# BAMI-I 2026

Biannual Journal H1 2026

**FROM MOTEL ROOMS TO MAIN LINES KP & ANJALI PANCHAL | US HYDROVAC INC.** How a $100K bet became the Midwest's most dynamic underground utility company (Cover Story at page 12)

**BAMI-I 2026 ANNUAL BOARD MEETING REPORT KEY DECISIONS, NEW BOARD MEMBERS & COMMITTEE LEADERSHIP** (See page 9)

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# BAMI-I 2026




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# Message from BAMI-I President


## Dr. Tom Iseley

Ph.D., P.E., Dist. M. ASCE, PWAM, BAMI-I President


Steve Allbee was a senior U.S. EPA representative and served as the Director-Gap Analysis which documented what was being invested in water and wastewater systems versus what was needed. He realized the gap was enormous. After conducting international research, he realized that asset management offered solutions. He became well respected for his leadership in developing EPA's commitment to assisting water and wastewater utilities understand the importance of asset management programs.

In the Foreword of the CTAM 100 manual, he wrote: "The work of Asset Management encompasses the work of the utility. Being really good demands bringing this new thinking and problem solving to the decision-making process on an hour-by-hour, task-by-task basis. The work of getting better starts with sorting through how well we are managing what we have. Asset Management on the whole is about doing things at the right time. If you replace an asset too early, you're wasting money; if you replace an asset too late, you're wasting money." How can utilities know the right time?

Mr. Allbee goes on to explain: "The goal is to have the ability to analyze the full range of maintenance, repair, renewal and replacement options in the same matrix and compare available strategies against the alternatives. The key steps in the Asset Management process include: asset identification, asset registry, condition and criticality assessment, definition of targeted service levels and prioritized decision-making with regard to the risk and consequence of asset failure."

Mr. Allbee wrote these statements in 2005. During the past 20 years, certainly progress has been made by utilities in developing risk-based asset management programs (AMPs), but not enough. Why? It takes leadership, commitment and courage. Last year, we identified 41 States moving forward with programs which require all water utilities to develop AMPs or at least providing incentives, etc.

Why does it take State legislators to require or even incentivize water utilities to develop and implement "best business practices"? High infiltration/inflow rates in sewer systems and the non-revenue water due to leakage is a cost transferred to the consumers through rates which must be controlled to address affordability.

We are pleased with the leadership, commitment and courage the State of Indiana legislators have demonstrated in recent years leading to the requirement that water utilities not only develop AMPs but monitor and certify compliance with their approved asset management plans.

BAMI-I is committed to assisting the State of Indiana and other States moving forward requiring comprehensive risk-based AMPs. Since the launch of CTAM 1.0, we have continued to grow with the developments in AMPs. CTAM 2.0 will be launched soon. A team of industry subject matter experts have been working diligently on the updates of the 4-course program which leads to certification. Asset management plans consist of technical, management and financial components. It is critical that these plans are developed by individuals certified and qualified in these areas. This gets to the heart of Mr. Allbee's statement: "Asset Management on the whole is about doing things at the right time. If you replace an asset too early, you're wasting money; if you replace an asset too late, you're wasting money."

Our message to water utility managers is to not wait until State legislators mandate the development and implementation of AMPs. Make it priority. Get active in BAMI-I. Learn from industry leaders on how to get started and have the commitment and courage to do what is right.

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# BAMI-I

## 2026 ELECTED BOARD OF DIRECTORS

# Message from Journal Editor


## Ms. Wei Liao

PWAM


After putting this issue together, I stepped back and looked across the articles for a common thread. It didn't take long to find one.

Piece after piece, from very different angles, they all point in the same direction: our industry is shifting from reactive response to proactive understanding.

And the driver of that shift isn't any single technology. It's a change in how we think about data.

I. Fix the Data Before You Fix the Pipe

Tacoma Zach contributed an article to this issue with a title that says it all: Fix the Data First. One line from his piece has stayed with me: if your data is inaccurate, incomplete, or unreliable, then every decision you make after that is a building on sand.

In our industry, this sounds like common sense. But how many of us actually live by it? How many times have we gone out to inspect a pipeline with drawings that are twenty years old? How many times have we invested in expensive inspection equipment, only to get data back in formats that can't be compared, can't be traced, can't be trusted? In my years of research at Purdue, I've seen project after project where the bottleneck wasn't the technology—it was the data foundation.

It comes down to a simple truth: you can only manage what you can see. And you can only see what the data honestly shows you.

II. What a Small Town Taught Me

Switz City is a very small community in Indiana. Before we started the asset management project there, almost no one thought a town that size needed something as formal as an "asset management plan." But the reality is, they face the same challenges as any large city—aging pipes, tight budgets, and uncertainty about what's actually in the ground.

