



Flanders  
State of  
the Art

# Experiences after 1 year of PFAS crisis in Flanders

Soil Management Department, OVAM  
Mechelen, Belgium

ENSOr4 – 20-21 October 2022  
'PFAS, more than a technical matter'

WE MAKE  
TOMORROW  
BEAUTIFUL

**OVAM**

# How helpfull is media attention for solving problems ... ?

- **PFAS became a priority for other environmental administrations, for local authorities, for research institutes, ...**
- **This resulted in a more intensive cooperation**



# Content

## Introduction

- 1. Inventory of PFAS contaminated sites in Flanders**
- 2. First results & insights – fire services related sites**
- 3. Guidelines for soil investigations**
- 4. Trigger values for PFAS in soil and groundwater**
- 5. What's next? Outlook towards the future**

# **INTRODUCTION**

## A person in a dark uniform is using a red fire extinguisher to fight a large fire. The fire is intense, with bright orange and yellow flames rising from a wooden structure. The person is positioned on the left, and the fire is on the right. The background is dark, and the ground is light-colored.

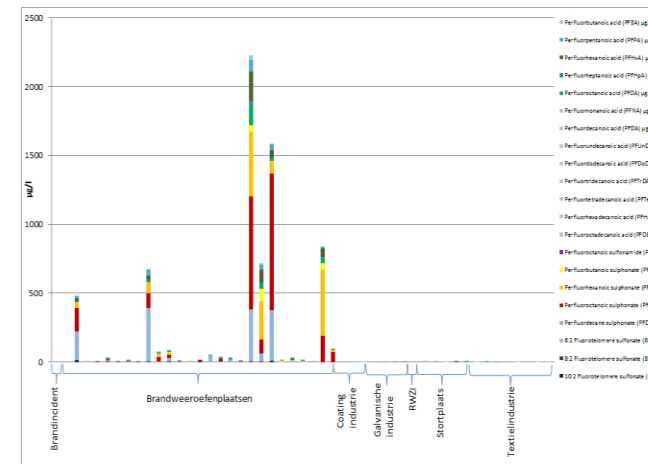
## Inventory of risk activities

- Especially on **fire fighting training grounds** soil & groundwater are contaminated with PFAS
- PFAS must be included as a suspect substance in soil investigations

- ✓ preventive actions in collaboration with fire services organizations
- ✓ development of trigger values for PFAS in soil & groundwater
- ✓ identification and inventory of PFAS contaminated sites
- ✓ development of guidelines for soil investigation

www: 'PFAS in soil and groundwater around risk activities in Flanders'

## Accelerated by the crisis !



# **1 Inventory of PFAS contaminated sites**

# Inventory of PFAS contaminated sites

- ▶ In Flanders: inventory of land with risk activities ('GI')
  - ▶ Use of fire extinguishing foam
    - Not included in 'GI'
    - Call to local authorities (July 2021, **first part**) for inventory of
      - Fire service training site
      - Fire service facilities (industry)
      - Fire extinguishing calamities
      - Military training areas and airports
      - Civil airports
- Result: **826** locations (fire service training sites and calamities)

# Inventory of PFAS contaminated sites

## ▶ PFAS processing industry

Call (July 2021, **second part**) to local authorities for inventory of risk activities as determined in the study of 2018

- Textile industry
- Paper industry
- Galvanic industry
- ...

→ Result: more than **4.000** locations (screening and prioritisation is still going on - two consultants)

# Investigation of fire services related sites

- ▶ In July 2021 OVAM started with the investigations
- ▶ By soil experts commissioned by OVAM (+/- 40 sites/month)
- ▶ ‘Preliminary’ soil investigations (according to a specific protocol):
  - Focused on PFAS
  - Limited sampling in source area
  - Sampling at borders of source area (to estimate risks surroundings)
  - Decision whether further soil investigations are needed
  - Determine priority class (1-5)
  - Determine ‘no regret measures’ by the Agency of Care and Health (AZG)

# What after the preliminary soil investigation?

- ▶ Meeting OVAM/AZG
- ▶ Letter with official request from OVAM to operator or owner ('polluter pays' principle)
  - descriptive soil investigation:
    - Investigation of the whole contamination
    - Determine the risks of the contamination
- ▶ Communication by AZG to the local authorities about the no regret measures

