SEPT 2023

ENSURING THE BEST DATA FOR YOUR PFAS PROJECTS

ANDREW WHITE – BUREAU VERITAS

LAND ACKNOWLEDGEMENT

As a visitor to this land, I would like to begin by acknowledging that we are gathered on the traditional and unceded lands of the Coast Salish peoples.

With this acknowledgement, we thank those indigenous peoples who live on and care for these lands and their ancestors, and we offer our support to future generations.

News release
June 6, 2023

Contact
Adam Olson, 651-757-2041, adam.j.olson@state.mn.us

Groundbreaking study shows unaffordable costs of PFAS cleanup from wastewater

Findings underscore need to reduce use of “forever chemicals”

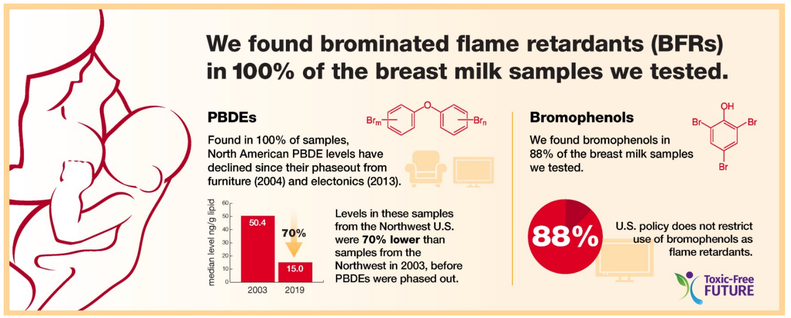
A new report published by the Minnesota Pollution Control Agency (MPCA) finds that technologies and expenses needed to remove and destroy per- and polyfluoroalkyl substances (PFAS) from certain wastewater streams across Minnesota would cost between $14 and $28 billion over 20 years. The study is the first of its

