



PERFORMANCE ANALYSIS
ASTERRA SATELLITE LEAK DETECTION SERVICES

City of Prichard, AL
August 2024



Executive Summary Report

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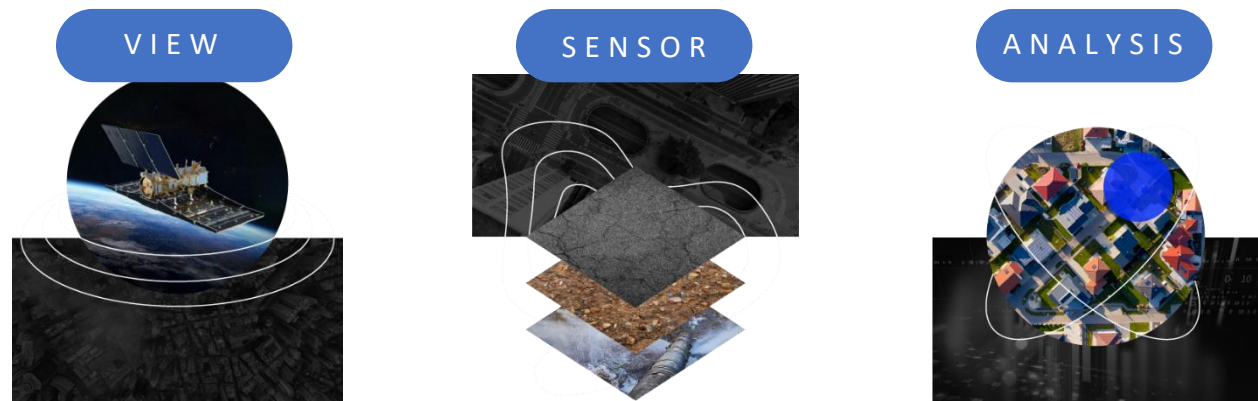
SUMMARY

This executive summary paper analyzes the ASTERRA satellite leak detection services performed in June 2024 for the City of Prichard, AL. Performance will be compared to benchmark results achieved in other ASTERRA projects around the world and North American traditional boots-on-the-ground (BOTG) leak detection projects.

- A total of **42 leaks** were found pursuant to the satellite directed field inspection; 21 leaks were on the utility side and 21 leaks were on the customer side of the meter.
- The water loss value identified is \$409,771 per year of water loss savings.
- The total real water loss volume found by this program was 0.41 MGD or 149 MGY.
- Each crew field day identified 9.9 MGY of water loss volume. A total of 15 field crew days identified 149 MGY of potential recovered water supply.
- The total service cost, ASTERRA satellite surveys plus BOTG field leak inspection, mobilization and report preparation was \$65,000.

The simple payback period is 1.9 months.

ASTERRA TECHNOLOGY



ASTERRA utilizes specialized radar signals taken from a satellite to scan the area of interest and collect the resulting reflected signals. These signals are analyzed and processed to identify specific indicators of wet soil saturated with potable water, screening out the signal noise and other interferences. The result is a map showing points of interest. The ASTERRA analysis typically highlights 5-10% of the entire system length, and only these locations, where there is expected to be a leak, are inspected by BOTG leak detection teams. Thus, the time and resource cost of leak detection is much lower than traditional leak detection approaches (e.g., full-system, random, systematic, or block map).

The steps taken during the City of Prichard, AL leak detection service begin at the satellite data acquisition phase and then move into the leak detection field investigation phase whereby the leak detectors investigate points of interest generated from the satellite imagery, and confirm the leaks in the field into actionable data. The steps taken over the course of the satellite service to the field investigation are outlined as follows:

- 1. Data Acquisition:** Obtain L-band satellite imagery of the City of Prichard's area of interest (potable water lines).
- 2. Analysis:** Apply patented algorithm based on soil saturation (highlighting points of interest within the City of Prichard's system showing elevated levels of potable water saturation). The number of points of interest generated for the City of Prichard represented 11% of the system (out of 269 miles of pipe analyzed, 11%, or 29 miles, was highlighted as points of interest). Therefore, instead of having to investigate all 269 miles for one survey, the leak detectors are

able to strategically investigate 29 miles of pipe highlighted by the satellite imagery.

3. **Data Integration:** Integrate points of interest data into online platform for the end-user to utilize and investigate via acoustic leak detection (platform is called EO Discover).

4. **Visualization:** Present points of interest visually within the EO Discover platform, which also includes the City of Prichard's water lines mapped out for reference when investigating points of interest in the field.