# No regret measures

Agency for Health and Care advice to residents in the neighbourhood (100 m ) of PFAS risk sites (fire fighting training sites and sites large industrial fires) to limit: [No regret-maatregelen brandweeroefenterreinen en sites van een zware industriële brand | Vlaanderen.be](https://www.vlaanderen.be/nl/overheid/advies/advies-afname-pfas-in-voedsel-uit-landbouw-gebied-100m-omgeving-pfas-rijke-locaties)

To avoid/limit\*

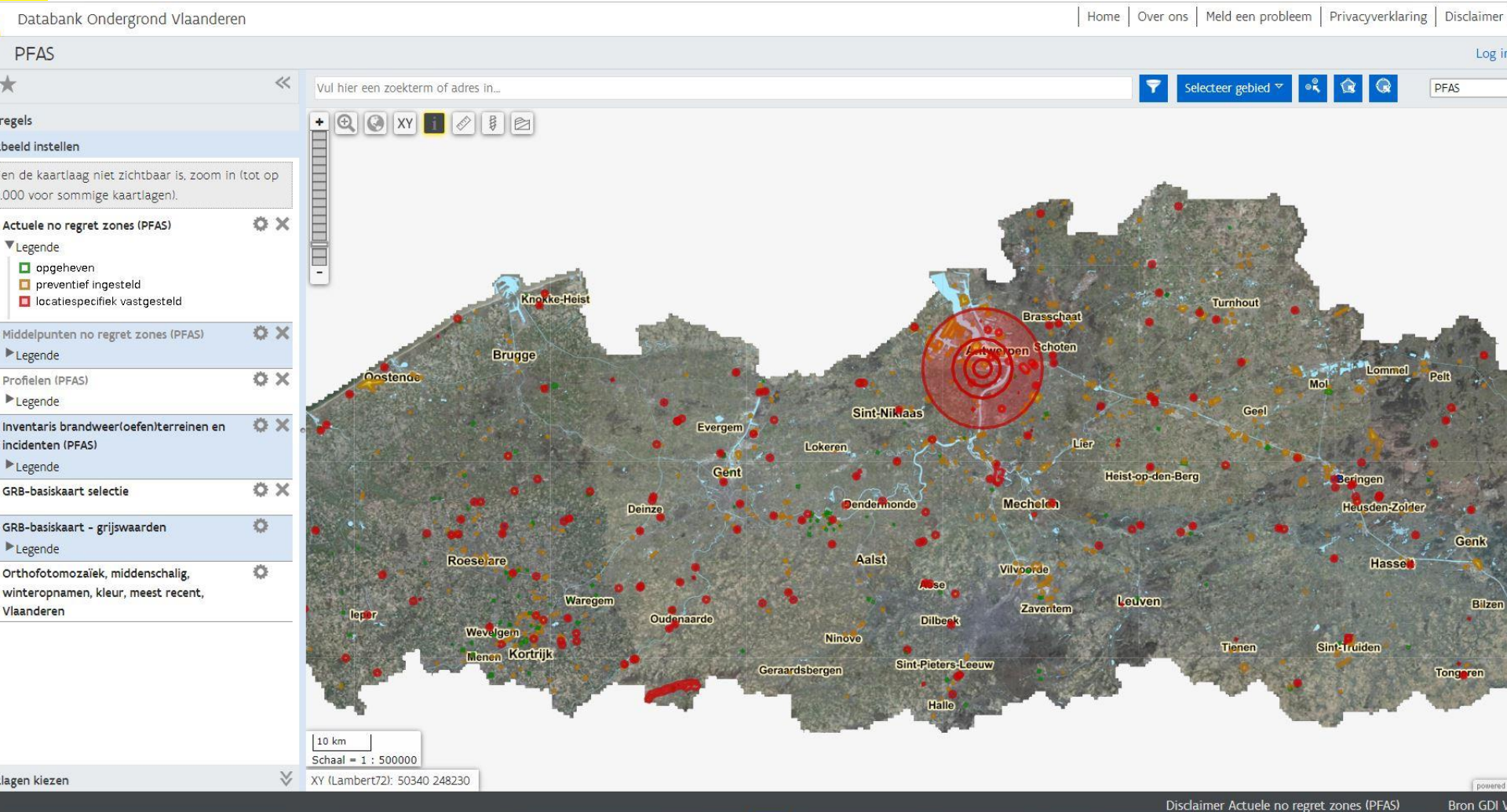
- Consumption of local food (**eggs**, vegetables)
- Use of groundwater (as drinking water, irrigation of kitchen garden and swimming pool)
- Use of compost