$14B Clean up

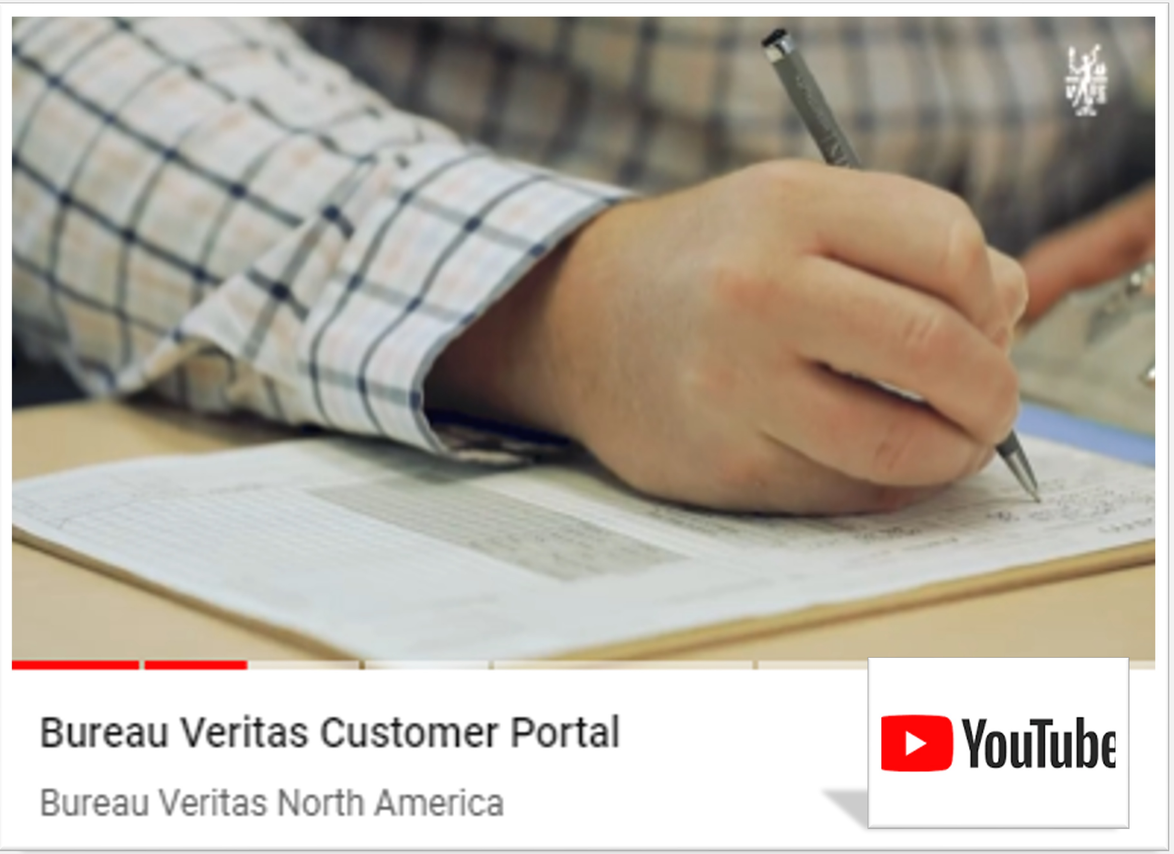
SUSTAINABILITY

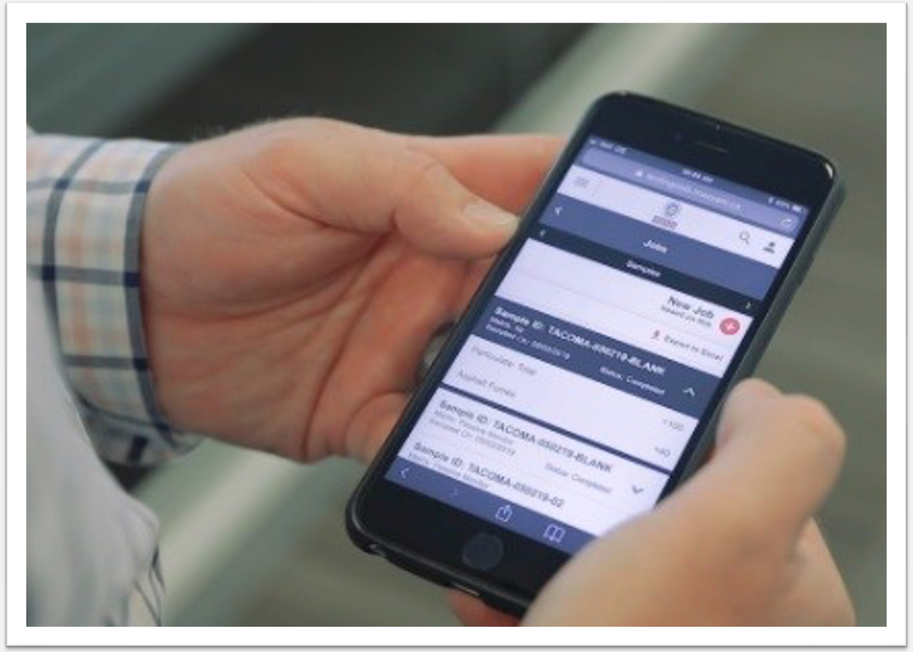
Why Fashion Still Uses Toxic ‘Forever Chemicals’

Brands from Canada Goose to Patagonia still rely on PFAS for performance attributes like waterproofing.



MY HAND TWIN!


Bureau Veritas Customer Portal
Bureau Veritas North America
YouTube

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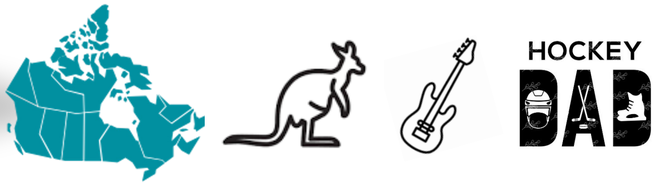
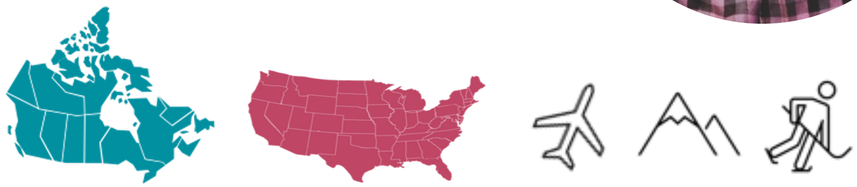
BUREAU VERITAS EMERGING MARKETS TEAM