5. **Quality Control:** Perform QA/QC on data prior to releasing data to end-user.

6. **Delivery:** Provided City of Prichard with delivery email containing a link to the online EO Discover platform containing points of interest and hosted a tutorial on the platform.

7. **Acoustic Field Investigation:** Subcontracted acoustic leak detection team then investigated the highlighted points of interest within the City of Prichard's system.

8. **Final summary/report:** City of Prichard received leak cards from the investigation for the repair crews to fix the leaks. The utility is also able to review the results from the survey via the online EO Discover platform. The cycle then repeats upon further satellite scans and analysis.

The aforementioned process is represented in the following summarized results from the satellite service and field work performed for City of Prichard in 2024.

CITY OF PRICHARD, AL SERVICE AREA RESULTS

The satellite image for the City of Prichard, AL service area was collected in April 2024 and covered the entirety of its service area. Table 1 shows the results from the work performed. A grand total of 42 leaks were found during this effort. Of the 42 leaks found by ASTERRA direction, 21 were on the utility side of the meter, and thus are non-revenue water leaks, while 21 were on the customer side of the meter. The 42 leaks were found in 15 crew inspection days. A total of 14 miles of pipeline were physically inspected by the BOTG crews. This resulted in a performance metric of 2.8 leaks per day found and 3 leaks found per mile inspected.



The field inspection work was conducted on June 3rd for 15 days. The breakdown of the 21 utility side leaks found by subtype is listed below in Table 1, which lists the flow size estimated by the leak detectors.

Table 1

Real Water Losses Identified

REAL WATER LOSS IDENTIFIED BY LEAK TYPE - GPM				
Leak Type	Number	POIs	Flow Rate (GPM)	Total Flow (GPM)
Main Pipe	1	10029	100	100
Main Pipe	2	10019, 10031	50	100
Main Pipe	1	20025	25	25
Fitting Valve	1	10067	20	20
Main Pipe	2	10058, 10082	10	20
Meter	2	10001, 10009	5	10
Connection	1	4520 Saint Stephens Rd	2	2
Connection	3	10043, 10064, 10068	1	3
Service Pipe	1	10025	1	1
Curbstop	1	10065	.5	.5
Curbstop	2	10051, 20030	.25	.5
Service	1	4834 Outlaw Rd	.25	.25
Meter Fitting	1	10073	.25	.25
Main Pipe	1	10019	.25	.25
Meter Fitting	1	10092	.1	.1
Total	21			282.8

DISCUSSION

The following analysis will focus on the real water loss value identified by the ASTERRA directed field leak inspection work. Real water loss value found by this program is 0.41 million gallons per day, or 149 million gallons per year, and the data is listed in table 2. This is calculated by multiplying the number of each type of leak (e.g., main, service, and other) found by the ASTERRA directed field inspections by its estimated leak flow rate approximated by the leak detectors from the field. This resulted in an average leak flow rate of 13.5 GPM. This factor was applied to the 21 utility side leaks found via the ASTERRA directed program.

Table 2

Water Loss Recovered

ASTERRA DIRECTED LEAKS - WATER LOSS				
	Number of Utility Leaks	Average Leak Flow Rate	Daily Water Loss Rate	Yearly Water Loss Reduction
Total	21	13.5 GPM	408,240 GPD	149 MGY

A total of 15 crew days were spent inspecting the points of interest (POIs) for leaks that contribute to the lost water. A total of 149 MGY of potential water loss was identified based on the leak estimates. Thus, each day a crew spent searching for leaks generated 9.9 MGY of potential water loss reduction, or effectively new supply. This lost water could be used to meet additional demand in the system without the need for additional aquifer withdrawals, or new capital improvements. These results show that crews spending days in the field searching for leaks, pursuant to the ASTERRA satellite program, generate valuable results.

Approximately 48% of the leaks found by field inspections (20 of 42) resulting in real water loss are due to leaks that have not yet surfaced. These leaks potentially can last for many months or even years before they are discovered without the ASTERRA survey program. Locating these leaks earlier adds to the value proposition of the satellite program. Furthermore, the efficiency of satellite guided leak detection can also be quantified by comparing the field investigation results for the City of Prichard, AL project with ASTERRA versus traditional methods (i.e. blind surveys) of leak detection as displayed below in Table 3.



