Inter-laboratory differences in PFAS determination in aquatic vegetation

16 June 2026

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The local reality

The Source:

- Military airbase north of Leeuwarden
- Historic use of PFOS-based firefighting foam (AFFF)
- Discovered in 2024 during sediment survey
- PFOS in surface water on the airbase up to ~8,800 ng/L
- Elevated PFAS/PFOS in Jelsumer Feart and surrounding ditches and sediments. (ca. 1.100 hectares affected)
- Further investigation to other sources

Introduction & Background

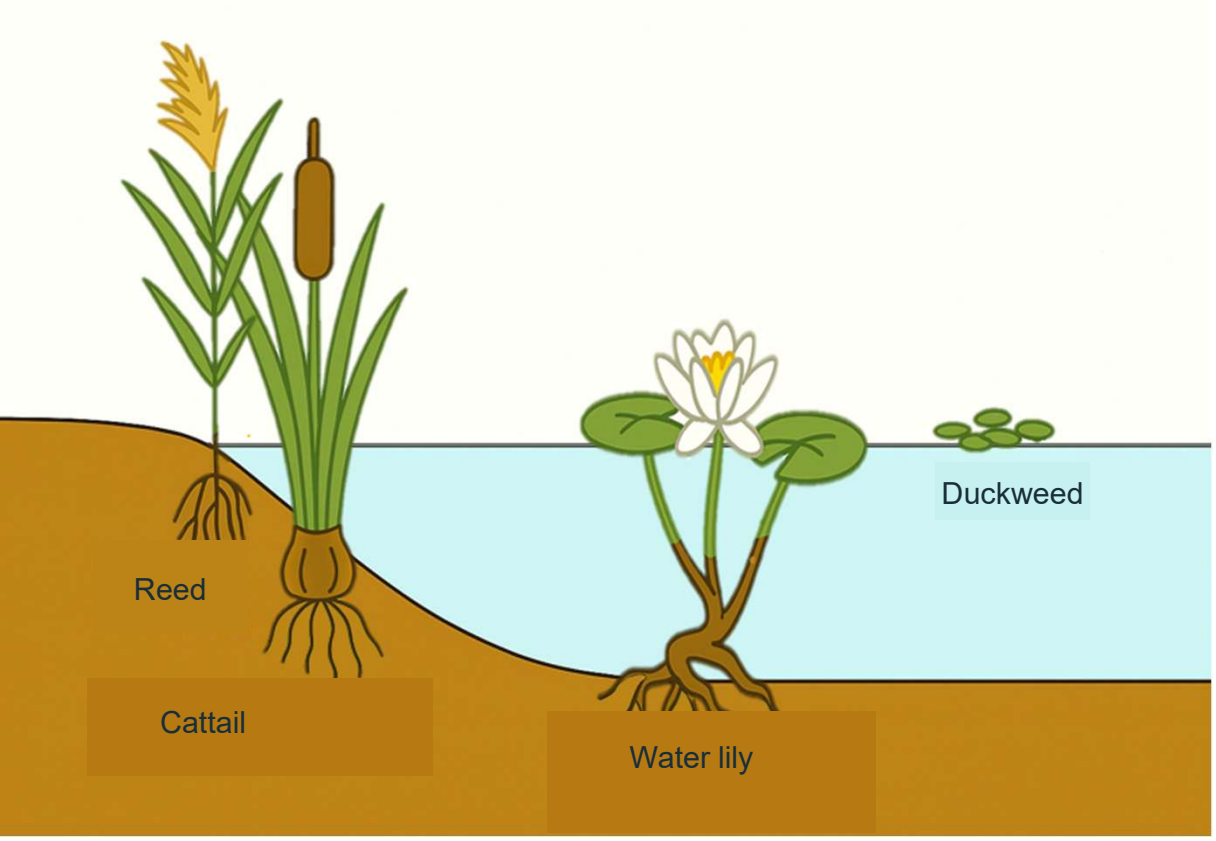
- How usable are PFAS analyses in ditch-cleared vegetation (aquatic vegetation)? Provide insight into differences between laboratories and analytical methods.
- Contribute to better comparability of results for policy and reuse of released PFAS-containing vegetation.
- Basis for a future standard method.

Introduction & Background

Context

- PFAS in soil and aquatic sediment is analysed using accredited methods (AS3000), ensuring comparable results between laboratories.
- No such standard exists for plant material. As a result, results can differ between laboratories.
- An interlaboratory study is needed to optimise the reliability and comparability of analyses in plants.

