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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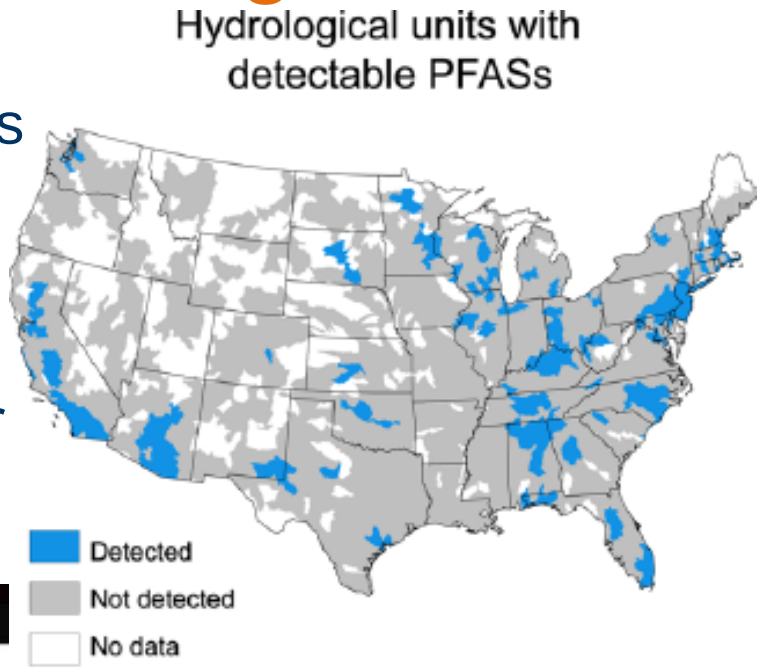
Monitoring contaminated drinking water US

- 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

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Letter

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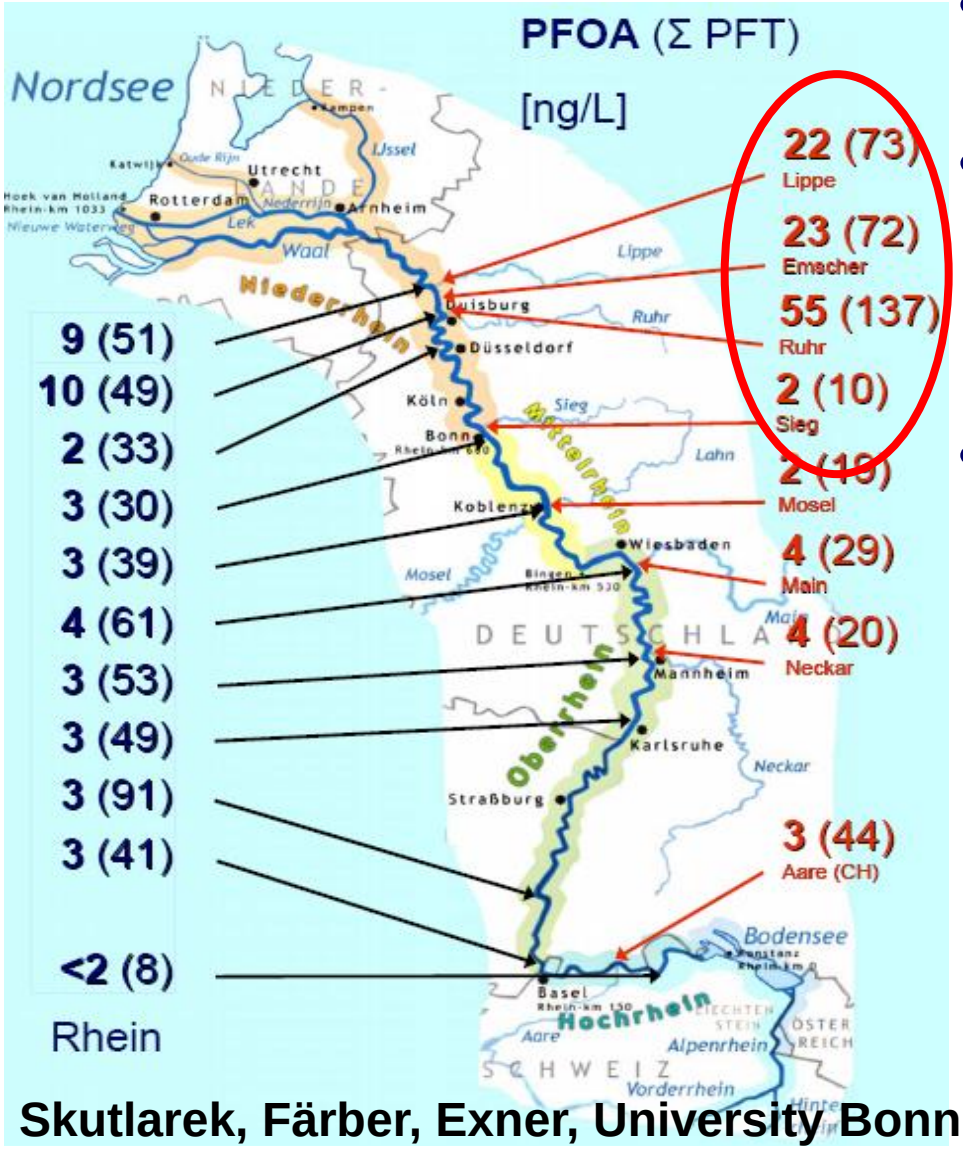
Hu et al. Environ. Sci. Technol. Lett., DOI:10.1021/acs.estlett.6b00260; August 9, 2016

