Contamination of water resources

”Water and Environmental Quality”

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WHO. Drinking water – key facts (2023)

- In 2021, over 2 billion people live in water-stressed countries.
- In 2022, globally, at least 1.7 billion people use a drinking water source contaminated with faeces.
- While the most important chemical risks in drinking water arise from **arsenic, fluoride or nitrate**, emerging contaminants such as **pharmaceuticals, pesticides, per- and polyfluoroalkyl substances (PFASs) and microplastics** generate public concern.
- Safe and sufficient water facilitates the **practice of hygiene**, which is a key measure to prevent not only diarrhoeal diseases, but acute r**espiratory infections** and numerous tropical diseases.
- Microbiologically contaminated drinking water can transmit diseases such as **diarrhoea, cholera, dysentery, typhoid and polio** and is estimated to cause approximately 505 000 diarrhoeal deaths each year.

Overview of the drinking water quality in European Union

National –wide reporting is based on the DW Directive 98/83/EC

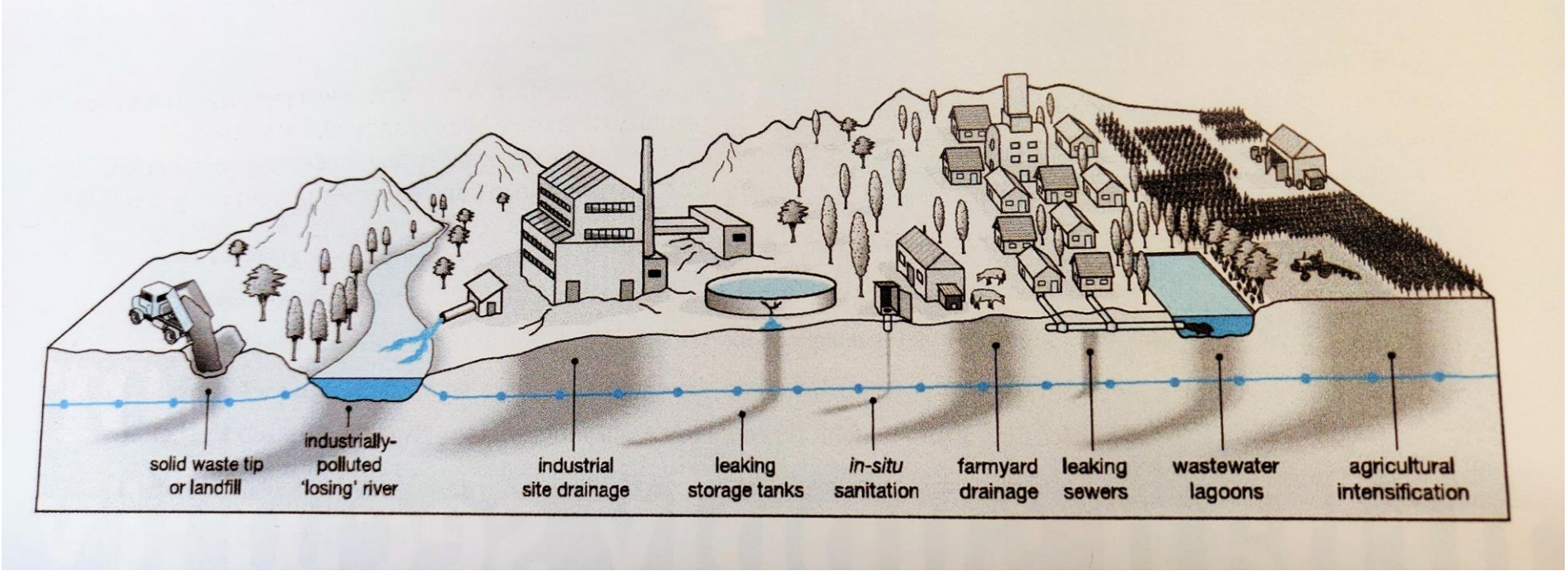
- New DWD approved 12.1.2021

The quality of DW is high in EU member states

- In general, over 99.5% compliance in microbiological and chemical parameters
  - *Pesticides have the lowest compliance rate*
- 98-99% compliance in indicator parameters
  - *Occurrence of coliform bacteria the most common quality problem*

Drinking water quality reports are available in the Internet:
http://ec.europa.eu/environment/water/water-drink/reporting_en.html

Land-use activities commonly causing groundwater pollution hazard



From: Source – The Magazine of International Water Association, July 2020

REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

on the implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based on Member State reports for the period 2016–2019

