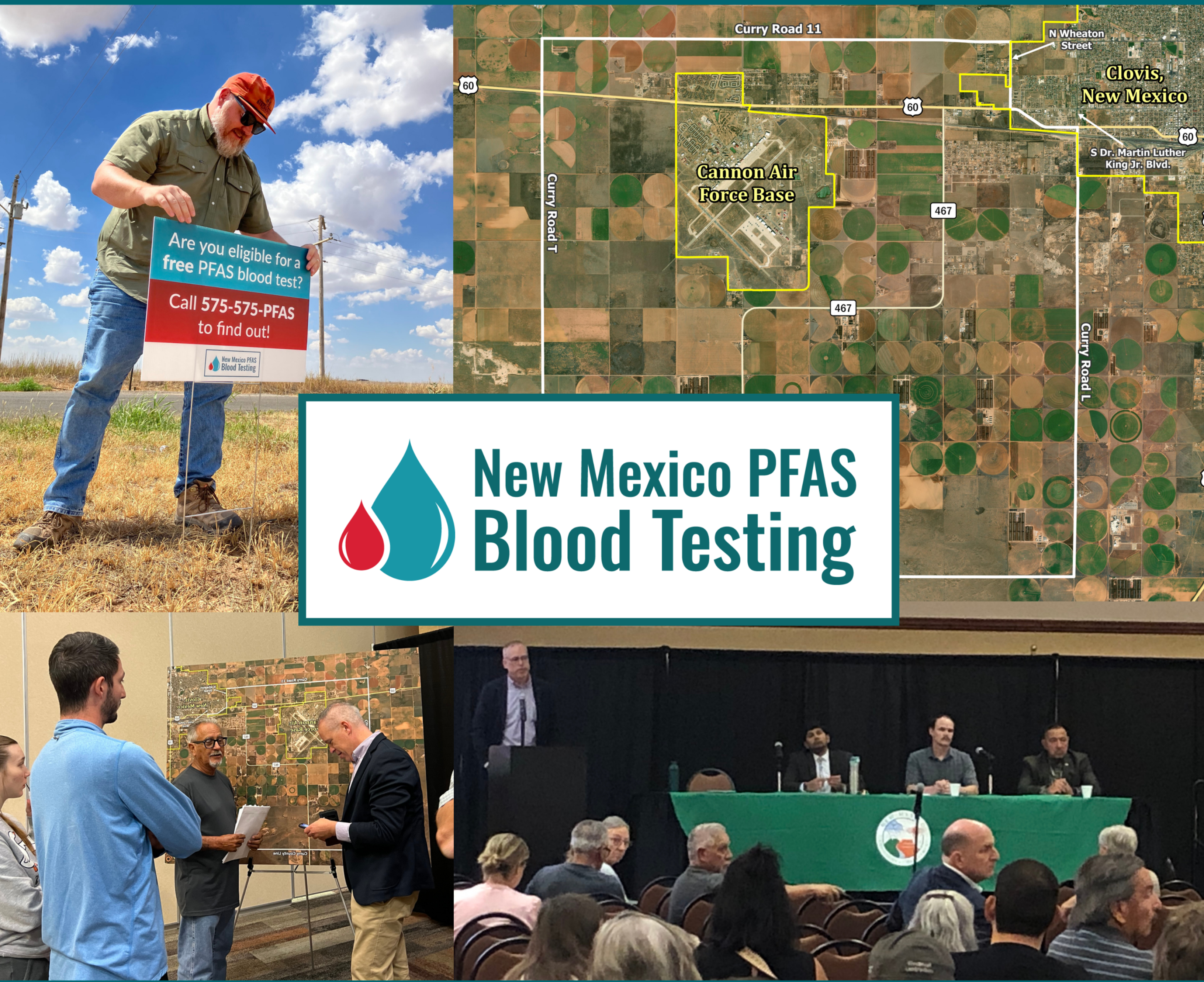
New Mexico PFAS Blood Testing Project Final Report

August 12, 2025



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ABBREVIATIONS

AFB	Air Force Base
ATSDR	Agency for Toxic Substances and Disease Registry
CDC	Centers for Disease Control and Prevention
EPA	U.S. Environmental Protection Agency
NASEM	National Academies of Sciences, Engineering, and Medicine
NHANES	National Health and Nutrition Examination Survey
NMDOH	New Mexico Department of Health
NMDVS	New Mexico Department of Veterans' Services
NMED	New Mexico Environment Department
NM-PBT	New Mexico PFAS Blood Testing Project
PFAS	per- and polyfluoroalkyl substances
SGS AXYS	SGS AXYS Analytical Services Ltd.
µg/L	micrograms per liter
ppt	part per trillion
MCL	Maximum Contaminant Level
USGS	United States Geological Survey

Refer to Table 1 for a list of abbreviations for specific PFAS.

New Mexico PFAS Blood Testing Project

August 2025

NM-PBT

Project Factsheet

1,085 incoming hotline calls

724 scheduled appointments

638 blood samples collected

628 blood samples analyzed

33 different PFAS chemicals

99.7% of participants had PFAS in their blood

3X More PFAS for participants who live/work on plume

14 participants in the highest national tier for PFAS in blood

$1.2M project cost

The New Mexico Department of Health (NMDOH) and the New Mexico Environment Department (NMED) launched the New Mexico PFAS Blood Testing Project (NM-PBT) to measure PFAS blood levels of people who lived or worked near Cannon Air Force Base in Curry County.

The results show that almost all participants had one or more PFAS in their blood. The most common PFAS chemicals found in the participants' blood is associated with firefighting foams.

Participants living or working above the PFAS plume extending off-base show a statistically significant higher blood level than other participants who do not live or work above the PFAS plume.

Reducing PFAS Exposure

Test Your Well Water: If you use well water, test it for PFAS.

Treat Your Well Water: If you use well water, consider a home water treatment system to reduce PFAS. Contact NMED for technical/financial information: strategic.initiatives@state.nm.us

Replace Your Filters Regularly: If you have a water filter, replace it regularly to maintain its effectiveness in reducing PFAS.

Use Public Water When Possible: If possible, use water from a public system to avoid potential PFAS exposure from well water.

Learn More: Guidance on PFAS Exposure, Testing, and Clinical Follow-Up and PFAS Information for Clinicians.

Project Factsheet

The most detected PFAS chemicals in blood samples were:

- **PFOS: 99.7% of blood samples.** Heavily used in firefighting foam often in military and airport settings.
- **PFOA: 99.5% of blood samples.** Found in firefighting foam, nonstick cookware, waterproof clothing, and food packaging.
- **PFHxS: 98.2% of blood samples**. Found in firefighting foam as a replacement to PFOS and water-repellent coatings.
- **PFNA: 90.4% of blood samples.** Occasionally used in firefighting foam and other industrial applications.

What are PFAS?

PFAS are a group of manmade chemicals found in firefighting foams like those used at Cannon Air Force Base for decades. PFAS are used in other industrial processes and consumer goods.

PFAS are linked to a range of health issues, including increased cancer risk, immune system suppression, elevated cholesterol, and more. PFAS accumulate in our bodies and do not break down and are not excreted. Cannon Air Force Base has released PFAS into the soil and groundwater on- and off-base for decades.

People who **lived or worked in the plume area** had PFHxS levels **more than 3x higher than the U.S. average,** likely from drinking PFAS-contaminated water.

26% of plume area participants had PFAS levels in the **highest concentration tier** used in National Academies of Sciences, Engineering, and Medicine's guidelines, which was over 10x the rate of the broader testing group.

Next Steps and Future Action

Public Health Actions. NMDOH will:

- ✓ Follow up with participants who have the highest PFAS levels, offering health screenings and addressing ongoing exposures.
- ✓ Educate healthcare providers on PFAS health effects and share new public resources.

Environmental Remediation Actions. NMED will:

- ✓ Continue evaluating groundwater PFAS mitigation and remediation opportunities.
- ✓ Expand PFAS exposure assessments to other communities, like Holloman Air Force Base.
- ✓ Strengthen and enforce regulations to protect against future contamination.

ACKNOWLEDGEMENTS

The New Mexico Environment Department (NMED) extends its sincere appreciation to the many individuals and organizations whose collaboration made the PFAS Blood Testing Project possible. This effort reflects our shared commitment to protecting public health and the environment in communities adversely impacted by the U.S. Department of Defense and the U.S. Air Force in New Mexico.

We thank the **New Mexico Department of Veterans Services** for providing valuable guidance and recommendations during the early planning stages. Their support helped shape a project focused on addressing the health concerns of those who have served our country and advised on strategies to encourage veterans to participate in the project.

We are deeply grateful to the **New Mexico Department of Health (NMDOH)** for their essential partnership throughout this project. As the public health authority, NMDOH safeguarded participants' personal health data, provided training to the project contractor, and ensured that the project design aligned with public health surveillance standards. Their involvement in public meetings and panel discussions, along with their ongoing support through the public health hotline, helped strengthen community trust and engagement.

We also thank **Curry County Manager Lance Pyle**, the **Curry County Commission**, and the **Curry County Health Council** for their strong community partnership and logistical support.

We acknowledge the **City of Clovis** for generously providing the **Youth Recreation Building**, which served as a welcoming and accessible space for participants, and thank the **Curry County Fairgrounds** for additional site accommodations.

We appreciate the support of **State Representative Martin Zamora, State Senator Pat Woods, the New Mexico Congressional Delegation and their staff,** and the **Office of the Governor of New Mexico** for championing this effort at the state level. Special thanks go to **John Wilhelmi** of **Eastern Research Group** for his technical expertise and dedicated assistance from planning through implementation.

Finally, we extend our deepest gratitude to the **participants, residents, and stakeholders** who contributed their time and trust to this project. Your involvement is vital to advancing environmental health and ensuring a safer, healthier future for New Mexico communities.

1.0 EXECUTIVE SUMMARY

In 2024, the New Mexico Department of Health (NMDOH) and the New Mexico Environment Department (NMED) designed and launched the New Mexico PFAS Blood Testing (NM-PBT) project. This public health surveillance project focused on per- and polyfluoroalkyl substances (PFAS), which are a group of synthetic chemicals that are highly persistent in the environment, resistant to breakdown, and toxic. The NM-PBT project was the first ever PFAS blood testing initiative of this scale conducted in New Mexico. This project was funded entirely by the NMED Hazardous Waste Bureau at the cost of $1,214,284. The U.S. Department of Defense and the U.S. Air Force did not provide any financial or technical support related to this project.

The state agencies designed the NM-PBT project to measure PFAS concentrations in the serum fraction of blood among adult New Mexico residents who have ever lived or worked in an area near a PFAS contamination site. The measured PFAS concentrations in serum would also be compared to nationwide averages, and statistical analyses would explore how serum PFAS concentrations relate to indicators of exposure history. The agencies decided to conduct the NM-PBT project in an area of Curry County around Cannon Air Force Base (AFB) primarily due to evidence of high levels of PFAS contamination in groundwater and some drinking water sources.

Recruitment efforts relied on community engagement and outreach strategies to encourage eligible individuals to enroll in the blood testing project primarily via a hotline. This recruitment strategy resulted in a convenience sample of eligible residents and workers from the project focus area; no attempt was made to recruit a statistically representative sample of the eligible population. Blood test appointments were scheduled during three week-long sampling events held at the Youth Recreation Building in Clovis, New Mexico. The events took place in September 2024, October 2024, and November 2024. During appointments, participants completed an exposure history questionnaire and provided a blood sample. A commercial laboratory analyzed the serum fraction of the blood samples for 33 PFAS. All participants received letters with their test results, including information on what their individual results mean and where participants can get more information on PFAS and its potential health effects.

This report summarizes the serum PFAS concentrations measured during the NM-PBT project. Participants' privacy and protected health information were safeguarded throughout the project to the extent required by law, and no protected health information has been released or appears in this report. NMDOH is the long-term custodian of all records and data generated during the project and will continue to protect participants' privacy.

Key project findings include:

1. Across the three week-long blood collection events, 724 PFAS blood test appointments were scheduled, and 638 of these appointments were kept. Otherwise stated, 88.1% of the scheduled appointments were kept. See Section 5.0.

2. Subsequent data analysis confirmed that 628 of the 638 kept appointments were for individuals who met the project's eligibility criteria. Ten individuals who kept their appointments were later found to have not met the project's eligibility criteria. These ten individuals' data are not evaluated in this report. See Section 5.0.

3. Every serum sample collected during the project was tested for 33 different PFAS. The number of PFAS detected in serum varied across the participants. Across all 628 blood samples from eligible participants, 16 PFAS were detected in at least one sample. The analytes detected most frequently were PFOS (detected in 99.7% of samples), PFOA (99.5%), PFHxS (98.2%), and PFNA

(90.4%). See Table 1 for the full chemical names for these PFAS. The data analyses in this report focus largely on these four PFAS. See Section 5.2.

4. 626 out of the 628 eligible participants—or 99.7% of participants—had at least one PFAS analyte detected in their serum samples. Only two participants of the 628 eligible participants—or 0.3% of participants—had no PFAS detected in their serum. This frequency of detection is generally consistent with what has been observed in nationwide PFAS blood testing efforts (ATSDR, 2022b; Calafat et al., 2007). See Section 5.2.

5. Measured concentrations for the sum of seven PFAS (ΣPFAS7) were compared to the National Academies of Sciences, Engineering, and Medicine's (NASEM's) medical screening guidelines for PFAS. Among the project's 628 eligible participants, 2.2% (n=14) had serum ΣPFAS7 concentrations greater than or equal to 20 µg/L—the highest concentration tier used in NASEM's guidelines. For comparison, an estimated 9% of the adult nationwide population has serum ΣPFAS7 concentrations above this level. See Section 5.3.

6. The age-adjusted geometric mean concentrations of PFOS, PFOA, PFNA, and PFHxS for the 628 NM-PBT project participants were all lower than the corresponding national averages, based on blood samples collected by the Centers for Disease Control and Prevention (CDC) in 2017 and 2018. These were all statistically significant findings, but there are two limitations. One limitation of this comparison is the different time frames when samples were collected. All NM-PBT project blood samples were collected in 2024, and the nationwide comparison data, although the most recent results published in an NHANES data release, were collected six to seven years prior. This is a limitation because serum PFAS concentrations in the general U.S. population are known to have been declining for years, but more recent statistically representative nationwide data are currently not available. Another limitation is that NHANES data are representative of the nationwide civilian, non-institutionalized population. These data are not necessarily representative of military populations. A nationally representative PFAS blood testing data set is currently not available to comment on whether PFAS levels among military households near Clovis, New Mexico are higher or lower than those found in military households nationwide. See Section 5.4 for further details on this topic, including additional comparisons of the NM-PBT blood testing results to those published in more recent studies that are not at a national scale.

7. Geometric mean serum PFAS concentrations were also calculated for the subset of NM-PBT project participants who have ever lived or worked in the "plume area" near Cannon AFB. NMED developed the plume area boundaries based on results from previous groundwater monitoring and private well sampling. For this subset of participants, the geometric mean serum concentrations for PFOS and PFHxS were considerably higher than the corresponding geometric mean concentrations for all other NM-PBT project participants. Further, for PFHxS, the geometric mean serum concentration for participants who lived or worked in the plume area was higher than the 2017-2018 nationwide average. The findings in this paragraph were all statistically significant. A logical inference is that exposure to PFAS-contaminated drinking water was the likely source of the elevated concentrations, but other pathways (e.g. inhalation) might have also contributed. See Section 5.6.

8. Regression models were used to identify participant characteristics and exposure factors that were correlated with serum PFAS concentrations. The models found that participant age, sex, and frequency of blood donation were the only variables correlated with serum concentrations for all five PFAS considered in this analysis (PFHxS, PFNA, PFOA, PFOS, ΣPFAS7). The analyses indicated that serum concentrations of these PFAS increased with participants' age, were higher

in male participants than in female participants, and were lower in participants who donated blood at least once per year than in those who donated blood less frequently. Other blood testing initiatives (e.g., ATSDR, 2022b) identified these same relationships between these variables and serum PFAS concentrations. See Section 5.5.

Section 7.0 of this report describes how NMDOH and NMED plan to use the NM-PBT project findings to support decision-making and to prioritize public health actions related to PFAS environmental contamination. The New Mexico agencies plan to host a public meeting in Curry County to present the blood test results to the local community.

2.0 INTRODUCTION

The New Mexico PFAS Blood Testing (NM-PBT) project was a public health surveillance effort conducted to determine the levels of per- and polyfluoroalkyl substances (PFAS) in the blood of people who live and/or work near Cannon Air Force Base (AFB) in Curry County, New Mexico. The project measured PFAS concentrations in blood samples from 638 individuals, and this report summarizes the results. This report summarizes the NM-PBT results and is organized as follows:

- Section 3.0, "Background and Purpose," includes background information on PFAS, describes PFAS contamination issues near Cannon AFB, and presents the NM-PBT project objectives.
- Section 4.0, "Methods," details various aspects of the NM-PBT project design, including participation eligibility criteria, recruitment strategies, and how data were collected and analyzed.
- Section 5.0, "Results and Discussion," summarizes all data collected during the project. It presents a profile of the participants, reviews the PFAS blood test results, and reports on associations between PFAS blood levels and indicators of PFAS exposure.
- Section 6.0, "Limitations," lists limitations associated with interpreting PFAS blood testing results.
- Section 7.0, "Future Directions and Use of Results," describes how New Mexico agencies might use the project results to improve public health and protect the environment.
- Section 8.0, "References," lists the references for all citations included in the report.

All figures and tables identified appear in the report text. Appendices to this report include copies of selected project resources and detailed tables and figures for the data analyses presented in Section 5.0.

3.0 BACKGROUND AND PURPOSE

In October 2018, Cannon AFB notified the NMED that PFAS had been detected in groundwater. While this is when the detection and notification occurred, the military's use of PFAS-containing firefighting foams dates back to the 1970s, suggesting that the release of these chemicals into the environment likely began much earlier. Exposure to PFAS is of concern due to these contaminants' widespread occurrence, their persistence, and their toxicity.

In an effort to better understand human exposure to PFAS in New Mexico, NMDOH and NMED launched a public health surveillance project to measure PFAS blood levels among adult New Mexico residents who have ever lived or worked in an area near Cannon AFB. As the PFAS blood testing project was public health surveillance rather than research, a human subjects review was not required. The agencies intend to use this project's findings to inform future public health actions and environmental initiatives. This section presents background information that factored into the agencies' decision to conduct the PFAS blood testing and identifies the NM-PBT project objectives.

3.1 What are PFAS?

PFAS are a group of thousands of synthetic chemicals commonly found in various consumer products and in many industrial formulations and processes. For example, PFAS have been used in paper and carboard packaging; as a component of water- and stain-resistant coatings applied to carpet, upholstery, and clothing; and in aqueous film-forming foam (AFFF) used in firefighting and various military practices (ATSDR, 2021). PFAS are extremely resistant to most natural degradation processes, making them highly persistent in the environment and in our bodies. Scientists have documented the presence of PFAS in ambient air, soil, water resources, aquatic and terrestrial biota, and other environmental media at locations throughout the country (ITRC, 2023).

People in the United States (U.S.) and elsewhere can be exposed to PFAS through the air they breathe, the water they drink, the food they eat, and other pathways. Once PFAS are in the human body, they are often found in the blood, kidneys, and liver (ATSDR, 2021; 2024). Because of their persistence, some PFAS can be identified in human blood several years after they entered someone's body. The U.S. Environmental Protection Agency (EPA) recently reported that it can take weeks to years for levels of many PFAS to decrease by half in human blood, assuming exposure is not ongoing (EPA, 2023); and for some PFAS, estimates of half-life in human blood are longer than a decade (ATSDR, 2021).

Multiple parties have documented the presence of PFAS in the serum fraction of human blood, and epidemiological studies generally use serum levels as the primary biomarker of PFAS exposure (ATSDR, 2021). Since 1999, the Centers for Disease Control and Prevention (CDC) has measured PFAS in serum as part of the agency's National Health and Nutrition Examination Survey (NHANES)—a statistically representative survey of health and nutritional status of U.S. residents that includes analysis of blood samples from participants. In the 1999-2000 survey cycle, NHANES detected at least one PFAS in the serum fraction of blood in more than 99% of the samples collected (Calafat et al., 2007). Similar findings have been reported in other NHANES survey cycles.

Additionally, the Agency for Toxic Substances and Disease Registry (ATSDR) conducted PFAS exposure assessments across ten U.S. sites near current and former military bases, where local drinking water suppliers were known to be contaminated with PFAS. Blood samples were collected from 2,384 individuals and the results indicated that the average age-adjusted levels for three PFAS compounds (PFOA; PFOS; PFHxS) tended to be higher in these communities as compared to national levels (ATSDR, 2022a). Section 5.4 compares this project's blood testing results to those reported by ATSDR in its PFAS exposure assessments. Multiple recent assessments thoroughly summarize the literature on releases of PFAS, their presence in the environment, and potential health effects in humans (e.g., ATSDR, 2021; ITRC, 2023).

