Invisible Chemicals, Visible Impact: Understanding PFAS and Cancer

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ABSTRACT

Per- and polyfluoroalkyl substances (PFAS) are persistent chemicals linked to health risks, including certain cancers. Military installations are significant sources of PFAS contamination due to the use of aqueous film-forming foam (AFFF) in firefighting training and emergency response. Preliminary findings suggest a correlation between PFAS exposure and higher cancer rates, particularly oral cavity and urinary tract cancers. This study aims to examine PFAS contamination in local water sources and its potential impact on cancer incidence, guiding public health actions for affected communities.

WASHINGTON STATE ALLOWED PFAS LEVELS

PFAS Chemical	SAL (ng/L)
PFBS	345
PFHxS	65
PFOS	15
PFOA	10
PFNA	9

(Durbin, unpublished)

These compounds belong to the larger family of per- and polyfluoroalkyl substances (PFAS). Each has a specific regulatory limit, measured in nanograms per liter (ng/L), established by Washington State to protect public health. The levels range from 345 ng/L for PFBS down to 9 ng/L for PFNA, reflecting their different potential health impacts and risks.

METHODS

This study examined links between per- and polyfluoroalkyl substances (PFAS) in drinking water and cancer rates from 2016 to 2021. It focused on U.S. counties with PFAS data from the Third Unregulated Contaminant Monitoring Rule (2013–2015) and the Fifth Unregulated Contaminant Monitoring Rule (2023–2024), using cancer data from the Surveillance, Epidemiology, and End Results (SEER) Program. PFAS levels were categorized as detected or above State Action Levels (SALs). Statistical models adjusted for other factors to assess the connection between PFAS and cancer. Limitations included underreported cancer cases, timing mismatches, and potential bias from county-level data. Despite these challenges, the study suggests PFAS in water may harm public health.

POSSIBLE SOLUTIONS

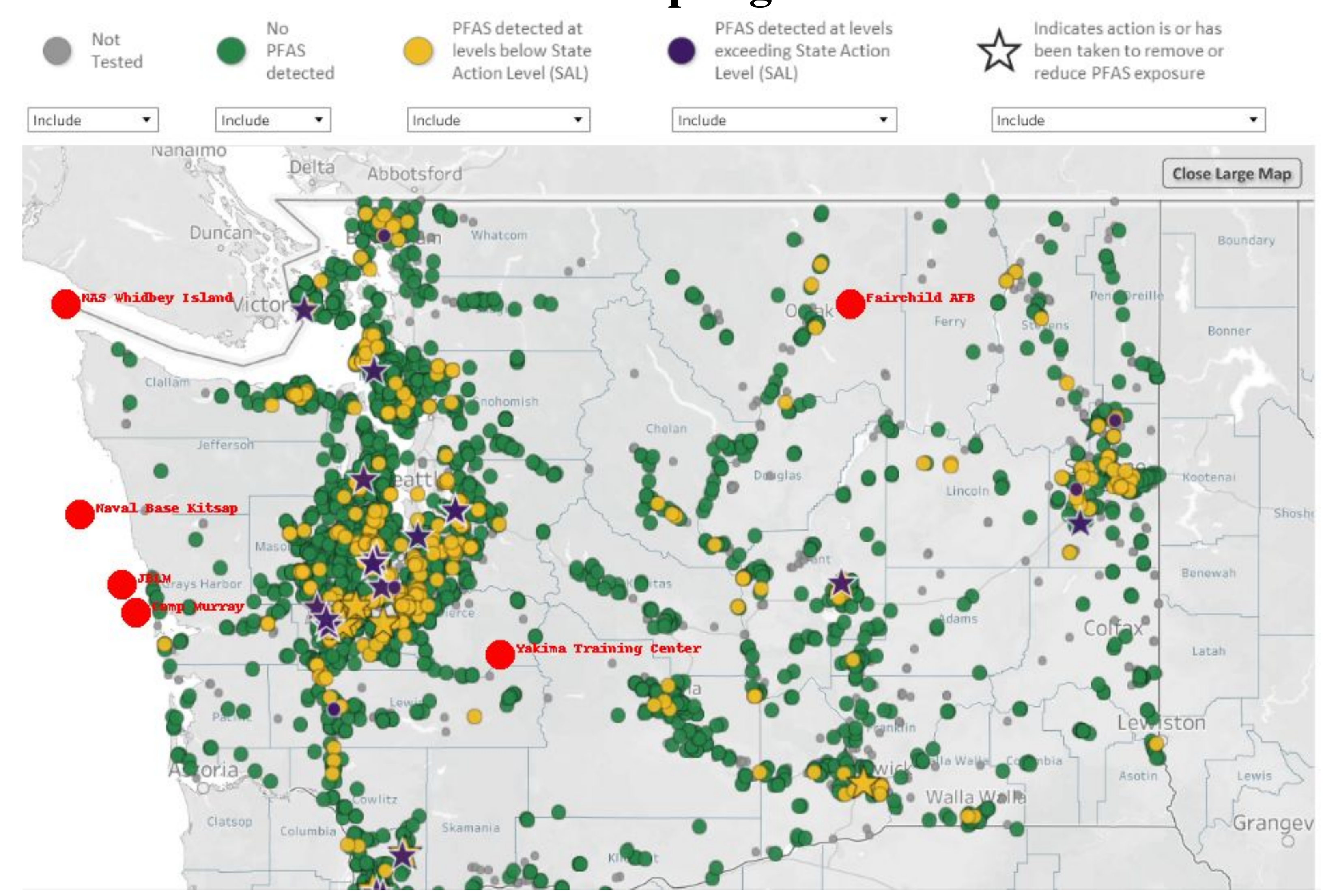
Possible solutions that could provide additional support to those who rely on PFAS contaminated drinking water are:

