



Science and Policy of Organohalogens pre-Dioxin Symposium 28. August 2016, Firenze, Italy

Some lessons learned from PFOS/PFAS management in Germany

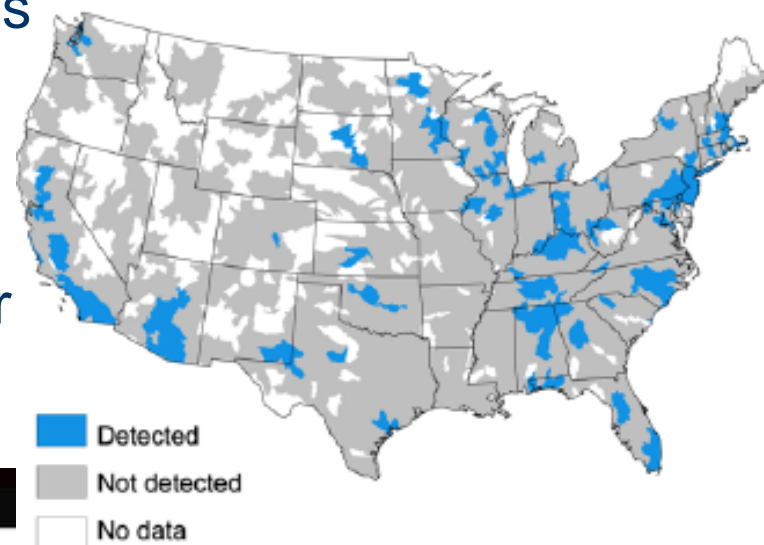
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Monitoring contaminated drinking water US

Hydrological units with
detectable PFASs

- Based on more than 36,000 water samples collected nationwide by the U.S. EPA (2013–2015), the drinking water supplies for 6 million U.S. residents exceed US EPA's lifetime health advisory (70 ng/L) for PFOS and PFOA.



The Washington Post

Energy and Environment

Researchers find unsafe levels of industrial chemicals in drinking water of 6 million Americans

ENVIRONMENTAL
Science & Technology **LETTERS**

ACS Editors' Choice

Letter

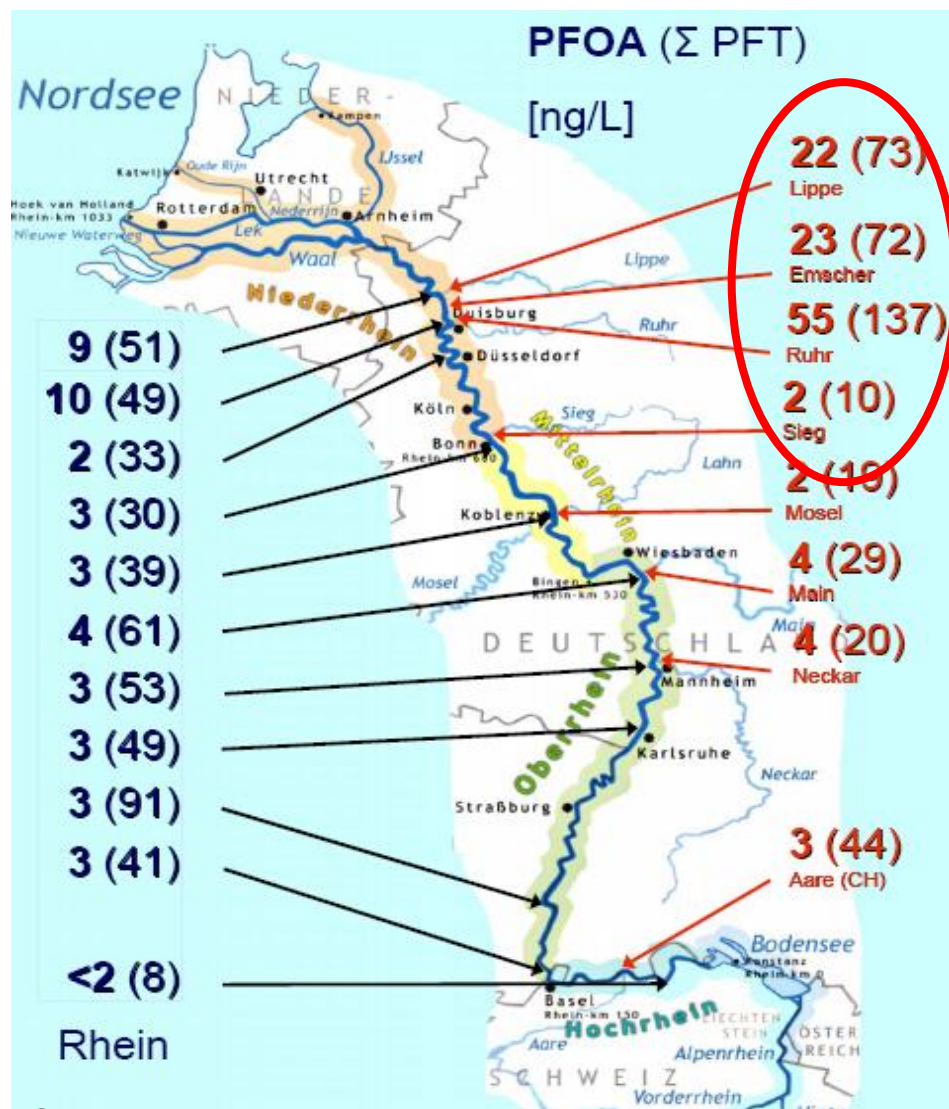
pubs.acs.org/journal/estlcu

Detection of Poly- and Perfluoroalkyl Substances (PFASs) in U.S. Drinking Water Linked to Industrial Sites, Military Fire Training Areas, and Wastewater Treatment Plants

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Hu et al. Environ. Sci. Technol. Lett., DOI:10.1021/acs.estlett.6b00260; August 9, 2016

