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Concentrations of Per- and Poly-fluoroalkyl substances (PFAS) in Private Wells in Southeastern NM, 2018-2019

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In the fall of 2018, the New Mexico Department of Health (NMDOH) was notified by colleagues in the New Mexico Environment Department (NMED) about soil and groundwater contamination with per- and poly-fluoroalkyl substances (PFAS) at Cannon Airforce Base (CAFB) in Clovis, NM. These compounds had been detected in groundwater at concentrations exceeding the United States Environmental Protection Agency (USEPA) lifetime health advisory (HA) for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) of 70 nanograms per liter (ng/l).[1] This is the concentration in drinking water that is not expected to cause harm with daily consumption over an entire lifetime. However, this is only an advisory; at the time and currently, there are no federal or New Mexico regulations for PFAS in drinking water.

PFAS is a group of man-made chemicals used in many consumer products and industries. Aqueous film-forming foam (AFFF) contained PFAS and was used historically as a petroleum fire-suppression agent at CAFB and at many other military and civilian fire-fighting facilities in the United. PFAS make products water-repellent, stain- and heat-resistant, and in addition to firefighting foam, are also used in food packaging, cleaning products, stain-resistant carpet treatments, and nonstick cookware, among other products.

This large group of chemicals includes more than 4,700 known PFAS compounds and has been used worldwide since the 1950s.[2] These compounds have a structure containing a chain of carbon atoms bonded to fluorine atoms (C-F bond) and a functional group (either a carboxylic acid or sulfonic acid) which provides high chemical stability. This stability leads to a long shelf life and environmental persistence and hence the name “forever chemicals.” Based on chemical structure or carbon chain length, PFAS are referred to as either “long chain” or “short chain.” [3] PFOA and PFOS were manufactured for many years and therefore are both widespread in the environment and also the most well-studied.

Researchers have identified contaminated drinking water as an important exposure route for PFAS.[4] However, little is known conclusively about the health effects of PFAS, especially short-chain chemicals and the effects of exposures to mixtures of PFAS. While research on harmful levels of PFAS exposure for human health is ongoing, current research indicates some PFAS may affect reproductive health, increase the risk of some cancers, affect childhood development, increase cholesterol levels, affect the immune system, and interfere with the body’s hormones.[5] To learn more about PFAS, please visit: https://nmtracking.org/environment/PFCS.html.

The primary drinking water source for the area surrounding CAFB is private water wells, with water quality unregulated under the Safe Drinking Water Act. This makes testing and treatment the responsibility of the well owner.[6] However, at around $300, PFAS water quality testing may be cost-prohibitive for some homeowners.

Area residents were concerned by PFAS detection in wells off-base. In response, NMDOH leveraged federal funds for private well PFAS testing in a four-mile radius of CAFB. Concentrations of PFAS in the samples described herein were provided to the community at the time and there were also presentations on the data. However, due to various delays, the largest of which has been the COVID-19 pandemic response, the write-up of this project is only happening now.

Methods

NMDOH, NMED and the New Mexico Department of Agriculture (NMDA) began sharing information and resources to make residents aware of the PFAS groundwater contamination around CAFB and to develop an action plan. NMDOH’s role was to develop: 1) a method to identify those potentially at risk in the area from consuming PFAS-contaminated drinking water 2) a plan to recruit at-risk individuals to get their drinking water tested and 3) a plan for how the samples would be collected and analyzed. The NMED

Groundwater Quality Bureau (GWQB) supported this effort by offering expertise on sampling protocols and by providing sampling personnel. NMED Drinking Water Bureau (DWB) also sampled any community water systems in the area for PFAS.

Results

1. Method to identify potentially at-risk individuals
NMDOH Epidemiology and Response Division's (ERD) Environmental Health Epidemiology Bureau (EHEB) Private Wells Program (PWP) gathered available well locations and owner information through the PWP well water quality database and the NM Office of the State Engineer (NM OSE) online application (POD Finder). Well owner contact information was obtained from the OSE Water Rights Reporting System database and district office. Well locations were compiled into a Geographic Information System (GIS) usable format and mapped along with known contamination sites that were provided by NMED.