The presence of PFAS in human blood is concerning due to scientific evidence of adverse health effects that are associated with exposures to these chemicals. Government agencies and other scientific bodies have published assessments of the evidence of toxicity for selected PFAS (e.g., ATSDR, 2021; EPA, 2024a, 2024b; ITRC, 2023). The adverse health effects linked to exposure vary from one PFAS to the next, and many PFAS have limited or no toxicity information. Examples of adverse health effects reported as being associated with exposures to certain PFAS include increased cholesterol levels, small decreases in birth weight, decreased antibody response to vaccines in children, kidney and testicular cancer, pregnancy-induced high blood pressure, and changes in liver enzymes (ATSDR, 2024; NASEM, 2022). While PFAS have been found in the blood of most humans who have been tested whether health effects occur depends on the magnitude, frequency, and duration of exposure, the life stages at which exposure occurs, individual susceptibilities, and other factors.

Recently, EPA set national standards for five PFAS compounds (PFOA; PFOS; PFNA; PFHxS; HFPO-DA) in drinking water. The maximum contaminant levels (MCLs) for these compounds range from 4 parts per trillion (ppt) to 10 ppt for individual concentrations and up to a hazard index (a long-established approach that EPA applies to chemical mixtures consisting of a sum of fractions) of 1 for mixtures (EPA, 2024c). This regulation aims to reduce overall PFAS levels in drinking water across the U.S., which would be expected to result in decreased human exposure.

3.2 Rationale for Conducting Blood Testing

While multiple public health and environmental programs across the United States have investigated PFAS levels in individuals' blood at the federal and state level, no such systematically collected data were previously available for New Mexico. To fill this critical gap, the New Mexico Department of Health (NMDOH), in collaboration with the New Mexico Environment Department (NMED) launched the New Mexico PFAS Blood Testing (NM-PBT) Project. This public health surveillance effort provides, for the first time, insights into PFAS levels in the blood of selected New Mexico residents.

The project was initiated in the community surrounding Cannon Air Force Base (CAFB) near Clovis, NM—an area with a known high concentration of PFAS in groundwater and contamination plume. The decision to focus on this location was based on the potential for elevated PFAS exposure through contaminated drinking water, other potential local environmental pathways, and to provide a health service to this impacted community.

The NM-PBT project aimed to assess both baseline and potentially elevated PFAS levels in the blood of participants. To accomplish this, the study involved direct collection of blood samples and the administration of an exposure assessment survey. The survey followed a protocol developed by the ATSDR to help identify likely sources and pathways of PFAS exposure for each participant.

Data collected through this project was compared to existing national and state data to better understand how PFAS exposure in this community compares to broader trends. NMDOH intends to use the results to determine whether public health interventions are needed to reduce exposure and improve health outcomes. At the same time, the results will enable NMED to evaluate environmental exposure pathways and guide the implementation of effective remedial actions to mitigate or eliminate future exposures and associated health risks.

The remainder of this section presents the rationale for selecting the area near Cannon AFB for the project (Section 3.3) and lists the objectives for the blood testing (Section 3.4).

3.3 Cannon Air Force Base PFAS Contamination

New Mexico, like most states nationwide, has numerous known areas of PFAS contamination. NMED, federal agencies, academics, consultants, and other parties have conducted sampling studies to characterize the nature and extent of PFAS contamination at multiple locations in New Mexico. Multiple studies have reported on PFAS found in groundwater, surface water, drinking water, and private wells across the state (NMED, 2024; USGS, 2024). Researchers have also measured alarming levels of PFAS in wildlife (UNM, 2024).

The state agencies selected the area near Cannon AFB, located in Curry County, for the blood testing project. That is because Cannon AFB is one of the most extensively studied PFAS contamination sites in New Mexico (NMDOH, 2022; NMED, 2024; USGS 2024); and the area had some of the highest known environmental contamination levels statewide. Several specific observations were considered when selecting this site for the project:

- *Known PFAS sources.* Studies have documented the presence of multiple sources of PFAS releases to the environment from Cannon AFB. These include fire training areas where PFAS-containing firefighting foam was previously used, former sewage lagoons and landfills that received waste containing PFAS, and current wastewater discharge sites (DBS&A, 2022). Documented releases have occurred as recently as July 2024, when approximately 7,000 gallons of PFAS-containing water were released to a retention pond with a compromised liner at the base (Cannon AFB, 2024).
- *PFAS groundwater contamination.* NMDOH, NMED, and the U.S. Geological Survey (USGS) have all reported on PFAS contamination in groundwater at or near the base (NMDOH, 2022; NMED, 2024; USGS, 2024). PFOA and PFOS have been detected at 26,200 parts per trillion in the groundwater at Cannon AFB (Cannon AFB Site Inspection Report, 2018). Multiple parties have generated maps showing the extent of PFAS groundwater contamination near Cannon AFB, with the highest concentrations generally found in the southeastern portion of the base. The groundwater contamination has migrated off the base in the direction of groundwater flow, which generally moves toward the southeast (DBS&A, 2022). Figure 1 shows the PFAS “plume area” map that this project considered when evaluating the blood sampling results. NMED generated this map based on PFAS sampling data collected in 2018 and 2019, and the yellow boundary estimates areas within which PFAS groundwater concentrations exceed 70 ppt which exceeds EPA health advisories and drinking water standards.

Figure 1: PFAS Plume Area near Cannon AFB

Note: NMED generated this map based on measured concentrations of six PFAS in groundwater. The chemicals considered when making this map were PFBS, PFHxS, PFOS, PFHpA, PFOA, and PFNA. See Table 1 for the full chemical names for these abbreviations.

- *PFAS drinking water contamination.* Some PFAS compounds have been detected in the drinking water systems that serve Cannon AFB and the Turquoise Estates development and in private wells near the base (NMED, 2024). Among the water sources used for drinking water, irrigation, and dairy supply, the highest contamination levels were observed in private wells located in areas southeast of Cannon AFB (NMED, 2024).
- *PFAS impacts.* The PFAS contamination originating from Cannon AFB led to contamination of cattle in a nearby dairy, which eventually had to euthanize its entire herd of 3,600 cattle due to the PFAS in their milk (NMED, 2022).

The information presented above only briefly reviews information on PFAS sources, contamination, and impacts at and near Cannon AFB. NMED's Cannon AFB website (https://www.env.nm.gov/hazardous-waste/cafb/) has a more complete and detailed chronology of the PFAS investigations that have been conducted there, and research into the PFAS contamination at the base is both ongoing and under litigation.

3.4 Project Goals and Objectives

NMDOH, NMDVS, and NMED launched the NM-PBT project to provide insights into PFAS blood levels in select New Mexico Residents and to achieve the following objectives:

- Characterize the magnitude of serum PFAS concentrations among adult New Mexico residents who have ever lived or worked in an area (see Section 4.1) near Cannon AFB.
- Compare the observed serum PFAS concentrations among these adult residents to national averages.

The results presented in this report are discussed in the context of **blood serum**, a fraction of blood that does not include blood cells or other clotting factors. PFAS are known to partition to blood serum as opposed to other blood components. The project collected blood samples from participants, and the serum that was extracted from these blood samples was then analyzed for PFAS. Therefore, when presenting results, this report consistently refers to serum PFAS concentrations.

- Determine how the serum PFAS concentrations among the participants relate to indicators of exposure history.

To achieve these objectives, the agencies developed a project that collected blood samples and exposure history information from eligible adults, and PFAS concentrations in the serum fraction of the blood were measured by a commercial laboratory. As described later in this report, the serum PFAS concentrations were then compared to the most recent CDC NHANES survey to understand how levels near Cannon AFB compare to national averages. CDC publishes summary statistics for its ongoing NHANES biological sampling. At the writing of this report, the most recent CDC-published summary of PFAS serum results is for the 2017-2018 NHANES cycle.

The overarching goal of this project was to identify whether and what interventions are needed to reduce PFAS exposure and to improve overall public health among residents and workers on or near the base. Further, the project findings were expected to inform understanding of PFAS exposure pathways and effective remedial efforts that can be used to mitigate or eliminate future exposure risks for individuals working and living near Cannon AFB. The remainder of this document details the methodology and findings of the NM-PBT project.

4.0 METHODS

This section describes the methodology used to conduct the NM-PBT project, including the eligibility criteria for participants, the community engagement and outreach strategies used in recruitment, how data were collected, the laboratory methods used to measure PFAS concentrations in serum, and the statistical analyses used to understand trends and patterns among the data. A more complete description of the methodology is found in the project protocol (NMDOH, NMDVS, NMED, 2024). This section summarizes key points from the protocol, including instances where the approach deviated from the steps outlined in the protocol.

NMDOH and NMED contributed to this project. NMDOH served as the public health authority, and its roles included helping to develop the project protocol, providing oversight for protected health information, and deciding how blood sampling results will be used to enhance public health. NMED funded the effort, provided insights on PFAS contamination levels at and near Cannon AFB, and issued and managed the contract used for contractor support. Eastern Research Group, Inc. (ERG) provided contractor support by developing standard operating procedures, recruiting participants, hosting the appointments, processing the blood samples into serum, coordinating with the analytical laboratory, and performing statistical analyses of data. SGS AXYS Analytical Services Ltd. (SGS), as a subcontractor to ERG, performed the laboratory analyses to measure PFAS concentrations in participants' serum.

4.1 Participant Eligibility Criteria

One of the first decisions made by the New Mexico agencies was deciding who would be eligible to participate in the NM-PBT project. The agencies established three participant eligibility criteria. To participate in the project, individuals had to:

- Have ever lived or worked in a geographic region that was referred to as the "project focus area."
- Be 18 years of age or older.
- Be a New Mexico resident.

The first criterion did not specify minimum residency or employment durations for participating. As a result, people who lived or worked in the project focus area for as little as one day were eligible to participate.

Figure 2 presents the project focus area used to assess eligibility. This area was based on NMDOH's 2018-2019 evaluation of private well contamination near Cannon AFB. That evaluation considered areas within 4 miles of the southeast corner of Cannon AFB as having the highest potential risk of PFAS groundwater contamination (NMDOH, 2022). The same area was initially considered for the NM-PBT project focus area. However, the circle drawn with a 4-mile radius cut through neighborhoods and through individual residential properties, which would have complicated efforts to define who is eligible to participate. The boundaries shown in Figure 2 were used because they approximated the area with a 4-mile radius and followed roadways and other landmarks that residents would likely recognize.

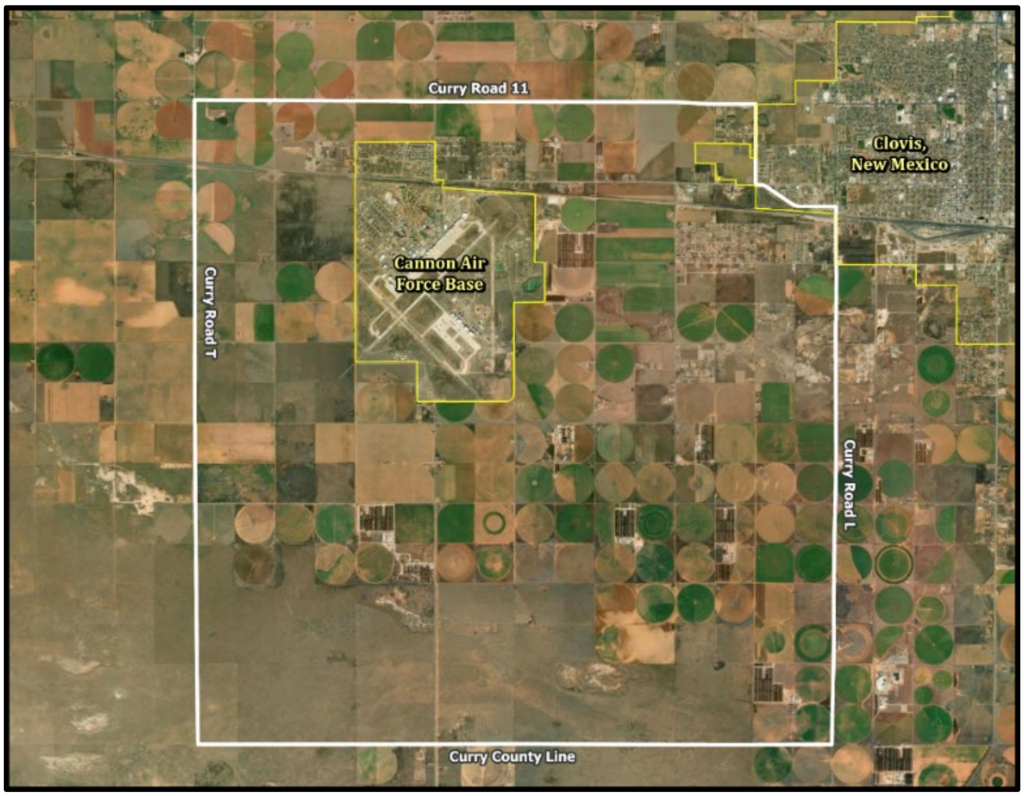
The final project focus area included all households located within 4 miles of the southeast corner of Cannon AFB, plus approximately 100 additional households just beyond 4 miles from that location but within the street boundaries shown in the map. The entire project focus area was within Curry County. The project focus area boundaries were:

- South Dr. Martin Luther King Jr. Boulevard and Curry Road L formed the eastern boundary of the project focus area.

- Curry Road 3 (and the county line) was the southern boundary of the project focus area.
- Curry Road T was the western boundary of the project focus area.
- Curry Road 11 was the northern boundary of the project focus area.
- In the northeast corner of the project focus area, the boundary ran south from Curry Road 11 along North Wheaton Ave. It then extended east along U.S. Highway 60 (Grand Avenue) to South Dr. Martin Luther King Jr. Boulevard (which becomes Curry Road L when the road passes south beyond the Clovis city limits).

Based on the 2022 American Community Survey, an estimated 3,243 adult residents who live in 1,375 households were in the project focus area; approximately 2% of these households have limited English spoken in the home, and Spanish is presumed to be the primary language in these households. The number of additional people who were eligible because they had ever worked in the project focus area is not known. Some people were eligible because they both lived and worked in the project focus area.

Figure 2: NM-PBT Project Focus Area



People who live in the project focus area get drinking water from different sources, which was an important consideration when evaluating the PFAS blood test results. Most residents in the area have drinking water provided by a community water system. According to EPA's Safe Drinking Water Information System (EPA, 2025a), the water systems that serve different portions of the project focus area include:

- EPCOR Water New Mexico, which serves a population of more than 41,000 in Clovis. However, a relatively small subset of the population served by this utility lives in the project focus area.
- The Cannon AFB water system, which serves an estimated population of more than 7,800.

- The Turquoise Estates Water Co-op, which serves a population of 265.
- The Desert Village RV and Mobile Home Park water system, which serves a population of 223.

In addition, residents of the project focus area who are not connected to community water systems generally obtain their drinking water from private wells, which include wells dedicated to individual households and shared wells that provide drinking water to multiple households. Private wells primarily serve households in the rural portions of the project focus area, including the area southeast of Cannon AFB.

4.2 Recruitment

The project used a convenience sample of eligible residents and workers in the project focus area, with no attempt to recruit a statistically representative sample of the eligible population. In other words, every adult who is a New Mexico resident and who has ever lived or worked in the project focus area was eligible to participate, provided they enrolled during the time frame when appointments were being scheduled. The enrollment hotline (1-575-575-PFAS) was staffed from August 27, 2024, to November 20, 2024; and several hotline staff who are fluent in Spanish were available to answer calls. Blood test appointments were scheduled for eligible individuals who called the hotline and who were available at the times when appointments were offered. See the "check-in" section below for how project staff handled individuals who requested walk-in appointments.

Participation in the NM-PBT project was voluntary, and the project relied on community engagement and outreach strategies to encourage eligible individuals to enroll. The engagement and outreach educated individuals about the project, made them aware of the eligibility criteria, and explained how they can make appointments. All printed outreach materials distributed for the project were issued in English and Spanish. The following strategies were used to boost recruitment:

- In August 2024, before recruitment began, project representatives hosted a booth at the Curry County Fair to inform local residents of the upcoming project. The representatives handed out postcards and flyers describing the NM-PBT project and encouraging people to attend the public meeting that launched the project.

- Representatives of NMDOH, NMDVS, and NMED hosted a public meeting at the Clovis Civic Center on August 27, 2024, to formally launch the project. Their presentations addressed many topics, including the goals and objectives of the NM-PBT project, how individuals could sign up for appointments, the risks and benefits of participating, the efforts that would be taken to protect participants' privacy, and how data would be used to inform public health actions. After the meeting, project representatives scheduled appointments for attendees who met the eligibility criteria and who wished to participate. The enrollment hotline (1-575-575-PFAS) opened on the day of the public meeting.

- Also on August 27, 2024, project representatives mailed invitation packages to every residential address within the project focus area. A commercial service was used to obtain the address list, and the packages contained a letter signed by New Mexico agency officials, a fact sheet, a post card, and a list of frequently asked questions. The invitation package encouraged residents to call the enrollment hotline to schedule appointments. (Note: Invitation packages were not mailed to households on Cannon AFB, instead informational materials were provided to CAFB Public Relations staff and leadership for distribution to on-base households and staff.)

- In the week after the public meeting, project representatives attempted to call every residential household in the project focus area. Telephone numbers were obtained from a commercial service, though some phone numbers were no longer in service or were otherwise incorrect. Project representatives made up to three calls to every valid telephone number, and they scheduled appointments for residents who answered their phones, who met the eligibility criteria, and who wanted to participate. All calls followed a script approved by NMDOH and NMED.
- Numerous other strategies were used to promote awareness of the NM-PBT project and to encourage participation. These strategies included placing yard signs at highly visible locations in the project focus area, issuing press releases about the project, and reaching out to Cannon AFB officials and to local organizations and requesting that they promote the project to their constituencies.

Participants scheduled appointments via one of the following ways: in-person at the end of the public meeting; during a recruitment phone call received at their household; or by calling the project hotline. For all three communications, an individual spoke with a project representative to enroll; and these communications were made in English or Spanish, depending on the individuals' preference. These conversations started with the project representative confirming that an individual met the eligibility criteria. Next, project representatives requested that individuals provide the following information:

- First and last name
- Home address, telephone number, and email address
- Employer and work address (only for participants who were eligible due to where they work)
- Preferred appointment date and time

Project representatives then scheduled appointments. Individuals who provided email addresses immediately received email confirmation of their appointments, and participants received up to two additional appointment reminders, using phone calls and email messages. The reminders indicated that participants must bring documentation proving they met the project's eligibility criteria. Overall, more than 700 appointments were scheduled across three week-long sampling events. See Section 5.1 for further information on the number of appointments scheduled, the number of appointments kept, and a breakdown of the participants in the NM-PBT project.

4.3 Data Collection and Analysis

This section presents the methodology that the project team followed to collect data during the PFAS blood test appointments, to measure serum PFAS concentrations, and to conduct statistical analyses of the data. Section 5.0 presents the findings that were generated by following the methodology described below.

4.3.1 Data Collection during Blood Test Appointments

All PFAS blood test appointments occurred during three week-long events held at the Youth Recreation Building in Clovis, New Mexico. The three events occurred on the following dates:

- September 12-18, 2024
- October 3-9, 2024

- November 14-20, 2024

During each event, up to 30 appointments were scheduled per day. Appointments typically lasted 45 minutes and comprised of participants completing five stations, described below. Participants generally completed appointments by themselves; however, participants that were part of the same household were allowed to complete appointments together. Appointments were offered in English and Spanish, depending on a participant's preference. The following text describes what occurred at the five stations for the PFAS blood test appointments.

All staff who worked at the appointments were trained in processes for handling protected health information, Health Insurance Portability and Accountability Act (HIPAA) privacy protections, health and safety requirements for handling blood samples, and various other relevant topics. The onsite staff were primarily ERG employees.

Check-In

The check-in station involved greeting incoming participants, verifying that participants met the eligibility criteria, and checking participants in for their scheduled appointments. Walk-in appointments were accepted when schedules permitted. However, because most days had full schedules, project staff generally were not able to accommodate walk-in appointments. Individuals who came to the sampling venue without an appointment and who could not be accepted as walk-ins were asked to call the project hotline to schedule an appointment during an available time.

At check-in, project representatives asked participants to provide their name, home and mailing address, phone number, and email address. Participants were also asked whether they wanted to receive their PFAS blood test results by email, U.S. mail, or both. All information provided by participants was logged into a project tracking spreadsheet on a secure central laptop that was not connected to the internet.

