

Xylem measurement technology for innovative rainwater and gray water management in Mannheim's new "Aubuckel" district

Water scarcity and heavy rainfall events

Increasing water scarcity and, at the same time, more frequent heavy rainfall events in urban areas pose considerable challenges for municipal water supply companies and sewerage systems. The "ReSource Mannheim" research project, funded by the German Federal Environmental Foundation, addresses these challenges through innovative rainwater and graywater management in Mannheim's new Aubuckel district. The goal is to treat, store, and reuse 100 % of the rainwater and graywater generated locally in order to conserve drinking water and reduce the burden on the sewer system. The district was officially opened in August 2025 and the technology was put into operation.

Xylem supported the project as the main supplier of measurement technology. Read on to learn more about the project and Xylem's measurement technology solution.

Conserving drinking water, improving the microclimate, promoting groundwater levels, and reducing the burden on the sewage system

In the new Mannheim city district, so-called gray water, i.e., wastewater from showers, sinks, and washing machines, is treated directly on site using modern process technology and reused as "service water." It is used in households as a substitute for valuable drinking water in toilet flushing and washing machines, as well as in the outdoor area of the district to feed an 80 m³ pond system. This consists of three interconnected ponds and is additionally fed with collected rainwater.

Storing service water and rainwater in the pond system reduces the load on the sewer system and improves the local microclimate. At the same time, it creates a "blue-green oasis" for local residents to relax and unwind. Excess water flows through the pond system and is fed into the groundwater via an infiltration basin – an additional contribution to promoting the local water balance.



Fig. 1, top: View of the pond system in the newly opened "Aubuckel" district of Mannheim

Fig. 2, bottom: Conceptual representation of the pond system, integrated into the new district.

Source: Technische Universität Darmstadt FG Entwerfen und Stadtentwicklung Prof. Dr.-Ing. Annette Rudolph-Cleff Dr.-Ing. Simon Gehrmann

Xylem measurement technology for process monitoring and control

To ensure the ecological balance in the pond system, continuous monitoring of water quality and availability is necessary. For this purpose, the fill level, temperature, oxygen content, conductivity, pH value, turbidity, ammonium, nitrate, orthophosphate, and chlorophyll are measured at various measuring points. The measurement data is transmitted to a local control unit and is used to regulate and optimize the entire system. The technical infrastructure of the facility comprises two underground operating rooms: one room for gray water recycling and one room for pond measurement technology.

- **Graywater recycling:**

In this area, graywater undergoes two-stage biological treatment, followed by ultrafiltration and UV disinfection (Figure 3). The treated water is stored in an intermediate tank and then fed into both households and the pond system as service water.

- **Pond measurement technology:**

Here there are three black plastic basins that are continuously fed with water from one of the three ponds (Figure 4). They serve as representative measuring points for reliably monitoring the pond water quality. For aesthetic and safety reasons, the measurement technology was not installed directly in the ponds themselves. Only the water level is measured directly in the ponds. The water flowing out of the measuring basins is collected in a collection tank and pumped back into the ponds.

In addition, a cistern has been installed outside to store rainwater collected from the roofs and make it available for filling the pond. Table 1 on the following page summarizes the measuring points and the parameters recorded for each. It also provides an overview of the target values and the respective control function.

A total of 24 sensors from Xylem were installed, which were integrated into two IQ SENSOR NET systems with over 200 meters of cable. These are installed in the room for pond measurement technology and transmit the measured values to the control technology via MODBUS TCP/IP. The division into two systems was made because the maximum capacity per system is 20 sensors. A complete list of all Xylem sensors and system components can be found in the appendix.

The recorded measurement data makes it possible to monitor the general condition of the system and identify correlations with meteorological events such as rain or temperature changes. In the future, there are also plans to integrate an AI-based control system that will optimize pond control based on current measurement data and weather forecasts, thereby preventing the pond ecosystem from tipping.



