



MEMORANDUM

SUBJECT: Development of the PFAS Wastewater Characterization Analytical Database

FROM: United States Environmental Protection Agency (EPA)
Office of Water, Engineering and Analysis Division

FOR: Effluent Limitations Guidelines and Standards Planning Record

DATE: November 17, 2022

In September 2021, EPA published its [Preliminary Effluent Guidelines Program Plan 15](#), announcing several efforts to address industrial discharges of per- and polyfluoroalkyl substances (PFAS) to surface waters and publicly owned treatment works (POTWs), including rulemakings for the Organic Chemicals, Plastics, Synthetics, and Fibers (OCPSF) and Metal Finishing point source categories and detailed studies for the Landfills and Textile Mills point source categories. EPA is collecting and reviewing information and data about the type and quantity of PFAS present in wastewater generated and/or discharged by facilities in these point source categories and other point source categories EPA selected for preliminary review. ERG is providing technical support to EPA in the compilation and analysis of these data using the PFAS Wastewater Characterization Analytical Database (hereafter referred to as “analytical database”) (ERG, 2022a).

This memorandum describes the development and design of the analytical database, the acceptance criteria for inclusion, and provides an overview of each data set that contains wastewater characterization data for one or more facilities in the point source categories. This memorandum includes the following:

- Section 1: Analytical database structure.
- Section 2: Data entry procedures.
- Section 3: Data acceptance criteria.
- Section 4: Data sources included in EPA’s analyses.

1. Database Structure

EPA developed the analytical database using Microsoft Access to store and analyze PFAS wastewater characterization data collected as part of the Multi-Industry PFAS Study and subsequent effluent guidelines rulemakings and detailed studies. The analytical database includes tables to organize the analytical data and standardize data entry procedures, including:

- Data dictionaries to describe each table and field.
- Look-up tables to standardize entry values for specific fields.
- Analytical data tables with sample-specific analytical results.

Table 1 summarizes the tables included in the analytical database. The analytical database includes sample results from each data source in source-specific data tables, differentiated by the data source name in the table title. Source-specific data are aggregated in the AnalyticalData_CompiledMaster table.

Table 1. Analytical Database Tables

Table Title	Description
00a_DataDictionary_Objects	Dictionary describing all analytical database tables.
00b_DataDictionary_AnalyticalDataFields	Dictionary describing the data fields for all tables containing analytical data (e.g., any table identified as “AnalyticalData”).
00c_QCTrackingSheet	Listing of queries and documentation of quality control checks.
AnalyticalData_ <i>DataSourceName</i> ^a	Formatted analytical data in each data source. See Section 4 for a description of each data source.
AnalyticalData_CompiledMaster	This table is an aggregation of the formatted analytical data from each data source.
AnalyticalData_Template	Template for the structure and format of all analytical data tables.
Crosswalk_40CFRParttoPSC	Crosswalk between PSC name and Title 40 CFR part.
Crosswalk_40CFRSubcategories	Crosswalk between PSC subcategory name and Title 40 CFR part.
Crosswalk_AnalyticalMethods	Crosswalk between pollutant name, CAS number, and standard limits in PFAS analytical methods.
Crosswalk_Facility	Crosswalk matching facility names to unique facility identifiers (FacilityID). For each facility, this crosswalk captures information on the discharge permits, discharge type, FRS number, industry type (PSC, SIC code, NAICS code), and receiving water/POTW. Also identifies data sources containing data for each facility.
Crosswalk_NAICSIndustry	Crosswalk used to link a NAICS code to industry description.
Crosswalk_NAICSStoPSC	Crosswalk used to link a NAICS code to a PSC code.
Crosswalk_NAICSStoSIC	Crosswalk used to link a NAICS code to a SIC code.
Crosswalk_NPDEStoPSC	Crosswalk between NPDES permit number and parameter code in the Pollutant Loading Tool to point source category. NPDES permits may include pollutants regulated under different point source categories; therefore, multiple point source categories may be associated with each NPDES permit.
Crosswalk_Pollutant	Crosswalk matching analyte names (as reported in original data sources) to a standardized list of pollutant names used in the database. Also lists PFAS type and CAS number.
Crosswalk_RecordIDtoDataSource	Crosswalk matching RecordIDs to DataSource.
Crosswalk_SICIndustry	Crosswalk used to link a SIC code to industry description.
Crosswalk_SICStoPSC	Crosswalk used to link a SIC code to a PSC.
Lookup_ConcentrationUnits	Standardized concentration units.
Lookup_FlowUnits	Standardized flow rate units.
Lookup_StreamClassification	Standardized classifications for wastewater streams.

