County of Brunswick

3954 Clearwell Dr NE
Leland, NC 28451

Northwest Plant Lab

Leland, NC
Samples Received: 9/26/19

Analytical Report
0919-752

Isotope Dilution Method

PFAS – Legacy 24, Gen-X, PFMOAA

Enthalpy Analytical, LLC – Ultratrace

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I certify that to the best of my knowledge all analytical data presented in this report:

- Have been checked for completeness
- Are accurate, error-free, and legible
- Have been conducted in accordance with approved protocol, and that all deviations and analytical problems are summarized in the appropriate narrative(s)

This analytical report was prepared in Portable Document Format (.PDF) and contains __14__ pages.

Juanica L. Thomas

QA Associate II
Review Performed by: Juanica L. Thomas

Report Issued Date: 10-10-19

ENTHALPY ANALYTICAL

Summary of Results

Summary of Results: PFAS

Enthalpy Ultratrace Batch # 10472

PFAS

Analyte	Method Blank ng/L	092619-S01 ng/L	092619-E01 ng/L
Acids			
PFBA	ND U	7.31	7.35
PFPeA	0.124 J	17.5	16.9
PFHxA	0.184 J	13.9	13.5
PFHpA	0.0990 J	9.98	9.14
PFOA	0.160 J	5.63	4.18
PFNA	0.105 J	0.838 B	0.681 B
PFDA	ND U	0.503	0.408
PFUnA	ND U	0.207 J	0.134 J
PFDoA	0.153 J	ND U	ND U
PFTrA	ND U	ND U	ND U
PFTA	ND U	ND U	ND U
Sulfonates			
L-PFBS	ND U	4.58	4.05
PFPeS	0.0602 J L	1.17	0.890
PFHxS	0.0913 J	4.90	3.75
PFHpS	0.0755 J L	0.245 B	0.132 J B
PFOS	0.0538 J	9.75	6.80
PFNS	0.0515 J L	ND U	ND U
PFDS	0.0703 J L	ND U	ND U
4:2 FTS	ND U	ND U	ND U
6:2 FTS	0.0764 J	0.0999 J B	0.157 J B
8:2 FTS	0.0854 J	ND U	ND U
Other			
PFOSA	ND U	ND U	ND U
N-MeFOSAA	0.350	ND U	ND U
N-EtFOSAA	0.0327 J L	ND U	ND U
HFPO-DA (Gen-X)	1.62 J L	11.1 B	10.5 B
PFMOAA*	ND U	243	282
Lab Sample ID	MB_10472	0919-752_10472_001	0919-752_10472_002

† - Gen-X and related compounds are currently not accredited analytes under the TNI standard

* - Analytical standard used is a non-accredited quality control standard

Narrative Summary

Enthalpy Analytical Narrative Summary

Company	County of Brunswick
Job#	0719-752 PFAS – Legacy 24, Gen X, PFMOAA
Client Project #	N/A

Custody	Naomi Harka of Enthalpy Analytical Wilmington received the samples (via client courier) on 9/26/19 on ice at 4.6°C in good condition. Prior to, during, and after analysis, the samples were stored in the laboratory with access only by authorized personnel of Enthalpy Analytical, LLC.
Analysis	The samples were analyzed by isotope dilution method for PFAS using Waters Acquity UPLC equipped with Xevo TQ MS (LC/MS/MS "Kili"). For aqueous samples, 250mL aliquot was weighed and spiked with Extraction Standard (ES). The sample was then mixed well and centrifuged. Cleanup procedures were performed on the supernatant and then extracted via SPE. Each final sample extract was transferred to an autosampler vial and spiked with 400 µL of Injection Standard (IS), prior to analysis.
Calibration	The analytes and labeled standards in the initial calibration exhibited RSDs less than 50%. All analytes passed the R2 coefficient correlation criteria. The internal calibration verification (ICV) met the ±30% criteria for native analytes and ±50% criteria for ES recoveries. The continuing calibrations (concal) met the ±30% criteria for native analytes and ±50% criteria for ES recoveries.
QC Notes	The QC injection (OPR) met the ±30% criteria for % Recovery and ±50% criteria for ES recoveries with the exception of the following: OPR – M2PFTeDA Method Blank – M2PFTeDA. Data is accepted due to target analyte criteria being met for all native analytes at >73% recovery in the OPR. Therefore, the out-of- range ES recoveries have no impact on the accuracy of the target analyte (native) compounds. Some analytes detected in the method blank (MB) exhibited values more than 1/10 the sample amount. Any analytes detected in the samples were notated with a B qualifier. The samples were extracted within the 14-day from collection holding time (on Sep 26). Extracts were analyzed within the 28-days from extraction to analysis holding time required by the method.

