

Remote Satellite Imaging for Leak Detection – Green Bay Water Utility Case Study

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ABSTRACT

In an effort to reduce real water losses, Green Bay, Wisconsin has embarked on a program using the Utilis satellite radar leak detection technology to identify likely leak locations within their service area. Green Bay has approximately 7% unaccounted for water, real and apparent losses, and 150 known water main leaks per year. During 2019 a total of 57 leaks were found using this innovation along with traditional boots-on-the-ground field leak correlation. This compares with an average of 13 leaks found per year using traditional leak detection methodologies during the previous ten years at Green Bay.

Introduction

Utilis utilizes Synthetic Aperture Radar (SAR) signals from satellites to illuminate the area of interest and collects the resulting reflected signals. These signals are analyzed with the Utilis patented algorithm and processed to identify specific indicators of wet soil saturated with potable water, screening out the signal noise and other interference. The result is a map showing likely leak locations, or Points of Interest (POI). These results typically encompass 5 – 10 % of the entire system length, so that the time and resource cost to inspect is much lower than traditional walk-the-line random inspections. Only locations where there is expected to be a leak are inspected.

The Green Bay Water Utility distribution system dates to the 1880's and now encompasses more than 500 miles of transmission and distribution mains. The utility has 35,600 service connections with an average daily demand of 18MGD. Green Bay has approximately 7% unaccounted for water, real and apparent losses, and 150 known water main leaks per year. To reduce real water losses Green Bay has embarked on a program using the Utilis satellite radar leak detection technology to identify likely leak locations within their service area. During 2019 a total of 57 leaks were found using the Utilis satellite imagery pre-location technology with

internal Green Bay crews performing the field leak detection work. Over the past 10-year time period Green Bay has pro-actively discovered an average of 13 leaks per year with their internal crews.

Green Bay currently has approximately 510 miles of transmission and distribution mains and serves 35,600 service connections. Their cost of water production is \$0.41 per 1000 gallons and the average retail customer water price is \$3.50 per 1000 gallons. Green Bay currently has two dedicated leak detection inspectors on staff. They work in two-person crews. This is the same method benchmark data and traditional data are compiled.

Results

Two satellite surveys and subsequent field inspection programs have been executed thus far at Green Bay during 2019. The overall results are listed in Table 1. This table shows all the leaks identified pursuant to the Utilis satellite surveys including customer side leaks. These outcomes result in a performance metric of 1.4 leaks being found per crew day and 1.0 leak found per mile physically inspected.

The total cost of the Utilis service was \$103,000. The satellite imagery and analysis were \$32,500 for each of the two services for a total of \$65,000. The cost of the field inspection is based on a

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Table 1

GREEN BAY UTILIS RESULTS					
	LEAKS	CREWDAYS	LEAK/DAY	MILES	LEAK/MILE
TOTAL	57	40	1.4	55	1.0

Table 2

GREEN BAY UTILIS RESULTS – LEAK LOCATIONS					
	MAINS	SERVICE	HYDRANT	VALVE	CUSTOMER
TOTAL	12(25.0%)	15(31.3%)	8(16.7%)	13(27.1%)	9(NA)

two-person crew cost of \$784 per day and a truck cost of \$168 per day, for a total of \$952 per crew day. Based on 40 crew days of work, the field inspection pursuant to the Utilis leak pre-location service was \$38,000.

The following analysis will utilize only the number of leaks found on main and service lines, as these are the utility-side leaks that contribute to lost revenue. This cohort of leaks will be used to calculate the value proposition of the work, including water loss reduction, dollars saved and return on investment.

The Utilis-directed work organized the leak types by seven categories: mains, services, valves, hydrants, curb stops, meters and customer side. This data is contained in Table 2. Customer-side leaks are reported in the table but will not be included in the analysis. Of the 57 leaks detected by Utilis, 48 are on the utility side of the meter and are thus considered non-revenue water leaks. Of these 48 leaks 12 were on a main line, or 25%, 15 leaks were on a service line, or 31.3%, 8 were at hydrants, or 16.7% and 13 were at valves, or 27.1%.

Cost Benefit Analysis

It is notoriously difficult to estimate the rate and duration of leakage from mains and service lines. Both factors weigh heavily on the value proposition, ROI and simple payback value metrics. In AWWA Manual M36, Water Audits and Loss Control Programs, main line leaks are estimated to be 10.4 gpm, service line and valve leaks are estimated to average 6.9 gpm, and hydrant leaks are estimated to average 3.5gpm. M36 is silent on curb stop and meter leaks. Using data from the cohort of 1800 traditional projects the average main line leak was 9.0 gpm, service line was 3.3 gpm, service connection was 1.6 gpm, valve was 6.7 gpm, hydrant was 1.0 gpm, curb stop leak was 0.7gpm and the average meter leak was 0.4gpm. This dataset will be the leak flow rates used in the following economic analysis as it is more conservative than the M36 metrics.

A total of 12 main line leaks, 15 service line leaks, 13 valve leaks, and 8 hydrant leaks were discovered by the Utilis program during the first two services. Based on the abovementioned leak flow rates the main line leaks total 108 gpm, the service line leaks total 49.5 gpm, the valve leaks total 87.1 gpm, and the hydrant leaks total 8 gpm, for a total water loss reduction of 173.6 gpm, or, 0.25 MGD. This is an overall yearly water loss reduction of 91.3 MGY. Identifying and repairing these leaks in the Green Bay system would result in a lowering of the unaccounted-for-water from 7% to 6.3%. This is a 10% reduction in total unaccounted for water volume.

The Green Bay cost of water production is estimated at \$0.41 per 1000 gallons. This is the avoided cost, or value proposition, of the water loss reduction. This equates to a value proposition of \$102 per day due to this leak detection and repair program, or \$37,400 per year in savings. Based on an investment of \$103,000 this equates to a ROI of 36% or a simple payback period of 2.7 years.

Conclusions

The results obtained pursuant to the Utilis directed work at Green Bay is consistent with other North American Utilis projects, even though their cost of water production and unaccounted-for-water is very low. Utilis was able to identify many more leaks per year than the traditional boots-on-the-ground, point-to-point, inspection program. The real water loss rate was reduced significantly due to this one-year program. Preliminary results from the 2020 Utilis work shows a similar number of leaks found and a similar distribution of leak types. In addition, the two services found a similar number of leaks in the same pressure zone, suggesting a clustering effect in that area. It has been anecdotally observed that the number of surfacing leaks has been reduced year-over-year. These results will be codified and reported in a subsequent presentation.