Abbreviations: CAS – Chemical Abstracts Service; CFR – Code of Federal Regulations; FRS – Federal Registry Service; PSC – point source category; NAICS – North American Industry Classification System; NPDES – National Pollutant Discharge Elimination System; OAR – EPA’s Office of Air and Radiation; POTW – publicly owned treatment works; SIC – Standard Industrial Classification.

a – The data source name will appear in place of the italicized text.

2. Analytical Data Format and General Data Processing Procedures

Analytical data submitted to or collected by EPA can be in different file types and formats. To facilitate data analyses, EPA standardizes the format for each analytical data set. EPA does not alter the submitted data, but instead reorganizes or reformats the data from its original data source into one consistent format. EPA retains a copy of the original data source in addition to the reformatted copy. Table 2 describes the data fields EPA uses in the analytical data tables. The remainder of this section discusses the data formatting steps and quality assurance procedures EPA uses to maintain data integrity.

Table 2. Analytical Data Fields

Field Name	Field Description
RecordID	Unique alphanumeric identifier assigned to each record (each data point) in the database.
CBIFlag	Indicator for whether the record is claimed as CBI.
DataSource	Name of data source the analytical data were imported from.
FacilityID	Facility identification number.
SourceFacilityName	Name of the facility, as identified in the original data source.
FRS	FRS number.
DischargeType	Indicates whether the facility is a direct or indirect discharger.
PermitID	Permit identification number. For direct discharge facilities, this typically represents the NPDES permit number. For indirect discharge facilities, this typically represents the pretreatment or industrial user permit number.
PSC	PSC code, from Title 40 of the CFR.
SIC	SIC code.
NAICS	NAICS code.
StreamClassification	Standardized classification for the process water or wastewater stream represented by sample (see Table 3) to allow comparison of data for similar streams between facilities and data sets.
SamplePoint	Sample point identifier or specific location of sample collected.
TypeOfWastewater	Description of process water or wastewater represented by sample, as reported in original data source.
SampleID	Number or identifier for each individual sample.
DateCollected	Date the sample was collected.
LabName	Analytical laboratory that analyzed the sample.
Analyte	Name of the chemical substance measured, as reported by the original data source.
CAS	CAS number specific to each chemical substance (analyte).
Method	Analytical method used to quantify the amount of the specified analyte in the sample.
PreparationType	Phase of the analyte represented by the sample result (e.g., total, dissolved, filtrate, solids).
Units	Standardized unit of measure for the Amount, J-Value Concentration, MDL, and QL fields.
NonDetectIndicator	Flag indicating whether the sample was detected at or above the sample-specific QL. Detections at or above the sample-specific QL are flagged as detections (“D”) while results less than the QL are flagged as nondetection (“ND”).
Amount	Concentration of the analyte in the sample. Populated for detections only (“D” in the NonDetectIndicator field).
JValueConcentration	Estimated concentration of the analyte that is detected above the MDL but below the QL. Populated for detections below the sample-specific QL only (“ND” in the NonDetectIndicator field).
MDL	Method detection limit. Minimum analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence.
QL	Quantitation limit. Lowest concentration of an analyte that produces a quantitative result within specified limits of precision and bias. Sometimes referred to as the reporting limit.
Dilution	Dilution factor, the ratio of the final volume of the sample to the aliquot volume.
Qualifier	Qualifier assigned by the analytical laboratory to flag any analytical issues or concerns.
Reason	Description of the reported qualifier.
SamplePointFlow	Flow rate at the sample point at the time of sample collection.
FlowUnits	Standardized unit of measure for the SamplePointFlow field.
SampleType	Flag indicating whether sample represents a single grab sample or composite of multiple samples.
QASample	Flag indicating a quality assurance (QA) sample (e.g., duplicate samples or field blank samples).
SampleDescription	Description of sample point, which can include details on sample location, sampling procedures, or wastewater type.
TreatmentDescription	Description of wastewater treatment configuration prior to sample point (if known).
DataSourceReference	Description of source of data, such as name and/or document control number (DCN) of a report or file.

Table 2. Analytical Data Fields

Field Name	Field Description
ProjectNotes	General notes about the sample not captured in the other fields.

Abbreviations: CAS – Chemical Abstracts Service; CBI – confidential business information; CFR – Code of Federal Regulations; FRS – Federal Registry Service; MDL – method detection limit; NAICS – North American Industry Classification System; NPDES – National Pollutant Discharge Elimination System; PSC – point source category; QL – quantitation limit; SIC – Standard Industrial Classification.

