ENHANCING URBAN CROSS BORE PREVENTION PROGRAMS WITH CLOUD-BASED GIS

Unearth delivers on the abandoned promises of legacy desktop GIS with a cloud-based GIS platform that's mobile-friendly and easy-to-use.

by Morgan Sullivan

Unearth provides a simpler, more profitable way to manage location-based data: one that's optimized for monitoring and maintaining physical structures.

The Cross-Bore Problem in the US

On March 13, 2006 in Middletown, Ohio, Mechelle Eldridge's family home was leveled by a massive gas explosion. Eldridge was at work when the explosion occurred, but her mother, Vikki Gibson, as well as her three children were in the house when the gas line was ruptured.

According to Gibson, the plumber they had hired to unclog a sewer line ran upstairs and told her she had three minutes to get the kids out of the home: saying, "the house could explode anytime." [1]

Gibson got the kids out of the house and, looking back, saw the structure engulfed in flames.

This near-tragedy is just one of a surprisingly long line of cross-bore related incidents in the United States.

As there were no injuries or atalities, the Middletown explosion - though by no means a positive occurrence - is one of the least calamitous cross bore gas explosions. Past incidents, such as the home explosion in Kenosha, Wisconsin in 1976 - the incident that first brought national attention to the lethal threat of cross

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bores - resulted in the deaths of two people: a father and son. [2]

What are Cross Bores?

Cross bores are the unintentional intersection of underground utilities. Though cross bores can occur between any type of utility, the most dangerous ones involve gas lines.

With the Middletown explosion, a gas line had unintentionally been bored through the sewer line. In a case like that, when a plumber attempts to clear a clogged sewer line, they often use a rotating root cutter - as is standard practice. [3]

The problem arises when that same root cutter meets the cross bored gas line, rupturing the pipe.

Gas from the ruptured line flows in the most natural direction: the structure above. From there, all it takes is a pilot light, or even the flick of a light switch to trigger an explosion.

What Causes Cross Bores?

Trenchless technology is at the heart of the cross bore problem in the United States. With minimal disruption to ground surface, traffic, and everyday activities, trenchless drilling is faster and more efficient than other methods of laying pipeline.

The problem is that trenchless technology, also referred to as horizontal drilling, doesn't allow the contractor or utility to see where the new line has been laid, or if it has intersected with anything along the way. There are an estimated 1 million cross-bores in the United States. [4] The more gas and sewer lines that exist in an area, the higher the likelihood of cross-bores. Within urban areas, some estimates for cross bores are as high as 2-3 per mile. [5]

Responsibility for legacy cross-bore detection and mitigation, as well as new cross bore prevention, falls to regional utilities. As significant as these programs are, they are also quite challenging to execute.

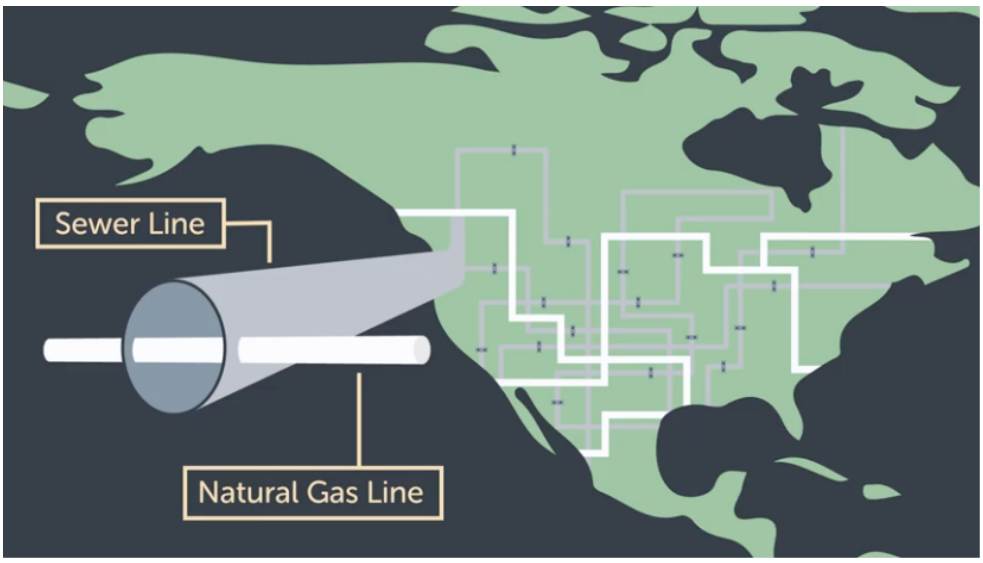

Figure 1: Illustration of Cross Bores in the United States.