{SWD(2021) 1001 final}

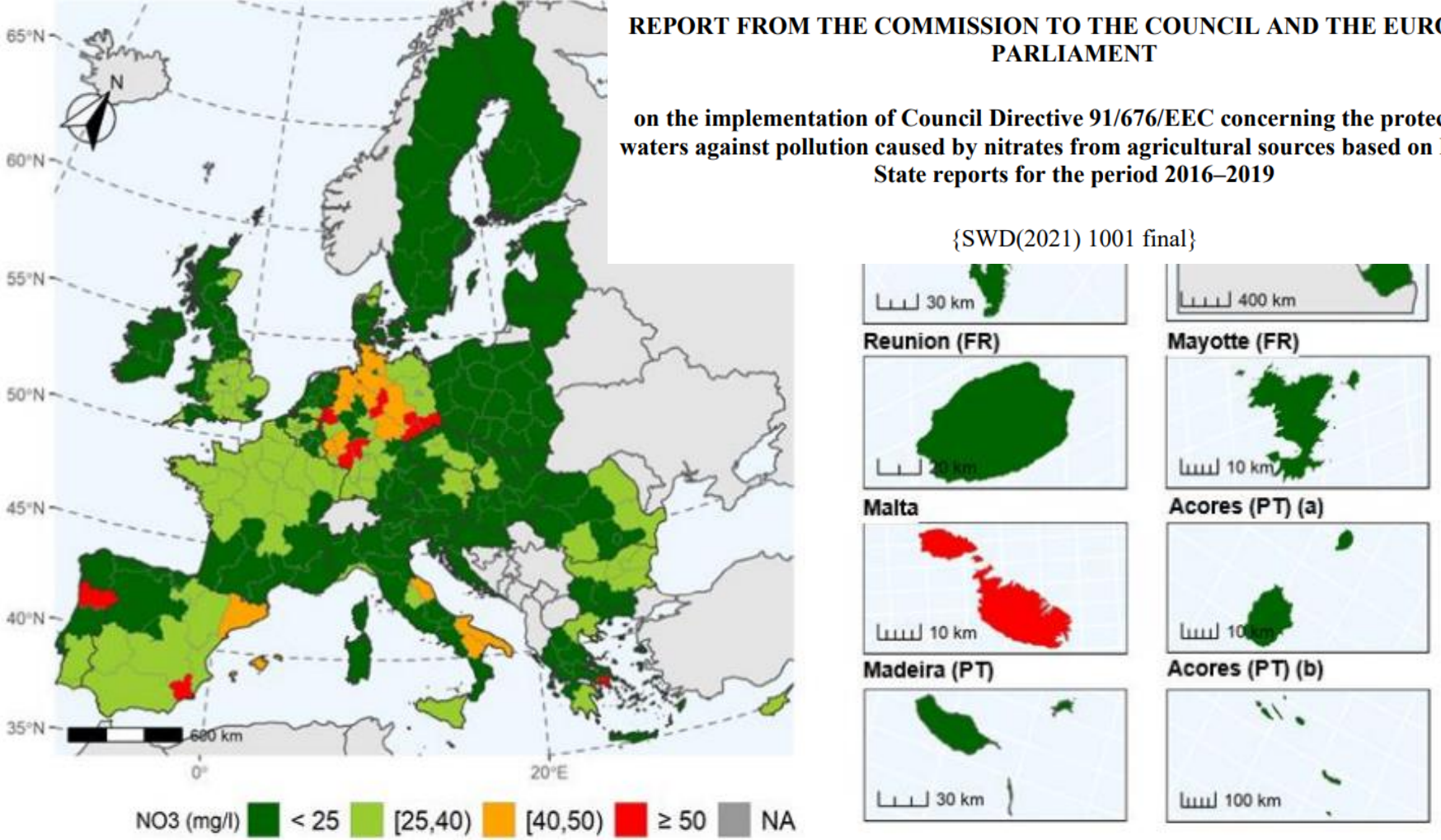


Figure 2: Annual average nitrate concentrations in groundwater at the NUTS2 level for the reporting period 2016-2019

Emerging contaminants in EU

- 100 000 surface water bodies, including streams, rivers, lakes, wetlands, and reservoirs
- Only 40% of surfaces waters are in good status

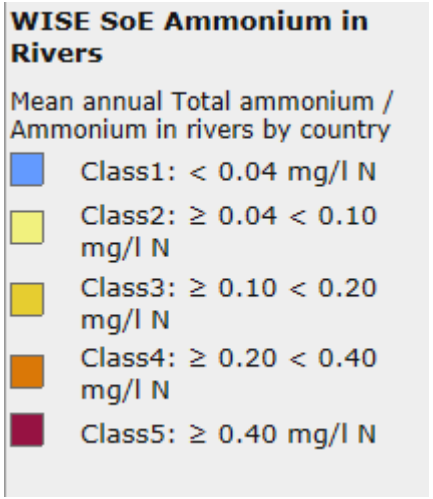
The **Priority Substances Directive** requires the progressive reduction or phasing out of these substances, referred to as 'priority substances

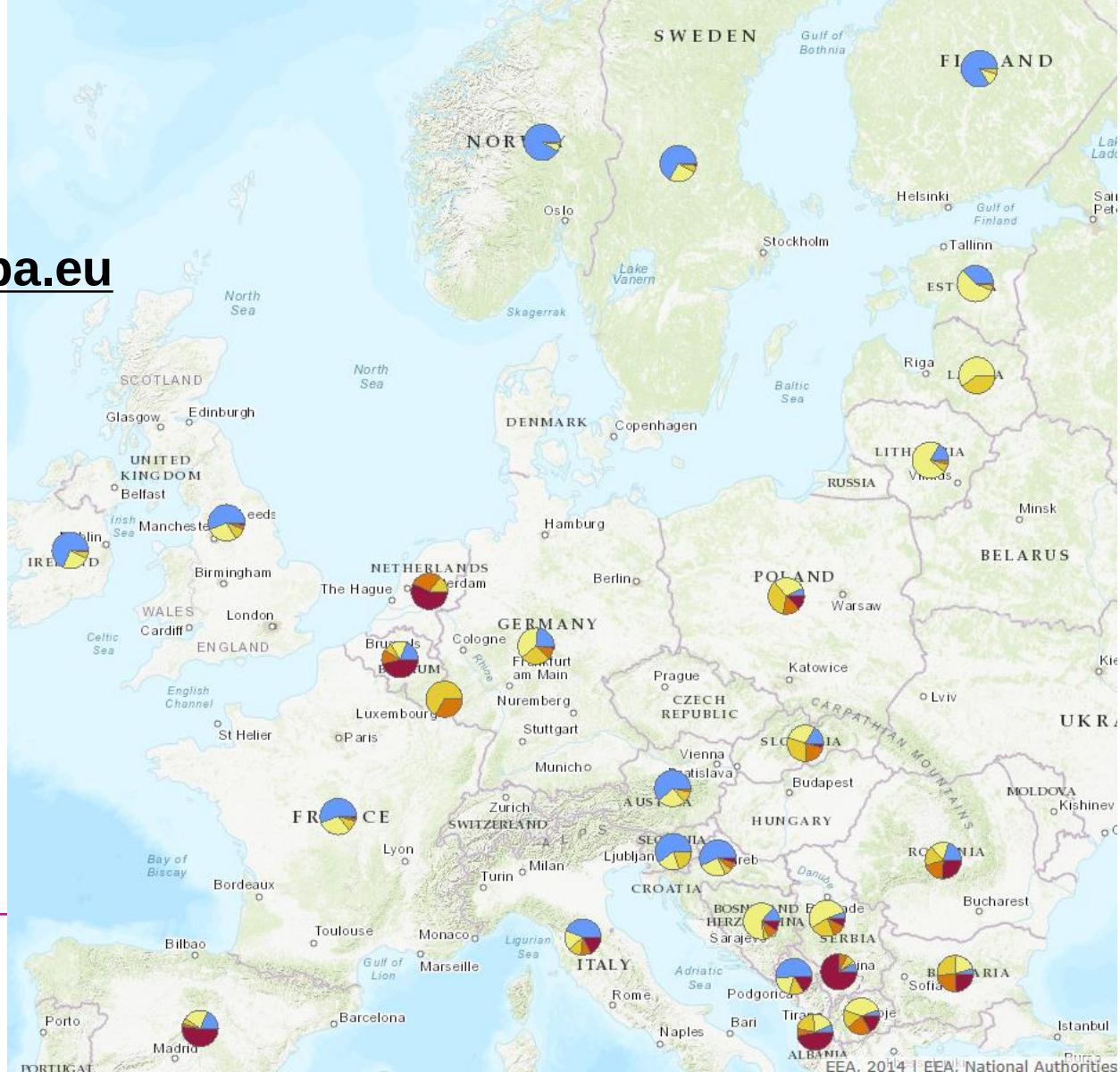
The proposal to revised list of priority substances in surface water (10/2022)

