WATERVERSE

Policy Brief

WATERVERSE & the Water Framework Directive: advancing integrated water data management

June 2025

Funded by
the European Union

WATERVERSE mission is to develop a Water Data Management Ecosystem (WDME) for making data management practices and resources in the water sector accessible, affordable, secure, FAIR (Findable, Accessible, Interoperable, Reusable), and easy to use, improving usability of data and metadata, as well as the interoperability of data-intensive processes, thus lowering the entry barrier to data spaces, enhancing the resilience of water utilities, boosting the perceived value of data, and therefore the market opportunities behind it. WATERVERSE takes a holistic, interdisciplinary approach in the water domain, blending complementary competencies of 17 partners located in 10 EU countries, representing the water domain with research organisations (including social sciences experts), water utilities, water domain technology providers and innovation companies, as well as the technical community that is driving the development of data spaces, thus increasing the resilience of the water sector and water utilities, as a whole. The objectives of the project are:

- Engage end-users and stakeholders to identify key challenges in integrating the water sector into quality European Data Spaces.
- Expand and integrate a range of data management tools into the WDME, supporting the entire data management lifecycle — from collection, federation, and harmonisation to validation, processing, and visualisation.
- Develop tools and methods to ensure the WDME's security and energy efficiency.
- Implement and test the WDME in real-world case studies across six European countries, involving diverse water sector stakeholders.
- Establish clear metrics to assess the FAIRness, and reliability of data within water-related data spaces.
- Provide recommendations on how the European regulatory framework can ensure the WDME's long-term sustainability, scalability, and business potential.

This brief outlines how WATERVERSE directly contributes to achieving the goals of the EU Water Framework Directive (WFD, 2000/60/EC), the legal foundation for water resources management across Europe, and provides policy recommendations for enhancing water governance in a data-driven Europe.

Policy Recommendations

1. **Integrate WDME into national water monitoring systems and RBMPs:** Encourage adoption of WATERVERSE tools to promote harmonisation of data models and digital reporting, improving compliance monitoring and reporting.
2. **Standardise data practices:** Promote harmonised use of common standards, ontologies, Smart Data Models, metadata frameworks and FAIR metrics across Member States via the CIS Guidance Documents to include digital interoperability requirements in RBMPs and to ensure cross-border comparability and interoperability of water data.
3. **Foster stakeholder engagement:** Institutionalise WATERVERSE's MSFs as best-practices to align data-driven innovation with local needs and regulatory targets, reinforcing citizen and stakeholder engagement in WFD implementation.
4. **Support digital capacity building:** Equip water authorities and municipalities with the skills and infrastructure needed to operate AI-enabled water management systems by expanding the scope of EU Water Acquis to digital water governance.

Strengthening WFD Implementation

The Water Framework Directive (WFD, 2000/60/EC)[1] is the cornerstone of EU water policy, establishing that all Member States achieve good ecological and chemical status for surface and groundwater bodies through integrated river basin management. Yet, over two decades since its adoption, the EU remains far from meeting its 2027 objectives.

According to the European Environment Agency's *Europe's State of Water 2024*[2] report, only 39.5% of surface waters in the EU currently achieve good ecological status, and a mere 26.8% meet good chemical status. Water stress is now a recurring phenomenon, affecting 20% of EU territory and 30% of the population annually. This reflects a persistent implementation gap despite significant regulatory efforts.

The latest Implementation Report[3] of the WFD[4] shows that "significant work is needed to meet EU targets on freshwater quality and quantity"[5]. The Implementation Report of the WFD also points out some barriers related to water data management to the successful implementation of the WFD's objectives:

- Monitoring obstacles:
  - Incomplete assessments due to the lack of robust reporting mechanisms;
  - Heterogeneity of reporting, monitoring and indicators schemes and methodologies between Member States, leading to inconsistent datasets that are hard to compare or integrate at the EU level.
- Digital obstacles[6]:
  - Lack of electronic reporting or partial submission of electronic reporting;
  - Insufficient digitalisation of water data by Member States and technical difficulties in using the EEA reporting platform (WISE-Freshwater[7]), that could improve monitoring, prediction, and decision-making.
- Governance obstacles:
  - Harmonisation gap of data water systems at EU level, which hampers comparing the overall status assessment and consolidating data for cross-border basins or EU-wide reporting;
  - Lack of funding, reduced administrative capacity and a lack of technical limits the effective use and maintenance of digital water systems;
  - Lack of coordination between Member States.

