanil
2,4-DB	Difenoconazole	Nicosulfuron
2-hydroxyatrazine	Dimethenamid	Norflurazon
3-PBA	Dimethenamid ESA	Desmethylnorflurazon
4F-3PBA	Dimethenamid OXA	Oxadiazon
Acetamiprid	Dimethoate	Oxydemeton-methyl
Acetochlor	Dinotefuran	para-nitrophenol (PNP)
Acetochlor ESA	Disulfoton sulfone	Methyl parathion
Acetochlor OA	Diuron	Methyl paraoxon
Alachlor	Ethofumesate	Pendimethalin
Alachlor ESA	Flufenacet OA	Phorate
Alachlor OA	Flumetsulam	Picloram
Aldicarb sulfone	Flutriafol	Picoxystrobin
Aldicarb sulfoxide	Fluxapyroxad	Prometon
AMPA	Fonofos	Prometryn
Atrazine	Glufosinate	Propachlor
Azoxystrobin	Glyphosate	Propachlor ESA
Bensulfuron-methyl	Halosulfuron-methyl	Propachlor OA
Bensulide	Hexazinone	Propazine
Bentazon	Imazamethabenz-acid	Propiconazole
Boscalid	Imazamethabenz-methyl	Pyraclostrobin
Bromacil	Imazamox	Pyroxasulfone
Bromoxynil	Imazapic	Saflufenacil
Carbaryl	Imazapyr	Sedaxane
Carbendazim	Imazaquin	Siduron
Carbofuran	Imazethapyr	Simazine
Chlorantraniliprole	Imidacloprid	Sulfometuron-methyl
Chlorimuron-ethyl	IMPY	Tebuconazole
Chlorpyrifos	Isoxaflutole	Tebuprimiphos
Chlorpyrifos oxon	Linuron	Tembotrione
cis-DCCA	Malathion	Terbufos
Clomazone	MCPA	Tetraconazole
Clopyralid	MCPB	Thiacloprid
Clothianidin	MCPP	Thiamethoxam
Cyanazine	Mesotrione	Thifensulfuron-methyl
Cyantraniliprole	Metalaxyl	Thiobencarb
Cyfluthrin	Metolachlor	Tolfenpyrad
Cypermethrin	Metolachlor ESA	*trans*-DCCA
DEDI atrazine	Metolachlor OA	Triallate
Deisopropylatrazine	Metribuzin	Triasulfuron
Desethylatrazine	Metribuzin DA	Triclopyr
Diazinon		

Volatile Organic Compounds (VOCs): Public water (finished) and private wells (raw and finished water)		
1,1,1,2-tetrachloroethane	4-chlorotoluene	Isopropylbenzene
1,1,1-trichloroethane	4-methyl-2-pentanone (MIBK)	m/p-xylene*
1,1,2,2-tetrachloroethane	Acetone	Methylene chloride
1,1,2-trichloroethane	Benzene	Methyl-t-butyl ether (MtBE)
1,1-dichloroethane	Bromobenzene	Naphthalene
1,1-dichloroethene	Bromochloromethane	n-butylbenzene
1,1-dichloropropene	Bromodichloromethane	n-propylbenzene
1,2,3-trichlorobenzene	Bromoform	o-xylene*
1,2,3-trichloropropane	Bromomethane	p-isopropyltoluene
1,2,4-trichlorobenzene	Carbon disulfide	sec-butylbenzene
1,2,4-trimethylbenzene	Carbon tetrachloride	Styrene
1,2-dibromo-3-chloropropane (DBCP)	Chlorobenzene	t-butanol
1,2-dibromoethane (EDB)	Chloroethane	t-butylbenzene
1,2-dichlorobenzene	Chloroform	Tert-amyl methyl ether (TAME)
1,2-dichloroethane	Chloromethane	Tetrachloroethene
1,2-dichloropropane	*cis*-1,2-dichloroethene	Tetrahydrofuran (THF)
1,3,5-trichlorobenzene	*cis*-1,3-dichloropropene	Toluene
1,3,5-trimethylbenzene	Dibromochloromethane	*trans*-1,2-dichloroethene
1,3-dichlorobenzene	Dibromomethane	*trans*-1,3-dichloropropene
1,3-dichloropropane	Dichlorodifluoromethane	Trichloroethene
1,4-dichlorobenzene	Diethylether	Trichlorofluoromethane
2,2-dichloropropane	Diisopropyl ether (DIPE)	Trihalomethanes
2-butanone (MEK)	Ethyl-t-butyl ether (ETBE)	Vinyl chloride
2-chlorotoluene	Ethylbenzene	*Xylenes (may be reported instead of m/p-xylene and o-xylene)
2-hexanone	Hexachlorobutadiene	

Appendix B
Combined TrACE Clinical Data and US Population Reference Information

Analyte	Matrix	NH PHL Biomonitoring Lab Method	Number of Specimens Tested	Number of Specimens with a Detectable Level (above the LOD)	Frequency of Detection (%)	Units	TrACE Geometric Mean and 95% Confidence Intervals	TrACE 50th Percentile	TrACE 95th Percentile	NH PHL Method LOD
2,4-D	Urine	Biom - Pesticide Metabolites	336	336	100	ug/L	0.391 (0.354, 0.431)	0.377	1.84	0.018
3-PBA	Urine	Biom - Pesticide Metabolites	336	227	67.6	ug/L	0.299 (0.232, 0.384)	0.480	9.56	0.022
4F-3-PBA	Urine	Biom - Pesticide Metabolites	335	93	27.8	ug/L	NA	<LOD	0.269	0.019
Antimony	Urine	Urine Multi-Element Analysis	336	80	23.8	ug/L	NA	<LOD	0.120	0.049
Arsenic (V) acid (AsV)	Urine	Arsenic Speciation	336	20	5.95	ug/L	NA	<LOD	0.218	0.146
Arsenobetaine (AB)	Urine	Arsenic Speciation	336	247	73.5	ug/L	2.88 (2.29, 3.61)	3.38	90.3	0.292
Arsenocholine (AC)	Urine	Arsenic Speciation	336	30	8.93	ug/L	NA	<LOD	0.270	0.117
Arsenous (III) acid (AsIII)	Urine	Arsenic Speciation	336	147	43.8	ug/L	0.137 (0.125, 0.150)	<LOD	0.656	0.105
Barium	Urine	Urine Multi-Element Analysis	336	336	100	ug/L	1.19 (1.08, 1.32)	1.16	4.98	0.1
Beryllium	Urine	Urine Multi-Element Analysis	336	34	10.1	ug/L	NA	<LOD	0.0415	0.029
Cadmium	Urine	Urine Multi-Element Analysis	336	332	98.8	ug/L	0.192 (0.172, 0.215)	0.213	0.886	0.022
Cadmium	Whole Blood	Biomonitoring - Blood Metals	334	334	100	ug/L	0.270 (0.252, 0.289)	0.270	0.714	0.044
Cesium	Urine	Urine Multi-Element Analysis	336	336	100	ug/L	4.67 (4.31, 5.06)	5.14	14.3	0.074
cis-DBCA	Urine	Biom - Pesticide Metabolites	335	46	13.7	ug/L	NA	<LOD	0.394	0.041
cis-DCCA	Urine	Biom - Pesticide Metabolites	336	281	83.6	ug/L	0.336 (0.289, 0.391)	0.285	4.63	0.074
Cobalt	Urine	Urine Multi-Element Analysis	336	331	98.5	ug/L	0.209 (0.185, 0.237)	0.208	1.53	0.028
Cotinine	Serum	Serum Cotinine	336	30	8.93	ug/L	NA	<LOD	0.425	0.028
Dimethylarsinic acid (DMA)	Urine	Arsenic Speciation	336	311	92.6	ug/L	2.19 (1.91, 2.51)	2.77	15.3	0.227
EtPFOSAA	Serum	Polyfluoroalkyl chemicals	336	19	5.65	ug/L	NA	<LOD	0.134	0.125
GenX	Serum	Polyfluoroalkyl chemicals	336	0	0	ug/L	NA	<LOD	<LOD	0.075
Inorganic Arsenic	Urine	Arsenic Speciation	336	313	93.2	ug/L	2.92 (2.60, 3.28)	3.22	15.9	NA
Lead	Urine	Urine Multi-Element Analysis	336	319	94.9	ug/L	0.349 (0.316, 0.386)	0.348	1.54	0.077
Lead	Whole Blood	Biomonitoring - Blood Metals	334	334	100	ug/dL	1.02 (0.952, 1.10)	1.04	2.84	0.05
Manganese	Urine	Urine Multi-Element Analysis	336	289	86	ug/L	0.0774 (0.0709, 0.0844)	0.0710	0.266	0.036
Manganese	Whole Blood	Biomonitoring - Blood Metals	334	334	100	ug/L	8.55 (8.27, 8.83)	8.48	14.6	0.552
MePFOSAA	Serum	Polyfluoroalkyl chemicals	336	113	33.6	ug/L	NA	<LOD	0.459	0.138
Mercury	Whole Blood	Biomonitoring - Blood Metals	334	301	90.1	ug/L	1.34 (1.19, 1.51)	1.51	8.00	0.246
Molybdenum	Urine	Urine Multi-Element Analysis	336	336	100	ug/L	29.4 (26.3, 32.8)	32.1	152	1.33
Monomethylarsonic acid (MMA)	Urine	Arsenic Speciation	336	198	58.9	ug/L	0.244 (0.219, 0.272)	0.211	1.29	0.129
PFBuS	Serum	Polyfluoroalkyl chemicals	336	12	3.57	ug/L	NA	<LOD	<LOD	0.069
PFDA	Serum	Polyfluoroalkyl chemicals	336	290	86.3	ug/L	0.192 (0.179, 0.205)	0.191	0.549	0.102
PFDoA	Serum	Polyfluoroalkyl chemicals	336	59	17.6	ug/L	NA	<LOD	0.137	0.094
PFHpA	Serum	Polyfluoroalkyl chemicals	336	48	14.3	ug/L	NA	<LOD	0.143	0.088
PFHxA	Serum	Polyfluoroalkyl chemicals	336	0	0	ug/L	NA	<LOD	<LOD	0.094
PFHxS	Serum	Polyfluoroalkyl chemicals	336	336	100	ug/L	0.974 (0.901, 1.05)	0.989	3.11	0.075
PFNA	Serum	Polyfluoroalkyl chemicals	336	336	100	ug/L	0.655 (0.617, 0.696)	0.653	1.49	0.08
PFOA	Serum	Polyfluoroalkyl chemicals	336	336	100	ug/L	1.69 (1.59, 1.79)	1.65	4.18	0.107
PFOS	Serum	Polyfluoroalkyl chemicals	336	336	100	ug/L	3.93 (3.64, 4.23)	4.05	11.0	0.167
PFOSA	Serum	Polyfluoroalkyl chemicals	336	0	0	ug/L	NA	<LOD	<LOD	0.087

Analyte	Matrix	NH PHL Biomonitoring Lab Method	Number of Specimens Tested	Number of Specimens with a Detectable Level (above the LOD)	Frequency of Detection (%)	Units	TrACE Geometric Mean and 95% Confidence Intervals	TrACE 50th Percentile	TrACE 95th Percentile	NH PHL Method LOD
PFUnDA	Serum	Polyfluoroalkyl chemicals	336	269	80.1	ug/L	0.149 (0.140, 0.159)	0.148	0.390	0.089
Platinum	Urine	Urine Multi-Element Analysis	336	11	3.27	ug/L	NA	<LOD	<LOD	0.008
PNP	Urine	Biom - Pesticide Metabolites	336	333	99.1	ug/L	0.714 (0.626, 0.814)	0.750	4.82	0.015
Selenium	Whole Blood	Biomonitoring - Blood Metals	334	334	100	ug/L	178 (175, 180)	176	221	17.5
Strontium	Urine	Urine Multi-Element Analysis	336	336	100	ug/L	82.9 (76.3, 90.1)	83.5	259	2.47
TCPy	Urine	Biom - Pesticide Metabolites	336	336	100	ug/L	0.712 (0.637, 0.796)	0.682	4.38	0.026
Thallium	Urine	Urine Multi-Element Analysis	336	329	97.9	ug/L	0.160 (0.147, 0.175)	0.170	0.528	0.029
Tin	Urine	Urine Multi-Element Analysis	336	273	81.2	ug/L	0.367 (0.325, 0.415)	0.363	2.68	0.114
Total Arsenic	Urine	Urine Multi-Element Analysis	336	336	100	ug/L	11.2 (9.72, 13.0)	9.71	148	0.249
trans-DCCA	Urine	Biom - Pesticide Metabolites	336	301	89.6	ug/L	0.520 (0.437, 0.618)	0.475	9.41	0.047
Tungsten	Urine	Urine Multi-Element Analysis	336	264	78.6	ug/L	0.0509 (0.0453, 0.0573)	0.0490	0.353	0.018
Uranium	Urine	Urine Multi-Element Analysis	336	193	57.4	ug/L	0.00649 (0.00578, 0.00728)	<LOD	0.0570	0.004

Notes
LOD: Limit of detection
NA: Geometric mean and associated information could not be determined when more than 40% of the results were below the limit of detection for the lab method. The method LOD for Inorganic Arsenic is not available; the measurements presented are from the sum of the inorganic arsenic species (AsIII, AsV, DMA, and MMA).
Two whole blood specimens could not be tested due to blood clots.

