Transforming leak detection capabilities using landscape modelling and drone thermal imaging

sweep

Impact Summary

This project boosted South West Water's understanding and potential capabilities to identify underground leaks, which can be hard to identify using standard 'in-pipe' monitoring. Operational leak detection methods and approaches were developed using publicly available datasets, remote sensing tools and drone technology. SWW's £10.5m investment in the Centre for Resilience in Environment, Water and Waste (CREWW) continues to strengthen their relationship with the University of Exeter.

Ways of Working

Innovative Knowledge Provision | Effective Collaboration | Capacity Building

Why it mattered?

Leaks from submerged water mains pipes and aqueducts give rise to major operational and environmental costs within the water services industry. Within the South West England water network, overseen by South West Water (SWW), there are over 15,000km of buried pipes and every year £7m is spent on detecting and tackling leaks in the network.

The biggest challenge towards addressing major systematic leaks is detecting them. Pipes often lie deep underground and identifying the exact location of a leak can be hard using standardised 'in-pipe' monitoring. Optical signatures of leaks seen above ground can be indistinguishable from natural patterns in soil surface wetness.

State-of-the-art thermal imaging approaches, previously developed by the University of Exeter SWEEP team, allow patterns of near-surface and surface water to be mapped from proximal sensing technology, including lightweight drones.

Analysis of thermal imaging data can be combined with spatial information describing surface structure, to provide useful proxies for identifying pathways of water movement through landscapes. This SWEEP project was developed to test these approaches in an operational setting.

> *"We've halved leakage levels in our region, but we know there's more work to do. We'll be investing over £50m in the next ive years to help us achieve a minimum 15% reduction in leakage by 2025."*
>
> **Tackling leakage, South West Water**

What we did

The SWEEP team was comprised of University of Exeter Impact Fellow Dr David Luscombe, and academics Dr Karen Anderson and Prof Richard Brazier. They worked closely with SWW staff to develop the technology and trial its operation. Activities involved:

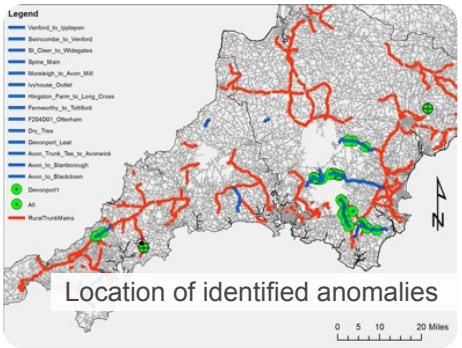
- Construction of the drone platform for data acquisition.
- Design construction and programming of ground validation sensors.
- Developing and implementing a provisional method to target leak detection effort, by combining the above technologies with freely available remote sensing data. Features which are not clearly visible on the ground, or able to be hydrologically understood in isolation from the surrounding landscape, can also be identified.
- Deploying Unmanned Aerial System (UAS) mounted thermal cameras, in combination with near infrared imaging sensors, to detect leaks from rural water supply infrastructure.

Key outputs included:

- Twenty candidate anomalies (areas where leakage from the water supply network is likely) identified in 2019 and supplied to SWW.
- Case study and report detailing the investigation of a specific anomaly near the village of Tregony in Cornwall.
- Review of limitations of approach for: (1) drone flight operation and subsequent data processing and interpretation; and (2) targeting of on-the-ground leak detection actvities.

Reports include:

- Poster report: Mains water leak detection using landscape modelling and UAV-based thermal imaging data: methods and approach.
- Final report to SWW.
- Tregony Case Study.



Location of identified anomalies

Impacts & benefits delivered

Attitudinal

Strengthened partnership approach at strategic level with SWW: Undertaken in partnership with SWW, this work enhanced the collaboration and transfer of research-based knowledge into SWW and the new £31m Centre for Resilience in Environment, Water and Waste (CREWW). CREWW is a transdisciplinary research centre, located at the University of Exeter, established in 2020 with investment from SWW (£10.5m) and Research England (£21.5m). CREWW is undertaking research into some of the most pressing environmental challenges facing the waste and water sectors.

Extended learning - methodologies developed were also used in:

- SWW-funded MIRES Project on peatland restoration monitoring.
- Research into UAS-based thermography and restoring (re-wetting) of drained peatland landscapes.
- £30k SWW-funded project on impact of summer drought on water pipe leakage.