Additionally, project representatives reviewed participants' documentation demonstrating eligibility and recorded the document type in the project tracking spreadsheet. Acceptable documentation included proof of age, proof of New Mexico residency, and proof of employment or residence within the project focus area. Examples of acceptable documentation included:

- New Mexico driver's license or identification card.
- Military badge or orders listing Cannon AFB as the base where stationed.
- Pay stub or employment verification letter from an employer within the project focus area.
- Utility bill, bank statement, or other document listing an address within the project focus area.

Eligibility for participants who had no such documentation (e.g., people who grew up in the project focus area decades ago but had no proof of that residency) was evaluated on a case-by-case basis.

Once the check-in process was complete, project staff assigned a unique identification number to the participant. The number (e.g., "NM125") was a string of five characters that included the state abbreviation ("NM") and three digits (e.g., "125"). Project staff at the check-in station explained to participants that the unique identification number was assigned to protect participants' privacy. As noted below, blood samples collected during appointments were labeled only with the unique identification numbers—not with participants' names. After completing check-in, participants were directed to the next station.

Participation Acknowledgment Forms

All participants, after check-in, immediately were directed to a station to complete a participation acknowledgment form. For privacy purposes, these forms were completed in an area at the Youth Recreation Building separated from others by partitions. The purpose of the acknowledgement form was to ensure that participants fully understood the NM-PBT project and to give participants an opportunity to ask questions before proceeding with their appointments. See Appendix A for a blank copy of the participation acknowledgment form.

Project representatives from ERG worked at the station where participation acknowledgment forms were completed. Participants were given the option of either reading the form on their own or having the project representative review the contents with them; participants were also offered copies of the form. The project representatives at the station reviewed the first two pages of the participation acknowledgment form with each participant. Those two pages included an introduction to the project, an explanation for why NMDOH was collecting blood samples and what the department intends to do with the results, information on privacy protections, discussion of the benefits and risks of participating, and a summary of the strengths and limitations of PFAS blood test results. During this discussion, participants were given the opportunity to ask questions.

Once participants confirmed that all their questions were answered, project representatives read ten acknowledgment statements out loud; and participants were asked to indicate whether they agreed with these statements by writing their initials in the appropriate box on the form (see the third page of the form). Participants were then asked to sign and date the final page of the form, and the project representative who worked in the station also signed and dated the form.

All completed forms were immediately placed in a locked file cabinet. Participants were then typically directed to the exposure history questionnaire station, but in some cases, participants were directed to the blood collection station before they completed their questionnaires.

Exposure History Questionnaire

Project representatives from ERG administered an exposure history questionnaire to every participant. For privacy, the questionnaires were also completed in an area at the Youth Recreation Building separated from others by partitions. The purpose of the questionnaire was to collect information on participants relevant to their potential PFAS exposures.

Appendix A has a copy of the exposure history questionnaire for the NM-PBT project. The questionnaires began with a review of NMDOH's Privacy Policy and how it applied to the blood testing project. Participants were given the option to take a copy of the policy. Project representatives then began asking questions from the questionnaire and logged responses in Epi Info software on dedicated laptops. This software is maintained by CDC and commonly used when collecting data for projects of this nature, and it included several quality control checks to ensure that questions were not inadvertently skipped. To protect participants' privacy, the laptops used for questionnaires were not connected to the internet.

The exposure history questionnaire included 39 questions that addressed numerous topics, including: participant information (e.g., name, contact details, eligibility), residential history, occupational history, sources of drinking water at home and work, and other potential sources of PFAS exposure (e.g., usage of stain resistant products, contact with soil, fast food consumption). For most questions, participants had the option to not answer or indicate that they did not know the answer.

After administering the questionnaire, project representatives closed the file on their laptop and escorted the participant to the next station, which was typically the blood collection station.

Note: The default approach involved in-person administration of exposure history questionnaires. This approach was used when the sampling event was fully staffed with project representatives. However, on days when the event was not fully staffed (e.g., when some project representatives were ill), a subset of exposure history questionnaires were administered by phone.

Blood Collection

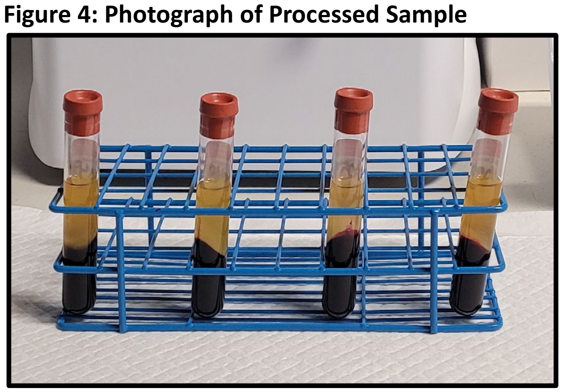
The primary activity at the blood collection station was participants providing a blood sample, which was taken by a licensed phlebotomist. When participants arrived at the station, project representatives from ERG entered the participants' identification numbers in a hard copy blood collection log, and pre-printed sample labels were retrieved. These labels only included participation identification numbers and dates. Participants' names were not entered into the log or written on the sample labels.

Participants then entered the blood collection area, which was also in an area at the Youth Recreation Building separated from others by partitions. A phlebotomist collected blood samples according to the project's manual of procedures, and blood was drawn into 10 milliliter (mL) red top blood tubes. After providing their blood samples, participants were observed for any adverse reactions, then escorted to a waiting area where they were offered snacks and beverages.

The phlebotomist, after finishing drawing blood, placed sample labels on the 10-mL red top blood tubes and temporarily stored them upright in a rack. Figure 3 shows a rack of blood samples collected during the project. The samples remained on the rack until the collected blood began to clot—a process that took between 30 minutes and 2 hours. Project representatives then placed the red top blood tubes in a centrifuge and spun the samples at 2,400 revolutions per minute for 15 minutes. This step was required to separate serum (which was the portion of the blood samples to be sent to the laboratory for analysis) from other blood components. After spinning samples, the less dense serum portion of the blood separated from and remained atop the denser material containing other blood components, as shown in Figure 4.

Figure 3: Photograph of Collected Blood Samples

Figure 4: Photograph of Processed Sample



Note: Figure 4 shows how serum separates from other blood components after a blood sample is centrifuged. The serum is the pale, yellow fluid at the top of the sample, and that portion of the sample was sent to the laboratory for PFAS analysis. The dark material at the bottom of the sample is blood cells, clotting factors, and other materials. That material and the used red top blood tubes were disposed of and managed as regulated medical waste.

Project representatives who were trained in blood sample processing then pipetted the serum fraction of the spun blood sample into 6-mL cryovials. As shown in Figure 5, this task was typically performed by two individuals: one pipetted the material from the original red top blood tube, and the other held the cryovial into which the serum was placed. Unique labels were affixed to every cryovial, and the labels contained participant identification numbers and collection dates.

Per specifications from the laboratory, project representatives attempted to transfer at least 4 mL of serum from the processed blood sample into the cryovial. The laboratory indicated that 4 mL of serum was preferred for analysis, but it could analyze samples that contained less than this amount. In some cases, samples initially yielded less than 4 mL of serum after being centrifuged. To achieve the desired sample volume, the project representatives typically re-spun these sample at the same settings noted above and pipetted additional serum into the cryovials.

After cryovials were filled, project representatives immediately sealed them and placed each sealed cryovial in its own 2”x4” plastic bag. The individual bagged serum samples were then placed in a labeled specimen box, which held up to 25 samples. The specimen boxes were stored on dry ice in coolers throughout each week-long sampling event. Section 4.3.2 describes subsequent steps of shipping the coolers to the analytical laboratory for analysis.

Figure 5: Photograph of Transferring Serum from Red Top Blood Tube to Cryovial

Note: Figure 5 shows how project representatives transferred serum from red top blood tubes to cryovials. The employee on the left is inserting a pipette into the serum portion of a red cap blood tube that had already been centrifuged. The employee then transferred the serum from the pipette (not shown in the photograph) into the cryovial that the employee on the right is holding.

The blood collection and processing steps described above were based on those that ATSDR used in its nationwide PFAS exposure assessment project (ATSDR, 2022b). In fact, some NM-PBT project representatives who processed blood samples also did so for ATSDR’s PFAS exposure assessments, as ERG was the contractor for that effort. All project representatives who staffed the blood collection station were trained on bloodborne pathogens, personal protective equipment, centrifuge safety, and other relevant topics; and they followed standard laboratory practices related to safety and sterility.

Check-Out

The final station for every blood test appointment was check-out, which occurred at the same location where participants originally checked in. After confirming that a participant had completed all appointment stations, project representatives at check-out presented the participant with a $25 gift card for their time. Participants were required to sign a gift card acknowledgment form to confirm that they received the card. Participants were also provided a "What to Expect Next" factsheet that indicated when participants would receive results and that instructed participants to call the project hotline with any questions or updates to their contact information.

Quality Assurance and Quality Control

Project representatives took numerous steps to ensure the samples and information collected were of a known and high quality. The following list describes several quality control steps taken at the end of every sampling day. Additional measures are documented in the project manual of procedures. By implementing the following steps, project representatives ensured that every participant had a completed participation acknowledgment form, exposure history questionnaire, blood sample[1], and gift card acknowledgment form. Examples of quality control steps included:

- Project representatives reviewed and reconciled entries in the participation acknowledgment forms, the gift card acknowledgment forms, the blood collection log entries, and the check-in tracking spreadsheet. This step ensured that all appointment documentation was accounted for, internally consistent, and retained for every participant.
- Project representatives performed several cross-checks on the exposure history questionnaires. They checked names, addresses, and participation identification numbers entered in the Epi Info questionnaire database against corresponding entries from the check-in tracking spreadsheet and against the signed acknowledgment forms. After confirming that the number of complete questionnaires in the database matched the number of appointments from the day, the project representatives used an encrypted, secure external flash drive to transfer the database of questionnaire responses from data collection laptops to the central laptop.
- Project representatives compared the number of serum samples against the number of appointments completed per day. They also reviewed the blood collection log to ensure that all fields were completed for every participant, and they inspected the coolers with specimen boxes to ensure that enough dry ice was present to keep samples frozen.

4.3.2 Laboratory Analysis

On the last day of the three week-long field events, project representatives sealed coolers that contained serum samples, prepared required shipment manifests, and brought the coolers to a delivery service for overnight shipment to SGS, the commercial analytical laboratory that analyzed the serum samples for PFAS. SGS, an accredited laboratory, was chosen to conduct the analysis as it met the National Academy of Sciences, Engineering, and Medicine's (NASEM's) criteria for PFAS testing of human blood and serum (NASEM, 2022). Specifically:

- SGS has an extensive quality assurance and quality control program.
- SGS has confirmed the quality of its serum PFAS measurements using standard reference materials.

[1] The phlebotomist was not able to draw a blood sample for one participant.

- SGS's analytical method achieves a relative standard deviation of less than 15% for replicate analyses of samples; and the laboratory's detection limits are comparable to those achieved by CDC.

SGS used EPA Method 1633A to measure serum PFAS concentrations. This method can be used for multiple matrixes and can reliably measure trace amounts of PFAS in serum, tissues, and other media (EPA, 2024d). Table 1 lists the 33 PFAS analytes that SGS tested for in the serum samples. The table also shows the analytes' associated abbreviations and reporting limits—all of which were between 0.1 and 1.0 µg/L. SGS destroyed any excess serum that remained after analyzing the samples.

Table 1: PFAS Analytes Measured in Serum

Analyte	Abbreviation	Laboratory Reporting Limit (µg/L)
Perfluorobutanoic acid	PFBA	0.4
Perfluoropentanoic acid	PFPeA	0.2
Perfluorohexanoic acid	PFHxA	0.1
Perfluoroheptanoic acid	PFHpA	0.1
Perfluorooctanoic acid	PFOA	0.1
Perfluorononanoic acid	PFNA	0.1
Perfluorodecanoic acid	PFDA	0.1
Perfluoroundecanoic acid	PFUnA	0.1
Perfluorododecanoic acid	PFDoA	0.1
Perfluorotridecanoic acid	PFTrDA	0.1
Perfluorotetradecanoic acid	PFTeDA	0.1
Perfluorobutanesulfonic acid	PFBS	0.1
Perfluoropentanesulfonic acid	PFPeS	0.1
Perfluorohexanesulfonic acid	PFHxS	0.1
Perfluoroheptanesulfonic acid	PFHpS	0.1
Perfluorooctanesulfonic acid	PFOS	0.1
Perfluorononanesulfonic acid	PFNS	0.1
Perfluorodecanesulfonic acid	PFDS	0.1
Perfluorododecanesulfonic acid	PFDoS	0.1
4:2 fluorotelomersulfonic acid	4:2 FTS	0.4
6:2 fluorotelomersulfonic acid	6:2 FTS	0.4
8:2 fluorotelomersulfonic acid	8:2 FTS	0.4
N-Methylperfluorooctanesulfonamidoacetic acid	N-MeFOSAA	0.1
N-Ethylperfluorooctanesulfonamidoacetic acid	N-EtFOSAA	0.1
Perfluorooctanesulfonamide	PFOSA	0.1
N-Methylperfluorooctanesulfonamide	N-MeFOSA	0.1
N-Ethylperfluorooctanesulfonamide	N-EtFOSA	0.1
N-Methylperfluorooctanesulfonamidoethanol	N-MeFOSE	1.0
N-Ethylperfluorooctanesulfonamidoethanol	N-EtFOSE	1.0
Perfluoro-2-propoxypropanoic acid	HFPO-DA	0.4
4-dioxa-3H-perfluorononanoic acid	ADONA	0.4
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	0.4
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	0.4

SGS took several steps to confirm that measurements were of a known and high quality. Examples included analyzing blank samples to assess presence of contamination in laboratory equipment, spiking samples with known amounts of analytes and measuring the amounts recovered, performing routine equipment calibrations and analyzing calibration verification samples, and others. SGS used data qualifiers for results that did not meet the laboratory's quality control criteria, and that typically occurred for selected analytes that were detected infrequently. Measured serum PFAS concentrations for the analytes detected most frequently (e.g., PFOS, PFOA, PFHxS, PFNA) consistently met the laboratory's quality control criteria.

SGS sent all measured serum PFAS concentrations in electronic data deliverables to the ERG project manager. The ERG data analysis team performed statistical analyses (see Section 4.3.3) of these deidentified results when preparing this report. ERG provided the complete set of measured serum PFAS concentrations to NMDOH, who will be the long-term custodian of the NM-PBT project data.

4.3.3 Statistical Analysis

The NM-PBT project generated a large volume of exposure history questionnaire data and measured serum PFAS concentrations for analysis. This section describes the statistical approach taken to analyze these data sources, with the goal being to understand meaningful trends and patterns among the extensive data set. The statistical approach was based on the one ATSDR used when conducting its nationwide PFAS exposure assessment.

How Exposure History Questionnaire Data Were Processed

The first step in processing exposure history questionnaire data was to compile a database that contained the original responses from all participants across the field sampling events. Project representatives reviewed the responses for accuracy and completeness. For example, numeric fields were checked for unexpected values (e.g., ages less than 18 or greater than 110). Any outliers were run by the project representative who administered the questionnaire, and that individual either confirmed or corrected the entry. Data completeness was not a concern because the Epi Info survey instrument was coded to require entries for all mandatory fields.

Many questions had multiple-choice response options. This occurred primarily for questions that asked about the frequency of a potential exposure. For example, the response options for "how often do you eat eggs from chickens or other fowl that are raised in the project focus area?" were: never, a few times per year, a few times per month, a few times per week, and daily. When processing data for this question, multiple response categories were collapsed into broader groups due to low counts of responses to the original categories. In this case, all responses were collapsed into two new categories of "once a month or more" and "yearly or less." A similar approach was applied to other questions that had response options with low response counts.

Another data processing step involved responses related to residential and occupational histories. The underlying questions asked participants to provide addresses where they had worked or lived. These responses were logged during the questionnaires and were not validated in real time. When processing the questionnaire database, project representatives geocoded all reported addresses to confirm whether they were inside or outside the project focus area. This geocoding revealed that some participants had never lived or worked within the project focus area and therefore did not meet the NM-PBT project eligibility criteria; these individuals were deemed ineligible and removed from the data analysis (see Section 5.0). For the participants whose eligibility was confirmed, project representatives used address information to confirm whether the participants had ever lived in, ever worked in, or both lived and worked in the project focus area; they also calculated from the questionnaire responses the total number of years that each participant lived or worked at addresses in the project focus area.

Two other data processing steps were implemented. First, the exposure history questionnaire asked participants about occupational histories in aviation-related jobs or the military. Participants reported various aviation-related occupations, including for the Air Force (not limited to Cannon AFB), for other branches of the military, and for commercial aviation. Because of the overlap of aviation and military occupations in this sample, these responses were collapsed into a new variable that documented whether participants had ever worked in aviation- or military-related jobs to facilitate statistical analyses. Second, the exposure history questionnaire asked participants a few questions that prompted narrative responses. Project representatives reviewed these responses to better understand participants' responses to selected multiple-choice questions.

After completing the aforementioned data processing steps, a final exposure history questionnaire database was available for further evaluation.

How Serum PFAS Concentration Data Were Processed

Project representatives assembled a database of serum PFAS concentrations from the electronic data deliverable files provided by SGS. They processed the serum data as follows:

- For analytes that were not detected in a serum sample, project representatives replaced the measured result with a value equal to the analyte reporting limit divided by the square root of two. This data processing convention is used by CDC when processing its NHANES data, which has reported on serum PFAS concentrations in the U.S. population for more than 20 years (CDC, 2025).
- Project representatives calculated a summed serum PFAS concentration for comparison to NASEM's PFAS screening thresholds (NASEM, 2022). This total, referred to as ΣPFAS7, is the sum of the following seven PFAS: MeFOSAA, PFDA, PFHxS, PFNA, PFOA, PFOS, and PFUnDA. This sum was calculated after non-detects were replaced with the reporting limits divided by the square root of two.

After completing these steps, a final serum PFAS concentration database was available for further evaluation; this could be linked to the exposure history questionnaire database using the unique participant identification numbers. All PFAS serum data that met laboratory quality control criteria were considered valid for purposes of this report.

How Statistical Analyses Were Conducted

The project team used statistical analysis software (SAS version 9.4) to analyze the exposure history questionnaire data and the serum PFAS concentration data. The following list describes some of the analyses that were performed:

- Throughout the report, demographic and exposure characteristics were summarized for three mutually exclusive eligibility categories: (1) participants who had ever worked in the project focus area but never lived in this area are referred to in this report as "only worked"; (2) participants who had ever lived in the project focus area but never worked in this area are referred to in this report as "only lived"; and (3) participants who both lived and worked in the project area.

- Descriptive statistics were calculated for exposure history questionnaire responses. For numeric variables (e.g., age, years of residence), statistics included ranges, arithmetic means, and standard deviations. For categorical variables (e.g., sex, source of drinking water), frequencies of responses were tabulated. To protect participant privacy, this report does not present statistics for subsets of participants with fewer than 10 individuals.
- Descriptive statistics were also calculated for serum PFAS concentrations. For every PFAS analyte and for ΣPFAS7, detection frequencies and the 25th, 50th, 75th, and 95th percentiles concentrations were calculated. For the four PFAS analytes detected in more than 60% of the samples (i.e., PFOS, PFOA, PFHxS, and PFNA), geometric mean concentrations and 95 percent confidence intervals were also calculated. These statistics were calculated for the entire NM-PBT project population and for subsets of participants stratified by eligibility category, age, sex, drinking water source, years lived and years worked in the project focus area, and years lived and years worked in the plume area.
- Two additional calculations were performed to provide further context for the results. First, the number of participants with serum ΣPFAS7 concentrations in the following ranges was tabulated: <2 µg/L; 2 to <20 µg/L; and ≥20 µg/L. These are ranges for which NASEM recommends certain types of medical screening (see Section 5.3). Second, geometric mean concentrations for different subsets of participants were compared to those for adults nationwide, as reported in the NHANES 2017-2018 survey cycle, which was the most recently available complete survey data at the writing of this report. To be consistent with NHANES, this comparison was limited to NM-PBT project participants aged 20 years and older; and to avoid any biases by populations having different age distributions, the comparison to NHANES was based on age-adjusted serum PFAS concentrations. Age-adjusted calculations were performed using the PROC SURVEYMEANS function in SAS 9.4.

Statistical Terms Used in This Report
Geometric mean: Used to represent the central tendency of serum PFAS concentrations among participants.
Confidence interval: Used to estimate the range of values within which the true average PFAS level likely falls.
P-value: Used to assess the likelihood that the observed PFAS results occurred by chance; p-values less than 0.05 were considered statistically significant.