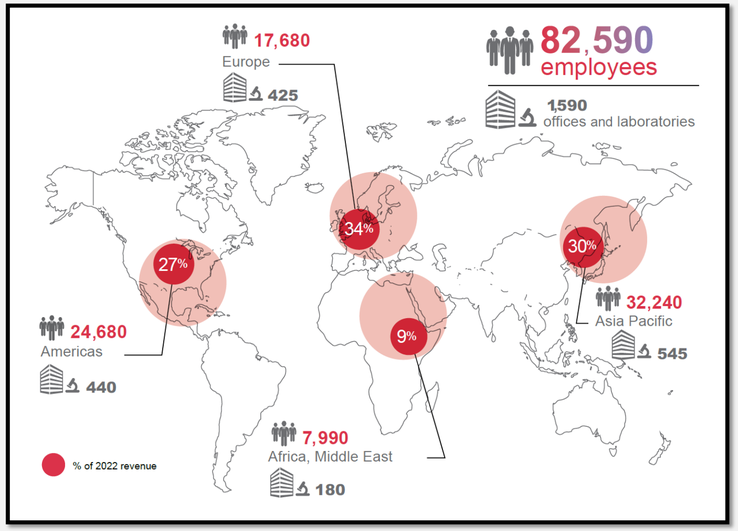
ANDREW WHITE, BSc
20 Years @ BV
Business Development
PFAS & eDNA

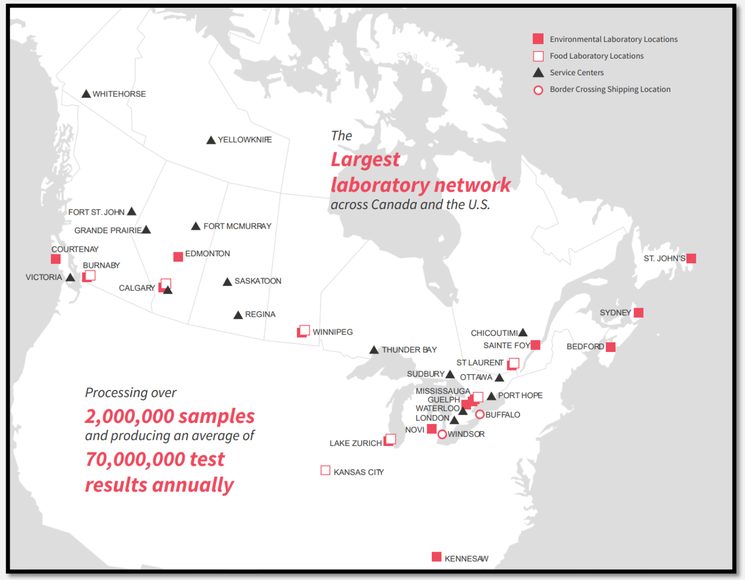


JOSHUA DIAS, BComm
16 Years @ BV
Director – Business Development
Emerging Markets



SHAPING A WORLD OF TRUST





BUILDING SCIENCE

- Asbestos by PLM
- Carbon Black & Soot
- Expert Witness Services
- Lead in Paint
- Legionella
- PCBs
- Radon Gas
- Transmission Electron Microscopy (TEM)

COMPRESSED GAS

- Automated Cylinder Program
- Dewpoint
- Medical Gas
- Oxygen Content
- Oil Mist
- SCUBA
- Z180 Compliance Certification

ENVIRONMENTAL DNA

- eDNA Assays
- eDNA Isolation & Cleanup
- eDNA Sampling Kits
- eDNA Water Sample Filtration
- eDNA Sample Archiving

INDUSTRIAL HYGIENE

- Aldehydes
- Amines
- Diesel Particulate
- Industrial Solvents
- Inorganic Acids
- Isocyanates
- Metals & Mercury
- Narcotics
- Particulates
- Pharmaceutical Active Ingredients
- Polycyclic Aromatic Hydrocarbons

MINING

- Acid Rock Drainage
- Cyanide
- Design/Build Onsite Labs
- Dustfall
- Ecotoxicology
- eDNA
- Exploration Geochemistry
- General Chemistry
- Metal Speciation
- Non-lethal Fish Testing Kits
- Nutrients
- Radiochemistry (Ra226)
- Sampling Training for Mining Monitoring Programs
- Ultra Clean Sampling Protocols & Sampling Kits
- Ultra Trace Metals

SITE ASSESSMENT & REMEDIATION

- Chlorinated & Industrial Solvents
- Chlorophenols
- Dioxins & Furans
- Herbicides
- Metals & Mercury
- Persistent Pesticides
- Perfluorinated Compounds
- Petroleum Hydrocarbons
- Polychlorinated Biphenyls
- Polycyclic Aromatic Hydrocarbons
- Radiochemistry
- Consulting Scientist Technical Support
- Environmental Forensics
- Field Technician Training Program
- Legal Protocols & Expert Witness

SOURCE EVALUATION

- Dioxins & Furans
- Mercury
- Metals Sampling Trains
- Impringer & Sampling Trains
- Isocyanates
- Particulate
- Polycylic Aromatic Hydrocarbons
- Regulatory Data Packages
- Sample Transport of Dangerous Sampling Materials
- Stack Testing Plan Review
- Volatile Organics (VOST)

WATER & WASTEWATER

- Automated Container Scheduling
- Biochemical Oxygen Demand
- E.coli, Fecal Coliforms & General Bacteria
- Ecotoxicology
- General Chemistry
- Haloacetic Acids
- Legal Protocols for Wastewater Enforcement
- Metals & Mercury
- Nutrients
- Pesticides & Herbicides
- Toxicity Investigation Evaluation
- Trihalomethanes

BUREAU VERITAS 1828

WHERE DOES GOOD DATA START?