Table 3

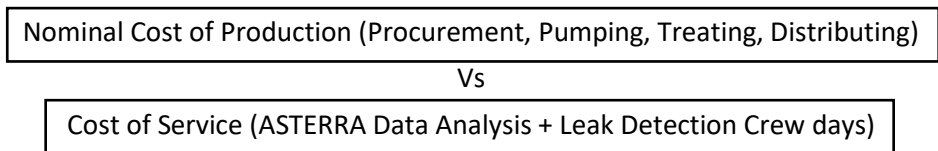
Benchmarking Comparison: ASTERRA Versus Traditional Leak Detection

ASTERRA Benchmarking			
Year	Leaks/Day	Miles/Day	Leaks/Mile
USA Average 2009-2018	1.3	3.9	0.33
City of Prichard, AL Results	2.8	0.9	3.0
Comparison	115% Increase	24%	809% Increase

Table 3 shows the results of the current project compared to the USA averages of leaks found using traditional methods of leak detection (without satellite guided technology) over a 9-year period. Table 3 conveys that using ASTERRA guided satellite leak detection, an increase in **115%** leaks were verified per day, whilst only having to investigate **24%** of the miles/day compared with traditional leak detection methods. Also, the current project achieved **809%** increase in the leaks/mile verified by the field crew compared to traditional methods of leak detection. The aforementioned benchmarks highlight the efficiency and effectiveness of satellite guided leak detection.

VALUE PROPOSITION

To calculate the value proposition of the ASTERRA satellite leak detection services, the cost of the work must be compared to the value of the water loss reduction. The value of the water is considered to be the nominal cost of production as opposed to the price to the customer. The cost of service is comprised of the satellite imagery collection and analysis cost plus the leak crew cost. The value of water loss reduction is calculated by estimating the volume of water lost, the duration of the leak and the cost of water procurement, treatment, and delivery.



To calculate the amount of water lost per leak, a number of options are available. The estimated flow rates approximated by the field crew are used in this analysis. Customer side leaks and work order leaks will not be used to calculate non-revenue water loss reduction. The daily leak loss rate will be normalized to a yearly value for the purposes of calculating the value benefit to City of Prichard, AL.

The cost of production is comprised of the cost of procurement, pumping, treatment, and distribution. The cost of water production is estimated to be \$2.75 per 1000 gallons. These factors generate the dataset used to create the individual figures and thus calculate the financial savings to City of Prichard, AL. **Overall total cost of service was \$65,000, and the total value accrued was \$409,771. This generates a simple payback period of 1.9 months.**

Another way to benchmark the value proposition of the ASTERRA service is to calculate the cost to recover water supply through the identification of non-revenue water leaks. This is calculated by dividing the total cost of service by the recovered water volume.

$$\text{Cost of Recovered Water Supply} = \text{Cost of Service} / \text{Recovered Water Volume}$$

When the cost of the recovered water is lower than the cost of production this signifies a low marginal cost of new supply. 149 MGY of water loss was identified at a cost of service of \$65,000, resulting in a cost of recovered water supply of \$436 per MG. Thus, the cost of the recovered water supply is significantly lower than the cost of production at \$2,750 per MG. This shows the value of the program.



RECOMMENDATION

It is recommended that City of Prichard, AL continue to pursue leak detection monitoring with ASTERRA. Leaks continue to arise even as non-surfacing leaks are found and repaired. By continuing with ASTERRA monitoring, real water loss levels will stabilize and ultimately reduce. Furthermore, renewing the ASTERRA monitoring service, and switching to our new subscription model generates a consistent and proactive leak assessment solution.

Having a proactive method of identifying high risk points in the system mitigates the risk and incurred costs of deploying emergency repair crews to customer identified leaks, all the while facilitating a planned response to subsurface leaks otherwise not identified. By utilizing ancillary services for planning their response to leaks within the system, this also reduces crews working over the weekend and creates safer excavations. It is recommended that City of Prichard, AL continues proactive leak detection monitoring with ASTERRA by subscribing to the Prevent or Advise package.

Benefits of the Prevent and Advise Packages:

Temporal/Spatial Analysis:

Often utilities deprioritize proactive leak detection and standard maintenance efforts due to resource constraints. In most cases, utilities are forced to use limited resources in response to call-ins or work orders. This results in falling further behind the curve and increased pipe breakage and non-revenue water losses. In order to re-invest in proactive system maintenance and leak detection, Recover provides a highly efficient means to survey points of interest and avoid blindly surveying an entire utility's system of pipes. Temporal and Spatial analysis identifies clusters of leaks whereby the client can better focus its efforts in the future. These clusters of leaks can be used for asset management purposes, e.g., capital improvement and replacement planning. Leaks are continuously arising and enlarging, thus temporal/spatial analysis over the course of a year, or over a period of years, will continue to generate a significant number of leaks even in areas previously inspected.

