

Microplastics in EU water policy and why monitoring matters

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Activities in MPs analytics** and reference materials*

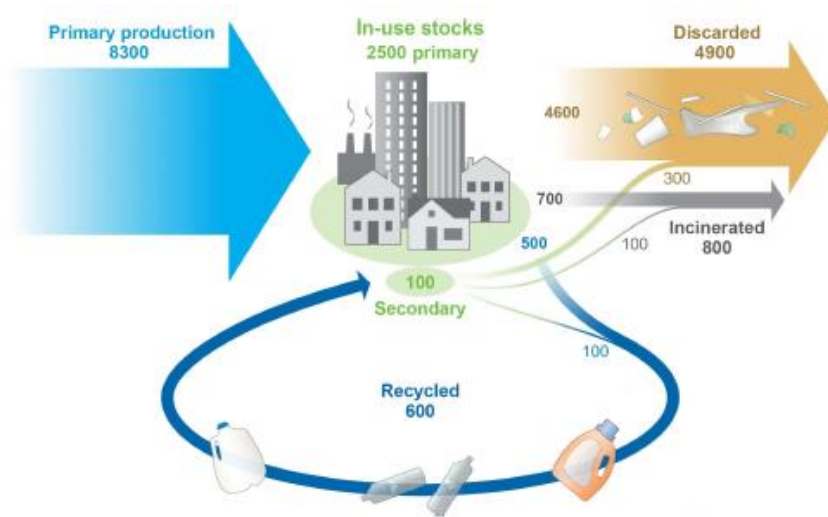


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Micro(nano)plastics - origins

Microplastics and their origins

Globally, 5 to 13 million tons of plastics leak into the environment every year.



Global production, use, and fate of polymer resins, synthetic fibers, and additives (1950 to 2015; in million metric tons).

Much of the leaked plastic may (eventually) be in particulate form

Primary microplastics (<5mm particle or 15mm length fibre)

- Deliberately manufactured particles added to products (cosmetics, scrubs etc) or spillage of raw materials (REACH)

Secondary microplastics

- Chemical and mechanical degradation of macroplastics waste
- Incidental as a result of normal use - tyre wear, paint fragments, textile fibre shedding etc

Garbage patch “Islands” of plastic



Land fill outflow

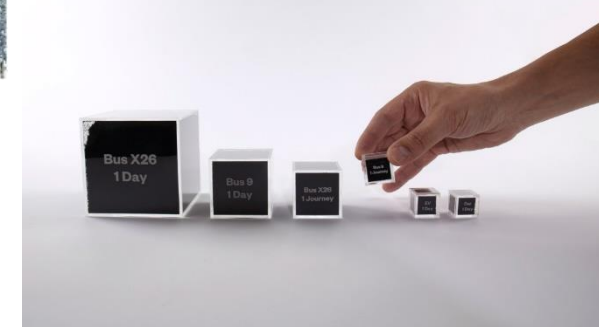


Textile Fibres



Tyre Wear

Tyre release in use



Microplastic pollutants – concerns

What were the main concerns?

- Interactions/uptake with cells/tissue/biota
- Vector transport of pollutants
- Trojan horse: additives or bacteria
- Other potential (undefined) risks to health