Research Plan – Why Ditch-Cleared Vegetation?



- Ditch-cleared vegetation/maintenance residue is released during regular ditch maintenance and is usually spread on adjacent parcels, creating a potential route for PFAS dispersion.
- Insight is needed into the risks of dispersion via organic material.
- Analyses in ditch-cleared vegetation currently have low reliability.

PFAS Research Protocol for Dredged Vegetation (Aquatic Vegetation)

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Research Plan – Fieldwork & Laboratory Testing

- Fieldwork: 8–9 July 2025, following the sampling protocol;
- Plant types: bank, aquatic and floating plants;
- 7 samples from one location, split into above- and below-ground parts;
- 5 composite samples per lab: reed, cattail (above/below ground), water lily and duckweed.

Sample	Subsample	Analysis[1]
Reed	Above-ground parts only (cut)	PFAS in washed material; dry matter
Duckweed	Whole plant	PFAS in washed material; dry matter
Cattail	Above-ground parts only	PFAS in washed material; dry matter
Cattail (roots)	Roots only	PFAS in washed material; dry matter
Water lily (plant+root)	Composite of above-ground water lily parts and roots	PFAS in washed material; dry matter

Analysis Packages by Laboratory

Analysis scope across the four laboratories (RIVM advisory list)

PFAS group	Lab 1	Lab 2	Lab 3	Lab 4	Notes
Perfluorocarboxylic acids	Full	Full	Partial	Partial	Long-chain PFHxDA and PFODA not included by Labs 3–4.
Perfluorosulfonic acids	Full	Full	Full	Partial	Lab 4 did not analyse PFBS; other sulfonates are covered.
Precursors / other PFAS	Limited	Limited	Limited	Limited	Coverage differs by method and reporting package.
Dry matter	Included	Included	Included	Included	Used to express concentrations on a dry-matter basis.

Full / included Partial / limited Not included

The detailed compound-by-compound package was condensed here to avoid an unreadable matrix; key method differences are captured for comparison across results slides.

Analysis Packages by Laboratory

Lab 1

Dry matter: 105°C (drying)

Analysis strategy: wet sample → conversion using DM%

Lab 2

Dry matter: 40°C, 2 weeks

Analysis strategy: dry sample → direct µg/kg dm

Lab 3

Dry matter: freeze-drying

Analysis strategy: wet sample → conversion using DM%

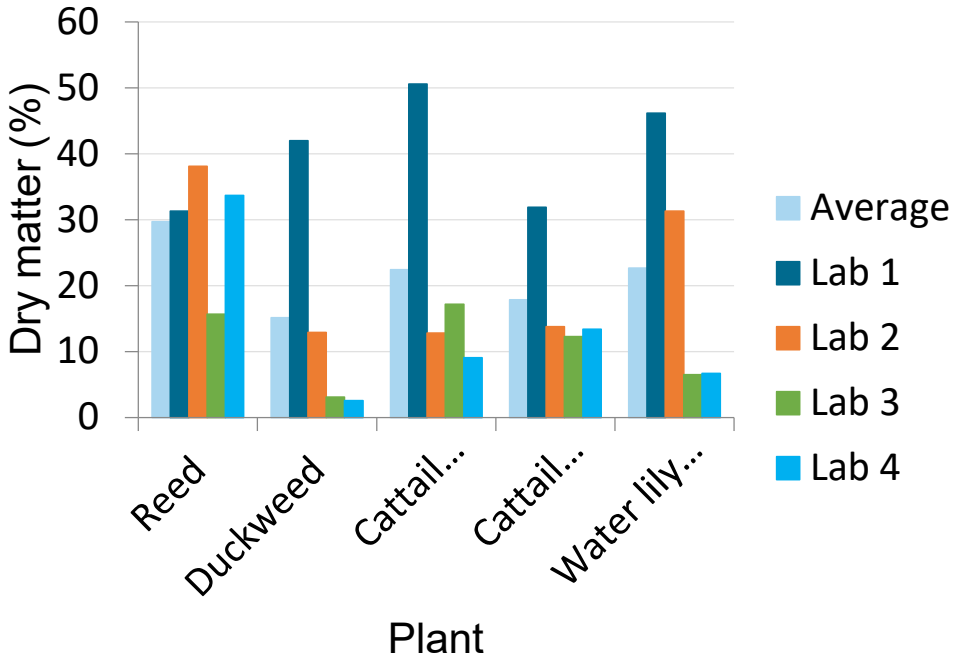
Lab 4

Dry matter: 103°C to constant weight

Analysis strategy: wet sample → conversion using DM%

⚠ **No standardised method – each lab uses its own protocol for DM determination and extraction → limited comparability**

