



## Identification of sewage leaks by active remote-sensing methods

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The increasing length of sewage pipelines, and concomitant risk of leaks due to urban and industrial growth and development is exposing the surrounding land to contamination risk and environmental harm. It is therefore important to locate such leaks in a timely manner, to minimize the damage.

Advances in active remote sensing Ground Penetrating Radar (GPR) and Frequency Domain Electromagnetic (FDEM) technologies was used to identify leaking potentially responsible for pollution and to identify minor spills before they cause widespread damage. This study focused on the development of these electromagnetic methods to replace conventional acoustic methods for the identification of leaks along sewage pipes. Electromagnetic methods provide an additional advantage in that they allow mapping of the fluid-transport system in the subsurface. Leak-detection systems using GPR and FDEM are not limited to large amounts of water, but enable detecting leaks of tens of liters per hour, because they can locate increases in environmental moisture content of only a few percentage along the pipes. The importance and uniqueness of this research lies in the development of practical tools to provide a snapshot and monitoring of the spatial changes in soil moisture content up to depths of about 3–4 m, in open and paved areas, at relatively low cost, in real time or close to real time. Spatial measurements performed using GPR and FDEM systems allow monitoring many tens of thousands of measurement points per hectare, thus providing a picture of the spatial situation along pipelines and the surrounding. The main purpose of this study was to develop a method for detecting sewage leaks using the above-proposed geophysical methods, since their contaminants can severely affect public health. We focused on identifying, locating and characterizing such leaks in sewage pipes in residential and industrial areas.