- 45 EU priority subtances + 8 other harmful substances + 15 national (Finland) selected significant harmful substances

Ammonium in rivers

https://www.eea.europa.eu/data-and-maps

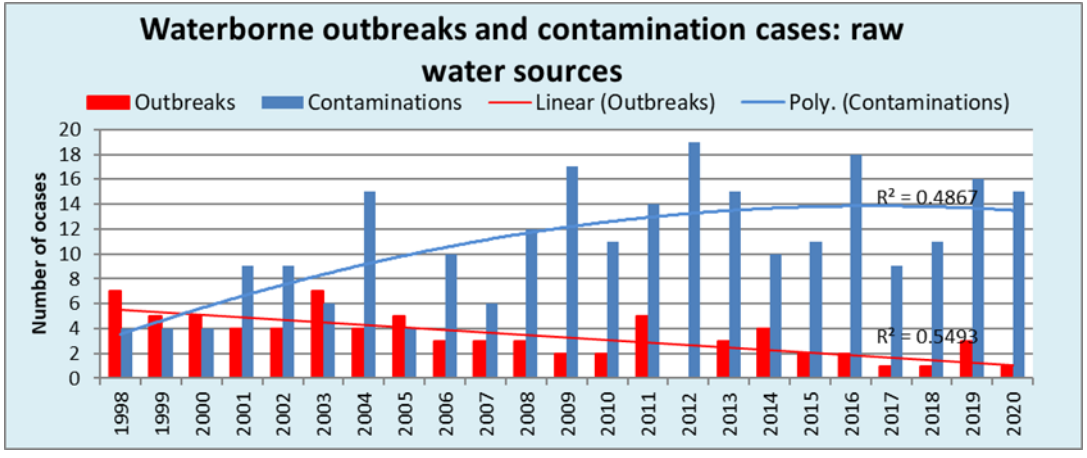




Contamination of raw water sources in Finland

By 2022, a total of 105 waterborne outbreaks have been observed.

Majority of waterborne outbreaks (93/105) and over half of the contamination cases (346/610) occurred at the drinking water (DW) systems using ground water supplies as a raw water sources.



Drinking water contamination cases and waterborne outbreaks caused by contamination of raw waters. (Source THL: notification reports of outbreaks /direct contacts concerning drinking water contaminations).

Chemical contaminants in drinking waters

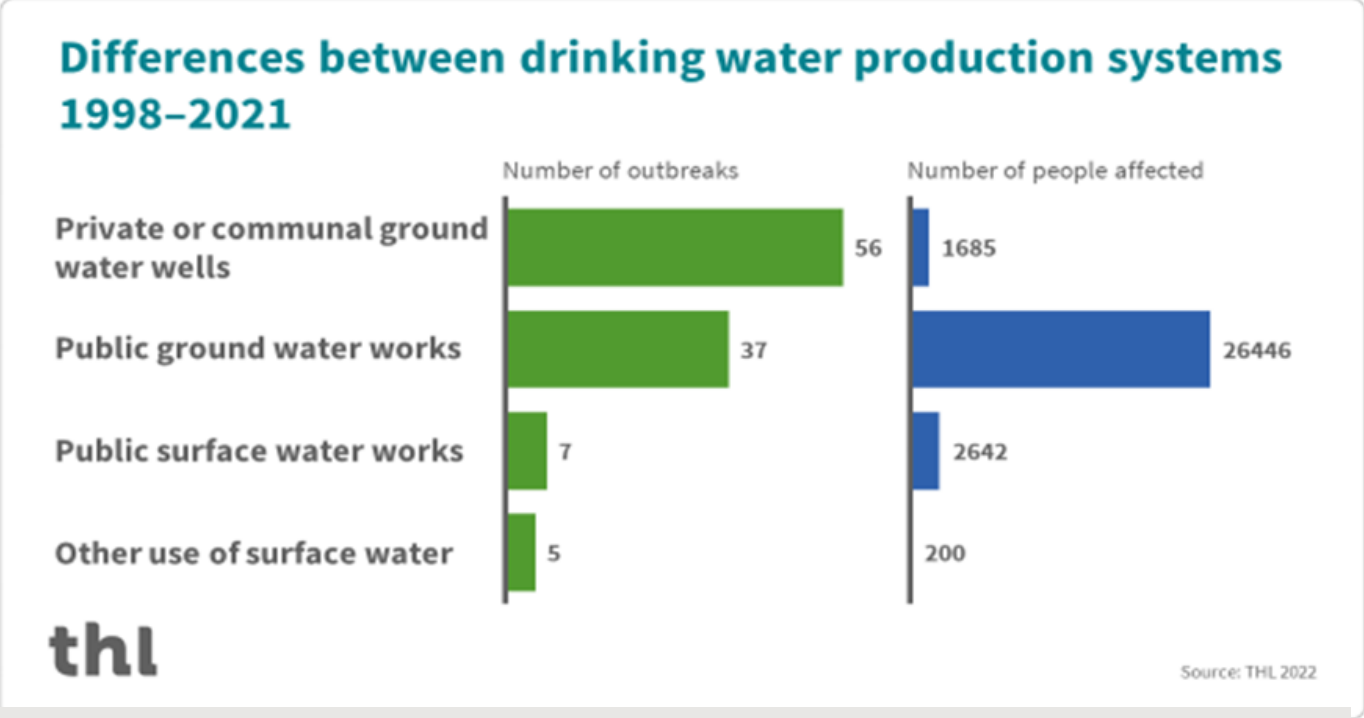
Reported chemical contaminants in ground water sources in Finland during 1998 to 2022