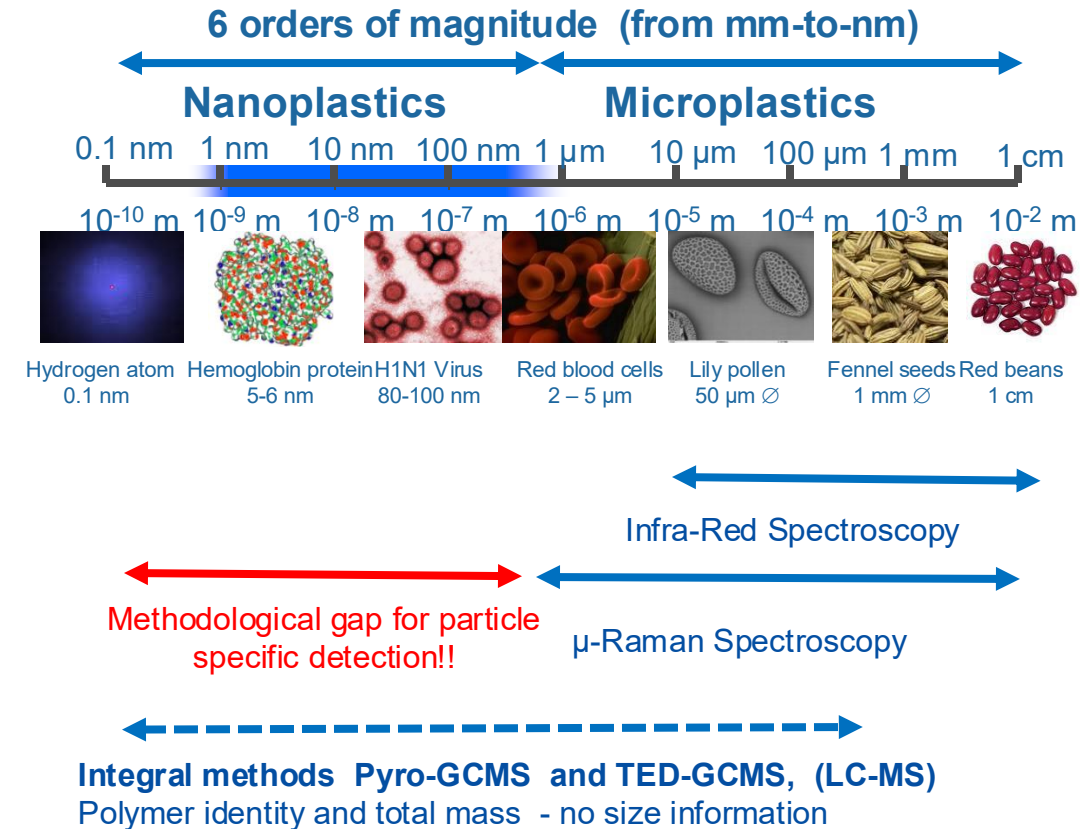
Major knowledge gaps

- Exposure/internalization levels, translocation and localization
- Biological responses to short term exposure or long term accumulation

Limitations of analytical methods a major factor contributing to knowledge gaps

- Microplastics – limited harmonization/standardization
- Sub-micron – no routine methods

**Many unanswered questions: Scale of pollution warrants acting on precautionary principle
=> Introduce targeted actions in active legislation: reduce release and monitor presence**



Microplastics related EU policies – snapshot 1/2

Registration, Evaluation, Authorisation and Restriction of Chemicals: REACH

COMMISSION REGULATION (EU) 2023/2055 - in force 25. Sept 2023

- Restricting the deliberate use of microplastics in consumer and industrial products
- Elimination, phasing-out or substitution with biodegradables

Mass based concentration limit: Currently no methods specified for monitoring or enforcement.

Pellet loss:

COMMISSION REGULATION (EU) 2025/2365 – effective from 16 Dec 2025

- Aims to reduce microplastic pollution by preventing plastic pellet losses (operators > 5 tons/year).
- Establishes rules to achieve zero pellet losses across the entire supply chain, obligations for risk management, spill prevention, and clean-up measures, and applies to all entities involved in the handling, storage, and transport of plastic pellets.