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

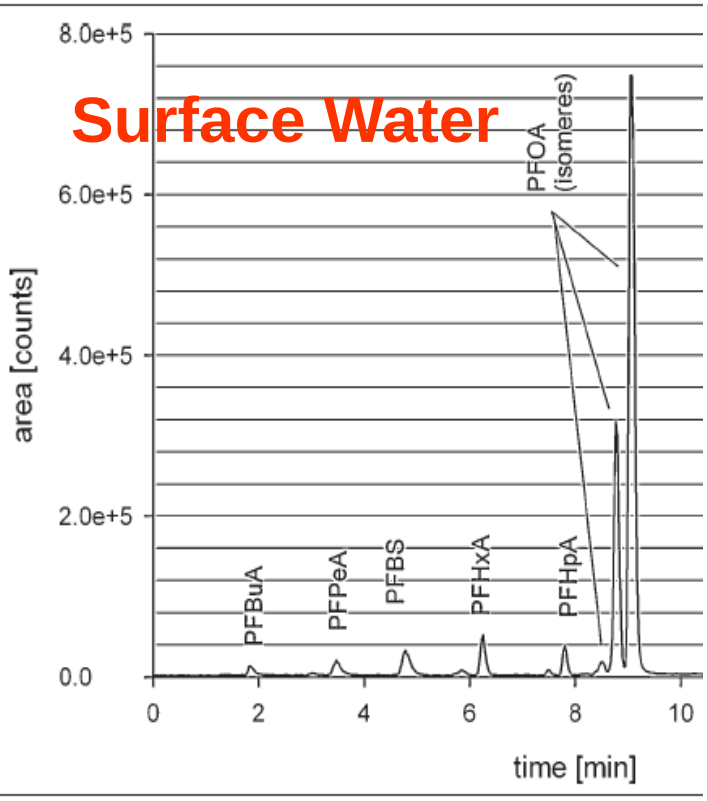


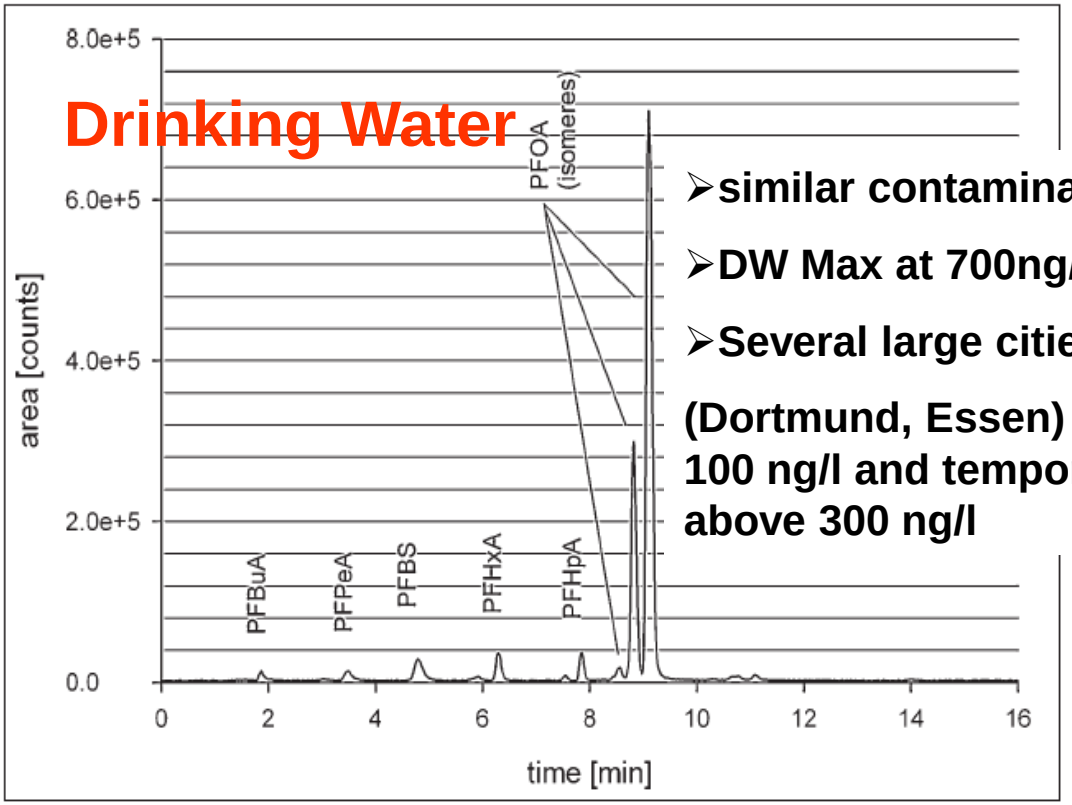
- Screening of PFAS in the Rhine river and tributaries (2006).
- High PFAS-contamination in Rhine tributary rivers Ruhr, Emscher and Lippe above 70 ng/l drinking water advisory US today.
- Dutch RIVM Institute (2010): PFOS maximum permissible concentration (MPC) for surface water: 0.65 ng/l (based on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

Skutlarek, Färber, Exner, University Bonn, March 2006)

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.