Apply exposure mitigation measure for soil contact

\*Advices are more stringent for vulnerable populations

**'no regret' advices will be re-evaluated and communicated after evaluation of on site measurements**

# No regret measures – in database DOV



# Preliminary soil investigations on fire services related sites – in database DOV

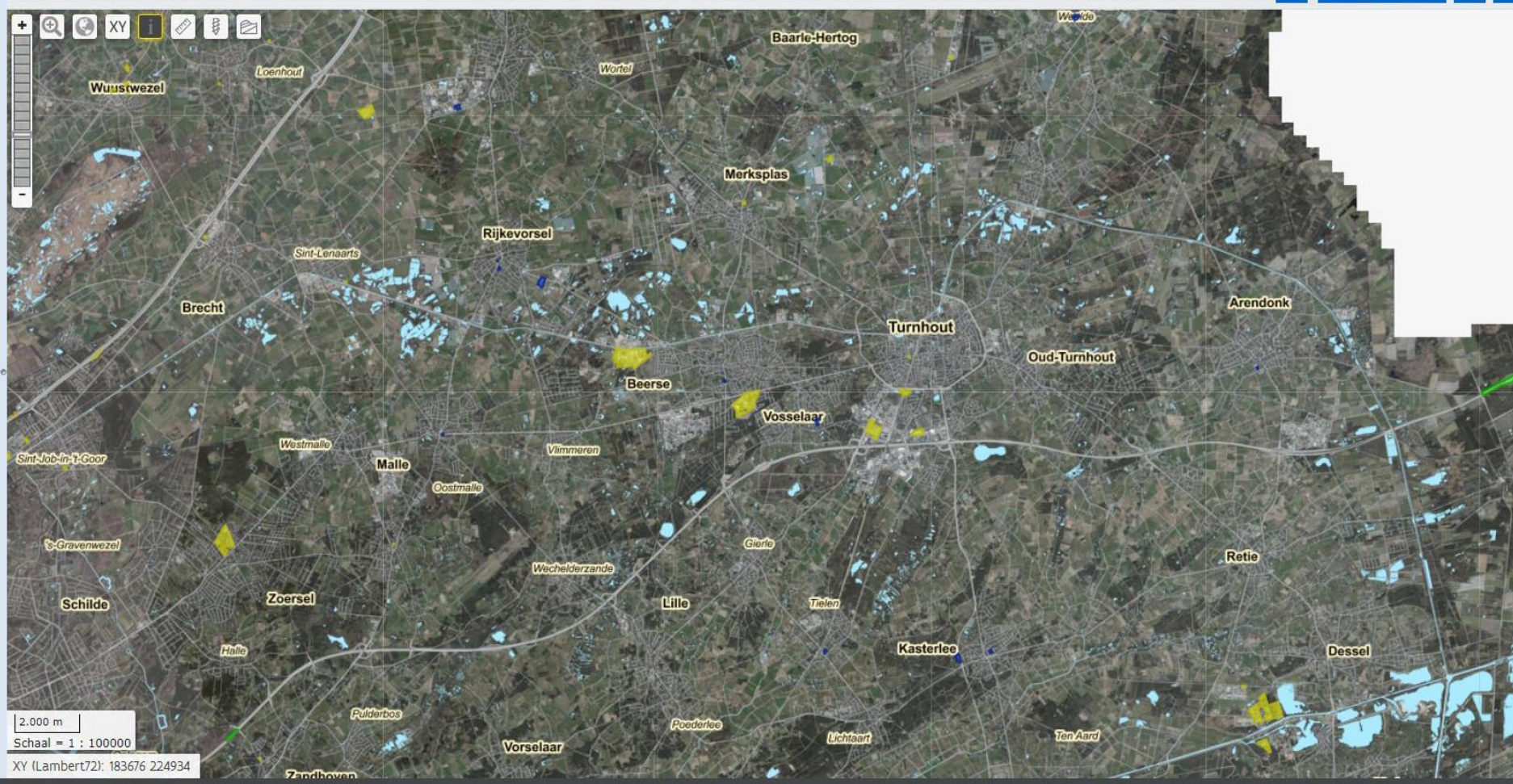
Databank Ondergrond Vlaanderen

[Home](#) | [Over ons](#) | [Meld een probleem](#) | [Priv](#)

PFAS

Vul hier een zoekterm of adres in...

Selecteer gebied ▾



# Current state of affairs

- ▶ **826** fire fighting related sites inventoried
- ▶ on **619** sites preliminary investigations are started
- ▶ 97 sites appear to be not PFAS suspected
- ▶ **397** investigations are in completion phase  
of which **268** are finished (i.e. local communities informed)
- ▶ For **189** out of 268 finished preliminary investigations there is a need for further action: a descriptive soil investigation and possibly remediation

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**First results &  
insights –  
fire services  
related sites**