Note: EPA may add fields to document data quality as the analytical data are reviewed against quality acceptance criteria in the PQAPP and to indicate which data points were accepted for use in individual analyses (e.g., wastewater characterization, pollutant loadings, etc.).

EPA reviews data sources containing wastewater information for PFAS. EPA evaluates each data source individually to determine the appropriate procedure for entering the data into the analytical database. EPA follows the four general steps below to ensure data are captured consistently and are usable in EPA’s analyses.

1. Convert the file to an Excel spreadsheet and rename/reformat fields from the original data source to match the analytical database fields listed in Table 2. Where appropriate, partition or combine information from the original source to match the analytical database fields (e.g., if source reports a value as “<5 ng/L”, EPA will reformat to “ND” in the NonDetectIndicator field, “5” in the QL field, and “ng/L” in the Units field). EPA does not populate fields that do not exist in the original source (i.e., fields are left blank where no data are provided).
2. Complete other fields from Table 2 using information from the source, such as RecordID, CBIFlag, DataSource, FacilityID, DischargeType, StreamClassification, NonDetectIndicator, SampleDescription, TreatmentDescription, DataSourceReference, and ProjectNotes fields. Table 3 describes the stream classifications used in the analytical database. Where a sample represents more than one stream classification (e.g., effluent from one unit and influent to another), EPA selects the effluent stream as the stream classification and notes the second in the SampleDescription field.
3. Import the Excel spreadsheet into the analytical database. Use queries to append all records from the source-specific data table to the AnalyticalData_Direct_CompiledMaster or AnalyticalData_Indirect_CompiledMaster table.
4. Perform quality review of the Excel spreadsheet and database tables for accuracy and completeness. Quality reviews include confirming the total count and, if numeric, sum of all fields matched the original source, verifying the total count of detection and nondetections results and count of results by pollutant match the original data source, accuracy of data transcription, and proper data field population to ensure accuracy and completeness prior to import into the analytical database. Additionally, EPA performs quality assurance checks to ensure the integrity of the import process (i.e., all records and fields were successfully imported) by confirming the total number of records matched and each data field was imported without formatting issues or data truncation.

As noted above, EPA classifies each sample by process water or wastewater stream type to allow comparison of data for similar streams between facilities and data sets. Table 3 provides a description for the wastestreams EPA included in the analytical database. As part of the Multi-Industry PFAS Study, EPA only compiled sample results that were categorized as facility effluent. However, EPA will also collect and compile data for samples collected within facilities (i.e., internal sample points prior to discharge of final effluent) as part of the ongoing detailed studies and rulemakings. EPA will update the table to reflect additional stream classifications as they are integrated into the analytical database.

Table 3. Process Water and Wastewater Stream Classifications

Stream Classification	Description
Process Influent	Process influent sample collected for feed water, such as well water, that is used as process water on-site.
Process Wastewater: Untreated	Process wastewater sample collected at an internal outfall or other in-plant monitoring point prior to pretreatment or the end-of-pipe wastewater treatment system.

