

Chino Basin Water Quality Colloquium  
May 2, 2019



# PFAS OCCURRENCE & MONITORING GUIDANCE for California water systems

**Rick Zimmer**  
**May 2, 2019**



## PRESENTATION OUTLINE

- National Occurrence
- Monitoring Orders requirements
- Sampling Guidance
- Analytical Methods
- Laboratory Challenges

# PFAS NATIONAL OCCURRENCE

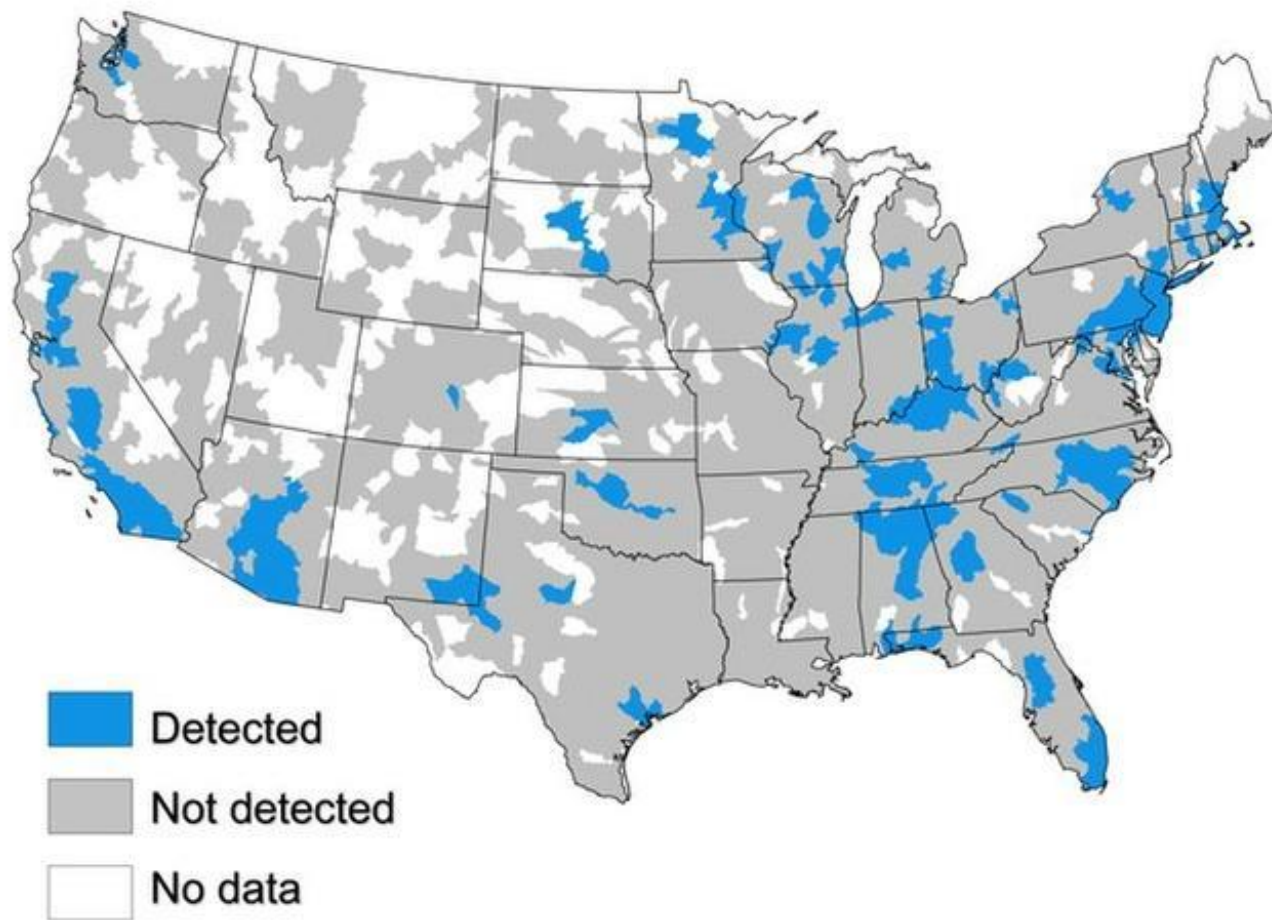
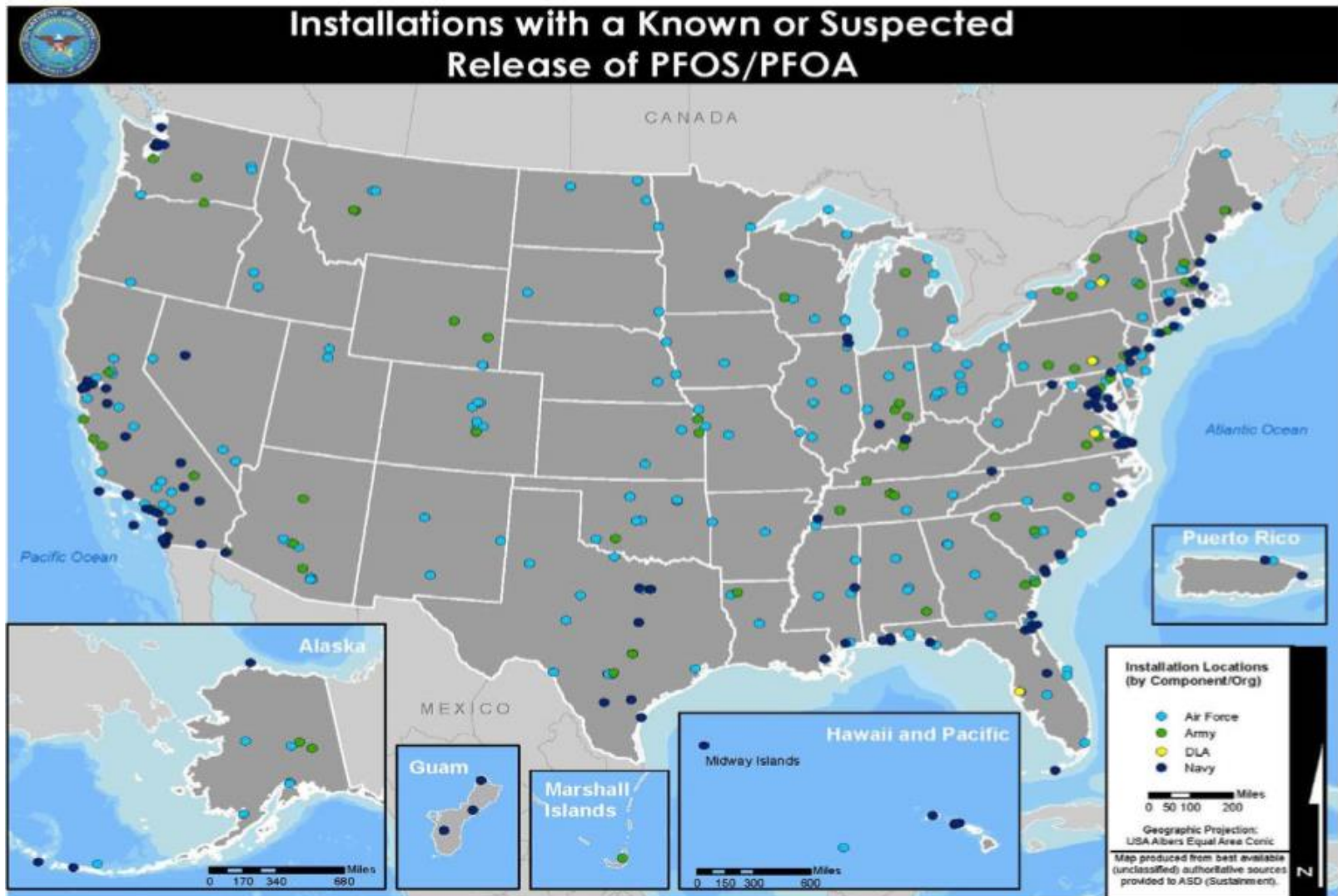
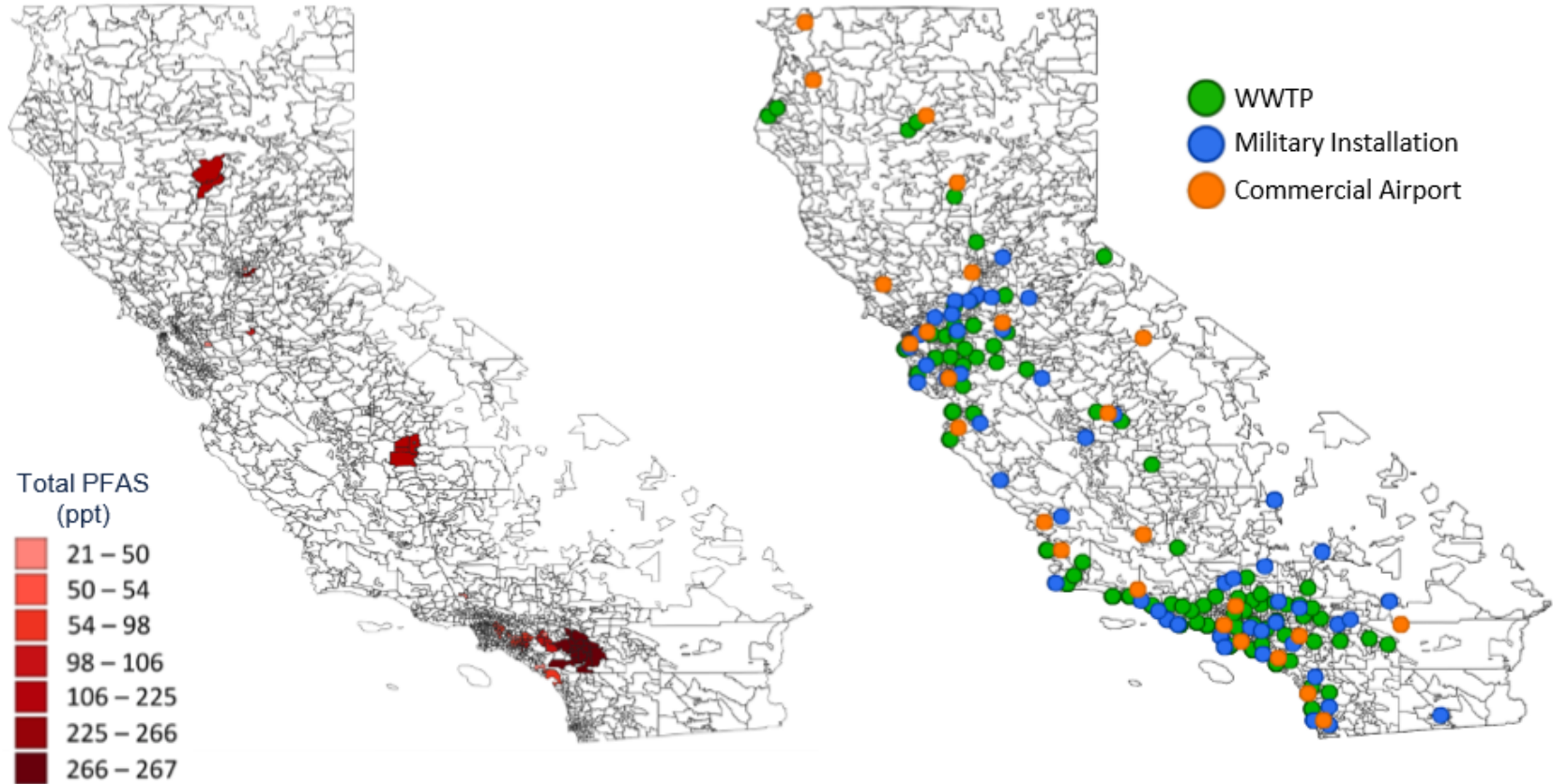