What stayed with me most wasn't the $650,000 in funding we eventually received from the Indiana Finance Authority—though that far exceeded our expectations. It was the feeling at the very beginning: starting from zero. No template to follow, no big-city resources to lean on. All we could do was walk into the field, one pipe at a time, and figure out the situation.

Switz City taught me something I carry with me: real asset management is not a luxury reserved for large utilities. It is a basic capability every community deserves. The question is—how do we make it simple enough, affordable enough, and smart enough for communities like Switz City to actually use?

III. When AI Steps Below the Manhole Cover

Jinwu Xiao, a PhD student at Purdue, presents a rapid manhole inspection approach using 360-degree scanning cameras and large language models. The system aims to reduce assessment time while maintaining engineering-level rigor.

I became aware of his research after presenting the Switz City asset management case, and the technical direction addresses long-standing challenges in inspection efficiency. His work reflects a broader shift within the industry: AI's role is not to replace engineers, but to reduce repetitive tasks and elevate judgment-based decision-making.

The meaningful application of AI in infrastructure will depend not on novelty, but on whether it strengthens clarity, consistency, and accountability in the field.

His work reinforces something I believe deeply: the real value of AI in this industry is not replacing people—it's freeing them from repetitive, low-efficiency tasks so they can focus on the work that requires judgment.

IV. What an Entrepreneur's Story Revealed

I wrote an article for this issue about KP Panchal. KP came to the United States from India, worked at a motel, and built his way up to founding US Hydrovac Inc.—growing the company from a $100,000 investment to significant annual revenue.

Writing that piece, I felt a strong sense of recognition. As someone who also came to America from another country and has spent years working in this industry, so much of KP's story felt familiar—the language barriers, the cultural distance, the fear of failure. But what struck me most during our conversation was something he said: that business isn't just about making money—it's about creating a better way to solve real problems.

I wrote that line into the article. And it has stayed with me since.

V. A Final Word

Dr. Iseley received the 2026 UCA Outstanding Educator Award this year. He said something very typical of him: "I never thought about winning awards. I just do what needs to be done."

As his colleague, student, and long-time collaborator, I know this isn't modesty—it's his actual operating philosophy. And it has shaped me profoundly. Not "what looks impressive on paper," but: is this work worth doing? And if we do it, will it genuinely help people?

Every issue of this journal, every industry conference, every site visit tells me the same thing: our infrastructure is aging, and our ways of understanding it are still stuck in the last era.

It's time for that to change. Not by tearing everything down, but by standing on the shoulders of those who came before—with better tools, clearer data, and smarter systems—so that every community, no matter how small, can truly see what lies beneath their feet and make informed decisions accordingly.

That is the direction reflected in this issue.

Thank you for reading.

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- Risk Management
- Government Regulations
- Case Study Examples

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- Developing Priorities & Key Performance Indicators
- Infrastructure Inspection, Mapping & RehabMethods
- Capacity, Management, Operation & Maintenance
- Asset Worth Value & Life-Cycle Analysis • Risk-Based Budgeting

CTAM-200 At-a-Glance:
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- Advantages, Rewards, Obstacles & Planning
- AssetInventory, Organization Strategies & Tools
- Water & Wastewater Condition Assessment
- Data Content, Analysis, Sharing & Distribution

CTAM-400 At-a-Glance:
- Financial Challenges & Developing Strategies
- Accounting Principles, Reporting & Budgeting
- Strategic Internal & External Financing Tools
- Public-Private Partnerships and Design- Build
- Level of Service and Capital Improvement Plans
- Life-Cycle Costing
- Case Study Examples

**Why offer courses in Asset Management?**

The Buried Asset Management Institute-International (BAMI-I) created the Certification of Training in Asset Management (CTAM) program to increase awareness and train utility personnel on the best way to implement and use asset management to extend the life and efficiency of their water and wastewater systems. CTAM is an educational series for obtaining certification of training in the management of water asset infrastructure.

**Levels of Certification**

- Certificate of Completion – requires completion of each course
- Associate Water Asset Manager (AWAM)–requires completion of CTAM 100-400 and an application submitted to the BAMI-I Asset Management Certification Board
- Professional Water Asset Manager (PWAM) – requires completion of CTAM 100-400, four years of relevant asset management experience, and an application submitted to the BAMI-I Asset Management Certification Board

**Benefits of the CTAM Series**

- Expand your knowledge and access to resources to enable you to initiate, continue or improve your own asset management program.
- Earn internationally recognized certification in the field of asset management.
- Earn CEU / PDHs* for each course.

# BAMI-I 2026 ANNUAL BOARD MEETING REPORT

## KEY DECISIONS, NEW BOARD MEMBERS & COMMITTEE LEADERSHIP


The Buried Asset Management Institute – International (BAMI-I) held its 2026 Annual Board of Directors and General Membership Meeting on January 26, 2026, at the Henry B. Gonzalez Convention Center in San Antonio, Texas, in conjunction with the 27th Utility Investigation School (UIS). BAMI-I extends its sincere appreciation to Underground Infrastructure Conference for its generous support in providing classroom facilities and complimentary registrations, which contributed significantly to the success of the BAMI-I BOD meeting and 27th UIS. With 15 members in attendance both in-person and virtually, the meeting covered governance matters, program updates, strategic priorities, and organizational restructuring. This article summarizes the major outcomes and announcements from the meeting.