Table 3. Process Water and Wastewater Stream Classifications

Stream Classification	Description
Process Wastewater: Pretreated	Process wastewater sample collected at an internal outfall or other in-plant monitoring point after pretreatment but prior to the end-of-pipe wastewater treatment system.
Nonprocess Wastewater: Untreated	Nonprocess wastewater sample collected at an internal outfall or other in-plant monitoring point prior to pretreatment or the end-of-pipe wastewater treatment system.
Nonprocess Wastewater: Pretreated	Nonprocess wastewater sample collected at an internal outfall or other in-plant monitoring point after pretreatment but prior to the end-of-pipe wastewater treatment system.
Wastewater Treatment System: Influent	Reflects the combined wastewaters entering the first treatment unit of the end-of-pipe wastewater treatment system after commingling.
Wastewater Treatment System: Effluent	Reflects the wastewater exiting the last treatment unit of the end-of-pipe wastewater treatment system prior to commingling with any other wastewaters.
Wastewater Treatment System: Partially Treated	Reflects wastewater samples collected between treatment units in the end-of-pipe wastewater treatment system.
Process Area Stormwater: Untreated	Untreated stormwater or wash water runoff from in areas that process raw materials, intermediate products, finished products, byproducts, or waste products.
Process Area Stormwater: Pretreated	Pretreated stormwater or wash water runoff from in areas that process raw materials, intermediate products, finished products, byproducts, or waste products.
Nonprocess Area Stormwater: Untreated	Untreated stormwater or wash water runoff from in areas that do not process raw materials, intermediate products, finished products, byproducts, or waste products.
Nonprocess Area Stormwater: Pretreated	Pretreated stormwater or wash water runoff from in areas that do not process raw materials, intermediate products, finished products, byproducts, or waste products.
Groundwater: Treated	Treated groundwater effluent from a pump and treat system on site.
Other	Reflects miscellaneous wastewater stream which does not meet any of the other definitions in the stream classification list.
Third-Party Wastewater	Reflects wastewater samples collected for streams that are generated offsite from the plant and transferred to the on-site end-of-pipe wastewater treatment system.
Landfill Leachate: Untreated	Landfill leachate sample collected at an internal outfall or other in-plant monitoring point prior to pretreatment or the end-of-pipe wastewater treatment system.
Landfill Leachate: Pretreated	Landfill leachate sample collected at an internal outfall or other in-plant monitoring point after pretreatment but prior to the end-of-pipe wastewater treatment system.
POTW Influent	Reflects the combined wastewaters entering a publicly owned treatment works after commingling.
Final Outfall	Reflects wastewater samples collected at a final outfall after commingling with other wastestreams but prior to discharge to a surface water or publicly owned treatment works.
Groundwater: Untreated	Untreated groundwater on site prior to treatment and use on site or discharge.

Abbreviations: POTW – publicly owned treatment works.

Note: Where available, EPA used facility configuration and sample collection information to assign a stream classification to each sample.

3. Data Acceptance Criteria

EPA is gathering information and data to determine type and quantity of PFAS present in wastewater from facilities in the point source categories being evaluated. ERG assists EPA with assessing the accuracy, reliability, and representativeness of all data sources to determine their quality and usability for the Multi-Industry PFAS Study and subsequent effluent guidelines rulemakings and detailed studies, as described in the PQAPP and expanded upon below.

Accuracy. ERG assumes that data and information contained in supporting government publications or databases, peer-reviewed journal articles, and other technical literature are sufficiently accurate to support the general characterization of wastewater discharges of PFAS. ERG considers the data and information obtained from direct correspondence with individual companies, industry trade associations, and state government representatives and regulators as sufficiently accurate to characterize and quantify specific PFAS wastewater discharges from individual facilities.

Reliability. ERG uses the following criteria to evaluate the reliability of available data and other information collected and used in its analyses:

- The work was clearly written, so that all assumptions and methodologies can be identified.
- The variability and uncertainty (quantitative and qualitative) of the information, or the procedures, measures, methods, or models used to compile the information, were evaluated and characterized.
- The assumptions and methods were consistently applied throughout the analysis, as reported in the source.
- Wastestreams, analytes, units, and limits (when appropriate) were clearly characterized.

ERG considers data sources that met these criteria sufficiently reliable to characterize and understand wastewater discharges associated with PFAS.

Representativeness. ERG evaluates whether data and information were characteristic of PFAS discharges and impacts across industries or sources and are relevant to and representative of typical operations relevant to PFAS.

EPA considers data sources that meet these criteria of being sufficiently accurate, reliable, and representative to characterize wastewater discharges of PFAS. To ensure that all information and data included in EPA's wastewater characterization analyses were also comparable, EPA also developed and applied the following acceptance criteria to all data sources:

- Sample locations must be unambiguous and clearly described such that the sample can be categorized as influent or effluent from a facility process/treatment unit or final discharge collected during typical facility operations and by level of treatment (e.g. treated, partially treated, untreated).
- Sample must be an aqueous wastewater sample.
- Sample results must represent total results (i.e., not dissolved component).
- Sample results must be reported as individual or average concentration results (i.e., not reported as a range or aggregation of results from multiple facilities).
- Sample results must be reported as a detection or nondetections, and detections must include the quantified concentration and unit of measure.

EPA and ERG evaluated all data sources along with individual sample results contained in the data sources to identify analytical data that meet the acceptance criteria for inclusion in analyses for characterizing PFAS in industrial wastewater discharges. Data that did not satisfy all acceptance criteria were not entered into the analytical database.

EPA has not yet promulgated a multi-laboratory validated standard method for PFAS analysis of wastewater matrices. Therefore, all wastewater samples currently in the analytical database were analyzed using other test

methods, such as proprietary industry and commercial laboratory analytical methods and modified drinking water methods. The analytical database includes all sample results meeting the stated acceptance criteria, regardless of analytical method.