Marine Strategy Framework Directive (MSFD)

- Guidance on the Monitoring of Marine Litter in European Seas: JRC technical report JRC133594 (2023): MPs considered as sub-category of micro-litter

Microplastics related EU policies – snapshot 2/2

Drinking Water Directive (EU) 2020/2184)

- Commission Directive including the obligation to adopt a methodology ((EU) 2024/1441) to measure microplastics in water intended for human consumption: Further action subject to inclusion of MPs on watch list

Revised Water Framework Directive (EU) 2026/805 – Entry Into Force (EIF) 20 April 2026

- Surface water and Ground water directives – Analytical methodology to be adopted 18M after EIF and subsequently inclusion on watch list of emerging substance of concern (24M after EIF)

Recast Urban WasteWater Treatment Directive (EU) 2024/3019

- Mandatory monitoring (future) of microplastics in UWWTP serving above 10,000 population equivalents
- Analytical Methodologies to be adopted July 2027

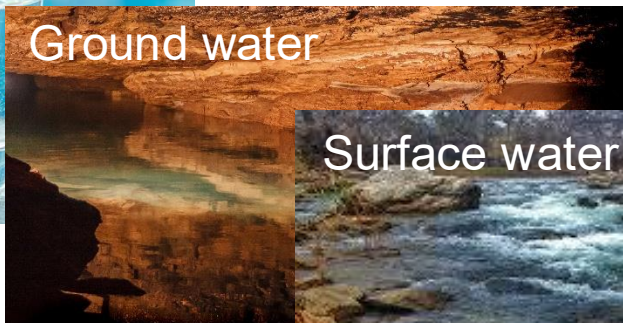
Monitoring in Legislation: Areas supported by JRC

Drinking water directive

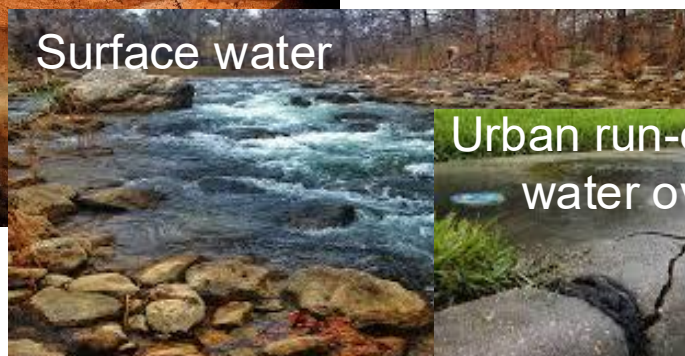


Revised Water Framework Directive:
(EU) 2026/805

Ground water



Surface water



Urban run-off, Storm-
water overflow



Urban Waste Water Treatment
Directive (EU) 2024/3019 (recast)



DELEGATED DECISION (EU) 2024/1441

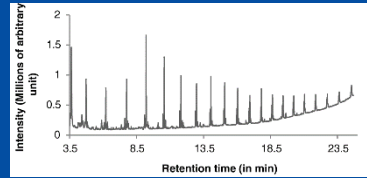
Methodology using large volume sampling and vibrational micro-spectroscopy to identify and quantify microplastic. Future application of methodology if MPs placed on watch list – requires guidance value(s)

WFD: “Commission shall include microplastics in the watch list, provided that methods of sampling and analysis that are reliable and do not entail excessive cost are available. By 1 December 2027 the Commission shall identify such methods of sampling and analysis.”

Note: WL requires threshold values be set which link to an effect/hazard

UWWTD: Influent, Effluent, Sludge,
Urban run-off, Stormwater overflow
Methodologies for 2 July 2027

Microplastics Analytics - Optical or Thermo-analytical methods



Pyrolysis-GCMS

Polymer identity and total mass

Tyre wear rubber detectable

TED-GCMS

Range of information and lower detectable size

Fluorescence Microscopy



Size range $>(2-5\mu\text{m})$ typically $>10-20\mu\text{m}$
Polymer number, shape and size

IR-spectroscopy (μ -FTIR or QCL-IR)



Size range $>5\mu\text{m}$ typically $>10-20\mu\text{m}$
Polymer identity, number, shape and size

