SCIENCE FOR ENVIRONMENT POLICY

Sewer leakage: first nationwide estimate of pollution leaking from urban systems, Germany

Sewer systems are a potentially major source of urban groundwater pollution; water can leak through structural faults (or 'exfiltration' — i.e. through fractures or intruding tree roots) and be absorbed by surrounding soil, which can introduce nutrients, suspended solids and microbes into nearby water bodies. Estimating sewer leakage and exfiltration is important for effective management of urban waste-water systems, say the researchers of a new study that explores sewer leakage at the national scale in Germany.

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Quantifying sewer exfiltration is challenging. Analysis is often limited to public systems[1] and major pipe areas and large networks where inspection data is available — and data is often reported for major defect sites where pipes have heavily deteriorated, meaning that results from smaller-scale studies cannot be accurately scaled up to municipality, district or state scales without a risk of leakage overestimation. Models typically either neglect or simplify the pollution contributions from sewers, leading to a key question: how significant is sewer leakage and exfiltration as a source of pollution in large-scale urban systems?

To address this question, the study proposes an extended model framework to integrate catchment-scale sewer data and evaluate exfiltration at the nationwide scale, applying it to the case study of Germany. According to the [German Association for Water, Wastewater and Waste](#), approximately 20% of Germany's public sewers are sufficiently defective to allow exfiltration and are in need of short- to mid-term rehabilitation, highlighting the value of improved modelling and understanding the country's urban waste-water systems.

The researchers aimed to a) estimate the potential magnitude and spatial distribution of sewer exfiltration nationally; b) quantify the contribution of different public and private ageing pipes to this exfiltration; c) estimate the nutrient loads attributable to sewer exfiltration in large urban systems; and d) predict the potential effects of non-compliance of remediation to ageing defective sewers[2].

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They analysed data from 11 379 municipalities in the 16 federal states of Germany[3] on the total connected populations, sewer network conditions, waste-water volume and loads, and number of effective days of storm-water events per year across Germany's sewer systems. The sewer system includes rain-water sewers, separated black-water sewers (BW; toilet wastewater) and combined sewers (CS, collecting rain and blackwater in a single-pipe system). Nutrient emission was quantified using the Modelling of Nutrient Emissions in River Systems (MONERIS) model, and exfiltration for public and private sewers was estimated via a mix of verified methods at local to city scales, upscaling techniques and expert knowledge.

The researchers find the average national sewer exfiltration rate to be less than 0.01 litres per second per kilometre (L/s/km), corresponding to a loss of roughly 2% of generated wastewater to groundwater. The highest exfiltration rates arise in urbanised regions with larger connected populations, higher densities and sewer networks which are often over 40 years old. Where sewers are mostly younger (built after 1981), private pipes might contribute twice as much exfiltration as public systems. In terms of nutrient loads, sewer exfiltration accounts for 9.8% and 17.2% of the total nitrate and phosphate loads[4] emitted to the environment from urban waste-water systems. This increases to a predicted 11.2% and 19.5% in a 'no remediation' scenario (as sewers become more defective with age).

Under the Urban Waste Water Treatment and EU Water Framework Directives, pollution from urban wastewater must be stringently controlled and mitigated to keep EU waters clean. As the first nationwide estimation of waste-water losses from leaking sewers in Germany, this study helps to quantify potential leakage in urban waste-water systems at the national scale, say the researchers, emphasising the importance of rehabilitation planning for ageing public and private sewer pipes and supporting improved strategies for long-term nutrient pollution control and urban waste-water management.

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