Image From: Hu XC et al., Environmental Science & Technology Letters, 2016

# PFAS NATIONAL OCCURRENCE



# PFAS IN CALIFORNIA



<https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule#3>

Hu XC, et al., 2016. Detection of PFASs in US drinking water linked to industrial sites, military fire training areas, and waste water treatment plants. *Env Sci and Tech Letters* 3(10):344–350

# CALIFORNIA PFAS MONITORING ORDERS



HEALTH AND SAFETY CODE SECTION 116400 ORDER REGARDING SAMPLING FOR PERFLUOROOCTANOIC ACID (“PFOA”)/PERFLUOROOCTANESULFONIC ACID (“PFOS”)

- **Source Water Monitoring Quarterly for 1 year**
- **First Sample by June 30<sup>th</sup>**
- **Resampling & Confirmation Sampling Options**
- **CCR and Notification Level Reporting (HSC 116455)**
- **Treated Sample Option**

# CALIFORNIA PFAS MONITORING ORDERS



	PFAS Detect	Near PFAS Detect (1 mi)	Near Landfill (1mi)	Near Airport (2mi)	Near Airport (2mi) and Landfill (1mi)	Near PFAS Detect (1mi) and Airport (2mi)	PFAS Detect and Near Airport (2 mi) and Landfill (1mi)	Near PFAS Detect (1mi) and Airport (2mi) and Landfill (1mi)	Grand Total
<b>Grand Total</b>	<b>99</b>	<b>161</b>	<b>138</b>	<b>215</b>	<b>32</b>	<b>10</b>	<b>3</b>	<b>2</b>	<b>660</b>

## Some Significant Local Impact...

<b>RIVERSIDE</b>	<b>91</b>
COACHELLA VWD: COVE COMMUNITY	2
CORONA, CITY OF	19
DESERT WATER AGENCY	14
EASTERN MUNICIPAL WD	7
ELSINORE VALLEY MWD	3
FERN VALLEY WD	1
GLEN IVY HOT SPRINGS	1
IDYLLWILD WATER DISTRICT	2
LAKE HEMET MWD	6
RIVERSIDE, CITY OF	33
RUBIDOUX COMMUNITY SD	3

<b>SAN BERNARDINO</b>	<b>45</b>
ADELANTO, CITY OF	2
CSA 42 ORO GRANDE	1
CUCAMONGA VALLEY WATER DISTRICT	3
EAST VALLEY WATER DISTRICT	4
LOMA LINDA, CITY OF	6
RUNNING SPRINGS WATER DISTRICT	1
SAN ANTONIO WATER COMPANY	4
SAN BERNARDINO CITY	2
SAN GABRIEL VALLEY WC - FONTANA	2
SBDNO COUNTY SERVICE AREA 70 CEDAR GLEN	1
SIERRA BUSINESS PARK OWNER'S ASSOCIATION	1
YUCAIPA VALLEY WATER DISTRICT	4

# CALIFORNIA PFAS MONITORING ORDERS



WATER CODE SECTION 13267 ORDER FOR THE DETERMINATION OF THE PRESENCE OF PER- AND POLYFLUOROALKYL SUBSTANCES

ORDER WQ 2019-0006-DWQ

WATER CODE SECTION 13267 ORDER FOR THE DETERMINATION OF THE PRESENCE OF PER- AND POLYFLUOROALKYL SUBSTANCES

ORDER WQ 2019-0005-DWQ

- **252 Municipal Landfills**

- **31 Airports**

## Requirements

- **One Time Assessment – Leachate, Groundwater, Soil**
- **Work Plan, Sampling & Analysis Plan**
- **Professional Geologist/Engineer Sign-Off**
- **Final Plan due 90 days from Work Plan approval**