Analyte	Matrix	NHANES Survey Years	Units	NHANES Geometric Mean	NHANES 50th Percentile	NHANES 95th Percentile	NHANES Method LOD	TrACE Results Above the NHANES 95th Percentile (%)
2,4-D	Urine	2009-2010	ug/L	0.328	0.3	1.57	0.15	7.44
3-PBA	Urine	2009-2010	ug/L	0.412	0.37	8.08	0.1	6.85
4F-3-PBA	Urine	2009-2010	ug/L	NA	<LOD	<LOD	0.1	15.2
Antimony	Urine	2015-2016	ug/L	0.044	0.043	0.178	0.022	1.49
Arsenic (V) acid (AsV)	Urine	2015-2016	ug/L	NA	<LOD	<LOD	0.79	1.49
Arsenobetaine (AB)	Urine	2015-2016	ug/L	NA	<LOD	23.2	1.16	19.3
Arsenocholine (AC)	Urine	2015-2016	ug/L	NA	<LOD	0.37	0.11	3.27
Arsenous (III) acid (AsIII)	Urine	2015-2016	ug/L	NA	<LOD	0.99	0.12	1.19
Barium	Urine	2015-2016	ug/L	1.25	1.3	5.67	0.06	3.87
Beryllium	Urine	2009-2010	ug/L	NA	<LOD	<LOD	0.072	0.893
Cadmium	Urine	2015-2016	ug/L	0.124	0.129	0.909	0.036	4.17
Cadmium	Whole Blood	2015-2016	ug/L	0.239	0.22	1.25	0.1	2.1
Cesium	Urine	2015-2016	ug/L	3.83	3.96	11.4	0.086	9.52
cis-DBCA	Urine	2009-2010	ug/L	NA	<LOD	<LOD	0.5	3.88
cis-DCCA	Urine	2001-2002	ug/L	NA	<LOD	0.9	0.1	22
Cobalt	Urine	2015-2016	ug/L	0.402	0.422	1.49	0.023	5.36
Cotinine	Serum	2013-2014	ug/L	NA	<LOD	1.09	0.015	4.76
Dimethylarsinic acid (DMA)	Urine	2015-2016	ug/L	2.67	2.46	9.18	1.91	10.4
EtPFOSAA	Serum	2011-2012	ug/L	NA	<LOD	0.12	0.1	5.65
GenX	Serum	NA	ug/L	NA	NA	NA	NA	0
Inorganic Arsenic	Urine	2015-2016	ug/L	3.93	3.6	11.4	3.02	8.93
Lead	Urine	2015-2016	ug/L	0.275	0.27	1.29	0.03	8.04
Lead	Whole Blood	2015-2016	ug/dL	0.835	0.79	2.72	0.07	5.69
Manganese	Urine	2015-2016	ug/L	NA	<LOD	0.3	0.13	3.57
Manganese	Whole Blood	2015-2016	ug/L	9.37	9.26	15.7	0.99	2.99
MePFOSAA	Serum	2015-2016	ug/L	NA	<LOD	0.7	0.1	2.68
Mercury	Whole Blood	2015-2016	ug/L	0.638	0.57	3.95	0.28	15
Molybdenum	Urine	2015-2016	ug/L	32.3	35.8	125	0.8	7.14
Monomethylarsonic acid (MMA)	Urine	2015-2016	ug/L	NA	0.24	1.22	0.2	5.65
PFBuS	Serum	2013-2014	ug/L	NA	<LOD	<LOD	0.1	2.68
PFDA	Serum	2015-2016	ug/L	0.15	0.1	0.6	0.1	3.87
PFDoA	Serum	2015-2016	ug/L	NA	<LOD	<LOD	0.1	15.2
PFHpA	Serum	2013-2014	ug/L	NA	<LOD	0.2	0.1	2.68
PFHxA	Serum	NA	ug/L	NA	NA	NA	NA	0
PFHxS	Serum	2015-2016	ug/L	1.32	1.3	5.8	0.1	1.49
PFNA	Serum	2015-2016	ug/L	0.576	0.6	1.9	0.1	3.57
PFOA	Serum	2015-2016	ug/L	1.69	1.77	4.47	NA	4.17
PFOS	Serum	2015-2016	ug/L	4.97	5.1	17.4	NA	1.49
PFOSA	Serum	2011-2012	ug/L	NA	<LOD	<LOD	0.1	0

Analyte	Matrix	NHANES Survey Years	Units	NHANES Geometric Mean	NHANES 50th Percentile	NHANES 95th Percentile	NHANES Method LOD	TrACE Results Above the NHANES 95th Percentile (%)
PFUnDA	Serum	2015-2016	ug/L	NA	<LOD	0.3	0.1	13.7
Platinum	Urine	2009-2010	ug/L	NA	<LOD	0.018	0.009	2.08
PNP	Urine	2009-2010	ug/L	0.44	0.49	3.14	0.1	9.23
Selenium	Whole Blood	2015-2016	ug/L	193	193	234	24.5	2.99
Strontium	Urine	2015-2016	ug/L	88.1	97.8	287	2.34	2.68
TCPy	Urine	2009-2010	ug/L	0.768	1.03	4.46	0.1	5.06
Thallium	Urine	2015-2016	ug/L	0.143	0.151	0.414	0.018	10.1
Tin	Urine	2015-2016	ug/L	0.474	0.44	4.44	0.09	2.98
Total Arsenic	Urine	2015-2016	ug/L	5.17	4.64	36.1	0.26	18.5
trans-DCCA	Urine	2009-2010	ug/L	NA	<LOD	6.13	0.6	8.04
Tungsten	Urine	2015-2016	ug/L	0.064	0.065	0.337	0.018	5.36
Uranium	Urine	2015-2016	ug/L	0.005	0.005	0.031	0.002	10.1

Notes

LOD: Limit of detection

NA: Geometric mean and associated information could not be determined when more than 40% of the results were below the limit of detection for the lab method. NHANES did not have survey data for GenX and PFHxA at the time of 2019 NH TrACE Study data analysis.

NHANES information is for the non-Hispanic white population.

Appendix C
Combined TrACE Home Water Data

Water Source and Sample Type	Analyte Type	Analyte and Units	Chemical Abstracts Service (CAS) Registry Number	Number of Samples Tested	Number of Samples with a Detectable Level (above the LOD)	Frequency of Detection (%)	Health Limit	Number of Samples above the Health Limit	Health Goal	Number of Samples above the Health Goal	Screening Level	Number of Samples above the Screening Level
Private Finished	Bacteria	E. coli (P-A/100mL)	NA	176	2	1.14	0	2	NA	0	NA	0
Private Finished	Bacteria	Total Coliform (P-A/100mL)	NA	176	42	23.86	0	42	NA	0	NA	0
Private Finished	Metal	Antimony (mg/L)	7440-36-0	176	0	0	0.006	0	0.006	0	NA	0
Private Finished	Metal	Arsenic (mg/L)	7440-38-2	176	58	32.95	0.005	28	0	58	NA	0
Private Finished	Metal	Barium (mg/L)	7440-39-3	176	79	44.89	2	0	2	0	NA	0
Private Finished	Metal	Beryllium (mg/L)	7440-41-7	176	0	0	0.004	0	0.004	0	NA	0
Private Finished	Metal	Cadmium (mg/L)	7440-43-9	176	1	0.57	0.005	0	0.005	0	NA	0
Private Finished	Metal	Cobalt (mg/L)	7440-48-4	176	0	0	NA	0	NA	0	0.07	0
Private Finished	Metal	Copper (flushed) (mg/L)	7440-50-8	176	34	19.32	1.3	0	1.3	0	NA	0
Private Finished	Metal	Copper (stagnant) (mg/L)	7440-50-8	176	114	64.77	1.3	14	1.3	14	NA	0
Private Finished	Metal	Iron (mg/L)	7439-89-6	176	35	19.89	NA	0	NA	0	NA	0
Private Finished	Metal	Lead (flushed) (mg/L)	7439-92-1	176	17	9.66	0.015	1	0	17	NA	0
Private Finished	Metal	Lead (stagnant) (mg/L)	7439-92-1	176	101	57.39	0.015	7	0	101	NA	0
Private Finished	Metal	Manganese (mg/L)	7439-96-5	176	47	26.7	0.3	1	NA	0	0.1	10
Private Finished	Metal	Selenium (mg/L)	7782-49-2	176	0	0	0.05	0	0.05	0	NA	0
Private Finished	Metal	Sodium (mg/L)	7440-23-5	176	176	100	NA	0	NA	0	20	72
Private Finished	Metal	Strontium (mg/L)	7440-24-6	174	109	62.64	NA	0	NA	0	1.5	2
Private Finished	Metal	Thallium (mg/L)	7440-28-0	176	0	0	0.002	0	0.005	0	NA	0
Private Finished	Nutrients	Nitrate (mg/L)	14797-55-8	176	77	43.75	10	0	10	0	NA	0
Private Finished	Nutrients	Nitrite (mg/L)	14797-65-0	176	1	0.57	1	0	1	0	NA	0
Private Finished	Nutrients	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N (mg/L)	NA	176	80	45.45	NA	0	NA	0	NA	0
Private Finished	Pesticides	1,2-Dibromo-3-chloropropane (DBCP) (ug/L)	96-12-8	176	0	0	0.2	0	0	0	NA	0
Private Finished	Pesticides	1,2-Dibromoethane (EDB) (ug/L)	106-93-4	176	0	0	0.05	0	0	0	NA	0
Private Finished	Physicochemical	Chloride (mg/L)	16887-00-6	176	132	75	NA	0	NA	0	NA	0
Private Finished	Physicochemical	Fluoride (mg/L)	16984-48-8	176	94	53.41	4	0	4	0	NA	0
Private Finished	Physicochemical	Hardness (Ca+Mg) (mg/L)	NA	176	133	75.57	NA	0	NA	0	NA	0
Private Finished	Physicochemical	pH (NONE)	NA	176	176	100	NA	0	NA	0	NA	0
Private Finished	Radiologicals	Radon (pCi/L)	14859-67-7	176	162	92.05	NA	0	NA	0	2000	66
Private Finished	Radiologicals	Uranium (ug/L)	7440-61-1	176	85	48.3	30	5	0	85	NA	0
Private Finished	VOC	1,1,1,2-Tetrachloroethane (ug/L)	630-20-6	176	0	0	70	0	NA	0	NA	0
Private Finished	VOC	1,1,1-Trichloroethane (ug/L)	71-55-6	176	0	0	200	0	200	0	NA	0
Private Finished	VOC	1,1,2,2-Tetrachloroethane (ug/L)	79-34-5	176	0	0	2	0	NA	0	NA	0
Private Finished	VOC	1,1,2-Trichloroethane (ug/L)	79-00-5	176	0	0	5	0	3	0	NA	0
Private Finished	VOC	1,1-Dichloroethane (ug/L)	75-34-3	176	0	0	81	0	NA	0	NA	0
Private Finished	VOC	1,1-Dichloroethene (ug/L)	75-35-4	176	0	0	7	0	7	0	NA	0
Private Finished	VOC	1,1-Dichloropropene (ug/L)	563-58-6	176	0	0	NA	0	NA	0	NA	0