- Using univariate linear regression models, correlations were investigated between serum PFAS concentrations and individual exposure history questionnaire variables. The correlations were calculated for concentrations of the four PFAS that were detected in more than 60% of the participants (i.e., PFOS, PFOA, PFHxS, and PFNA) and for ΣPFAS7. The correlations considered a range of exposure history parameters including, but not limited to: duration of residency and employment in the project focus area, cups of tap water consumed at home and work, primary drinking water source, age, sex, fast food consumption, blood donation frequency, and experience working in occupations with high potential for PFAS exposure (e.g., firefighting). The univariate correlations were run on log-transformed PFAS levels using the PROC GLM function in SAS version 9.4.
- Multivariate regression models were used to further explore relationships that the univariate analyses identified between serum PFAS concentrations and exposure factors. Unlike univariate models, which consider only how two parameters are related (e.g., serum PFOS concentration vs. age), multivariate models explore relationships between numerous parameters and can

explore more complex data interactions. Multivariate models were constructed and run both for the entire population of participants and for different subsets of participants based on eligibility category (e.g., "only lived", "only worked"). The outputs for these models quantified the relationship between different metrics of serum PFAS concentrations and exposure factors and identified which relationships were statistically significant. As with the univariate modeling, all multivariate modeling was run on log-transformed PFAS levels using the PROC GLM function in SAS 9.4.

- Additional analyses were performed to investigate serum PFAS concentration data for participants with a residential or work history within the PFAS plume area (see Figure 1). This subset of participants was identified by geocoding participants' residential and occupational addresses and overlaying them with plume boundaries provided by NMED. Analyses for this population considered whether serum PFAS concentrations were higher than participants with no occupational or residential history in the plume area, whether serum PFAS concentrations were higher than national averages, how serum PFAS concentrations compare to NASEM medical screening guidelines, and how serum PFAS concentrations compared to selected exposure history parameters. Analyses for this population were limited by the limited number of participants (n=19) in this subset.

4.4 Data Reporting

Immediately after receiving the serum PFAS concentration data from SGS, project representatives began preparing results letters to inform participants of their serum PFAS concentrations and what those results mean. Appendix A has a copy of the result letter that was used. Based on participants' preferences, letters were sent either by encrypted email from a NMDOH account or by certified U.S. mail with return receipts sent to NMDOH. Some participants requested and received results via both email and U.S. mail. The results were sent to participants in February 2025 and March 2025.

The letters invited participants to attend open availability sessions at the Youth Recreation Building in Clovis, where they could speak one-on-one with NMDOH representatives about their blood test results or with NMED representatives with questions about PFAS contamination in groundwater and drinking water. State officials hosted open availability sessions on the following dates: February 20-22, 2025; and April 5, 2025.

5.0 RESULTS AND DISCUSSION

This section presents the results of the PFAS blood tests, including information on participants, measured serum PFAS concentrations, and trends and patterns among those concentrations. As Table 2 shows, across the three week-long blood collection events, 724 PFAS blood test appointments were scheduled, and 638 of these appointments were kept. Otherwise stated, 88.1% of the scheduled appointments were kept. (Note: A "kept appointment" was an appointment for which a participant arrived at their scheduled time and began their appointment. As noted below, two participants kept their appointments but did not complete them.)

Table 2: Participant Counts by Blood Sample Collection Event

Event	Dates	Number of Appointments Scheduled	Number of Appointments Kept	Response Rate
1	September 12-18, 2024	252	228	90.5%
2	October 3-9, 2024	253	222	87.7%
3	November 14-20, 2024	219	188	85.8%
	Totals	**724**	**638**	**88.1%**

All analyses in this section are based on results from the 628 that kept appointments (out of the 638 scheduled appointments). Results from ten participants were not considered for the following reasons:

- One participant attended their appointment but left the venue while completing the participation acknowledgment form. This participant did not return to complete the appointment.
- The phlebotomist was not able to draw a blood sample from one participant.
- Eight participants scheduled and kept their appointments. During subsequent data analyses, however, these participants were found to not meet the eligibility criteria, primarily because the residential or occupational addresses that they provided were determined to be outside the project focus area.

Note that all participants, including the 10 found to be ineligible, were notified of their blood test results; and they were provided resources to understand what the results mean. See Section 4.4 for more information on how results were communicated to all participants.

The 628 eligible participants fell into the following three mutually exclusive eligibility categories:

- 182 participants had worked in the project focus area at some time but never lived there. These are referred to in this section as "only worked" participants.
- 167 participants had lived in the project focus area at some time but never worked there. These are referred to in this section as "only lived" participants.
- 279 participants had lived and worked in the project focus area at some time, but not necessarily at the same time.

The remainder of this section presents a profile of the 628 eligible participants who kept appointments (Section 5.1), summarizes their serum PFAS concentrations (Sections 5.2, 5.3, and 5.4), and reports on associations between their serum PFAS concentrations and exposure parameters (Section 5.5). The section also summarizes serum PFAS concentrations for the subset of the participants who ever lived or worked in the plume area (Section 5.6).

5.1 Profile of Participants

Table 3 summarizes the demographic and exposure characteristics of the 628 eligible participants. These data are also broken down by the three eligibility categories (i.e., “only lived” in the project focus area, “only worked” in the project focus area, both lived and worked in the project focus area). Selected characteristics of the NM-PBT project participants follow:

- The average age of participants was 44 years; 55% identified as male, and 44% identified as female. More than half of participants (64%) identified their race as non-Hispanic white; and 23% identified as Hispanic or Latino.
- The participants had a broad range of responses for the number of years that they worked or lived in the project focus area: 24.3% of the “ever lived” participants resided in the project focus area for more than 25 years, and 23.6% of the “ever worked” participants were employed in the project focus area for more than 8 years.
- The participants (n=167) who only lived in the project focus area obtained drinking water at their household from various sources: 43.7% of these participants obtained drinking water from private wells; 35.3% obtained drinking water from a public water system; and 20.4% reported using bottled water as their primary drinking water source. More than half of these participants indicated that their drinking water at home was not treated. On average, and regardless of the drinking water source, these participants drank 6.7 eight-ounce cups of drinking water per day. Similar statistics are shown in Table 3 for drinking water patterns for participants who worked in the project focus area.
- Of the 628 participants considered in this analysis, 294 participants—or 46.3% of them—currently or previously lived at Cannon AFB, currently or previously worked there, or both.

Table 3: Characteristics of NM-PBT Participants

Note: Unless otherwise indicated, the data in each cell is presented as the number of participants, followed by the percentage of participants shown in parentheses.

Characteristic	All Participants* (n=628)	Participants who only worked in the project focus area* (n=182)	Participants who only lived in the project focus area* (n=167)	Participants who both lived and worked in the project focus area* (n=279)
Average age, years (standard deviation)	44 (±17)	40 (±14)	47 (±18)	45 (±18)
<30 years	146 (23.2%)	42 (23.1%)	41 (24.6%)	63 (22.6%)
30 to <50 years	270 (43.0%)	101 (55.5%)	55 (32.9%)	114 (40.9%)
≥50 years	212 (33.8%)	39 (21.4%)	71 (42.5%)	102 (36.5%)
Sex				
Male	348 (55.4%)	122 (67.0%)	44 (26.4%)	182 (65.2%)
Female	279 (44.4%)	60 (33.0%)	122 (73.0%)	97 (34.8%)
Race and ethnicity**				
Hispanic or Latino	145 (23.1%)	31 (17.0%)	66 (39.5%)	48 (17.2%)
Non-Hispanic Black	31 (4.9%)	***	***	21 (7.5%)
Non-Hispanic White	404 (64.3%)	126 (69.2%)	92 (55.1%)	186 (66.7%)
Non-Hispanic other/more than one race	45 (7.2%)	16 (8.8%)	***	22 (7.9%)

Characteristic	All Participants* (n=628)	Participants who only worked in the project focus area* (n=182)	Participants who only lived in the project focus area* (n=167)	Participants who both lived and worked in the project focus area* (n=279)
Did not answer or missing	***	0 (0%)	***	***
Average years lived in project focus area (standard deviation)	8.5 (±13.0)	--	14.7 (±14.4)	10.2 (±13.6)
<5 years	405 (64.5%)	182 (100%)	63 (37.7%)	160 (57.4%)
5 to <15 years	83 (13.2%)	0	31 (18.6%)	52 (18.6%)
15 to <25 years	55 (8.8%)	0	32 (19.2%)	23 (8.2%)
25+ years	85 (13.5%)	0	41 (24.6%)	44 (15.8%)
Average years worked in project focus area (standard deviation)	5.6 (±8.9)	6.6 (±8.6)	0	8.3 (±10.3)
<2 years	275 (43.8%)	47 (25.8%)	167 (100%)	61 (21.9%)
2 to <4 years	123 (19.6%)	58 (31.9%)	0	65 (23.3%)
4 to <8 years	92 (14.7%)	34 (18.7%)	0	58 (20.8%)
8+ years	138 (22.0%)	43 (23.6%)	0	95 (34.1%)
Average number of 8-ounce cups of tap water consumed per day at current home or at the most recent residence within the project focus area (standard deviation)	7.5 (±7.7)	--	6.7 (±7.2)	8.0 (±8.0)
0 cups	86 (19.5%)	--	38 (22.9%)	48 (17.4%)
>0 to ≤5 cups	127 (28.7%)	--	52 (31.3%)	75 (27.2%)
>5 to ≤10 cups	122 (27.6%)	--	42 (25.3%)	80 (29.0%)
>10 cups	107 (24.2%)	--	35 (21.1%)	72 (26.1%)
Average number of 8-ounce cups of tap water consumed per day at work within the project focus area (standard deviation)	5.4 (±6.2)	5.4 (±6.2)	--	5.4 (±6.2)
0 cups	105 (22.8%)	40 (22.0%)	--	65 (23.3%)
>0 to ≤3 cups	87 (18.9%)	36 (19.8%)	--	51 (18.3%)
>3 to ≤6 cups	83 (18.0%)	44 (24.2%)	--	39 (14.0%)
>6 cups	142 (30.8%)	55 (30.2%)	--	87 (31.2%)
Current primary drinking water source at home				
Public water system	211 (33.6%)	0	59 (35.3%)	152 (54.5%)
Private well	136 (21.7%)	0	73 (43.7%)	63 (22.6%)
Bottled water	95 (15.1%)	0	34 (20.4%)	61 (21.9%)
Live outside of project area	182 (29.0%)	182 (100%)	0 (0%)	0 (0%)
Do not know	***	0	***	***
Current use of drinking water treatment or filtration device at home				
One or more devices	229 (51.4%)	--	73 (43.7%)	156 (55.9%)
No treatment or filtration	217 (48.6%)	--	94 (56.3%)	123 (44.1%)
Work history in industries with potentially high PFAS exposures				
Aviation (not U.S. Air Force)	21 (3.3%)	10 (5.5%)	***	***
Firefighting	34 (5.4%)	14 (7.7%)	***	15 (5.4%)
Stain coatings	***	0 (0%)	***	***
Aviation-related role in the military	135 (21.5%)	61 (33.5%)	***	72 (25.8%)
Military non-aviation roles	163 (26.0%)	70 (38.5%)	***	85 (30.5%)

* The sums of participants for different fields in this table do not always add up to expected values, because not every participant answered corresponding questions on the exposure history questionnaire. In addition, the sums of percentages for

different fields in this table do not always add up to 100%, because not every participant answered corresponding questions during the questionnaire and because of rounding conventions used.
** Some race and ethnicity categories were collapsed because of limited responses in certain categories.
*** As noted previously, this report does not present statistics for subsets of participants with fewer than 10 individuals. Data points are not shown for these entries because they did not have 10 or more responses.

The questionnaire gathered information on additional topics not summarized in Table 3. For example, the questionnaire asked participants with private wells if their well water had been tested for PFAS. Of the 136 participants who obtained household drinking water from private wells, nearly half of them (n=64) reported their water had been tested for PFAS. Some of these participants described their test results when completing their exposure history questionnaires, but most could not recall detailed information (e.g., measured concentrations) from their well water tests.

5.2 Serum PFAS Concentrations Among NM-PBT Participants

The 628 participants' serum samples were analyzed for 33 unique PFAS analytes. This provided 20,724 serum PFAS measurements (i.e., 628 x 33) to evaluate. Table 4 presents descriptive statistics for the 16 PFAS analytes that were detected above reporting limits in at least one serum sample. The table also presents descriptive statistics for ΣPFAS7. As noted previously, ΣPFAS7 is the sum of concentrations of the seven PFAS compounds (MeFOSAA, PFDA, PFHxS, PFNA, PFOA, PFOS, and PFUnDA) considered in the NASEM medical screening recommendations, and this sum is calculated after replacing non-detects with concentrations equal to the analytes' reporting limits divided by the square root of two. Entries in the table are presented in decreasing order of frequency of detection: the analyte detected most frequently (PFOS) is shown first, and the analyte detected least frequently (NEtFOSAA) is shown last.

For each analyte, the table presents the following parameters:

- The frequency of detection, which is the percentage of samples for which the laboratory reported a measured concentration, as opposed to a non-detect.
- The maximum measured concentration.
- The geometric mean concentration and the 95 percent confidence interval around that value. These parameters are shown only for analytes detected in at least 60% of the samples, and they were calculated after replacing non-detect observations with the analyte's reporting limit divided by the square root of two. The values shown in Table 4 are not age-adjusted.
- The 25^{th}, 50^{th}, 75^{th}, and 95^{th} percentile concentrations. These values were based only on measured concentrations above the reporting limits.

For a visual depiction of the measured serum PFAS concentrations, Figure 6 shows the distribution of concentrations for the four PFAS detected in at least 60% of the samples and for ΣPFAS7. The data points are further stratified by eligibility category. The figure is a "box and whisker" plot with data shown on a logarithmic scale—a scale that allows for highly variable data to be better displayed on one figure. In this plot, the shaded boxes represent the interquartile range of data or the "middle 50%" of serum PFAS concentrations for a particular analyte and eligibility category. The horizontal lines within these shaded boxes are median concentrations; and the diamonds are geometric mean concentrations. The vertical lines extending beneath and above the shaded boxes indicate the spread of data beyond the interquartile range, and the circles shown in the plot are outliers as defined by the software used to generate the plots.[2]

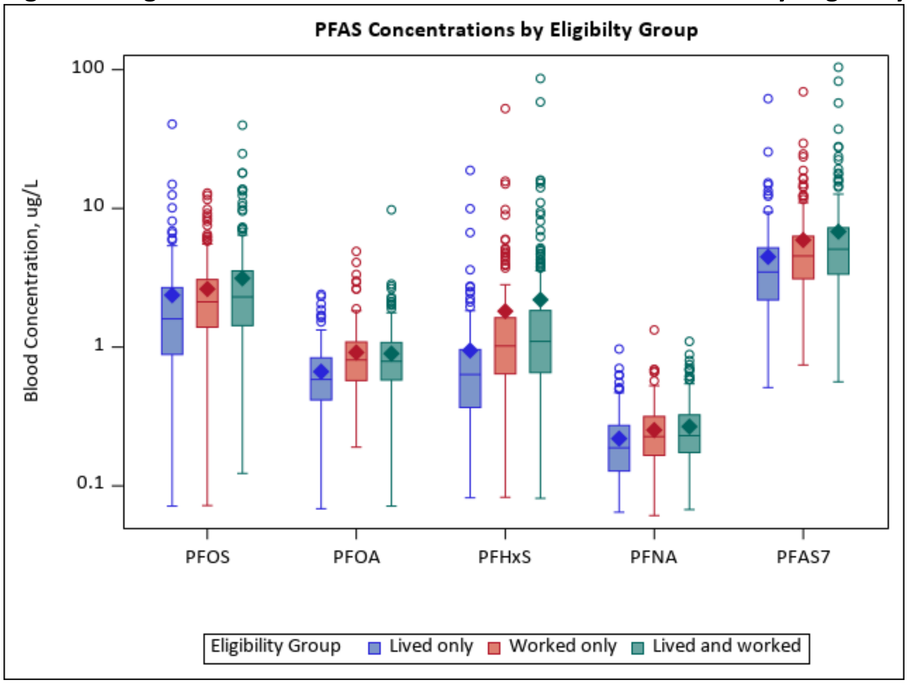
Table 4: Statistics for PFAS in Blood Among NM-PBT participants

PFAS	FOD (%)	Max (µg/L)	Geometric Mean (µg/L)	95% CI for Geometric Mean (µg/L)	Percentiles			
					25th	50th (median)	75th	95th
PFOS	99.7%	40.5	2.00	1.88-2.13	1.25	2.04	3.16	6.71
PFOA	99.5%	9.77	0.713	0.681-0.746	0.522	0.739	1.02	1.69
PFHxS	98.2%	86.4	0.927	0.859-0.999	0.528	0.912	1.53	4.54
PFNA	90.4%	1.33	0.216	0.206-0.225	0.157	0.221	0.311	0.502
PFDA	37.9%	1.61	--	--	<0.100	<0.100	0.128	0.258
PFHpS	36.8%	2.67	--	--	<0.100	<0.100	0.129	0.259
PFUnA	15.9%	0.721	--	--	<0.100	<0.100	<0.100	0.165
PFPeS	8.3%	0.649	--	--	<0.100	<0.100	<0.100	0.140
NMeFOSAA	7.8%	1.23	--	--	<0.100	<0.100	<0.100	0.180
PFHpA	3.0%	0.415	--	--	<0.100	<0.100	<0.100	<0.100
PFBA	1.0%	0.889	--	--	<0.400	<0.400	<0.400	<0.400
PFTrDA	1.0%	0.298	--	--	<0.100	<0.100	<0.100	<0.100
PFBS	0.8%	0.177	--	--	<0.100	<0.100	<0.100	<0.100
PFDoA	0.8%	0.159	--	--	<0.100	<0.100	<0.100	<0.100
PFHxA	0.3%	0.136	--	--	<0.100	<0.100	<0.100	<0.100
NEtFOSAA	0.2%	0.108	--	--	<0.100	<0.100	<0.100	<0.100
ΣPFAS7	--	104	4.44	4.21-4.69	2.86	4.49	6.50	12.7

FOD = frequency of detection, µg/L=micrograms per liter, CI=confidence interval.
Concentrations that begin with "<" are non-detects, and the values shown are the analytes' reporting limits (see Table 1).

[2] Outliers in the box and whisker plot are concentrations greater than the 75th percentile plus 1.5 times the interquartile range. This algorithm is routinely used when generating box-and-whisker plots.

Figure 6: Log-Scale Distribution of Serum PFAS Concentrations by Eligibility Category



The serum PFAS concentration descriptive statistics support the following summary statements:

- The laboratory tested every serum sample for 33 PFAS. The number of PFAS detected in serum varied across the participants, and 16 PFAS were detected in at least one sample. The analytes detected most frequently were PFOS (detected in 99.7% of samples), PFOA (99.5%), PFHxS (98.2%), and PFNA (90.4%). Statistical analyses throughout this section focus on these four analytes and ΣPFAS7.
- 626 out of the 628 eligible participants—or 99.7% of participants—had at least one PFAS analyte detected in their serum samples. Only two participants of the 628 eligible participants—or 0.3% of participants—had no PFAS detected in their serum. This frequency of detection is generally consistent with what has been observed in other PFAS blood testing efforts nationwide (e.g., ATSDR, 2022b; Calafat et al., 2007).
- The three analytes with the highest serum concentrations were PFHxS (86.4 µg/L), PFOS (40.5 µg/L), and PFOA (9.77 µg/L). All other analytes had serum concentrations no higher than 3 µg/L across all samples.
- Geometric mean concentrations were calculated for the four analytes detected most frequently. These concentrations are a measure of the central tendency of serum PFAS concentrations among the NM-PBT project participants. The geometric mean concentrations, in decreasing order, are 2.00 µg/L for PFOS, 0.927 µg/L for PFHxS, 0.713 µg/L for PFOA, and 0.216 µg/L for PFNA.

Appendix B presents additional box and whisker plots showing how serum concentrations for the four most frequently detected PFAS varied by the participants' age and sex. The first plot in the appendix indicates that, on average, serum concentrations of the four PFAS were highest among participants aged 50 years and older and lowest among participants under 30 years of age. The second plot indicates that, on average, serum concentrations of the four PFAS were higher among males when compared to females. The trends implied by these plots—serum PFAS concentrations increasing with age in adulthood and serum PFAS concentrations higher in men than in women—are consistent with those reported in nationwide studies (e.g., ATSDR, 2022b). Section 5.5 explores the relationships between serum PFAS concentrations and participants' age and sex using more refined statistical approaches.