The only way to avoid deaths from existing cross bores is to manually inspect every length of sewer pipe in the United States. Prevention programs often follow the same protocols as legacy, but with a narrower focus. [6] The line is drilled and then, with utmost precision, every sewer lateral within the path of the drill is inspected for cross-bore occurrence.

The challenge of collecting, managing, and storing this quantity of dispersed location-based data is immense. This is where cloud-based GIS comes into play.

Simply put, cloud-based GIS enables utilities and their inspectors to create permanent, easily accessible records of all cross-bore detection, mitigation, and prevention activity. More than that, it enables field teams to collect data using a mobile device and upload it directly into the GIS mapping system.

These capabilities stand in direct contrast to desktop GIS: solving a multitude of issues and inefficiencies.

What Causes Cross Bores?

Cross bore prevention programs are focused on preventing the occurrence of new cross bores.

These programs progress in three general phases: pre-inspection, inspection, and post-inspection review and recording. [7] Cloud-based GIS increases the efficiency and speed throughout all three phases.

Increased efficiency is important for several reasons. Primarily, it allows utilities and contractors to complete inspections faster with the same, or even lower budget. This means that more lines can be inspected in a shorter amount of time, decreasing the risk of ruptured cross bores and increasing safety overall.

Part 1: Pre-inspection

Objective:

1. Check records to identify existing gas and sewer lines
2. Create maps with gas facilities, wastewater, and planned construction.

Challenges: The system of record for cross bore detection and mitigation is often varied in methods and difficult to maintain. Most utilities rely on a combination of desktop GIS, paper maps, handwritten documentation, and inspection videos - often stored on external hard drives and DVD's.

As each utility is responsible for hundreds, if not thousands of miles of pipeline, the data is often convoluted and incomplete.

Role of cloud-based GIS: Cloud-based GIS bridges the gap between data collection and data management, which in turn simplifies the process of record keeping and map making. With cloud-based GIS, inspection crews can upload photos, videos, and map annotation while they're still in the field - creating a record in real-time.

Real-time record keeping eliminates the need for manual transcription, allows for immediate data review, and ensures that the data is organized and readily available for future reference.

Part 2: Inspection

Objective:

1. Clear sewer main lines with cameras
   and sonde locators
2. Clear lateral lines with cameras and sonde locators
3. Gather GPS coordinates of relevant structures in both main and lateral lines
4. If cross bores are found, repair immediately.

There are two schools of thought when it comes to prevention inspection. One posits that all lines should be mapped and accounted for in order to help drilling crews avoid cross bore creation completely.

These inspections rely on cameras attached to sonde locators, which use radio frequency to report horizontal position and approximate depth of sewer lines. The lines are then marked on the surface above using paint.

The other approach is to drill without pre-inspection, and then inspect immediately after to see if any cross bores were created. This approach may seem counter intuitive at first, but it is actually favored by some because it eliminates the duplicative work inherent to the pre-inspection option. With pre-inspection, even if all lines are mapped ahead of time, they must still be inspected after drilling to ensure that no cross bores were created accidentally. [8]

Challenges: No matter the approach, this part of the process creates an incredible amount of location-based data. This information must be collected onsite, transmitted to the office, integrated into the larger inspection program, and recorded for future use.

Figure 2: Illustration of Inspection.

Inspection data is often recorded using paper maps. This method presents a multitude of issues, ranging from the physical limitations of paper (getting wet or torn), to lack of organization, to something as seemingly mundane as poor handwriting.

Not only that, but even if all the data is collected and recorded successfully on paper maps, it must then be transferred by hand into a digital database: wasting time and increasing opportunities for error.

Pipeline inspection also involves terabytes of video recording. These videos must be saved, associated to a specific location on the map, and stored for future reference. As you might imagine, associating digital videos to paper maps at scale is a considerable organizational challenge.

Role of cloud-based GIS: Cloud-based GIS enables effective data capture in the field by allowing GIS access via web browser or mobile app. Maps can be created and updated from anywhere, and videos can be associated with a specific location on the map.

Data collection is one area where traditional desktop GIS falls particularly short. Though many desktop GIS providers also have mobile applications, they are historically underdeveloped and often don't work without internet connection - rendering them useless in many field situations.

Most cloud-based GIS systems are inherently mobile friendly, and many include an offline mode. These features open the connection between field and office: saving time, ensuring greater accuracy of field data, and speeding up the next step in the process-review.

Part 3: Post-Inspection: Review and Documentation

Objective:

1. Ensure inspection accuracy
2. Collate data and integrate into program documentation.

Challenges: This step is incredibly time consuming. With no standardized method for data collection and reporting, inspections can often return incomplete. If an inspection is found to be incomplete during QA/QC review, the inspection team must return to the field to obtain the missing information. This results in significant delays, as reports must be sent back and forth multiple times until they contain all necessary information.