# CALIFORNIA PFAS MONITORING ORDERS



## Limited Local Impact...

REGIONAL WATER QUALITY CONTROL BOARD	GEOTRACKER GLOBAL ID	FACILITY	CITY	COUNTY	ZIP CODE
LAHONTAN (TAHOE)	L10009864393	EAGLEVILLE SWDS	EAGLEVILLE	MODOC	96110
LAHONTAN (TAHOE)	L10001022155	EASTERN REGIONAL LANDFILL	TRUCKEE	PLACER	96161
LAHONTAN (TAHOE)	L10005084717	FORT BIDWELL SWDS	FORT BIDWELL	MODOC	96112
LAHONTAN (VICTORVILLE)	L10004311928	FURNACE CREEK CLASS III LANDFILL	DEATH VALLEY	INYO	92328
LAHONTAN (VICTORVILLE)	L10001835552	HESPERIA CLASS III LANDFILL	HESPERIA	SAN BERNARDINO	92345
LAHONTAN (VICTORVILLE)	L10002649623	INDEPENDENCE LANDFILL	INDEPENDENCE	INYO	93526
LAHONTAN (TAHOE)	L10008644871	LAKE CITY SWDS OLD	LAKE CITY	MODOC	96115
LAHONTAN (VICTORVILLE)	L10009466231	LANCASTER LANDFILL	LANCASTER	LOS ANGELES	91325
LAHONTAN (VICTORVILLE)	L10001573087	LENWOOD-HINKLEY LANDFILL	HINKLEY	SAN BERNARDINO	92347
LAHONTAN (TAHOE)	L10003238783	MADELINE SWDS	MADELINE	LASSEN	96119
LAHONTAN (VICTORVILLE)	L10001517468	MOJAVE ROSAMOND LANDFILL	MOJAVE	KERN	96150
LAHONTAN (TAHOE)	L10007593280	RAVENDALE SWDS	RAVENDALE	LASSEN	96123
LAHONTAN (VICTORVILLE)	L10005485793	RIDGECREST-INYO KERN LANDFILL	RIDGECREST	KERN	93555
LAHONTAN (VICTORVILLE)	L10004106157	TEHACHAPI LANDFILL	TEHACHAPI	KERN	93561
LAHONTAN (VICTORVILLE)	L10004389991	VICTORVILLE LANDFILL	VICTORVILLE	SAN BERNARDINO	92392
LAHONTAN (VICTORVILLE)	L10003032143	WALKER SANITARY LANDFILL	WALKER	MONO	96107

FACILITY NAME <sup>1</sup> (AIRPORT ID)	GEOTRACKER GLOBAL ID	PROPERTY ADDRESS	OWNER <sup>1</sup>
STOCKTON METROPOLITAN (SCK)	T10000012778	5000 S. AIRPORT WAY ROOM 202 STOCKTON, CA 95206	COUNTY OF SAN JOAQUIN 5000 S AIRPORT WAY STOCKTON, CA 95206
REDDING MUNI (RDD)	T10000012779	REDDING MUNI AIRPORT, 6751 WOODRUM CIRCLE SUITE 200 REDDING, CA 96002	CITY OF REDDING AIRPORTS DIVISION, 6751 WOODRUM CIRCLE, #200 REDDING, CA 96002-6071
MAMMOTH YOSEMITE (MMH)	T10000012789	1300 Airport Road MAMMOTH LAKES, CA 93546	TOWN OF MAMMOTH LAKES 1300 AIRPORT ROAD MAMMOTH LAKES, CA 93546 760-934-3813
SOUTHERN CALIFORNIA LOGISTICS (VCV)	T10000012780	18374 PHANTOM WEST VICTORVILLE, CA 92394	SOUTHERN CA LOGISTICS ARPT AUTH 18374 PHANTOM VICTORVILLE, CA 92394
IMPERIAL COUNTY (IPL)	T10000012781	1099 AIRPORT ROAD IMPERIAL, CA 92251	IMPERIAL COUNTY 1099 AIRPORT ROAD IMPERIAL, CA 92251
PALM SPRINGS INTL (PSP)	T10000012782	3400 E. TAHQUITZ-CANYON WAY, SUITE OFC PALM SPRINGS, CA 92262	CITY OF PALM SPRINGS 3400 E. TAHQUITZ CANYON WAY PALM SPRINGS, CA 92262
MC CLELLAN-PALOMAR (CRQ)	T10000012786	2192 PALOMAR AIRPORT ROAD CARLSBAD, CA 92011-4409	COUNTY OF SAN DIEGO 1960 JOE CROSSON DRIVE EL CAJON, CA 92020-1235
SAN DIEGO INTL (SAN)	T10000012787	3225 N HARBOR DRIVE SAN DIEGO, CA 92101-1022	SAN DIEGO CNTY REG ARPT AUTHORITY 3225 N HARBOR DRIVE SAN DIEGO, CA 92101-1022