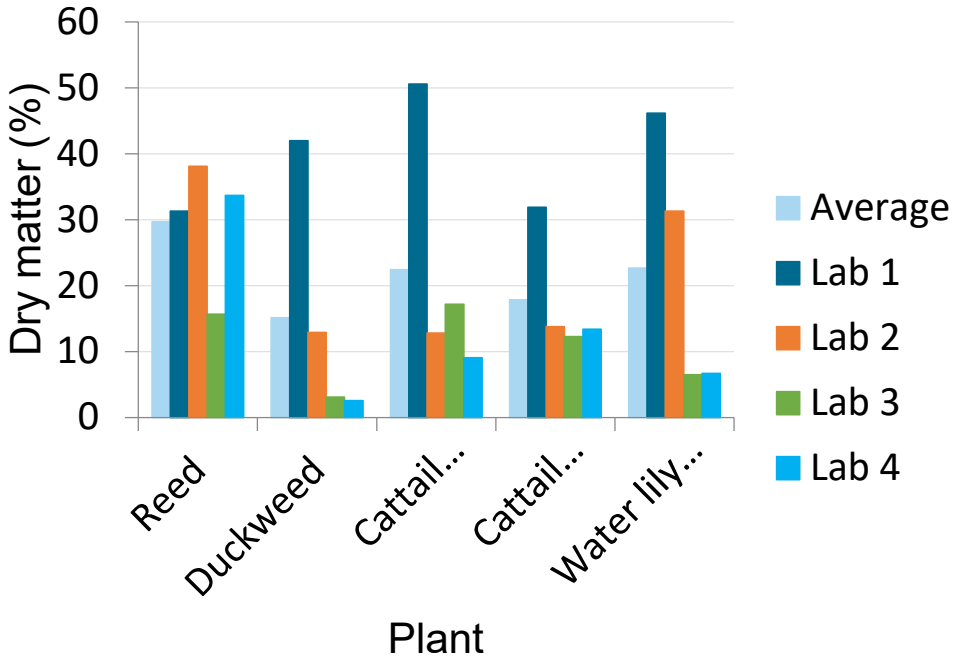
Research Results – Dry Matter Percentage



Average measured dry matter (%) per plant; black bars indicate the standard deviation (n=4).

- The variation between the four laboratories is substantial, especially for duckweed, cattail (root) and water lily (standard deviation 16–17).
- Lab 1 consistently reports the highest dry matter percentages (above the standard deviation), presumably due to sand and/or silt in its samples.
- Lab 3 and Lab 4 report the lowest values: lower dry matter indicates less residual moisture and less contamination. Lab 4 dries at 103°C to constant weight.
- A small exception: Lab 3 measures lower for reed than all others; there is no direct explanation (possibly also a difference in sand/silt content).

