ATMOSPHERIC DEPOSITION OF PFAS AROUND FLUOROCHEMICAL PROCESSING PLANTS

THE IMPACT OF ATMOSPHERIC DEPOSITION AND THE INFLUENCE OF SOIL TYPE

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2019 - PFAS problems in the Netherlands

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July 2019:

Standard of 0.1 µg/kg for PFAS in nature/rural areas

December 2019:

Background values for nature/rural areas

- 0.9 µg/kg PFOS
- 0.8 µg/kg PFOA

Tractor tijdens demonstratie Grond in Verzet op het Malieveld. Foto Marijn Fidder voor het FD

Bouwers en hun voertuigen op Malieveld voor het bouwersprotest Grond in Verzet (ANP ROBIN VAN LONKHUIJSEN)

Teflon production facility in Dordrecht

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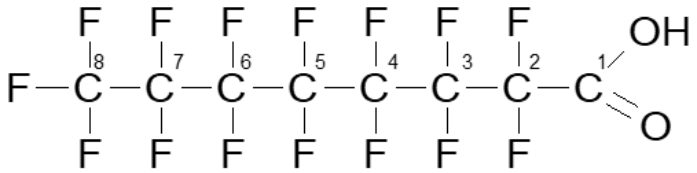
PFOA Perfluorooctanoic acid (C8)



Production of fluoropolymers since 1967

PFOA in top soil

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Results soil top 50 cm

- < LOD (0,1 µg/kg)
- 0,1 - 1,0 µg/kg
- 1,0 - 5,0 µg/kg
- 5,0 - 10 µg/kg
- 10 - 50 µg/kg
- 50 - 100 µg/kg
- >100 µg/kg

0 1 2 3 4 5 Kilometers

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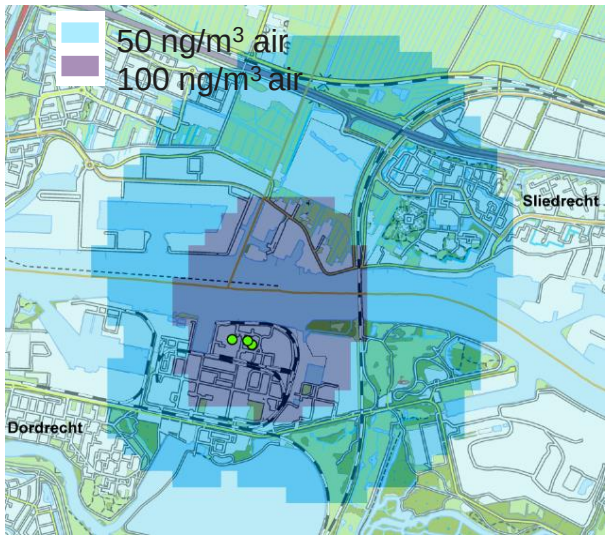
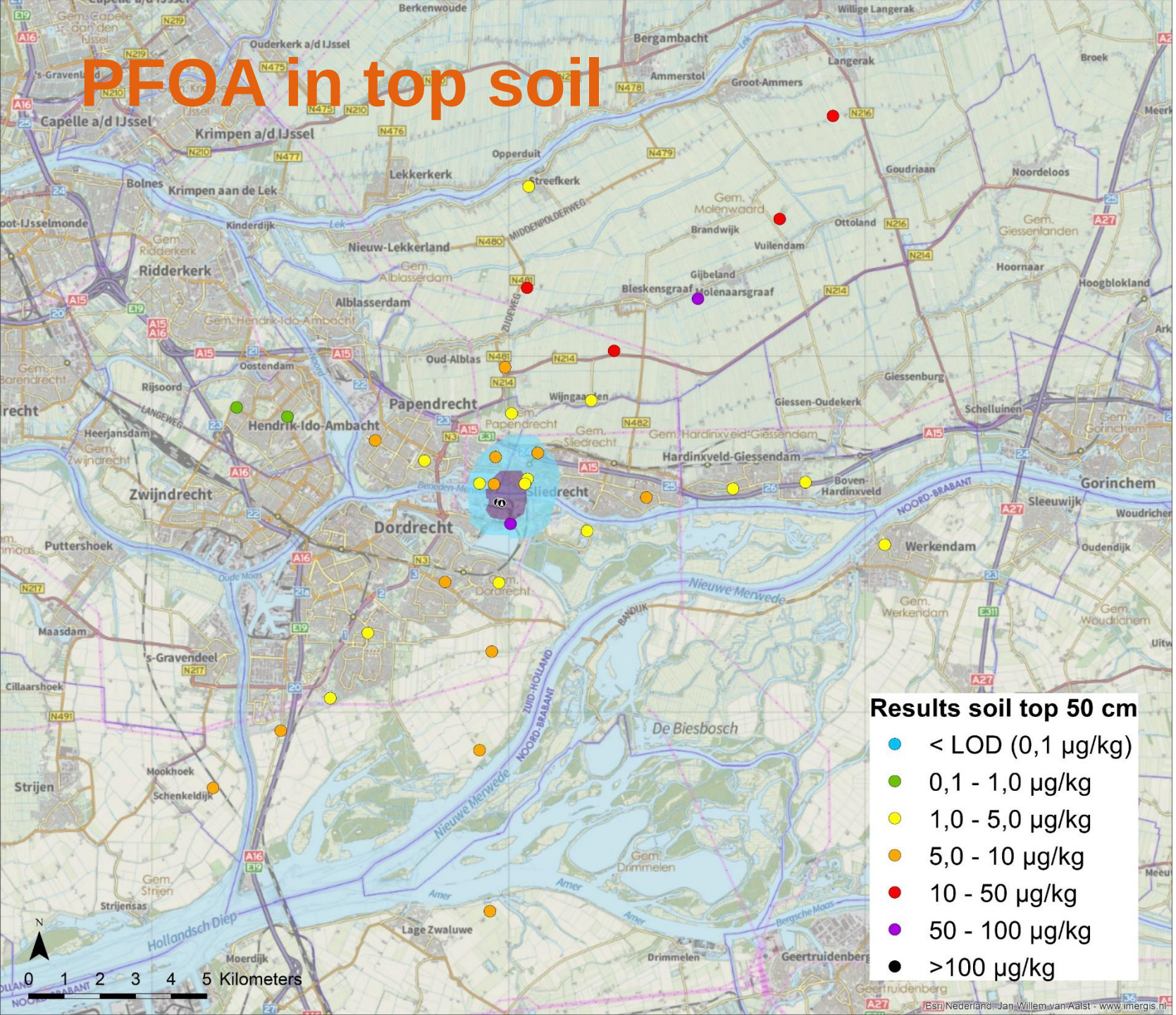
Contours air emission



Source: Zeilmaker et al., 2016. Risicoinschatting emissie PFOA voor omwonenden. Locatie DuPont/Chemours, Dordrecht, Nederland. RIVM briefrapport 2016-0049