5.3 Comparison of Serum PFAS Concentrations to NASEM Medical Screening Guidelines

In their results letters, participants learned how their individual blood test results compare to NASEM's medical screening guidelines (NASEM, 2022). The results letters (see Appendix A) informed participants of recommended screenings. This section makes similar comparisons, except for the entire population of 628 participants. For reference, the NASEM guidelines are:

- **ΣPFAS7 serum concentrations less than 2 µg/L.** NASEM recommends no special health screenings for adults with serum ΣPFAS7 concentrations in this range. NASEM estimates that 2% of the nation's adult population has a serum concentration in this range.
- **ΣPFAS7 serum concentrations greater than or equal to 2 µg/L and less than 20 µg/L.** NASEM recommends adults with serum concentrations in this range receive screenings for high cholesterol, for high blood pressure (among pregnant women only), and for breast cancer (among women only).[3] NASEM also recommends exposure reduction, especially for pregnant women, if a PFAS source has been identified. NASEM estimates that 89% of the nation's adult population has serum concentrations in this range.
- **ΣPFAS7 serum concentrations greater than or equal to 20 µg/L.** NASEM recommends adults with serum concentrations in this range receive screenings for screenings for high cholesterol, thyroid function tests, and assessments of signs and symptoms of testicular cancer (in males), kidney cancer, and ulcerative colitis.[4] NASEM also recommends exposure reduction, especially for pregnant women, if a PFAS source has been identified. NASEM estimates that 9% of the nation's adult population has serum concentrations in this range.

Table 5 shows how the NM-PBT project participants' serum ΣPFAS7 concentrations compared to the NASEM medical screening guidelines. The table makes similar comparisons for the project's three eligibility categories. Overall, 2.2% of the 628 NM-PBT project participants had serum ΣPFAS7 concentrations greater than or equal to 20 µg/L—a percentage that is lower than what NASEM estimated for the nationwide population. The majority of participants (86.6%) fell into the middle category of NASEM's medical screening guidelines, with ΣPFAS7 levels between 2 and <20 µg/L; and the remaining 11.2% of participants had ΣPFAS7 levels below 2 µg/L.

[3] Refer to page 149 in NASEM's *Guidance on PFAS Exposure, Testing, and Clinical Follow-Up* (NASEM, 2022) for the exact wording used for recommended medical screening. This reference is available for free at https://nap.nationalacademies.org/download/26156.

[4] Refer to page 149 in NASEM's *Guidance on PFAS Exposure, Testing, and Clinical Follow-Up* (NASEM, 2022) for the exact wording used for recommended medical screening. This reference is available for free at https://nap.nationalacademies.org/download/26156.

Table 5: Comparison of Participants' Serum ΣPFAS7 Concentrations to NASEM's Medical Screening Guidelines

NASEM Category (ΣPFAS7)	All Participants (n=628)	Participants who only worked in the project focus area (n=182)	Participants who only lived in the project focus area (n=167)	Participants who both lived and worked in the project focus area (n=279)
<2 µg/L	70 (11.2%)	17 (9.3%)	36 (21.6%)	17 (6.1%)
2 to <20 µg/L	544 (86.6%)	161 (88.5%)	129 (77.3%)	254 (91.0%)
≥20 µg/L	14 (2.2%)	4 (2.2%)	2 (1.2%)	8 (2.9%)

µg/L=micrograms per liter

5.4 Comparison of Serum PFAS Concentrations to National Levels

This section compares serum PFAS concentrations measured during the NM-PBT project to nationwide levels reported in NHANES. NHANES is a long-running, nationally representative survey that collects data on various health indicators, including serum PFAS concentrations. The survey is designed to be representative of the nationwide population of adults aged 20 years and older. At the writing of this report, the most recent published NHANES data for serum PFAS concentrations is from the 2017-2018 survey cycle. This section first compares the NM-PBT results to the 2017-2018 NHANES data, then presents two additional comparisons of NM-PBT results to other data sets for additional context.

Two data processing steps were taken to ensure a meaningful data comparison. First, the comparison was limited to NM-PBT project participants who were 20 years and older, as this is the same age range used in NHANES. This data processing step removed six participants from the comparison because they were under 20 years old at the time when they provided their blood samples. Second, the NM-PBT project serum PFAS concentrations were age-adjusted to account for differences in the age distributions between the two data sets. Age adjustment was based on the U.S. population distribution from the 2017-2018 NHANES survey, ensuring comparability between the two groups.

Table 6 compares geometric mean serum PFAS concentrations from the 2017-2018 NHANES survey to the corresponding age-adjusted geometric mean serum PFAS concentrations from the NM-PBT project. For the four PFAS detected most frequently in the present work, comparisons were made for geometric mean concentrations and for 95th percentile concentrations. The comparisons revealed the following:

- **Geometric mean concentrations.** The age-adjusted geometric mean concentrations of PFOS, PFOA, PFNA, and PFHxS for NM-PBT project participants were all lower than the corresponding national averages, based on the 2017-2018 NHANES survey. These were all statistically significant findings.
- **95th percentile concentrations.** For PFOS, PFOA, and PFNA, the 95th percentile age-adjusted serum concentrations from the NM-PBT project were lower than the corresponding 95th percentiles nationwide, based on the 2017-2018 NHANES survey. On the other hand, the age-adjusted 95th percentile serum PFHxS concentration from the NM-PBT project (4.50 µg/L) was higher than the corresponding 95th percentile nationwide (3.80 µg/L). Further, 6.9% of the NM-PBT project participants had serum PFHxS concentrations greater than the NHANES 95th percentile. This indicates that serum PFHxS concentrations from project participants have a skewed distribution, because the central tendency measure is lower than the national averages, yet the 95th percentile concentrations are higher.

The data comparisons noted above have two limitations. One limitation of this section's data comparisons is the different time frames that samples were collected. All NM-PBT project blood samples were collected in 2024, but all NHANES blood samples used for comparison were collected six to seven years earlier (i.e., in 2017 and 2018). This difference is important because serum PFAS concentrations in the general U.S. population have been declining for years (Sonnenberg et al., 2023). The rate of decline in nationwide serum levels varies from one PFAS analyte to the next and can be viewed in the "human exposure" section of ATSDR's *PFAS Information for Clinicians* resource (ATSDR, 2024). Therefore, even though Table 6 indicates that NM-PBT project participants' serum PFAS concentrations from 2024 are lower than the national averages from 2017-2018, it is unclear whether the participants' levels are lower than current nationwide averages because nationally representative serum PFAS data are not available for 2024.

Another limitation is that the NHANES comparison data pertain to the nationwide civilian, non-institutionalized population. These data are not necessarily representative of military populations. CDC has not conducted a similar biomonitoring effort to characterize nationwide average PFAS serum concentrations for military personnel or military households.

Table 6: Comparison of PFAS Blood Levels in NM-PBT Participants to the U.S. Nationwide Averages

PFAS	2017-18 NHANES Geometric Mean (95% CI)*	NM-PBT Age-adjusted Geometric Mean (95% CI)*; and *p-value*	NHANES 95th Percentile	NM-PBT 95th Percentile (adjusted)	Percent of NM-PBT Participants with Results over NHANES 95th Percentile
PFOS	4.50 (4.15-4.89)	2.08 (1.94-2.24) *p<0.001*	15.1	8.08	0.8%
PFOA	1.45 (1.35-1.56)	0.719 (0.684-0.755) *p<0.001*	3.87	1.70	0.5%
PFHxS	1.11 (1.03-1.21)	0.935 (0.862-1.02) *p=0.007*	3.80	4.50	6.9%
PFNA	0.419 (0.371-0.474)	0.215 (0.205- 0.225) *p<0.001*	1.40	0.499	0%

95% CI = 95% confidence interval.
All results are shown in units of µg/L.
P-values represent a t-test comparison between the NM-PBT and the NHANES geometric means. A p-value of <0.05 indicates a statistically significant difference between NM-PBT and NHANES geometric means.
**For compatibility with NHANES, these geometric means only include participants aged 20 years and older.*

Two other data comparisons were conducted for further context. First, even though CDC has not issued its standard NHANES data summary tables for PFAS serum measurements in the 2019-2020 cycle, some CDC scientists recently authored an article in the peer-reviewed literature that, among other things, reported NHANES summary statistics for samples collected between 2017 and March 2020 (Botelho et al., 2025). NHANES data for the entire calendar year 2020 are not available because sample collection was interrupted by the emerging COVID pandemic in March 2020. The geometric mean concentrations reported for NHANES 2017-March 2020 in that article (PFOA, 3.93 µg/L; PFOS, 1.38 µg/L; PFHxS, 1.04 µg/L; PFNA, 0.460 µg/L) (Botelho et al., 2025) are all higher than the corresponding NM-PBT age-adjusted geometric mean concentrations (see Table 6). The journal article does not provide enough data to determine if the differences between the NM-PBT results and the NHANES 2017-2020 results are statistically significant.

Second, the NM-PBT blood test results were compared to the age-adjusted geometric mean PFAS concentrations reported for the ten sites that were part of ATSDR's PFAS exposure assessment project (ATSDR, 2022b). Those ten sites were selected due to their documented evidence of PFAS-contaminated drinking water due to PFAS releases from military installations, not because the sites are nationally representative. For the four PFAS analytes shown in Table 6, the age-adjusted geometric mean concentrations from the NM-PBT project were considerably lower than those reported for the ten ATSDR exposure assessment sites:

- The age-adjusted geometric mean PFOS concentrations at the ten ATSDR sites ranged from 3.58 to 39.1 µg/L; and all ten sites had higher values than the age-adjusted geometric mean PFOS concentration (2.08 µg/L) in the NM-PBT project.
- The age-adjusted geometric mean PFOA concentrations at the ten ATSDR sites ranged from 1.32 to 8.91 µg/L; and all ten sites had higher values than the age-adjusted geometric mean PFOA concentration (0.719 µg/L) in the NM-PBT project.
- The age-adjusted geometric mean PFHxS concentrations at the ten ATSDR sites ranged from 2.62 to 65.6 µg/L; and all ten sites had higher values than the age-adjusted geometric mean PFHxS concentration (0.935 µg/L) in the NM-PBT project.
- The age-adjusted geometric mean PFNA concentrations at the ten ATSDR sites ranged from 0.169 to 0.692 µg/L; and nine of the ten sites had higher values than the age-adjusted geometric mean PFNA concentration (0.215 µg/L) in the NM-PBT project.

The previous comparisons indicate that serum PFAS levels in selected areas with documented evidence of community-wide drinking water contamination were consistently (and for some sites, considerably) higher than the corresponding serum PFAS levels from the NM-PBT project, which included participants with widely varying levels of PFAS exposures via contaminated drinking water.

5.5 Associations Between PFAS Exposure Variables and Serum PFAS Concentrations

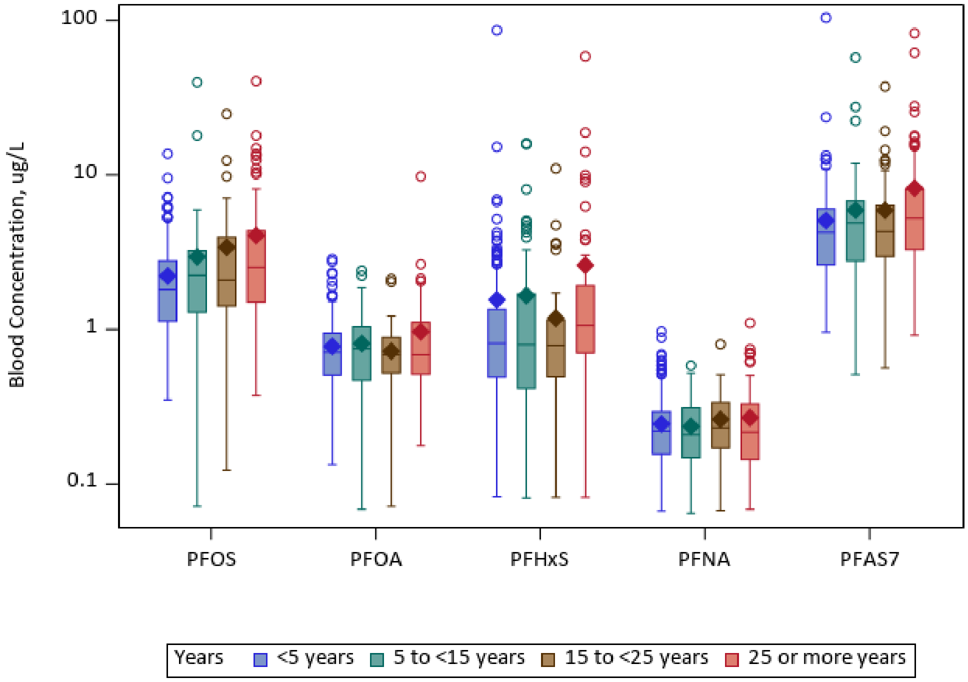
This section presents data analyses conducted to achieve the NM-PBT project's third objective (see Section 3.4): evaluating how serum PFAS concentrations among participants relate to indicators of exposure history. The analyses investigated associations between dozens of variables from the exposure history questionnaires and serum concentrations of PFOS, PFOA, PFHxS, PFNA, and ΣPFAS7; and the analyses were also stratified by eligibility category.

Three tiers of data analyses were used to identify and characterize the associations. First, data for different variables were plotted to visualize how variables were related to serum PFAS concentrations. Next, univariate linear regression models were used to identify the subset of variables that should be further investigated. Finally, these variables were evaluated further using multivariate regression models, which were the most robust statistical tools used in this evaluation. The NM-PBT project's main findings are based on statistically significant associations identified with the multivariate models. Results from all three tiers of data analyses follow, with more emphasis placed on the multivariate regression models.

Initial Data Exploration

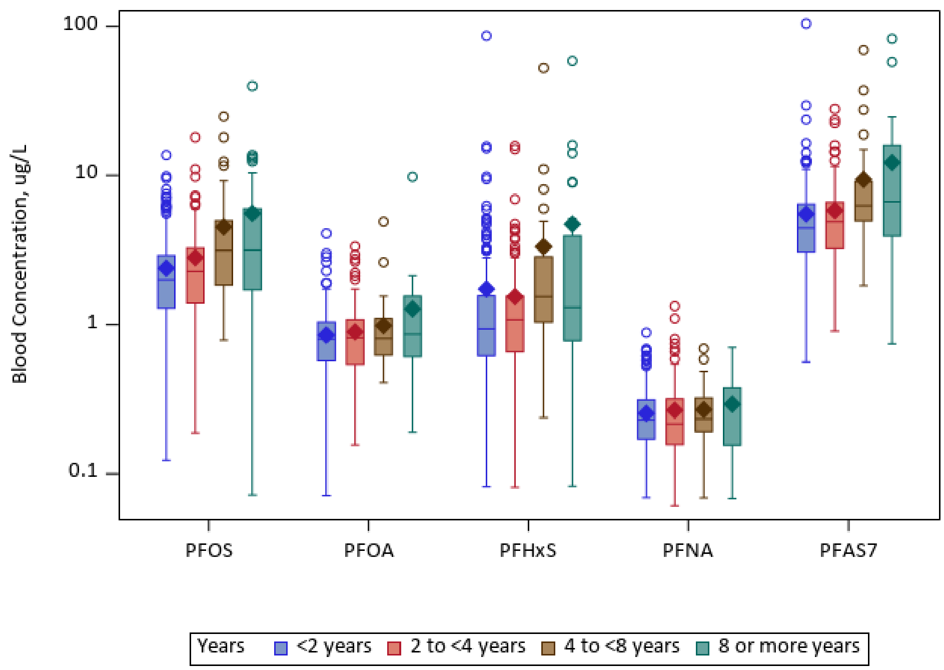
For initial insights into trends and patterns among the data, project representatives generated box and whisker plots to visualize how an exposure variable related to serum PFAS concentrations. For example, Figure 7 shows how serum PFAS concentrations vary with duration of residency in the project focus area for the subset of participants who lived, but never worked, in the area. Figure 8 shows a similar plot, except it is based on duration of employment in the project focus area for the subset of participants who worked, but never lived, in the area. Both figures suggest that serum PFAS concentrations—particularly for PFOS—increased with duration of residency and employment in the project focus area. Similar plots were generated for other variables, but the plots do not identify statistically significant trends and only supported initial data visualizations. The regression models described below investigated the associations more rigorously.

Figure 7: Log-Scale Distribution of Serum PFAS Concentrations by Years Lived in the Project Area



Note: Only includes NM-PBT participants who only ever lived in the project focus area.

Figure 8: Log-Scale Distribution of Serum PFAS Concentrations by Years Worked in the Project Area



Note: Only includes NM-PBT participants who only ever worked in the project focus area.

Correlations in Univariate Regression Models

The next step in the data evaluation was to use univariate regression models to determine which variables are independently associated with serum concentrations for PFOS, PFOA, PFHxS, PFNA, or ΣPFAS7. The models were run for 31 different exposure variables, and Appendix C presents the univariate modeling results. The following variables had statistically significant ($p < 0.05$) associations with at least one PFAS analyte in the univariate analyses, and these variables were further evaluated using the more robust multiple regression models, described later in this section:

- Variables indicative of PFAS drinking water exposures
  - Number of years lived in the project focus area
  - Number of years worked in the project focus area
  - Source of water at home (private well, public water system, bottled water)
  - Source of water at work (bottled water, tap water from home, tap water from work)
  - Eight-ounce cups of tap water consumed per day at home
  - Eight-ounce cups of tap water consumed per day at work
- Demographic variables
  - Age
  - Race and ethnicity
  - Sex
- Behavioral and occupational exposure variables
  - Blood donation frequency
  - Dirt exposure frequency
  - Whether participant consumed local eggs
  - Local egg consumption frequency
  - Fast food consumption frequency
  - Local fruit and vegetable consumption frequency
  - Firefighting experience
  - Military and/or aviation experience

Although the univariate regression models identified variables that are independently associated with serum PFAS concentrations, these models do not account for confounding factors—or whether and to what extent other variables might have explained the independent associations. Multivariate regression models were run to address this limitation, and the models were only run for the 11 variables with statistically significant associations identified in the univariate analysis.

Note that the univariate models did not find significant findings for the variables specific to female participants (e.g., number of pregnancies carried to term, history of breastfeeding). Because of this, these variables were not considered in the multivariate regression models.

Correlations in Multivariate Regression Models

Multivariate regression models were run to explore correlations between the variables listed above and serum PFAS concentrations. For every variable, separate models were run for concentrations of PFOS, PFOA, PFHxS, PFNA, and ΣPFAS7; and separate models were run for the entire population of eligible participants and for two eligibility categories. Appendix E presents output for the variables found to have statistically significant correlations, and Table 7 summarizes the findings. Specifically, Table 7 indicates which specific variables had statistically significant correlations with serum concentrations of different PFAS.

The modeling results found that age, sex, and frequency of blood donation were the only variables correlated with serum concentrations for all five PFAS considered. Other blood testing initiatives identified these same three variables as being related to serum PFAS concentrations (e.g., ATSDR, 2022b). Further details of these correlations follow:

- **Age.** Across the entire pool of participants, serum concentrations of PFOS, PFOA, PFHxS, PFNA, and ΣPFAS7 all increased with age; and this finding was statistically significant. This finding was also observed in the subset of participants who had ever lived in the project focus area, but who had never worked there. For the entire population, the strongest correlation with age was observed for PFNA for which serum concentrations increased by 2.0% per year.
- **Sex.** For the complete set of 628 eligible participants, serum concentrations of PFOS, PFOA, PFHxS, PFNA, and ΣPFAS7 in men were higher than those in women; and the concentration difference was statistically significant. The magnitude of the concentration difference varied across the PFAS analytes.
- **Frequency of blood donation.** Across all participants, serum concentrations of PFOS, PFOA, PFHxS, PFNA, and ΣPFAS7 in people who donate blood at least once per year were lower than the concentrations in people who "rarely" or "never" donate blood; and the concentration difference was statistically significant. The magnitude of the concentration difference varied across the PFAS analytes and among the eligibility categories.