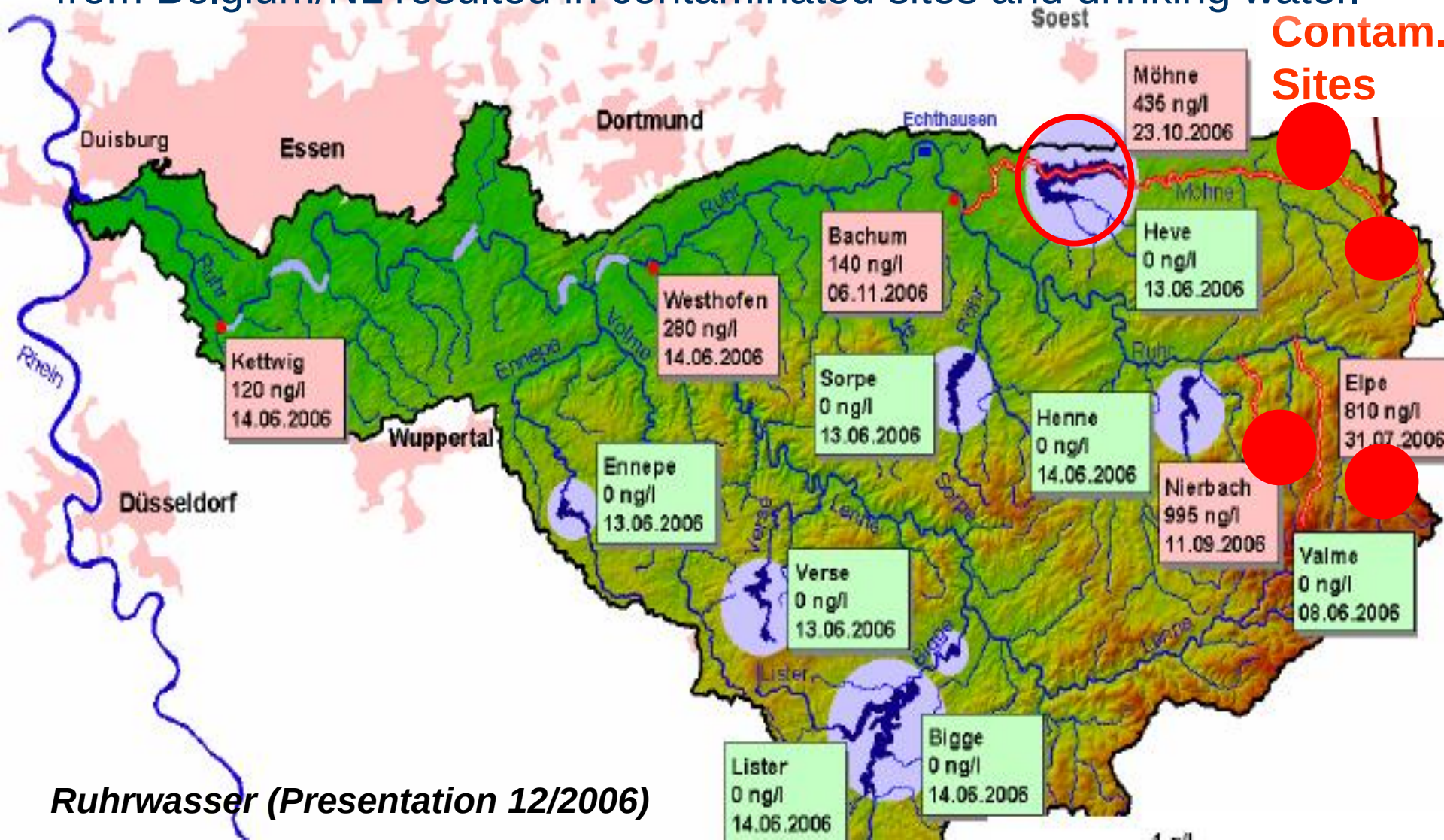


- **similar contamination**
- **DW Max at 700ng/l PFAS**
- **Several large cities**

(Dortmund, Essen) above 100 ng/l and temporarily above 300 ng/l

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



Ruhrwasser (Presentation 12/2006)

Prel. Recommendation of German Health Agency for Drinking Water

Type of Limits	Abrev.	PFOS/PFOA	Reasoning
Target value (minimum quality)	GOW	.1 µg/l	ealth precaution ife span)
Health guiding value	LWTW	≤0.3 µg/l	cceptable value (Life span)
Precautionary action value infants	VMW_{SK}	0.5 µg	Precuationary protection infants
Action value adults	VMW_{E}	5.0 µg/l	Recom: Not use for nutrition purpose

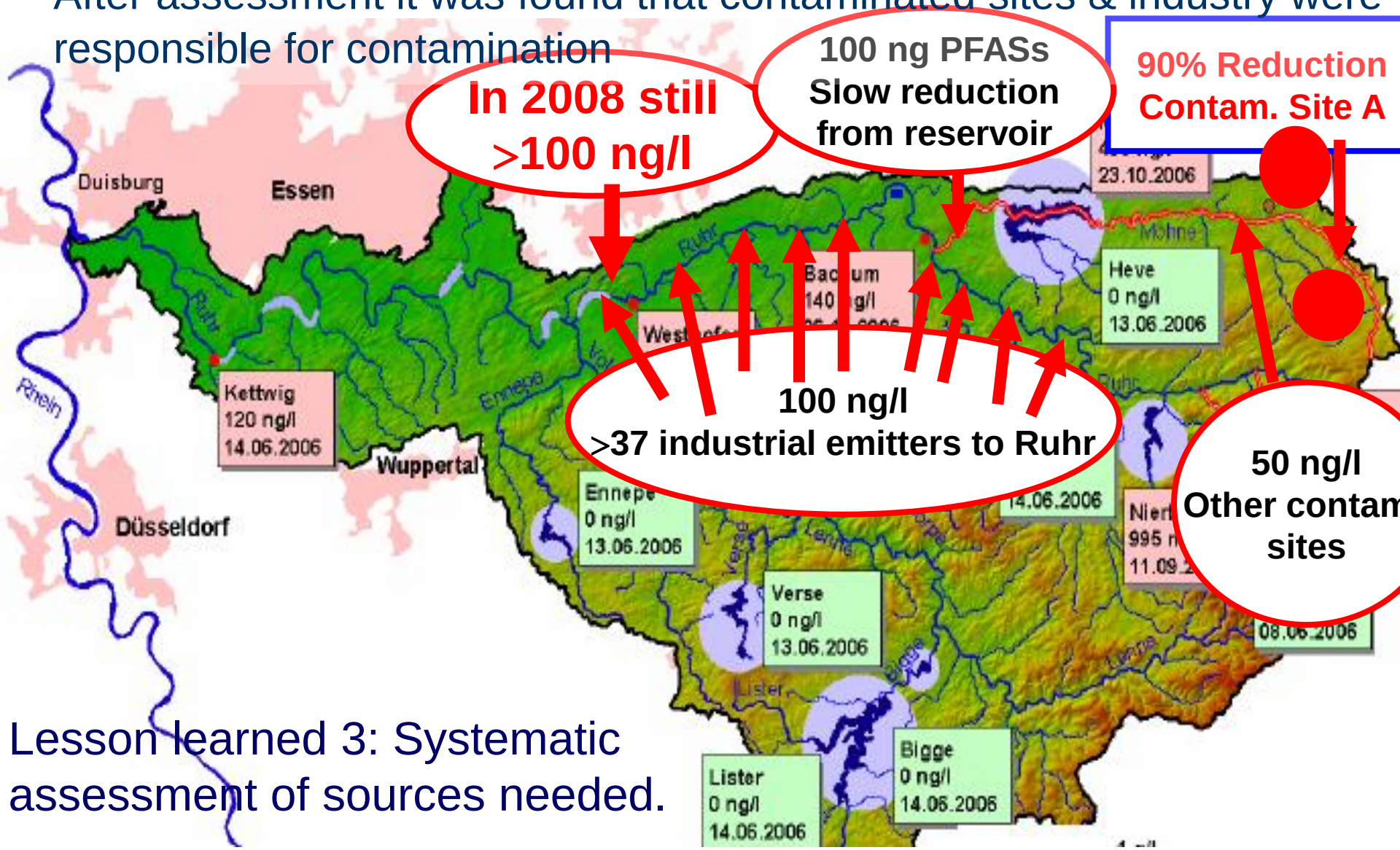
Stellungsnahme Trinkwasserkommission BMG (beim UBA) 21.06.06; revised 13.07.06

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….