ASK THE RIGHT QUESTIONS

What PFAS data do I need?

Is it for regulatory purposes, investigation, or future risk?

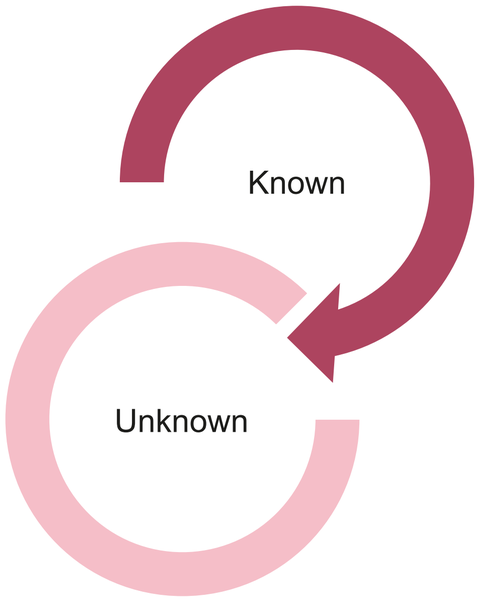
What detection limits are required?

What methodology approach should be taken?

What sampling considerations should be included?

How is that data going to be interpreted?

POTENTIAL SOURCES OF FIELD CONTAMINATION



SAMPLE CONTAINERS

Plastic

Glass

DON’T FORGET YOUR _____!

Equipment Blank
Lab supplied water is used for a final rinse of sampling equipment and field filtration apparatus

Field Blank
Blank matrix transferred to another container at the sampling site and preserved.

Trip Blank
Lab supplied, contaminant free blank matrix taken to the sampling site and returned to lab unopened.

THIS IS **NOT** YOUR AVERAGE TEST

EVOLUTION OF THE PFAS TOOL KIT

PFAS BY LC-MS/MS

- *Report specific PFAS chemicals with accurate low reporting limits*
- *Methods EPA 537m, EPA 537.1, EPA 533, EPA Draft Method 1633, ASTM*
- *Bureau Veritas accreditation in all of Canada and many US states.*

TOPS ASSAY (TOTAL OXIDIZABLE PRECURSORS)

- *Report specific PFAS chemicals– BEFORE & AFTER oxidizing sample to simulate natural processes*
- *Analysis complies with EPA 537m (CAM SOP-00894)*
- *Bureau Veritas accreditation in all of Canada and many US states.*

TOF BY CIC (TOTAL ORGANIC FLUORINE)

- *Report total organofluorine from ‘all’ PFAS in the sample*
- *Validated according to ISO 9562:2014 and Industry Application Note*
- *Bureau Veritas accreditation through Standards Council of Canada (SCC) and US NELAP*

ANALYTICAL NEED	PFAS BY LC/MS/MS	TOPS ASSAY	TOF BY CIC
Regulatory compliance	✓		
Site characterization	✓	✓	
Contaminant delineation	✓	✓	✓
Completeness of remedial actions	✓	✓	✓
Site risk (Future liability)		✓	✓
PFAS-Free AFFF			✓

Advantages & Limitations

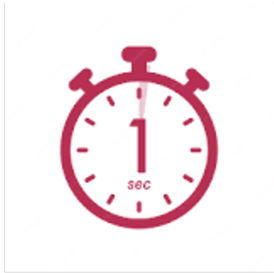
Test	Objective	Advantages	Limitations
PFAS by LC/MS/MS	• Characterization and quantitation of individual PFAS at ultra trace levels • Regulatory compliance • Risk Assessment	• Multiple methods available • Accurate low level measurement of individual compounds	• Higher cost test • “Targeted” analysis • 30-40 individual compounds…out of thousands of PFAS
Total Oxidizable Precursors (TOPs) Assay	• Report specific PFAS compounds– BEFORE & AFTER oxidizing sample to simulate natural processes • Regulatory compliance • Indication of total PFAS	• Provides accurate concentrations for individual compounds • Indicates the presence of PFAS not measured by standard LC/MS/MS • (“Dark Matter”) • Indicates potential for future liability due to transformation of precursor compounds	• Highest cost • Labor intensive means longer turnaround times • High sample variability • Not fully quantitative • Does not necessarily provide a “total” PFAS result
Total Organic Fluorine (TOF)	• Measure of total PFAS • “Is my sample “PFAS-free?”	• Provides concentration of organic fluorine, which is representative of the presence or absence of PFAS • Less labour intensive • Lower priced analysis	• Moderate Reporting limits: - 1 ug/L in water - 200 ng/g in soil • Non-selective analysis