## Key Announcements & Decisions

### 2026–27 Officers Elected

All officer positions were filled by unanimous consent. Dr. Tom Iseley was re-elected as Chairman of the Board, Richard Thompson as Vice Chairman, Leonard Ingram as Treasurer, and Greg Jefferis as Secretary.

The board was strengthened with the addition of new members, bringing renewed energy and diverse perspectives to BAMI-I's mission and programs. Four new board members were formally installed and welcomed:

### Tim Back

**Principal Engineer, Back Municipal Consulting & Owner, BMC Trenchless**

Tim Back brings 33 years of hands-on experience in the wastewater industry to the BAMI-I Board. He has ex-

tensive experience with construction management, inspection and testing of trenchless projects. He is a member of NASTT, ASCE, AWWA, WEF Collection System Committee, an officer for ASTM F17.67 subcommittee and the chair of the ASCE PINS Committee.

Through BMC Trenchless, Tim provides educational materials and webinars on industry topics, operating a platform that has become a trusted resource for utilities, engineers, and contractors. With over 100,000 contacts in his professional database, Tim brings not only technical knowledge but also an extraordinary network and proven marketing infrastructure that will be invaluable as BAMI-I scales its CTAM program nationwide.

## Mustafa Kilic

**Civil & Geological Engineering Professional**

Mustafa Kilic is a civil and geological engineering professional specializing in geotechnical engineering and buried asset management. He holds an M.S. in Civil Engineering from Purdue University and has international experience in seismic risk studies and water master planning. He contributed to the Switz City project and led ADA compliance efforts for BAMI-I publications. He is an Associate Water Asset Manager (AWAM).

## Alberto Florez

**Mechanical Engineer & Director of Communications, LAMS**

Alberto Florez, Mechanical Engineer and Director of Communications for LAMS, brings 22 years of underground utility mapping experience. He led the launch of the Latin American Trenchless Technology Magazine and supports cross-regional collaboration between North and Latin America.

## Chuck Burtron

**Director of Organizational Excellence, Waggoner Engineering**

Chuck Burtron joins the BAMI-I Board bringing leadership and organizational management expertise from his role at Waggoner Engineering, a multidisciplinary firm with deep roots in infrastructure planning, design, and program management across the southeastern United States.

As Director of Organizational Excellence, Chuck is responsible for driving process improvement, strategic alignment, and operational performance — skills that translate directly to the asset management discipline, where organizational capacity and systematic planning are essential to long-term infrastructure sustainability. His expertise will be particularly valuable as BAMI-I works to scale its CTAM program and build sustainable partnerships with state agencies.

## CTAM Program Restructuring Update

Jim Harris, chair of the CTAM upgrade committee, presented the most significant overhaul of the CTAM certification program since its inception in 2010. Draft content has been completed for all four course levels, and the restructuring introduces several transformative changes:

CTAM 100 is now a four-hour introductory course designed to build foundational awareness of asset management principles, with plans to develop a low-cost e-learning version.

CTAM 200 & 300 now include dedicated modules for both gravity and pressure pipelines — a major expansion from the previous gravity-only focus. These courses will be offered as a sequential two-day program, available both in-person and as live virtual sessions.

CTAM 400 has been redesigned as a four-hour executive-level course focused on rate structures, financial sustainability, and internal funding strategies. Completion of CTAM 200 and 300 is no longer required.

Overlap and redundancy between courses has been eliminated, and the entire program is being formatted into a cohesive presentation package.

Course overlap has been eliminated, and the program is being standardized into a unified presentation format. To support scaling to 20–30 offerings annually, the board discussed establishing a formal train-the-trainer certification pathway. A new Promotion & Marketing Committee was created to support national expansion.

## Indiana Water Innovation and Infrastructure Center

Dr. Iseley reported significant progress toward establishing a state-level Water Innovation and Infrastructure Center, a joint initiative between BAMI-I and World Trade Indianapolis. The proposed center would serve as the coordinating body for water utility asset management across Indiana, supporting the implementation of recent state legislation that requires all water utilities to develop and certify asset management plans on a four-year cycle.

## Switz City Project Completion

The Switz City Asset Management Plan project — a landmark initiative that helped a small Indiana utility serving 870 residents confront a 78.6% water loss rate — was reported as substantially complete. Funded in part through an IFA (Indiana Finance Authority) grant, the project has been documented extensively in the BAMI-I Journal and serves as a proof-of-concept for the statewide expansion model now being proposed through the Water Innovation and Infrastructure Center.