# Evaluation of results of the first preliminary soil investigation reports

- ▶ 68 reports were evaluated

| Amount of reports               | Soil analysed (59) | Groundwater analysed (55) |
|---------------------------------|--------------------|---------------------------|
| Further investigation needed    | 23 (39%)           | 47 (85%)                  |
| No further investigation needed | 36 (61%)           | 8 (15%)                   |

- ▶ Per site: max conc in soil and in groundwater for the different PFAS listed

# Soil investigations (fire services related sites)

- Frequently found PFAS parameters  
(in more than 25% of the cases max conc > target value)

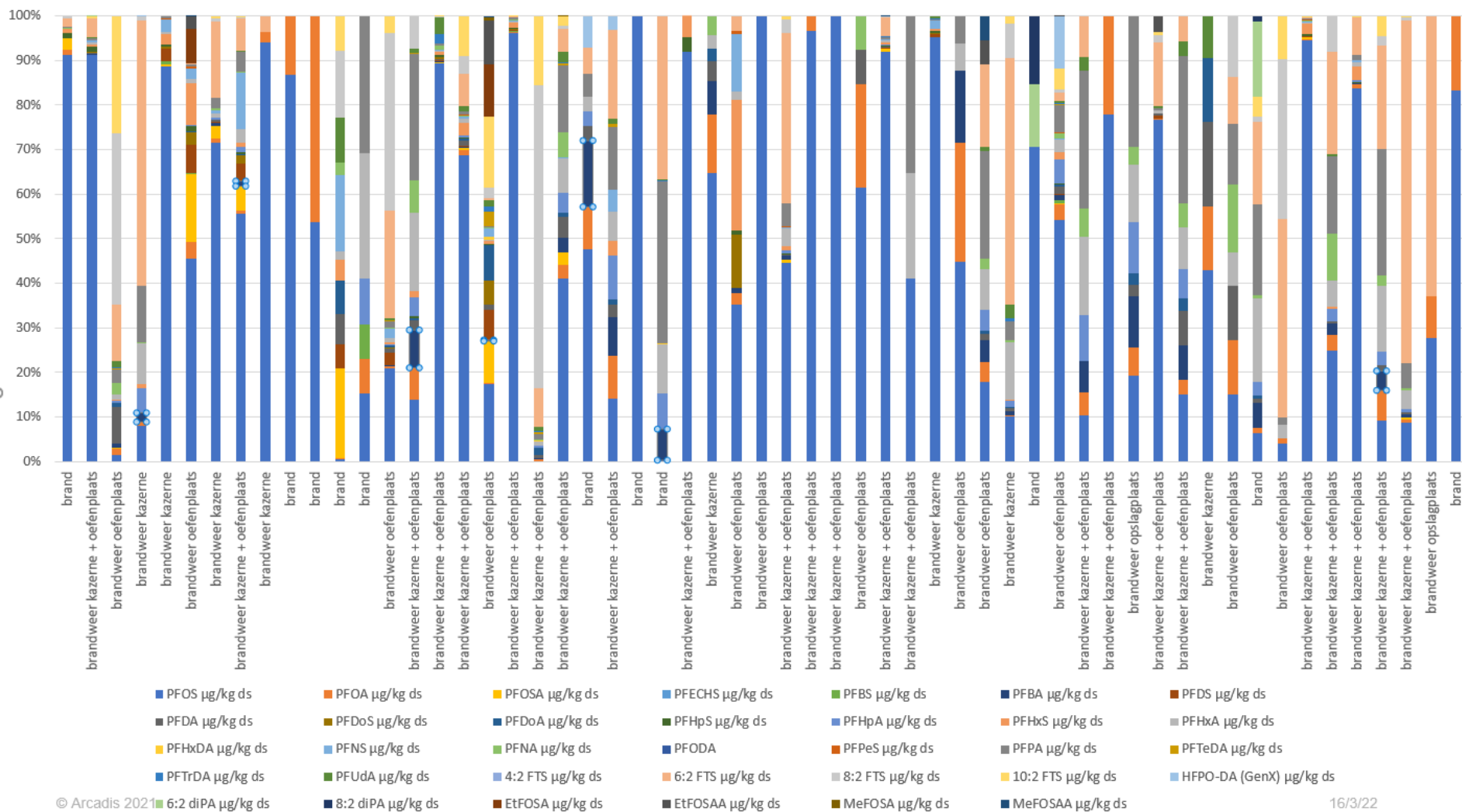
| Soil     | Groundwater | Soil and groundwater |
|----------|-------------|----------------------|
| 8:2 FTS  | PFBA        | PFOS                 |
| 10:2 FTS | PFHxA       | PFHxS                |
|          | PFHpA       | 6:2 FTS              |
|          | PFOA        | PFPA                 |
|          | PFPeS       |                      |
|          | PFBS        |                      |