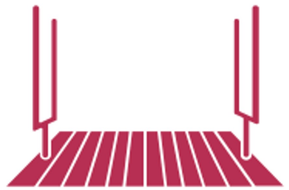
BUREAU VERITAS

IN THE LAB

MAINTAINING PFAS FREE EQUIPMENT AND SUPPLIES

- All supplies are proofed prior to use (including sampling and lab supplies) for the spectrum of PFAS compounds.
- Massive effort to keep laboratory conditions pristine and PFAS free.





Typical reporting limits are 50x less

IN THE LAB

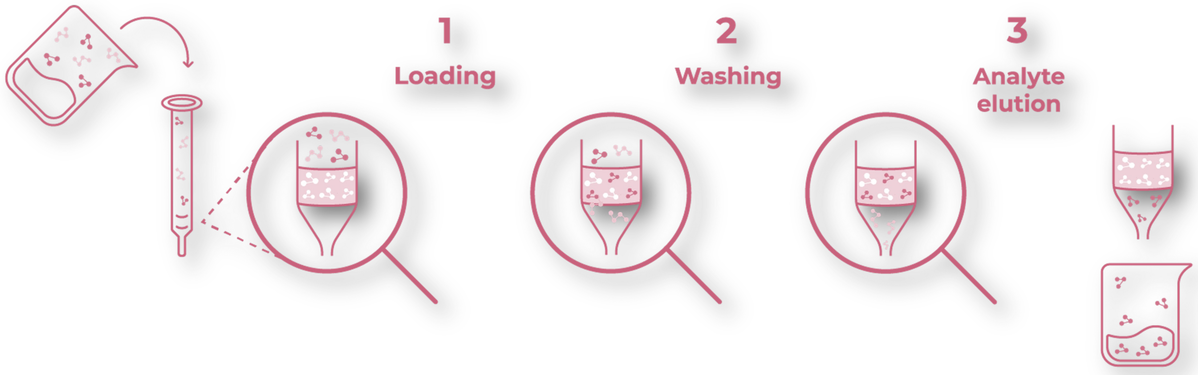
PROFICIENCY

- Maintaining numerous accreditations for multiple methods requires continuous participation in multi-lab method comparisons, proficiency testing and regular audits
- Industry shortage of LCMS trained Analysts – specifically versed in PFAS
- Typical proficiency requires 1-3 months for extraction and 3-6 months for analysis
- Continual staff proficiency assessments
- Adaptation to new and evolving methods
- Every method has its own specifications