Other variables had statistically significant correlations with serum concentrations of certain PFAS, but not for all five of the PFAS considered in the multivariate models. Some findings noted below are consistent with expectations and with findings reported in other research; and other findings are inconsistent with expectations or may have occurred by chance. Examples include:

- **Race and ethnicity.** Participants identifying as Hispanic or Latino had lower serum concentrations of PFHxS, PFNA, and PFOA when compared to participants identifying as white, non-Hispanic. However, statistically significant concentration differences were not observed for PFOS or ΣPFAS7.
- **Indicators of drinking water exposure.** Three variables that relate to drinking water exposure (e.g., years worked in the project area, years lived in the project area, and cups of tap water consumed at work) had statistically significant correlations with serum concentrations of some, but not all, PFAS analytes considered. For example, the number of years worked in the project focus area had the strongest association with serum PFHxS concentrations. For the complete participant population, each additional year of work in the project focus area corresponded to a 1.6% increase in serum PFHxS concentration. A significant but weaker finding was also observed for the number of years participants lived in the project focus area when looking only at the subset of participants who have "only lived" in the area. However, residency duration and employment duration were not significantly associated with serum concentrations of PFNA, PFOA, or PFOS.
- **Fast-food consumption.** Self-reported frequency of fast-food consumption had statistically significant negative correlations with PFAS serum levels. In other words, participants who reported eating fast-food most frequently had statistically lower PFAS serum levels for certain analytes when compared to those who reported never eating fast-food or eating it infrequently. The reason for this association, which is not consistent with expectations (because PFAS have been found in fast-food wrappers) is not clear.

- **Other variables.** As Table 7 shows, additional variables had statistically significant correlations with serum concentrations of certain PFAS. For example, participants with a work history in firefighting had higher serum PFOS concentrations when compared to participants without this work history. Similarly, participants with a work history in the military or aviation had higher serum PFNA and PFOA serum concentrations when compared to all other participants. As another example, participants who ate eggs from chickens or other fowl that are raised in the project focus area a few times a month or more had higher serum PFNA concentrations than participants who rarely or never consumed the locally produced eggs. Finally, participants who are exposed to dirt while at work had higher serum concentrations of ΣPFAS7 than participants who did not report this exposure pathway. All correlations noted in this paragraph were statistically significant.

5.6 Serum PFAS Concentration Trends for Participants in the Plume Area

The final data analysis considered whether participants who ever lived or worked in the plume area near Cannon AFB (see Figure 1) had different serum PFAS concentrations when compared to all other participants and to nationwide averages. This analysis was performed due to the PFAS contamination in the groundwater plume and the fact that residents in this area generally get their drinking water from private wells. Overall, 19 participants had either worked, lived, or both within the plume area.

The box and whisker plot in Figure 9 shows serum concentrations for the four most frequently detected PFAS and for ΣPFAS7. The figure suggests that the serum concentrations among those who lived or worked in the plume area are higher than the concentrations among NM-PBT project participants who did not. Table 8 provides quantitative context for these comparisons:

- For PFHxS, the geometric mean concentration for the plume area participants (3.56 µg/L) is four times higher than the corresponding geometric mean concentration for all other participants (0.89 µg/L). Similarly, for PFOS, the geometric mean concentration for the plume area participants (4.38 µg/L) is 2.2 times higher than the corresponding geometric mean concentration for all other participants (1.95 µg/L). Finally, for ∑PFAS7, the geometric mean concentration for the plume area participants (11.28 µg/L) is 2.6 times higher than the corresponding geometric mean concentration for the remainder of participants (4.31 µg/L). The concentration differences for these three PFAS are all statistically significant.
- The table also indicates that two PFAS analytes—PFHpS and PFDA—were detected in more than 60% of the serum samples from participants who ever lived or worked in the plume area. In comparison, these analytes were detected less frequently in the serum from the remainder of NM-PBT project participants.

A logical inference is that exposures to PFAS-contaminated drinking water was the likely source of the elevated serum concentrations for participants who lived or worked in the plume area, but other pathways (e.g. inhalation) might have also contributed.

Table 7: Associations Characterized Using Multivariate Linear Regression Models

Parameter	PFHxS			PFNA			PFOA			PFOS			ΣPFAS7		
	Entire Sample	Lived only	Worked only	Entire Sample	Lived only	Worked only	Entire Sample	Lived only	Worked only	Entire Sample	Lived only	Worked only	Entire Sample	Lived only	Worked only
Age	✓	✓	—	✓	✓	—	✓	✓	—	✓	✓	—	✓	✓	—
Sex	✓	✓	✓	✓	—	✓	✓	—	✓	✓	✓	✓	✓	✓	✓
Race	✓	—	—	✓	—	✓	✓	—	✓	NA	NA	NA	NA	NA	NA
Years working in the project area	✓	NA	✓	—	NA	—	—	NA	—	—	NA	—	✓	NA	—
Years lived in the project area	—	✓	NA	—	—	NA	NA	NA	NA	—	—	NA	—	—	NA
8-oz cups of water consumed at work each day	—	NA	—	—	NA	✓	—	NA	—	—	NA	✓	—	NA	—
Blood donation	✓	—	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Local egg consumption frequency	NA	NA	NA	✓	—	—	NA	NA	NA	—	—	—	NA	NA	NA
Dirt exposure frequency	—	—	—	NA	NA	NA	NA	NA	NA	—	—	—	—	—	✓
Firefighting work history	—	✓	—	NA	NA	NA	NA	NA	NA	✓	—	✓	—	—	✓
Work history in the USAF, military, or aviation	—	—	—	✓	—	✓	✓	—	—	—	—	—	—	—	—

✓= statistically significant association identified in the multivariate regression model.
'—' = association was not statistically significant.
NA = not applicable; these variables were not explored in the multivariate analysis because they did not have statistically significant independent associations identified in the univariate analysis.

Figure 9: Log-Scale Distribution of Serum PFAS Concentrations by History in the Plume Area

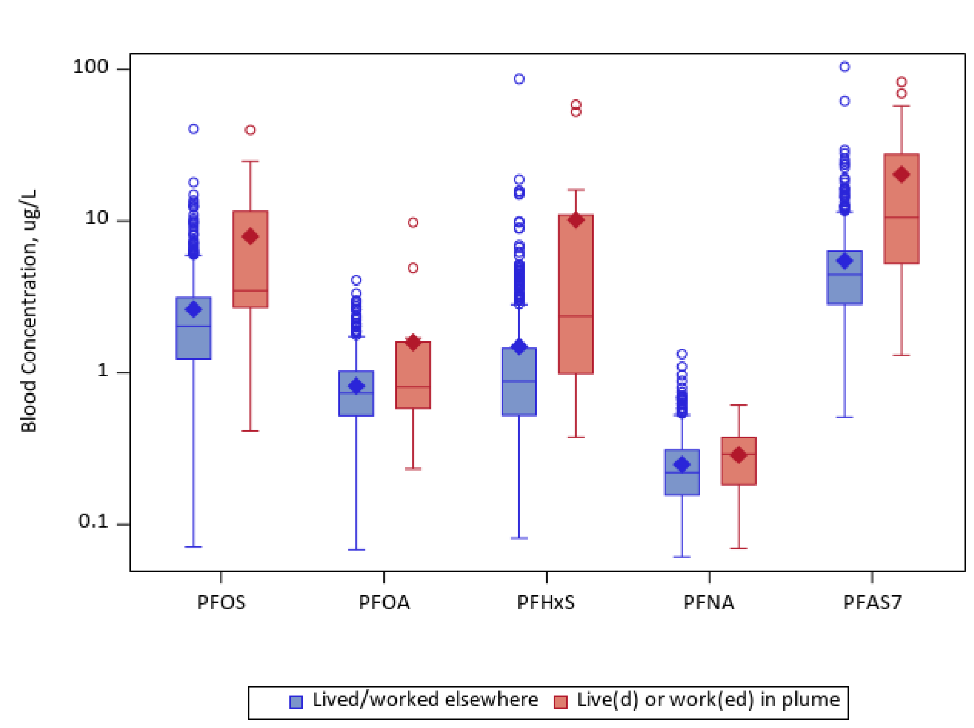


Table 8: Comparison of PFAS Blood Levels Among those with and without History in the Plume Area

PFAS	Never Lived or Worked in Plume Area (n=607)				Ever Lived or Worked in Plume Area (n=19)				p-value
	FOD	Geometric Mean	95% CI		FOD	Geometric Mean	95% CI		
PFOS	100%	1.95	0.83	0.96	100%	4.38	2.55	7.52	0.006
PFOA	100%	0.71	0.67	0.74	100%	1.00	0.66	1.52	0.101
PFHxS	98%	0.89	0.83	0.96	100%	3.56	1.71	7.41	0.036
PFNA	90%	0.21	0.21	0.22	95%	0.26	0.20	0.33	0.162
PFHpS	35%	0.10	0.09	0.10	79%	0.29	0.16	0.53	--
PFDA	37%	0.10	0.09	0.10	63%	0.11	0.09	0.14	--
PFAS7	NA	4.31	4.09	4.54	NA	11.28	6.58	19.32	0.001

T-tests between groups were performed for PFAS detected in 60% or more of the entire sample as well as for PFAS7. T-tests were performed on log-transformed concentrations due to the skewed nature of the data.
**P-values represent a t-test comparison between geometric mean values for those who never lived or worked in the plume area and those who did. A p-value of <0.05 indicates a significant difference between these groups.*

The plume area serum PFAS concentration results were also compared to nationwide averages, using the 2017-2018 NHANES survey data. This comparison found that the geometric mean serum PFHxS concentration for the plume area participants (3.56 µg/L) was higher than the nationwide average (1.11 µg/L); and the concentration difference was statistically significant. Geometric mean serum concentrations for PFNA, PFOA, and PFOS among plume area participants were all lower than those reported for the adult population in the 2017-2018 NHANES survey cycle.

Among the 19 participants who had ever lived or ever worked in the plume area, 5 had serum ΣPFAS7 concentrations greater than 20 µg/L—the higher concentration threshold used in NASEM's medical screening guidelines for PFAS. Thus, 26% of the plume area participants had ΣPFAS7 concentrations in the highest medical screening tier issued by NASEM; on the other hand, 2.2% of the overall NM-PBT participants had serum concentrations in this range.

The previous observations indicate that serum concentrations for certain PFAS are elevated for people who lived or worked in the plume area both when compared to other NM-PBT project participants and to nationwide results. While multivariate models could explore the underlying factors that contributed to these elevated serum PFAS concentrations in the plume area, the small sample size (i.e., 19 participants) caused the multivariate models to be unstable.

6.0 LIMITATIONS

The serum PFAS concentrations measured during the NM-PBT project provide valuable insight into PFAS exposures among Curry County residents who have worked or lived near a site (Cannon AFB) with known PFAS contamination. However, there are known limitations that should be considered when interpreting this project's serum concentration data. Examples include:

- Recruitment focused on people who have ever lived or worked in a specific area within Curry County (i.e., the project focus area). The serum concentration results pertain to the individuals who voluntarily participated and should not be generalized to people who chose not to participate, to people in other Curry County locations, or to people living elsewhere in New Mexico.
- By design, the NM-PBT project considered a convenience sample of those who chose to participate. However, that sample might not be statistically representative of all eligible participants due to self-selection bias. For example, individuals who are more informed about local PFAS contamination issues might have been more inclined to participate; and other individual characteristics (e.g., poor health status, inability to drive) might have limited participation in certain segments of the population.
- The most recent nationwide comparison data for serum PFAS concentrations are from the 2017-2018 NHANES survey. Nationwide comparison data are not available for 2024, when the NM-PBT project samples were collected.
- The exposure history questionnaire data were based entirely on self-reported responses, which introduces the potential for recall bias. Participants might not have accurately remembered or reported past behaviors, which could affect data quality. Additionally, the questionnaire responses provided insights on potential PFAS exposure pathways, but they do not quantify actual PFAS exposures.
- The current state of the science does not allow one to determine whether serum PFAS concentrations are harmful to health. Test results cannot tell someone if an existing health problem is related to PFAS exposure or if an adverse health effect will develop in the future (ATSDR, 2024). The blood test results should not be interpreted as diagnostic or prognostic tools for individual health outcomes.
- The laboratory analytical method used in the NM-PBT project provided extensive insights by measuring serum concentrations of 33 PFAS, but the method did not provide comprehensive insights. No analytical method measures the full range of PFAS compounds that might be encountered in the environment.
- PFAS blood test results indicate serum concentrations on the date that samples were collected. The serum concentrations may increase or decrease over time, depending on the magnitude and frequency of ongoing exposures and other factors. Further, the test results do not indicate when a participant was exposed to PFAS or where the PFAS in the blood sample came from.

7.0 FUTURE DIRECTIONS AND USE OF RESULTS

This report summarizes the main findings from the NM-PBT project. As of the report date, three week-long PFAS blood testing events were held, PFAS blood tests were given to 638 participants, results letters were sent to all participants, and NMDOH and NMED held two open availability sessions in Clovis to discuss results with participants in a confidential setting. The agencies intend to hold a public meeting in Curry County to present NM-PBT results to the entire community, not just to those who participated in the project. Further, the agencies that sponsored this project have several planned follow-up activities based on the project findings.

NMDOH will:

- Follow up with the participants who have the highest serum PFAS concentrations. This will include discussing recommended health screenings and helping to identify and address any ongoing exposures.
- Continue to educate local physicians on the health effects associated with PFAS exposure, and on the NASEM medical screening recommendations for different ranges of serum PFAS concentrations.
- Develop and disseminate new resources with the latest scientific information on what residents and other stakeholders can do to reduce their PFAS exposure.

NMED will:

- Continue evaluating water mitigation and remediation opportunities including pursuing alternative drinking water solutions for residents, businesses, and agricultural operations impacted by Cannon AFB's PFAS contamination, including:
    - Water treatment systems for residents, businesses, and agricultural operations; and
    - Public drinking water supply lines for nearby and willing residents currently serviced by private drinking water wells located, or within the path of, the PFAS groundwater plume that remains uncontrolled and untreated.
- Expand PFAS exposure assessments to other impacted communities across New Mexico, such as Holloman Air Force Base as well as additional sites identified through federal or state monitoring data.
- Develop and strengthen regulatory frameworks and advancing legal action against the U.S. Air Force until such time the community is adequately protected from off-site releases, including:
    - Enforcing the recently passed HB212 which requires an end to the use of PFAS-containing AFFF for anything other than emergency purposes; and
    - Incorporate PFAS into hazardous waste permitting and compliance frameworks.

In addition, NMDOH and NMED will continue to review national, regional, and state data sets related to PFAS exposures and may update this report to compare the NM-PBT project data with more recent data sets. This may result in updated conclusions, stakeholder engagement, and community interventions.

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9.0 APPENDICES

Appendix A: Selected NM-PBT Project Resources
Appendix B: Distribution of Serum PFAS Concentrations by Participants' Age and Sex
Appendix C: Descriptive Statistics for PFHxS, PFNA, PFOA, PFOS and ΣPFAS7 by Eligibility Group
Appendix D: Univariate Model Results for PFHxS, PFNA, PFOA, PFOS, and ΣPFAS7
Appendix E: Multivariate Models

APPENDIX A: SELECTED NM-PBT PROJECT RESOURCES

PARTICIPATION ACKNOWLEDGMENT FORM

Thank you for scheduling a blood sampling appointment for the New Mexico PFAS Blood Testing Project. PFAS refers to a large group of chemicals named per- and polyfluoroalkyl substances. The New Mexico Department of Health, in collaboration with NMED, initiated this project to determine the amounts of PFAS in the blood of people who live and work near Cannon Air Force Base, where PFAS contamination has been found in the environment. This form provides further information about this project, such that you can confirm with us that you want to proceed with your appointment.

<u>Why is the New Mexico Department of Health conducting this project?</u>

PFAS are of public health importance because they are found in many parts of the environment, they do not break down easily, and they are harmful to human health. Nationwide programs have found PFAS in nearly everyone's blood, but similar programs have not taken place in New Mexico. The New Mexico Department of Health is launching this project to fill that data gap.

<u>What will the New Mexico Department of Health do with the PFAS blood sampling results?</u>

The Department will use the results from all participants to inform public health actions and other decisions in New Mexico with respect to PFAS. These actions might include educating healthcare professionals about PFAS and advising people how to reduce exposures. The specific public health actions taken will depend on the amounts of PFAS found in participants' blood.

<u>Who will see my results?</u>

Your test results will be protected to the greatest extent provided by law. Only you, the New Mexico Department of Health, and the contractor that is assisting with this project will see your PFAS blood sampling results along with your name attached to them. After preparing a final report for this project, the contractor will transfer all its files from this project to the New Mexico Department of Health. The New Mexico Department of Health might share blood sampling results with other parties, but that would only be "de-identified" data that does not include any names of the participants.

<u>What will your PFAS blood sampling results tell you? What will they not tell you?</u>

Your blood will be analyzed for more than 30 different PFAS. Your test results will tell you which PFAS were detected, at what levels, and for some PFAS chemicals, how those levels compare to nationwide averages. Your PFAS levels will also be compared to guidelines issued by the National Academies of Sciences, Engineering, and Medicine about whether health screenings are appropriate.

Your blood results will not tell you if the PFAS levels are harmful to your health. The results cannot tell you if an existing health problem is related to your PFAS exposure or if you will develop a health problem in the future. The results also will not tell you when you were exposed to PFAS or where the PFAS in your body came from, because the PFAS could have come from many sources.

What are the benefits of participating?

Your participation will help the New Mexico Department of Health understand which PFAS, and how much PFAS, are found in the blood of some Curry County residents who live and work at and near Cannon AFB and how levels of certain PFAS compare to the average person in the United States. This understanding will help the New Mexico Department of Health determine if there are any public health actions needed for PFAS.

You will learn how your PFAS blood levels compare with those observed nationwide, and you will learn if certain health screenings are recommended based on your PFAS blood levels. This comparison will be made for those PFAS chemicals with national data. You will not have to pay for participating, but if your doctor should order health screenings, you will be responsible for covering those costs.

What are the risks of participating?

The main risk of participating is that associated with providing a blood sample. We will collect approximately 6 milliliters of blood, which is roughly 1 teaspoon. You might feel a sting from the needle used to draw blood, and you might develop a bruise or small blood clot at the puncture site. Although it is not common, the needle could irritate a nerve and that may cause localized numbness.

The risks associated with blood draws are higher for people with bleeding disorders, people who are anemic, and for anyone on blood thinning medications, such as Coumadin. If any of these apply to you, we recommend you either consult with your physician first about participating in this project or you do not participate in this project. Finally, even though we will use sterilized needles, there is always risk of infection as a result of the needle puncture through the skin. You or your health insurance company would be responsible for any follow-up care if you are injured as a result of the blood draw.

What else should I know about my PFAS blood test?

- You will have a small amount of blood drawn from your arm by a trained phlebotomist.
- You will not have to pay for your test. If you complete your appointment, you will receive a $25 gift card for your time.
- Your name will not be included with your blood sample. Your sample will only have a code attached to it. Only the site lead here will know who gave each sample.
- Your blood will only be tested for PFAS. It will not be tested for diseases, DNA, or the presence of alcohol or drugs.
- Your blood sample will be destroyed after the lab analyzes it.

How will I learn about my results? And who can help me understand what they mean?

It will be your choice as to whether you receive your results by secure email or by U.S. mail. You will get your results approximately 3 months after your test. The results will come to you in a letter that indicates which PFAS were found in your blood, at what levels, and for certain PFAS chemicals, how those levels compare to national averages. There will also be information related to health screenings that might be appropriate based on your PFAS levels. The letter will include a phone number that you can call if you have further questions about your results. Also, after all participants have received their results, the New Mexico Department of Health and partners will host a public meeting in the greater Clovis area to discuss what the results mean and to answer any questions. The Department will also provide informational materials on PFAS to healthcare providers in your area.

<u>What if I change my mind?</u>

Participation in this project is voluntary. If you ever choose not to participate, please call 1-575-575-PFAS. If you decide after today to no longer participate and call this phone number, we will destroy your blood sample and you will not get your result.

Acknowledgments

By marking the check boxes below and signing this form, you are confirming that you understand the goals of the project, and that you agree, of your own free will, to participate. You are also confirming that you will allow the project staff to collect and store the information gathered for the project as described above. A copy of this form will be provided for your records if you request one.

A project representative will read the following statements out loud to you. We ask that you answer each statement with either "Yes" or "No." *[Check boxes for "Yes" and "No" will be included on the final form.]*

1) I confirm that I have read and understood the information provided to me about the New Mexico PFAS Blood Testing project.
2) I confirm that I have had the opportunity to ask questions and the coordinator has answered any questions about the study to my satisfaction.
3) I understand that my participation is voluntary and that I do not have to participate.
4) I agree to participate in the New Mexico PFAS Blood Testing project and provide a blood sample.
5) I understand that this project is being done to further public health in New Mexico and to help the Department of Health understand the public health issues in my area that are subject to this project.
6) I understand that I will receive my PFAS blood test results by *[circle one: mail/email]* and that my results package will tell me how my blood test compares with national averages for certain PFAS.
7) I understand that public health surveillance involves collecting, testing, analyzing, and using information or biospecimens to improve public health and prevent disease and that the Department of Health may use combined data to inform public health actions.
8) I understand that my PFAS blood test results will be able to tell me if certain health screenings are recommended, but my PFAS blood test results will not be able to tell me where the PFAS in my blood came from, when I was exposed, and how the PFAS levels might impact my health.
9) I understand that any protected health information (PHI) collected during the course of the project will eventually be retained by the New Mexico Department of Health and no other party. The information collected may not be used for analyses not described here.