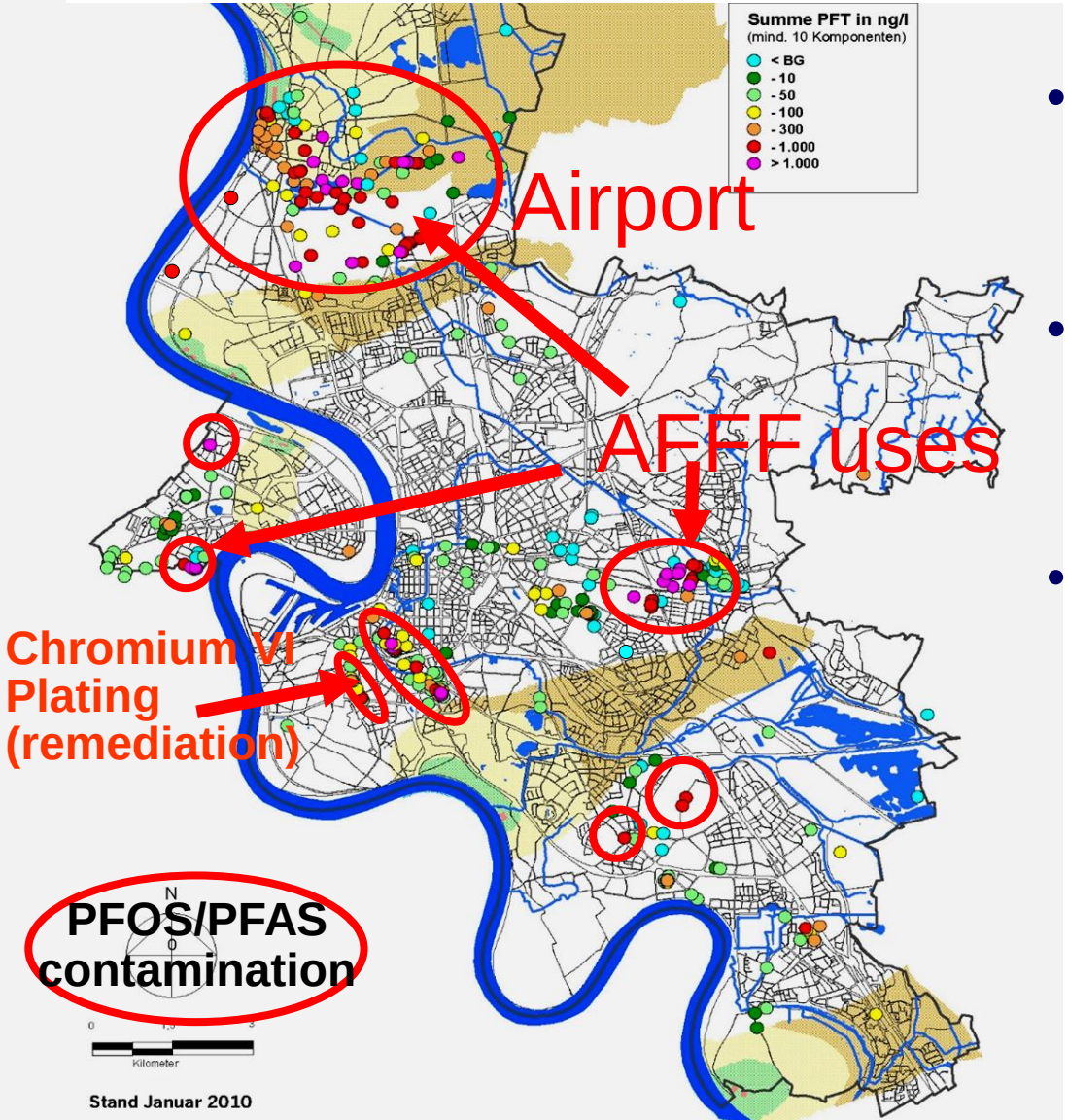
PFAS pollution in Ruhr & tributaries (2008) impacting drinking water of 5 million people

- 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

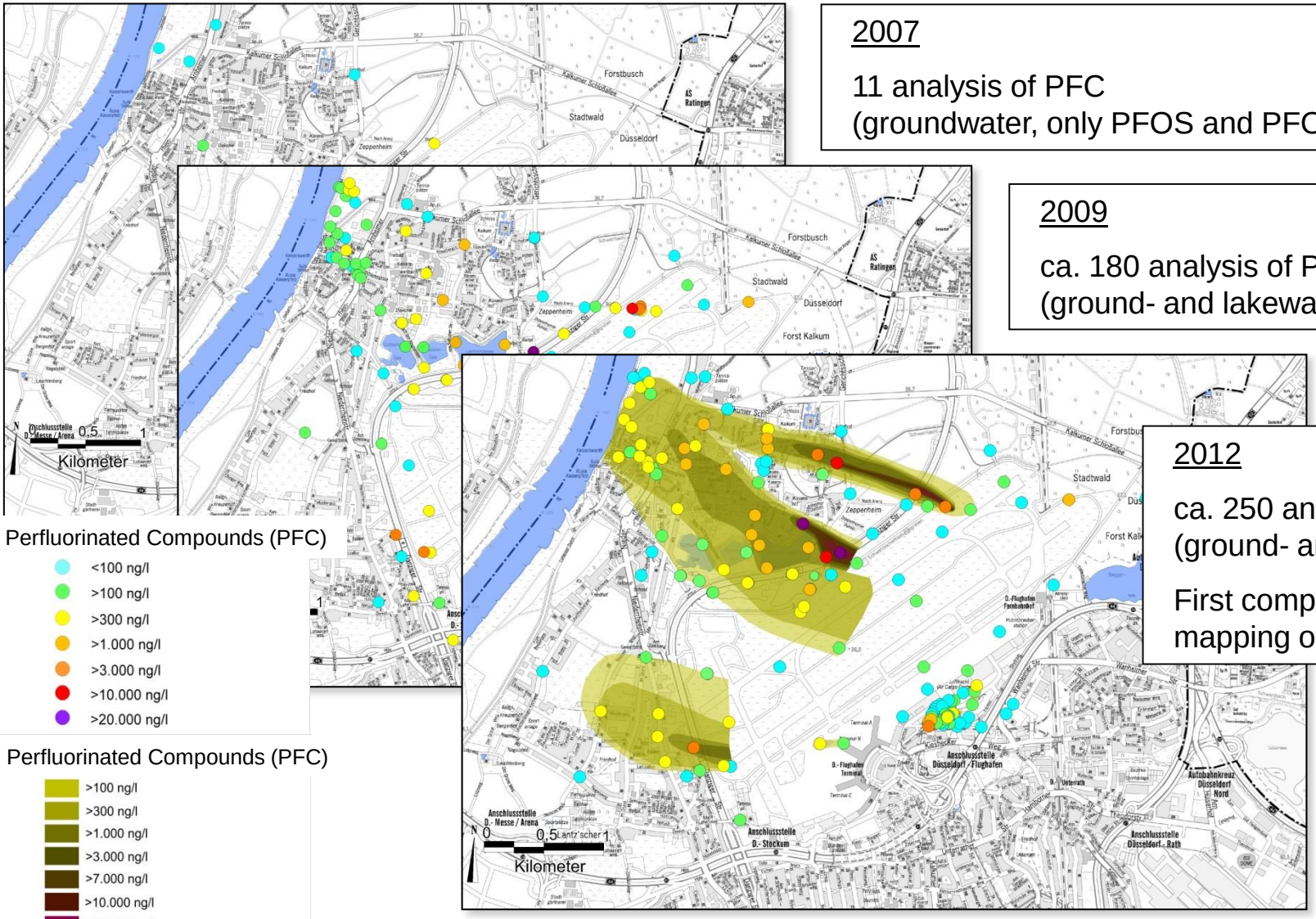


- Ruhr/Möhne case triggered assessement of PFAS contamination in the area.
- Düsseldorf has an ongoing program and screen of PFAS contaminated sites.
- PFOS/PFAS contamination @
  - Sites of major fires & AFFF
  - Airport (AFFF + other?)
  - Fire fighting practice areas
  - At chromium plating factories

Source: Weber R, Bantz et al. Presentation 30th International Symposium on Halogenated Organic Pollutants (*DIOXIN 2010*) , San Antonio 12-17 September 2010.