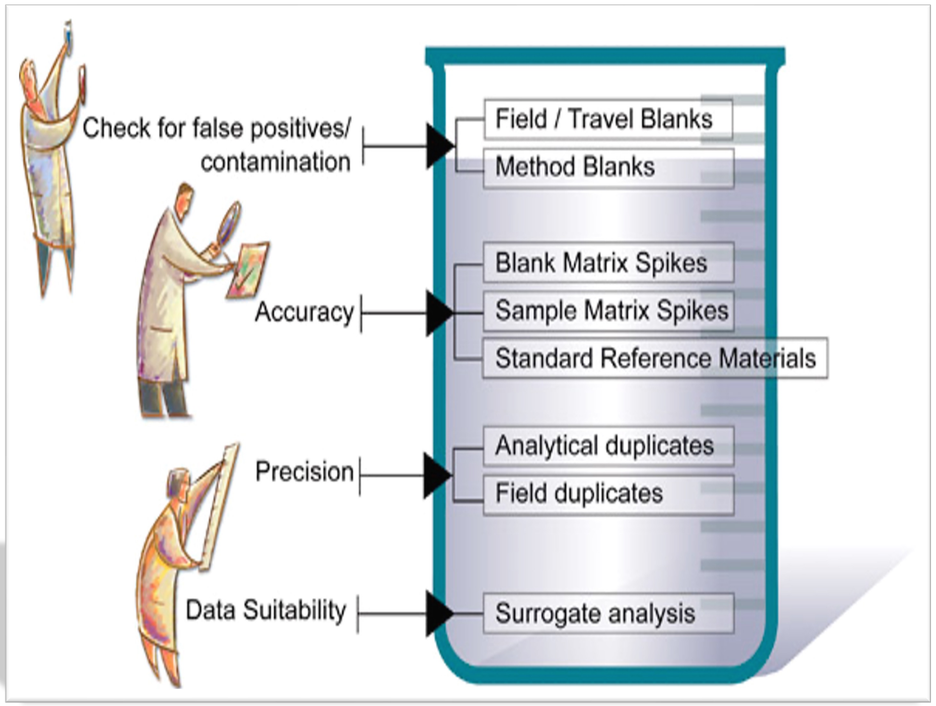
IN THE LAB

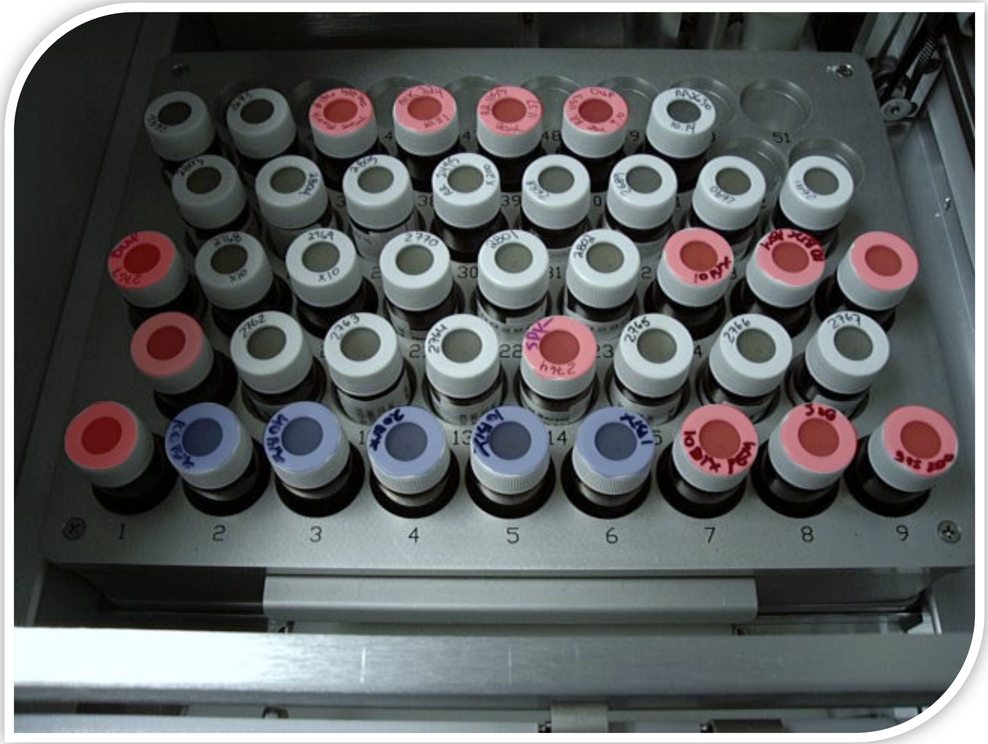
ROBUST AND STRINGENT QUALITY CONTROL MEASURES

- Isotope dilution – Provides greater accuracy over other calibration methods
- Instrument calibration and maintenance – Highly sensitive
- Branched vs Linear PFAS quantification – We employ a mixture and quantify on both
- Handling matrix interference (Stratification, Partitioning and Inhibition)



IN THE LAB


Check for false positives/ contamination
Field / Travel Blanks
Method Blanks
Accuracy
Blank Matrix Spikes
Sample Matrix Spikes
Standard Reference Materials
Precision
Analytical duplicates
Field duplicates
Data Suitability
Surrogate analysis



~30%

OUR REWORK RATE

WHAT IS A REWORK?