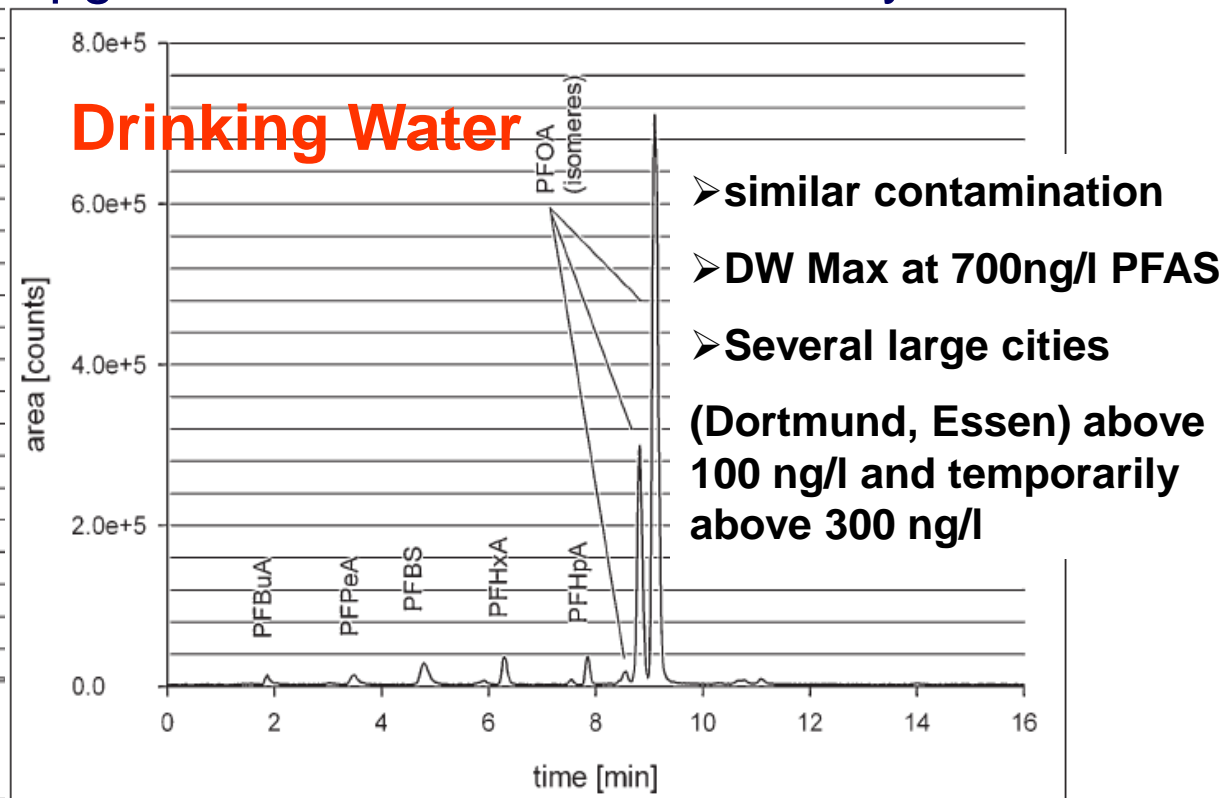
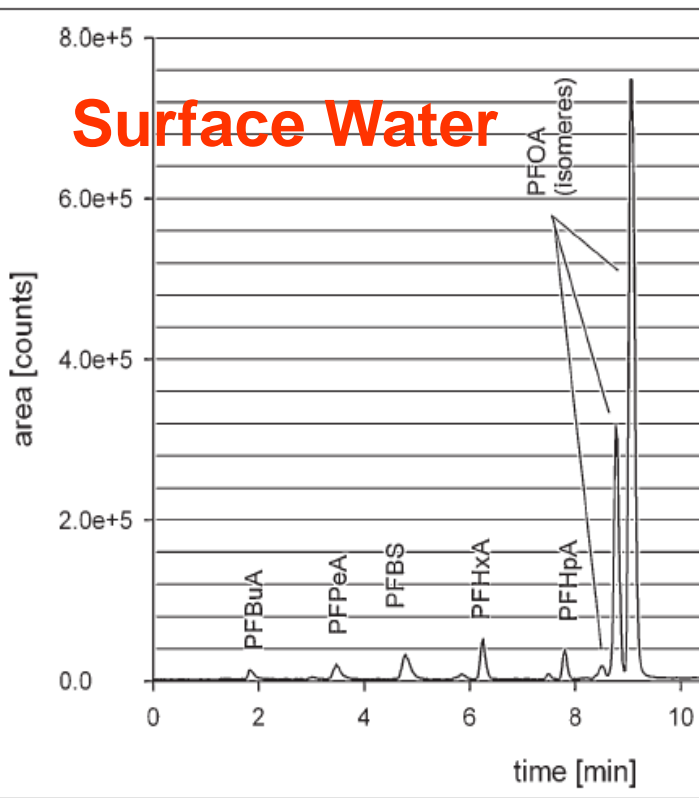
PFAS pollution in Ruhr & tributaries (2006) impacting drinking water of 5 million people



- Screening of PFAS in the Rhine river and tributaries (2006).
- High PFAS-contamination in Rhine tributary rivers Ruhr, Emscher and Lippe above 70 ng/l drinking water advisory US today.
- Dutch RIVM Institute (2010): PFOS maximum permissible concentration (MPC) for surface water: 0.65 ng/l (based on EFSA TDI 150 ng/kg/d). Exceedance!

PFAS pollution in Ruhr & tributaries (2006) impacting drinking water of 5 million people

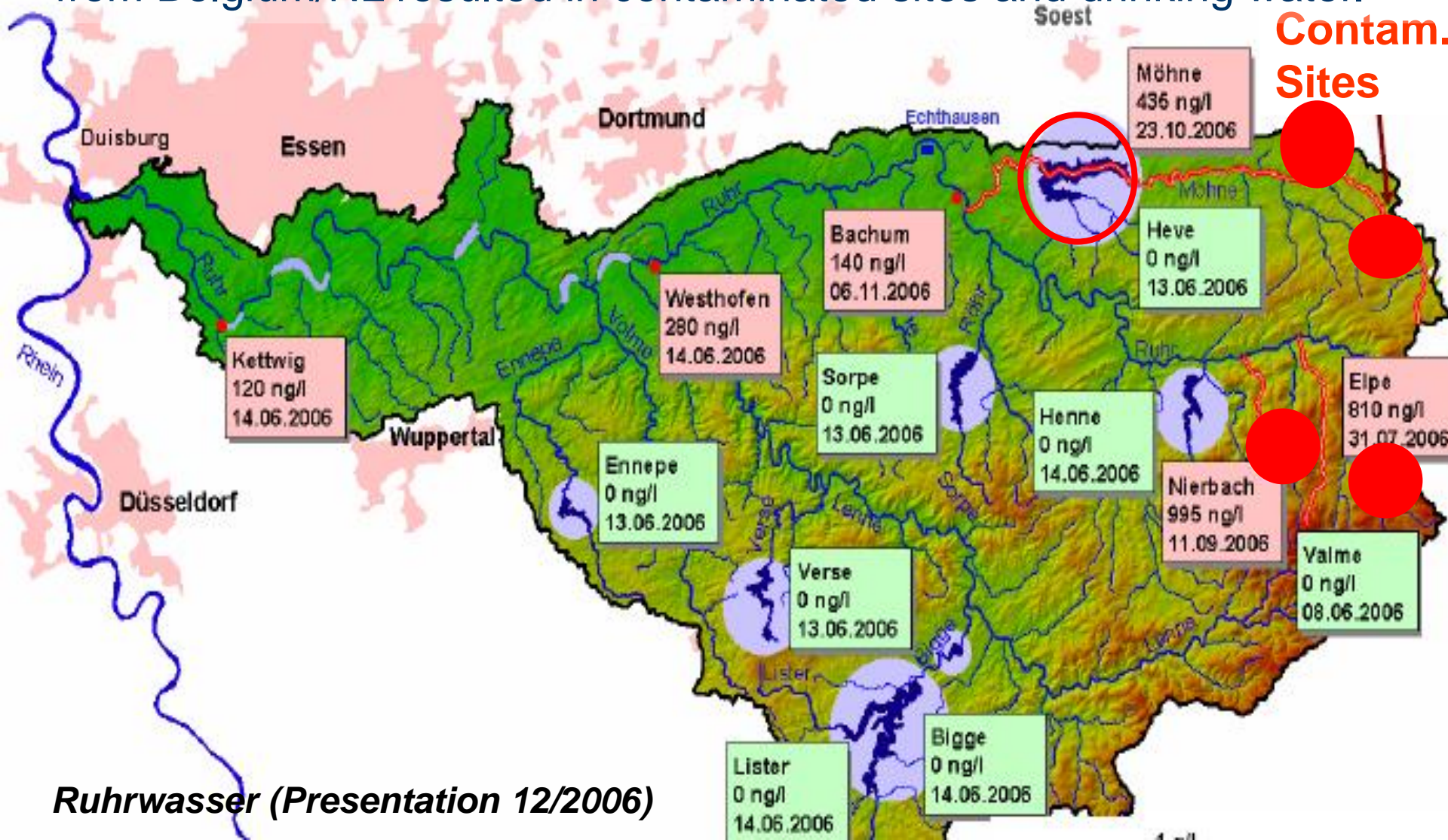
- Discovery 2006: Large challenges to manage PFAS contamination in drinking water. **German water works did not eliminate PFAS in 2006.**
- The drinking water treatment in several WW needed to be upgraded (e.g. AC filters) to reduce exposure (**cost approx. 100 million EURO**).
- Lessons learned 1: Huge costs to filter drinking water for PFOS/PFOA and other PFAS and the upgrade of water works can take years.