PFOA in top soil



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Elevated concentrations up to

20 km downwind

PFOA in top soil

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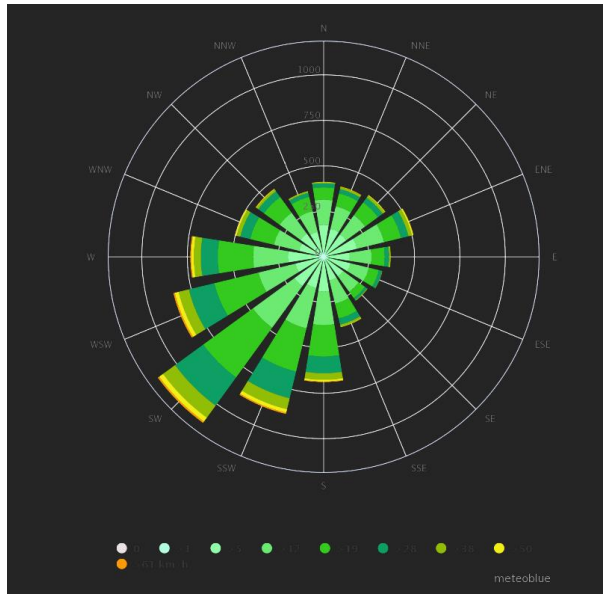

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RIVM background values

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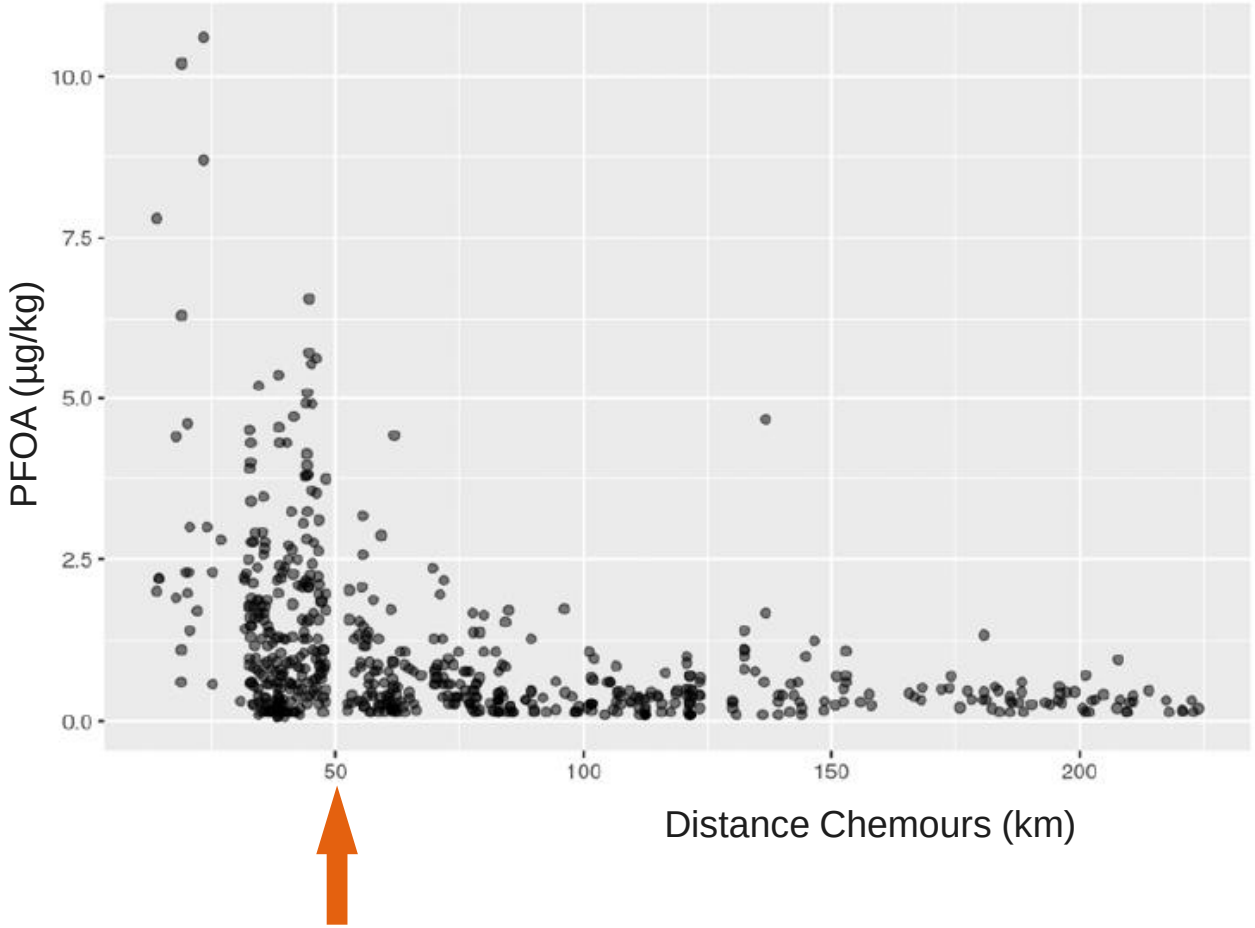