μ Raman spectroscopy



Size range $>1\mu\text{m}$
Polymer identity, number, shape and size

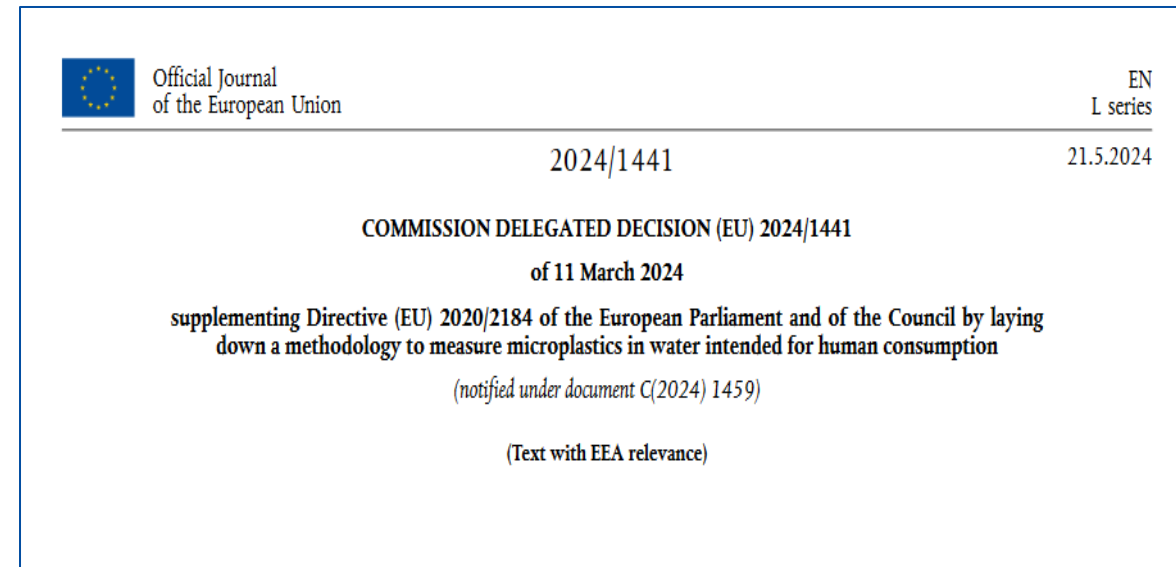
Complexity, cost and analysis time

Legislative Support: Monitoring microplastics in Drinking Water Directive (EU) 2020/2184 (recast DWD)

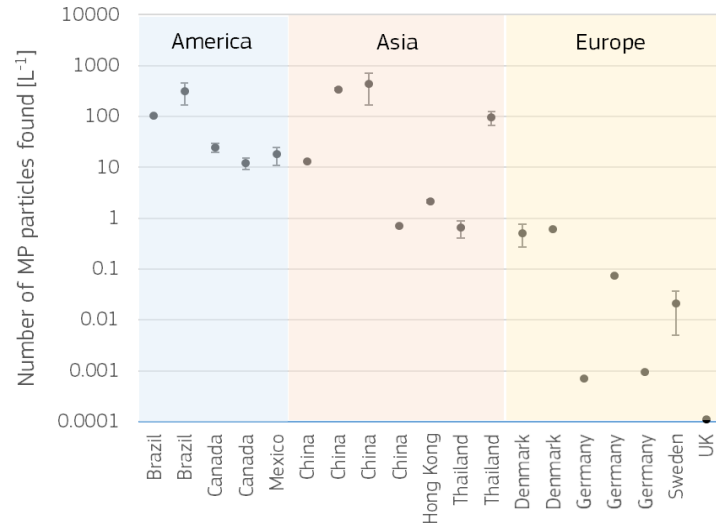
“By 12 January 2024, the Commission shall adopt delegated acts in accordance with Article 21 in order to supplement this Directive by adopting a methodology to measure microplastics with a view to including them on the watch list referred to in”.

Challenges: No suitable (standard) methodology was available, no specific details on monitoring needs in legislation.