Water Source and Sample Type	Analyte Type	Analyte and Units	Chemical Abstracts Service (CAS) Registry Number	Number of Samples Tested	Number of Samples with a Detectable Level (above the LOD)	Frequency of Detection (%)	Health Limit	Number of Samples above the Health Limit	Health Goal	Number of Samples above the Health Goal	Screening Level	Number of Samples above the Screening Level
Private Finished	VOC	1,2,3-TCP (ug/L)	96-18-4	176	0	0	0.5	0	NA	0	NA	0
Private Finished	VOC	1,2,3-Trichlorobenzene (ug/L)	87-61-6	176	0	0	NA	0	NA	0	7	0
Private Finished	VOC	1,2,4-Trichlorobenzene (ug/L)	120-82-1	176	0	0	70	0	70	0	NA	0
Private Finished	VOC	1,2,4-Trimethylbenzene (ug/L)	95-63-6	176	0	0	330	0	NA	0	NA	0
Private Finished	VOC	1,2-Dichlorobenzene (ug/L)	95-50-1	176	0	0	600	0	600	0	NA	0
Private Finished	VOC	1,2-Dichloroethane (ug/L)	107-06-2	176	1	0.57	5	0	0	1	NA	0
Private Finished	VOC	1,2-Dichloropropane (ug/L)	78-87-5	176	0	0	5	0	0	0	NA	0
Private Finished	VOC	1,3,5-Trichlorobenzene (ug/L)	108-70-3	176	0	0	40	0	NA	0	NA	0
Private Finished	VOC	1,3,5-Trimethylbenzene (ug/L)	108-67-8	176	0	0	330	0	NA	0	NA	0
Private Finished	VOC	1,3-Dichlorobenzene (ug/L)	541-73-1	176	0	0	600	0	NA	0	NA	0
Private Finished	VOC	1,3-Dichloropropane (ug/L)	142-28-9	176	0	0	NA	0	NA	0	3700	0
Private Finished	VOC	1,4-Dichlorobenzene (ug/L)	106-46-7	176	1	0.57	75	0	75	0	NA	0
Private Finished	VOC	2,2-Dichloropropane (ug/L)	594-20-7	176	0	0	NA	0	NA	0	NA	0
Private Finished	VOC	2-Butanone (MEK) (ug/L)	78-93-3	176	0	0	4000	0	NA	0	NA	0
Private Finished	VOC	2-Chlorotoluene (ug/L)	95-49-8	176	0	0	100	0	NA	0	NA	0
Private Finished	VOC	2-Hexanone (ug/L)	591-78-6	176	0	0	NA	0	NA	0	38	0
Private Finished	VOC	4-Chlorotoluene (ug/L)	106-43-4	176	0	0	NA	0	NA	0	100	0
Private Finished	VOC	4-Methyl-2-pentanone (MIBK) (ug/L)	108-10-1	176	0	0	2000	0	NA	0	NA	0
Private Finished	VOC	Acetone (ug/L)	67-64-1	176	0	0	6000	0	NA	0	NA	0
Private Finished	VOC	Benzene (ug/L)	71-43-2	176	0	0	5	0	0	0	NA	0
Private Finished	VOC	Bromobenzene (ug/L)	108-86-1	176	0	0	60	0	NA	0	NA	0
Private Finished	VOC	Bromochloromethane (ug/L)	74-97-5	176	0	0	NA	0	NA	0	90	0
Private Finished	VOC	Bromodichloromethane (ug/L)	75-27-4	176	1	0.57	80	0	0	1	NA	0
Private Finished	VOC	Bromoform (ug/L)	75-25-2	176	0	0	80	0	0	0	NA	0
Private Finished	VOC	Bromomethane (ug/L)	74-83-9	176	0	0	10	0	NA	0	NA	0
Private Finished	VOC	Carbon Disulfide (ug/L)	75-15-0	176	0	0	70	0	NA	0	NA	0
Private Finished	VOC	Carbon Tetrachloride (ug/L)	56-23-5	176	0	0	5	0	0	0	NA	0
Private Finished	VOC	Chlorobenzene (ug/L)	108-90-7	176	0	0	100	0	100	0	NA	0
Private Finished	VOC	Chloroethane (ug/L)	75-00-3	176	0	0	NA	0	NA	0	2100	0
Private Finished	VOC	Chloroform (ug/L)	67-66-3	176	4	2.27	80	0	70	0	NA	0
Private Finished	VOC	Chloromethane (ug/L)	74-87-3	176	0	0	30	0	NA	0	NA	0
Private Finished	VOC	cis-1,2-Dichloroethene (ug/L)	156-59-2	176	0	0	70	0	70	0	NA	0
Private Finished	VOC	cis-1,3-Dichloropropene (ug/L)	10061-01-5	176	0	0	NA	0	NA	0	NA	0
Private Finished	VOC	Dibromochloromethane (ug/L)	124-48-1	176	1	0.57	80	0	60	0	NA	0
Private Finished	VOC	Dibromomethane (ug/L)	74-95-3	176	0	0	NA	0	NA	0	8.3	0
Private Finished	VOC	Dichlorodifluoromethane (ug/L)	75-71-8	176	0	0	1000	0	NA	0	NA	0
Private Finished	VOC	Diethylether (ug/L)	60-29-7	176	0	0	1400	0	NA	0	NA	0
Private Finished	VOC	DIPE-diisopropyl ether (ug/L)	108-20-3	176	0	0	120	0	NA	0	NA	0
Private Finished	VOC	ETBE-ethyl-t-butyl ether (ug/L)	637-92-3	176	0	0	40	0	NA	0	NA	0
Private Finished	VOC	Ethylbenzene (ug/L)	100-41-4	176	0	0	700	0	700	0	NA	0
Private Finished	VOC	Hexachlorobutadiene (ug/L)	87-68-3	176	0	0	0.5	0	NA	0	NA	0

Water Source and Sample Type	Analyte Type	Analyte and Units	Chemical Abstracts Service (CAS) Registry Number	Number of Samples Tested	Number of Samples with a Detectable Level (above the LOD)	Frequency of Detection (%)	Health Limit	Number of Samples above the Health Limit	Health Goal	Number of Samples above the Health Goal	Screening Level	Number of Samples above the Screening Level
Private Finished	VOC	Isopropylbenzene (ug/L)	98-82-8	176	0	0	800	0	NA	0	NA	0
Private Finished	VOC	m/p-Xylene (ug/L)	NA	176	0	0	10000	0	10000	0	NA	0
Private Finished	VOC	Methylene Chloride (ug/L)	75-09-2	176	1	0.57	5	0	0	1	NA	0
Private Finished	VOC	Methyl-t-butyl ether (MTBE) (ug/L)	1634-04-4	176	5	2.84	13	0	NA	0	NA	0
Private Finished	VOC	Naphthalene (ug/L)	91-20-3	176	0	0	100	0	NA	0	NA	0
Private Finished	VOC	n-Butylbenzene (ug/L)	104-51-8	176	0	0	260	0	NA	0	NA	0
Private Finished	VOC	n-Propylbenzene (ug/L)	103-65-1	176	0	0	260	0	NA	0	NA	0
Private Finished	VOC	o-Xylene (ug/L)	95-47-6	176	1	0.57	10000	0	10000	0	NA	0
Private Finished	VOC	p-Isopropyltoluene (ug/L)	99-87-6	176	0	0	260	0	NA	0	NA	0
Private Finished	VOC	sec-Butylbenzene (ug/L)	135-98-8	176	0	0	130	0	NA	0	NA	0
Private Finished	VOC	Styrene (ug/L)	100-42-5	176	0	0	100	0	100	0	NA	0
Private Finished	VOC	t-butanol (ug/L)	75-65-0	176	0	0	40	0	NA	0	NA	0
Private Finished	VOC	t-Butylbenzene (ug/L)	98-06-6	176	0	0	260	0	NA	0	NA	0
Private Finished	VOC	tert-Amyl methyl ether (TAME) (ug/L)	994-05-8	176	0	0	140	0	NA	0	NA	0
Private Finished	VOC	Tetrachloroethene (ug/L)	127-18-4	176	1	0.57	5	0	0	1	NA	0
Private Finished	VOC	Tetrahydrofuran (THF) (ug/L)	109-99-9	176	0	0	600	0	NA	0	NA	0
Private Finished	VOC	Toluene (ug/L)	108-88-3	176	1	0.57	1000	0	1000	0	NA	0
Private Finished	VOC	trans-1,2-Dichloroethene (ug/L)	156-60-5	176	0	0	100	0	100	0	NA	0
Private Finished	VOC	trans-1,3-Dichloropropene (ug/L)	10061-02-6	176	0	0	NA	0	NA	0	NA	0
Private Finished	VOC	Trichloroethene (ug/L)	79-01-6	176	0	0	5	0	0	0	NA	0
Private Finished	VOC	Trichlorofluoromethane (ug/L)	75-69-4	176	0	0	2000	0	NA	0	NA	0
Private Finished	VOC	Vinyl Chloride (ug/L)	75-01-4	176	0	0	2	0	0	0	NA	0
Private Finished	VOC	Xylenes (ug/L)	1330-20-7	176	1	0.57	NA	0	NA	0	NA	0
Private Raw	Bacteria	E. coli (P-A/100mL)	NA	180	2	1.11	0	2	NA	0	NA	0
Private Raw	Bacteria	Total Coliform (P-A/100mL)	NA	180	29	16.11	0	29	NA	0	NA	0
Private Raw	Herbicides	2,4,5-T (ug/L)	93-76-5	180	0	0	NA	0	NA	0	60	0
Private Raw	Herbicides	2,4,5-TP (ug/L)	93-72-1	180	0	0	50	0	50	0	NA	0
Private Raw	Herbicides	2,4-D (ug/L)	94-75-7	180	0	0	70	0	70	0	NA	0
Private Raw	Herbicides	2,4-DB (ug/L)	94-82-6	180	0	0	NA	0	NA	0	200	0
Private Raw	Herbicides	Acetochlor (ug/L)	34256-82-1	180	0	0	NA	0	NA	0	100	0
Private Raw	Herbicides	Alachlor (ug/L)	15972-60-8	180	0	0	2	0	0	0	NA	0
Private Raw	Herbicides	Atrazine (ug/L)	1912-24-9	180	0	0	3	0	3	0	NA	0
Private Raw	Herbicides	Bentazon (ug/L)	25057-89-0	180	0	0	NA	0	NA	0	1000	0
Private Raw	Herbicides	Bromacil (ug/L)	314-40-9	180	0	0	NA	0	NA	0	70	0
Private Raw	Herbicides	Bromoxynil (ug/L)	1689-84-5	180	0	0	NA	0	NA	0	0.31	0
Private Raw	Herbicides	Clopyralid (ug/L)	1702-17-6	180	0	0	3500	0	NA	0	960	0
Private Raw	Herbicides	Cyanazine (ug/L)	21725-46-2	180	0	0	1	0	NA	0	NA	0
Private Raw	Herbicides	Desethylatrazine (ug/L)	6190-65-4	180	0	0	NA	0	NA	0	NA	0
Private Raw	Herbicides	Dicamba (ug/L)	1918-00-9	180	1	0.56	NA	0	NA	0	300	0

