Division of Water Resources Identification of Select Emerging PFAS Compounds in Public Water Supply Reservoirs of the Catawba, French Broad, and Tar River Basins (2022)

NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER RESOURCES
WATER SCIENCES SECTION

THIS REPORT HAS BEEN APPROVED FOR RELEASE

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Methods

Selected sites were sampled in conjunction with regularly scheduled sampling events as part of ALMP monitoring. Samples were collected in accordance with ISB's Standard Operating Procedures Manual: Physical and Chemical Monitoring v2.1, Dec. 2013, and Ambient Lakes Quality Assurance Project Plan v2.0, March 2014, as well as ISB's Draft Standard Operating Procedures Manual: Per- and Polyfluorinated Alkyl Substances (PFAS) - Field Collection Method. Physical parameters were collected at surface (0.15 m) using an In-Situ multiparameter hydrosonde. Chemical samples were collected as surface grab samples. All PFAS and 1,4- dioxane samples were analyzed by the DWR central laboratory in Raleigh, NC. Appropriate QA/QC samples were collected during each sampling event including trip blanks, field blanks, duplicates, matrix spikes and matrix spike duplicates. Guidance on acceptable supplies, equipment, and personal care products is provided within the ISB Draft Standard Operating Procedures Manual: Per- and Polyfluorinated Alkyl Substances (PFAS) - Field Collection Method. Full PFAS sampling results are shown below in Table 2.

Table 1. *Station ID, description, and coordinates of 2022 ALM sampled sites.*

WATERBODY NAME	Station ID	LATITUDE	LONGITUDE
LAKE RHODHISS (NEAR BATON)	CTB040ASUR	35.7802271	-81.5230461
LAKE RHODHISS (NEAR RHODHISS)	CTB040BSUR	35.773457	-81.4408725
LOOKOUT SHOALS LAKE	CTB058GSUR	35.7596437	-81.0904201
LAKE NORMAN (HUNTERSVILLE WATER INTAKE)	CTB082AASUR	35.4542000	-80.9020000
LAKE NORMAN (CORNELIUS CREEK ARM)	CTB082ASUR	35.6165900	-80.8854300
LAKE NORMAN (MOUNTAIN CREEK ARM)	CTB082MSUR	35.5660215	-80.9902451
LAKE NORMAN (DAVIDSON WATER INTAKE)	CTB082QSUR	35.5053504	-80.9113342
MOUNTAIN ISLAND LAKE (GAR CREEK)	CTB086CSUR	35.3491523	-80.9338758
MOUNTAIN ISLAND LAKE (DAM NEAR MT. HOLLY)	CTB087ASUR	35.3370682	-80.9882372
CATAWBA RIVER AT SOUTH BELMONT	CTB103SUR	35.2119725	-81.0069424
BESSEMER CITY LAKE	CTBBCL1SUR	35.2964702	-812998305
LAKE HICKORY	CTB04ASUR	35.7592381	-81.3757576
BEETREE RESERVOIR	FRBBTR1SUR	35.6426119	-82.40092
BURNETT RESERVOIR	FRBBUR4SUR	35.6639803	-82.3433306
ALLEN CREEK RESERVOIR	FRBACR4SUR	35.4236854	-83.0093878
TAR RIVER RESERVOIR	TAR017FSUR	35.8982716	-77.8857183