Contaminant	Number of cases
Fe	10
Mn	7
Mineral oil	7
Solvents	5
MTBE/ETBE	4
PAH	3
Pesticides	3
Chlor phenols	2
Rn/U	3
As	3
F	2

Source: THL – contacts related with chemical contamination cases

Waterborne outbreaks 1998-2021

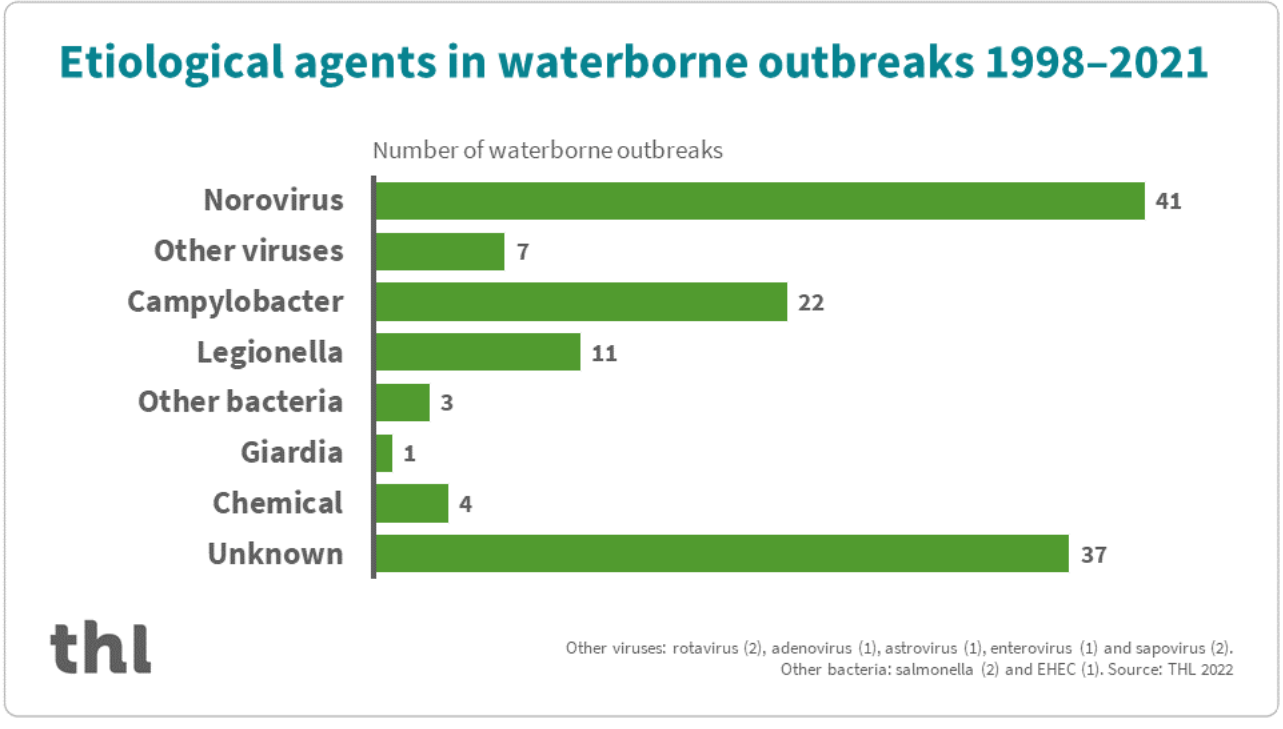
Number of outbreaks (N= 105) and illness cases (N=30 983)



Vast majority of outbreaks concerns either public or private ground water suppliers (93/105).

Waterborne outbreaks in 1998- 2021 in Finland

Agents causing waterborne outbreaks – number of outbreaks



Noroviruses and campylobacters are the most frequent identified microbial agents causing waterborne outbreaks.

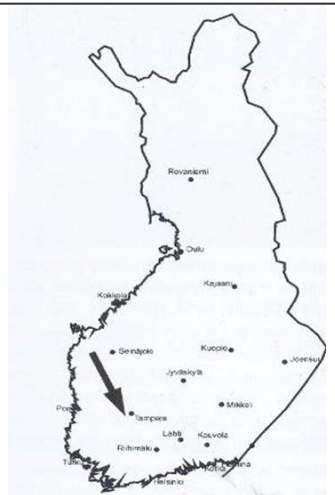
The largest waterborne outbreak in Finland – Nokia 2007

- Source of contamination: city´s own waste water plant
- Cross-connection of wastewater with the DW distribution network
  - Open line between waste water and DW lines
  - Sudden lower pressure event in waste water --> intrusion into DW pipeline

→450m^3 of treated sewage effluent entered into network

Result: 10 000 inhabitants lived in the contaminated area

Location of the removed pipeline section between tap water and waste water lines



Kuva 1. Onnettomuuspaikka.
Bild 1. Olycksplats.