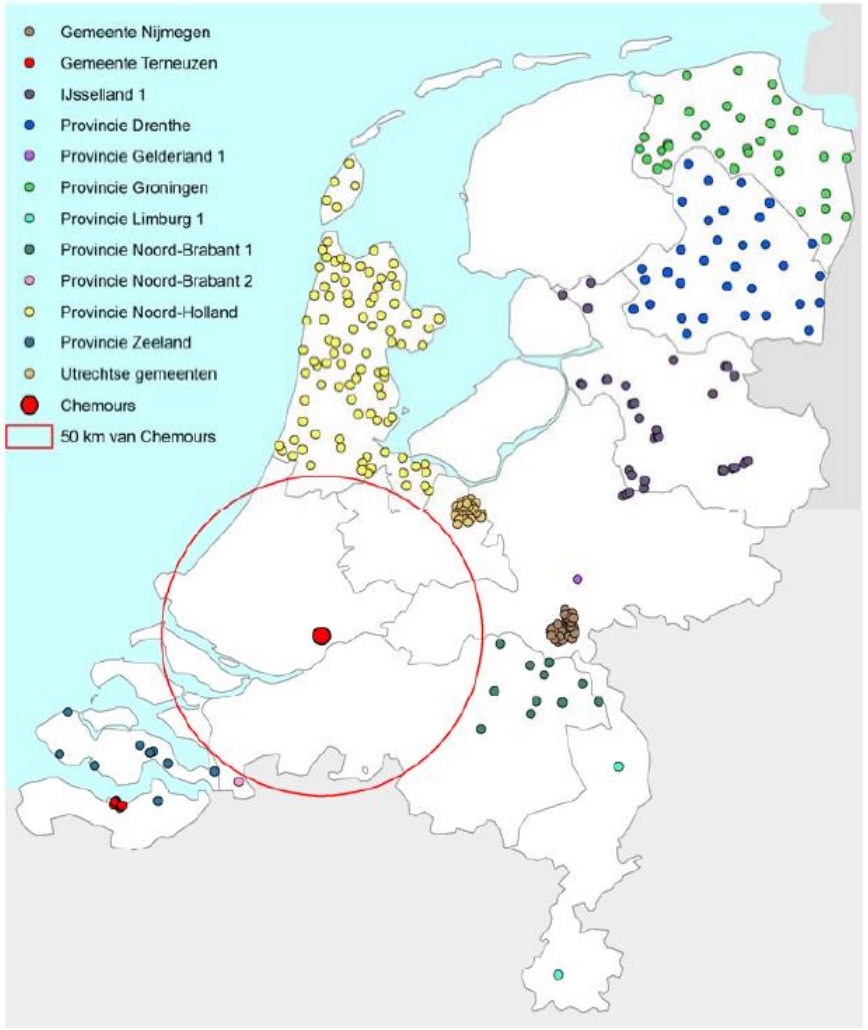

Elevated background values up to 50 km from source

RIVM -Tijdelijke landelijke achtergrondwaarden bodem voor PFOS en PFOA, 28 november 2019

What's going on?

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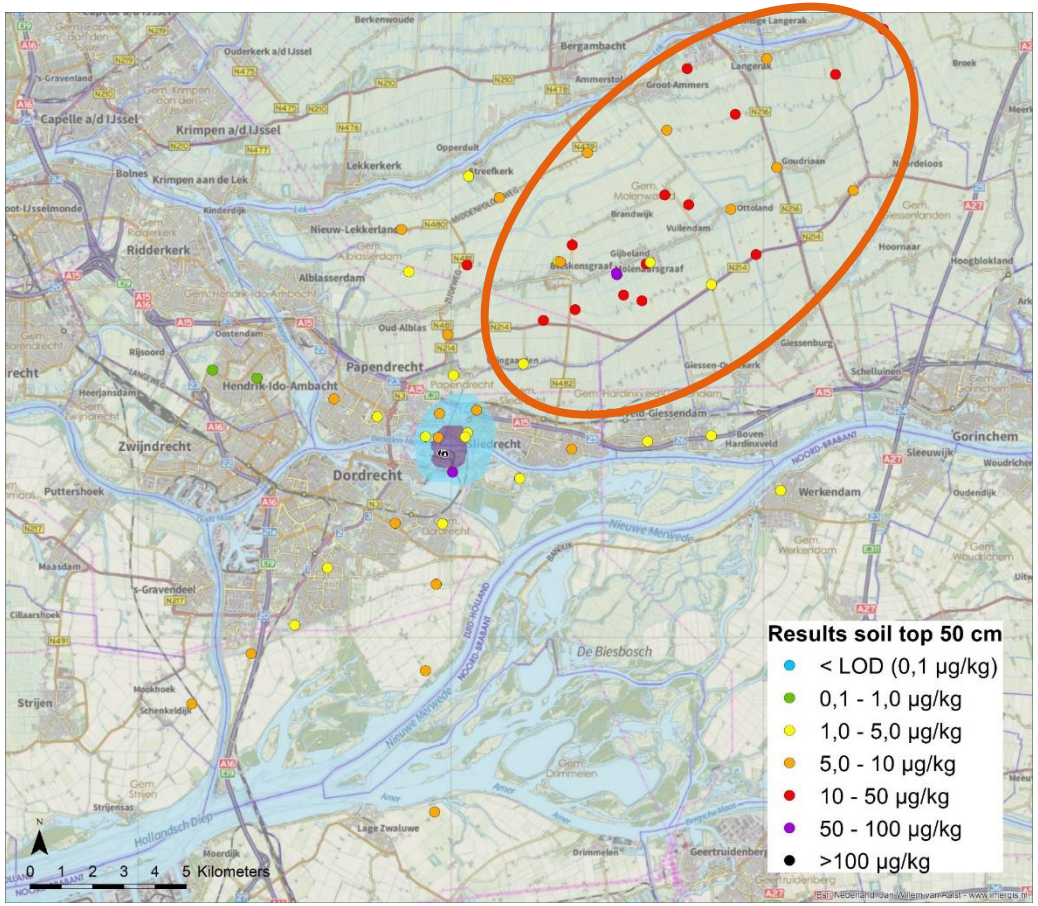