10) I agree to let the New Mexico Department of Health keep my contact information and contact me in the future with follow-up information related to my PFAS blood test results.

[Participant will be prompted to fill out the rest of the form, which will include fields for: printed name, signature, date signed, mailing address, and phone number. The senior ERG employee who described this form to the participant will also sign the form.]

EXPOSURE HISTORY QUESTIONNAIRE

General information:

1. What is your first and last name?
2. What is your date of birth?
3. What is your sex or gender identity?
    - Male
    - Female
    - Transgender Man
    - Transgender Woman
    - Non-binary
    - Something else – please specify
    - Decline or prefer not to answer
4. What is your height?
5. What is your weight?
6. Which of the following would you say is your race/ethnicity? You can give multiple responses. (Mexican American, Other Hispanic, Non-Hispanic White, Non-Hispanic Black, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander, Other, prefer not to say)
7. Reason for eligibility in the NM-PBT project:
    - Currently live in the project focus area
    - Currently work in the project focus area
    - Currently both live and work in the project focus area

Residential History

8. What is your home address? (Street number, street name, city, state, zip code)
9. How long have you lived at this address? (Years, months; estimates accepted)
10. Is this currently your full-time residence? (Yes/No; if no, ask how much time the participant lives at the address in terms of days per week, weeks per month, and months per year)
11. Please list the places in the project focus area that you have lived over the last 10 years, starting with the most recent. (Complete Table 5. If a former residence is in the Clovis area, ask for the street address. If a former residence is outside the Clovis area, ask for just the city and state.)
12. Please indicate the number of years you have lived outside the project focus area.

Table 5. Residential History Response Form

Entry	Location of Former Residence	Start Date at Residence (mm/yy)	End Date at Residence (mm/yy)
1			
2			
3			
4			
5			

6			
7			
8			
9			
10			

Source of Drinking Water at Home

13. What is your current main source of drinking water in your home?
    - Public water system – ask for name on their water bill (e.g., Cannon AFB, City of Clovis Water Division, Turquoise Estates, etc.)
    - Private well
    - Bottled water
    - Do not know
14. If you have a private well, has it been tested for PFAS? (Yes/No/Do not know)
    - If yes, ask for details on when the well was tested, how many times the well was tested, who performed the tests, and what the tests found.
15. At your current residence, on average, how many 8-ounce cups of tap water or beverages prepared with tap water, such as tea or coffee, do you drink while at home per day? (ERG field team member will display a coffee mug, a glass, or some other item to demonstrate during the interview what an 8-ounce cup is.)
    - Indicate number of cups
    - Not applicable, participant does not drink tap water at home
    - Do not know
16. Which, if any, water filters or treatment devices are you currently using to filter or treat the tap water that you drink at home? (Multiple responses are allowed; photographs will be available to explain what the response options mean)
    - Not applicable, participant does not drink tap water at home
    - Whole house carbon filter
    - Under the sink carbon filter
    - A filter at the faucet
    - A filter on a water pitcher
    - A refrigerator filter
    - A reverse osmosis (RO) system
    - Other treatment device (ask for details)
    - No filters or treatment devices
    - Do not know if the tap water is filtered or treated

Occupational History

17. Are you currently employed? (If “no,” questionnaire software will skip many of the questions that follow.)

18. What is your occupation or job title?
19. For whom do you work?
20. Is this work full-time or part-time?
21. What is the address of your employer? (Street number, street name, city, state, zip code)
22. How long have you held this job? (Years, months; estimates accepted)
23. Please indicate the main source of drinking water that you consume while you are at work.
    - Tap water from work
    - Tap water from home (i.e., participant brings tap water from home to work). Use this selection for farmers and other individuals who work from home and who drink that tap water.
    - Bottled water
    - Does not drink water at work
    - Do not know
24. Please list all other places in the project focus area that you have worked over the last 10 years, starting with the most recent. (Complete Table 6. If a former occupation is in the Clovis area, enter a street address in the location field. If a former occupation is outside the Clovis area, just enter the city and state in the location field. Enter full-time or part-time under status. Use codes beneath the table for the drinking water source.)

Table 6. Occupational History Response Form

Entry	Employer	Location	Job Title	Status	Year Started	Year Ended	Drinking Water Source
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Drinking water source codes:
1 = Tap water from work 3 = Bottled water
2 = Tap water from home 4 = Do not know

25. During the time that you worked, including at your current job, how many 8-ounce cups of tap water or beverages prepared with tap water, like tea or coffee, did you drink while at work per day? (ERG field team member will display a coffee mug, a glass, or some other item to demonstrate during the interview what an 8-ounce cup is.)
    - Indicate number of cups
    - Not applicable, participant did not drink water at work
    - Not applicable, participant has not held a job

- Do not know

26. Please indicate (Yes/No) if you worked in any of the following industries in the past 20 years? (Multiple responses allowed)
    - Manufacturing of nonstick cookware such as Teflon® coated pots/pans
    - Manufacturing of stain resistant coatings (e.g., Scotchgard®) used on carpets, upholstery, and other fabrics
    - Manufacturing of water-resistant clothing (e.g., Gore-Tex®)
    - Manufacturing of aqueous film-forming foam (AFFF)
    - Manufacturing/processing/formulating facility of PFAS (3M, DuPont, Chemours, etc.)
    - Military
    - Aviation
    - Firefighting – full-time
    - Firefighting – volunteer
27. (For every Yes response to the previous question…) Please indicate the employer, how many years worked in the position, and daily job duties, including any that involved working with PFAS.

Health-Related Questions

28. How frequently do you donate blood and/or plasma?
    - Once every 2 months
    - A few times per year
    - Once per year
    - Rarely
    - Never
29. Have you ever had your blood tested for any PFAS? (Yes/No/Do not know)
    - If yes, ask for details on when and where the test occurred, who performed the test, and what the test found.
30. *For female participants only:* Have you given birth to any children? (Yes/No; if yes, ask how many)
31. *For female participants only:* Have you ever breastfed an infant? (Yes/No; if yes ask for estimated total duration [months] of breastfeeding; this will be the sum across all children. Do not know will be an acceptable answer.)

Potential Sources of PFAS Exposure

32. Do you apply stain resistant products to carpeting, upholstered furniture, clothing, and other items in your home? (Mention Scotchgard® as an example.)
    - No
    - Do not know
    - Yes. How often do you apply stain resistant products in your home?
        - Daily
        - A few times per week
        - A few times per month
        - A few times per year

33. Do you eat fruits or vegetables that are grown at home or grown at other locations in the project focus area? (Show map of the project focus area.)
    - No
    - Do not know
    - Yes. How often do you eat these locally grown or home-grown fruits and vegetables?
        - Daily
        - A few times per week
        - A few times per month
        - A few times per year
34. Do you consume milk from animals that are raised in the project focus area? (Show map of the project focus area.)
    - No
    - Do not know
    - Yes. How often do you consume locally produced milk?
        - Daily
        - A few times per week
        - A few times per month
        - A few times per year
35. Do you eat eggs from chickens or other fowl that are raised in the project focus area? (Show map of the project focus area.)
    - No
    - Do not know
    - Yes. How often do you consume these eggs?
        - Daily
        - A few times per week
        - A few times per month
        - A few times per year
36. Do you eat fast food?
    - No
    - Do not know
    - Yes. How often do you eat fast food?
        - Daily
        - A few times per week
        - A few times per month
        - A few times per year
37. Do you come in direct contact with soil at any location in the project focus area? This may occur through digging, gardening, farming, and other activities. (Show map of the project focus area.)
    - No
    - Do not know
    - Yes. How often do you come into contact with the soil in the project focus area?
        - Daily

    - A few times per week
    - A few times per month
    - A few times per year
    - Rarely
  - If yes, at what location do you come into contact with soil most frequently? (Enter enough information to pinpoint the location. If necessary, use the map of the project focus area to help the participant answer this question.)

Final Question

19. Is there anything else you want to tell us about your PFAS exposures? (Open response)

RESULTS LETTER TEMPLATE

February 10, 2025

Full Name
Mailing Address
City, State Zip Code

Subject: PFAS Blood Test Results

Dear Full Name,

Thank you for participating in the New Mexico PFAS Blood Testing (NM-PBT) project. The goals of this inter-agency project are to determine if PFAS (per- and polyfluoroalkyl substances) are present in the blood of people who have lived or worked at or near Cannon Air Force Base, which PFAS chemicals might be detected and at what concentrations, and to compare those PFAS levels to the general U.S. population.

This letter provides your test results along with how they compare to others in the United States. The New Mexico Department of Health and the New Mexico Environment Department expects to release the final project report in the summer of 2025. That report will compare your results to the other Curry County residents and workers who participated in the NM-PBT project.

When reviewing your results, please remember that PFAS are widely used in firefighting foams and many consumer products. They are persistent in the environment and have been found in the blood of people all over the world. PFAS blood tests reflect exposures from all sources, including drinking water, food packaging, fabrics, and certain building materials. For some PFAS, blood test results reflect a combination of recent exposures and exposures that occurred months or years ago.

If you have further questions about the meaning of your PFAS test results, you can share them with your doctor and/or call the New Mexico Department of Health's Helpline at 1-833-SWNURSE (1-833-796-8773). Additionally, the New Mexico Department of Health and the New Mexico Environment Department will host an open office session at the Youth Recreation Building in Clovis to answer any questions that you have. The Youth Recreation Building is located at 1504 E 7th Street, at the corner of 7th Street and Sycamore Street. It is where you originally provided your blood sample. Here are the dates and times for the open office session:

- Thursday, February 20, 2025, from 12:00 p.m. to 8:00 p.m.
- Friday, February 21, 2025, from 12:00 p.m. to 8:00 p.m.
- Saturday, February 22, 2025, from 9:00 a.m. to 5:00 p.m.

Thank you again for participating in this project.

- The New Mexico PFAS Blood Testing Project Team

What do the results in Table 1 mean?
The following explains what the abbreviations are for the PFAS that were tested. The table also indicates which PFAS were detected in your blood and at what levels.

Table 1. Your Test Results

PFAS	Full Name of PFAS Chemical	Was This PFAS Detected in Your Blood?	Your Result (µg/L)
PFBA	Perfluorobutanoic acid	No/Yes	ND/#
PFPeA	Perfluoropentanoic acid	No/Yes	ND/#
PFHxA	Perfluorohexanoic acid	No/Yes	ND/#
PFHpA	Perfluoroheptanoic acid	No/Yes	ND/#
PFOA	Perfluorooctanoic acid	No/Yes	ND/#
PFNA	Perfluorononanoic acid	No/Yes	ND/#
PFDA	Perfluorodecanoic acid	No/Yes	ND/#
PFUnA	Perfluoroundecanoic acid	No/Yes	ND/#
PFDoA	Perfluorododecanoic acid	No/Yes	ND/#
[…and so on]			

ND = Not detected; the PFAS analyte was not detected in your sample.

What do the results in Table 2 mean?

The following table compares your results for certain PFAS chemicals to levels in the general U.S population, as reported by the Centers for Disease Control and Prevention (CDC). You will see in this table if your results are higher, lower, or about the same as others nationwide. Information for the U.S. population is only available for seven PFAS chemicals.

(1) PFAS	(2) Your Result (µg/L)	(3) U.S. Population Geometric Mean (µg/L)	(4) U.S. Population 95th Percentile (µg/L)
PFDA			

(4) This column lists the different PFAS that we measured in your blood.

(4) This column shows the amount (the concentration) of the PFAS that we found in your blood. If this number is bold, that means your level is above the national average. If this number is bold and italicized, that means your level is higher than that found in 95% of Americans.
(4) This column shows the geometric mean PFAS level, which is a measure of the average amount of PFAS in blood for the U.S. population.
(4) This column indicates the 95th percentile amount of PFAS in blood for the U.S. population. This means that 95 percent of the U.S. population has PFAS in their blood lower than this level.

Table 2. Your PFAS Results Compared to the U.S. General Population

PFAS	Your Result (µg/L)	U.S. Population Geometric Mean (µg/L)	U.S. Population 95th Percentile (µg/L)
MeFOSAA	#	0.130	0.60
PFDA	#	0.193	0.60
PFHxS	#	1.08	3.80
PFNA	#	0.411	1.40
PFOA	#	1.42	3.87
PFOS	#	4.25	15.1
PFUnA	#	0.125	0.40

Notes:

- The U.S. population numbers are based on data from CDC's 2017-2018 National Health and Nutrition Examination Survey (NHANES). That study only includes blood concentrations for the seven PFAS shown in the table, and NHANES focuses on the civilian non-institutionalized population.
- Not enough data are available from NHANES to compare your results to people of similar demographic characteristics: we cannot match your data to others with the same age, sex, race/ethnicity, and other factors.
- The comparison to the nationwide population is provided for context only. Having PFAS blood test results above or below the national averages does not tell you anything about possible adverse health effects.

What do the results in Table 3 mean?

The following table shows how we calculated the combined amount of seven common PFAS. The text after the table tells you if any health screenings are recommended for you based on the combined amount. We are using guidelines issued by the National Academies of Sciences, Engineering, and Medicine to let you know about health screenings. While some PFAS may increase the risk of certain diseases, which is why some screenings are recommended, your test results alone cannot tell you if a past, current, or future health issue is caused by your PFAS exposure. Scientists continue to evaluate the connections between PFAS blood levels and health effects.

Table 3. Sum of Blood Concentrations for Seven Common PFAS and Health Screenings

PFAS	Your Result (µg/L)
MeFOSAA	#
PFDA	#
PFHxS	#
PFNA	#
PFOA	#
PFOS	#
PFUnDA	#
Sum of seven PFAS	#

Note:

When calculating the "sum of seven PFAS" value, all non-detect results were replaced with the laboratory's detection limit divided by the square root of two. This is the approach recommended by the National Academies of Sciences, Engineering, and Medicine.

Understanding Table 3:

[Option 1]

Your "sum of seven PFAS" result is # µg/L.

That value is less than 2 µg/L.

The National Academies of Sciences, Engineering, and Medicine recommends no special health screenings for adults with "sum of seven PFAS" blood concentrations in this range.

[Option 2]

Your "sum of seven PFAS" result is # µg/L.

That value is between 2 and 20 µg/L.

The National Academies of Sciences, Engineering, and Medicine recommends the following for adults with "sum of seven PFAS" blood concentrations in this range:

- Reduce ongoing PFAS exposure if a source of exposure has been identified, especially for pregnant women. Refer to the attached fact sheet, "How can I reduce my PFAS exposure?", for further information.

- Screening for high cholesterol, for high blood pressure (among pregnant women only), and for breast cancer (among women only).
- Here is the technical terminology used by the National Academies. This language might be useful to share with your doctor:

  "With the usual standard of care physicians should:

  3) Prioritize screening for dyslipidemia with a lipid panel (…once every 4 to 6 years over age 20) as recommended by the Association of American Physicians and the American Heart Association.
  3) Screen for hypertensive disorders of pregnancy at all prenatal visits per the American College of Obstetricians and Gynecologists.
  3) Screen for breast cancer based on clinical practice guidelines based on age and other risk factors such as those recommended by the U.S. Preventive Services Task Force."
- Remember: These health screenings are recommended as a preventive measure. They do not mean that you will necessarily develop the associated health conditions.

[Option 3]

Your "sum of seven PFAS" result is # µg/L.

That value is above 20 µg/L.

The National Academies of Sciences, Engineering, and Medicine recommends the following for adults with "sum of seven PFAS" blood concentrations in this range:

- Reduce ongoing PFAS exposure if a source of exposure has been identified, especially for pregnant women. Refer to the attached fact sheet named "How can I reduce my PFAS exposure?" for further information.
- Screening for high cholesterol, testing of thyroid function, and looking for signs and symptoms of testicular cancer (in males), kidney cancer, and ulcerative colitis.
- Here is the technical terminology used by the National Academies. This language might be useful to share with your doctor:

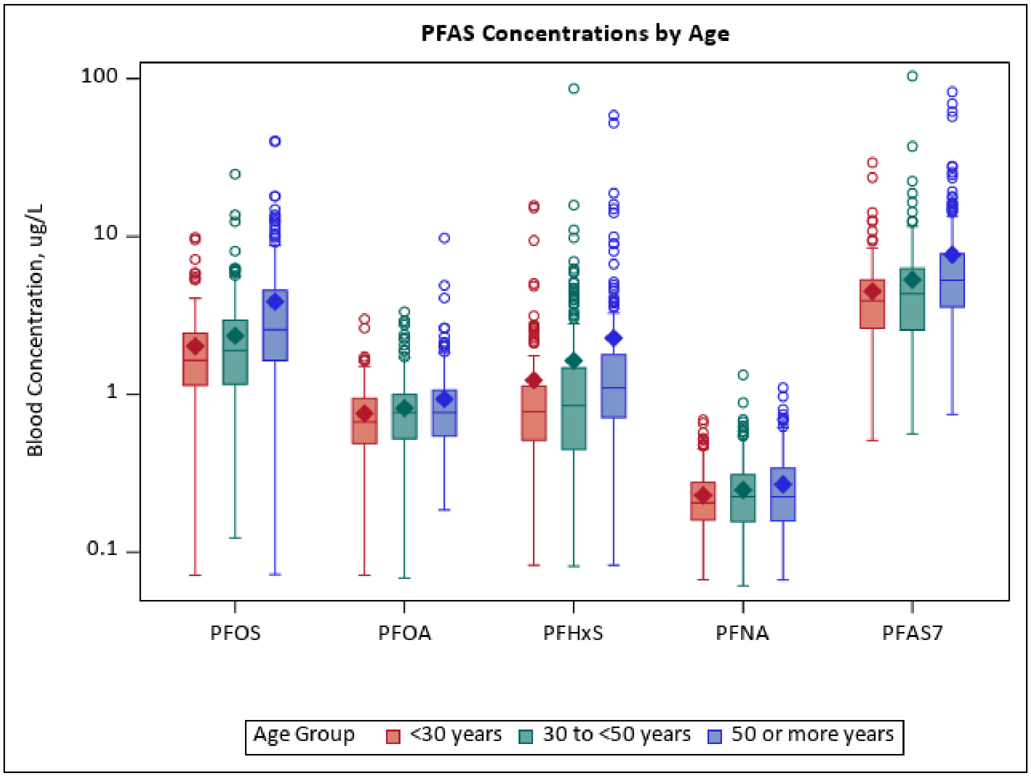
  "In addition to the usual standard of care physicians should:

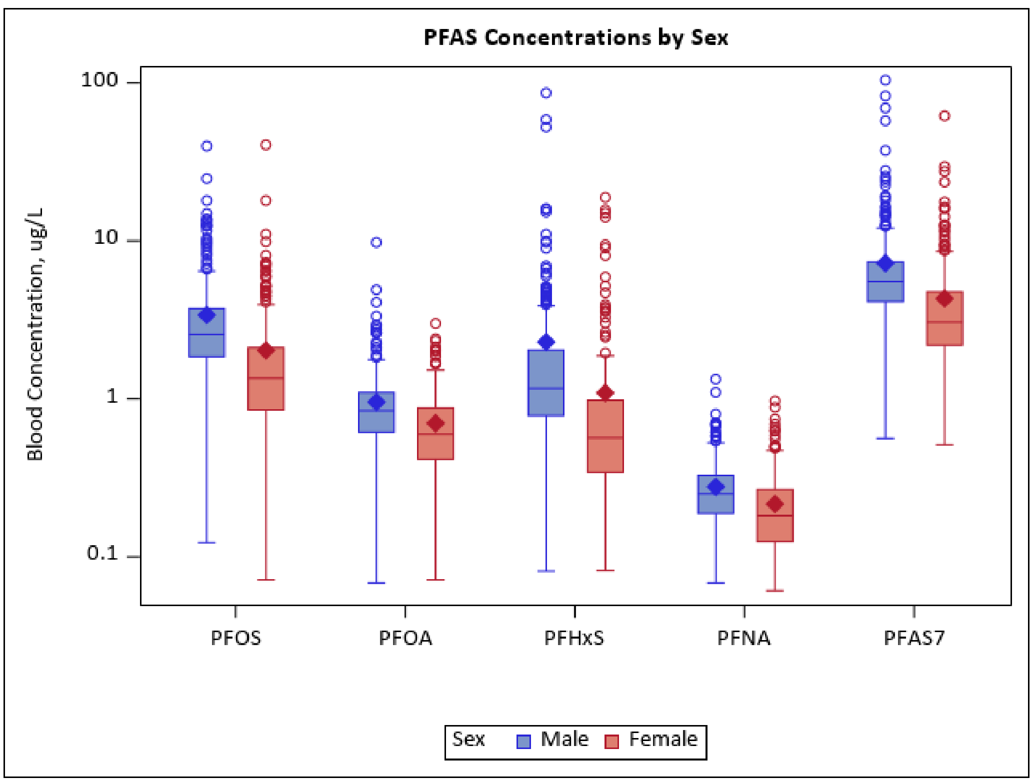
  2) Prioritize screening for dyslipidemia with a lipid panel…following recommendations…and American Heart Association guidance for high-risk adults.
  2) At all well visits:

a. Conduct thyroid function testing (for patients over age 18) with serum thyroid stimulating hormone (TSH);
b. Assess for signs and symptoms of kidney cancer (for patients over age 45), including with urinalysis; and
c. For patients over age 15, assess for signs and symptoms of testicular cancer and ulcerative colitis."