## Latin American Expansion & LAMS Partnership

Arlex Toro, Executive Director of the Latin American Society for Trenchless Technology (LAMS), and Alberto Florez presented updates on expanding BAMI-I's reach across Latin America. LAMS now represents 16 countries and has certified approximately 800 NASCO inspectors over 12 years. The society has launched the second version of its Data Mapping course aligned with BAMI-I and ASCE UESI standards, and Alberto debuted the first-ever Latin American Trenchless Technology Magazine — a digital publication covering 15 countries. Arlex also highlighted demand from Uruguay and Peru for risk-based asset management training, and proposed leveraging BAMI-I's affiliation with the International Society for Trenchless Technology (ISTT) to expand CTAM courses globally. The board expressed strong support for these international initiatives and established the International Committee to coordinate this work.

## UIS Expansion

The 27th Utility Investigation School, held in conjunction with the board meeting in San Antonio, underscored the growing industry recognition and strategic importance of UIS within the underground infrastructure sector. Grounded in the technical framework of ASCE 38 and ASCE 75 standards, the program continues to strengthen its role in advancing best practices, risk reduction, and professional competency in utility investigation. In response to sustained demand and increasing professional engagement, the UIS model is being evaluated for expansion to four or five recurring sessions annually at established locations to better serve the industry's evolving needs.

## BAMI-I Journal: Continued Publication & New Direction

The Board reaffirmed the BAMI-I Journal as a flagship member benefit and a strategic industry platform. Since its launch, seven issues have been published featuring technical innovations, project case studies, policy developments, and BAMI-I initiatives, including a comprehensive report on the Switz City Asset Management Plan.

Published twice annually in print, the Journal serves as a high-quality archival publication distributed to industry leaders and infrastructure decision-makers. To expand reach, BAMI-I is increasing its digital presence through periodic online feature articles highlighting advanced technologies, innovative projects, and influential professionals.

In collaboration with the Latin American Society for Trenchless Technology (LAMS), which publishes across 15 countries, BAMI-I is exploring cross-publication of selected articles in Spanish to extend visibility throughout the Americas. This integrated print–digital strategy enhances exposure for contributors and advertisers while maintaining the credibility of a formal industry publication.

## BAMI-I Committee Leadership

The board reviewed and reorganized BAMI-I's committee structure, appointing new chairs, establishing two new committees, and reaffirming its commitment to focusing energy on committees with active, passionate leadership.

## Looking Ahead: Three Strategic Priorities for 2026

The board identified three strategic priorities that will define BAMI-I's direction in the coming year:

1. Launch the restructured CTAM certification platform with updated courses, virtual delivery options, a train-the-trainer pipeline, and dedicated marketing to drive enrollment nationwide.
2. Expand the Utility Investigation School program to four or five sessions per year at recurring locations, strengthening this proven revenue source and extending its reach to more owners and engineers.
3. Establish the Indiana Water Innovation and Infrastructure Center with potential state funding, positioning Indiana as a national model and BAMI-I as the coordinating body for water utility asset management statewide.

BAMI-I extends its sincere thanks to all board members, both returning and new, for their dedication and service. With an expanded and energized board, active committee leadership, a restructured CTAM program, and growing international partnerships, the organization enters 2026 better equipped than ever to lead the advancement of buried asset management practices — in Indiana, across the United States, and around the world.

*BAMI-I Journal — Seven Issues Published Since Launch*

| COMMITTEE | CHAIR | NOTE |
|---|---|---|
| Education & Research | Jim Harris | *New chair* |
| Pipeline Condition Assessment | Smith Rangel | *New appointment* |
| Utility Investigation | Alberto Florez | *New chair; leading UI 2.0* |
| Financial Management | Greg Baird | *New chair, Extensive multi-state AMP experience; emphasis on financial sustainability* |
| Trenchless Technology | Mark Wade | |
| TT – Renewable Energy | Kent Weisenberg | |
| Promotion & Marketing NEW | Jimmy Stewart | *Supported by Jim Harris, Tim Back, Greg Baird* |
| International NEW | Smith Rangel | *oversee International ambassadors program* |
| Oil & Gas | - | *Currently inactive* |

# FROM MOTEL ROOMS TO MAIN LINES: THE KP PANCHAL STORY

## How a young immigrant entrepreneur turned his late father's life savings into one of the Midwest's most dynamic underground utility service companies


**Editor's Note:** *When I was reviewing the registration list for the 26th Utility Investigation School (UIS)—a training program organized by BAMI-I at Kiewit Campus in Denver, Colorado —one name caught my attention: KP Panchal, Owner, US Hydrovac Inc. I knew the company well. Over the years, US Hydrovac had generously sponsored BAMI-I student delegations to attend industry events, but I had never met the person behind it. Seeing the founder himself signed up made me eager to finally put a face to the name.*