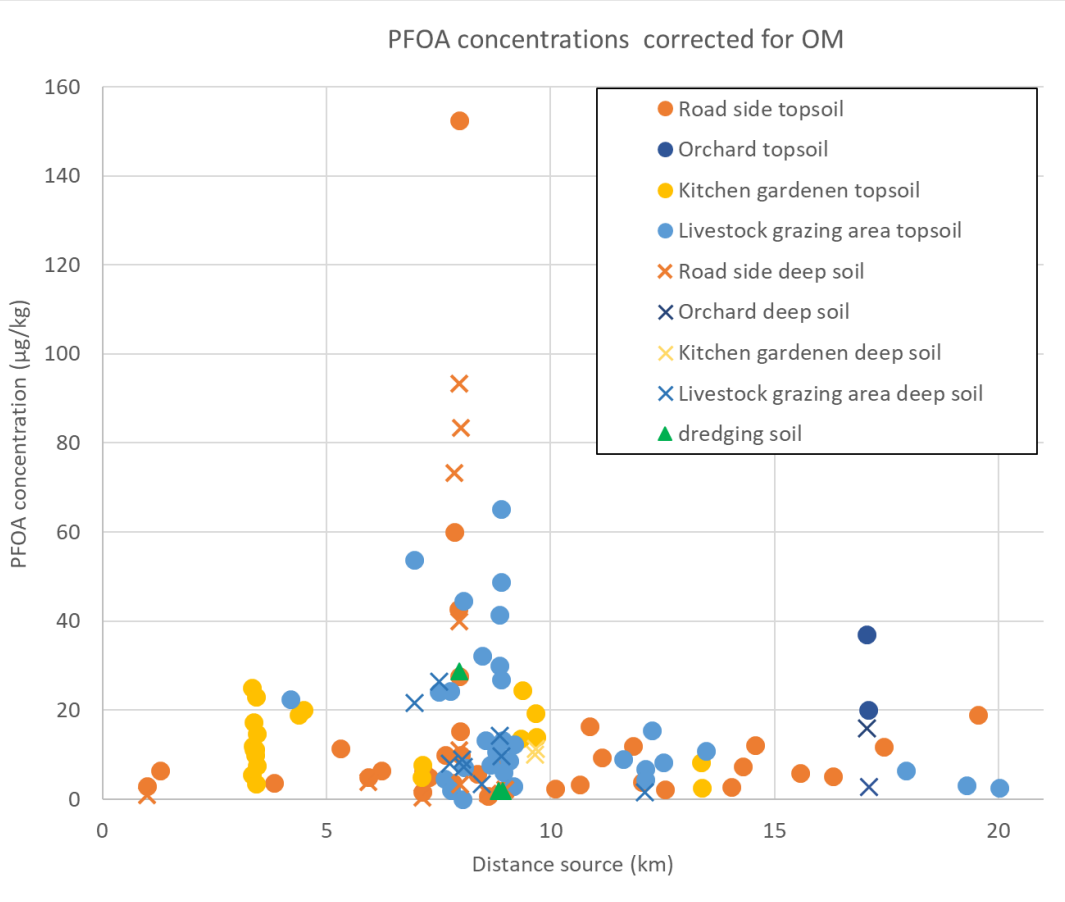

Different soil type

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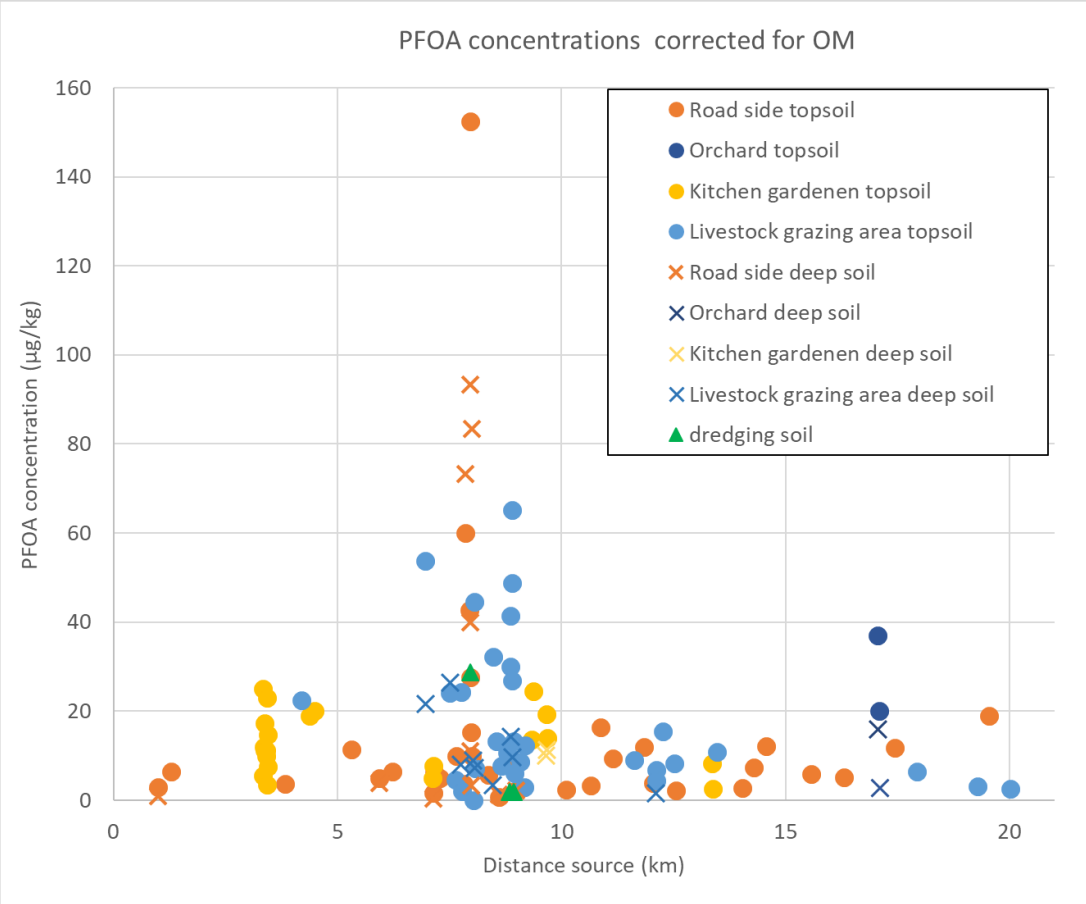

