Identification of Potential Sources of PFAS in the Gurabo Water Treatment Plant Watershed

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Abstract

The drinking water treatment plant (WTP) of the municipality of Gurabo in Puerto Rico, is owned and operated by the Puerto Rico Aqueduct and Sewer Authority (PRASA). In its 2023 drinking water quality report, the WTP detected the presence of per- and polyfluoroalkyl substances (PFAS). Although there are thousands of PFAS compounds, the report specifically identified four: PFBA, PFHxA, PFOS, and PFPeA. This study aims to identify potential sources of PFAS contamination in the surface waters supplying the Gurabo WTP's watershed. Additionally, the research explores the relationship between PFAS concentrations and land use types within the watershed, comparing estimated PFAS levels from different land uses to the actual concentrations reported in 2023. The study identified 22 industry types within the watershed with potential PFAS contamination due to their use of these chemicals in their processes. The comparison between estimated and reported PFAS concentrations revealed an error margin of 10%, providing insights into the accuracy of land use association with contaminant concentrations under study

Introduction

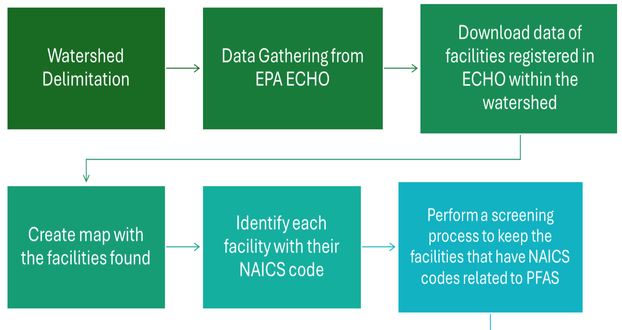
PFAS are a group of synthetic chemicals that have raised significant environmental and health concerns due to their persistence in the environment and their potential to contaminate water sources. This study focuses on the identification of potential PFAS contamination sources within the watershed that supplies the Gurabo WTP, where PFAS compounds have already been detected. Utilizing a dual-method approach, this investigation first identified facilities within the watershed that could be associated with PFAS pollution, using data from the EPA's ECHO database and NAICS codes linked to PFAS-related industries. The second method explored the relationship between land use types within the watershed and the contributions of PFAS concentrations, employing a weighted average analysis based on land use data and past research. The outcomes of this research offer a preliminary understanding of PFAS sources and can serve as a basis for future environmental planning and mitigation efforts.

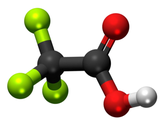
Objectives

- ✓ Delimitation of the watershed that supplies the Gurabo WTP
- ✓ Identify potential facilities for spreading PFAS within the watershed
- ✓ Analyze spatial distribution of PFAS using a relationship of Land Use and PFAS concentration
- ✓ Compare PFAS concentration results obtained through the Land Use/Concentration relationship with the results reported by PRASA 2023.

Methodology

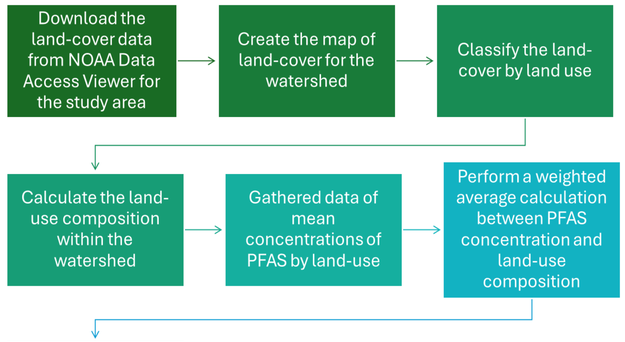
Method 1 - Identification of potential facilities for the use of PFAS through their North American Industry Classification (NAICS) codes.

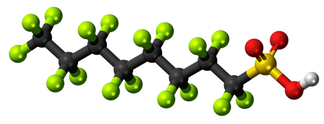




Short-Chain PFAS Molecule, Trifluoroacetic Acid (TFA). (B. Chandramouli, 2023)