Outcomes of the Nokia outbreak

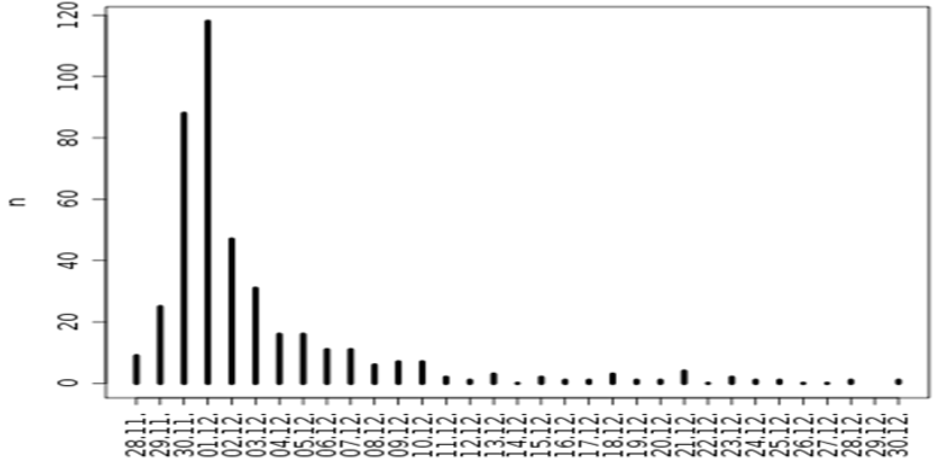
Cleaning of the pipelines

- Flushing
- Chlorination from 0.5 up to 3 mg/l.
- Pipeline internal gauging (pigging) and air/water pulsed flushing
  - *78 km of cleaned pipelines*
- Shock chlorination (10 mg/l)

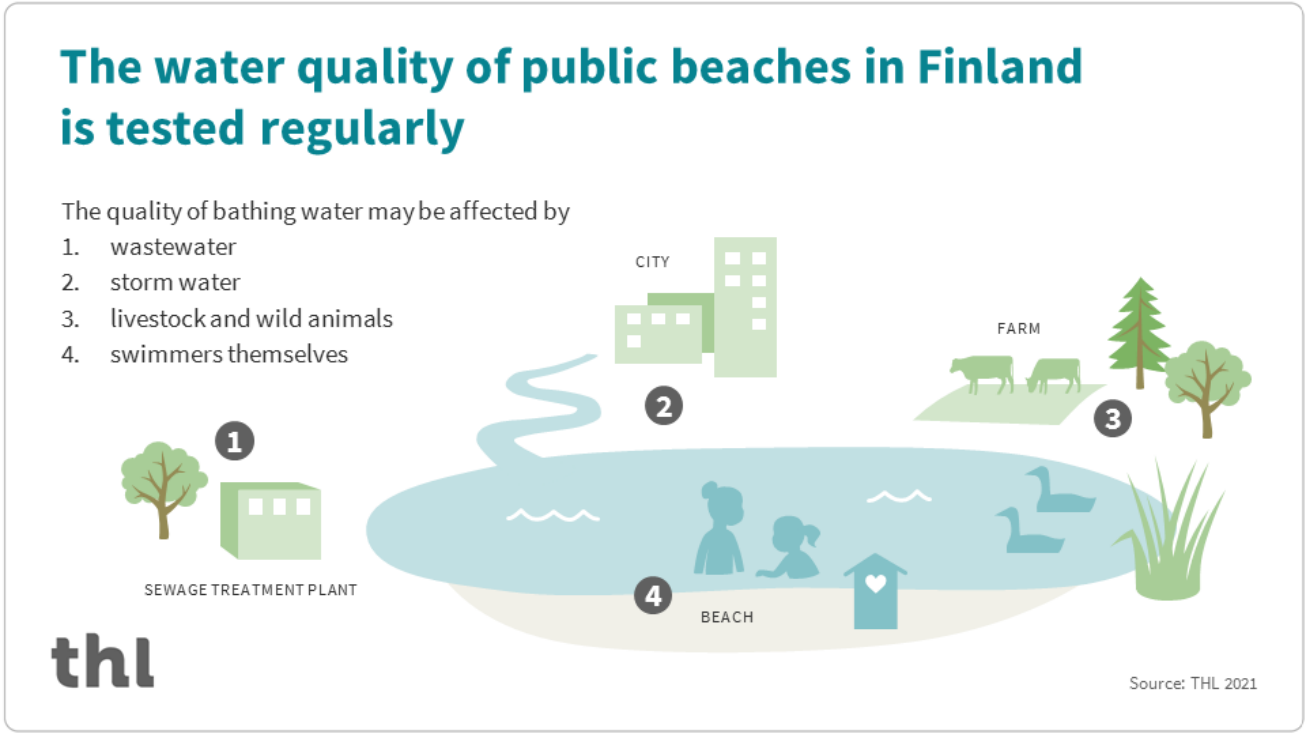
Epidemiological study

- *Total of 8,451 cases of gastroenteritis occurred during the outbreak.*
- *1000 persons sought care at the municipal health centre*
- *Nearly 200 were treated in hospital.*

Total costs approx. 4.6 milj EUROS



Bathing waters



Number of bathing water outbreaks in Finland 2014-22

Year	Counts
2014	**8**
2015	0
2016	1
2017	1
2018	**3**
2019	0
2020	0
2021	1
2022	**2**

Lessons learned from bathing water outbreaks

Outbreaks related with:

- Long heat periods
- Extensive usage of bathing sites (exposure) resulting human load to bathing waters

Noroviruses main microbial pathogen causing outbreaks

- Human to human transmission via bathing water and contaminated surfaces (changing rooms, toilets)

Urban waste waters in EU

In the EU

* Over 90% of urban wastewater is dealt with in line with EU standards
* 92% of toxic pollutants in wastewater come from the pharmaceutical and cosmetics sectors
* 10 million Europeans still lack access to basic sanitation services

Contaminants related with waste waters

Urban wastewater is one of the main sources of water pollution if it is not collected and treated.