Fig. 3, top: The graywater recycling room with 2-stage biological treatment and UF of the graywater



Fig. 4, bottom: The pond measurement technology room with extensive Xylem measurement technology

Location	Parameters	Target value	Control function
Ponds	Fill Level	> 9 cm	If too low, then fill the pond with rainwater/service water
Basins with pond water	Oxygen	> 4 mg/L	If too low, start circulation and sprinklers to introduce O ₂ .
	Temperature	< 30 °C	If too high, start circulation and sprinklers, or feed in colder rainwater/service water
	Conductivity	< 700 µS/cm	If too high, dilute with rainwater/service water
	pH	7-8	Monitoring and possible buffering with rainwater/service water
	Turbidity	—	Monitoring of algae growth and possible activation of circulation and dilution
	Nitrate	0.5–1 mg/L	
	Orthophosphate	10–35 mg/m³	
	Chlorophyll	< 7 mg/m³	
Pond water collection tank	Fill Level	< Maximum	If too high, return to the ponds
Cistern	Fill Level	—	Monitor the availability of rainwater for pond feeding
Service water tank	Fill Level	—	Monitor the availability of service water for pond feeding
	Oxygen	4–8 mg/L	Monitor and, if necessary, do not feed into ponds
	Temperature	< 30 °C	
	Greywater recycling system	Control of the 2-stage biology and UF-MBR system (operation and provision by other manufacturers)	

Table 1: Summary of measuring points and measured parameters, as well as target values and control function

Figures 5 and 6 provide an overview of the recorded fill levels and pond measurement data for Pond 1 from August 1, 2025, to September 17, 2025. Rainy days and rainfall amounts are also marked. Among other things, it can be seen that the fill levels of Ponds 1 to 3 rise on rainy days, as expected. On August 25, 2025, there is also a noticeable increase in the water levels of the ponds, which is due to manual filling with tap water.

In Pond 1, daily variations in pH and oxygen content (O₂) typical of pond ecosystems can also be observed. These are mainly due to the photosynthetic activity of aquatic plants. During the day, the plants consume carbon dioxide for photosynthesis, which causes