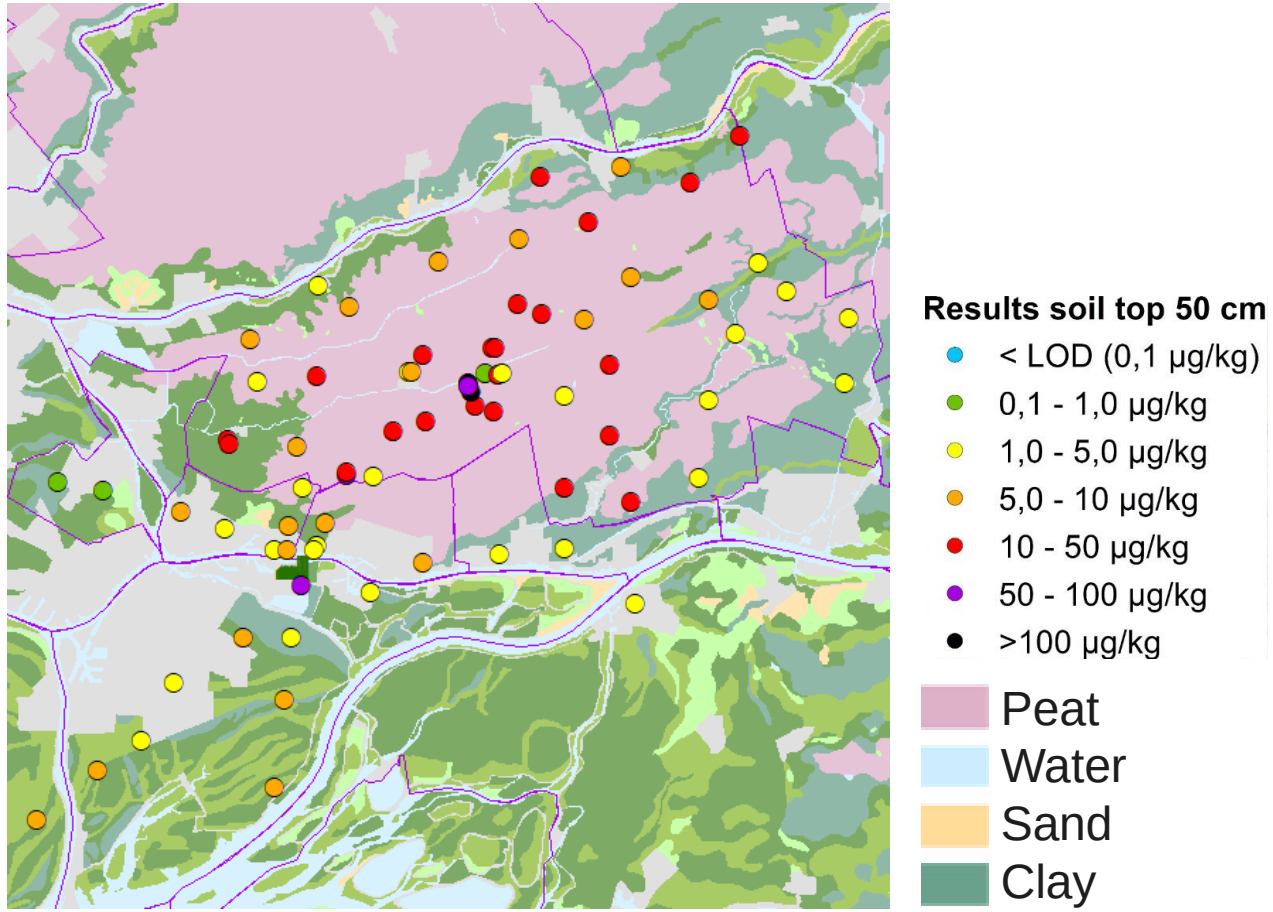

The effect of soil type

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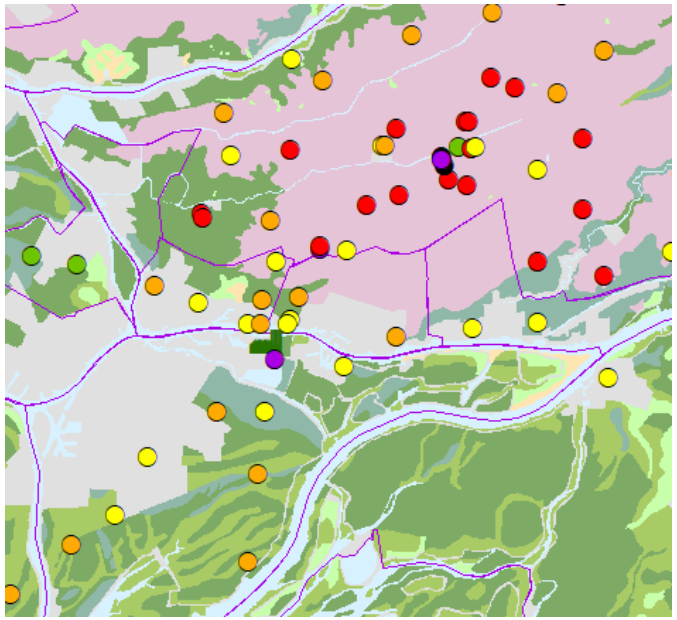
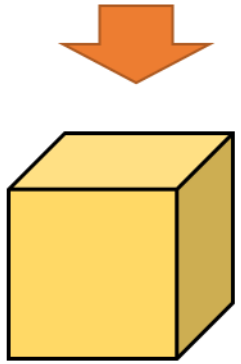


Density effect of atmospheric deposition sand in comparison to peat

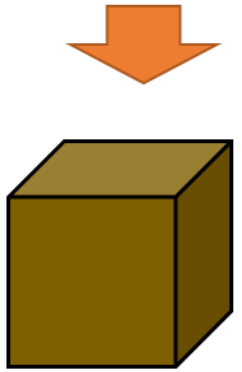
PFOA deposition 7,500 µg/m^2



Sand
Density:
1,550 kg/m^3 (dry)

4.8 µg/kg

PFOA deposition 7,500 µg/m^2



Peat
Density:
400 kg/m^3 (dry)

18.8 µg/kg

The effect of groundwater level

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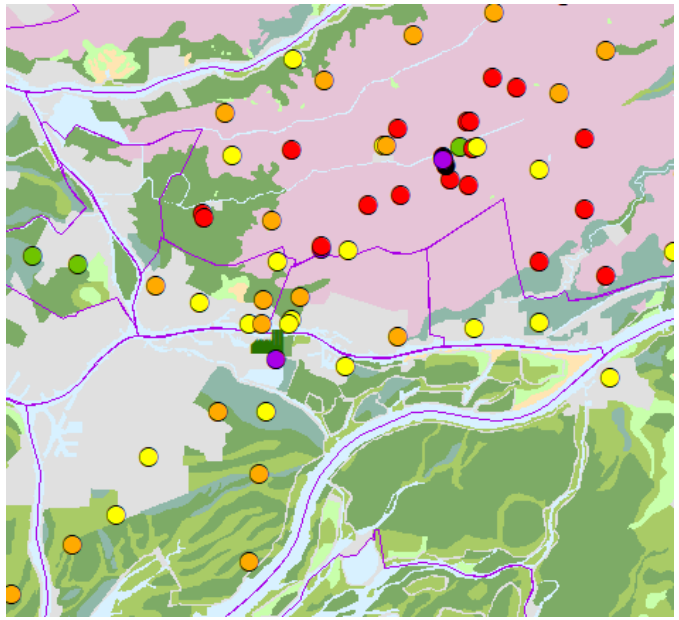