Main components of effluents include organic matter, nitrogen and phosphorous

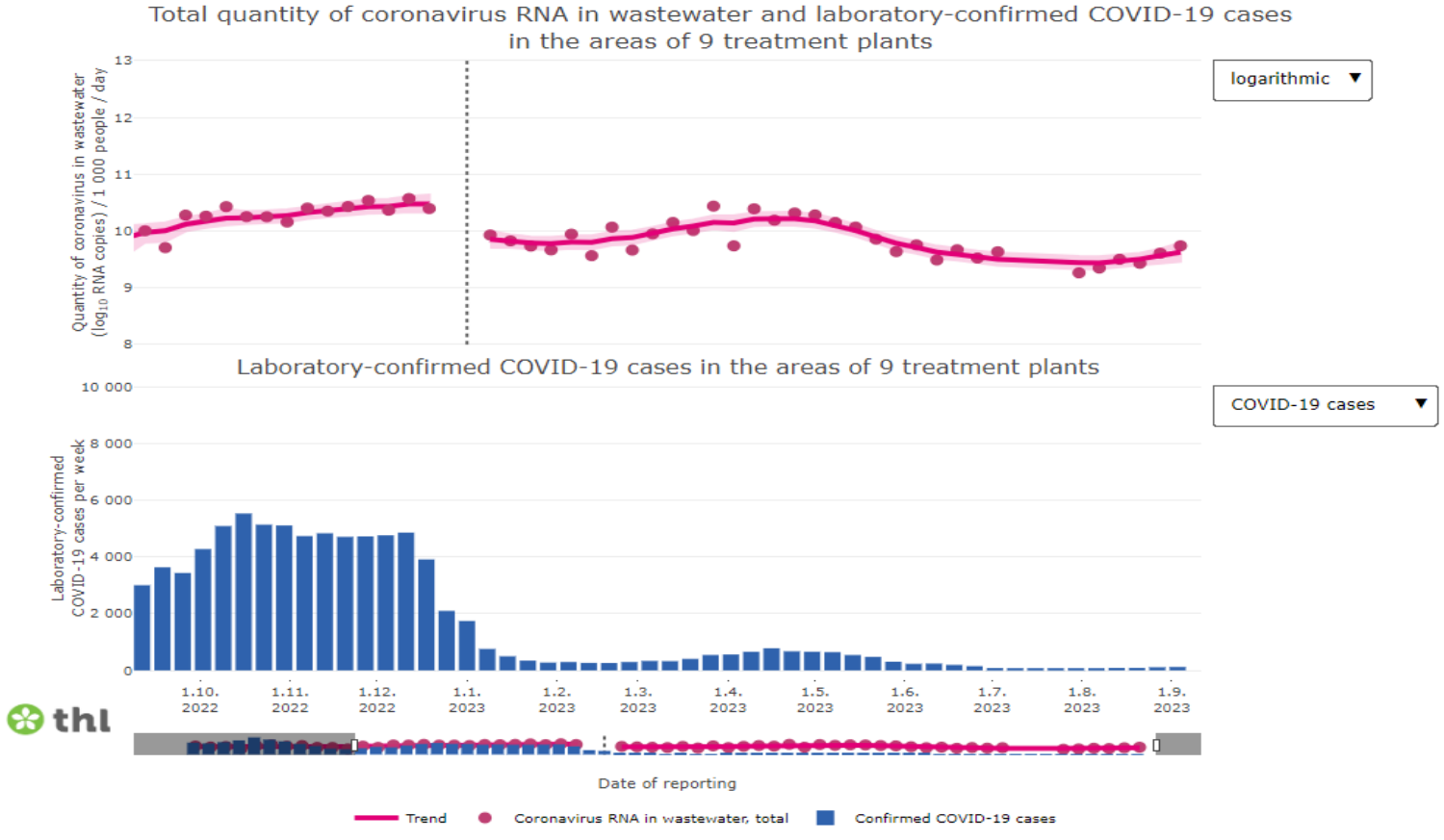
Waste waters contain also microbes, antibiotics, pharmaceuticals, personal care products (PPCPs), endocrine disruptors, hormones, industrial chemicals, microbeads, heavy metals and microplastics.

Use of waste waters in monitoring

Surveillance purpose of waste waters

- Since the start of the COVID-19 pandemic, wastewater surveillance has been used as a tool to help track the presence of the virus ("watch tower monitoring") –
- In March 2021: Recommendation on monitoring COVID-19 and its variants in wastewaters in the EU.
- The aim is to provide new independent information on the presence of SARS-CoV-2 and its variant in wastewater.
- In Finland:
  - Polio virus surveillance in Finland since 60´s
  - Drugs abuse usage surveillance in Finland since 2012
  - Sars-Cov-2 virus surveillance since 8/2020

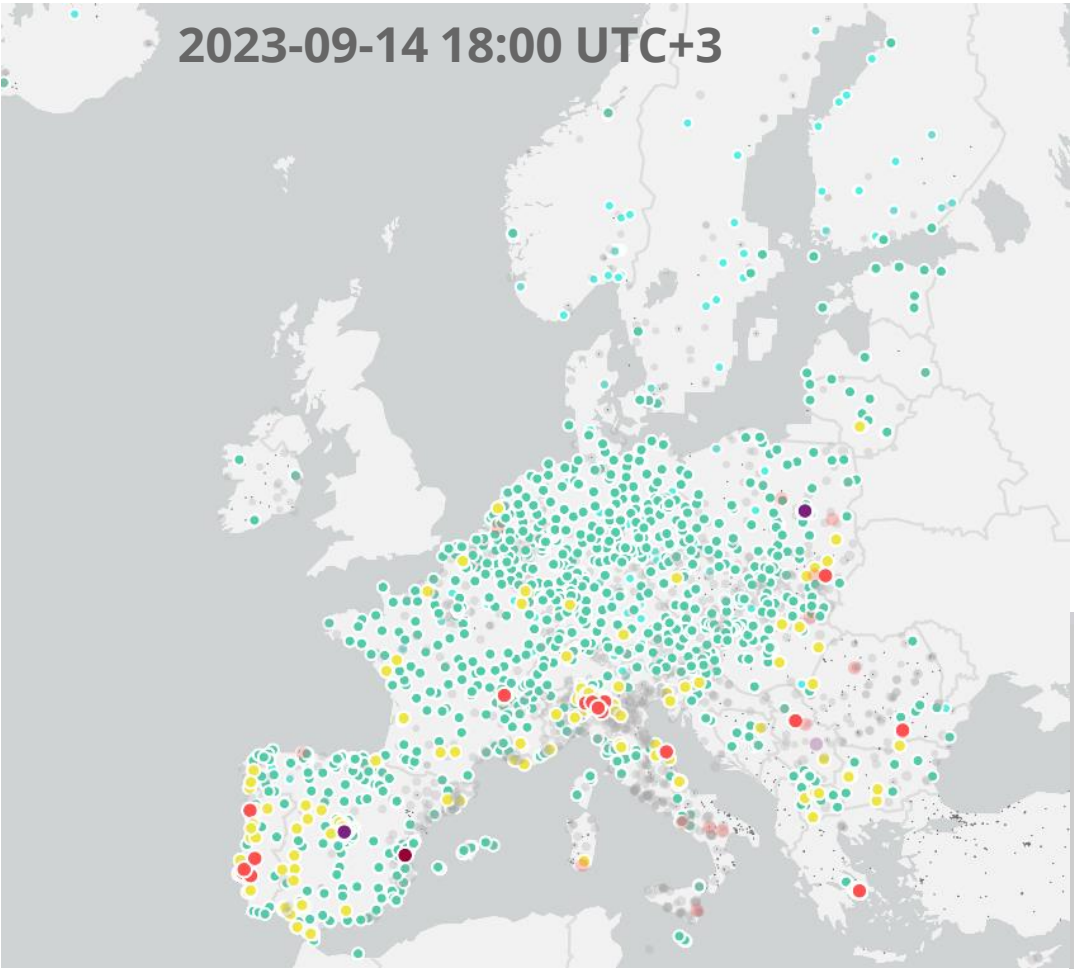
Monitoring of Sars-Cov-2 virus in waste waters