- Water filtration systems like Point of Entry Treatment (POET) systems that filter and disinfect all water entering the house.
- Soil and groundwater cleaning using tactics like soil washing and water repurposing.
- Acquiring screenings and blood work panels regularly to monitor levels of PFAS in the body and catch any early onset cancer before it becomes to late.

ACKNOWLEDGMENTS

Thanks to Mrs. Gamache for her support and guidance as both my teacher and club advisor. Her leadership helped me stay focused and achieve my goals, and I appreciate her time and effort throughout this experience.

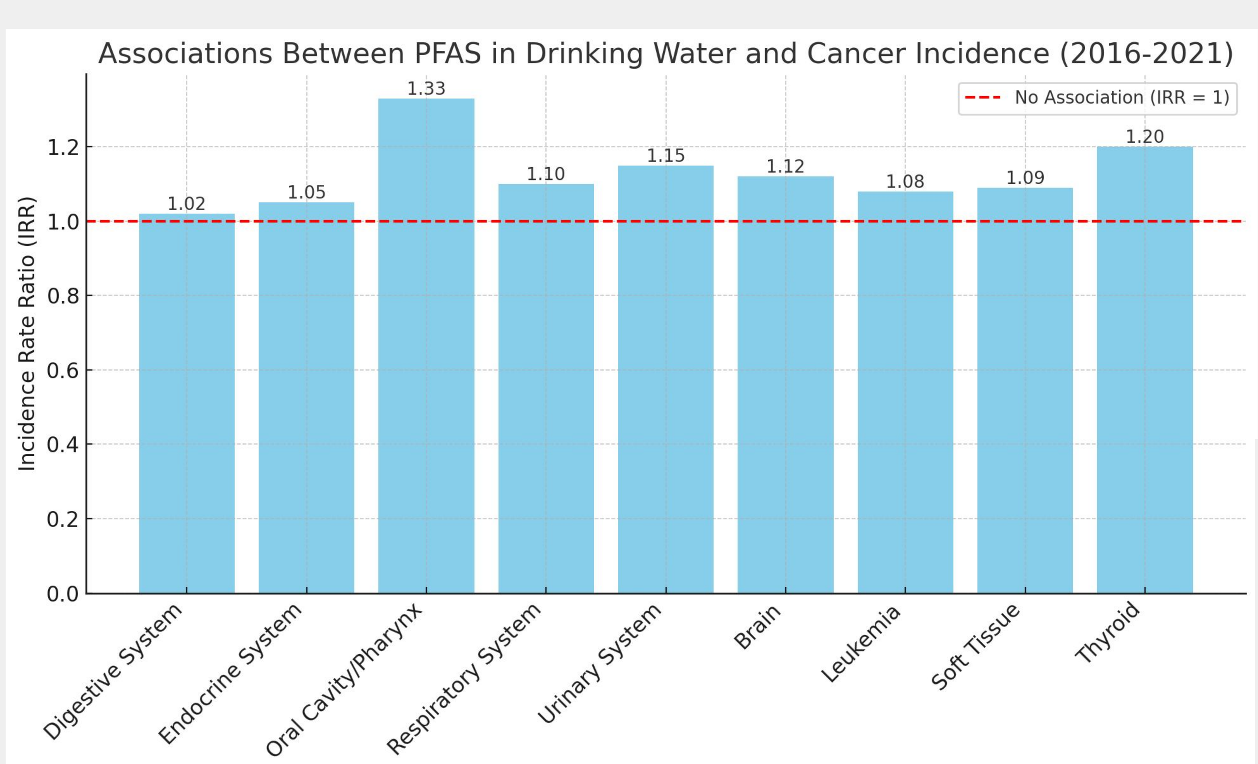
Geographical Correlation Between Military Bases and PFAS Sampling Wells