# CALIFORNIA PFAS SAMPLING GUIDANCE



## DRINKING WATER SAMPLE COLLECTION FOR PER AND POLYFLUORINATED ALKYL SUBSTANCES (PFAS) SAMPLING GUIDANCE



Photo by Valerie Gregory

STATE WATER RESOURCES CONTROL BOARD  
DIVISION OF DRINKING WATER

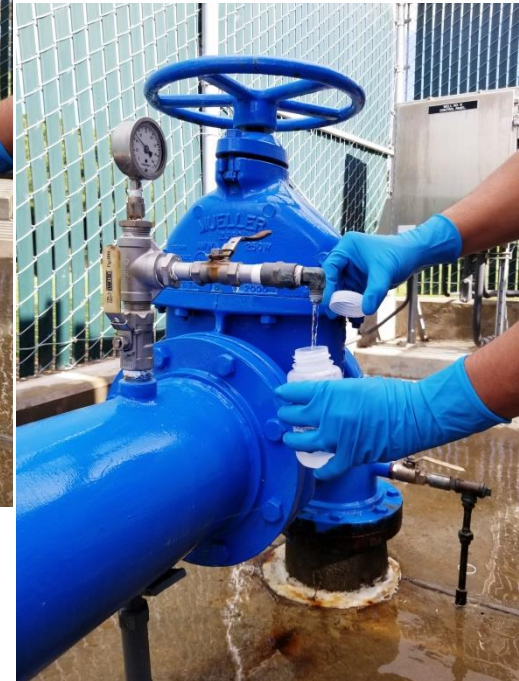
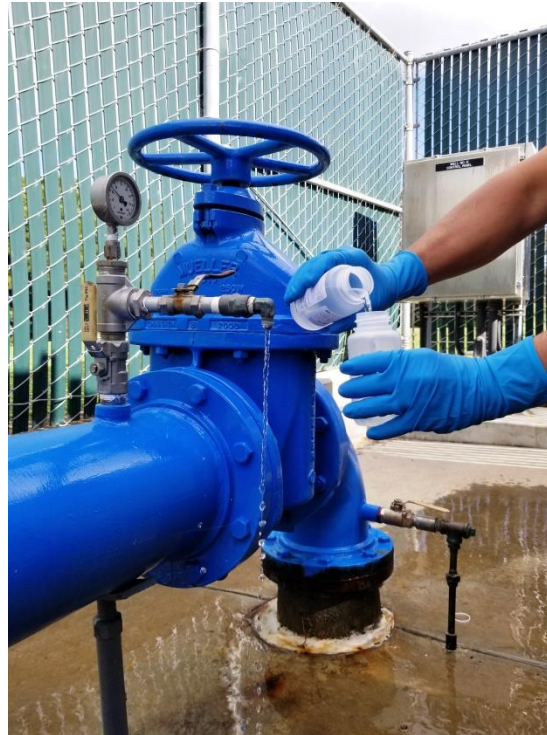
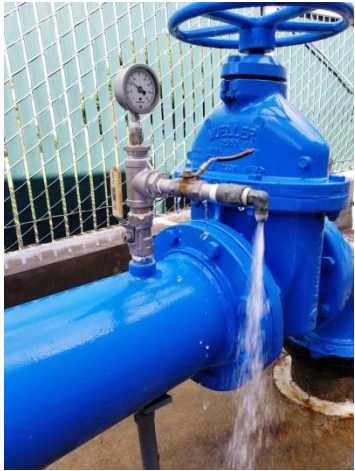
*Revised April 2019*