What about environment (soil, air etc.)?

Air quality

http://airindex.eea.europa.eu/

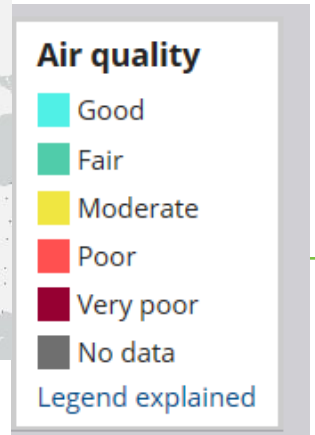


Legend explained x

Circles and dots on the map represent the locations of air quality monitoring stations. The colour corresponds to the air quality index at the given hour at that station. Note that it does not reflect the annual average measured at the air quality situation which may differ significantly (see Info).

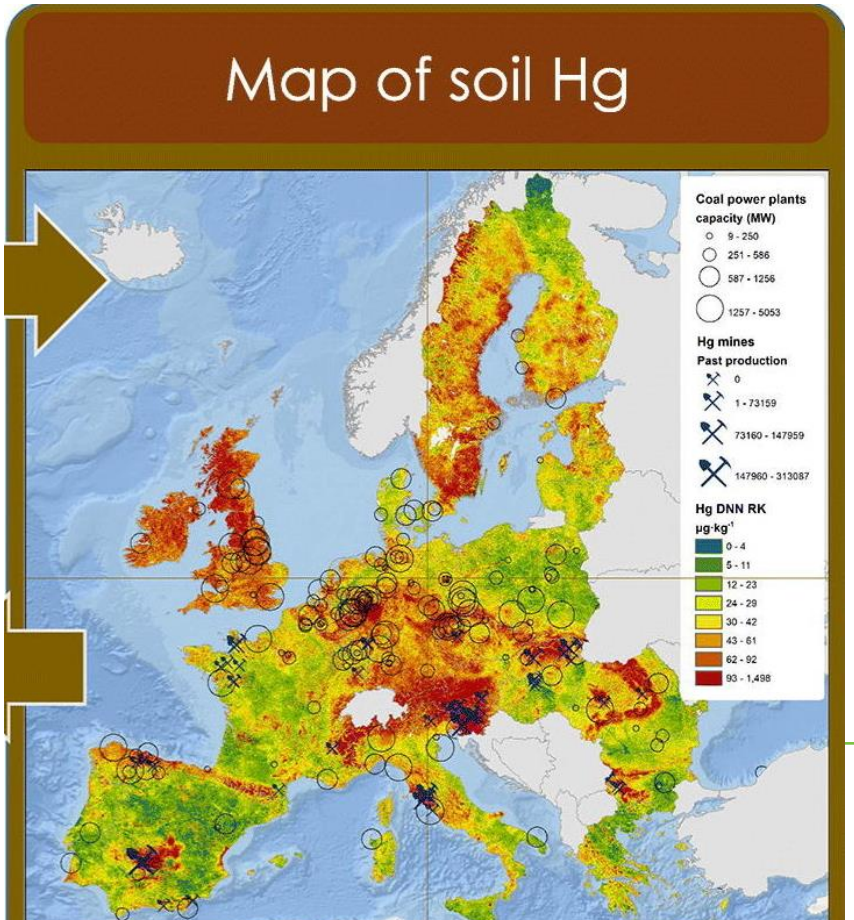
Measurements of up to five key pollutants supported by modelled data determine the index level that describes the current air quality situation at each monitoring station. The index corresponds to the poorest level for any of five pollutants according to the following scheme.