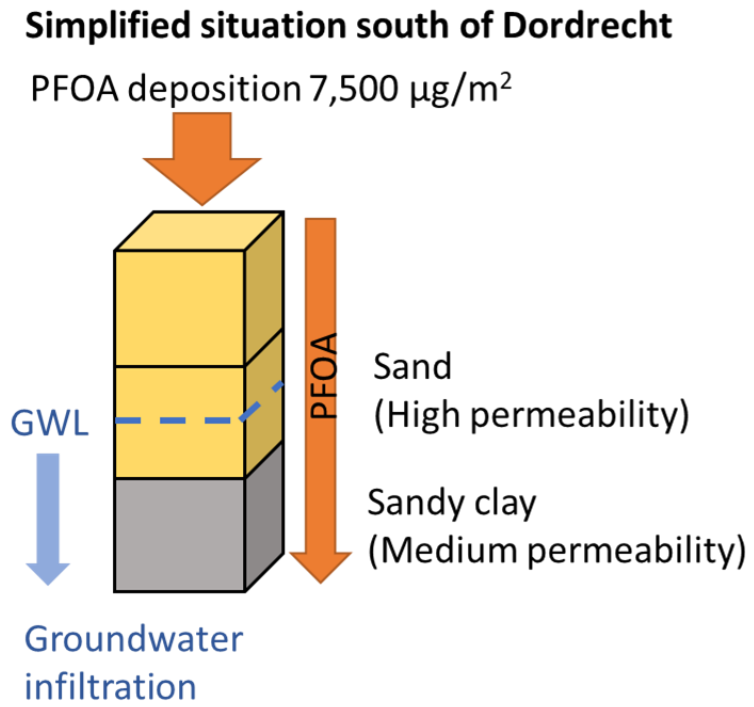

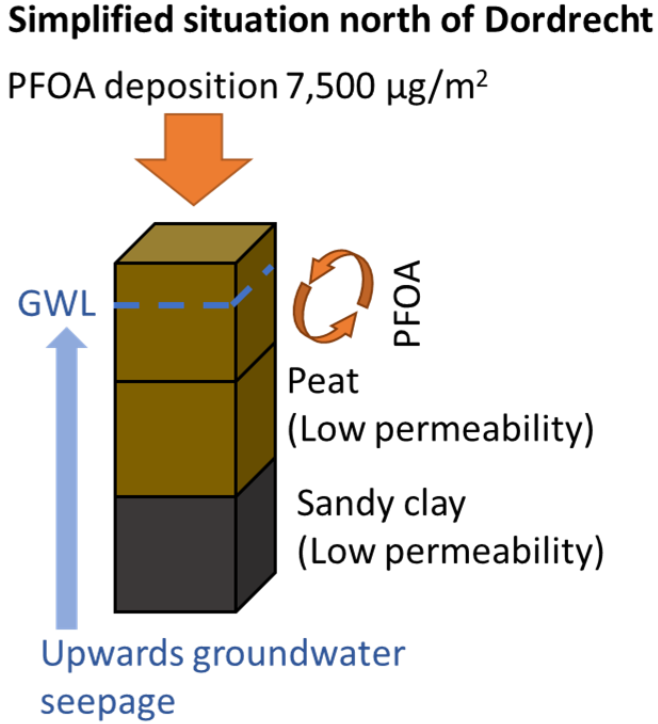

PFOA in soil – the risks

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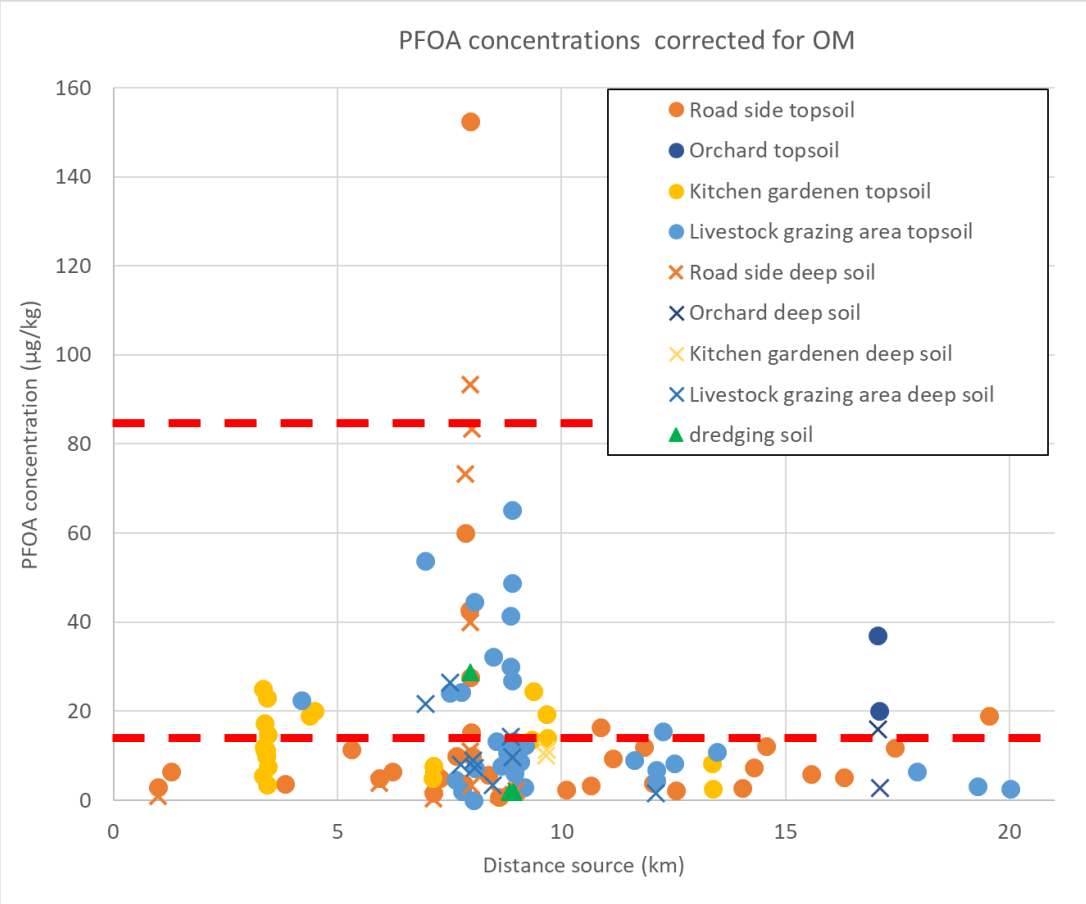

Risk limit PFOA agriculture

Livestock - 15 µg/kg_{ds}

Kitchen Garden - 86 µg/kg_{ds}

2002 - PFOA replaced by GenX

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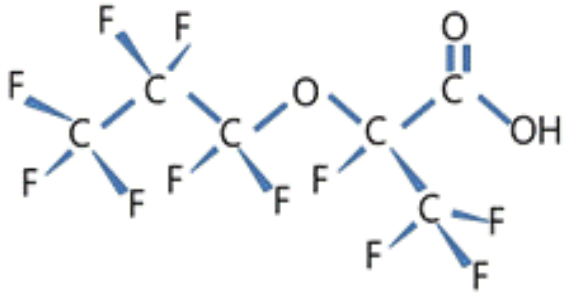
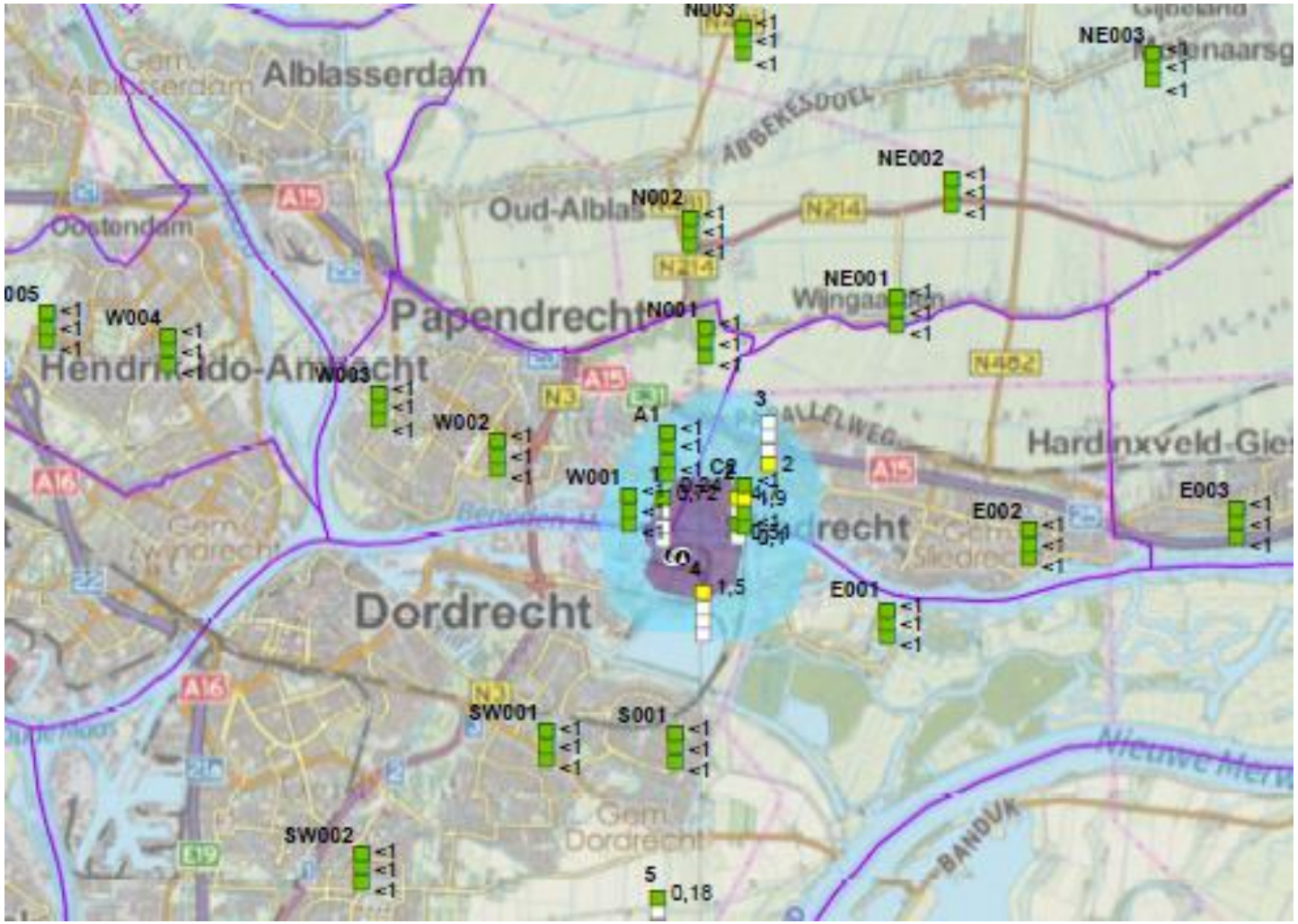
- GenX: perfluoroether (2,3,3,3-tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)propanoic acid)
- Replacement product for PFOA in Teflon production
- Very mobile, soluble, low to no adsorption
- No biodegradation
- Emitted in lower amounts than PFOA