SWRCB PFAS Website: <https://www.waterboards.ca.gov/pfas/>

DOW PFAS Website: [https://www.waterboards.ca.gov/drinking\\_water/certific/drinkingwater/PFOA\\_PFO5.html](https://www.waterboards.ca.gov/drinking_water/certific/drinkingwater/PFOA_PFO5.html)

- 15 minute flush
- Avoid PFAS products
- Wet Ice (no Gel Packs)
- Clean Hands-Dirty Hands
- QC Field Samples
- Bagged Samples
- Uline Strapper Tape
- Time and Temperature requirements

# CALIFORNIA PFAS SAMPLING GUIDANCE



# PFAS ANALYTICAL METHODS



EPA Method 537 Rev 1.1* (14 PFAS analytes)		EPA Method 537.1* (18 PFAS analytes)	
Analyte	Detection Limit <sup>[1]</sup> (ng/L)	Analyte	Detection Limit <sup>[1]</sup> (ng/L)
PFBS	3.1	PFBS	1.8
PFHxA	1.6	PFHxA	1.0
PFHpA	0.5	PFHpA	0.71
PFHxS	2.0	PFHxS	1.4
<b>PFOA</b>	<b>1.7</b>	<b>PFOA</b>	<b>0.53</b>
<b>PFOS</b>	<b>1.4</b>	<b>PFOS</b>	<b>1.1</b>
PFNA	0.7	PFNA	0.7
PFDA	0.7	PFDA	1.6
NMeFOSAA	6.5	NMeFOSAA	2.4
PFUnA	2.8	PFUnA	1.6
NEtFOSAA	4.2	NEtFOSAA	2.8
PFDaA	1.1	PFDaA	1.2
PFTrDA	2.2	PFTrDA	0.72
PFTA	1.7	PFTA	1.1
		HFPO-DA	1.9
		ADONA	0.88
		9Cl-PF3ONS	1.4
		11Cl-PF3OUdS	1.5

\*in reagent water

TABLE 1. PFAS Analytes Subject to Analysis

Chemical Name	Abbreviation	Chemical Abstracts Service (CAS) No.
2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid	HFPO-DA	13262-13-6*
10:2 Fluorotelomer sulfonic acid	10:2 FTS	120226-80-0*
2,3,3,3-tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy) propanoic Acid	HFPA-DA	13262-13-6 *
Perfluorooctadecanoic acid	PFOcDA	16517-11-6*
N-Ethyl perfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2*
Perfluorooctane sulfonic acid	PFOS	1763-23-1
Perfluoroundecanoic acid	PFUnDA	2058-94-8
N-Methyl perfluorooctane sulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-Methyl perfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7*
Perfluoropentanoic Acid	PFPeA	2706-90-3
Perfluoropentane sulfonic acid	PFPeS	2708-91-4
6:2 Fluorotelomer sulfonic acid	6:2 FTS	27619-97-2
N-Ethyl perfluorooctane sulfonamidoacetic acid	NEtFOSAA	2991-50-6
Perfluorohexanoic acid	PFHxA	307-24-4
1,0-Perfluorododecanoic acid	PFDaA	307-55-1
N-Methyl perfluorooctane sulfonamide	MeFOSA	31506-32-8*
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorodecane sulfonic acid	PFDS	335-77-3
4,4,5,5,6,6,6-Heptafluorohexanoic Acid	3:3 FTCA	356-02-5*
Perfluorohexane sulfonic acid	PFHxS	355-46-4
Perfluorobutanoic acid	PFBA	375-22-4
Perfluorobutane sulfonic acid	PFBS	375-73-5
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluoroheptane sulfonic acid	PFHpS	375-92-8
Perfluorononanoic acid	PFNA	375-95-1
Perfluorotetradecanoic acid	PFTeDA	376-06-7
2H,2H,3H,3H-Perfluorodecanoic acid	7:3 FTCA	812-70-4*
8:2 Fluorotelomer sulfonic acid	8:2 FTS	39108-34-4
N-Ethyl perfluorooctane sulfonamide	EtFOSA	4151-50-2*
Perfluorononane sulfonic acid	PFNS	474511-07-4*
Perfluorohexadecanoic acid	PFHxDA	67905-19-5*
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorooctanesulfonamide	FOSA	754-91-6
4:2 Fluorotelomer sulfonic acid	4:2 FTS	757124-72-4
Perfluoro(2-((6-chlorohexyl)oxy)ethanesulfonic acid)	9Cl-PF3ONS	766426-58-1*
2-((8-Chloro-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8-hexadecafluorooctyl)oxy)-1,1,2,2-tetrafluoroethanesulfonic acid	11Cl-PF3OUdS	763051-92-9*
2H,2H,3H,3H-Perfluorooctanoic Acid (CAS 914637-49-3)	5:3 FTCA	914637-49-3*
4,8-Dioxo-3H-perfluorononanoic acid	Adona	919005-14-4*