- Focus for further research on risk assessment, setting of trigger values, ...

# Soil investigations (fire services related sites)

- ▶ Effect of pavement?
- ▶ High variability in PFAS compounds (fingerprinting)
  - Old extinguishing foam: PFOS important
  - New extinguishing foam: 10:2 FTS, 8:2 FTS en 6:2 FTS
  - Before / after 2011 – difficult to distinguish
- ▶ Different composition in soil vs groundwater (complex leaching behaviour)

# Fingerprinting (op basis van max conc) in grond (%)

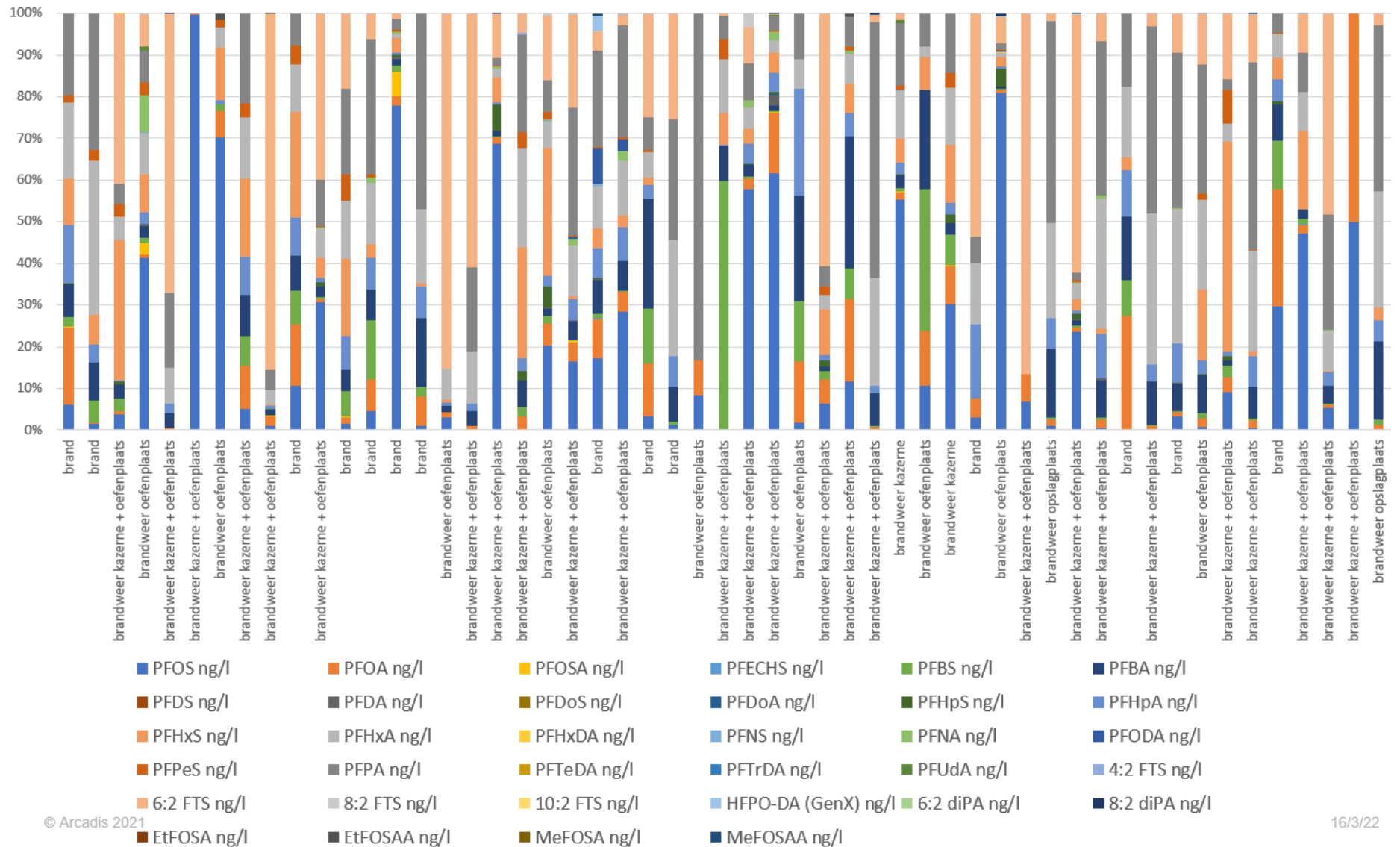


16/3/22



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# Fingerprinting (op basis van max conc per locatie) in grondwater (%)



# **3**

## **Guidelines for soil investigations**

# Available guidelines on PFAS

- ▶ General guidelines
  - When is a soil investigation needed? When is PFAS a 'suspected' substance?
  - Specific recommendations on PFAS - analytical methods
  - Excavated soils