Results

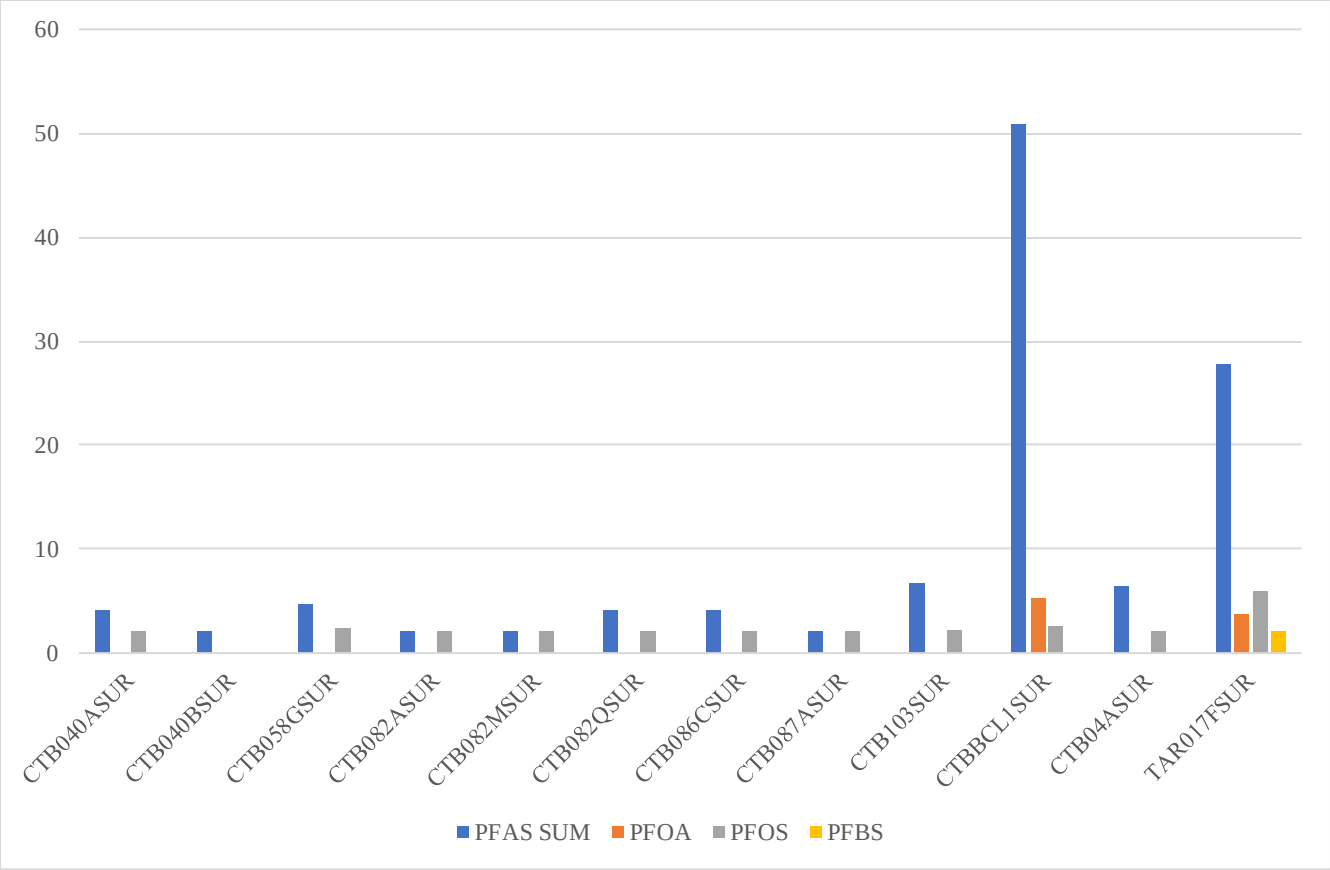
PFAS analysis was conducted by DWR at the Central Laboratory in Raleigh, NC. Of the 28 PFAS compounds selected for this study, the following nine compounds were found above the PQL on at least one occasion: PHBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFBS, PFHpS, and PFOS. These results again demonstrate the widespread distribution of detectable PFAS in public lakes and reservoirs. Values of detected compounds and the associated detection dates for sites with compounds above the PQL are listed in the table below.

1,4-dioxane was not found above the PQL (1.0 µg/l) for any of the sites sampled.