- JRC provided support to DG-ENV in defining a methodology
- Methodology based on optical spectroscopy and published as delegated decision (EU) 2024/1441



Defining a Methodology for drinking water



Low levels of microplastics expected in Europe (<1MP L⁻¹)



Large sampling volume required (1m³)

FT-IR/QCL-IR



μ-Raman



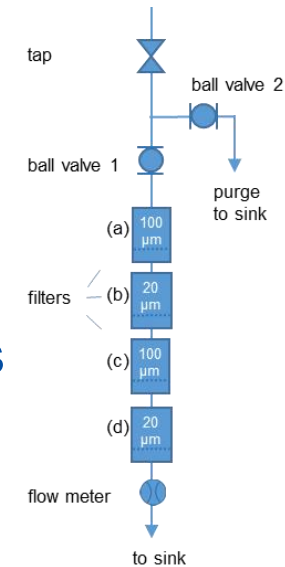
Sensitive, polymer specific analysis with size information

Methodology based on optical micro-spectroscopy (IR, Raman) analysis of filter cascade collected materials : 1m³ sampling volume with collection on 20μm and 100μm filters

Analytical methodology

What it aims to do - key points

- Describes analyte – not a general COM definition but definition for the purposes of the act.
- The analytical techniques to be used – **IR and Raman microspectroscopy**
- The metric – **number based – (particles/fibres) m⁻³**
- Sample volumes (**1000L**) and filtration (**min 20µm**)
- Sample handling and pre-treatment options
- Obliges recovery evaluation and analysis of procedural blanks
- Criteria for categorising the size, shape and composition data
- Additional procedural data relevant to reporting
- Methodology is not a Standard Operating Procedure(SOP) or standardized method

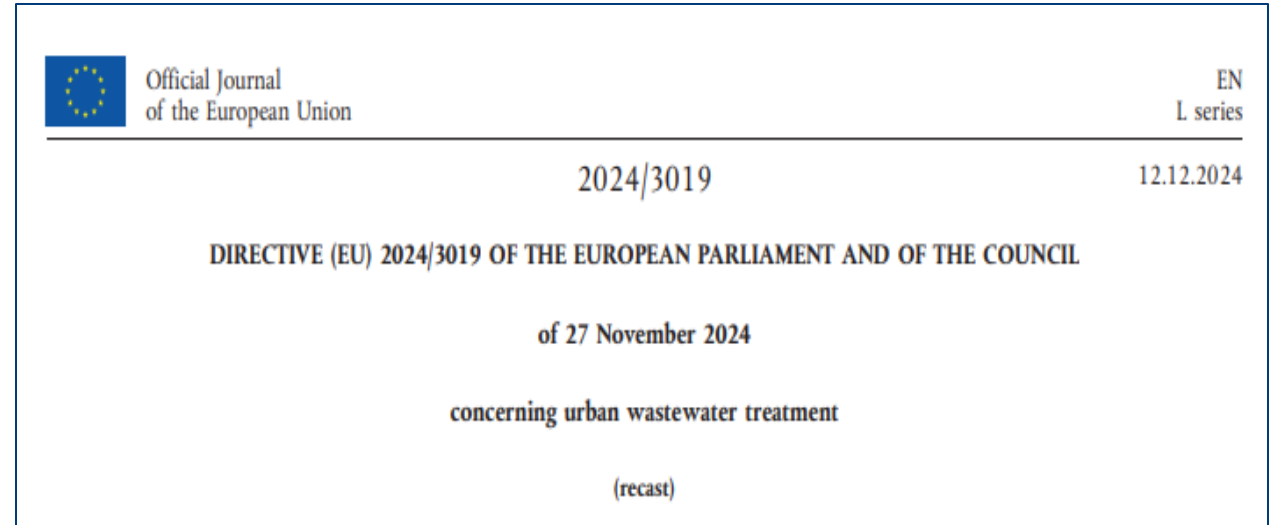


Filter cascade

Status: Method adopted but monitoring requires guidance/threshold values

Legislative Support: Monitoring microplastics under the Urban WasteWater Treatment Directive (UWWTD)