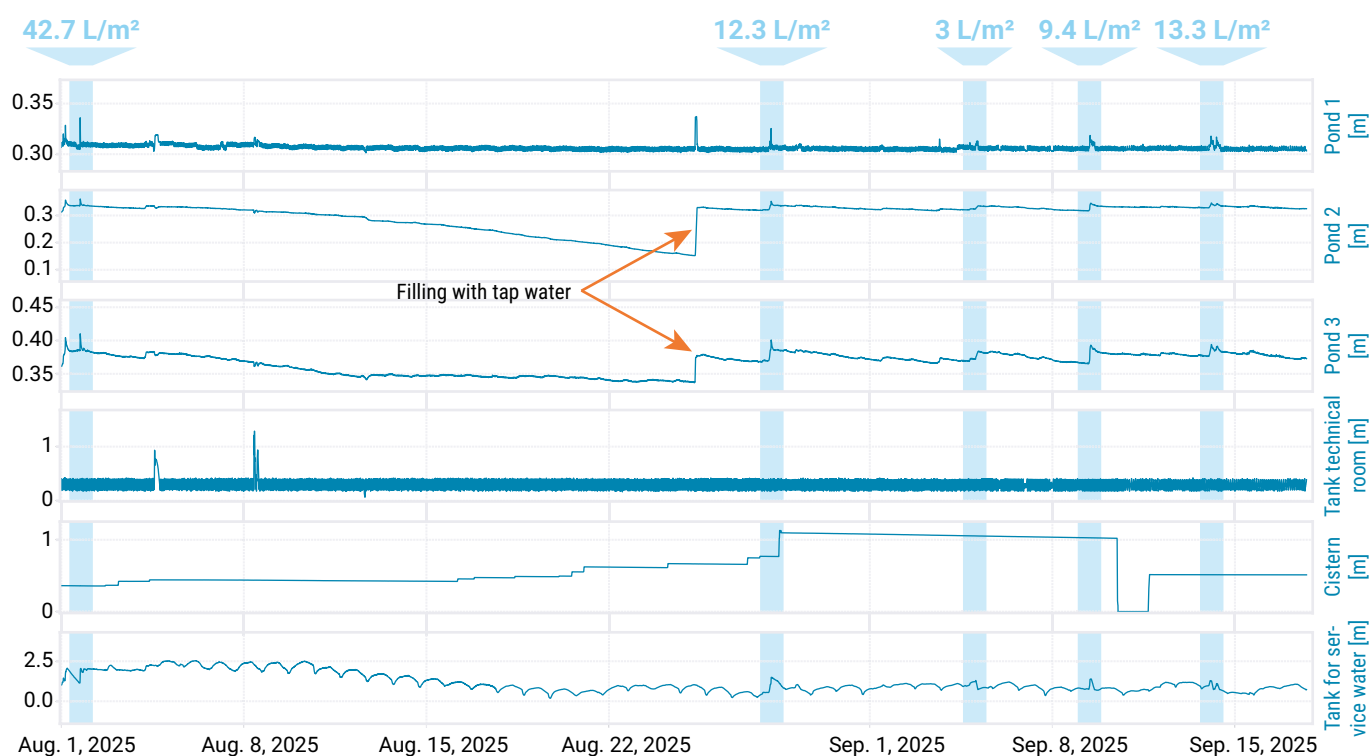


Fig. 5: Fill level measurements with marking of rainy days and rainfall amounts

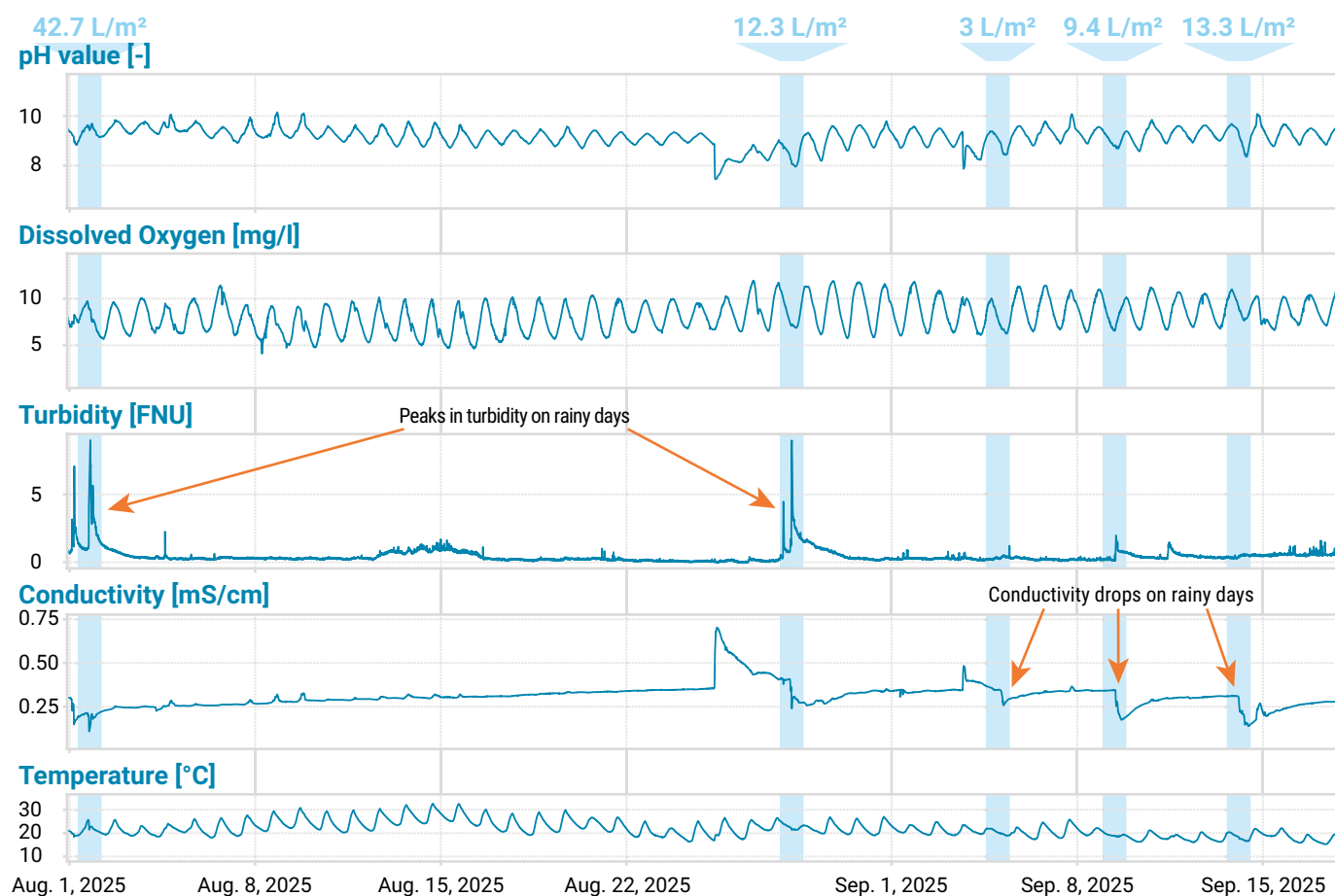


Fig. 6: Water quality measurements in pond 1 with marking of rainy days and rainfall amounts

the pH value and oxygen content to rise, while at night they release CO_2 and consume oxygen during cellular respiration, causing the pH value and oxygen content to fall. Other influencing factors are:

- **Temperature:**
Warm water can bind less oxygen.
- **Cloud cover:**
Less light leads to less photosynthesis.
- **Nutrient content:**
High nutrient concentrations promote algal blooms and thus greater fluctuations in daily cycles.
- **Water movement:**
Mixing can distribute oxygen or bring in fresh air.

Turbidity and conductivity respond to rainfall events, with turbidity rising sharply and conductivity falling due to dilution by rainwater. Manual filling on August 25, 2025, can be recognized by a sharp drop in pH and an increase in conductivity. A detailed evaluation of the nutrient parameters $\text{PO}_4\text{-P}$ and $\text{NO}_3\text{-N}$ is not currently possible due to the short operating time. Nevertheless, the results to date confirm the functionality and suitability of the measurement technology for the project.

Summary

In the flagship project “ReSource Mannheim” an innovative concept for urban rainwater and gray water management was implemented in the new Aubuckel district of Mannheim. Rainwater and gray water are treated locally and used both as service water in households and to feed a pond system. This saves valuable drinking water resources and effectively reduces the load on the sewage system. As the main supplier of measurement technology, Xylem supports the project with sensors and analyzers to monitor various fill levels and water quality in a pond system. The data obtained is used to control and regulate the pond system with the aim of ensuring ecological balance and providing residents with a “blue-green oasis” for local recreation.