PFAS plume Düsseldorf Airport Lohausen / Kaiserswerth

Landeshauptstadt Düsseldorf



2007

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

2009

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

2012

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

First complete extensive mapping of the plume

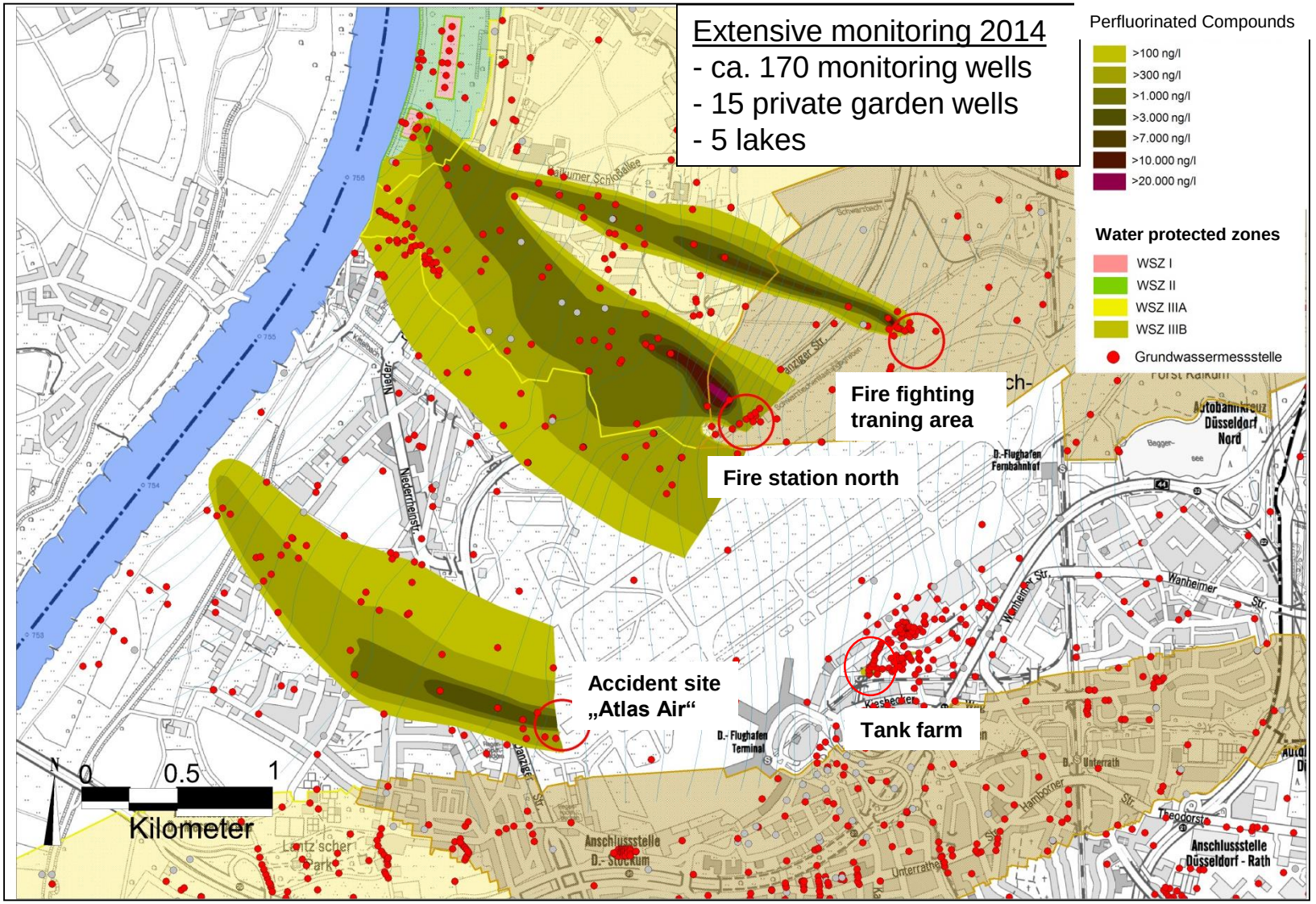
Perfluorinated Compounds (PFC)

- <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

Perfluorinated Compounds (PFC)