PFOS/PFOA pollution in Ruhr & tributaries (2006)⁵

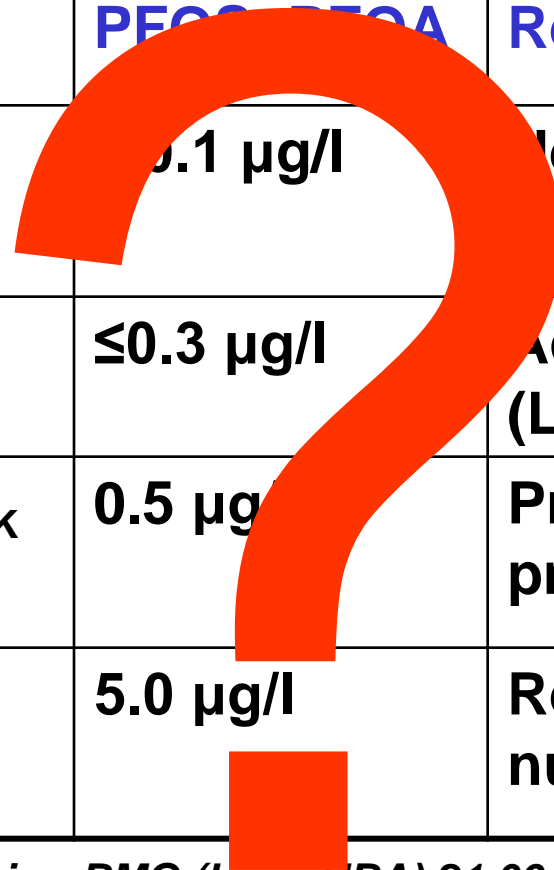
impacting drinking water of 5 million people

- In the Ruhrgebiet/Germany the mismanagement of industrial sludges from Belgium/NL resulted in contaminated sites and drinking water.



Prel. Recommendation of German⁶ Health Agency for Drinking Water

Type of Limits	Abrev.	PECO PFOA	Reasoning
Target value (minimum quality)	GOW	0.1 µg/l	Health precaution (Life span)
Health guiding value	LWTW	≤0.3 µg/l	Acceptable value (Life span)
Precautionary action value infants	VMW _{SK}	0.5 µg/l	Precuatory protection infants
Action value adults	VMW _E	5.0 µg/l	Recom: Not use for nutrition purpose



Stellungsnahme Trinkwasserkommission BMG (beim UBA) 21.06.06; revised 13.07.06

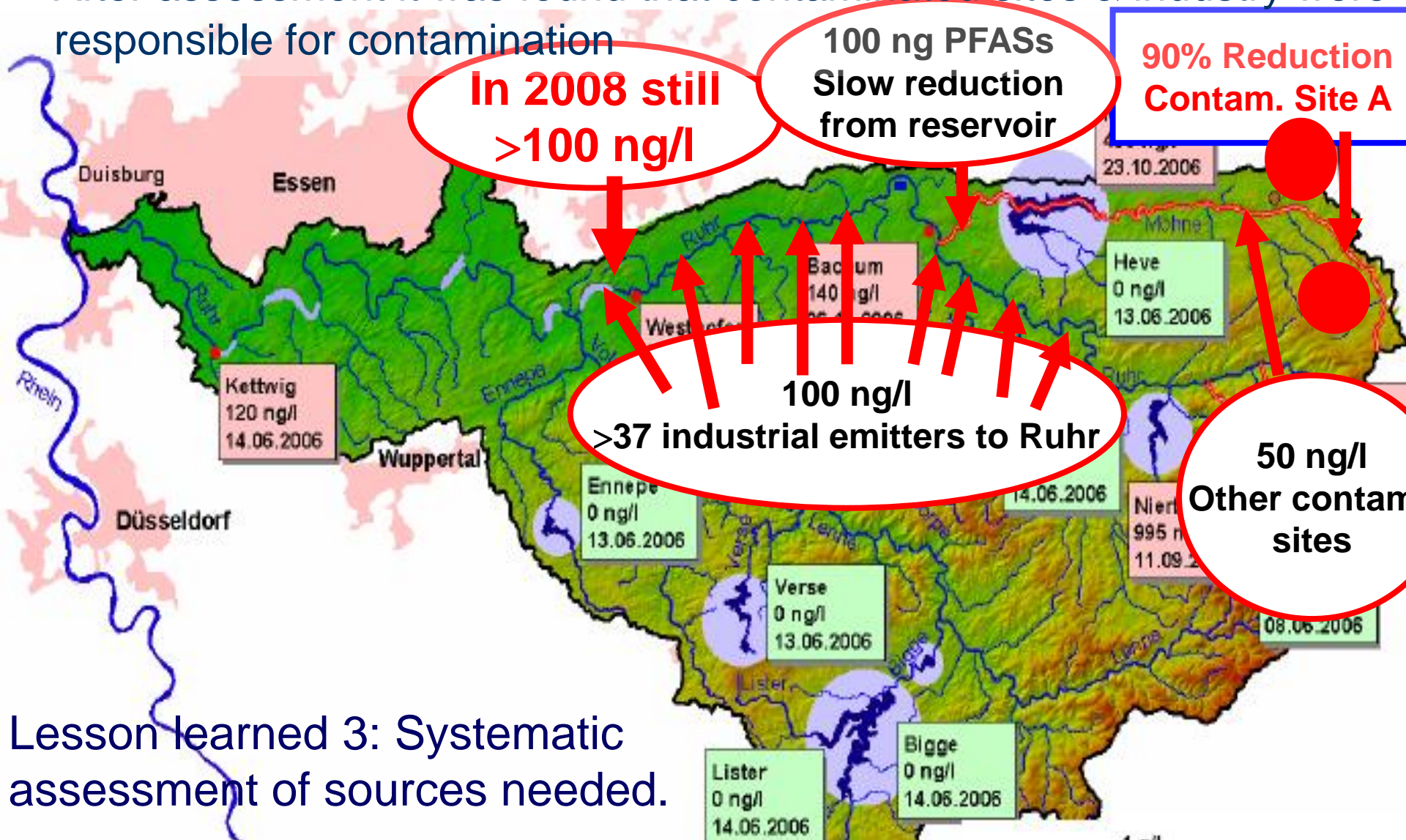
New Yersey (2007): drinking water limit RA based PFOA 40 ng/l.

Lesson learned 2: Drinking water limit rather set by achievable level. After 10 years they are still valid! Currently evaluated....