Summary

Evaluation of physical and chemical results from this study suggest that while there are detectable levels of target analytes at all public water supply reservoirs tested in the Catawba and Tar River Basins additional long-term monitoring would need to be conducted to evaluate persistence of these compounds and their associated effects on drinking water. There were no detectable concentrations of PFAS in the public water supply reservoirs tested in the French Broad River Basin. Tar River Reservoir (TAR017FSUR) exhibited the greatest diversity of target analytes (n=8) while Bessemer City Lake (CTBBCL1SUR) had the highest total PFAS concentration (50.9 ng/L). The highest PFOA and PFOS concentrations were detected at Bessemer City Lake (5.3 ng/L and 2.5 ng/L) and the highest PFBS concentration was detected at the Tar River Reservoir (2.1 ng/L). No lakes had detectable levels of HFPO-DA (GenX).

Figure 1. Per- and polyfluoroalkyl concentrations at ambient lakes monitoring stations nearest the surface water intake of 12 public water supply reservoirs in the Catawba and Tar River Basins. Only values greater than the PQL (2.0 ng/L)



Appendix 1. *List of 28 analyzed PFAS compounds screened by the NCDEQ Chemistry Laboratory.*

Abbreviation	***Name***	***CAS#***
PFBA	Perfluorobutanoate	45048-62-2
PFPeA	Perfluoropentanoate	45167-47-3
PFHxA	Perfluorohexanoate	92612-52-7
PFHpA	Perfluoroheptanoate	120885-29-2
PFOA	Perfluorooctanoate	45285-51-6
PFNA	Perfluorononanoate	72007-68-2
PFDA	Perfluorodecanoate	73829-36-4
PFUnA	Perfluoroundecanoate	196859-54-8
PFDoA	Perfluorododecanoate	171978-95-3
PFTrDA	Perfluorotridecanoate	862374-87-6
PFTeDA	Perfluorotetradecanoate	365971-87-5
PFBS	Perfluorobutanesulfonate	45187-15-3
PFPeS	Perfluoropentanesulfonate	175905-36-9
PFHxS	Perfluorohexanesulfonate	108427-53-8
PFHpS	Perfluoroheptanesulfonate	146689-46-5
PFOS	Perfluorooctanesulfonate	45298-90-6
PFNS	Perfluorononanesulfonate	474511-07-4
PFDS	Perfluorodecanesulfonate	126105-34-8
PFDoS	Perfluorododecanesulfonate	343629-43-6
4:2 FTS	4:2 fluorotelomersulfonate	414911-30-1
6:2 FTS	6:2 fluorotelomersulfonate	425670-75-3
8:2 FTS	8:2 fluorotelomersulfonate	481071-78-7
N-MeFOSAA	N-Methylperfluorooctanesulfonamidoacetic acid	2355-31-9
N-EtFOSAA	N-Ethylperfluorooctanesulfonamidoacetic acid	2991-50-6
HFPO-DA	Hexafluoropropylene oxide dimer acid	13252-13-6
ADONA	4,8-dioxa-3H-perfluorononanoic acid	919005-14-4
11Cl-PFOUdS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9
9Cl-PF3ONS	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	756426-58-1

Table 2. *Values of detected PFAS compounds and detection date for sites with values above PQLs.*

Site ID & Description	Date	PFOA	PFOS	HFPO-DA (GenX)	PFBS	PFAS Sum (ng/L)	Analytes Detected	Analyte	Result (ng/L)	Analytes below PQL	PFAS Compounds below PQL
CTB040ASUR LAKE RODHISS NEAR BATON	09/07/22	U	2.0	U	U	4.0	2	PFOS PFPeA	2.0 2.0	26	PFBA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFPeS; PFHxS; PFHpS; PFOS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
CTB040BSUR LAKE RODHISS NEAR RODHISS	09/07/22	U	2.1	U	U	2.1	1	PFOS	2.1	27	PFBA; PFPeA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
CTB048ASUR LAKE HICKORY	09/07/22	U	2.0	U	U	6.4	3	PFOS PFHxA PFPeA	2.0 2.1 2.3	25	PFBA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
CTB058GSUR LOOKOUT SHOALS LAKE	09/08/22	U	2.3	U	U	4.7	2	PFOS PFPeA	2.3 2.4	26	PFBA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
CTB082AASUR LAKE NORMAN HUNTERSVILLE WATER INTAKE	09/08/22	U	U	U	U	0	0	-	-	28	PFBA; PFPeA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFOS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS