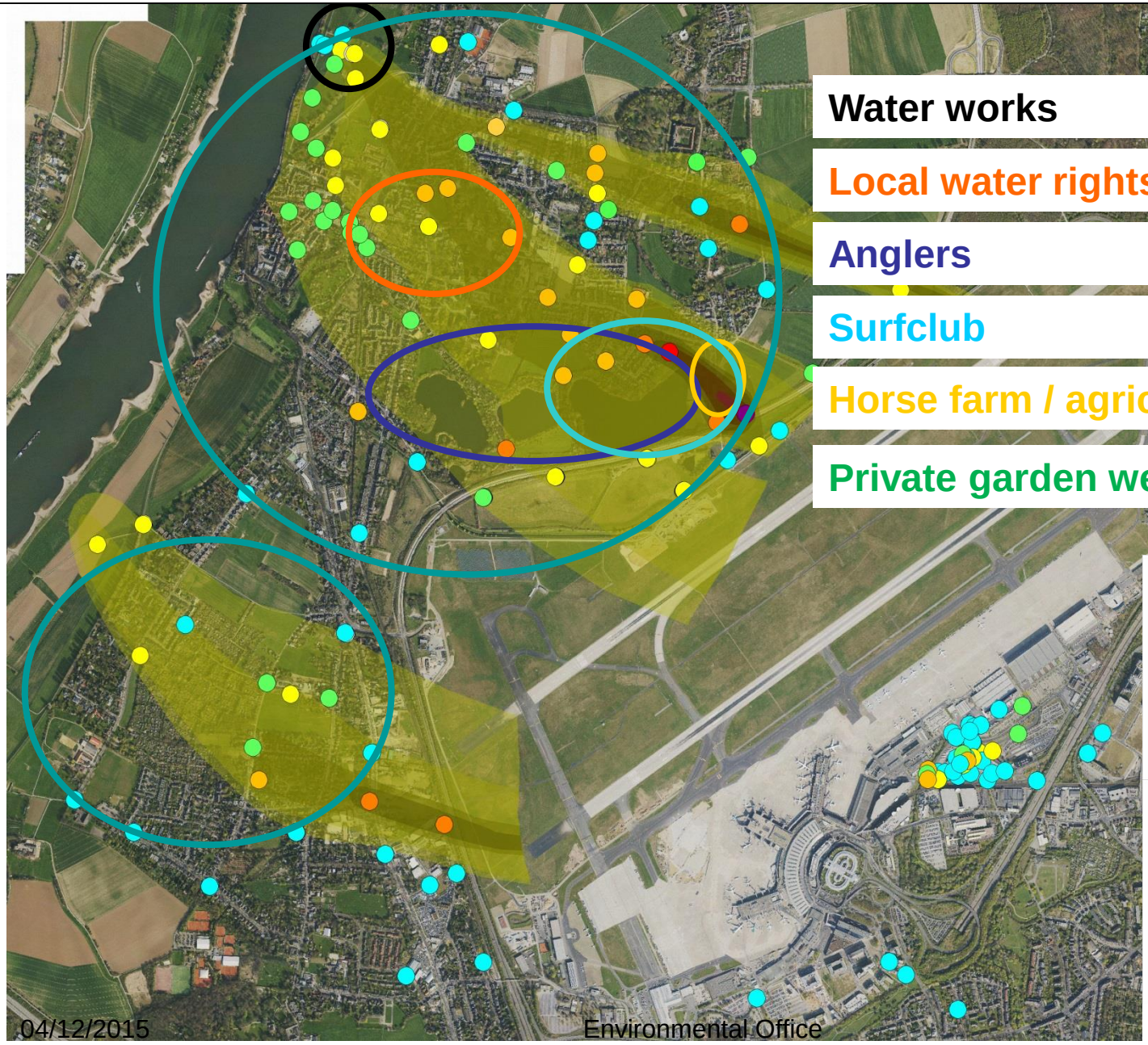
- >100 ng/l
- >300 ng/l
- >1.000 ng/l
- >3.000 ng/l
- >7.000 ng/l
- >10.000 ng/l
- >20.000 ng/l