DIRECT IMPACT TO TAT

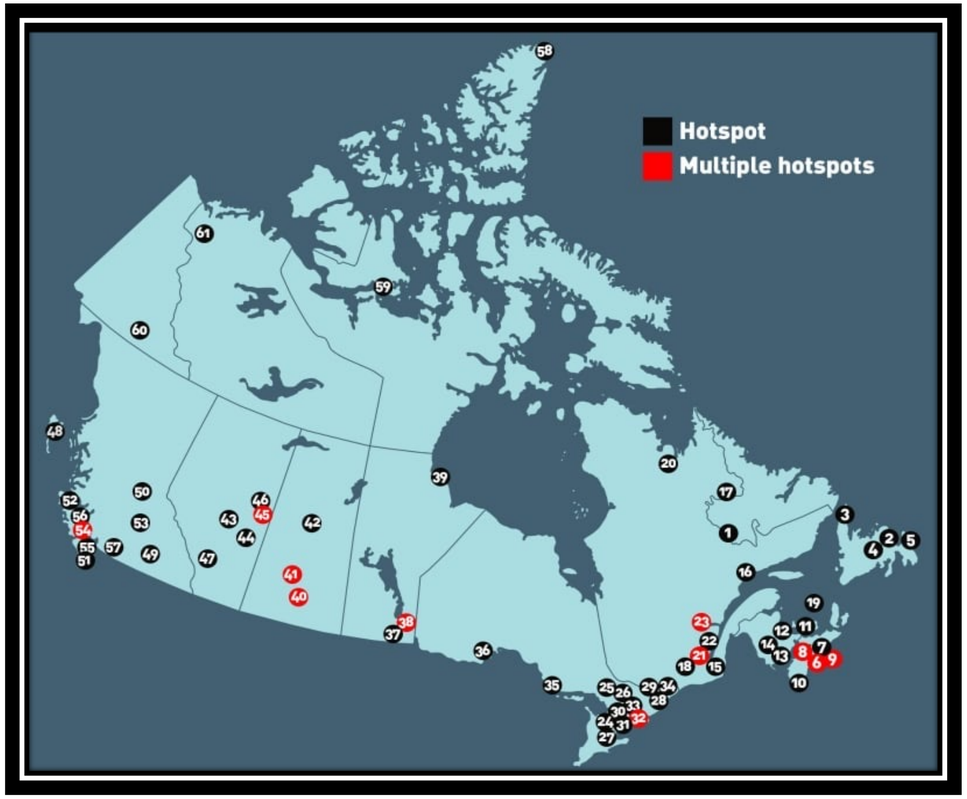
A re-work is when a sample is re-extracted and re-analyzed in the laboratory. Due to the complexity and sensitivity of PFAS analyses, reworks may be necessary for a variety of reasons:

- **Matrix effects:** The presence of other substances (such as other non-targeted PFAS compounds) in the sample can interfere with the analysis, either by suppressing or enhancing the signal for the internal standard which in turn will bias the results.
- **Regulatory compliance**: Some reworks are generated as a requirement of some regulatory guidelines.
- **Extraction efficiency:** The efficiency of extracting PFAS compounds from samples can vary due to differences in composition for soils, organic matter content or the presence of sediment in water samples.
- **Quality Control failure**: A QC failure of blank spike, reference material or blanks indicates a problem that needs to be rectified and will require a re-work of all the samples on that batch.

Avoiding Bad Data

- **Minimize exposure of samples/extracts to potential sources of PFAS**
- **Avoid exposure to glass**
- **Understand the differences in methods**
- **Keep in mind the chemistry surrounding PFAS**
  - *Stratification*
  - *Partitioning*
  - *Inhibition*
- **Work with the lab to understand how the data was generated**
  - *e.g. Linear or branched (…or both)*

WHAT'S NEXT?



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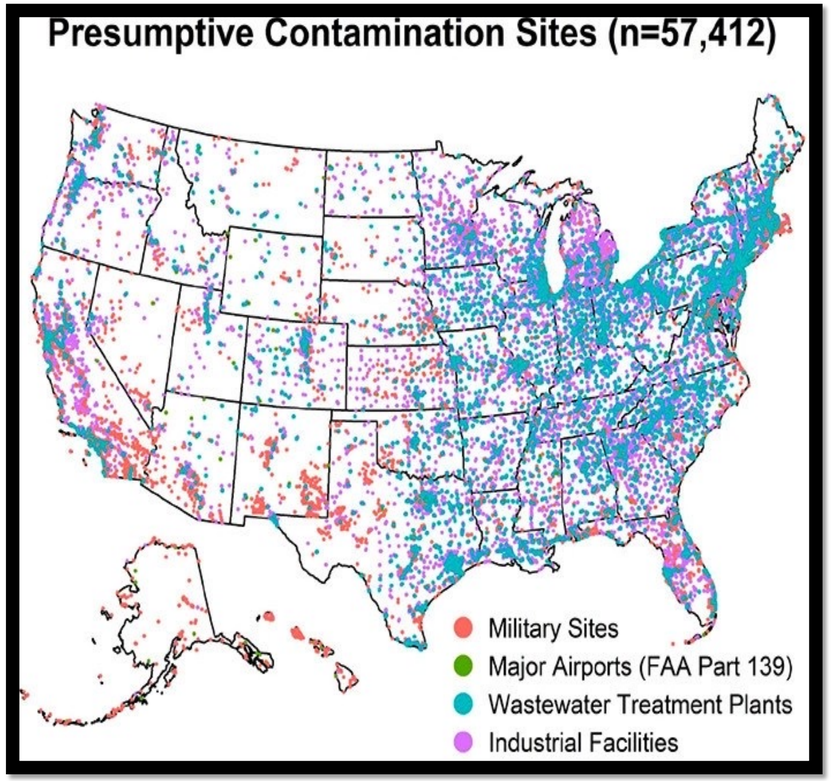


WHAT'S NEXT?