Water Source and Sample Type	Analyte Type	Analyte and Units	Chemical Abstracts Service (CAS) Registry Number	Number of Samples Tested	Number of Samples with a Detectable Level (above the LOD)	Frequency of Detection (%)	Health Limit	Number of Samples above the Health Limit	Health Goal	Number of Samples above the Health Goal	Screening Level	Number of Samples above the Screening Level
Private Raw	Herbicides	Dichlorprop (ug/L)	120-36-5	180	0	0	NA	0	NA	0	200	0
Private Raw	Herbicides	Diuron (ug/L)	330-54-1	180	1	0.56	NA	0	NA	0	2	0
Private Raw	Herbicides	Glyphosate (ug/L)	1071-83-6	180	0	0	700	0	700	0	NA	0
Private Raw	Herbicides	Linuron (ug/L)	330-55-2	180	0	0	NA	0	NA	0	49	0
Private Raw	Herbicides	MCPA (ug/L)	94-74-6	180	0	0	NA	0	NA	0	30	0
Private Raw	Herbicides	MCPB (ug/L)	94-81-5	180	0	0	NA	0	NA	0	28	0
Private Raw	Herbicides	Metolachlor (ug/L)	51218-45-2	180	0	0	70	0	NA	0	600	0
Private Raw	Herbicides	Metribuzin (ug/L)	21087-64-9	180	0	0	70	0	NA	0	8	0
Private Raw	Herbicides	Norflurazon (ug/L)	27314-13-2	180	0	0	NA	0	NA	0	96	0
Private Raw	Herbicides	Pendimethalin (ug/L)	40487-42-1	180	0	0	NA	0	NA	0	2000	0
Private Raw	Herbicides	PICLORAM (ug/L)	6607	180	0	0	NA	0	NA	0	NA	0
Private Raw	Herbicides	Prometon (ug/L)	1610-18-0	180	0	0	NA	0	NA	0	300	0
Private Raw	Herbicides	Propachlor (ug/L)	1918-16-7	180	0	0	NA	0	NA	0	1	0
Private Raw	Herbicides	Simazine (ug/L)	122-34-9	180	0	0	4	0	NA	0	NA	0
Private Raw	Herbicides	Thiobencarb (ug/L)	28249-77-6	180	0	0	NA	0	NA	0	60	0
Private Raw	Herbicides	Triallate (ug/L)	2303-17-5	180	0	0	NA	0	NA	0	0.44	0
Private Raw	Herbicides	Triclopyr (ug/L)	55335-06-3	180	0	0	NA	0	NA	0	300	0
Private Raw	Metal	Arsenic (mg/L)	7440-38-2	180	72	40	0.005	39	0	72	NA	0
Private Raw	Metal	CALCIUM (mg/L)	7440-70-2	180	180	100	NA	0	NA	0	NA	0
Private Raw	Metal	Copper (flushed) (mg/L)	7440-50-8	180	72	40	1.3	0	1.3	0	NA	0
Private Raw	Metal	Hexavalent Chromium (mg/L)	18540-29-9	180	0	0	NA	0	NA	0	NA	0
Private Raw	Metal	Iron (mg/L)	7439-89-6	180	78	43.33	NA	0	NA	0	NA	0
Private Raw	Metal	Lead (flushed) (mg/L)	7439-92-1	180	35	19.44	0.015	0	0	35	NA	0
Private Raw	Metal	Manganese (mg/L)	7439-96-5	180	88	48.89	0.3	13	NA	0	0.1	27
Private Raw	Metal	Sodium (mg/L)	7440-23-5	180	180	100	NA	0	NA	0	20	51
Private Raw	Nutrients	Nitrate (mg/L)	14797-55-8	180	81	45	10	0	10	0	NA	0
Private Raw	Nutrients	Nitrite (mg/L)	14797-65-0	180	6	3.33	1	0	1	0	NA	0
Private Raw	Pesticides	1,2-Dibromo-3-chloropropane (DBCP) (ug/L)	96-12-8	180	0	0	0.2	0	0	0	NA	0
Private Raw	Pesticides	1,2-Dibromoethane (EDB) (ug/L)	106-93-4	180	0	0	0.05	0	0	0	NA	0
Private Raw	Pesticides	Aldicarb Sulfone (ug/L)	1646-88-4	180	0	0	2	0	1	0	NA	0
Private Raw	Pesticides	Aldicarb Sulfoxide (ug/L)	1646-87-3	180	0	0	4	0	1	0	NA	0
Private Raw	Pesticides	Azoxystrobin (ug/L)	131860-33-8	180	0	0	NA	0	NA	0	1200	0
Private Raw	Pesticides	Carbaryl (ug/L)	63-25-2	180	0	0	NA	0	NA	0	40	0
Private Raw	Pesticides	Carbofuran (ug/L)	1563-66-2	180	0	0	40	0	40	0	NA	0
Private Raw	Pesticides	Chlorpyrifos (ug/L)	2921-88-2	180	0	0	NA	0	NA	0	2	0
Private Raw	Pesticides	Diazinon (ug/L)	333-41-5	180	0	0	NA	0	NA	0	1	0
Private Raw	Pesticides	Dimethoate (ug/L)	60-51-5	180	0	0	NA	0	NA	0	14	0
Private Raw	Pesticides	Fonofos (ug/L)	944-22-9	180	0	0	NA	0	NA	0	10	0
Private Raw	Pesticides	Imidacloprid (ug/L)	138261-41-3	180	12	6.67	NA	0	NA	0	360	0

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Private Raw	Pesticides	Malathion (ug/L)	121-75-5	180	0	0	NA	0	NA	0	60	0
Private Raw	Pesticides	MCPP (ug/L)	93-65-2	180	0	0	NA	0	NA	0	16	0
Private Raw	Pesticides	Metalaxyl (ug/L)	57837-19-1	180	0	0	NA	0	NA	0	474	0
Private Raw	Pesticides	Methyl Parathion (ug/L)	298-00-0	180	0	0	NA	0	NA	0	1	0
Private Raw	Pesticides	Phorate (ug/L)	298-02-2	180	0	0	NA	0	NA	0	1.1	0
Private Raw	Pesticides	Propiconazole (ug/L)	60207-90-1	180	1	0.56	NA	0	NA	0	600	0
Private Raw	Pesticides	Terbufos (ug/L)	13071-79-9	180	0	0	NA	0	NA	0	0.06	0
Private Raw	PFAS	6:2 FTSA (ng/L)	27619-97-2	180	1	0.56	NA	0	NA	0	NA	0
Private Raw	PFAS	8:2 FTSA (ng/L)	39108-34-4	180	2	1.11	NA	0	NA	0	NA	0
Private Raw	PFAS	FOSA (ng/L)	754-91-6	180	26	14.44	NA	0	NA	0	NA	0
Private Raw	PFAS	NETFOSAA (ng/L)	2991-50-6	180	1	0.56	NA	0	NA	0	NA	0
Private Raw	PFAS	NMEFOSAA (ng/L)	2355-31-9	180	0	0	NA	0	NA	0	NA	0
Private Raw	PFAS	PFBA (ng/L)	375-22-4	180	81	45	NA	0	NA	0	NA	0
Private Raw	PFAS	PFBS (ng/L)	375-73-5	180	77	42.78	NA	0	NA	0	NA	0
Private Raw	PFAS	PFDA (ng/L)	335-76-2	180	7	3.89	NA	0	NA	0	NA	0
Private Raw	PFAS	PFDOA (ng/L)	307-55-1	180	4	2.22	NA	0	NA	0	NA	0
Private Raw	PFAS	PFDS (ng/L)	335-77-3	180	0	0	NA	0	NA	0	NA	0
Private Raw	PFAS	PFHPA (ng/L)	375-85-9	180	58	32.22	NA	0	NA	0	NA	0
Private Raw	PFAS	PFHPS (ng/L)	375-92-8	180	10	5.56	NA	0	NA	0	NA	0
Private Raw	PFAS	PFHXA (ng/L)	307-24-4	180	53	29.44	NA	0	NA	0	NA	0
Private Raw	PFAS	PFHXDA (ng/L)	67905-19-5	180	1	0.56	NA	0	NA	0	NA	0
Private Raw	PFAS	PFHXS (ng/L)	355-46-4	180	175	97.22	18	0	NA	0	NA	0
Private Raw	PFAS	PFNA (ng/L)	375-95-1	180	24	13.33	11	0	NA	0	NA	0
Private Raw	PFAS	PFOA (ng/L)	335-67-1	180	91	50.56	12	5	NA	0	NA	0
Private Raw	PFAS	PFOS (ng/L)	1763-23-1	180	60	33.33	15	2	NA	0	NA	0
Private Raw	PFAS	PFPEA (ng/L)	2706-90-3	180	52	28.89	NA	0	NA	0	NA	0
Private Raw	PFAS	PFTEA (ng/L)	376-06-7	180	12	6.67	NA	0	NA	0	NA	0
Private Raw	PFAS	PFTRA (ng/L)	72629-94-8	180	1	0.56	NA	0	NA	0	NA	0
Private Raw	PFAS	PFUNA (ng/L)	2058-94-8	180	0	0	NA	0	NA	0	NA	0
Private Raw	Physicochemical	ALKALINITY, TOTAL (mg/L)	NA	180	180	100	NA	0	NA	0	NA	0
Private Raw	Physicochemical	Chloride (mg/L)	16887-00-6	180	174	96.67	NA	0	NA	0	NA	0
Private Raw	Physicochemical	Fluoride (mg/L)	16984-48-8	180	103	57.22	4	0	4	0	NA	0
Private Raw	Physicochemical	Hardness (Ca+Mg) (mg/L)	NA	180	179	99.44	NA	0	NA	0	NA	0
Private Raw	Physicochemical	Perchlorate (ug/L)	14797-73-0	180	6	3.33	NA	0	NA	0	15	0
Private Raw	Physicochemical	pH (NONE)	NA	180	180	100	NA	0	NA	0	NA	0
Private Raw	Physicochemical	SOLIDS, DISSOLVED (mg/L)	NA	180	180	100	NA	0	NA	0	NA	0
Private Raw	Physicochemical	SPECIFIC CONDUCTANCE (UMHO/CM)	NA	180	178	98.89	NA	0	NA	0	NA	0
Private Raw	Radiologicals	Analytical Gross Alpha (pCi/L)	12587-46-1	180	180	100	NA	0	NA	0	NA	0
Private Raw	Radiologicals	Analytical Gross Beta (pCi/L)	12587-47-2	180	180	100	NA	0	NA	0	NA	0