2. Plan to recruit at-risk individuals
A joint agency press release (NMED, NMDOH, and NMDA) summarized what was known about the location and extent of PFAS contamination in groundwater at the time, including off-base well concentrations of up to 1,600 ppt.[7] EHEB requested that Clovis residents call the NMDOH on-call line so that residents could be recruited for collection of in-person water samples for PFAS analysis. Based on recommendations from the NMED and the characteristics of the contamination plume, a four-mile radius from the air force base property boundary was identified as the area with the highest potential risk of groundwater contamination.

NMDOH-ERD was approved to use funds from the Centers for Disease Control and Prevention (CDC) Environmental Public Health Tracking (EPHT) grant to test private domestic wells. Residents within the four-mile radius were offered free water testing. Inclusion was determined by geocoding the residential address of callers requesting testing. All callers within the area were assigned a unique identifier. Geocoding was done following the NMDOH address geocoding protocol and using ESRI ArcMap. A four-mile buffer around CAFB and a spatial join were used to determine address inclusion or exclusion within the four-mile boundary.

3. Sampling plan and water analysis results
The plan specified inclusion criteria, sampling personnel, the selected contracted testing laboratory, NMDOH responses for results above and below the USEPA HA level, and actions NMDOH would not take, such as providing water treatment systems.

Using the participant's geocoded physical address, GIS methods were employed to separate sampling locations into 3 sectors with a team and sample date assigned to each sector. Residents of each sector were notified to schedule in-person sampling, and this was coordinated with field teams. Sampling of well water was conducted by NMED and NMDOH-EHEB personnel following the NMDOH/NMED PFAS field sampling protocol and documented on a PFAS-well test form. Each participant was provided a PFAS- and private wells-focused information packet. Samples were collected prior to any treatment. Samples were provided to the contracted laboratory and analyzed for 6 compounds following USEPA method 537.[8]

NMDOH answered public inquiries and addressed concerns through on-call services and attending a public meeting. A total of 130 people contacted NMDOH through the on-call line (includes repeat callers). Among these, 59% asked about water testing, 13% about the contamination, 9% had concerns about livestock/animals drinking the water, 4% had health concerns, 4% asked about the four-mile radius, 3% wanted guidance, 3% had economic concerns, 3% had specific questions for CAFB, and 2% had questions about water treatment. All callers were asked if they wanted water testing, 126 (97%) said yes, 2 (1.5%) had no recorded response, and 2 (1.5%) said maybe. Over 100 well owner/users received NMDOH information packets. The EPHT and PWP, with other EHEB partners, developed educational materials. Materials included: PFAS and Health fact sheet, nmtracking.org webpages on PFAS and health and testing and treating private wells for PFAS, a FAQ document, and information on water hauling (for livestock). NMDOH online PFAS resources on nmtracking.org were accessed nearly 500 times between October 2018-August 2019.

Ninety-three water samples were analyzed in 2018 for 6 perfluorinated compounds (PFBS, PFHpA, PFHxS, PFNA, PFOS and PFOA[3]). These compounds were of highest concern at the time. One sample had a low-level detection of PFHxS. The results confirmed testing previously done by CAFB. Sixteen wells were tested in 2019 for 21 PFAS compounds, by EPA method 537, including the one well with a detection in 2018.[8] The number of PFAS compounds analyzed were increased to 21 as a result of updated research and the review of national best practices.

Overall, a total of 109 well water samples were analyzed for PFAS. Three private wells to the southeast of the base and in the contamination plume defined by CAFB had detections of PFBA, PFPeA, PFHxA, PFBS and PFHxS.[3] Participants were called within three days of receipt of laboratory results. Follow-up letters were sent out to all participants with results and an explanation. Further questions were directed through the on-call service or to the EHEB sampling coordinator.