PFAS plume Düsseldorf airport Lohausen / Kaiserswerth 2014



Affected usages in the area of the PFAS plume

Landeshauptstadt Düsseldorf

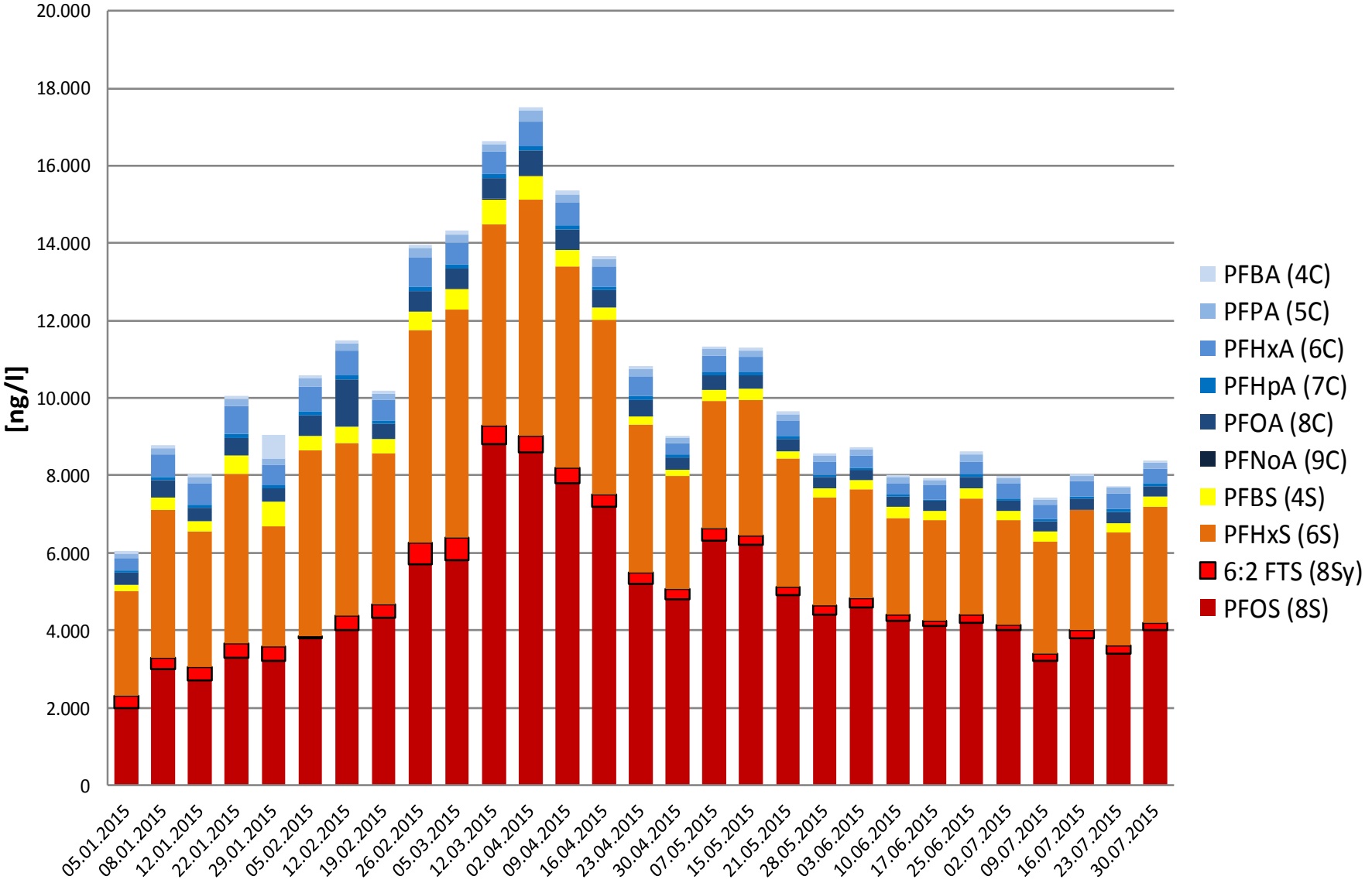


Status: September 2014

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

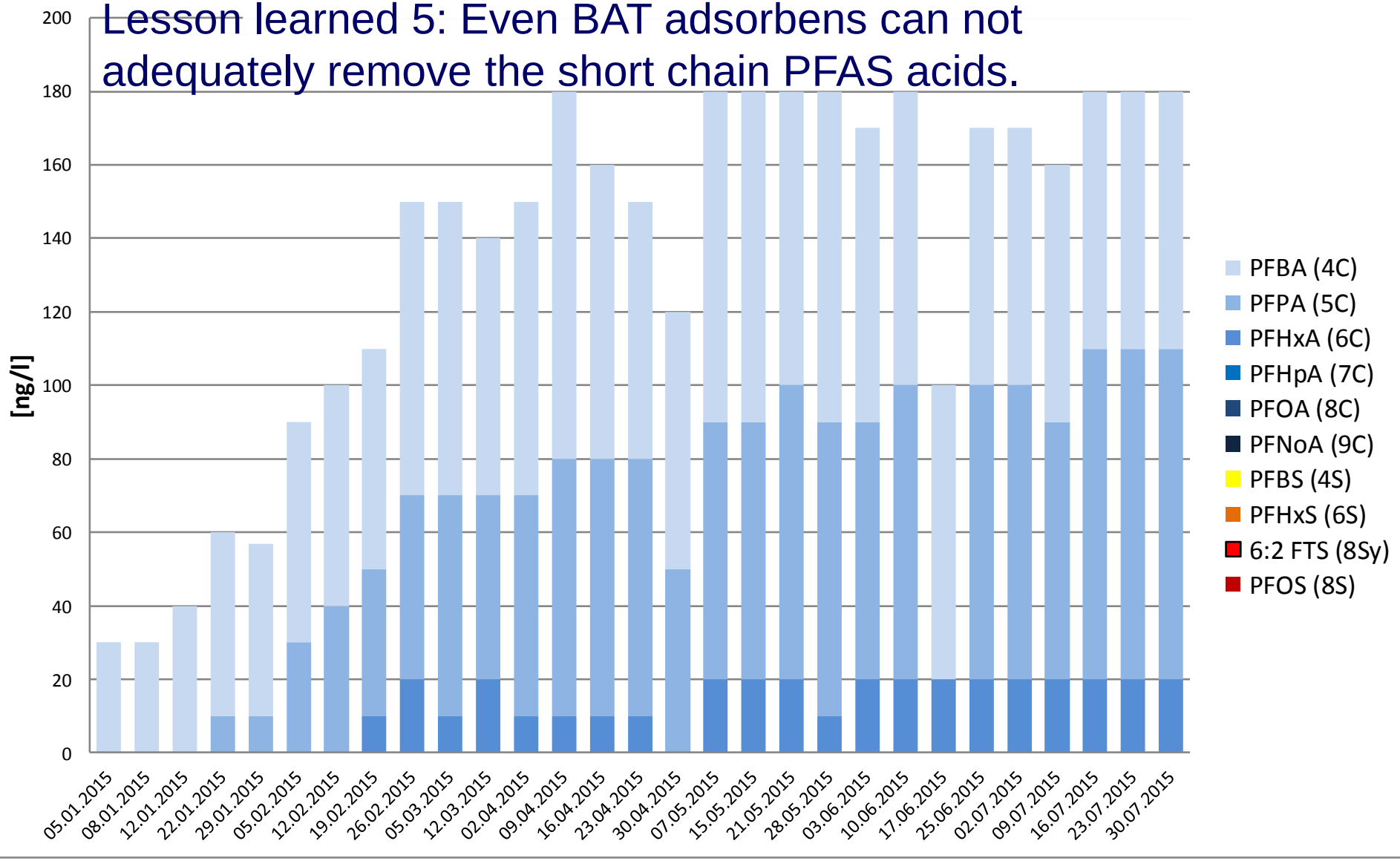
Landeshauptstad
Düsseldorf



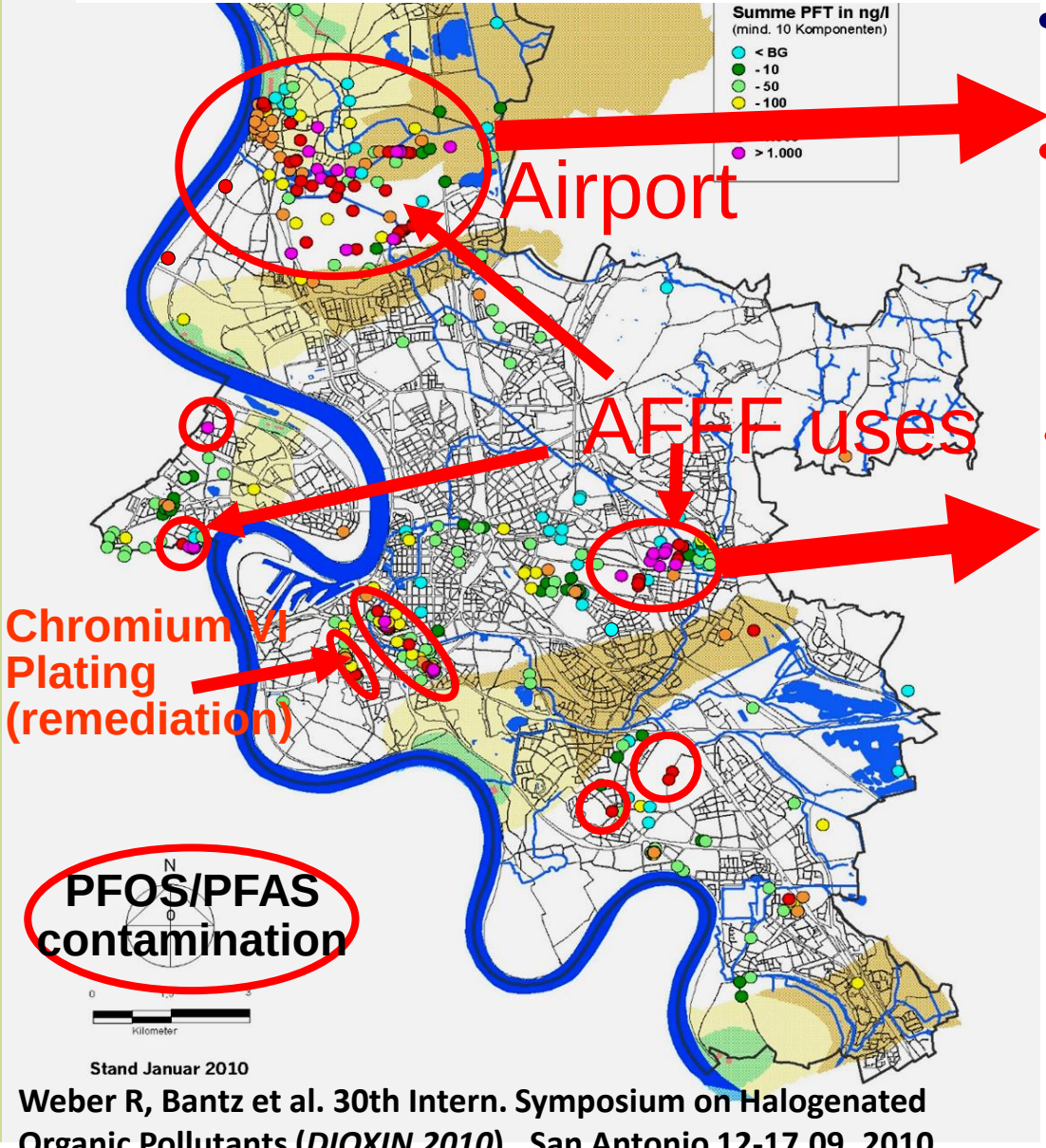
PFAS concentration in treated groundwater after ion exchange resin (Düsseld. Air Port)