4. Data Sources

EPA collected analytical data related to discharges of PFAS discharges through existing (secondary) data sources, including discharge monitoring reports (DMRs), individual companies and facilities, state and local wastewater authorities, and agency databases and data sets. Table 4 summarizes data sources that met the acceptance criteria for inclusion in the analytical database.

Table 4. Analytical Data Sources

Data Source	Data Collection Dates	Discharge Type	Count of Facilities Represented	Count of Sampling Results Accepted	Count of PFAS Reported	Data Source Reference(s)
2019 Discharge Monitoring Reports	1/31/2019 to 12/31/2019	Direct	33	1,258	21	EPA, 2020
2020 Discharge Monitoring Reports	1/31/2020 to 12/31/2020	Direct	71	2302	47	EPA, 2021a
3M Company	1/1/2018 to 12/31/2019	Direct	3	520	15	3M, 2020
The Chemours Company	3/2/2020 to 3/30/2020	Direct	1	80	16	Chemours, 2020
Georgia-Pacific LLC	4/13/2021 to 4/21/2021	Direct & Indirect	4	12	2	EPA, 2021b
Michigan Department of Environment, Great Lakes, and Energy	8/24/2016-3/10/2022	Direct & Indirect	893	17,859	26	MI EGLE, 2020a MI EGLE, 2020b MI EGLE, 2020c MI EGLE, 2022a MI EGLE, 2022b MI EGLE, 2022c
New Jersey Department of Environmental Protection	1/2/2018 to 2/2/2022	Direct & Indirect	44	3287	16	NJ DEP, 2020 NJ DEP, 2022
Vermont Department of Environmental Conservation	8/21/2019 to 11/6/2019	Direct & Indirect	25	7,514	26	VT DEC, 2020
EPA's Office of Enforcement and Compliance Assurance	1/2/2013 to 12/20/2018	Direct	4	10,423	72	OECA, 2020
EPA Region 3	8/29/2019	Indirect	1	72	6	EPA Region 3, 2020
Lang, 2017	2/25/2013 to 12/11/2014	Indirect	18	6,090	69	Lang et al., 2017
Solo-Gabriele, 2020	Unknown	Indirect	5	276	12	Solo-Gabriele et al., 2020
American Forest and Paper Association	5/9/2019 to 3/24/2020	Direct	6	457	36	AF&PA, 2022

Table 4. Analytical Data Sources

Data Source	Data Collection Dates	Discharge Type	Count of Facilities Represented	Count of Sampling Results Accepted	Count of PFAS Reported	Data Source Reference(s)
California Geotracker	8/4/2016 to 4/6/2022	Indirect	90	4,396	39	California Geotracker, 2022
Chemours ANPRM	6/6/2019 to 1/21/2021	Direct	1	134	20	Chemours ANPRM, 2020
Daikin ANPRM	2/10/2020 to 3/2/2021	Direct	1	125	7	Daikin ANPRM, 2020
Metropolitan Council Environmental Services Twin Cities	5/1/2010 to 4/24/2013	Indirect	12	232	13	MCES Twin Cities, 2022
Michigan Waste & Recycling Association	11/19/2018 to 12/28/2018	Indirect	32	66	2	MIW&RA, 2022
Minnesota Pollution Control Agency	6/20/2005 to 11/8/2021	Indirect	26	1770	39	MPCA, 2022a MPCA, 2022b
North Carolina Department of Environmental Quality	10/23/2019 to 12/11/2019	Direct	1	69	23	NC DEQ, 2022
New Hampshire Department of Environmental Services	4/3/2016 to 9/1/2020	Direct & Indirect	76	5,097	28	NH DES, 2022a NH DES, 2022b
OCPSF 308 Data Request	1/22/2019 to 2/2/2022	Direct, Indirect, & Infiltration	11	19332	66	ERG, 2022c
Merrimack New Hampshire WWTF	10/30/2019 to 9/8/2021	Indirect	1	224	29	NH Merrimack WWTF, 2022a NH Merrimack WWTF, 2022b NH Merrimack WWTF, 2022c NH Merrimack WWTF, 2022d NH Merrimack WWTF, 2022e NH Merrimack WWTF, 2022f
Textile Mills 308 Data Request	12/20/2018 to 3/10/2020	Indirect	5	159	28	ERG, 2022b
Wisconsin Department of Natural Resources	1/1/2020 to 4/21/2021	Direct & Indirect	118	3,966	36	WI DNR 2022a WI DNR 2022b WI DNR 2022c WI DNR 2022d

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