Reporting Notes	The samples exhibited matrix interferences that adversely affected the injection standard (JS) signal for M3PFBA. As a consequence, those compounds whose recoveries are measured relative to M3PFBA (M3PFBS and M5PFPeA) exhibited elevated recoveries outside the limits. Some analytes in the samples fell outside the limits for ES recoveries. Although the cause was undetermined, it is theorized to be matrix effects. Based on the native results in the OPR meeting criteria, the out-of- range ES recoveries have no impact on the accuracy of the target analyte (native) compounds. Therefore, the data are considered acceptable. The results presented in this report are representative of the samples as provided to the laboratory. These analyses met the requirements of the TNI Standard. Any deviations from the requirements of the reference method or TNI Standard have been stated above.

General Reporting Notes – Data Qualifiers

The following are general reporting notes that are applicable to all Enthalpy Analytical, Inc.-Wilmington, NC data reports, unless specifically noted otherwise.

General Data Qualifiers / Data Attributes

- B – The analyte was found in the method blank, at a concentration that was at least 10% of the concentration in the sample.
- C – Two or more congeners co-elute. In EDDs, C denotes the lowest IUPAC congener in a co-elution group and additional co-eluters for the group are shown with the number of the lowest IUPAC co-eluter**.**
- E – The reported concentration exceeds the calibration range (upper point of the calibration curve).
- EMPC – Represents an estimated maximum possible concentration. EMPCs arise in cases where the signal/noise ratio is not sufficient for peak identification (the determined ion-abundance ratio is outside the allowed theoretical range), or where there is a co-eluting interference.
- J – Indicates that an analyte has a concentration below the reporting limit (lowest point of the calibration curve).
- L - Indicates that an analyte has a concentration below the Minimum Detection Limit (MDL).
- ND – Indicates a non-detect.
- NR – Indicates a value that is not reportable.
- PR – Due to interference, the associated congener is poorly resolved.
- DI – Indicates the presence of a quantitative interference.
- SI – Denotes “Single Ion Mode” and is utilized for PCBs where the secondary ion trace has a significantly elevated noise level due to background PFK. Responses for such peaks are calculated using an EMPC approach based solely on the primary ion area(s) and may be considered estimates.
- U – The analyte was not detected. The Estimated Detection Limit (EDL) may be reported for this analyte.
- V – The labeled standard recovery was found to be outside of the method control limits.

DRBC/TMDL Specific Data Qualifiers / Data Attributes

- J – The reported result is an estimate. The value is less than the minimum calibration level but greater than the Estimated Detection Limit (EDL).
- U – The analyte was not detected in the sample at the Estimated Detection Limit (EDL).

- E – The reported concentration is an estimate. The value exceeds the upper calibration range (upper point of the calibration curve).
- D – Dilution Data. Result was obtained from the analysis of a dilution.
- B – Analyte found in the sample and associated method blank.
- Cxx – Co-elutes with the indicated congener, data is reported under the lowest IUPAC congener. 'xx' denotes the IUPAC number with the lowest numerical designated congener.
- NR – Analyte is not reportable because of problems in sample preparation or analysis.
- V – Labeled standard recovery is not within method control limits.
- X – Results from re-injection/repeat/second-column analysis.
- EMPC – Estimated Maximum Possible Concentration. Indicates that a peak is identified but did not meet the method specified ion-abundance ratio.

Lab Identifiers

- AR – Indicates use of the archived portion of the sample extract.
- CU – Indicates a sample that required additional clean-up prior to HRMS injection/processing.
- D – Indicates a dilution of the sample extract. The number that follows the "D" indicates the dilution factor.
- DE – Indicates a dilution performed with the addition of ES (Extraction Standard) solution.
- DUP – Designation for a duplicate sample.
- MS – Designation for a matrix spike.
- MSD – Designation for a matrix spike duplicate.
- RJ – Indicates a reinjection of the sample extract.
- S – Indicates a sample split. The number that follows the "S" indicates the split factor.