PFAS pollution in Ruhr & tributaries (2008)

impacting drinking water of 5 million people

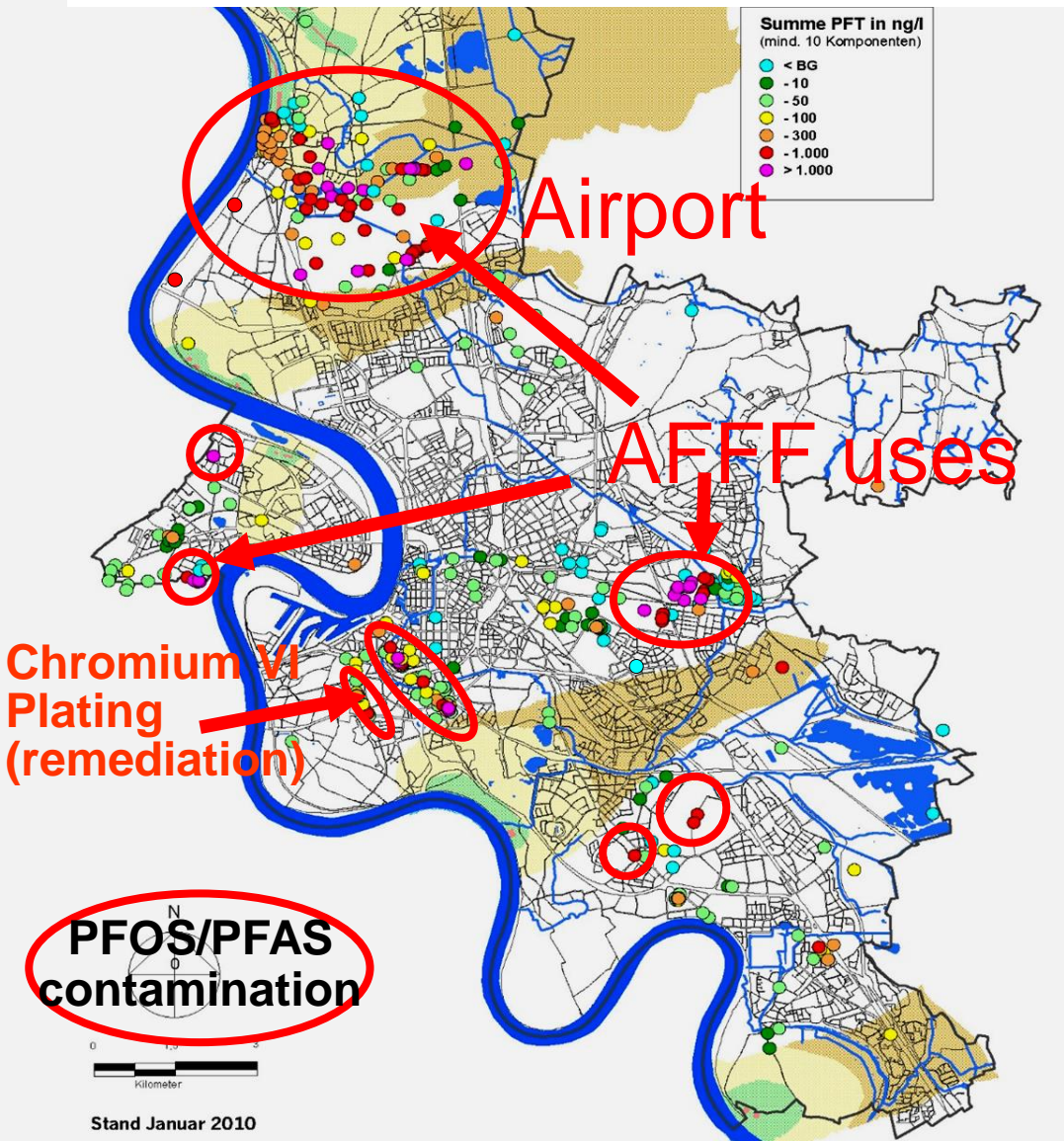
- After assessment it was found that contaminated sites & industry were responsible for contamination



Lesson learned 3: Systematic assessment of sources needed.

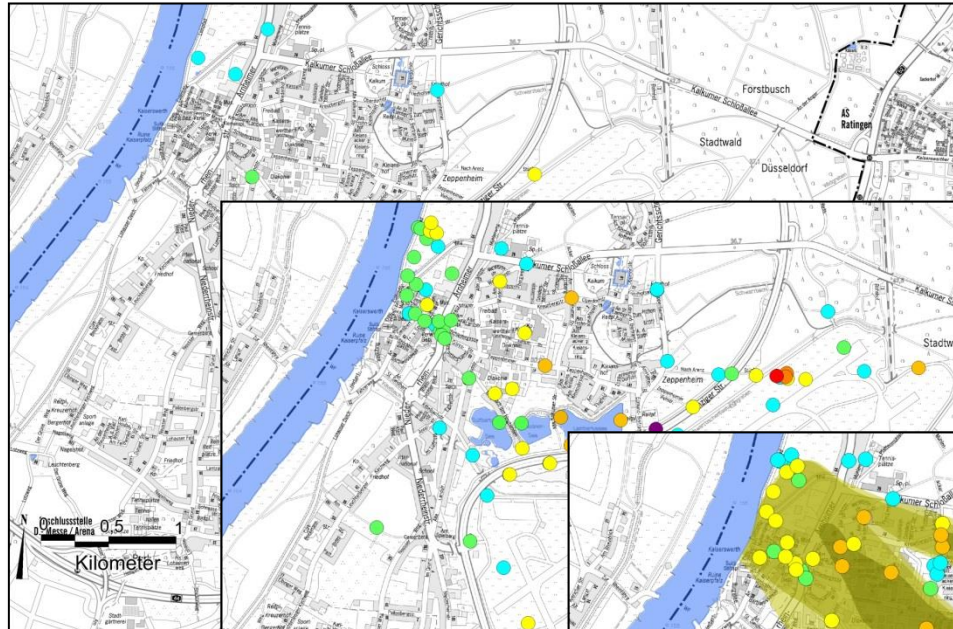
PFOS/PFAS contaminated sites?

Groundwater screening in Düsseldorf city



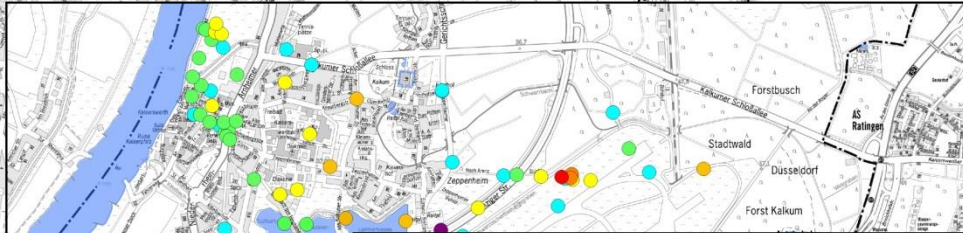
- Ruhr/Möhne case triggered assesement of PFAS contamination in the area.
- Düsseldorf has an ongoing program and screen of PFAS contaminated sites.
- PFOS/PFAS contamination @
 - Sites of major fires & AFFF
 - Airport (AFFF + other?)
 - Fire fighting practice areas
 - At chromium plating factories

PFAS plume Düsseldorf Airport Lohausen / Kaiserswerth



2007

11 analysis of PFC
(groundwater, only PFOS and PFOA)



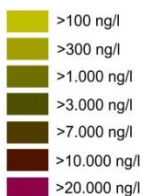
2009

ca. 180 analysis of PFC
(ground- and lakewater)

Perfluorinated Compounds (PFC)



Perfluorinated Compounds (PFC)