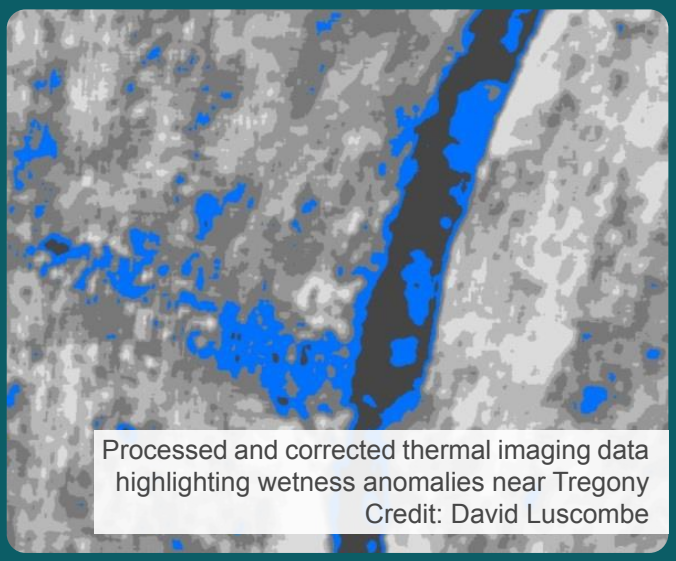
Organisational Function

Improved SWW's capabilities and knowledge for leak detection: This project developed: (1) operational leak detection method for detecting surface anomalies consistent with water main leaks using publicly available datasets and remote sensing tools; and (2) an operational approach for deployment of drones at locations identified as candidate leak anomalies, to aid in leak detection in hard to access or survey locations.

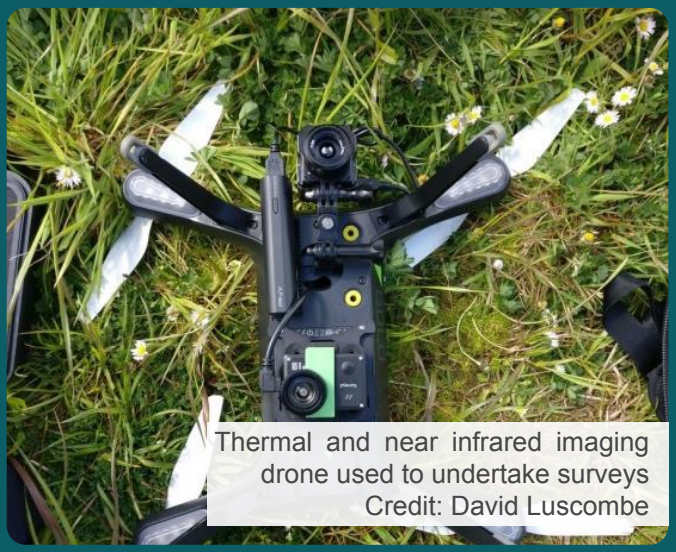
Organisational Function

Potential reductions in potable water lost from the water network:

- may reduce the requirement to abstract water from natural watercourses, improving overall aquatic health and environmental/resource resilience.
- benefit business and consumers via reduced water supply costs.



Processed and corrected thermal imaging data highlighting wetness anomalies near Tregony
Credit: David Luscombe



Thermal and near infrared imaging drone used to undertake surveys
Credit: David Luscombe

Looking to the future

For more information contact sweep@exeter.ac.uk

Organisation we worked with

South West Water

Underpinning NERC Science

- NE/J015237/1 - Fragments, functions and flows - the scaling of biodiversity and ecosystem services in urban ecosystems
- NE/F000421/1 - Remote sensing of peatland responses to hydrological change
- NE/TS/K00266X/1 - Developing a New Integrated Aerial Vehicle Platform 'Quest Earthwater' for assessing hidden blue water supplies

About SWEEP

The South West Partnership for Environmental & Economical Prosperity (SWEEP) is a partnership between the University of Exeter, the University of Plymouth, and Plymouth Marine Laboratory. Funded by the Natural Environment Research Council and stakeholders together to solve key challenges faced by those working with our natural resources. **www.sweep.ac.uk**

UKRI Natural Environment Research Council