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Transferability of exfiltration rates from sewer systems

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Models to describe in- and exfiltration of sewer systems require a large amount of data for calibration, which are often difficult and expensive to measure and to acquire. Therefore, it is to be questioned whether results from various studies could be joined in one model. Herein, the transferability of exfiltration rates from one sewer(-catchment) to another is one of the crucial points. Thus, exfiltration rates derived from field measurements and from literature (field and laboratory investigations) are compared with respect to

- Catchment characteristics: Measurements were performed within 5 homogeneous catchments. It is to be tested whether catchment characteristics significantly affect wastewater exfiltration.
- Applied methods: Tracer tests (.....Rieckermann et al., 2005) provide the fraction of tracer loss from a sewer line. Single defects cannot be located. Pressure testing aims at estimating exfiltration of single damages to correlate exfiltration to the kind of related damage. Yet, it is unconfirmed whether such tests represent leakage under real conditions or whether they even changes the leakage of the pipe to the worse. Thus, only tests under non-pressurized conditions are considered here. Test rigs and their simulated damages cannot represent the dimensions and soil conditions in real sewer systems. Overall, the varying experimental setup makes it difficult to compare the results.
- Experimental site: Laboratory studies on exfiltration seem to be more attractive due to the defined boundary conditions. Field studies always require a high effort to obtain reliable results, even more in sewers. Hence, it is to be tested, whether results from laboratory studies differ significantly from field studies

and why.

- Leakage area: Closed-circuit television (CCTV) serves as a substitute for sewer characteristics. From those records the leakage area is obtained calculating an exfiltration per day and cm^2 leakage area.

We measured exfiltration in 2 catchments and compared our findings with published data of 2 catchments and 1 laboratory study. As expected, exfiltration rates are different. Therefore, we investigated whether experimental design dominates the variance of measured data. The results were compared by means of statistical methods to reveal significant differences in means and variances.

We present Kruskal-Wallis analysis of ranks and analysis of covariance (ANCOVA), which yield significant differences between all predictors and dependent variable (exfiltration rate), indicating that transferability of data might be difficult. ANCOVA exhibited significant differences in exfiltration rates grouped by method, controlled by catchment as covariate with a reduction in treatment variance.

References:

.Rieckermann, J., Borsuk, M., Reichert, P., and Gujer, W. (2005) A novel tracer method for quantifying sewer exfiltration. *Water Resources Research* **41**(5).