Once the inspections are complete, a packet is sent back to the utility who then needs to integrate the inspection data into their larger cross bore prevention program.

This step is particularly complex because most prevention programs cover massive territories with thousands of miles of pipeline. Maintaining an organized, easily accessible system of program record is challenging and, using traditional methods, often falls short.

Role of cloud-based GIS: With cloud-based GIS, project managers in the

office can review data uploaded from the field in real-time. This eliminates the waiting period between data capture and review.

Any issues or incomplete information can be caught and addressed immediately, while inspection crews are still in the field. This reduces the margin for error overall and eliminates the need for rework or re-inspection.

For utilities, the post-inspection benefit is largely the same as the pre-inspection benefit: a real -time record. A single system of digital record, shared by both the contractor and the utility, increases overall accuracy, saves time from start to finish, and ensures that data is organized effectively.

Benefits of Cloud-based GIS

In laying out the steps and challenges of a cross bore prevention program, a clear theme emerges. In order to ensure the safety of populated urban cores, the utility industry needs a single system of record: one that simplifies pre-inspection research, enables data capture in the field, and streamlines data review and storage.

Cloud-based GIS is the only software category that comes even remotely close to addressing these needs.

If cross bore prevention is ever to reach maximum efficiency and effectiveness, the industry must focus on two overarching problems: speed and cost.

Cloud-based GIS offers the most opportunity to advance these goals from both a short- and longer-term perspective.

Short term benefits: Cloud-based GIS simplifies time-consuming tasks and eliminates redundant processes: increasing inspection speeds from start to finish. As overall efficiency increases, per unit inspection costs will decrease. This means teams will be able to inspect more pipeline on the same budget.

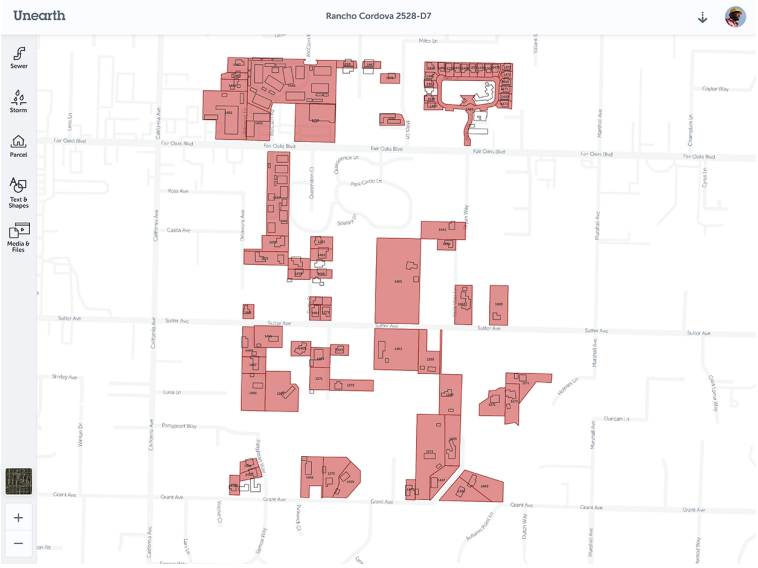

Figure 3: Unearth Cloud-based GIS Platform.

Moreover, moving to a single system from various point solutions decreases the budget spent on both hardware and software. These savings can then be redirected towards expanding the size and scope of prevention programs.

Long term benefits: Long term benefits are where cloud-based GIS gets really exciting. As inspection data accumulates in a single system, it increases the potential for predictive analysis. With enough easily accessible inspection data, everyone - from contractors to homeowners to utilities - can empower themselves to lower cross bore risk during construction and maintenance.

Though predictive analysis is more exciting from a legacy cross bore explosions and increased safety for all.

Cloud-based GIS Built for Utilities: A note on Unearth

Unearth is a modern GIS system for built-world organizations. We provide a simpler, more profitable way to manage location-based data: one that's optimized for monitoring and maintaining physical structures.

When managed correctly, data enhances your operations and saves millions of dollars. Without proper management, you become buried beneath the data: slowing down operations and costing millions. Unfortunately, most built-world industries are in the latter situation.

Unearth delivers on the abandoned promises of legacy desktop GIS with a cloud-based GIS platform that's mobile-friendly and easy-to-use. Our platform saves time and money by streamlining your digital workflow and connecting field with office.

We strongly believe in the importance of detecting, mitigating, and preventing cross bores, and are excited to be helping the utility industry move swiftly towards a solution.

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