The NMED DWB tested a community water system to the north of the base for 6 PFAS and had a low-level detection of PFHxS. NMDOH resampled this community water for the more inclusive suite of 21 PFAS; the total PFAS was 63.4 ppt (detections of PFBA, PFPeA, PFHxA, PFHpA, PFBS, and PFHxS). Table 1 shows summary results of 2018 and 2019 private well testing.

Discussion

While laboratory analysis confirmed detections of PFAS compounds around CAFB, concentrations were low and did not exceed the EPA lifetime HA level for PFOA and PFOS of 70 nanograms per liter (ng/L).

Drinking water analysis for PFAS continues to rapidly evolve and become more comprehensive. Because PFAS is an emerging contaminant, one challenge of this response effort was compiling timely, verified information including: identifying certified laboratories, residential water treatment technologies, and companies that serve rural NM.

Finding and reaching well owners in a timely manner during any water quality-related response in NM is a challenge. This area has high agricultural use in a mixed urban-rural county, presenting unique challenges. The locations of homes and wells and distances between properties presented logistical challenges for sampling teams. The presence of pit wells (large pit around the well to provide access to the underground water line connections below the frost line) also presented access challenges.[9] The proximity of dairies to potential contamination sites added complexity. For example, in addition to exposure through groundwater contamination, PFAS uptake into plants (feed) can occur through irrigated soil. PFAS are excreted through the milk, feces, and urine of dairy cows.

Updates and Recommendations

Groundwater contamination plumes change over time as the plume moves through the aquifer system and the PFAS fate and transport in the environment is still being studied; therefore, it is important to continue to monitor PFAS in groundwater in the impacted area. Current work, led by NMED and supported by NMDOH, includes continued environmental surveillance of potentially-impacted private wells.

During the 2020 Legislative Session, $100,000 was appropriated to NMED "for a well testing program for signs of contaminated drinking and agricultural water resources in Curry and Roosevelt counties." With this funding, NMED developed and implemented a PFAS sampling program, in partnership with the USGS, testing for 28 different PFAS compounds. Sampling occurred in spring and summer of 2021 totaling 57 private well water samples with 9 PFAS detections. The highest total PFAS concentration detected at any single well was 7.4 ng/L (neither PFOA nor PFOS were detected).[10] All well owners were given results and an information sheet including contact information for the EHEB for health-related questions. Further information on NMED's ongoing PFAS efforts can be found online at https://www.env.nm.gov/pfas/.

Well owners can best protect their water supply. General recommendations to maintain a clean, healthy drinking water supply include: keeping possible contamination sources a safe distance from the well, regular water quality testing and if needed, treatment. More guidance is available at https://nmtracking.org/water. Water treatment options for PFAS include reverse osmosis, granular and powdered activated carbon, anion exchange, and advanced oxidation. There are no treatments to reduce PFAS in the body. Some strategies to reduce exposure can include reducing use/exposure to products that may include PFAS such as non-stick cookware, grease-resistant food packaging and stain resistant materials.

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Table 1. Summary of PFAS private wells sampling 2018 and 2019 (n=109 wells)
93 wells tested for 6 PFAS compounds in 2018
16 wells tested for 21 PFAS compounds in 2019

	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnA	PFDoA	PFTTriC	PFTeA	PFBS	PFHxS	PFHpS	PFOS	PFDS	FOSA	NMeFOSAA	NEtFOSAA	6:2 FTS	8:2 FTS
2018	-	-	-	ND	ND	ND	-	-	-	-	-	ND	6.9	-	ND	-	-	-	-	-	-
2019	10	25	27	ND	ND	ND	ND	ND	ND	ND	ND	14	11	ND	ND	ND	ND	ND	ND	ND	ND

Note: ND= non-detect. To protect the privacy of individual well results, aggregate results (any detections) are shown. One sample had a low-level detection of PFHxS in 2018 with the 2019 expanded constituent list showing three private wells to the southeast of the base, in the contamination plume defined by CAFB, to have detections of PFBA, PFPeA, PFHxA, PFBS and PFHxS.

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