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Private Raw	Radiologicals	Compliance Gross Alpha (pCi/L)	NA	180	180	100	NA	0	NA	0	NA	0
Private Raw	Radiologicals	Radium 226 (pCi/L)	13982-63-3	180	180	100	5	3	NA	0	NA	0
Private Raw	Radiologicals	Radium 228 (pCi/L)	15262-20-1	180	180	100	5	0	NA	0	NA	0
Private Raw	Radiologicals	Radon (pCi/L)	14859-67-7	179	179	100	NA	0	NA	0	2000	89
Private Raw	Radiologicals	Uranium (ug/L)	7440-61-1	180	80	44.44	30	7	0	80	NA	0
Private Raw	Radiologicals	Uranium alpha (pCi/L)	7440-61-1	180	80	44.44	20	7	0	80	NA	0
Private Raw	VOC	1,1,1,2-Tetrachloroethane (ug/L)	630-20-6	180	0	0	70	0	NA	0	NA	0
Private Raw	VOC	1,1,1-Trichloroethane (ug/L)	71-55-6	180	0	0	200	0	200	0	NA	0
Private Raw	VOC	1,1,2,2-Tetrachloroethane (ug/L)	79-34-5	180	0	0	2	0	NA	0	NA	0
Private Raw	VOC	1,1,2-Trichloroethane (ug/L)	79-00-5	180	0	0	5	0	3	0	NA	0
Private Raw	VOC	1,1-Dichloroethane (ug/L)	75-34-3	180	0	0	81	0	NA	0	NA	0
Private Raw	VOC	1,1-Dichloroethene (ug/L)	75-35-4	180	0	0	7	0	7	0	NA	0
Private Raw	VOC	1,1-Dichloropropene (ug/L)	563-58-6	180	0	0	NA	0	NA	0	NA	0
Private Raw	VOC	1,2,3-TCP (ug/L)	96-18-4	180	0	0	0.5	0	NA	0	NA	0
Private Raw	VOC	1,2,3-Trichlorobenzene (ug/L)	87-61-6	180	0	0	NA	0	NA	0	7	0
Private Raw	VOC	1,2,4-Trichlorobenzene (ug/L)	120-82-1	180	0	0	70	0	70	0	NA	0
Private Raw	VOC	1,2,4-Trimethylbenzene (ug/L)	95-63-6	180	0	0	330	0	NA	0	NA	0
Private Raw	VOC	1,2-Dichlorobenzene (ug/L)	95-50-1	180	0	0	600	0	600	0	NA	0
Private Raw	VOC	1,2-Dichloroethane (ug/L)	107-06-2	180	0	0	5	0	0	0	NA	0
Private Raw	VOC	1,2-Dichloropropane (ug/L)	78-87-5	180	0	0	5	0	0	0	NA	0
Private Raw	VOC	1,3,5-Trichlorobenzene (ug/L)	108-70-3	180	0	0	40	0	NA	0	NA	0
Private Raw	VOC	1,3,5-Trimethylbenzene (ug/L)	108-67-8	180	0	0	330	0	NA	0	NA	0
Private Raw	VOC	1,3-Dichlorobenzene (ug/L)	541-73-1	180	0	0	600	0	NA	0	NA	0
Private Raw	VOC	1,3-Dichloropropane (ug/L)	142-28-9	180	0	0	NA	0	NA	0	3700	0
Private Raw	VOC	1,4-Dichlorobenzene (ug/L)	106-46-7	180	0	0	75	0	75	0	NA	0
Private Raw	VOC	1,4-Dioxane (ug/L)	123-91-1	180	2	1.11	0.32	2	NA	0	NA	0
Private Raw	VOC	2,2-Dichloropropane (ug/L)	594-20-7	180	0	0	NA	0	NA	0	NA	0
Private Raw	VOC	2-Butanone (MEK) (ug/L)	78-93-3	180	0	0	4000	0	NA	0	NA	0
Private Raw	VOC	2-Chlorotoluene (ug/L)	95-49-8	180	0	0	100	0	NA	0	NA	0
Private Raw	VOC	2-Hexanone (ug/L)	591-78-6	180	0	0	NA	0	NA	0	38	0
Private Raw	VOC	4-Chlorotoluene (ug/L)	106-43-4	180	0	0	NA	0	NA	0	100	0
Private Raw	VOC	4-Methyl-2-pentanone (MIBK) (ug/L)	108-10-1	180	0	0	2000	0	NA	0	NA	0
Private Raw	VOC	Acetone (ug/L)	67-64-1	180	0	0	6000	0	NA	0	NA	0
Private Raw	VOC	Benzene (ug/L)	71-43-2	180	0	0	5	0	0	0	NA	0
Private Raw	VOC	Bromobenzene (ug/L)	108-86-1	180	0	0	60	0	NA	0	NA	0
Private Raw	VOC	Bromochloromethane (ug/L)	74-97-5	180	0	0	NA	0	NA	0	90	0
Private Raw	VOC	Bromodichloromethane (ug/L)	75-27-4	180	1	0.56	80	0	0	1	NA	0
Private Raw	VOC	Bromoform (ug/L)	75-25-2	180	25	13.89	80	0	0	25	NA	0
Private Raw	VOC	Bromomethane (ug/L)	74-83-9	180	1	0.56	10	0	NA	0	NA	0

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Private Raw	VOC	Carbon Disulfide (ug/L)	75-15-0	180	0	0	70	0	NA	0	NA	0
Private Raw	VOC	Carbon Tetrachloride (ug/L)	56-23-5	180	0	0	5	0	0	0	NA	0
Private Raw	VOC	Chlorobenzene (ug/L)	108-90-7	180	0	0	100	0	100	0	NA	0
Private Raw	VOC	Chloroethane (ug/L)	75-00-3	180	0	0	NA	0	NA	0	2100	0
Private Raw	VOC	Chloroform (ug/L)	67-66-3	180	3	1.67	80	0	70	0	NA	0
Private Raw	VOC	Chloromethane (ug/L)	74-87-3	180	0	0	30	0	NA	0	NA	0
Private Raw	VOC	cis-1,2-Dichloroethene (ug/L)	156-59-2	180	0	0	70	0	70	0	NA	0
Private Raw	VOC	cis-1,3-Dichloropropene (ug/L)	10061-01-5	180	0	0	NA	0	NA	0	NA	0
Private Raw	VOC	Dibromochloromethane (ug/L)	124-48-1	180	24	13.33	80	0	60	0	NA	0
Private Raw	VOC	Dibromomethane (ug/L)	74-95-3	180	0	0	NA	0	NA	0	8.3	0
Private Raw	VOC	Dichlorodifluoromethane (ug/L)	75-71-8	180	0	0	1000	0	NA	0	NA	0
Private Raw	VOC	Diethylether (ug/L)	60-29-7	180	0	0	1400	0	NA	0	NA	0
Private Raw	VOC	DIPE-diisopropyl ether (ug/L)	108-20-3	180	0	0	120	0	NA	0	NA	0
Private Raw	VOC	ETBE-ethyl-t-butyl ether (ug/L)	637-92-3	180	0	0	40	0	NA	0	NA	0
Private Raw	VOC	Ethylbenzene (ug/L)	100-41-4	180	0	0	700	0	700	0	NA	0
Private Raw	VOC	Hexachlorobutadiene (ug/L)	87-68-3	180	0	0	0.5	0	NA	0	NA	0
Private Raw	VOC	Isopropylbenzene (ug/L)	98-82-8	180	0	0	800	0	NA	0	NA	0
Private Raw	VOC	Methylene Chloride (ug/L)	75-09-2	180	0	0	5	0	0	0	NA	0
Private Raw	VOC	Methyl-t-butyl ether (MTBE) (ug/L)	1634-04-4	180	5	2.78	13	0	NA	0	NA	0
Private Raw	VOC	Naphthalene (ug/L)	91-20-3	180	0	0	100	0	NA	0	NA	0
Private Raw	VOC	n-Butylbenzene (ug/L)	104-51-8	180	0	0	260	0	NA	0	NA	0
Private Raw	VOC	n-Propylbenzene (ug/L)	103-65-1	180	0	0	260	0	NA	0	NA	0
Private Raw	VOC	para-nitrophenol (PNP) (ug/L)	100-02-7	180	0	0	NA	0	NA	0	50	0
Private Raw	VOC	p-Isopropyltoluene (ug/L)	99-87-6	180	0	0	260	0	NA	0	NA	0
Private Raw	VOC	sec-Butylbenzene (ug/L)	135-98-8	180	0	0	130	0	NA	0	NA	0
Private Raw	VOC	Styrene (ug/L)	100-42-5	180	0	0	100	0	100	0	NA	0
Private Raw	VOC	t-butanol (ug/L)	75-65-0	180	0	0	40	0	NA	0	NA	0
Private Raw	VOC	t-Butylbenzene (ug/L)	98-06-6	180	0	0	260	0	NA	0	NA	0
Private Raw	VOC	tert-Amyl methyl ether (TAME) (ug/L)	994-05-8	180	0	0	140	0	NA	0	NA	0
Private Raw	VOC	Tetrachloroethene (ug/L)	127-18-4	180	1	0.56	5	0	0	1	NA	0
Private Raw	VOC	Tetrahydrofuran (THF) (ug/L)	109-99-9	180	0	0	600	0	NA	0	NA	0
Private Raw	VOC	Toluene (ug/L)	108-88-3	180	1	0.56	1000	0	1000	0	NA	0
Private Raw	VOC	trans-1,2-Dichloroethene (ug/L)	156-60-5	180	0	0	100	0	100	0	NA	0
Private Raw	VOC	trans-1,3-Dichloropropene (ug/L)	10061-02-6	180	0	0	NA	0	NA	0	NA	0
Private Raw	VOC	Trichloroethene (ug/L)	79-01-6	180	0	0	5	0	0	0	NA	0
Private Raw	VOC	Trichlorofluoromethane (ug/L)	75-69-4	180	0	0	2000	0	NA	0	NA	0
Private Raw	VOC	Vinyl Chloride (ug/L)	75-01-4	180	0	0	2	0	0	0	NA	0
Private Raw	VOC	Xylenes (ug/L)	1330-20-7	180	0	0	NA	0	NA	0	NA	0
Public Finished	Bacteria	E. coli (P-A/100mL)	NA	93	0	0	0	0	NA	0	NA	0