- ▶ Guidelines for preliminary soil investigation
- ▶ Code of good practice – additional guidelines for descriptive soil investigation

# General guidelines on PFAS

## ► When is PFAS a 'suspected' substance?

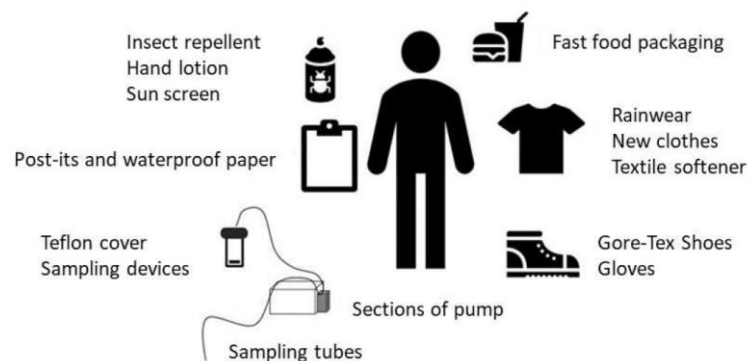
- Soil investigation
- Technical report

## ► List of risk activities - high/limited risk for PFAS contamination of soil & groundwater

### High risk:

- PFAS production sites
  - PFAS processing industry (galvanic industry)
  - Sites where fire fighting foam was used (fire incidents & fire fighting training grounds)
- 
- include PFAS when soil investigation is needed
  - Include PFAS in technical report on excavated soil

## ► Checklist for sampling



## ► Analytical method: CMA/3/D

→ LC – MS/MS

## ► Starting date: 1/9/2020

# Guidelines for descriptive soil investigations

## – Code of good practice – some highlights

► A conservative & pragmatic methodology is followed for risk assessment:

→ 3 groups: PFCAs / PFSA's / other PFAS

Sum PFCAs → PFOA

Sum PFSA's → PFOS

Other: highest value  
→ PFOS

| PFCA's (20)   |             | PFSA's (14)  |            | Andere PFAS (2) |             |
|---------------|-------------|--------------|------------|-----------------|-------------|
| PFBA          | 375-22-4    | PFBS         | 375-73-5   | HFPODA - GenX   | 13252-13-6  |
| PFPeA         | 2706-90-3   | PFPeS        | 2706-91-4  | ADONA           | 919005-14-4 |
| PFHxA         | 307-24-2    | PFHxS        | 355-46-4   |                 |             |
| PFHpA         | 375-85-9    | PFHpS        | 375-92-8   |                 |             |
| <b>PFOA</b>   | 335-67-1    | <b>PFOS</b>  | 1763-23-1  |                 |             |
| PFNA          | 375-95-1    | PFNS         | 68259-12-1 |                 |             |
| PFDA          | 335-76-2    | PFDS         | 335-77-3   |                 |             |
| PFUnDA        | 2058-94-8   | PFECHS       | 646-83-3   |                 |             |
| PFDoA         | 307-55-1    | <i>PFDoS</i> | 79780-39-5 |                 |             |
| PFTTrDA       | 72629-94-8  | PFOSA        | 754-91-6   |                 |             |
| PFTeDA        | 376-06-7    | MePFOSA      | 31506-32-8 |                 |             |
| PFHxDA        | 67905-19-5  | EtPFOSA      | 4151-50-2  |                 |             |
| <i>PFODA</i>  | 16517-11-6  | MePFOSAA     | 2355-31-9  |                 |             |
| 4:2 FTS       | 757124-72-4 | EtPFOSAA     | 2991-50-6  |                 |             |
| 6:2 FTS       | 27619-97-2  |              |            |                 |             |
| 8:2 FTS       | 39108-34-4  |              |            |                 |             |
| 10:2 FTS      | 120226-60-0 |              |            |                 |             |
| 6:2 diPAP     | 57677-95-9  |              |            |                 |             |
| 6:2/8:2 diPAP | 943913-15-3 |              |            |                 |             |
| 8:2 diPAP     | 678-41-1    |              |            |                 |             |

# Guidelines for descriptive soil investigations

## – Code of good practice - some highlights

- ▶ For large vegetable gardens:  
analyses of vegetables is needed



- ▶ When free range chicken are present:  
analyses of eggs is needed



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**Trigger values  
for PFAS in soil  
and  
groundwater**

# Overview of soil thresholds used in Flanders



soil

background  
values

target  
values

soil remediation  
standards

nature  
agriculture

residence

recreation

industry

conc in soil



excavated soil

values for  
free use

values for  
construction purposes

+ sediments  
conc in soil



added to soil

Criteria for soil improving  
agents and fertilizers

conc in fertilizer

# Development of soil criteria for PFAS

Only for PFOS and PFOA: necessary data available to derive soil remediation criteria

Soil remediation criteria are derived by VITO, for **PFOS** & **PFOA**

human tox: using transfer & exposure model [S-Risk](#)

ecotox : same values used as RIVM (NL)

→ lowest value is retained



Criteria for excavated soil & soil materials: most urgent

for free use of excavated soil

for construction purposes

→ derivation based on soil remediation criteria  
& leaching properties



Discussion in working groups with different experts & stakeholders

resulted in a **temporary action framework**

→ soil criteria were adjusted; applicable since April 19, 2022

# Soil remediation criteria for PFOS - soil

| PFOS<br>Land use type             | I/II<br>nature /<br>agriculture | III<br>residence | IV<br>recreation | V<br>industry |
|-----------------------------------|---------------------------------|------------------|------------------|---------------|
| Human tox (µg/kg dm)              | 3,1                             | 205              | 1.949            | 1.949         |
| Ecotox (µg/kg dm)                 | 3                               | 18               | 110              | 9.100         |
|                                   |                                 |                  |                  |               |
| Soil remediation value (µg/kg dm) | 3,8*                            | 3,8** / 18       | 110              | 110           |