*During the school, I had the opportunity to sit down with KP for an extended conversation—and what I heard was one of the most compelling stories I have encountered in two decades in this industry: an immigrant childhood spent cleaning motel rooms across ten states, the devastating loss of his father at 22, the audacity of investing a family's life savings into an unfamiliar business, and the relentless perseverance that carried him through years of rejection. After the school, KP invited our team to visit US Hydrovac's Indianapolis operations and subsequently we invited KP and his wife Anjali to speak to students in our Construction Business Management course at Purdue. Watching a room full of graduate students lean in and connect with his story reinforced my conviction that this is a voice our industry needs to hear.*

*This cover story is my attempt to share that voice more broadly. KP represents a new generation of builder who combines hands-on grit with entrepreneurial vision, who leads with empathy, and who proves that innovation in construction sometimes comes not from technology, but from people brave enough to do things differently. I believe his story can inspire more young professionals to take action and move our industry forward.*

***— Wei Liao***

KP was born in India and came to the United States with his family at the age of four. His parents entered the American economy through one of its most unglamorous doorways: the budget motel industry. His mother worked as a maid and front desk clerk. His father maintained the properties and renovated rooms. For young KP, childhood was not defined by play dates and little league, but by paint rollers, drywall mud, and an endless rotation of unfamiliar towns.

"Before I turned 16, we moved across maybe ten different states," KP recalled during his guest lecture at Purdue University in February 2026. "We cleaned rooms, did maintenance, worked the front desk for other families. At the time, I thought this was a terrible life. I didn't even have friends."

> "Before I turned 16, we moved across maybe ten different states, We cleaned rooms, did maintenance, worked the front desk for other families. At the time, I thought this was a terrible life. I didn't even have friends."

But looking back, KP recognizes those formative years as the foundation of everything that followed. His father taught him trade skills out of necessity: painting, drywall installation, wallpapering, tiling, flooring, and eventually basic electrical work. By 16, KP and his father could fully renovate a motel interior—from studs to finish. "I even got shocked once cutting a 12-gauge Romex wire with pliers," he admitted with a grin. "Nobody told me you weren't supposed to do that."

Those skills, hard-won in dusty motel corridors, would prove more valuable than any textbook. They gave KP an intuitive understanding of field work, of the sweat and danger that accompany every project, and of the human dynamics that make or break a crew.

*US Hydrovac's earliest days: the crew and equipment that launched a company. (2018)*

## A Father's Dream, Cut Short

At 22, KP enrolled at IUPUI (Indiana University–Purdue University Indianapolis), determined to build a life beyond the motel circuit. His father, however, needed help on a roofing job in Springfield, Illinois, and urged him to stay. KP refused. "Dad, I can't work with you forever," he told him. It was the right decision. It was also the last full conversation they would have.

On the day after his first class, KP received a phone call: his father had fallen from the roof of a three-story hotel. KP drove from Indianapolis to Springfield at speeds that could have ended his own life. "I was going 120 miles an hour," he said quietly. "I thought, if a cop pulls me over, I'll just tell him my dad is dying."

His father spent eight days in the hospital before passing away. KP withdrew from school, buried his father's ashes in Indiana, and spent months adrift. "I had this person who guided me, told me what to do. I didn't have that anymore."

When he eventually returned to school, he encountered Dr. Tom Iseley—a professor whose research on trenchless technology and underground infrastructure would later intersect with KP's career in ways neither could have predicted. But at the time, KP had a simpler ambition: he wanted to become a general contractor, just like his father.

## Learning the Industry, One Job Site at a Time

KP's first industry job was with Patriot Engineering, earning $13 per hour conducting concrete slump tests across multiple job sites. It was unglamorous work, but it forced him into a daily routine of meeting superintendents, project managers, foremen, and field crews—each with different communication styles and expectations. "I hated it at first. I was uncomfortable," he admitted. "I felt like a tiny kid trying to talk to these experienced construction workers. But I learned that if you ask questions and come with a learning mindset, people respect you."

His first internship came at Bulley & Andrews, a major general contractor in Chicago. After graduating, he joined Clayco, another prominent GC, as a project engineer on a large warehouse logistics project. Eventually he moved into the estimating department—an experience he considers among the most formative of his career.

"Estimating taught me how to price work, how to understand cost structures," KP explained. "But being able to also understand the life of the people doing the work in the field—that's where the real value is. When you combine both perspectives, you become dangerous in the best possible way."

It was during an estimating session at Clayco that KP first heard the word "hydrovac." The project team was budgeting $100,000 for vacuum excavation services to avoid utility strikes on a $20 million urban project. Around the same time, while pursuing his MBA, KP's business partner mentioned paying $3,000–$4,000 per day to rent a single hydrovac truck. The economics clicked. A seed was planted.

## $100,000 and a Prayer

KP's father had left behind a modest investment—approximately $100,000, the accumulated savings of a lifetime of manual labor. For six months, KP researched the hydrovac market, drafted a business plan, analyzed competitors, and mapped out potential customers. In January 2018, he told his wife Anjali: "Let's move to Indianapolis and start a company."