Above shows Washington State Military bases. Military bases, which are major contributors to PFAS contamination, are primarily located in rural areas. As a result, most nearby drinking water sources are privately owned wells. These privately owned wells are not included in mandatory testing requirements and are therefore not prioritized for identification, sampling, or public education. This leaves residents who rely on these wells vulnerable to PFAS exposure.

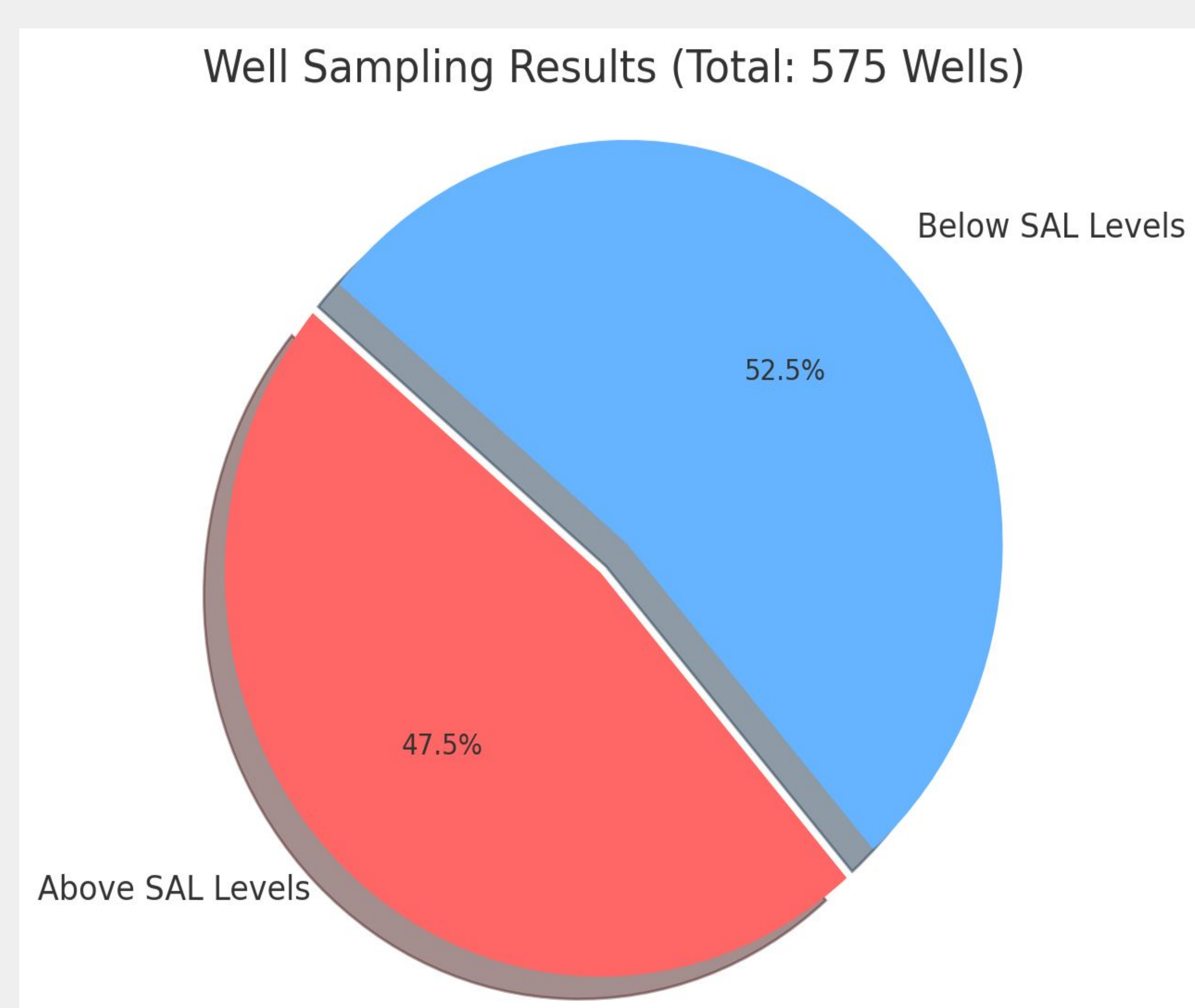
EPH-WTN--Washington Tracking Network--4300. (n.d.-b). PFAS Testing Results Dashboard. Washington State Department of Health. https://doh.wa.gov/data-and-statistical-reports/washington-tracking-network-wtn/pfas/dashboard