Research Results – Dry Matter Percentage

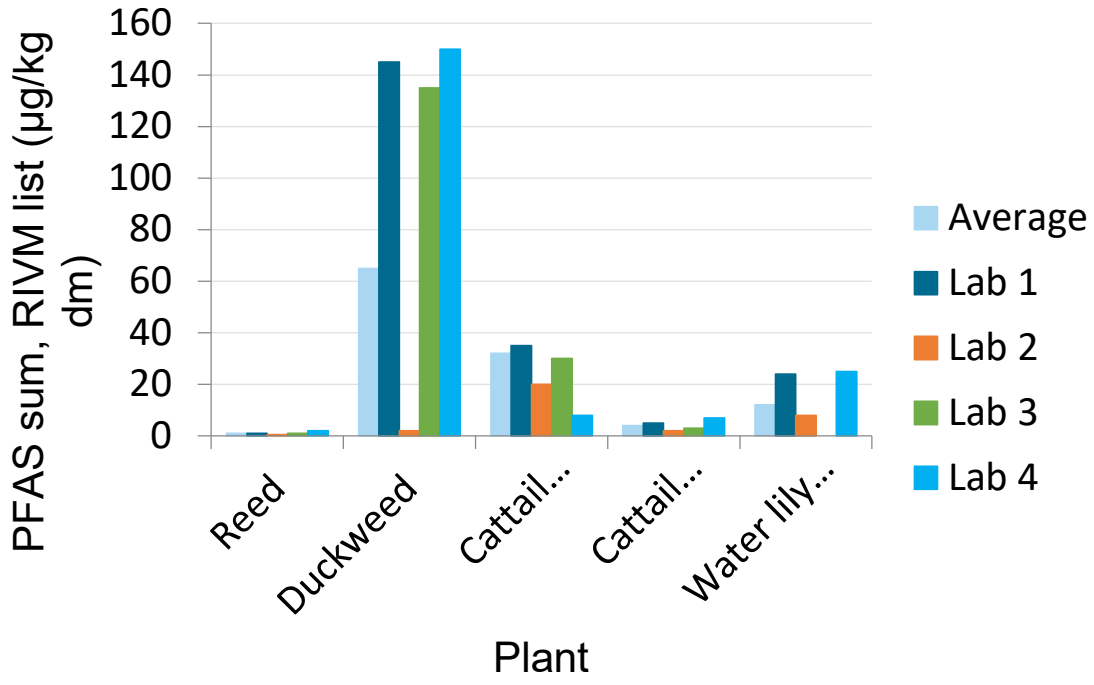


Average measured dry matter (%) per plant; black bars indicate the standard deviation (n=4).

Key message

The lack of a standardised drying method, likely together with cleaning, is the main cause of measurement differences, because the PFAS concentration is calculated directly from the dry matter percentage.

Research Results – PFAS Compounds

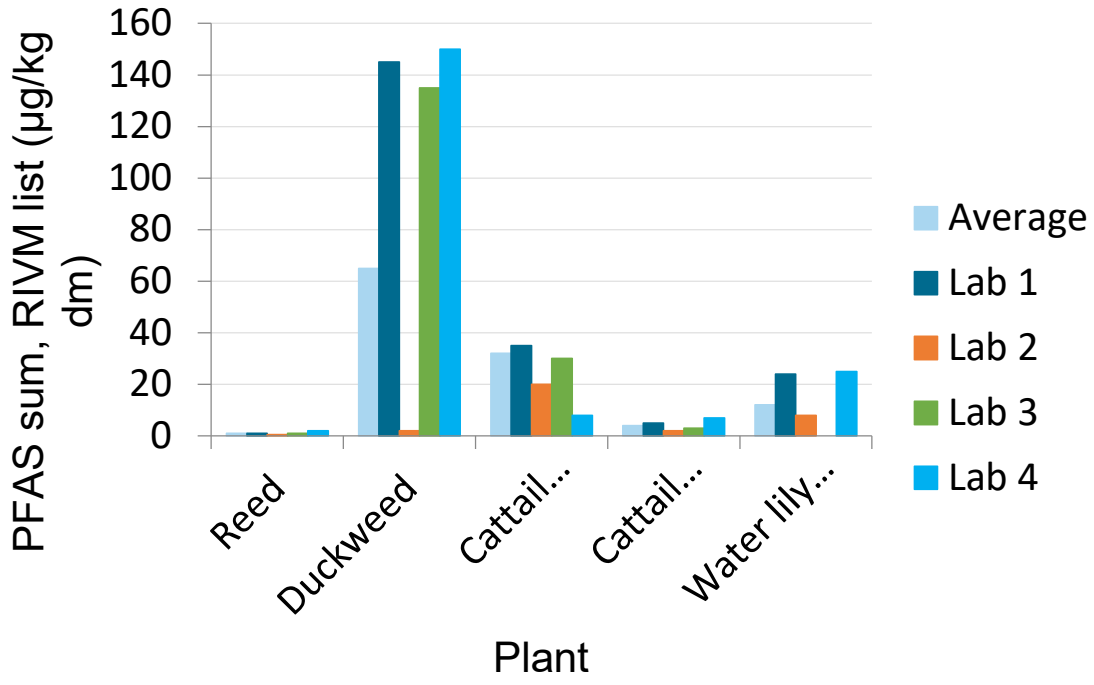


Average measured SUM PFAS concentration (µg/kg dm) per plant; black bars in the source chart indicated standard deviation (n=4).

What was detected:
PFOS and PFHxS dominate; both are stable compounds. Duckweed contains the highest total concentrations; cattail roots show the greatest diversity of compounds.