GenX found in rivers up stream

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Search for source of GenX in rivers in province of Brabant

Speurtocht naar lozing GenX in Brabantse rivieren

22-11-2017, 18:30 AANGEPAST 22-11-2017, 21:53 BINNENLAND

Conceptual site model

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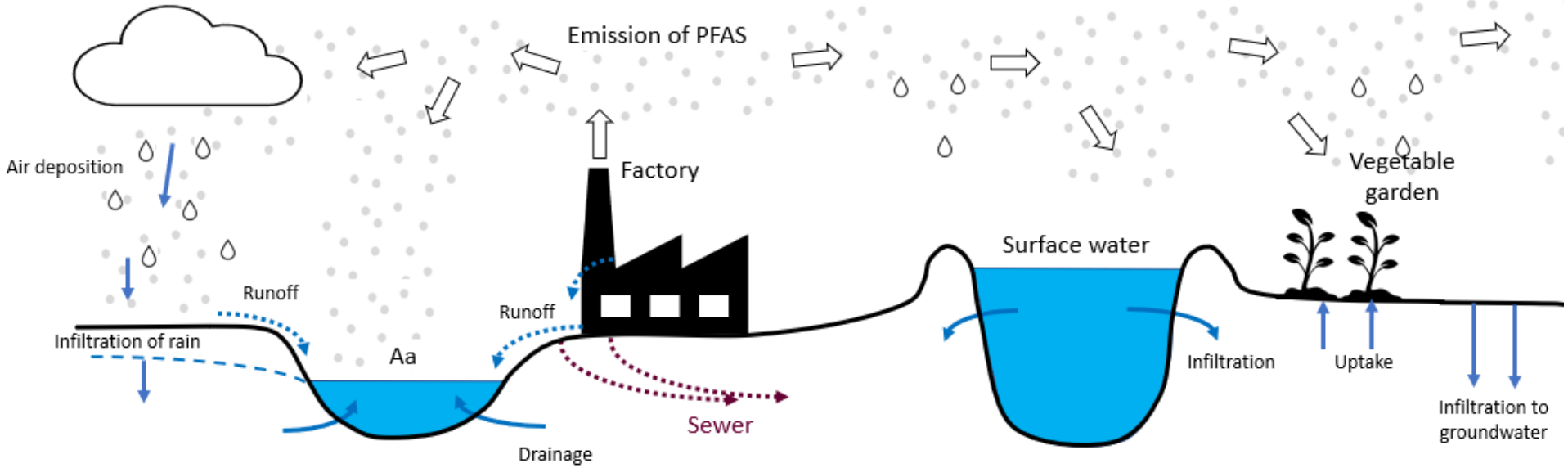
5,4 µg/l GenX
2,1 µg/l PFOA