We would like to express our sincere thanks to everyone involved in the project for their excellent cooperation, especially the Department of Design and Urban Development at TU Darmstadt, which supported Resource:Mannheim with great commitment from the conceptual development stage right through to implementation.

Key Takeaways

- Xylem convinced: Quality, consulting, and service contributed significantly to the success of the project.
- Sustainable water management: Local treatment and reuse of rainwater and gray water conserves drinking water resources and reduces the burden on the sewage system.
- Modern technology & future potential: Comprehensive measurement technology monitors water quality; in the future, AI-supported control will ensure a stable ecosystem.

Appendix

Products used in this application:

Location	Parameters and, if applicable, pond assignment	Xylem measurement technology
Service water	Fill Level	Expert™ 7060
	Oxygen	FDO® 700 IQ with pipe fitting
Cistern	Fill Level	Expert™ 7060
Ponds	3x Fill Level (pond 1, 2, 3)	Expert™ 7060
	Fill Level in the collection container	Expert™ 7060
Measurement technology room	3x Oxygen (pond 1, 2, 3)	IDS FDO® 925
	3x pH (pond 1, 2, 3)	IDS SenTix® 945
	3x Conductivity (pond 1, 2, 3)	IDS TetraCon® 925
	3x Turbidity (pond 1, 2, 3)	VisoTurb® 700 IQ
	2x Nitrate, Nitrite (pond 2, 3)	UV 705 IQ NOx
	2x PO ₄ (pond 2, 3)	Alyza® IQ PO4
	1x Chlorophyll (variable Position)	EXO3s with Total Algae Sensor (ProDSS Total Algae PC Sensor)
		2x MIQ/TC 2020 3G
System components		2x MIQ/PS
		3x MIQ/IDS4
		2x MIQ/MC3
		3x MIQ/JB
		1x MIQ/IC2
		> 200 m sensor cable SACIQ



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