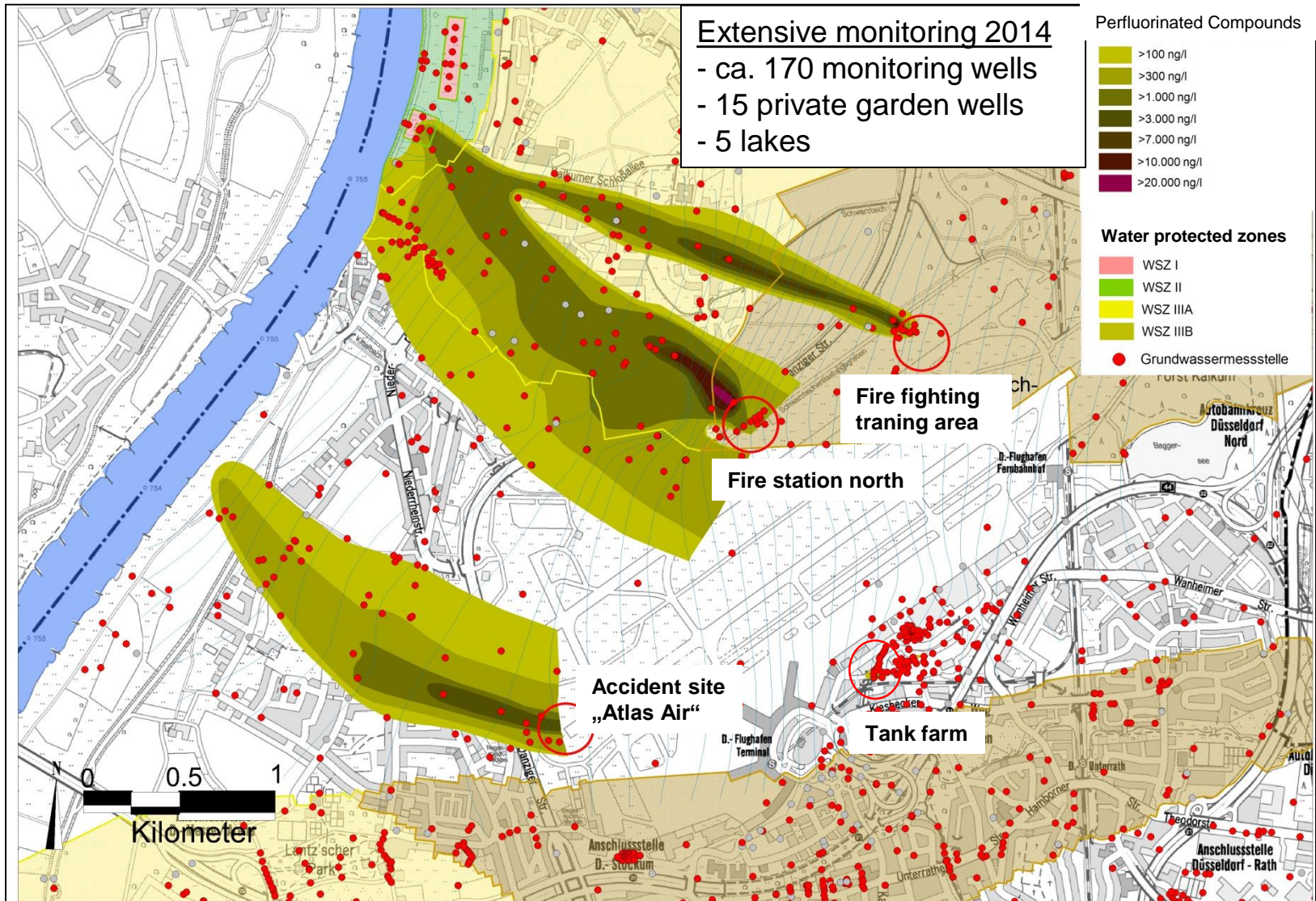


2012

ca. 250 analysis of PFC
(ground- and lakewater)

First complete extensive
mapping of the plume

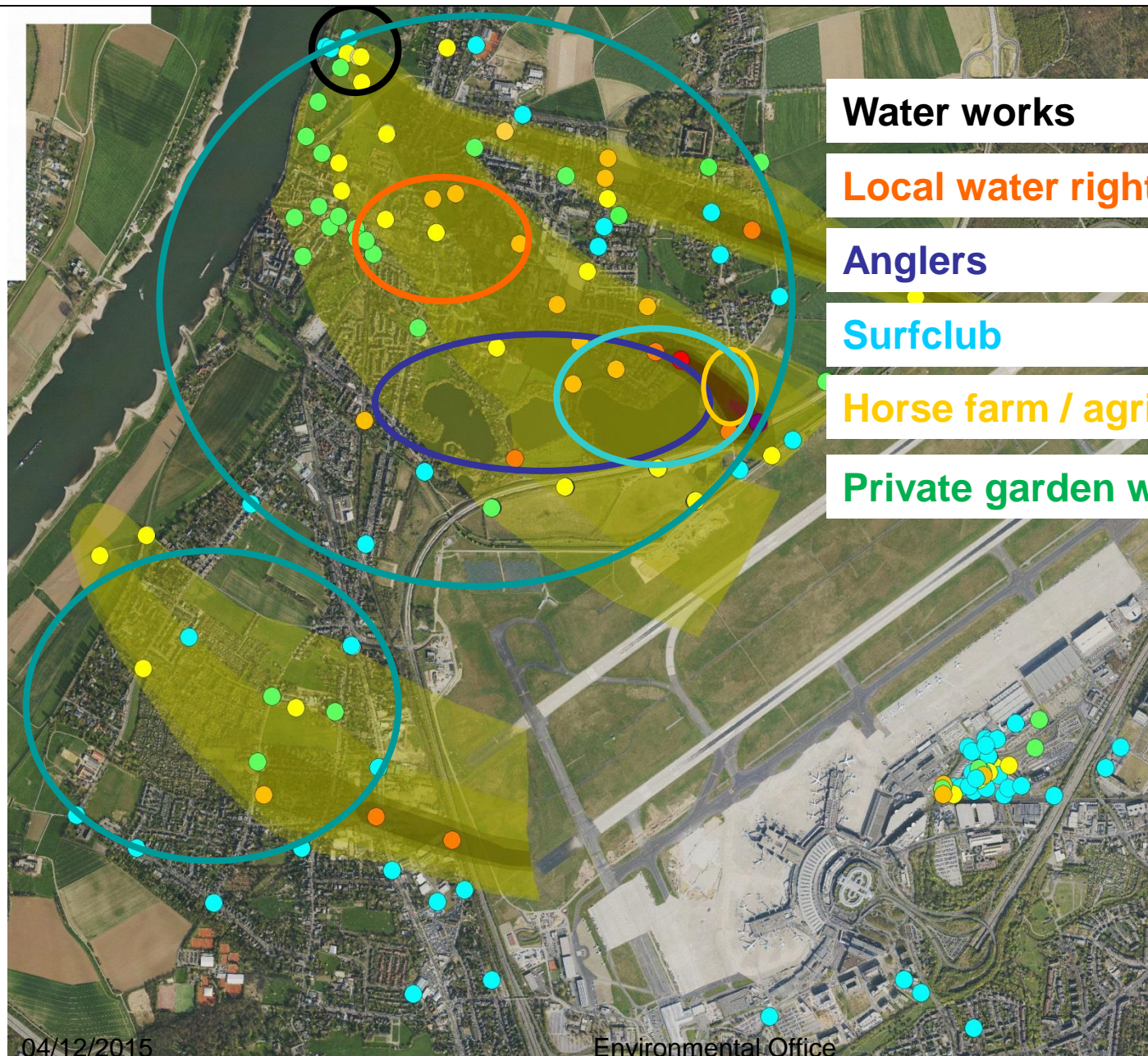
PFAS plume Düsseldorf airport Lohausen / Kaiserswerth 2014