Anjali, whose background is in finance, questioned the logic. Why not Chicago, where they already lived? KP's answer was pragmatic: "You need ten times the money and ten times the people in Chicago, and you still won't get anywhere. I know the Indianapolis market. I went to school there. I know the GCs and the subs."

They moved to Indianapolis on January 17, 2018, and US Hydrovac was born. KP rented two vacuum trucks at $12,000 each per month—a decision rooted in a lesson from his father's small business: never depend on a single unit or a single client. He hired two operators, paying them roughly $1,000 per week with no work yet lined up.

Then came the rejection. As a young, minority entrepreneur in a deeply traditional industry, KP found doors closed everywhere. Equipment suppliers ignored his calls. Insurance companies balked at a startup. Banks refused anyone without three years of profitable tax returns. For two months, KP visited roughly ten job sites or offices every day, facing eight or nine rejections each time. His hit rate was about two percent—but that was enough. By March, US Hydrovac booked its first shift, a hydrovac job worth about $1,200. KP personally went to the site to photograph the crew and make sure the customer was happy. Those photos still hang in the company's office today.

By the end of those first three months, the $100,000 was gone. KP borrowed well over $100,000 from Anjali's parents—personal loans that took years to repay. Banks were out of the question. The couple survived on Anjali's income; KP drew no salary. It was Anjali—armed with a finance background and a sharp instinct for cash management—who kept the numbers from spiraling out of control, tracking every dollar and making the difficult calls about what could be deferred and what had to be paid immediately.

## The Math of Survival: Utilization as Destiny

KP's first-year results were stark: the company lost money. With one to two units, the economics simply did not work. Revenue of $3,000–$5,000 per week from a truck running two to three days could not cover the fixed costs of rental, insurance, and labor.

But KP was studying the numbers obsessively. He discovered that three to five units could break even; beyond that, profitability became possible. The key metric was utilization: a truck working two days a week lost money; three to four days broke even; five days generated profit. Everything in the company's strategy became oriented around keeping assets busy across multiple verticals—DOT and municipal projects, utility owners, general contractors, developers, mass earthwork companies, and industrial clients.

> " I never wanted any single customer to represent more than ten percent of our business, my competitor had over 50 percent of their work from one client. That looked risky to me. What if that relationship changes? What if someone new enters the market? "

"I never wanted any single customer to represent more than ten percent of our business," KP emphasized. "My competitor had over 50 percent of their work from one client. That looked risky to me. What if that relationship changes? What if someone new enters the market?" This philosophy of diversification became a guiding principle that insulated US Hydrovac from the volatility that has claimed many small contractors.

## The Financial Architect: Anjali Panchal

If KP is the face and voice of US Hydrovac, then Anjali Panchal is the financial architecture that holds the enterprise together. KP himself puts it in unequivocal terms: "She's realistically the one that made the business successful." Her background is in finance—a world far removed from underground construction—but she brought something essential: the ability to translate entrepreneurial ambition into financial viability. From day one, Anjali served as CFO, building the accounting infrastructure, managing cash flow, and establishing the controls that kept the company alive through its most cash-starved years.

When no bank would speak to a startup without three years of profitable returns, it was Anjali who identified alternative lending channels—smaller institutions specializing in minority-owned and women-owned businesses. The terms were harsh, but those early loans enabled US Hydrovac to purchase its first truck in 2019, eliminating crippling rental costs. By 2020, enough financial history had accumulated that mainstream banks finally began reaching out—a turning point she calls the moment "the banking relationships really made a big difference." She also drafted the company's first operating agreement, took on management of multiple outside law firms, and navigated the complex financial mechanics of converting to a union shop.

Perhaps most critically, Anjali recognized that financial literacy is one of the most underestimated challenges facing small construction businesses. "Most small businesses can't afford a finance person," she observed. "Usually it's just the owner trying to figure it out." At US Hydrovac, every strategic decision—whether to rent or buy, when to add a division, how aggressively to pursue union status—was grounded in rigorous financial analysis. KP builds the relationships; Anjali builds the financial foundation on which those relationships can be sustained.

*Anjali Panchal, CFO of US Hydrovac, the financial architect behind the company's growth.*

## Building Year-Round Capability

By year three, KP faced a familiar construction dilemma: seasonal work meant his best people had nothing to do in winter. The solution was to launch a Pipeline Inspection and Cleaning Division (CCP). While hydrovac work slows with construction activity, stormwater and sanitary sewer maintenance is year-round. The new division kept field crews employed through the off-season and opened an entirely new revenue stream.

Today, CCP accounts for roughly 30 percent of the business, with hydrovac contributing 70 percent. KP described the two as fundamentally different: "Hydrovac is more of a commodity—it's about price and quality. Pipeline inspection is value-driven. It requires expertise, and that's where we differentiate."