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Public Finished	Bacteria	Total Coliform (P-A/100mL)	NA	93	1	1.1	0	1	NA	0	NA	0
Public Finished	Metal	Antimony (mg/L)	7440-36-0	93	0	0	0.006	0	0.006	0	NA	0
Public Finished	Metal	Arsenic (mg/L)	7440-38-2	94	9	9.6	0.005	4	0	9	NA	0
Public Finished	Metal	Barium (mg/L)	7440-39-3	93	67	72	2	0	2	0	NA	0
Public Finished	Metal	Beryllium (mg/L)	7440-41-7	93	0	0	0.004	0	0.004	0	NA	0
Public Finished	Metal	Cadmium (mg/L)	7440-43-9	93	0	0	0.005	0	0.005	0	NA	0
Public Finished	Metal	Cobalt (mg/L)	7440-48-4	93	0	0	NA	0	NA	0	0.07	0
Public Finished	Metal	Copper (flushed) (mg/L)	7440-50-8	94	9	9.6	1.3	0	1.3	0	NA	0
Public Finished	Metal	Copper (stagnant) (mg/L)	7440-50-8	94	55	58.5	1.3	1	1.3	1	NA	0
Public Finished	Metal	Iron (mg/L)	7439-89-6	94	12	12.8	NA	0	NA	0	NA	0
Public Finished	Metal	Lead (flushed) (mg/L)	7439-92-1	94	0	0	0.015	0	0	0	NA	0
Public Finished	Metal	Lead (stagnant) (mg/L)	7439-92-1	94	32	34	0.015	2	0	32	NA	0
Public Finished	Metal	Manganese (mg/L)	7439-96-5	94	29	30.9	0.3	1	NA	0	0.1	1
Public Finished	Metal	Selenium (mg/L)	7782-49-2	93	0	0	0.05	0	0.05	0	NA	0
Public Finished	Metal	Sodium (mg/L)	7440-23-5	94	94	100	NA	0	NA	0	20	75
Public Finished	Metal	Strontium (mg/L)	7440-24-6	92	50	54.3	NA	0	NA	0	1.5	0
Public Finished	Metal	Thallium (mg/L)	7440-28-0	93	0	0	0.002	0	0.005	0	NA	0
Public Finished	Nutrients	Nitrate (mg/L)	14797-55-8	58	43	74.1	10	0	10	0	NA	0
Public Finished	Nutrients	Nitrite (mg/L)	14797-65-0	58	6	10.3	1	0	1	0	NA	0
Public Finished	Nutrients	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N (mg/L)	NA	94	68	72.3	NA	0	NA	0	NA	0
Public Finished	Pesticides	1,2-Dibromo-3-chloropropane (DBCP) (ug/L)	96-12-8	94	0	0	0.2	0	0	0	NA	0
Public Finished	Pesticides	1,2-Dibromoethane (EDB) (ug/L)	106-93-4	94	0	0	0.05	0	0	0	NA	0
Public Finished	Physicochemical	Chloride (mg/L)	16887-00-6	94	91	96.8	NA	0	NA	0	NA	0
Public Finished	Physicochemical	Fluoride (mg/L)	16984-48-8	94	43	45.7	4	0	4	0	NA	0
Public Finished	Physicochemical	Hardness (Ca+Mg) (mg/L)	NA	94	92	97.9	NA	0	NA	0	NA	0
Public Finished	Physicochemical	pH (NONE)	NA	94	94	100	NA	0	NA	0	NA	0
Public Finished	Radiologicals	Radon (pCi/L)	14859-67-7	94	45	47.9	NA	0	NA	0	2000	4
Public Finished	Radiologicals	Uranium (ug/L)	7440-61-1	94	9	9.6	30	0	0	9	NA	0
Public Finished	VOC	1,1,1,2-Tetrachloroethane (ug/L)	630-20-6	94	0	0	70	0	NA	0	NA	0
Public Finished	VOC	1,1,1-Trichloroethane (ug/L)	71-55-6	94	0	0	200	0	200	0	NA	0
Public Finished	VOC	1,1,2,2-Tetrachloroethane (ug/L)	79-34-5	94	0	0	2	0	NA	0	NA	0
Public Finished	VOC	1,1,2-Trichloroethane (ug/L)	79-00-5	94	0	0	5	0	3	0	NA	0
Public Finished	VOC	1,1-Dichloroethane (ug/L)	75-34-3	94	0	0	81	0	NA	0	NA	0
Public Finished	VOC	1,1-Dichloroethene (ug/L)	75-35-4	94	0	0	7	0	7	0	NA	0
Public Finished	VOC	1,1-Dichloropropene (ug/L)	563-58-6	94	0	0	NA	0	NA	0	NA	0
Public Finished	VOC	1,2,3-TCP (ug/L)	96-18-4	94	0	0	0.5	0	NA	0	NA	0
Public Finished	VOC	1,2,3-Trichlorobenzene (ug/L)	87-61-6	94	0	0	NA	0	NA	0	7	0
Public Finished	VOC	1,2,4-Trichlorobenzene (ug/L)	120-82-1	94	0	0	70	0	70	0	NA	0
Public Finished	VOC	1,2,4-Trimethylbenzene (ug/L)	95-63-6	94	0	0	330	0	NA	0	NA	0

Water Source and Sample Type	Analyte Type	Analyte and Units	Chemical Abstracts Service (CAS) Registry Number	Number of Samples Tested	Number of Samples with a Detectable Level (above the LOD)	Frequency of Detection (%)	Health Limit	Number of Samples above the Health Limit	Health Goal	Number of Samples above the Health Goal	Screening Level	Number of Samples above the Screening Level
Public Finished	VOC	1,2-Dichlorobenzene (ug/L)	95-50-1	94	0	0	600	0	600	0	NA	0
Public Finished	VOC	1,2-Dichloroethane (ug/L)	107-06-2	94	0	0	5	0	0	0	NA	0
Public Finished	VOC	1,2-Dichloropropane (ug/L)	78-87-5	94	0	0	5	0	0	0	NA	0
Public Finished	VOC	1,3,5-Trichlorobenzene (ug/L)	108-70-3	94	0	0	40	0	NA	0	NA	0
Public Finished	VOC	1,3,5-Trimethylbenzene (ug/L)	108-67-8	94	0	0	330	0	NA	0	NA	0
Public Finished	VOC	1,3-Dichlorobenzene (ug/L)	541-73-1	94	0	0	600	0	NA	0	NA	0
Public Finished	VOC	1,3-Dichloropropane (ug/L)	142-28-9	94	0	0	NA	0	NA	0	3700	0
Public Finished	VOC	1,4-Dichlorobenzene (ug/L)	106-46-7	94	0	0	75	0	75	0	NA	0
Public Finished	VOC	2,2-Dichloropropane (ug/L)	594-20-7	94	0	0	NA	0	NA	0	NA	0
Public Finished	VOC	2-Butanone (MEK) (ug/L)	78-93-3	94	0	0	4000	0	NA	0	NA	0
Public Finished	VOC	2-Chlorotoluene (ug/L)	95-49-8	94	0	0	100	0	NA	0	NA	0
Public Finished	VOC	2-Hexanone (ug/L)	591-78-6	94	0	0	NA	0	NA	0	38	0
Public Finished	VOC	4-Chlorotoluene (ug/L)	106-43-4	94	0	0	NA	0	NA	0	100	0
Public Finished	VOC	4-Methyl-2-pentanone (MIBK) (ug/L)	108-10-1	94	0	0	2000	0	NA	0	NA	0
Public Finished	VOC	Acetone (ug/L)	67-64-1	94	2	2.1	6000	0	NA	0	NA	0
Public Finished	VOC	Benzene (ug/L)	71-43-2	94	0	0	5	0	0	0	NA	0
Public Finished	VOC	Bromobenzene (ug/L)	108-86-1	94	0	0	60	0	NA	0	NA	0
Public Finished	VOC	Bromochloromethane (ug/L)	74-97-5	94	0	0	NA	0	NA	0	90	0
Public Finished	VOC	Bromodichloromethane (ug/L)	75-27-4	94	80	85.1	80	0	0	80	NA	0
Public Finished	VOC	Bromoform (ug/L)	75-25-2	94	23	24.5	80	0	0	23	NA	0
Public Finished	VOC	Bromomethane (ug/L)	74-83-9	94	0	0	10	0	NA	0	NA	0
Public Finished	VOC	Carbon Disulfide (ug/L)	75-15-0	94	0	0	70	0	NA	0	NA	0
Public Finished	VOC	Carbon Tetrachloride (ug/L)	56-23-5	94	0	0	5	0	0	0	NA	0
Public Finished	VOC	Chlorobenzene (ug/L)	108-90-7	94	0	0	100	0	100	0	NA	0
Public Finished	VOC	Chloroethane (ug/L)	75-00-3	94	0	0	NA	0	NA	0	2100	0
Public Finished	VOC	Chloroform (ug/L)	67-66-3	94	79	84	80	0	70	4	NA	0
Public Finished	VOC	Chloromethane (ug/L)	74-87-3	94	0	0	30	0	NA	0	NA	0
Public Finished	VOC	cis-1,2-Dichloroethene (ug/L)	156-59-2	94	0	0	70	0	70	0	NA	0
Public Finished	VOC	cis-1,3-Dichloropropene (ug/L)	10061-01-5	94	0	0	NA	0	NA	0	NA	0
Public Finished	VOC	Dibromochloromethane (ug/L)	124-48-1	94	68	72.3	80	0	60	0	NA	0
Public Finished	VOC	Dibromomethane (ug/L)	74-95-3	94	0	0	NA	0	NA	0	8.3	0
Public Finished	VOC	Dichlorodifluoromethane (ug/L)	75-71-8	94	0	0	1000	0	NA	0	NA	0
Public Finished	VOC	Diethylether (ug/L)	60-29-7	94	0	0	1400	0	NA	0	NA	0
Public Finished	VOC	DIPE-diisopropyl ether (ug/L)	108-20-3	94	0	0	120	0	NA	0	NA	0
Public Finished	VOC	ETBE-ethyl-t-butyl ether (ug/L)	637-92-3	94	0	0	40	0	NA	0	NA	0
Public Finished	VOC	Ethylbenzene (ug/L)	100-41-4	94	0	0	700	0	700	0	NA	0
Public Finished	VOC	Hexachlorobutadiene (ug/L)	87-68-3	94	0	0	0.5	0	NA	0	NA	0
Public Finished	VOC	Isopropylbenzene (ug/L)	98-82-8	94	0	0	800	0	NA	0	NA	0
Public Finished	VOC	m/p-Xylene (ug/L)	NA	94	0	0	10000	0	10000	0	NA	0

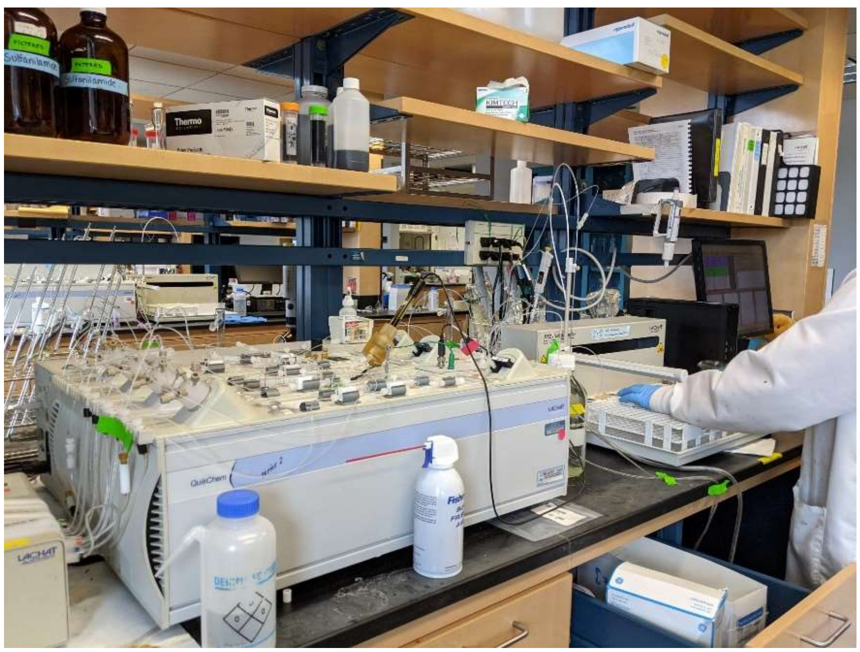
Water Source and Sample Type	Analyte Type	Analyte and Units	Chemical Abstracts Service (CAS) Registry Number	Number of Samples Tested	Number of Samples with a Detectable Level (above the LOD)	Frequency of Detection (%)	Health Limit	Number of Samples above the Health Limit	Health Goal	Number of Samples above the Health Goal	Screening Level	Number of Samples above the Screening Level
Public Finished	VOC	Methylene Chloride (ug/L)	75-09-2	94	0	0	5	0	0	0	NA	0
Public Finished	VOC	Methyl-t-butyl ether (MTBE) (ug/L)	1634-04-4	94	2	2.1	13	0	NA	0	NA	0
Public Finished	VOC	Naphthalene (ug/L)	91-20-3	94	0	0	100	0	NA	0	NA	0
Public Finished	VOC	n-Butylbenzene (ug/L)	104-51-8	94	0	0	260	0	NA	0	NA	0
Public Finished	VOC	n-Propylbenzene (ug/L)	103-65-1	94	0	0	260	0	NA	0	NA	0
Public Finished	VOC	o-Xylene (ug/L)	95-47-6	94	0	0	10000	0	10000	0	NA	0
Public Finished	VOC	p-Isopropyltoluene (ug/L)	99-87-6	94	0	0	260	0	NA	0	NA	0
Public Finished	VOC	sec-Butylbenzene (ug/L)	135-98-8	94	0	0	130	0	NA	0	NA	0
Public Finished	VOC	Styrene (ug/L)	100-42-5	94	0	0	100	0	100	0	NA	0
Public Finished	VOC	t-butanol (ug/L)	75-65-0	94	0	0	40	0	NA	0	NA	0
Public Finished	VOC	t-Butylbenzene (ug/L)	98-06-6	94	0	0	260	0	NA	0	NA	0
Public Finished	VOC	tert-Amyl methyl ether (TAME) (ug/L)	994-05-8	94	0	0	140	0	NA	0	NA	0
Public Finished	VOC	Tetrachloroethene (ug/L)	127-18-4	94	1	1.1	5	0	0	1	NA	0
Public Finished	VOC	Tetrahydrofuran (THF) (ug/L)	109-99-9	94	0	0	600	0	NA	0	NA	0
Public Finished	VOC	Toluene (ug/L)	108-88-3	94	0	0	1000	0	1000	0	NA	0
Public Finished	VOC	trans-1,2-Dichloroethene (ug/L)	156-60-5	94	0	0	100	0	100	0	NA	0
Public Finished	VOC	trans-1,3-Dichloropropene (ug/L)	10061-02-6	94	0	0	NA	0	NA	0	NA	0
Public Finished	VOC	Trichloroethene (ug/L)	79-01-6	94	0	0	5	0	0	0	NA	0
Public Finished	VOC	Trichlorofluoromethane (ug/L)	75-69-4	94	0	0	2000	0	NA	0	NA	0
Public Finished	VOC	Vinyl Chloride (ug/L)	75-01-4	94	0	0	2	0	0	0	NA	0
Public Finished	VOC	Xylenes (ug/L)	1330-20-7	94	0	0	NA	0	NA	0	NA	0