Affected usages in the area of the PFAS plume



Landeshauptstadt
Düsseldorf



Water works

Local water rights (drinking water)

Anglers

Surfclub

Horse farm / agricultural use

Private garden wells

PFT-Konzentrationen (Pegel)

- <100 ng/l
- >100 ng/l
- >300 ng/l
- >1.000 ng/l
- >3.000 ng/l
- >10.000 ng/l
- >20.000 ng/l

PFT-Konzentrationen (Fläche)

- >100 ng/l
- >300 ng/l
- >1.000 ng/l
- >3.000 ng/l
- >7.000 ng/l
- >10.000 ng/l
- >20.000 ng/l

04/12/2015

Environmental Office

Status: September 2014

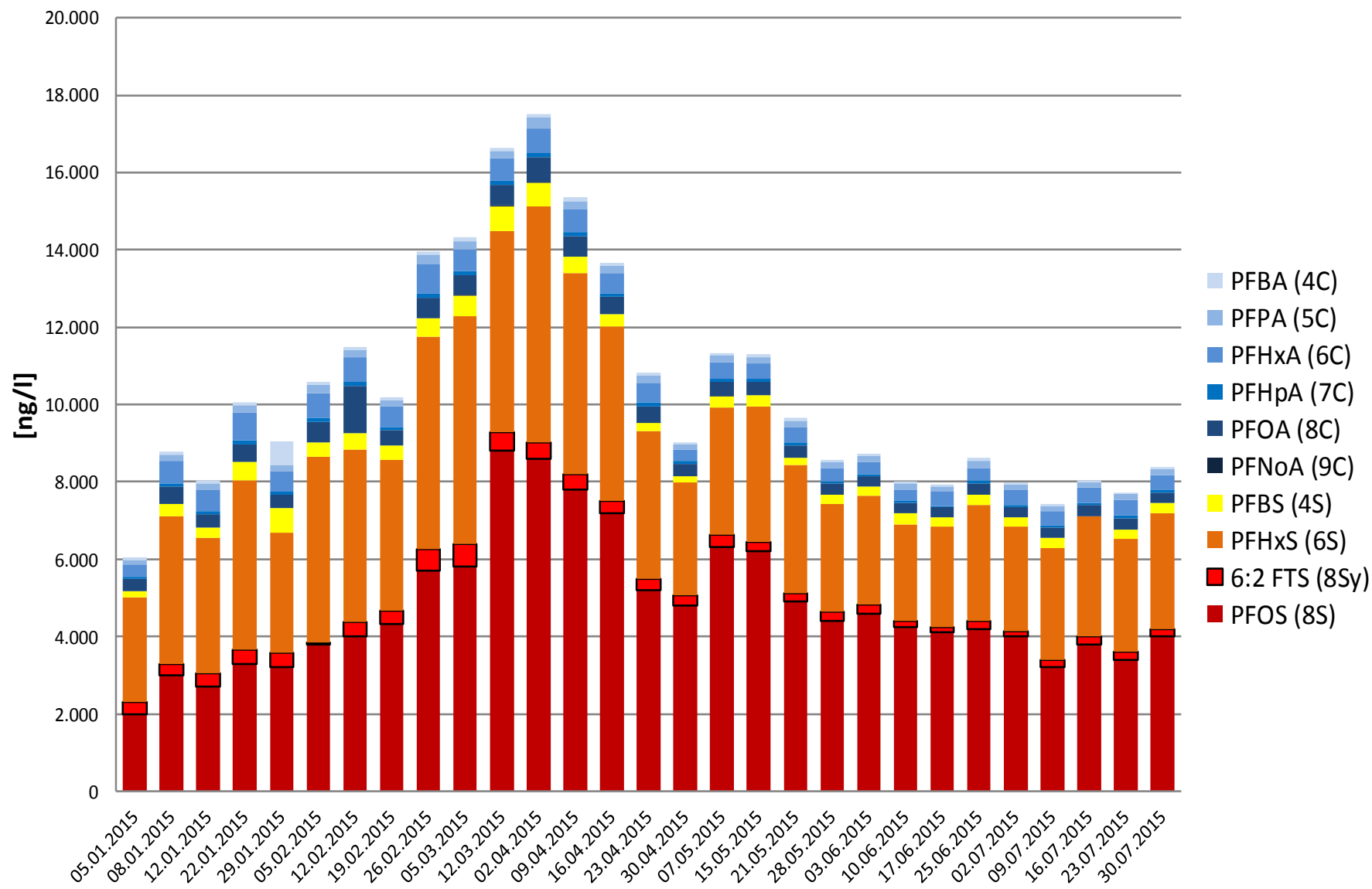
Lesson learned 4: Assessment take years and need dedicated people in competent authority