## A Defining Project: Louisville MSD Broadway Street

In 2021, US Hydrovac received a call that would catalyze the company's trajectory. A rehabilitation contractor working on the Louisville Metropolitan Sewer District's Broadway Street project in downtown Louisville, Kentucky, needed jetting and pipeline inspection services on a century-old brick sewer that served multiple hospitals in the heart of the city. Shutting down the sewer was not an option. The project was extraordinarily difficult.

US Hydrovac started with one crew and one truck. Within weeks, the scope expanded to four crews with more than 12 people working six to seven days a week, often in 12-hour shifts—and sometimes around the clock with rotating crews. Much of the work had to be done manually: high-pressure water jets risked dislodging the deteriorating brickwork, so crews cleaned and televised the sewer by hand, in conditions where standard equipment could not reach.

The project lasted over eight months, performed under contract to Temple & Temple, with payment terms of 2-net-10 that supported US Hydrovac's ability to hire and grow during the engagement. More importantly, the Broadway Street project demonstrated the company's ability to perform at a level few competitors could match—and it directly enabled US Hydrovac's transition to union signatory status, a decision that positioned the company for larger, more complex projects going forward.

Today, US Hydrovac is the only union-specialized subcontractor in the Midwest that performs specialty inspections such as laser profiling, live-line floating inspections using rafts, and robotic cutting inside pipes and structures.

## Navigating the Union Transition

The decision to go union was forced by circumstance: US Hydrovac's largest client, Miller Pipeline, came under union pressure and told KP, "We can't use you anymore." Going union meant labor costs rising roughly 25 percent, with substantial monthly payments calculated by the hour for every worker. The financial impact was severe—the company lost money for three consecutive years after the transition, as growth had outpaced operational controls. It was not until recently that US Hydrovac implemented rigorous KPI tracking and unit-level profitability analysis to regain its footing. "Every stage of business ownership has different challenges," KP observed. "What you face as a startup is completely different from what you face at scale."

## The People Equation

Ask KP what he is most passionate about, and the answer is immediate: people. Not equipment, not contracts, not market share. People.

"My focus has always been on the people part of the business," he stated, "The people that work for us and the people that support us—our customers—are what I am truly passionate about. Teaching and empowering my people are my main job, and that is what has allowed this company to grow beyond our expectations."

The numbers bear this out. Over 75 percent of US Hydrovac's employees are under 30. The average field worker's salary is approximately $91,000—a figure that would surprise many in an industry where young workers are often underpaid and undervalued. The company actively recruits people with no prior utility experience, preferring to train from scratch rather than inherit what KP calls "past baggage" from other organizations.

*The US Hydrovac team*

> "Teaching and empowering my people are my main job, and that is what has allowed this company to grow beyond our expectations"


*Chase Albers who has been with US Hydrovac for over 5 years and has seen the company's growth over the years.*

"We had a 20-year-old kid who got his CDL through a high school program and was earning $100,000 by the time he turned 21," KP shared. "When you give opportunities to people who might not get them at established companies, they remember. They talk about it. They tell their friends."

KP's philosophy on employee retention is decidedly non-transactional. "Money is just short-term relief," he said. "What keeps people long-term is when they feel like part of a team, when they work with people they genuinely care about. Don't just talk to your employees about work—get to know their personal lives, their families, what they enjoy. We're all more similar than we think. If you find common ground, you can build a relationship. And that matters more than a paycheck."

## Scaling Leadership

US Hydrovac has recently made several strategic leadership hires that signal the company's transition from entrepreneurial startup to structured growth organization. Chris Lombardo has joined as Director of Operations, bringing over a decade of operations management and team development experience, with particular expertise in opening satellite branches. Jake Whitney, a six-year veteran of US Hydrovac who built the Pipeline Inspection and Cleaning Division from inception, has been promoted to Director of Client Strategy, serving as the primary point of contact for key clients on complex transportation and infrastructure projects.

The company has also brought on a contracted safety director, added human resources capacity, and is building out its administrative infrastructure. KP is candid about his own limitations in this evolution: "I'm good at motivating people. I'm not really good at managing them or having hard discussions. That's why we have to put the right people in place."

Underpinning all of these organizational changes is Anjali Panchal's continued financial stewardship. As CFO, she now manages a significantly more complex financial operation than the one she built from scratch in

*The BAMI-I team visiting US Hydrovac's Indianapolis operations, where the company's 15+ unit fleet is dispatched daily across the Midwest.*

*KP and Anjali Panchal sharing their entrepreneurial journey with graduate students in Purdue University's Construction Business Management course, February 2026.*

2018: union payroll obligations, multi-state tax compliance, equipment financing portfolios with individual truck payments approaching $10,000 per month, and legal relationships spanning multiple outside firms. Her ability to scale the financial infrastructure in lockstep with operational growth has been, in KP's words, "the real secret sauce" of the company's evolution. "I can go out and talk to people and make them use the company," KP said during the Purdue lecture. "But the real secret sauce in every company is the person making everything happen—from implementing systems to standards, protocols, and expectations." That person, unmistakably, is Anjali.