Method 2 - Determination of land use and PFAS concentration relationship

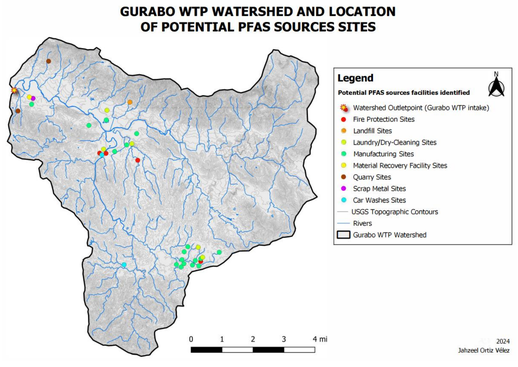


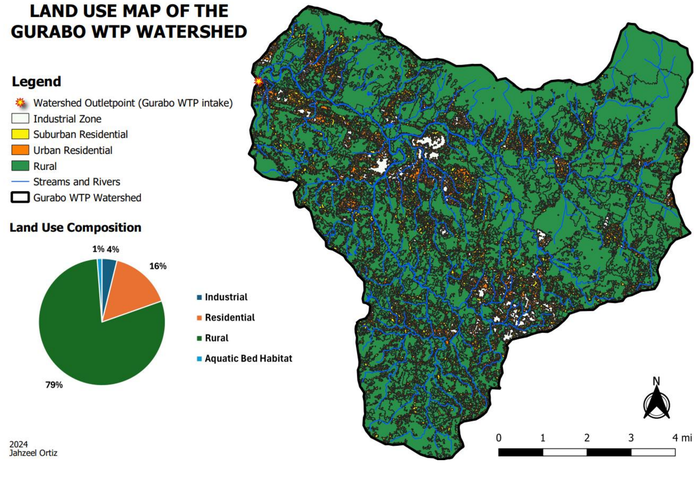


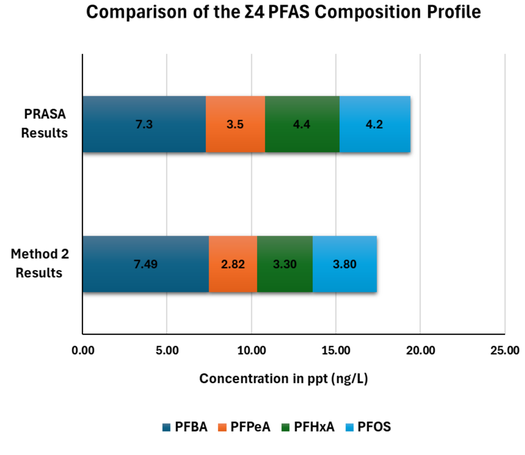
Long-Chain perfluorooctanes ulfonic acid molecule (PFOS). (Jynto, 2011)

Results

2022 NAICs	NAICS title or description	Municipality Registered			
		Juncos	Las Piedras	Gurabo	Grand Total
812320	Drycleaning and Laundry Services (except Coin-Operated)	3	2		5
325412	Pharmaceutical Preparations	1	1	2	4
339112	Primarily engaged in manufacturing medical, surgical, and ophthalmic.	2	2		4
922160	Fire Protection related	2			2
323111	Commercial printing (except screen printing, books printing)		2		2
212311-19	Stone Mining and Quarrying/Crushed and broken stone, dimension stone			2	2
335314	Electrical component manufacturing		1		1
562212	Solid Waste Landfill	1			1
423140	Motor Vehicle Parts (Used) Merchant Wholesalers			1	1
325510	Paint and coating manufacturing		1		1
335139	Electric Lamp Bulb and Other Lighting Equipment Manufacturing			1	1
325611	Soap and other detergent manufacturing	1			1
311613	Rendering and Meat Byproduct Processing		1		1
562219	Other Nonhazardous Waste Treatment and Disposal/Refuse System			1	1
423930	Recyclable Material Merchant Wholesalers/Scrap and waste material			1	1
312230	Manufacturing cigarettes or other tobacco products.	1			1
311615	Poultry Processing		1		1
334419	Other electronic component manufacturing	1			1
811192	Car washes	1			1
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing/Manufacturing Indus	1			1
332321	Metal Window and Door Manufacturing, Metal product manufacturing			1	1
334413	Semiconductor and related device manufacturing	1			1
Grand Total		15	11	9	35







Conclusions

This study successfully identified potential sources of PFAS contamination within the watershed supplying the Gurabo WTP. A total of 35 facilities were identified as potential contributors to PFAS pollution, with the majority being located near water bodies, highlighting the risk of both point and non-point source pollution. Additionally, a strong correlation between land use types and PFAS concentrations was established, with rural land use representing the dominant type in the watershed. The estimated total PFAS concentration derived from this analysis was within a 10% deviation from the actual values reported in 2023 by PRASA, confirming the validity of the approach used.

Recommendations & Future Work

To enhance future studies, field sampling of surface water and sediments within different land use types—industrial, residential, and rural—is recommended. Further, advanced modeling tools such as the Soil & Water Assessment Tool (SWAT) and MODFLOW could be employed to simulate PFAS fate and transport in the watershed, offering predictive insights into future contamination risks. Such efforts will provide a more detailed understanding of how PFAS moves through the environment and aid in the development of more effective treatment technologies and mitigation strategies.

Acknowledgements

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