Note: Only the 23 analytes without the asterisk (\*) are required to be analyzed as part of this Order. The analytes with the asterisk (\*) are included in some but not all lists provided by accredited laboratories and are encouraged to be analyzed as part of this effort.

# PFAS ANALYTICAL ISSUES



## EPA 537.1 versus EPA 537 rev1.1

- 4 extra compounds
- 1 extra surrogate
- Tighter CCV acceptance

## EPA 537 rev1.1 and EPA 537.1 for Drinking Water

- All 250 mls must pass through SPE w/no pre-treatment
- High concentrations require dilution – loss of surrogates
- SPE type specified by the method for 18 target compounds

# PFAS ANALYTICAL ISSUES



## DoD QSM 5.2 Table B-5

- Isotope Dilution or Extracted Internal Standards
- LC/MS/MS + Carbon Cleanup
- Broader Control Limits
- Expanded List of Analytes

## New Methods

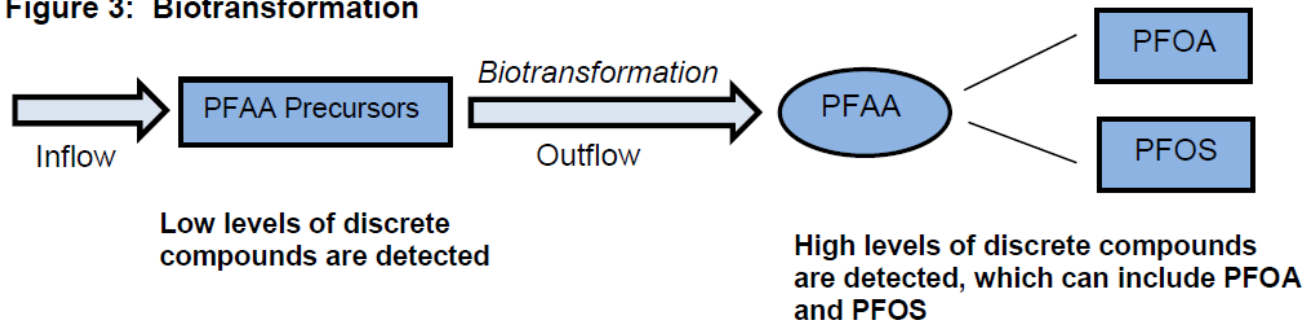
- EPA 533 – ORD/OW – Updated Target Analytes
- EPA 8327 (ASTM D7979) – OLEM – Direct Inject Screen
- EPA 8328 – OLEM/ORD – Isotope Dilution



## Total Oxidizable Precursor (TOP) Assay

- Conversion of polyfluorinated PFAA precursors in PFAAs using an oxidation reaction
- Replicates what micro-organisms would do over time
- Quantifies the sum of PFAAs that could be converted in the environment - Post-TOP minus Pre-TOP = Non-Discrete Oxidizable PFAA Precursors

Figure 3: Biotransformation





## Lab Contamination and Challenges

- **Reagent and Glassware Inventory & Management**
- **Dedicated Extraction – Limit Changeover**
- **Dedicated Instrumentation – Limit Changeover**
- **Dedicated Analyst DOC**
- **Frequent Laboratory QC – Instrument Blanks, Field Blanks, DI Water Blanks, Lab Spikes, Matrix Spikes, Surrogates**



**THANK YOU**



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