ASTERRA

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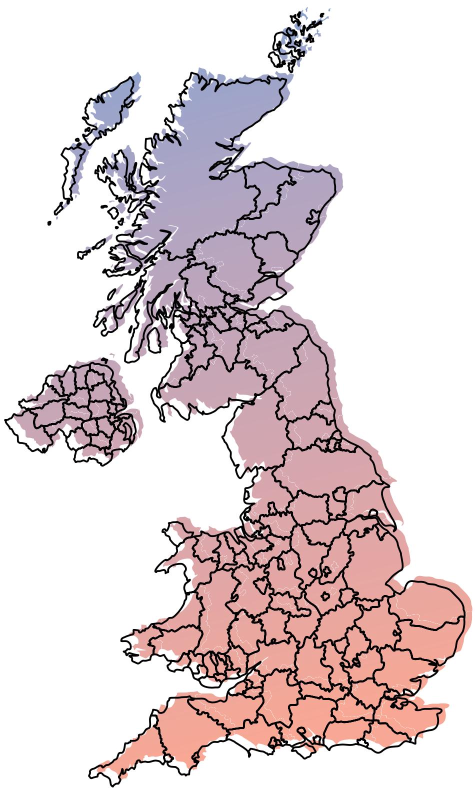
Identifying Sewer Exfiltration Using Satellites

UK Utility | Together with SUEZ UK

BACKGROUND

Identifying defects and exfiltration in sewer pipes is difficult and costly for utilities that own and operate these assets. However, not identifying defects is costly as well. Infiltration adds treatment costs and contributes to system overflows, and exfiltration causes contamination of surrounding water bodies and ground areas, potentially leading to penalties. New techniques must be developed and tested to allow utilities to identify sewer line defects in an efficient and cost-effective manner, at scale. This case study examines the ongoing use of L-band synthetic aperture radar (SAR) satellite imagery analysis to detect sewer leaks, and identify sites of probable exfiltration (SOPEs). ASTERRA pioneered the use of SAR from satellites to detect leaks from underground potable water pipes. The technology was commercialized in 2016 and has to date identified almost 100,000 potable water leaks worldwide. The analysis of the radar backscatter signals can identify likely leaking locations via the detection of wet subsurface soil that has potable water characteristics. The efficacy of this technique in potable water applications has led to the development of an algorithm to detect wastewater exfiltration in the same manner. ASTERRA has partnered with SUEZ UK and a UK utility to perform a test to corroborate the ability of SAR to detect sewer exfiltration locations.

The retrospective study was designed to determine if the ASTERRA algorithm could detect the presence of wastewater exfiltration in the vicinity of a sewer rising forcemain. The rising main is a sewer pipe system that is pressurized by a pump station to lift the wastewater so it can be gravity fed to a treatment plant location. A series of pump stations and associated rising main pipe sections were identified by the utility. Some of these locations had experienced pipe bursts and subsequent exfiltration in the preceding months. This information was not provided to ASTERRA and thus this is a blind retrospective study. ASTERRA analyzed historical satellite images of these areas that were collected prior to the time period being analyzed. The goal was for the ASTERRA algorithm to detect the SOPE that correlated to the actual pipe burst. This would show the ability of the program to identify sewer pipe defects early in their life cycle so that they could be repaired and contamination avoided.



Three SOPE's were identified as having an elevated chance of sewage exfiltration in this study. A fourth pipe burst occurred within the time period and area identified for the study but a SOPE was not recorded. This may be due to the fact that the satellite image was collected almost three weeks prior to the burst. The pipe may not have been leaking at this point in time. This suggests that an ongoing survey of pipe sections be conducted so that early warning of defects can be noted and rapidly deteriorating pipe sections can be identified.

The technology achieved a 75% hit rate, in that it was able to identify 3 of 4 pipe bursts in the study area. This is consistent with a study performed in Florida in 2020 where 80%, four of five, of the SOPE's identified by ASTERRA on forcemains exhibited signs of wastewater contamination based on soil and water sampling. A total of 14 SOPEs related to gravity mains were also identified with 71% of them, 10 of 14, having defects that would result in exfiltration.

These defects were identified by CCTV images that were analyzed by an AI driven algorithm. The systems where pipe bursts were predicted were in-line and terminal pump stations and the rising mains consisted of both iron and PVC piping. The pipe type is not a factor in the ability of the technology to identify SOPEs.

The ASTERRA technology showed it can successfully identify sewer pipe defect locations that can cause wastewater exfiltration.

Other technologies that are used in pressurized systems include acoustic monitoring and gas tracer protocols. The acoustic methodologies do not work well since the pressure in the

pipe network is not very high. The higher the systems pressure the louder the sound emanating from a leak and the more successful an acoustic sensor would be at finding the leak. Helium tracer techniques have a better performance compared to acoustic techniques and require fewer modifications to the pipe network. Gas tracers can be used to pinpoint the defect subsequent to the ASTERRA program identifying SOPEs.

CONCLUSIONS

- The ASTERRA program can help minimize the areas where pinpointing functions such as gas tracers have to be deployed
- The ASTERRA satellite analysis can identify SOPE which can then be checked by field teams with gas tracers to determine exact location of defects. This can save time and money for the utility.
- ASTERRA can also provide an early warning notification so that utilities can avoid high category pollution events.

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