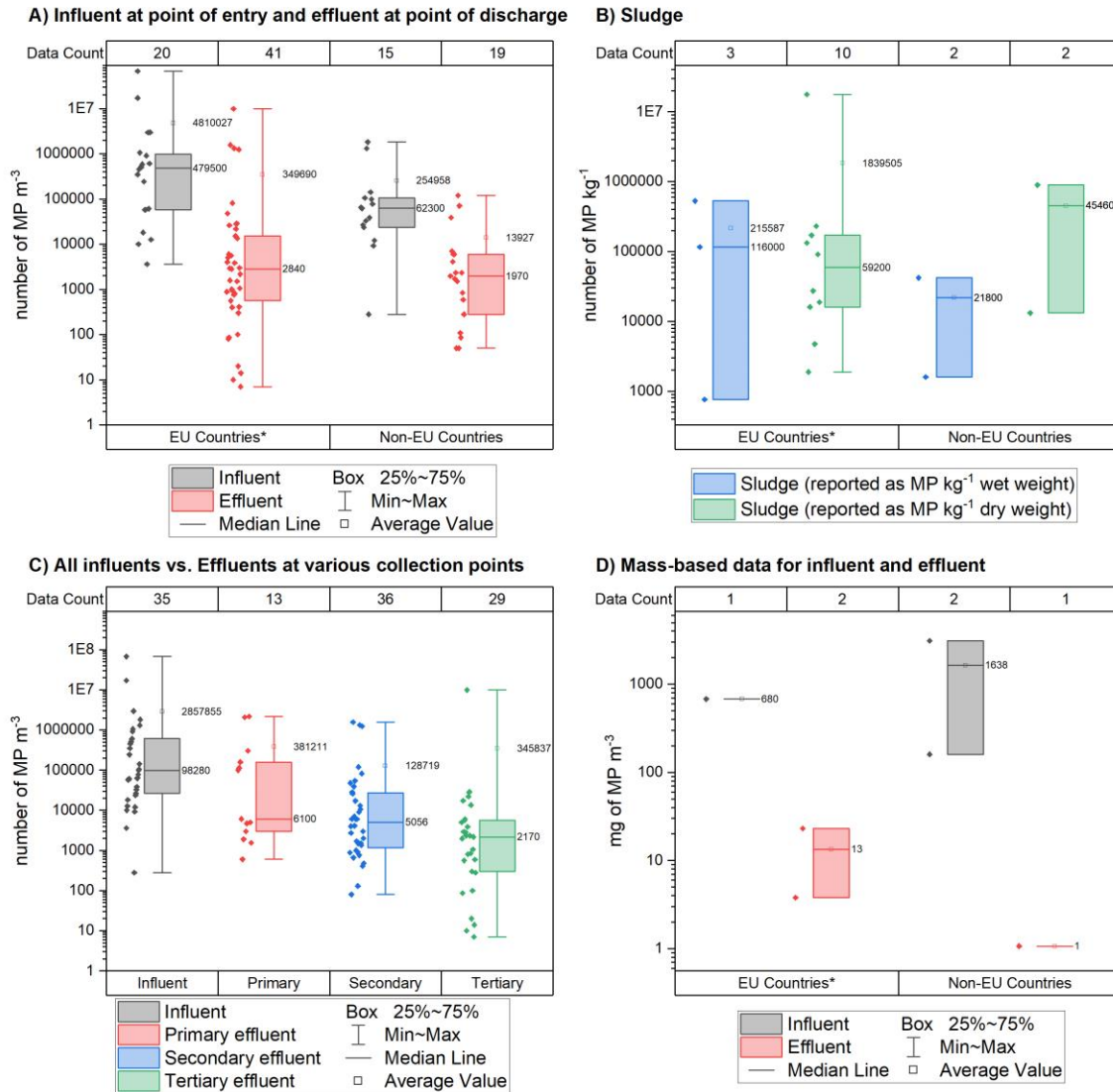
“The Commission is empowered to adopt implementing acts in order to establish methodologies for measuring, estimating and modelling direct and indirect GHG emissions from urban wastewater treatment plants, and microplastics in urban wastewater and sludge. Those implementing acts shall be adopted by 2 July 2027 in accordance with.... “