GenX in Helmond

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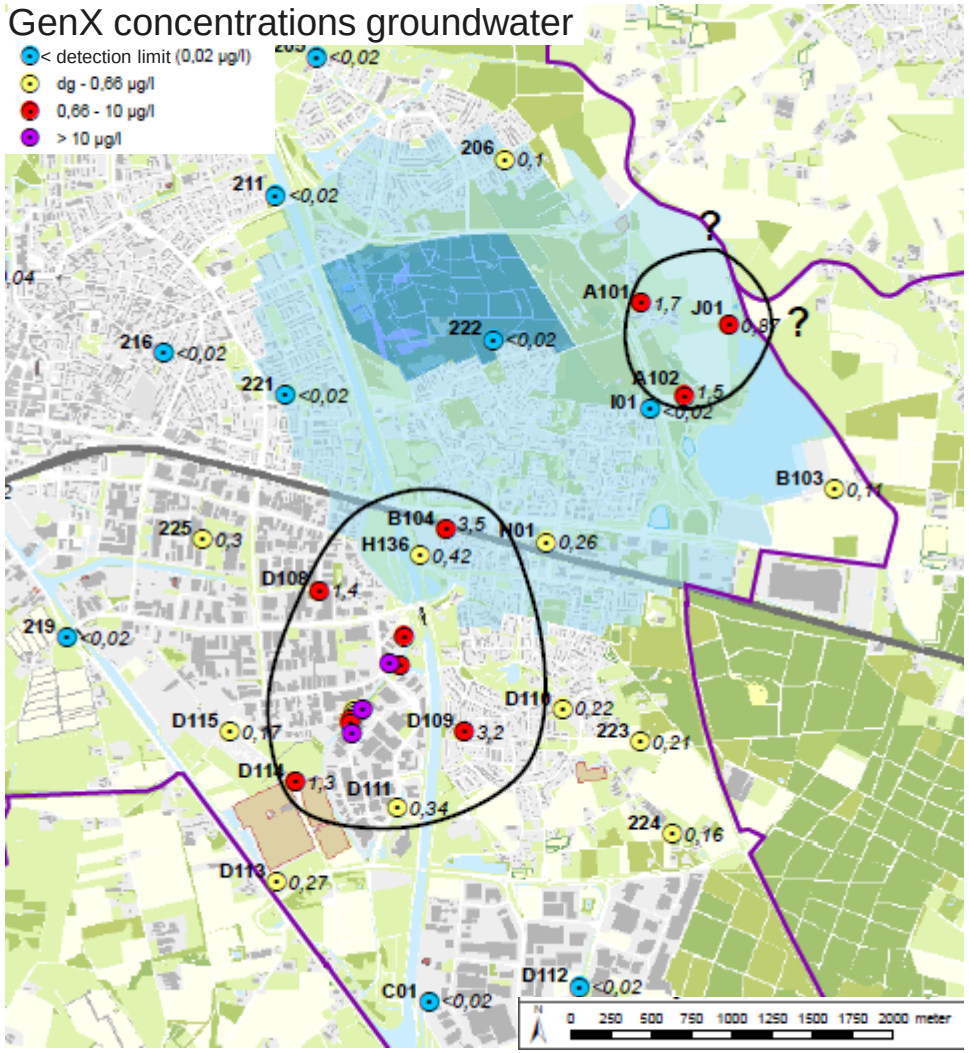
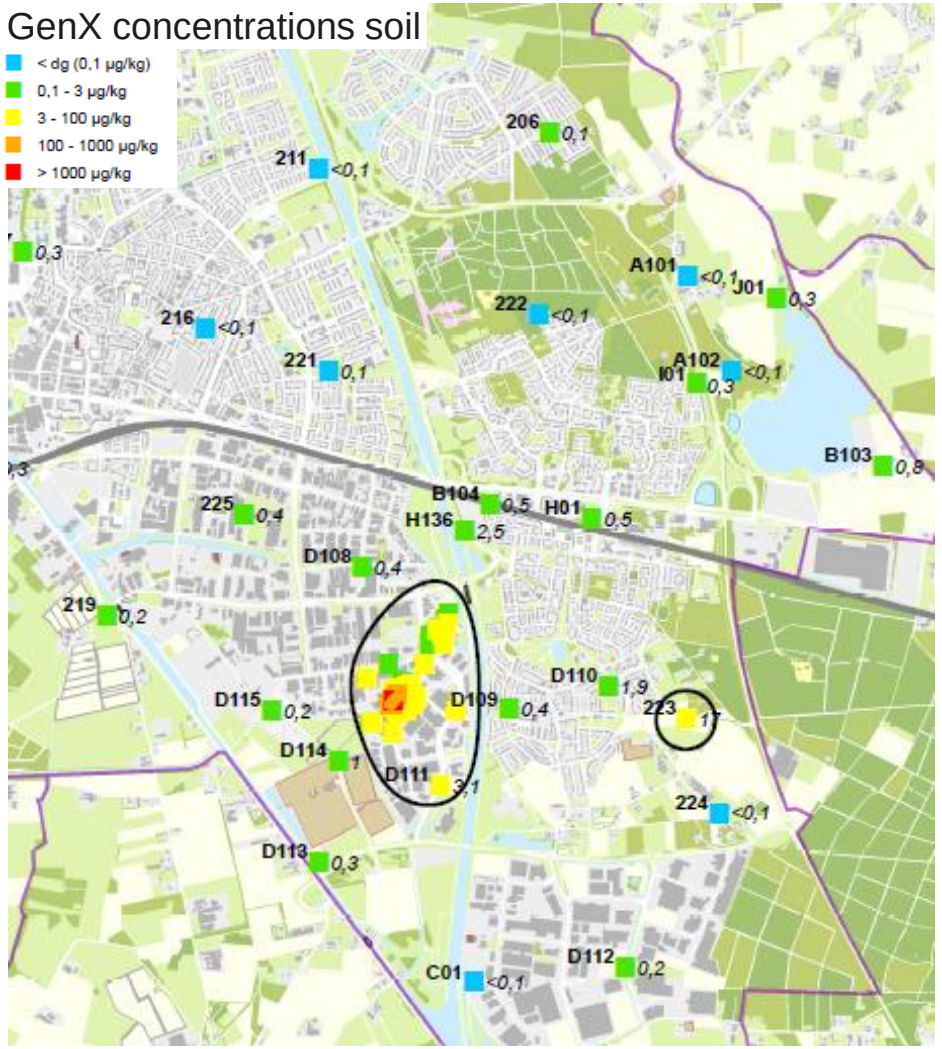
GenX concentrations groundwater



GenX concentrations soil



PFOA and GenX in food – the risks

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Table 2. The PFOA and GenX concentration (ng/g) in milk and meat of cows and sheep exposed to contaminated ditch water or silage.

Animal	Product	PFOA (ng/g)		GenX (ng/g)	
		Ditch water	Silage	Ditch water	Silage
Cow	Milk	0.06[1]	0.003[1]	<0.01[2]	X[3]
	Meat	0.28[1]	0.01[1]	<0.06[2]	X[3]
Sheep	Milk	0.2 - 0.7[4]	0.01 – 0.04[4]	0.04 - 0.14[2]	X[3]
	Meat	0.2[4]	0.01[4]	0.04[2]	X[3]

[1]Modelled; [2]Reasoned assumption; i.e. assuming less efficient transfer of GenX relative to PFOA at comparable exposure; [3]X: negligible; [4]Estimated based on a pilot experiment (N=2)(Kowalczyk et al., 2012).

Table 3. Analyzed PFOA- and GenX-concentrations in dairy products, egg and fish sampled near the companies DuPont/Chemours in Dordrecht and Custom Powders in Helmond.

Location	Product	Concentration (ng/g)		
		N	PFOA	GenX
Dordrecht	Dairy products			
	Milk[1]	15	<0.01[4]	<0.10
	Cheese[2]	1	<0.10	<0.10
	Yoghurt[2]	1	<0.10	<0.10
	Egg[3]	1	0.14	<0.25
Helmond	Dairy products			
	Milk[2]	2	<0.01	<0.10
	Egg[3]	1	<0.025	<0.25
	Fish			
	Eel (farmed)	1	<0.05	<0.10
	Carp	1	1.3	4.7

[1]Cow (N=14) and goat (N=1); [2]Cow; [3]Chicken; [4]< means <LOQ

Modelled/reasoned

Analyzed

Source: Netherlands Food and Consumer Product Safety Authority (NVWA) . 2019. Advice on PFOA and GenX in food.

Take home message

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- Atmospheric deposition from fluor production and fluor processing plants can result in enhanced PFAS background levels
- The impact can reach far (> 20 km)
- Soil type and the hydrological system effect the measured concentrations
- Possible risks for drinking water production, kitchen gardens and agriculture

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ARCADIS Design & Consultancy for natural and built assets

Questions?

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