PFAS contamination in extracted groundwater Düs AP

- Pump trials at the fire fighting training area



Landeshauptstadt
Düsseldorf

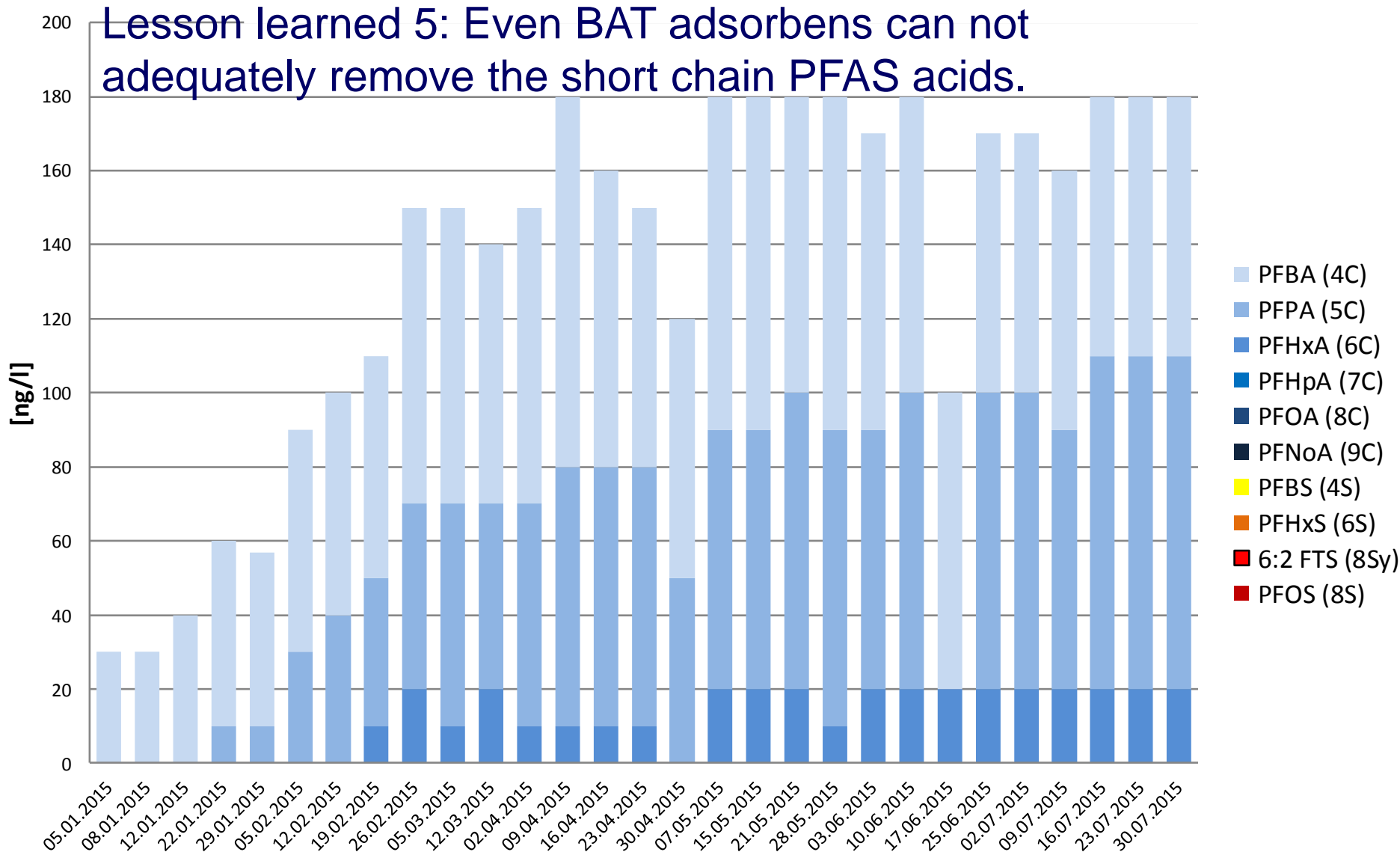


Landeshauptstadt
Düsseldorf

Lesson learned 5: Even BAT adsorbents can not adequately remove the short chain PFAS acids.

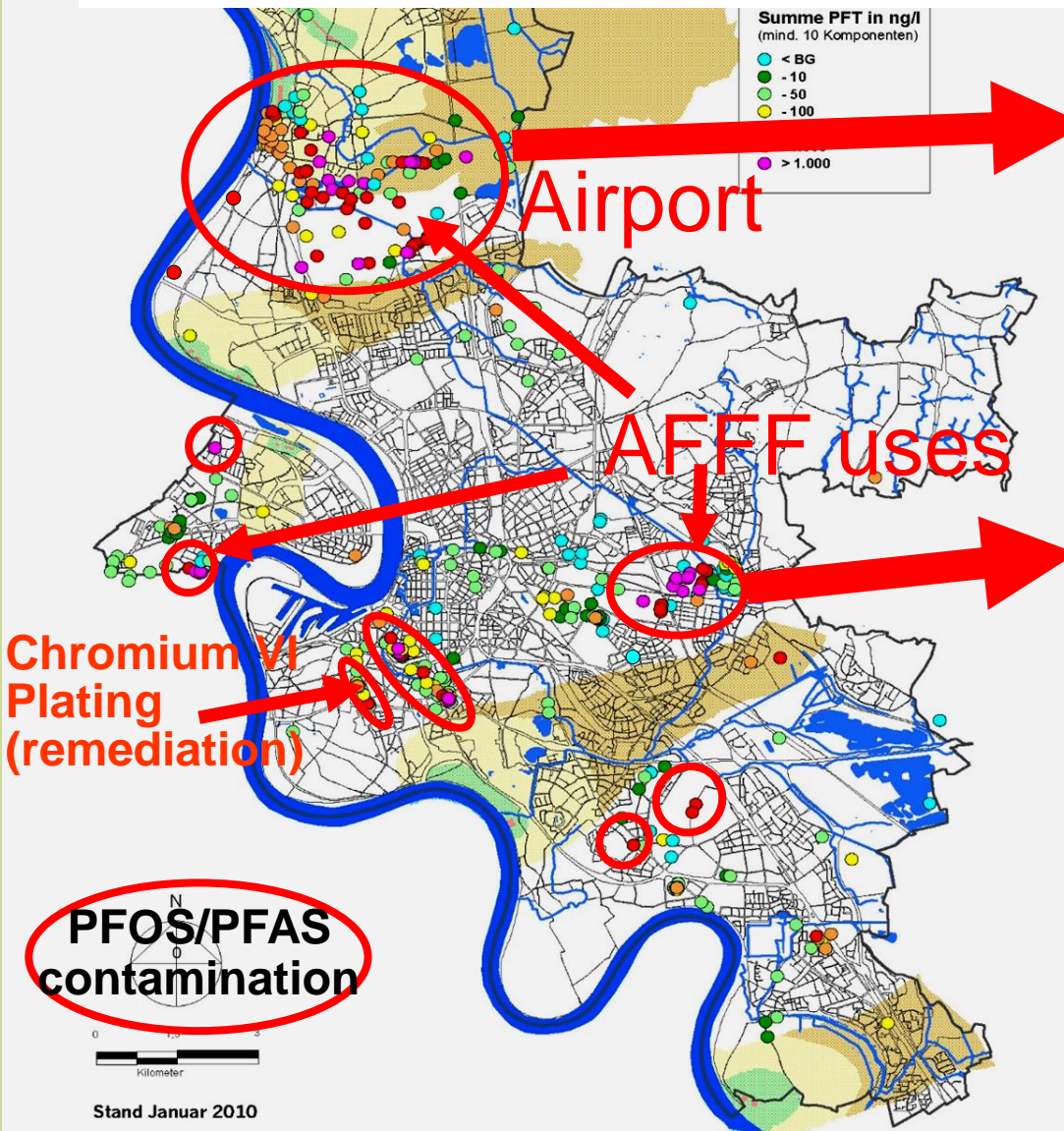
The chart displays the concentration of short-chain PFAS acids in ng/l over time. The y-axis ranges from 0 to 200 ng/l. The x-axis shows dates from 05.01.2015 to 30.07.2015. The data is presented in two series: a dark blue series (bottom) and a light blue series (top). The total concentration generally increases over time, with significant peaks in May and June.

Date	Dark Blue Series (ng/l)	Light Blue Series (ng/l)	Total (ng/l)
05.01.2015	30	0	30
08.01.2015	30	0	30
12.01.2015	40	0	40
22.01.2015	10	50	60
29.01.2015	10	47	57
05.02.2015	30	60	90
12.02.2015	40	60	100
19.02.2015	10	100	110
26.02.2015	20	130	150
05.03.2015	10	140	150
12.03.2015	20	120	140
02.04.2015	10	140	150
09.04.2015	10	170	180
16.04.2015	10	150	160
23.04.2015	10	140	150
30.04.2015	50	70	120
07.05.2015	20	160	180
15.05.2015	20	160	180
21.05.2015	20	160	180
28.05.2015	10	170	180
03.06.2015	20	150	170
10.06.2015	20	160	180
17.06.2015	20	80	100
25.06.2015	20	150	170
02.07.2015	20	150	170
09.07.2015	20	140	160
16.07.2015	20	190	210
23.07.2015	20	190	210
30.07.2015	20	190	210



PFOS/PFAS contaminated sites ?

Groundwater screening in Düsseldorf city



- Cost of three wells controlling the point sources were **2 million €**.
- **Total remediation** estimate for the airport: might reach **100 million €**.
<http://www.derwesten-recherche.org/2013/10/pft-alarm-am-flughafen-dusseldorf-verseuchung-noch-extremer-sanierung-konnte-100-millionen-kosten/>
- **Remediation cost** of a fire were 42 m3 AFFF were used:
 - 1 million Euro assessment.
 - >10 million Euro remediation.
- Ongoing case Baden-Württ. **Soil exchange estimate 1-3 billion €**.
<http://www.faz.net/aktuell/wissen/baden-wuerttemberg-chemische-abfaelle-auf-dem-acker-14419295.html>

Lesson learned 6: Remediation of PFAS from groundwater/soil is challenging and expensive. No natural degradation!