Site ID & Description	Date	PFOA	PFOS	HFPO-DA (GenX)	PFBS	PFAS Sum (ng/L)	Analytes Detected	Analyte	Result (ng/L)	Analytes below PQL	PFAS Compounds below PQL
CTB082ASUR LAKE NORMAN CORNELIUS CREEK	09/08/22	U	2.1	U	U	2.1	1	PFOS	2.1	27	PFBA; PFPeA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
CTB082MSUR LAKE NORMAN MOUNTAIN CREEK	09/08/22	U	2.1	U	U	2.1	1	PFOS	2.1	27	PFBA; PFPeA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
CTB082QSUR LAKE NORMAN DAVIDSON WATER INTAKE	09/08/22	U	2.1	U	U	4.1	2	PFOS PFPeA	2.1 2.0	26	PFBA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
CTB086CSUR MOUNTAIN LAKE AT GAR CREEK	09/13/22	U	2.0	U	U	4.1	2	PFOS PFPeA	2.0 2.1	26	PFBA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
CTB087ASUR MOUNTAIN LAKE AT DAM NEAR MT. HOLLY	09/13/22	U	2.0	U	U	2.0	1	PFOS	2.0	27	PFBA; PFPeA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS

Site ID & Description	Date	PFOA	PFOS	HFPO-DA (GenX)	PFBS	PFAS Sum (ng/L)	Analytes Detected	Analyte	Result (ng/L)	Analytes below PQL	PFAS Compounds below PQL
CTBBCL1SUR BESSEMER CITY LAKE	09/13/22	5.3	2.5	U	U	50.9	7	PFOA PFOS PFBA PFHpA PFHxA PFNA PFPeA	5.3 2.5 6.0 (J2) 7.9 10.0 2.2 17.0	21	PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
CTB103SUR CATAWBA RIVER AT SOUTH BELMONT	09/14/22	U	2.2	U	U	6.7	3	PFOS PFHxA PFPeA	2.2 2.1 2.4	25	PFBA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
FRBACR4SUR ALLEN CREEK RESERVOIR	09/14/22	U	U	U	U	0	0	-	-	28	PFBA; PFPeA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFOS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
FRBBTR1SUR BEETREE RESERVOIR	09/06/22	U	U	U	U	0	0	-	-	28	PFBA; PFPeA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFOS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS

Site ID & Description	Date	PFOA	PFOS	HFPO-DA (GenX)	PFBS	PFAS Sum (ng/L)	Analytes Detected	Analyte	Result (ng/L)	Analytes below PQL	PFAS Compounds below PQL
FRBBUR4SUR BURNETT RESERVOIR	09/06/22	U	U	U	U	0	0	-	-	28	PFBA; PFPeA; PFHxA; PFHpA; PFOA; PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFBS; PFPeS; PFHxS; PFHpS; PFOS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS
TAR017FSUR TAR RIVER RESERVOIR	09/01/22	3.7	5.9	U	2.1	27.8	8	PFOA PFOS PFBS PFBA PFHpA PFHpS PFHxA PFPeA	3.7 5.9 2.1 2.9 6.6 2.4 2.0 2.2	20	PFNA; PFDA; PFUnA; PFDoA; PFTrDA; PFTeDA; PFPeS; PFHxS; PFNS; PFDS; PFDoS; 4:2 FTS; 6:2 FTS; 8:2 FTS; N-MeFOSAA; N-EtFOSAA; HFPO-DA; ADONA; 11Cl-PFOUdS; 9Cl-PF3ONS

Data Qualifier Codes:

J2 – The reported value failed to meet the established quality control criteria for either precision accuracy.

U – Indicates that the analyte was analyzed for, but not detected above the reported PQL.