Issue: No suitable (standard) methodology available for the range of complex media covered by UWWTD

- JRC providing technical support to DG ENV in defining a methodology(ies) for influent, effluent and sludge

Literature review – quantities in WW media



Particle concentrations: Number based

- High (variable) levels in Influent and Sludge – samples of few litres (even less) might be sufficient
- Effluent – MPs removal is > 95-98% so larger sample size should be considered (10-100Litres (<1000 litres...))

Microplastics mass:

- Very few studies of mass (py-GCMS)
 - mg/L influent
 - ug/L in the effluent

Number/mass influenced by particle size distributions and cut-off values of filters used in collection and processing

Methodology for UWWTD

- Define analytical approach – number/mass metric?

Concentrations ARE compatible with both number and mass based methods c.f DWD

- Inclusion of tyre wear? (Input MS and DG-ENV)

Only thermo-analytical methods possible for tyre wear

- Develop in-house experience with prep/analysis of complex media

Effluent and Influent – Optical and thermo-analytical possible

Sludge – thermo-analytical better tolerate less “clean” samples

- Testing/evaluation “toolbox” of existing standards (ISO/ASTM etc)
- Collaboration with experts – LIFECASTADE

=> Establish fit-for-purpose methodology utilising standards where appropriate



Concluding remarks

Legislative monitoring of microplastics – many challenges

- Huge range of concentrations, sizes and sample complexity
- Many distinct characteristics and uncertainty of their link to hazard/risk
- Hazard and exposure data scattered – challenging to derive effect threshold values
- Monitoring on EU scale – large sample numbers, slow throughput and relevant cost

But.... ubiquitous and growing pollutant - precautionary principle is relevant

- Adopt pragmatic approaches which can harmonize data, oblige minimum quality control and (as much as possible) balance conflicting technical and economic factors
- Try to future proof data for use when understanding of hazard/risk matures
- Encourage researchers to use existing data to extract effect thresholds

Thank you

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Standards –progress in relevant areas

Analysis

- **ISO16094-2:2025** “Water quality — Analysis of microplastic in water — Part 2: **Vibrational spectroscopy** methods for waters with low content of suspended solids including drinking water” (see also **AFNOR** XP T90-968-1 OS,DW)
- **ISO/DIS 16094-3** “Water quality — Analysis of microplastic in water — Part 3: **Thermo-analytical** methods for waters with low content of suspended solids including drinking water (see also **AFNOR** XP T90-968-2 TA, DW)
- **ISO/TS 21396:2017** “**Rubber** — Determination of mass concentration of tire and road wear particles (TRWP) in soil and sediments — **Pyrolysis-GC/MS method**”
- **ASTM D8401-24** “Standard Test Method for Identification of Polymer Type and Quantity of Microplastic Particles and Fibers in Waters with High to Low Suspended Solids Using Pyrolysis-Gas Chromatography/Mass Spectrometry
- **California State Water Resources Control Board** : Methodology for DW using μ FTIR or μ Raman

Supporting standards – collection and preparation

- **ISO 5667-27:2025** “Water quality — Sampling — Part 27: Guidance on sampling for microplastics in water
- **ISO 5667-10:2020** “Water quality — Sampling — Part 10: Guidance on sampling of wastewater” – General guidance on wastewater sampling.
- **ASTM D8332-20** “Standard Practice for Preparation of Water Samples with High, Medium, or Low Suspended Solids for Identification and Quantification of Microplastic Particles and Fibers Using Raman Spectroscopy, IR Spectroscopy, or Pyrolysis-GC/MS”

No single standard covers full process of sampling, pre-treatment and analysis for any UWWTP matrix nor SW/GW.