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[1] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, EUR-LEX, November 2014

[2] *Europe's state of water 2024: the need for improved water resilience*, EEA Report 07/2024, European Environment Agency, October 2024

[3] *7th Implementation Report* (2024), COM/2025/2 final, EUR-Lex, February 2025

[4] The Implementation Reports are the result of the EU Commission's assessment of the third river basin management plans (RBMPs) and second flood risk management plans (FRMPs), upon which the governance of the WFD is framed. Further, the implementation of the WFD is also supported by a Common Implementation Strategy (CIS) Working Group, which provides guidance and technical documents to the implementation of the WFD.

[5] *Commission reports show faster progress is needed across Europe to protect waters and better manage flood risks*, European Commission, Press Release, February 2025

[6] Digital barriers have been identified previously by the European Commission in its publication *Digitalization in the water sector recommendations for policy developments at EU Level - Publications Office of the EU*, 2022

[7] Water Framework Directive | WISE Freshwater

In parallel, climate change is intensifying pressures on water resources, while underexploited digital innovation hinders timely and effective decision-making. In this context, advancing integrated, data-driven water governance is essential, as stressed by the Water Resilience Strategy. Strategic initiatives aligned with the WFD's objectives must therefore address both technological and institutional boundaries to ensure water resilience across Europe.

WATERVERSE addresses systemic gaps in digital water governance by establishing a secure, inclusive, and replicable Water Data Management Ecosystem, as explored in the next section. It enables efficient data management, sharing, and interoperability, resulting in better decision-making and enhanced cross-sector collaboration. Its alignment with the WFD, the backbone of EU water policy, strengthens Europe's capacity to monitor, protect, and restore water bodies amid increasing climate and societal pressures. Scaling up its use across EU Member States can support the achievement of the WFD objectives and support the implementation of the recently published EU Water Resilience Strategy.

WATERVERSE contributions to the Water Framework Directive

WATERVERSE contributes to enhanced water resilience in the EU by contributing to the Water Framework Directive:

WFD article	WFD Objective	Contribution of WATERVERSE	Relevance
Art. 3, Coordination of administrative arrangements within river basin districts **Art. 13, River basin management plans**	Art. 3: Ensure cross-border coordination for transboundary basins Art. 13: RBMPs must be developed for each river basin every 6 years	**Interoperable tools for integrated river basin management:** • The WDME employs FIWARE Smart Data Models and EU-aligned ontologies (e.g., SAREF4WATR) to break silos and standardise reporting across regions[8]. • Data models are compatible with INSPIRE and support ETSI NGSI-LD and DCAT-AP standards, ensuring cross-border operability of River Basin Management Plans (RBMPs)[9].	WDME enables **interoperable** RBMPs, hence contributing to harmonised planning across river basins. WATERVERSE fosters **data sharing and cooperation** among water authorities, sectors (e.g., agriculture, energy), and countries, which is critical for integrated River Basin Management Plans (RBMPs) under the WFD. Improved interoperability helps manage **transboundary water bodies** more effectively.
Art. 8, Monitoring of surface water status, groundwater status and protected areas **Art. 15, Reporting**	Art. 8: Establish monitoring programmes and ensure standardised sampling and data management Art. 15: Member States must submit implementation reports every 6 years	**Smarter monitoring and reporting systems:** • WATERVERSE enables real-time, high-resolution monitoring through integration of heterogeneous data sources (IoT, satellite, SCADA, legacy systems)[10]. • FAIR Data Metrics and MELODA5[11] are applied to assess and optimise data and metadata quality, traceability, and reuse across borders and authorities[12].	WATERVERSE **improves data accuracy** and reporting by facilitating **real-time, high-resolution monitoring**, improving the **quality** and extension of national monitoring programmes.
Art. 14, Public information and consultation	Involve stakeholders and citizens early and effectively	**Enhanced Public Participation and Stakeholder Inclusion:**	WATERVERSE Multi-Stakeholder Forums (MSFs) promote **public participation**,

[8] For more information: https://www.fiware.org/smart-data-models/

[9] Gerasimos Antzoulatos, Di Bernardo, R.; Vargiu E., Unlocking value-added services for Data Management in Water Sector: The WATERVERSE case (accepted to announced in SWAN Conference 2025)