- Remember: These health screenings are recommended as a preventive measure. They do not mean that you will necessarily develop the associated health conditions.

APPENDIX B: DISTRIBUTION OF SERUM PFAS CONCENTRATIONS BY PARTICIPANTS' AGE AND SEX





APPENDIX C: DESCRIPTIVE STATISTICS FOR PFHxS, PFNA, PFOA, PFOS AND ΣPFAS7 BY ELIGIBILITY GROUP

Descriptive statistics for those who only lived in the project focus area (n=167)

PFAS	FOD	Max	Geometric Mean	95% CI for Geometric mean	Percentiles			
					25th	50th (median)	75th	95th
PFOS	99.4%	40.5	1.58	(1.39, 1.8)	0.88	1.56	2.67	5.72
PFOA	98.8%	2.40	0.565	(0.52, 0.62)	0.41	0.583	0.828	1.32
PFHxS	98.2%	18.8	0.609	(0.54, 0.69)	0.36	0.629	0.956	2.20
PFNA	82.6%	0.969	0.183	(0.17, 0.2)	0.13	0.186	0.269	0.468
ΣPFAS7	--	61.8	3.41	(3.08, 3.79)	2.2	3.48	5.12	9.13

Descriptive statistics for those who worked only in the project focus area (n=182)

PFAS	FOD	Max	Geometric Mean	95% CI for Geometric mean	Percentiles			
					25th	50th (median)	75th	95th
PFOS	99.5%	12.9	2.03	(1.82, 2.26)	1.38	2.11	3.05	6.48
PFOA	100.0%	4.90	0.783	(0.723, 0.848)	0.571	0.807	1.08	1.73
PFHxS	97.3%	52.4	1.01	(0.872, 1.16)	0.633	1.01	1.63	4.85
PFNA	92.3%	1.33	0.221	(0.205, 0.238)	0.165	0.226	0.314	0.451
ΣPFAS7	--	69.3	4.59	(4.17, 5.06)	3.11	4.52	6.25	14.1

Descriptive statistics for those who both lived and worked in the project focus area (n=279)

PFAS	FOD	Max	Geometric Mean	95% CI for Geometric mean	Percentiles			
					25th	50th (median)	75th	95th
PFOS	100.0%	39.8	2.29	(2.09, 2.5)	1.43	2.29	3.53	7.14
PFOA	99.6%	9.77	0.770	(0.722, 0.821)	0.579	0.790	1.07	1.71
PFHxS	98.9%	86.4	1.13	(1.01, 1.26)	0.653	1.10	1.83	4.94
PFNA	93.9%	1.10	0.234	(0.22, 0.249)	0.174	0.230	0.321	0.541
ΣPFAS7	--	104	5.08	(4.69, 5.51)	3.35	5.02	7.21	14.6

APPENDIX D: UNIVARIATE MODEL RESULTS FOR PFHxS, PFNA, PFOA, PFOS, AND ΣPFAS7

Univariate Models

Variable	N	Category	PFHxS		PFNA		PFOA		PFOS		ΣPFAS 7	
			Coef.	P value	Coef.	P value	Coef.	P value	Coef.	P value	Coef.	P value
Age	628	NA – continuous variable	**0.010**	**<.0001**	**0.003**	**0.0147**	**0.004**	**0.0016**	**0.012**	**<.0001**	**0.009**	**<.0001**
Aviation (non-USAF)	628	No aviation experience (reference)	--	--	--	--	--	--	--	--	--	--
		Aviation experience	0.300	0.1602	0.218	0.0771	0.124	0.3346	0.244	0.1669	0.223	0.1468
USAF, Military, and/or Aviation	628	Yes, experience in the USAF, military, and/or aviation	**0.259**	**0.0007**	**0.224**	**<.0001**	**0.241**	**<.0001**	**0.152**	**0.0162**	**0.160**	**0.0037**
		No (reference)	--	--	--	--	--	--	--	--	--	--
Birth	279	Given birth	-0.0296	0.8058	-0.0076	0.9207	-0.091	0.2259	-0.0068	0.9472	-0.010	0.9044
		Never given birth	--	--	--	--	--	--	--	--	--	--
Blood Donation	628	Once per year or more	**-0.243**	**0.0415**	**-0.203**	**0.0031**	**-0.189**	**0.0081**	**-0.321**	**0.0011**	**-0.251**	**0.0034**
		Never or rarely	--	--	--	--	--	--	--	--	--	--
Breast-feeding	278	Yes	-0.036	0.7532	-0.0196	0.7844	-0.085	0.2284	-0.085	0.3790	-0.053	0.5094
		No	--	--	--	--	--	--	--	--	--	--
Dirt Exposure	627	Yes	0.066	0.4123	0.018	0.6981	-0.011	0.8169	0.091	0.1712	0.0699	0.2279
		No	--	--	--	--	--	--	--	--	--	--
Dirt Exposure Frequency	355	A few times a month or more	0.198	0.0584	0.074	0.2316	0.059	0.3406	**0.282**	**0.0015**	**0.214**	**0.0053**
		A few times a year or less	--	--	--	--	--	--	--	--	--	--
Egg Consumption	557	Yes	-0.021	0.8110	**0.1157**	**0.0231**	0.0025	0.9625	**0.1576**	**0.0297**	0.078	0.2230
		No	--	--	--	--	--	--	--	--	--	--
Egg Consumption Frequency	577	A few times a month or more	-0.028	0.7719	**0.131**	**0.0179**	0.005	0.9328	**0.190**	**0.0157**	0.094	0.1740
		A few times a year or less	--	--	--	--	--	--	--	--	--	--
Fast Food Consumption	627	Yes	-0.154	0.2542	-0.134	0.0847	-0.120	0.1387	-0.125	0.2607	-0.123	0.2053
		No	--	--	--	--	--	--	--	--	--	--

Variable	N	Category	PFHxS		PFNA		PFOA		PFOS		ΣPFAS 7	
			Coef.	P value	Coef.	P value	Coef.	P value	Coef.	P value	Coef.	P value
Fast Food Consumption Frequency	626	A few times a month or more	**-0.230**	**0.0130**	**-0.1897**	**0.0004**	**-0.141**	**0.0110**	**-0.197**	**0.0103**	**-0.184**	**0.0059**
		A few times a year or less	--	--	--	--	--	--	--	--	--	--
Water Filtration (Home)	446	Any	-0.056	0.5335	-0.060	0.2622	0.042	0.4527	-0.139	0.0711	-0.87	0.1901
		None	--	--	--	--	--	--	--	--	--	--
Reverse Osmosis or Carbon Filter	446	Home has reverse osmosis or whole-house carbon filter	0.186	0.1715	0.081	0.3186	0.160	0.0547	0.016	0.8902	0.076	0.4483
		Home does not have reverse osmosis or whole-house carbon filter	--	--	--	--	--	--	--	--	--	--
Firefighting	628	Firefighting experience	**0.477**	**0.0049**	0.078	0.4290	0.155	0.1281	**0.435**	**0.0019**	**0.352**	**0.0039**
		No firefighting experience (reference)	--	--	--	--	--	--	--	--	--	--
Fruit and Vegetable Consumption	557	Yes	-0.075	0.3833	-0.029	0.5552	-0.088	0.0879	0.014	0.8408	-0.032	0.6064
		No	--	--	--	--	--	--	--	--	--	--
Fruit and Vegetable Consumption Frequency	407	A few times a month or more	0.093	0.5330	**0.186**	**0.0315**	0.036	0.6915	**0.248**	**0.0441**	0.164	0.1341
		A few times a year or less	--	--	--	--	--	--	--	--	--	--
8 oz Cups of Tap Water/Day	441	NA – continuous variable	0.0098	0.0991	0.006	0.0905	**0.007**	**0.0460**	**0.011**	**0.0258**	**0.009**	**0.0318**
Source of Water at Home	442	Bottled water	-0.224	0.0566	0.024	0.7367	-0.065	0.3659	-0.021	0.8314	-0.0796	0.3549
		Private well	0.099	0.3444	0.116	0.0642	0.068	0.2901	**0.275**	**0.0019**	**0.191**	**0.0130**
		Public water system	--	--	--	--	--	--	--	--	--	--
Source of Water at Work	460	Bottled water	-0.099	0.3373	-0041	0.4613	-0.023	0.6933	-0.069	0.3980	-0.069	0.3368
		Do not drink water at work	0.637	0.0841	**0.491**	**0.0151**	**0.5697**	**0.0066**	0.506	0.0829	**0.607**	**0.0190**
		Tap water from home	0.114	0.3574	-0.01999	0.7669	0.061	0.3832	-0.051	0.6030	0.022	0.7965
		Tap water from work	--	--	--	--	--	--	--	--	--	--
Milk Consumption	546	Yes	0.054	0.6662	0.140	0.0551	0.112	0.1430	**0.241**	**0.0219**	0.149	0.1046
		No	--	--	--	--	--	--	--	--	--	--

Variable	N	Category	PFHxS		PFNA		PFOA		PFOS		ΣPFAS 7	
			Coef.	P value	Coef.	P value	Coef.	P value	Coef.	P value	Coef.	P value
Milk Consumption Frequency	546	A few times a month or more	0.078	0.5846	0.141	0.0876	0.1297	0.1307	0.226	0.0564	0.153	0.1393
		A few times a year or less	--	--	--	--	--	--	--	--	--	--
Number of pregnancies carried to term	279	NA – continuous variable	-0.005	0.9015	-0.014	0.6182	-0.043	0.1106	0.008	0.8283	-0.00005	0.9986
Race	625	Hispanic or Latino	**-0.249**	**0.0072**	**-0.115**	**0.0309**	**-0.156**	**0.0051**	-0.066	0.3943	-0.105	0.1189
		Non-Hispanic Black	**-0.501**	**0.0050**	-0.039	0.7042	-0.197	0.0651	-0.165	0.2664	-0.202	0.1183
		Non-Hispanic Other	0.050	0.7388	**0.274**	**0.0016**	**0.208**	**0.0211**	0.028	0.8240	0.104	0.3410
		Non-Hispanic White	--	--	--	--	--	--	--	--	--	--
Sex	627	Female	**-0.7598**	**<0.0001**	**-0.313**	**<0.0001**	**-0.328**	**<0.0001**	**-0.641**	**<0.0001**	**-0.547**	**<0.0001**
		Male	--	--	--	--	--	--	--	--	--	--
Application of Stain Resistant Products to Carpeting, Upholstered Furniture, Clothing, or Other Items	622	Yes	-0.156	0.1519	-0.087	0.1648	-0.021	0.7421	-0.104	0.2454	-0.093	0.2357
		No	--	--	--	--	--	--	--	--	--	--
Application of Stain Resistant Products to Carpeting, Upholstered Furniture, Clothing, or Other Items Frequency	622	A few times a month or more	0.515	0.0791	-0.030	0.8587	0.135	0.4440	0.322	0.1831	0.329	0.1193
		A few times a year or less	--	--	--	--	--	--	--	--	--	--
Occupation in Staincoating	628	Yes	0.149	0.7892	-0.189	0.5575	0.185	0.5817	-0.117	0.7989	-0.066	0.8692
		No	--	--	--	--	--	--	--	--	--	--
8 oz Cups of Tap Water/Day at Work	417	NA – continuous variable	00.004	0.5923	0.008	0.0524	0.005	0.2910	**0.013**	**0.0271**	0.008	0.1368

Variable	N	Category	PFHxS		PFNA		PFOA		PFOS		ΣPFAS 7	
			Coef.	P value	Coef.	P value	Coef.	P value	Coef.	P value	Coef.	P value
Total Number of Years Living in the Project Focus Area	628	NA – continuous variable	**0.006**	**0.0394**	0.001	0.5188	0.009	0.6277	**0.009**	**0.0002**	**0.007**	**0.0014**
Total Number of Years Working in the Project Focus Area	628	NA – continuous variable	**0.028**	**<0.0001**	**0.006**	**0.0217**	**0.011**	**<0.0001**	**0.019**	**<0.0001**	**0.020**	**<0.0001**

Note: Associations significant at α<0.05 are shown in bold text.

APPENDIX E: MULTIVARIATE MODELING RESULTS

PFHxS

Final Multivariate Model for PFHxS – All Eligible Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Age	0.007	0.003	0.002, 0.012
Sex*	-0.712	<.001	-0.850, -0.574
Race**			
Hispanic or Latino	-0.206	0.014	-0.370, -0.042
Non-Hispanic Black	-0.416	0.010	-0.731, -0.101
Non-Hispanic Other	0.090	0.502	-.0173, 0.353
Blood Donation***	-0.288	0.007	-0.498, -0.078
Total years working in project area	0.016	<0.001	0.008, 0.025

Model statistics: R^2=0.230; p-value= <.0001; n=624; intercept = -.043
*Reference category: Male
**Reference category: White, non-Hispanic
***Reference category: Never or rarely donate

Final Multivariate Model for PFHxS – "Lived Only" Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Age (years)	0.014	<0.001	0.007, 0.021
Sex*	-0.536	<0.001	-0.793, -0.280
Years lived in project area	0.009	0.045	0.000, 0.018
Firefighting**	0.633	0.056	-0.015, 1.281

Model stats: R^2= 0.289; p-value= <.0001; n=156; intercept = -0.921
*Reference category: Male
**Reference category: Never worked as a firefighter

Final Multivariate Model for PFHxS – "Worked Only" Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Sex*	-0.952	<0.001	-1.220, -0.685
Blood Donation**	-0.374	0.039	-0.727, -0.020
Years worked in project area	0.013	0.072	-0.001, 0.028

Model stats: R^2= 0.239; p-value= <.0001; n=182; intercept = 0.287
*Reference category: Male
**Reference category: Never or rarely donate

PFNA

Final Multivariate Model for PFNA – All Eligible Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Age	0.004	<0.001	0.002, 0.007
Sex*	-0.253	<.0001	-0.344, -0.162
Race**			
Hispanic or Latino	-0.094	0.086	-0.201, 0.013
Non-Hispanic Black	0.002	0.983	-0.200, 0.204
Non-Hispanic Other	0.298	0.001	0.125, 0.470
Blood donation***	-0.226	0.001	-0.363, -0.089
Egg consumption****	0.124	0.019	0.020, 0.227
Work history in the military and/or aviation, including USAF	0.160	0.001	0.063, 0.257

Model stats: R2=0.151; p-value= <.0001; n=574; intercept =-1.690
*Reference category: Male
**Reference category: White, non-Hispanic
***Reference category: Never or rarely donate
****Reference category: A few times a year or less

Final Multivariate Model for PFNA – "Lived Only" Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Age	0.010	<0.001	0.006, 0.015

Model stats: R^2= 0.099; p-value= <.0001; n=167; intercept = -2.179

Final Multivariate Model for PFNA – "Worked Only" Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Sex*	-0.391	<0.001	-0.549, -0.233
Race**			
Hispanic or Latino	-0.115	0.264	-0.316, 0.087
Non-Hispanic Black	-0.133	0.437	-0.471, 0.204
Non-Hispanic Other	0.261	0.043	0.008, 0.514
Blood donation***	-0.231	0.022	-0.429, -0.034
Work history in the military and/or aviation, including USAF	0.188	0.033	0.015, 0.360
8-oz cups of water consumed at work each day	0.012	0.044	0.000, 0.024

Model stats: R^2= 0.232; p-value= <.0001; n=175; intercept = -1.551
*Reference category: Male
**Reference category: White, non-Hispanic
*** Reference category: Never or rarely donate

PFOA

Final Multivariate Model for PFOA – All Eligible Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Age	0.006	<0.001	0.003, 0.008
Sex*	-0.268	<0.001	-0.359, -0.176
Race**			
Hispanic or Latino	-0.113	0.037	-0.219, -0.007
Non-Hispanic Black	-0.177	0.079	-0.375, 0.021
Non-Hispanic Other	0.232	0.006	0.066, 0.397
Blood donation***	-0.230	0.007	-0.362, -0.098
Work history in the military and/or aviation, including USAF	0.179	0.003	0.083, 0.275

Model stats: R^2=0.157; p-value= <.0001; n=624; intercept =-0.508
*Reference category: Male
**Reference category: White, non-Hispanic
*** Reference category: Never or rarely donate

Final Multivariate Model for PFOA – "Lived Only" Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Age	0.011	<0.001	0.006, 0.016
Blood donation*	-0.413	0.007	-0.712, -0.114

Model stats: R^2= 0.147; p-value= <.0001; n=166; intercept = -1.038
* Reference category: Never or rarely donate

Final Multivariate Model for PFOA – "Worked Only" Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Sex*	-0.440	<0.001	-0.597, -0.283
Race**			
Hispanic or Latino	-0.003	0.974	-0.1992, 0.192
Non-Hispanic Black	-0.308	0.079	-0.651, 0.035
Non-Hispanic Other	0.226	0.086	-0.033, 0.484
Blood donation***	-0.216	0.039	-0.420, -0.011

Model stats: R^2=0.210; p-value= <.0001; n=182; intercept = -0.072
*Reference category: Male
**Reference category: White, non-Hispanic
*** Reference category: Never or rarely donate

PFOS

Final Multivariate Model for PFOS – All Eligible Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Age	0.012	<0.001	0.009, 0.015
Sex*	-0.656	<0.001	-0.766, -0.547
Blood donation**	-0.312	<0.001	-0.480, -0.144
Firefighting***	0.234	0.057	-0.007, 0.475

Model stats: R^2=0.256; p-value= <.0001; n=627; intercept =0.469
*Reference category: Male
** Reference category: Never or rarely donate
***Reference category: Never worked as a firefighter

Final Multivariate Model for PFOS – "Lived Only" Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Age	0.019	<0.001	0.013, 0.025
Sex*	-0.500	<0.001	-0.749, -0.251
Blood donation**	-0.497	0.011	-0.879, -0.115

Model stats: R2=0.301; p-value= <.0001; n=166; intercept = -.038
*Reference category: Male
** Reference category: Never or rarely donate

Final Multivariate Model for PFOS – "Worked Only" Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Sex*	-0.806	<0.001	-1.01, -0.600
Blood donation**	-0.332	0.015	-0.599, -0.065
Firefighting***	0.370	0.044	0.011, 0.729
8-oz cups of water consumed at work per day	0.017	0.033	0.001, 0.032

Model stats: R2= 0.314; p-value= <.0001; n=175; intercept = 0.898
*Reference category: Male
** Reference category: Never or rarely donate
***Reference category: Never worked as a firefighter

ΣPFAS7

Final Multivariate Model for ΣPFAS7 – All Eligible Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Age	0.008	<0.001	0.005, 0.011
Sex*	-0.540	<0.001	-0.638, -0.443
Blood donation**	-0.235	0.002	-0.383, -0.087
Years of work in the project area	0.009	0.004	0.003, 0.015

Model stats: R^2=0.2424; p-value= <.0001; n=627; intercept =1.346
*Reference category: Male
** Reference category: Never or rarely donate

Final Multivariate Model for ΣPFAS7 – "Lived Only" Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Age	0.016	<0.001	0.011, 0.021
Sex*	-0.390	<0.001	-0.590, -0.191
Blood donation**	-0.359	0.022	-0.665, -0.054

Model stats: R^2=0.305089; p-value= <.0001; n=166; intercept = 0.790
*Reference category: Male
** Reference category: Never or rarely donate

Final Multivariate Model for ΣPFAS7 – "Worked Only" Participants

Parameter	Coefficient	p-value	95% Confidence Interval
Sex*	-0.628	<0.001	-0.810, -0.446
Blood donation**	-0.294	0.017	-0.534, -0.054
Firefighting***	0.330	0.044	0.009, 0.651
Dirt exposure frequency****	0.161	0.072	-0.014, 0.336

Model stats: R^2=0.278; p-value= <.0001; n=182; intercept =1.687
*Reference category: Male
** Reference category: Never or rarely donate
***Reference category: Never worked as a firefighter
****Reference category: A few times a year or less