Landeshauptstadt Düsseldorf

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



PFOS/PFAS contaminated sites ? Groundwater screening in Düsseldorf city



Weber R, Bantz et al. 30th Intern. Symposium on Halogenated Organic Pollutants (*DIOXIN 2010*) , San Antonio 12-17.09. 2010.

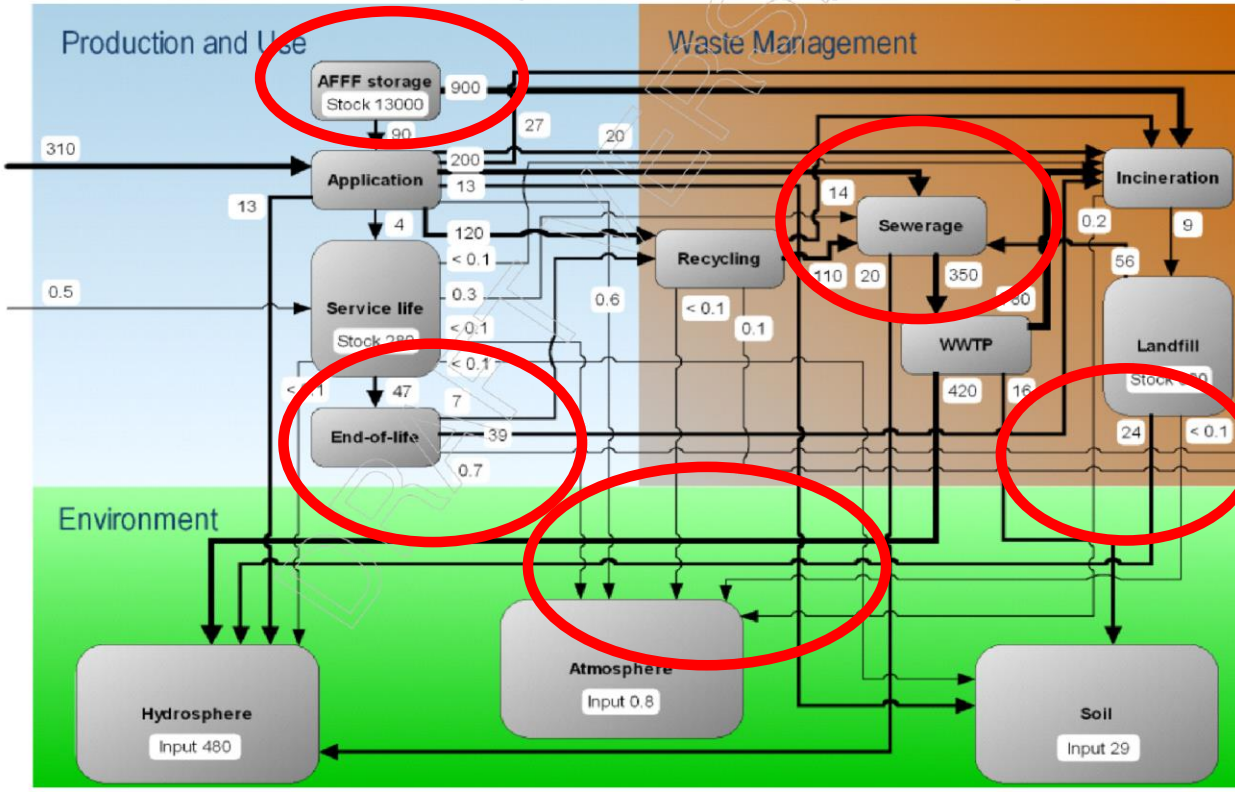
- Cost of three wells controlling the point sources were 2 million €.
- Total remediation estimate for the airport: might reach 100 million €.
  http://www.derwesten-recherche.org/2013/10/pft-alarm-am-flughafen-dusseldorf-verseuchung-noch-extremer-sanierung-konnte-100-millionen-kosten/
- Remediation 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!

Tracking PFOS/PFAS contamination sites

- In most cases no official cost estimates yet. Nürnberg airport (South/East Germany) set 10 million Euro for initial remediation.
- Other airports found contaminated (all? if AFFF fire fighting practice).
- All other sites where F-AFFF etc. have been used the last 30 years.
- Sites where PFOS/PFAS has been produced, used (metal plating, surface treatment, insecticide use, oil drilling, PTFE etc.) or disposed.

- The major stock of PFAS are most probably in landfills. Assessment of long term release and fate to groundwater needed.



MFA/SFA of PFOS/PFOA; Morf and Buser; report Swiss BUWAL (2008

Assessment need for large unknown stock

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	FOSAAcOH
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)

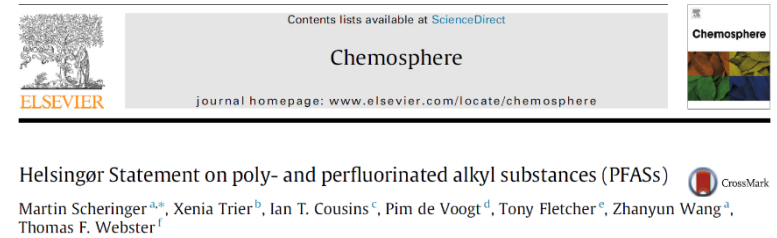
Major former PFOS use area in the EU were in applications like carpets, textiles and paper which have ended in landfills

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)



Helsingør Statement on poly- and perfluorinated alkyl substances (PFASs)

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http://ehp.niehs.nih.gov/1509934/
http://ehp.niehs.nih.gov/1509910/
http://ehp.niehs.nih.gov/1510207/

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

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

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

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.

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/