[10] WATERVERSE, D3.2 – WATERVERSE Water Data Management Ecosystem v2, 2024 (sensitive). In this document, WATERVERSE reviews each tool that will be part of the ecosystem including data sources and layers such as data connectors and IoT agents

[11] Other tools have been developed by WATERVERSE that enable to assess and validate the quality of the data: Data Quality Assessment Tool, Data Validation and Reconciliation Tool, and Data Balancing Tool

[12] WATERVERSE, D4.5, FAIR metrics and FAIR evaluations services V2, 2024

		• Through Multi-Stakeholder Forums (MSFs), WATERVERSE brings together environmental agencies, utilities, municipalities, civil society, and researchers to co-design digital tools and data strategies[13]. • The case of the DESAL+ Living Lab (Spain) shows how digital engagement strengthens stakeholder trust and responsiveness to local challenges[14].	strengthening **stakeholder legitimacy**. By making water data more **accessible, transparent, and understandable**, WATERVERSE empowers citizens and stakeholders to engage in WFD-mandated participatory planning processes.
Art. 16, Strategies against pollution of water	Progressive reduction & elimination of water pollution by priority substances	**Advanced monitoring of priority substances:** • WATERVERSE enables real-time, high-resolution monitoring through integration of heterogeneous data sources (IoT, satellite, SCADA, legacy systems)[15]. • AI-driven modelling tools predict water quality[16]. • WATERVERSE uses semantic data models (FIWARE, SAREF4WATR) compatible with INSPIRE and DCAT-AP standards, ensuring comparable pollution data across Member States.	WATERVERSE supports **pollution reduction** tracking and contributes to reducing priority hazardous substances by helping to **detect the presence and evolutionary trends** of priority substances through **AI-driven tools**. Additionally, WATERVERSE promotes services for the **continuous monitoring** of **water quality** in water bodies by detecting **algal bloom concentrations** through **satellite imagery analysis**.

Policy Recommendations

WATERVERSE demonstrates that integrating digital innovation, synthetic data, and multi-stakeholder engagement enhances the efficiency and resilience of water management systems. WATERVERSE can support the WFD going beyond its goal of ensuring good water quality and support the transition towards increased water availability by contributing to smart water control, providing reliable and real-time monitoring data harmonising data and reporting schemes between Member States, while reducing administrative burdens.

Policymakers are encouraged to adopt the following recommendations:

[13] Torello M. ; Seshan S.; Vamvakeridou-Lyroudia L. ; van der Leulen S., "Engaging the WATERVERSE: A case study in stakeholder co-creation and engagement for the sustainable development of a Water Data Management Ecosystem", September 2023

[14] The DESAL+ Living Lab (Las Palmas, Canary Islands, Spain), Water4All_Atlas of WOLLs_2024 .pdf

[15] WATERVERSE D4.1, FAIR Principles Guidelines, 2023

[16] WATERVERSE First Policy Brief, *Driving a Water-Smart EU with Interoperable and AI-Enabled Water Data Ecosystems*, WATERVERSE-Policy-Brief-final.pdf, May 2025

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Scaling the WATERVERSE WDME across EU Member States presents a transformative opportunity. As Europe prepares for the upcoming Water Resilience Strategy, harmonising digital infrastructure with governance will be critical to ensuring sustainable water management for future generations.

In the Dutch pilot site[17], WATERVERSE deployed its Water Data Management Ecosystem (WDME) to integrate real-time data from IoT sensors, SCADA systems, and satellite observations across multiple regional water authorities.

Using FIWARE-based smart data models, the pilot harmonised diverse datasets on water quality and infrastructure performance. This enabled the creation of a unified approach through the WDME, which supports:

- Continuous monitoring and assessment of ecological and chemical status under the WFD
- Cross-agency coordination on pollution hotspots and groundwater abstraction
- Proactive decision-making using AI-driven trend forecasting for chloride levels
- Trigger alerts thanks to satellite imagery, informing real-time operational decisions on Algal Bloom development

The pilot demonstrated how digital tools can enhance data interoperability, monitoring accuracy, and adaptive governance, directly supporting Articles 8, 13, and 16 of the WFD.

[17] WATERVERSE Pilot 1. Prediction of water quality and its impact in the treatment steps, Province of North Holland, Netherlands, Pilot 1 – WATERVERSE

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