DATA ANALYSIS



(Durbin, unpublished)

Cancer Risk Analysis: The Incidence Rate Ratio (IRR) demonstrates the increased probability of cancer occurrence in relation to PFAS exposure. An IRR value exceeding 1.00 indicates elevated risk - specifically, for each 0.01 increase above 1.00, there is a corresponding increase in cancer likelihood. This metric helps quantify the relationship between PFAS exposure and cancer risk in affected communities.



(Durbin, unpublished)

Well Testing Results Summary: Of the 575 wells sampled across the study area, a concerning 47.5% (273 wells) exceeded the State Action Levels (SAL) for PFAS contamination. This significant proportion of wells testing above regulatory limits highlights the widespread nature of PFAS contamination in local water sources and underscores the need for intervention measures.

BACKGROUND

Per- and polyfluoroalkyl substances (PFAS) have been used in aqueous film-forming foam (AFFF) since the 1970s, when the U.S. military began using it to fight fires. Since then, these chemicals have leaked into the environment and contaminated drinking water sources, exposing people to these carcinogenic compounds. As a result, the topic of PFAS and their links to cancer are being researched to better understand how communities can better protect themselves from the effects of PFAS.

HEALTH DISPARITIES

It is estimated that 45% of water in the nation contains 1 or more form of PFAS. This raises serious concerns for affected communities, such as those in impoverished areas. As stated in the Data Analysis, exposure to PFAS at or above the State Action Levels (SAL) increases your rates of cancer by up to 33%. Impoverished areas are at risk for complications due to PFAS levels, because of the expenses associated with possible solutions, such as regular and thorough cancer screenings. Impoverished areas are also at risk due to the value of their property declining when PFAS is found on or near their property. Poverty is a problem that can not be chalked up to just PFAS, but by the military bases responsible reaching out and providing water filtration systems or bottled water can certainly help lessen the effects of the contamination and reduce health risks for vulnerable communities.

CONCLUSION AND RESULTS

The results show strong links between PFAS exposure in drinking water and cancer. The bar chart to the left shows that exposure to PFAS at or above the State Action Levels (SAL) increases cancer risk by up to 33%. The pie chart next to it shows that 47.5% of the 575 wells sampled by the Yakima Health District exceeded the SAL. These private wells in east Selah, near the Yakima Training Center, are not shown on the map above because they are private and therefore not mandated to sample.

The proximity to military activity suggests a clear connection to PFAS contamination. Residents using these wells face serious health risks due to limited testing and regulation. Additionally, the high cost of water filtration systems and health screenings makes it harder for these communities to protect themselves. These results highlight the need for regular well testing, affordable filtration options, and better public health support to reduce the risks of PFAS exposure.

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Reflection

a) Briefly describe your research process from start to finish:

My research began after discovering that nearly half of East Selah's tested wells exceed state PFAS safety levels. I gathered local contamination data from public records, researched scientific literature on PFAS-cancer links, and collected community perspectives. I organized this information to highlight how these chemicals disproportionately affect lower-income communities and synthesized my findings into an informative poster presentation.

b) What barriers or challenges did you face in this project?

Challenges included limited public awareness about PFAS despite its health implications, difficulty accessing comprehensive testing data, and translating technical information into accessible language. I also struggled with maintaining objectivity while researching an issue directly affecting people in my community.

c) What influenced your thinking and approach to this project?

My approach was shaped by community conversations, scientific literature on environmental justice, public health reports, and EPA guidelines. News coverage of similar contamination issues in other communities provided valuable perspectives. I also utilized AI as a brainstorming tool to help organize my thoughts and identify research directions.

d) What support did you receive throughout the project?

I received guidance from teachers on research methodologies and accessing academic resources. Community members shared their experiences, while local environmental advocates offered insights and connections to relevant resources. School resources provided technical support for my poster design, and family members offered emotional encouragement.

e) What lesson(s) did you learn that can be applied to future experiences?

I learned to make scientific information accessible without oversimplification and the power of combining data with personal narratives. I gained appreciation for environmental justice perspectives and developed valuable research skills. Most importantly, I discovered that research can serve as community advocacy, empowering people to make informed health decisions.