Notes
NA: No health limit, health goal, or screening level available.
PFAS: per- and polyfluorinated alkyl substances
Private finished: water collected from a private well at the kitchen faucet or similar, post-water-treatment system (if present).
Private raw: water collected from a private well prior to any water treatment system.
Public finished: water collected from a public water system at the kitchen faucet or similar, post-water-treatmetn system (if present).
VOC: volatile organic compounds
Four Private Finished samples may have been improperly collected. These were omitted from data analysis.

Appendix D
Evaluation of Biomonitoring Results by Home Water Consumption

The TrACE Study also examined the levels of certain chemicals in participants based on how much home water they drank and their water quality. Lead, PFOS, PFOA, and uranium were evaluated because private well users had significantly different biomonitoring results from public drinking water users for these chemicals. Inorganic arsenic was also evaluated because it is a common contaminant in NH groundwater.

The following bar charts group the amount of home tap water consumed by less than four cups per day and four or more cups per day. They also group water concentration for each chemical by not detected (light blue), less than the health limit (MCL or NHDES adopted health limit) (medium blue), or greater than or equal to the health limit (dark blue). Water at or above the health limit should be treated to assure good water quality. The blood, serum, or urine levels depicted in these charts are the average for the particular water concentration and water consumption group evaluated. The water results are combined for both TrACE public water systems and TrACE private wells except for PFOS and PFOA which are only private well water results. PFAS were not tested for in public water samples due to budget restrictions and because that information is available from the water distributor.



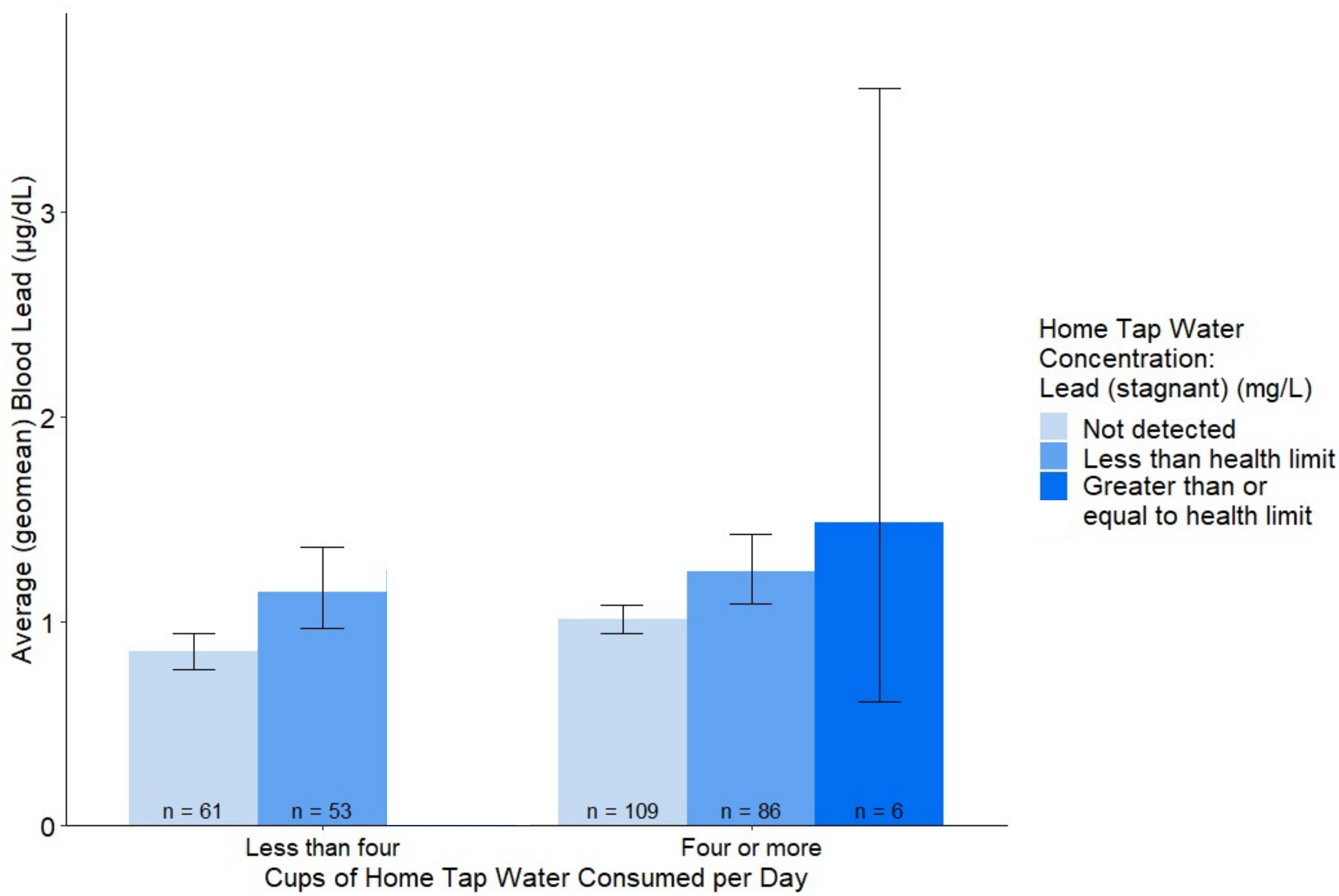
Jillian Fellbaum, NH PHL Laboratory Scientist, prepares to test water samples for chloride, nitrate, and nitrite.

Lead

Stagnant water is water that has been sitting in household plumbing undisturbed for a long period of time, such as overnight or when away from the home for the workday. Water that is corrosive (see Key Terms) and sitting stagnant in the plumbing may allow metals like lead and copper to exit the plumbing and faucets and enter the water. Water that is used after sitting stagnant may have these metals. This is why a stagnant water sample should be collected and tested for lead and copper. **The TrACE Study found a trend of more lead in participant blood when there was more lead in home stagnant water and when more home water was consumed per day (Figure 12).** There was significantly different and more lead in the blood of people who drank water from homes with a stagnant lead result less than the health limit (medium blue) compared to people who drank water without lead (light blue) regardless of how much home water they drank each day. **This means home drinking water may be contributing to the higher levels of lead in their bodies and those residents may need to consider treating their water.** There was not a significant difference between the people who consumed water with a stagnant lead result less than the health limit (medium blue) compared to those who consumed water with a stagnant lead result at or above the health limit (dark blue). Only a small amount of people had household water at or above the health limit (with one group too small to reliably share results), so this may explain the lack of significance.

Key Finding - Lead
Participants drinking home water with a stagnant lead result less than the health limit had more lead in their blood than people drinking water without lead.

Figure 12. TrACE Study blood lead average level grouped by cups of home water consumed per day and water concentration of stagnant lead.

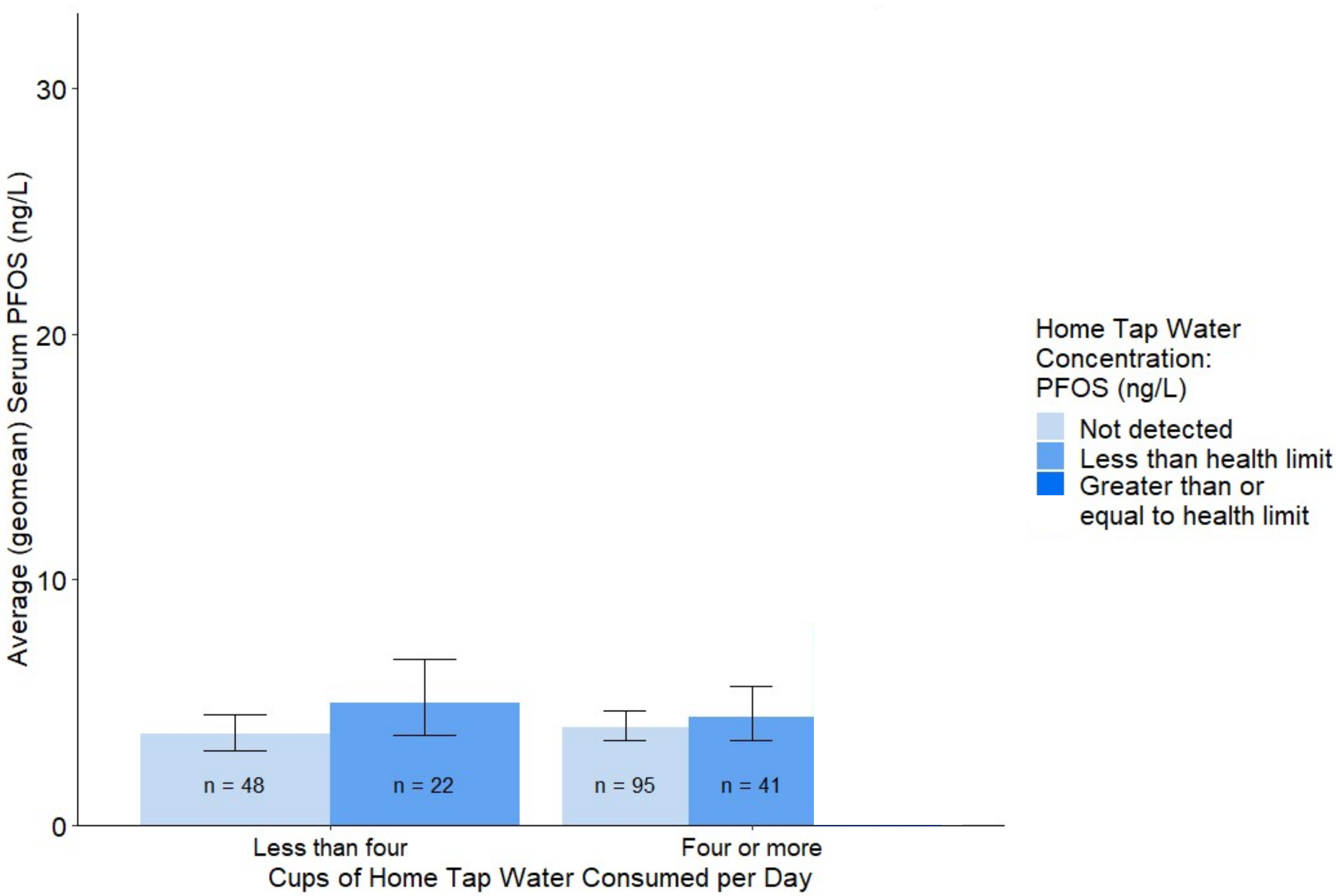


PFOS

Although the average amount of PFOS in participant serum increased when the water concentration of PFOS increased these results were not significant (Figure 13). There were not enough participants drinking four or more cups of home water per day with a water concentration of PFOS greater than or equal to the health limit to share those results in the following figure. There were no participants who drank less than four cups per day with a water concentration greater than or equal to the health limit. It is important to remember that people are exposed to PFOS in many ways and that water is only one potential source of exposure. Public water was not tested for PFOS (see page 29) and so TrACE participants using public water are not included in this particular analysis.