Comparison between laboratories (RIVM advisory list):
Lab 1 and Lab 4 report the highest PFAS values. The explanation lies in the method:
- Lab 1 measures PFAS probably due to the presence of other dry matter.
- Lab 2 dries at 40°C and analyses the dried sample, which can influence released PFAS mobility and increase detection of short-chain compounds.

Research Results – PFAS Compounds

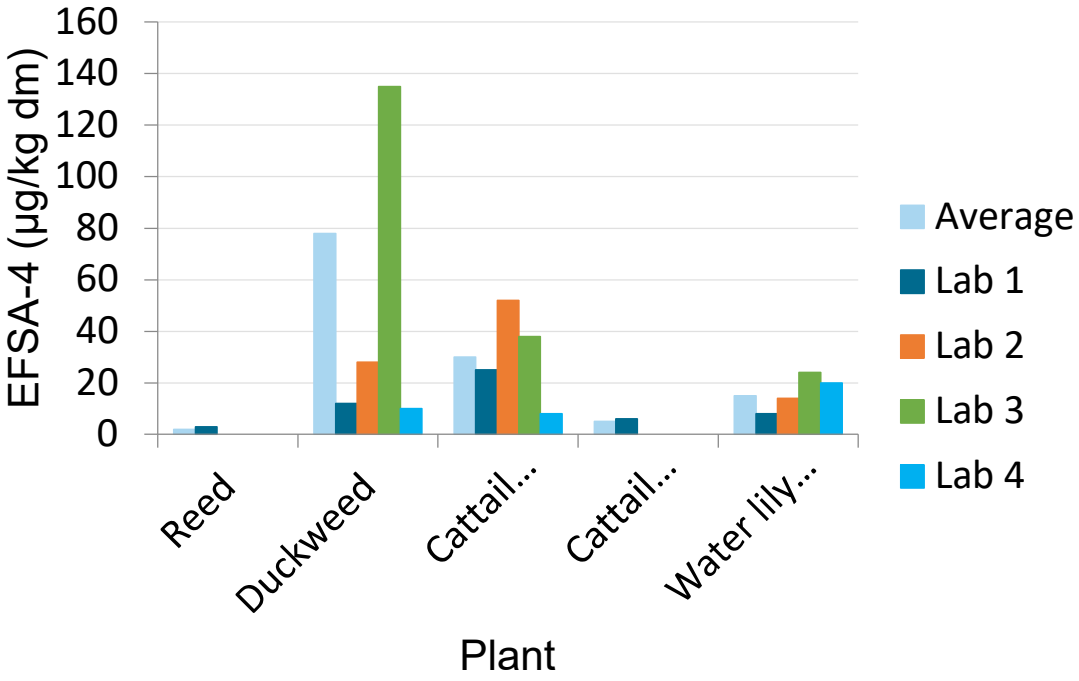


Average measured SUM PFAS concentration (µg/kg dm) per plant; black bars in the source chart indicated standard deviation (n=4).

Key message

Methodological differences (analysis sequence, storage time) strongly influence outcomes and make direct comparison less reliable.

Research Results – EFSA-4



Average measured EFSA-4 concentration (µg/kg dm) per plant and spread of the data from four laboratories; black bars in the source chart indicated standard deviation (n=4).

Results
consistent with total PFAS sum

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Research Results – Discussion

Sample preparation and homogenisation

The samples were not homogenised in advance. Variations in sand and silt content can differ. Distribute a homogenised master sample to participating labs in duplicate.

Analysis package and compound selection

Different PFAS compound sets were analysed, making the total concentration a distorted picture. A standardised analysis package would help; EFSA-4 provides an initial useful basis.

Washed vs. unwashed material

Analysis of washed, sand/silt-free material provides insight into the PFAS concentration in the pure plant and likely results in lower values. Cleaned ditch-cleared vegetation shows demonstrably lower PFAS values.

Dry matter method and calculation effect

The DM method differs per lab and directly influences the reported PFAS concentration. A uniform drying method with duplicate measurements reduces this variation.

Research Results – Conclusion…

- **Lab 3 and Lab 4 report comparable, high concentrations on both indices (RIVM & EFSA-4).**
- **Lab 1 consistently reports the lowest values, probably due to high DM content.**
- **Lab 2 more often detects short-chain PFAS, possibly due to the low drying temperature.**
- **The spread of the results is large: without a standard method, results cannot be compared unambiguously.**

Thank you for your attention

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