\* adjusted for background value & target value

\*\* for residential area with vegetable garden / free range chicken coop

- ▶ Applicable since April 19, 2022
- ▶ Temporary framework

# Soil remediation criteria for PFOA - soil

| PFOA                              | I/II<br>nature /<br>agriculture | III<br>residence | IV<br>recreation | V<br>industry |
|-----------------------------------|---------------------------------|------------------|------------------|---------------|
| Land use type                     |                                 |                  |                  |               |
| Human tox (µg/kg dm)              | 4,3                             | 205              | 643              | 643           |
| Ecotox (µg/kg dm)                 | 7                               | 89               | 1.100            | 50.000        |
|                                   |                                 |                  |                  |               |
| Soil remediation value (µg/kg dm) | 4,3                             | 4,3* / 89        | 643              | 643           |

\* for residential area with vegetable garden / free range chicken coop

- ▶ Applicable since April 19, 2022
- ▶ Temporary framework

# Soil remediation criterium - groundwater

Soil remediation criterium for groundwater is set at the European limit for drinking water:

0,1 µg/l for the sum of 20 PFAS (Drinking Water Directive) &  
0,5 µg/l for the sum of all quantitative measurable PFAS

Applicable since April 19, 2022 - temporary framework

# Background values, target values / values for free use of excavated soil



|                                       | Background values<br>( $\mu\text{g/kg dm}$ ) | Target value / free use of<br>excavated soil ( $\mu\text{g/kg dm}$ ) |
|---------------------------------------|----------------------------------------------|----------------------------------------------------------------------|
| PFOS                                  | 1,5                                          | 3                                                                    |
| PFOA                                  | 1,0                                          | 3                                                                    |
| Sum PFAS (quantitative<br>measurable) |                                              | 8                                                                    |

For the **use in construction purposes** less strict criteria can be applied, on the responsibility of the soil expert.

Applicable since April 19, 2022 - temporary framework

# Implementation in legislation

- ▶ A demand for more legal certainty from stakeholders  
→ implementation in legal documents
- ▶ EFSA's recommended daily intake of PFAS translated into food criteria  
  
→ new update of the framework by VITO:

| Soil remediation criteria<br>Land use type | I/II<br>nature /<br>agriculture | III<br>residence | IV<br>recreation | V<br>industry |
|--------------------------------------------|---------------------------------|------------------|------------------|---------------|
| PFOS (µg/kg dm)                            | 3,8*                            | 4,9              | 110              | 268           |
| PFOA (µg/kg dm)                            | 2,5*                            | 7,9              | 632              | 303           |

\* adjusted for background value & target value

# Implementation in legislation



- For excavated soils / soil materials: target value / free use

|                                       | Background values<br>( $\mu\text{g/kg dm}$ ) | Target value / free use of<br>excavated soil ( $\mu\text{g/kg dm}$ ) |
|---------------------------------------|----------------------------------------------|----------------------------------------------------------------------|
| PFOS                                  | 1,5                                          | 3                                                                    |
| PFOA                                  | 1,0                                          | 2                                                                    |
| Sum PFAS (quantitative<br>measurable) |                                              | 8                                                                    |

+ quality test for underwater applications & applications in drinking water protection zones

- For use in construction purposes: → decision tree & methodology based on leaching - max. conc = highest SRV

Decision process is ongoing, not yet final!

# **5**

## **What's next?**

**Outlook  
towards the  
future**

# Ongoing actions and research activities

- ▶ Leaching of PFAS from soil to groundwater: experiments + modelling
- ▶ Diffuse presence of PFAS in groundwater in Flanders
- ▶ Development of methods for dealing with the sum of PFAS in action frameworks
- ▶ Characterisation of PFAS in soil & groundwater on sites with different risk activities, using non target methods
- ▶ Measurement of PFAS in house dust & contribution to exposure
- ▶ ...
- ▶ International knowledge exchange: EmConSoil, ...

# Thank you for your attention

OVAM  
Public Waste agency of Flanders

[www.ovam.be](http://www.ovam.be)

**EmConSoil:**

[www.ovamenglish.be/emconsoil](http://www.ovamenglish.be/emconsoil)