PFAS Compound Acronym List	
Acronym	**Compound Name**
Target Analytes	
PFBA	Perfluorobutanoic Acid
PFPeA	Perfluoropentanoic Acid
PFHxA	Perfluorohexanoic Acid
PFHpA	Perfluoroheptanoic Acid
PFOA	Perfluorooctanoic Acid
PFNA	Perfluorononanoic Acid
PFDA	Perfluorodecanoic acid
PFUnA (PFUnDA)	Perfluoroundecanoic acid
PFDoA (PFDoDA)	Perfluorododecanoic acid
PFTrDA (PFTriA)	Perfluorotridecanoic acid
PFTeDA (PFTA)	Perfluorotetradecanoic acid
PFBS	Perfluorobutane sulfonic acid
PFPeS	Perfluoropentane sulfonic acid
PFHxS	Perfluorohexane sulfonic acid
PFHpS	Perfluoroheptane sulfonic acid
PFOS	Perfluorooctane sulfonic acid
PFNS	Perfluorononane sulfonic acid
PFDS	Perfluorodecane sulfonic acid
4:2 FTS	4:2 fluorotelomer sulfonic acid
6:2 FTS	6:2 fluorotelomer sulfonic acid
8:2 FTS	8:2 fluorotelomer sulfonic acid
PFOSA (FOSA)	Perfluorooctane sulfonamide
N-MeFOSAA	N-methyl perfluorooctane sulfonamido acetic acid
N-EtFOSAA	N-ethyl perfluorooctane sulfonamido acetic acid
HFPO-DA	2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (Gen-X)
Extraction Standards	
MPFBA	Perfluoro-n-[13C4]butanoic acid
M5PFPeA	Perfluoro-n-[13C5]pentanoic acid
M3PFBS	Sodium perfluoro-1-[2,3,4-13C3]-butanesulfonic acid
M2-4:2 FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-13C2]-hexane sulfonic acid
M5PFHxA	Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid
M3HFPO-DA	2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-13C3-propanoic acid
M4PFHpA	Perfluoro-n-[1,2,3,4-13C4]heptanoic acid
M3PFHxS	Sodium perfluoro-1-[1,2,3-13C3]-hexanesulfonic acid
M2-6:2 FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-13C2]-octane sulfonic acid
M8PFOA	Perfluoro-n-[13C8]octanoic acid
M9PFNA	Perfluoro-n-[13C9]nonanoic acid
M8PFOS	Sodium perfluoro-1-[13C8]-octanesulfonic acid
M2-8:2 FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-13C2]-decane sulfonic acid
M8FOSA	Perfluoro-1-[13C8]octanesulfonamide
M6PFDA	Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid
d3-N-MeFOSAA	N-methyl-d3-perfluoro-1-octanesulfonamide
d5-N-EtFOSAA	N-ethyl-d5-perfluoro-1-octanesulfonamide
M7PFUnDA (M7PFUdA)	Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid
MPFDoA	Perfluoro-n-[1,2-13C2]dodecanoic acid
M2PFTeDA	Perfluoro-n-[1,2-13C2]tetradecanoic acid

Injection Standards	
M3PFBA	Perfluoro-n-[2,3,4-13C3]butanoic acid
M2PFOA	Perfluoro-n-[1,2-13C2]octanoic acid
MPFDA	Perfluoro-n-[1,2-13C2]decanoic acid
MPFOS	Sodium perfluoro-1-[1,2,3,4-13C4]-octanesulfonic acid

Sample Custody

ENTHALPY
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ENTHALPY
analytical

Chain of Custody Record

Enthalpy Ultratrace Job#: ___________ COC Page_____of_____

Special Handling:

- ☑ Standard Turn Around Time
- ☐ Rush Turn Around Time -- Date Needed__________
- All Fast TATs Subject to Approval by Enthalpy Analytical, Inc.
- All Samples Disposed of After 6 months Unless Otherwise Instructed.

Enthalpy Analytical-Wilmington, NC has added enhancements to standard methods to improve accuracy, precision and permit an assessment of laboratory performance in the context of your specific data needs. For more information email Cindy.James@enthalpy.com.

Client Name: BRUNSWICK COUNTY WATER	Project Number:	PO#:	This Chain of Custody is applicable to Non-Air samples. Standard TAT differ per analysis and are provided by request.
Project Manager: GLENN WALKER	Site Name: N.W. PLANT LAB	Telephone#:	
Report To: SAME	Location: LELAND	Email:	

Client Special Instructions:

Matrix: GW-Groundwater, WW-Wastewater, NW-Non-Potable Water, DW-Drinking Water, S-Soil, SL-Sludge, BT-Biological Tissue, O-Other

Type: G=Grab C=Composite Q=Quality Control

Sample ID	Date	Time	Sample Volume	Type	Matrix	# of Bottles	# of Jars	# of Bags	# Other				Method 1613	Method 8290	Method 1668A/B/C PCB	PFAS by LC/MS/MS	PAHs by HRGC/HRMS	Sample on Hold	EPA537+GENX PFMBA		Notes:
092619-S01	9-26-19	0820	250 mL	G	NW	2													✓		
092619-E01	9-26-19	0820	250 mL	G	DW	2													✓		

Relinquished By:	Date:	Received By:	Date:	Time:	Sample Temperature Upon Receipt:
[signature]	9-26-19	[signature]	9/26/19	0905	☒ Iced ☐ Ambient °C 4.6 T9
					☐ Iced ☐ Ambient °C______
					☐ Iced ☐ Ambient °C______

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Client Courier, on ice, no skew, good condition [initials] 9/26/19

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