Formalization of draft criteria and methods

- Expect to see PFAS added to more compliance guidelines/objectives (sewer/landfill)
- EPA1633 Method Finalization for Soils/Biota, 1621 AOF (Currently Draft)
- Guidance from Health Canada on Total PFAS approach – List, Method and summation
- Treatment of PFAS as a class – how will analytical approaches handle this?

Additional demand for methods and matrices

- Air, Biosolids, Food and Food sources, Milk and other highly consumed products

WHAT'S NEXT

Continued corporate pressure

- Expect to see PFAS become part of corporate sustainability and ESG reports
- Continued litigation will drive more sampling events for large corporations

Emphasis on future risk

- Expect risk assessors/litigators to be looking for PFAS monitoring prior to any enforced regulation for future liability

Expect to see more source and material testing

- Biosolids on dairy and beef farms, "PFAS Free" branding. Raw materials

CANADIAN LITIGATION

Industries at risk of litigation

- High: Manufacturing, Oil and Gas, Utilities, Mining, Transportation and Government
- Moderate: Retail/Wholesale, Warehouse, agriculture and construction industries
- Low: Hospitality, amusement and education industries

2 Canadian cases

- Homeowners vs The National Research Council of Canada
  - *Local fire research lab potentially polluted drinking water and devalued homes*
- Firefighter successfully proved exposure to PFAS in firefighting foam led to his developing Cancer.

THE CHALLENGE AHEAD

Continual evolution of testing methods

- Challenging for labs to remain current and proficient as methods and regulation requirements change
- Expect to see demand for reaching new lows in detection limits.

Industry demand for analysis

- Currently there is a shortage of well trained PFAS analysts and industry capacity
- Demand for testing volume has outpaced the industry's ability to sustain
- Limited insight into future sample volumes

Industry engagement and education

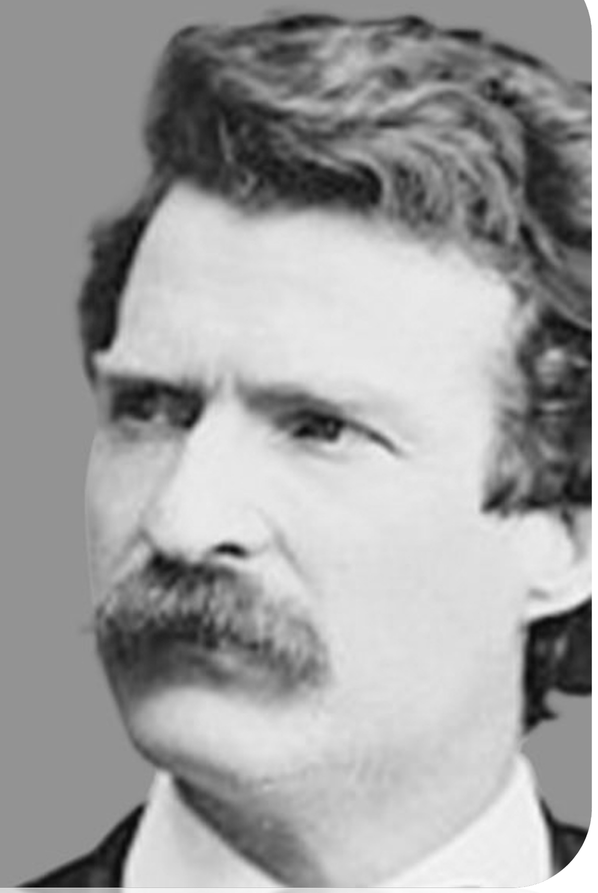
- Critical we continue to engage industry stakeholders such as ESAA, SABCS, ONEIA, CCIL etc to collaborate with policymakers and industry to ensure what is proposed is feasible in practice.

CALIFORNIA PFAS REPORTING MANDATES

OPEN DATA

“Data is like garbage. You’d better know what you are going to do with it before you collect it.”

Mark Twain




THANK YOU!