Pollutant	Index level (based on pollutant concentrations in µg/m3)					
	Good	Fair	Moderate	Poor	Very poor	Extremely poor
Particles less than 2.5 µm ($PM_{2.5}$)	0-10	10-20	20-25	25-50	50-75	75-800
Particles less than 10 µm (PM_{10})	0-20	20-40	40-50	50-100	100-150	150-1200
Nitrogen dioxide (NO_2)	0-40	40-90	90-120	120-230	230-340	340-1000
Ozone (O_3)	0-50	50-100	100-130	130-240	240-380	380-800
Sulphur dioxide	0-100	100-200	200-350	350-500	500-750	750-1250



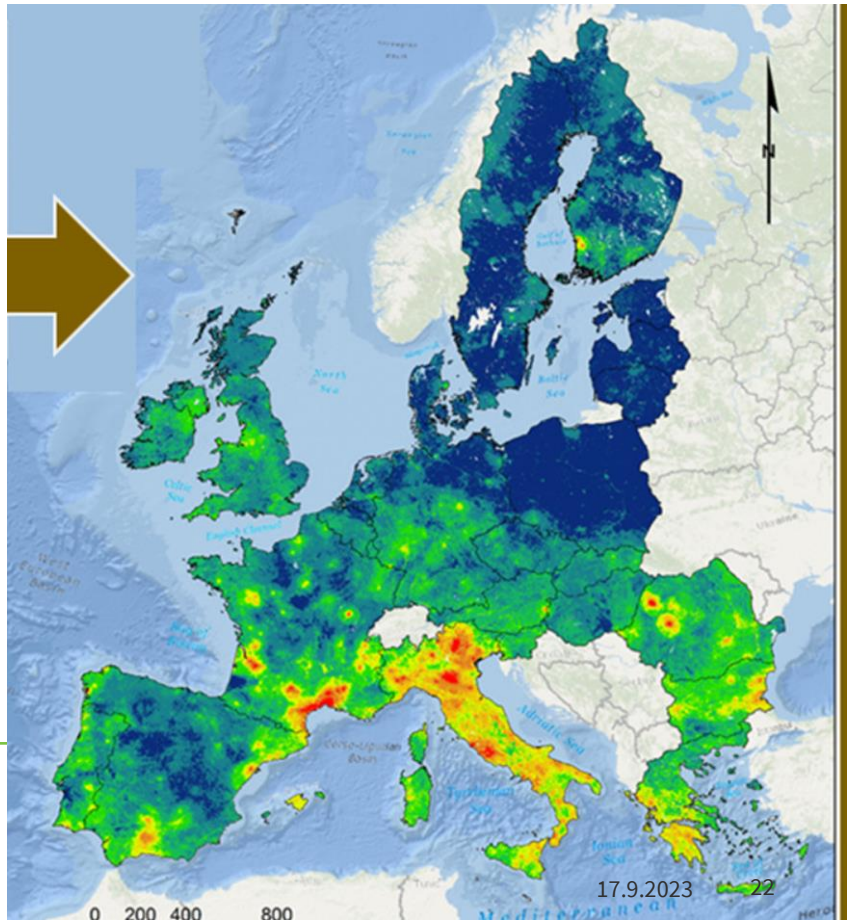
Soil quality

Science of The Total Environment
Volume 769, 15 May 2021, 144755

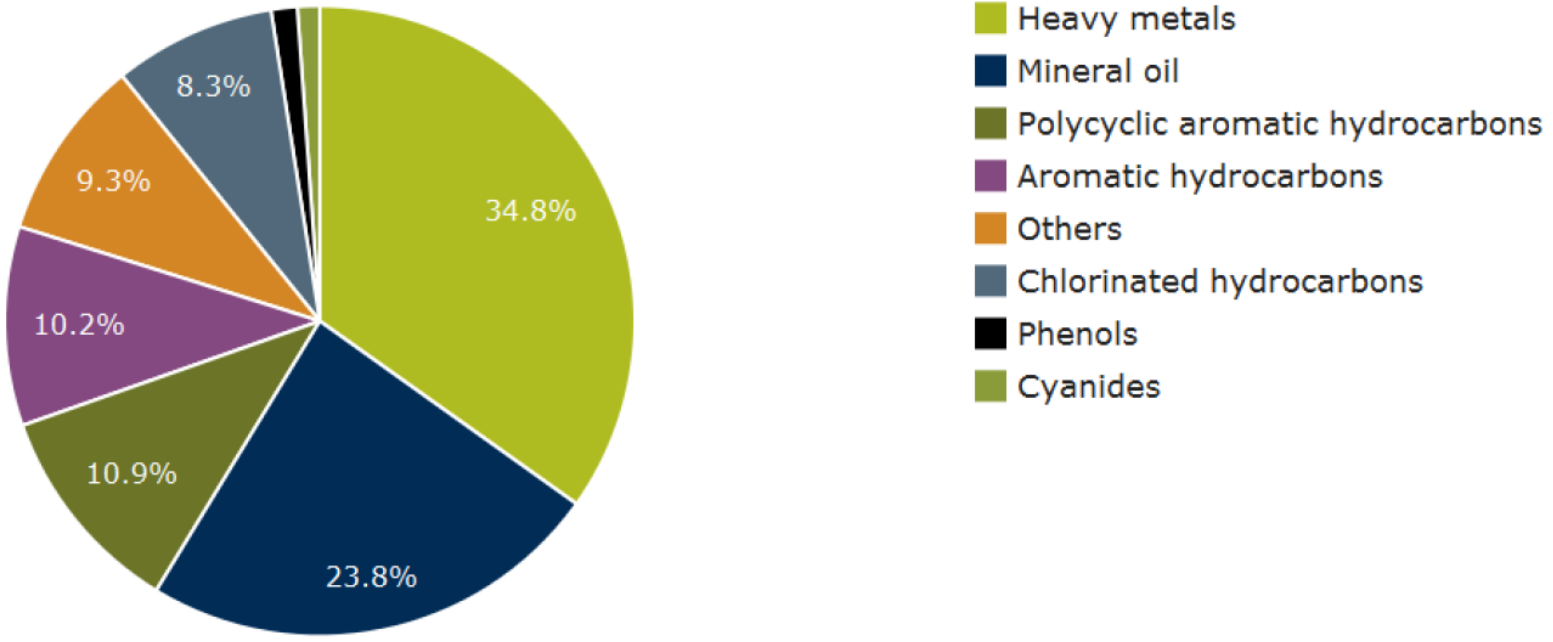


Copper (Ballabio et al,. 2018)

Science of The Total Environment
Volume 636, 15 September 2018, Pages 282-298



Contaminants affecting the solid matrix (soil, sludge, sediment) (2011)



Data sources: JRC. Eionet NRC Soil data collection on contaminated sites; EEA – Indicator LSI003

Related content

Industrial pollution to air, soil and water