Key Finding - PFOS
No significant results, however there was a trend of more PFOS in the body when there was more PFOS in home water and when more home water was consumed per day.

Figure 13. TrACE Study serum PFOS average level grouped by cups of home water consumed per day and water concentration of PFOS. There were no TrACE participants who consumed less than four cups of home tap water per day with a PFOS water concentration greater than or equal to the health limit (dark blue category for "Less than four").

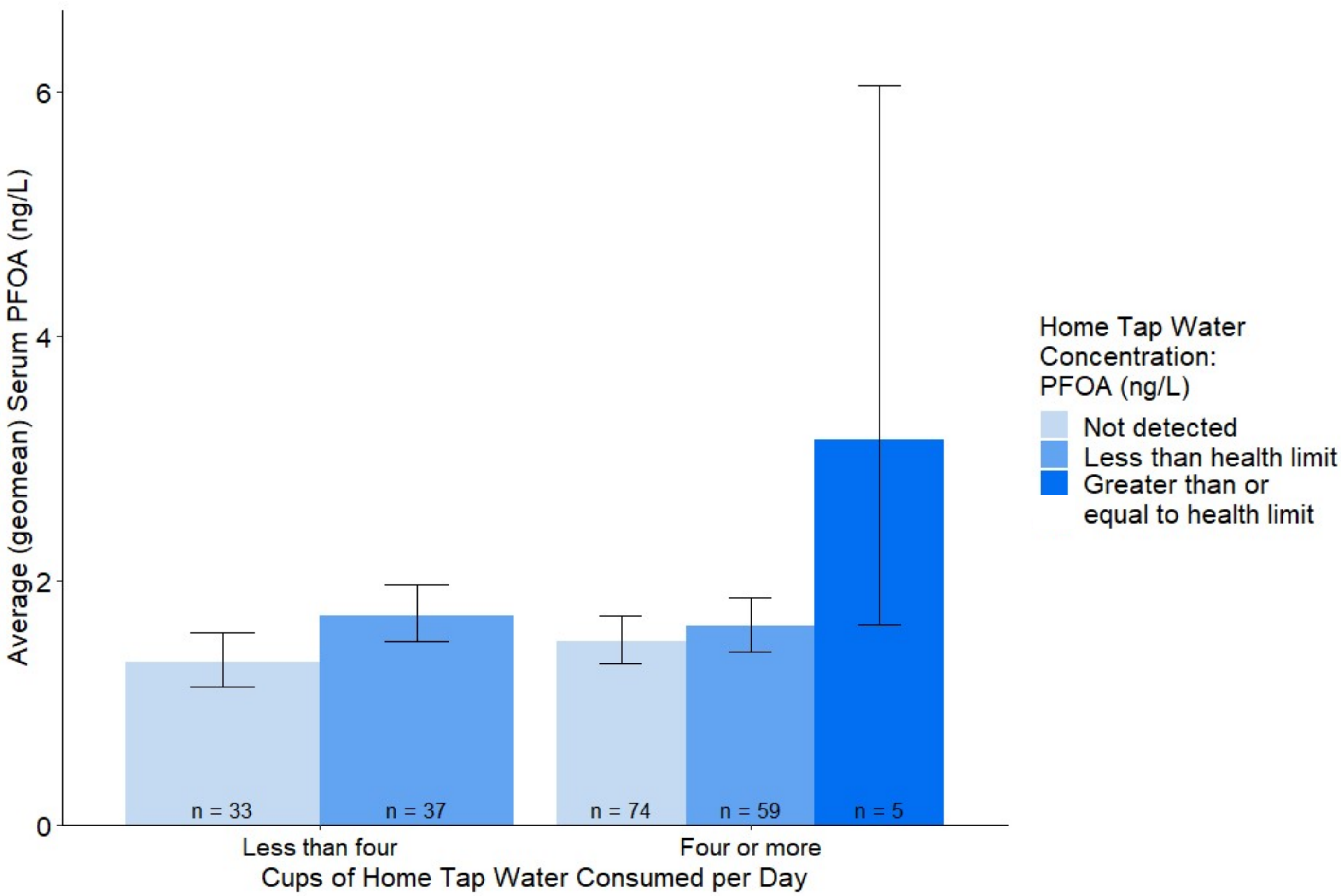


PFOA

The TrACE Study found a trend of more PFOA in participant serum when there was more PFOA in home water (Figure 14). These results were not significant. It is important to remember that people are exposed to PFOA in many ways and that water is only one potential source of exposure. Public water was not tested for PFOA (see page 29) and so TrACE participants using public water are not included in this particular analysis.

Key Finding - PFOA
No significant results, however there was a trend of more PFOA in the body when there was more PFOA in home water.

Figure 14. TrACE Study serum PFOA average level grouped by cups of home water consumed per day and water concentration of PFOA. There were no TrACE participants who consumed less than four cups of home tap water per day with a PFOA water concentration greater than or equal to the health limit (dark blue category for "Less than four").



Inorganic Arsenic

There are many ways a person may be exposed to inorganic arsenic. Some of them are drinking or cooking with contaminated water, eating rice grown in contaminated water or the foods made from this rice, drinking contaminated fruit juice, and smoking tobacco. These various exposures were not taken into account (controlled for) when analyzing the study data. **The following information must be considered with the potential for the influence (confounding) of these other exposures.**

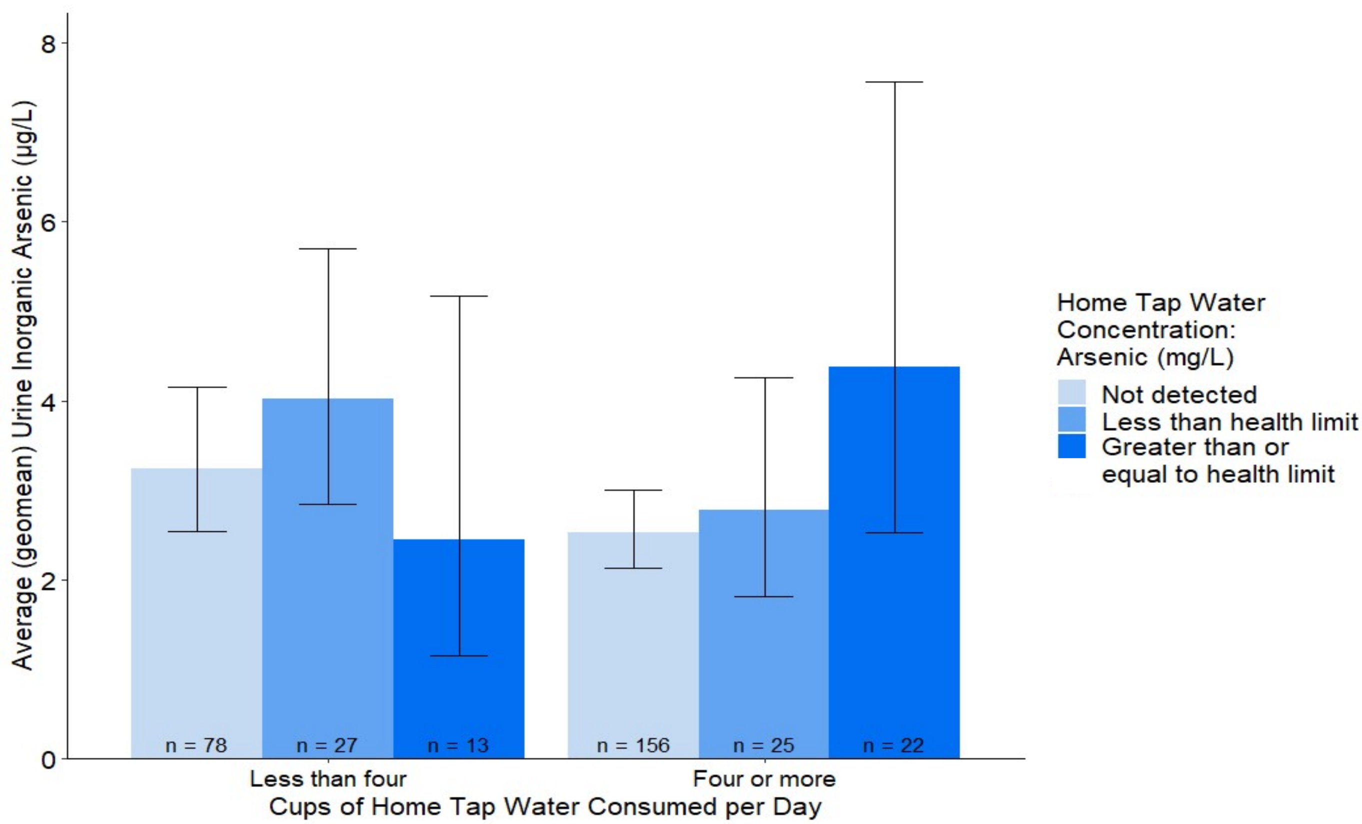
For those who drank four or more cups of home water per day, there was a trend of more inorganic arsenic in participant urine as the amount of arsenic in home water increased (Figure 15). These results were not significant, however the relationship between arsenic in water and inorganic arsenic in the body is well known. Anyone with arsenic in their home water should consider treating their water. This is because the US EPA has set a health goal of zero arsenic in drinking water.

For those who drank less than four cups of home water per day, participants with high levels of arsenic in their water (dark blue) had a lower average amount of inorganic arsenic in their urine than those with less or no arsenic in their home water (medium and light blue). This was not a significant result, however exposure to inorganic arsenic from food or other sources may explain these findings.

Key Finding - Inorganic Arsenic

No significant results, however there was a trend of more inorganic arsenic in the body when there was more arsenic in home water and when four or more cups of home water were consumed per day.

Figure 15. TrACE Study urine inorganic arsenic average level grouped by cups of home water consumed per day and water concentration of arsenic.



Uranium

Participants drinking four or more cups of home water per day with a uranium result less than the health limit had significantly different and more uranium in their urine than people drinking water without uranium (Figure 16). This means home drinking water may be contributing to the higher levels of uranium in their bodies. There were not enough participants drinking home water with a concentration of uranium greater than or equal to the health limit to share those results in the following figure. Anyone with uranium in their home water should consider treating their water. This is because the US EPA has set a health goal of zero uranium in drinking water.

Key Finding - Uranium

For participants drinking at least four cups of home water per day, those with a uranium result less than the health limit had more uranium in their urine than those drinking water without uranium.

Figure 16. TrACE Study urine uranium average level grouped by cups of home water consumed per day and water concentration of uranium.