-
- The diagram illustrates the life cycle of a car, categorized into three main phases: Production and Use, Waste Management, and Environment.
- Production and Use (Blue background):**
- AFFE storage** (Stock 13000) receives 310 units of material and sends 900 units to **Application**.
 - Application** receives 13 units from the environment and sends 4 units to **Service life** and 120 units to **End-of-life**.
 - Service life** (Stock 289) receives 0.5 units from the environment and sends 47 units to **End-of-life**.
 - End-of-life** sends 39 units to **Recycling** and 0.7 units to the **Environment**.
- Waste Management (Brown background):**
- Recycling** receives 0.6 units from **End-of-life** and sends 110 units to **Sewerage** and 20 units to **Landfill**.
 - Sewerage** receives 14 units from **Recycling** and sends 350 units to **WWTP**.
 - WWTP** sends 420 units to **Landfill** and 16 units to the **Environment**.
 - Incineration** receives 9 units from **Landfill** and sends 0.2 units to the **Environment**.
 - Landfill** (Stock 20) receives 24 units from **Incineration** and sends < 0.1 units to the **Environment**.
- Environment (Green background):**
- Hydrosphere** (Input 480) receives material from the **Environment** and sends it to **Application**.
 - Atmosphere** (Input 0.8) receives material from the **Environment** and sends it to **Application**.
 - Soil** (Input 29) receives material from the **Environment** and sends it to **Application**.

Assessment need for large unknown stock

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Estimated former PFOS use area in the EU (2000)

Industrial application	EU consumption (Tonnes/year)	PFOS & PFOS- related chemical
Verchromung Plating	10	PFOS, FOSE
Fotolithografie	0,47	
Fotografie	0,85	FOSA AcOH
Photographic	0,75	Polymer
Luftfahrt Aviation	0,73	Perfluorsulfonate
Feuerlöschmittel AFFF	0,57	FOSA
Faserveredelung Fiber coating	240	FOSE-Polymere
Papierveredelung Paper	160	FOSE-Polymere
Beschichtung Surface	90	

Source: Risk and Policy Analysts (2004); Fricke & Lahl, UWSF 17, 36 – 49 (2005)

Major former PFOS use area in the EU were in applications like carpets, textiles and paper which have ended in landfills

Development of guidelines for systemically tracking PFAS contaminated sites in Germany

- Current monitoring activities should **only be the start of a systematic** national and global **assessment** of pollution & remediation needs.
- The **German federal states contaminated site working group has developed a guidance** for competent authorities (+other stakeholders) for systematic **monitoring of PFAS contaminated sites (in German)**.
- Also the German military has developed a guidance for monitoring of contaminated sites since military areas have been found contaminated.
- For PFOS and precursors this is in line with the Stockholm Convention Article 6 including contaminated site assessment (“and if remediation is conducted then to do it in an environmentally sound manner”).
- Contaminated sites & impacted population are associated with costs.
- Lesson learned 7: Along with the associated cost, the liability question and financing need to be raised (Extended Producer Responsibility; substitution of PFAS – Madrid Statement).

The Madrid Statement on PFASs

- Dioxin Conference in Madrid in 2014
- Builds on Helsingør Statement (2014)
- Documents the scientific consensus regarding the persistence and potential for harm of poly- and perfluoroalkyl substances (PFAS)
- **Lays out a roadmap to gather needed information and prevent further harm.**
- Dialogue with industry (Fluorocouncil)


<http://ehp.niehs.nih.gov/1509934/>

<http://ehp.niehs.nih.gov/1509910/>

<http://ehp.niehs.nih.gov/1510207/>

Madrid Statement signed by >200 scientist
<http://greensciencepolicy.org/Madrid-Statement>



Helsingør Statement on poly- and perfluorinated alkyl substances (PFASs) 
Martin Scheringer^{a,*}, Xenia Trier^b, Ian T. Cousins^c, Pim de Voogt^d, Tony Fletcher^e, Zhanyun Wang^g,
Thomas F. Webster^f



Perspectives | Brief Communication

The Madrid Statement on Poly- and Perfluoroalkyl Substances (PFASs)

<http://dx.doi.org/10.1289/ehp.1509934>

Stockholm Convention POPs free initiative: Substitution of POPs with green & sustainable alternatives

- A 'POPs-free initiative' has been initiated by the Secretariat of the Stockholm Convention to improve the exchange of information on alternatives to POPs.
- Here an electronic publication "*POPs in articles and phasing-out opportunities*" has been developed compiling information on alternatives to POPs & phase out and how to assess and select alternatives (Web-version with Basel/Stockholm Convention Regional Centre Asia & the Pacific). <http://poppub.bcrc.cn/>
- POP Review Committee is updating compilation on alternatives to PFOS.
- SAICM has PFAS as focal topic.

⇒ Global progress to safer alternatives.

The screenshot displays the Stockholm Convention POPs free initiative website. The header features the Stockholm Convention logo and the title 'PUBLICATION POPs in Articles and Phasing-Out Opportunities'. A search bar is located in the top right corner.

The main content area is divided into several sections:

- DOWNLOAD PAGE:** A large orange button with the text 'DOWNLOAD PAGE' and a link 'Access the Publication download page'.
- ACCESS INFORMATION:** Two blue buttons with the text 'ACCESS INFORMATION' and links 'Access information on Chemical identity and properties of POPs' and 'Access information on Guidance materials and other useful links'.
- Preface, Acknowledgements, Abbreviations and Acronyms:** A section with a 'More>' link.
- Part I Introduction:** A section describing the Stockholm Convention on Persistent Organic Pollutants (POPs) and its adoption in 2001 and 2004.
- Part II Snapshots of information on each chemical in articles and products:** A section providing snapshots of information on chemicals.
- Part III POPs-free/POPs alternatives – overview and case studies:** A section providing an overview and case studies of POPs-free alternatives.
- Part IV How can we add more understanding on the use of POPs and alternatives in products and articles?:** A section providing guidance on the use of POPs and alternatives.
- Part V Conclusions and recommendations:** A section providing conclusions and recommendations.
- Part VI Annexes:** A section providing annexes.

The footer includes a 'Contact Us' link and a 'Disclaimer' link.

Thank you for your attention ! Questions?

More Information <http://ehp.niehs.nih.gov/1509934/>

Basel Convention: www.basel.int

Rotterdam Convention: www.pic.int

Stockholm Convention: <http://chm.pops.int/>

Montreal Protocol/Vienna Convention: <http://ozone.unep.org>

SAICM: <http://www.saicm.org/>

POPs phase out & alternatives <http://poppub.bcrc.cn/>

OECD/IOMC: <http://www.oecd.org/chemicalsafety/>

Science: www.ipcp.ch; <http://greensciencepolicy.org/>

NGO: www.ban.org; www.ipen.org; www.ihpa.info; www.chemsec.org

Better-world-links: <http://www.betterworldlinks.org/>



Basel Convention

Rotterdam Convention

Stockholm Convention

Synergies

<http://synergies.pops.int/>

SYNERGIES
among the Basel, Rotterdam
and Stockholm conventions