## Looking Ahead: Innovation and Regional Growth

KP's ambition is to build US Hydrovac into a dominant regional force in the Midwest's water and wastewater infrastructure market. The company currently operates across Indiana, Ohio, and Kentucky, with plans to open its first satellite office in the coming year.

But geographic expansion is only part of the story. KP is equally passionate about bringing innovation to an industry he sees as stubbornly resistant to change. "All of my competitors are—honestly—a bunch of old, set-in-their-ways people," he said bluntly. "I love innovation. I love looking at new things and figuring out how I can provide more value to my customers."

US Hydrovac has already begun deploying AI-powered technology that provides clients with real-time visibility on their assets. The company's capabilities range from cleaning 120-inch-plus brick sewers to performing complex interceptor inspections in challenging environments. KP's vision is not to be the largest company in the market, but to be the most capable and most client-focused.

"If you can make your customer's life even one percent easier, you probably have a customer," KP told the Purdue students. "If you can figure out how to make their life five percent easier, you have a partner who will take you wherever they go."

## A Message for the Next Generation

Near the end of his Purdue lecture I asked KP: "If you could give just one piece of advice to students entering this industry, what would it be?"

KP's response was simple and heartfelt: "Don't be afraid to ask questions. Don't be afraid to look dumb. Just learn. Learn from the people around you. When I was growing up, I didn't ask questions because I thought, 'What if I look stupid? Will the kids in the next class laugh at me?' Being comfortable with discomfort is what makes you grow. We all like to stay in our comfort zone, but we don't grow until we step outside of it. If what you're doing doesn't make you uncomfortable, you're probably not challenging yourself enough."

He paused, then added: "I only have one life. I might as well do as much as I can and maximize it."

KP Panchal's story is not merely an entrepreneurial success narrative. It is a reminder that the underground infrastructure industry—an industry often perceived as slow-moving, tradition-bound, and resistant to new voices—has room for anyone with the courage to show up, the humility to learn, and the resilience to persist when the odds seem impossible. From a four-year-old immigrant cleaning motel rooms to the founder of a 48-person, multi-state underground utility company, KP's journey—built alongside Anjali's indispensable financial leadership—embodies the spirit of innovation and determination that BAMI-I seeks to champion.

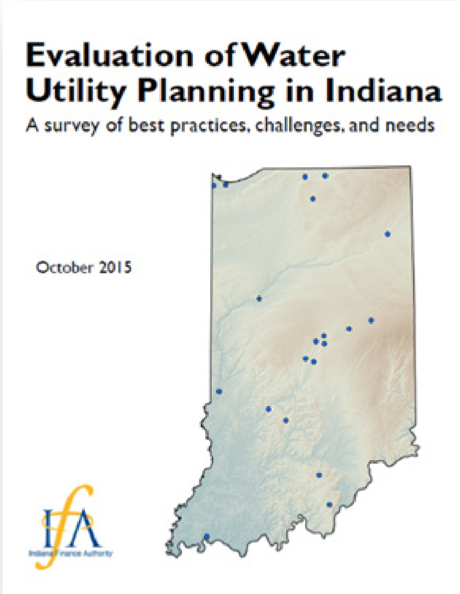
We are proud to feature KP and Anjali Panchal and their team at US Hydrovac on our cover, and we look forward to watching this remarkable company's next chapter unfold.

### COMPANY PROFILE: US Hydrovac Inc.

**Founded:** 2018, Indianapolis, Indiana
**Founder & Owner:** KP Panchal
**CFO:** Anjali Panchal
**Employees:** 48 (12 office/management, 36 union field personnel)
**Fleet:** 15+ units (hydrovac trucks, jet/vac trucks, camera vans)
**Markets Served:** Indiana, Ohio, Kentucky (expanding)
**Core Services:** Hydrovac excavation, pipeline inspection (CCTV, laser profiling, floating inspection), sewer cleaning, robotic cutting
**Client Segments:** DOT/Municipalities, Utility Owners, General & Sub-Contractors, Infrastructure Contractors, Developers, Mass Earthwork, Industrial Services
**Union Status:** Union signatory – only union-specialized subcontractor in the Midwest for specialty pipeline inspections
**Distinction:** 75%+ of employees under age 30; average field worker salary ~$91,000

# WHY DID THE INDIANA STATE LEGISLATURE AUTHORIZE THE ESTABLISHMENT OF A STATEWIDE WATER ASSET MANAGEMENT CENTER?

A Story of Infrastructure, Governance, and Institutional Persistence




*By Charles Burtron & Tom Iseley*

Indiana's water and wastewater infrastructure faces the same slow crisis unfolding across the United States: aging systems, deferred maintenance, and a replacement rate that cannot keep pace with deterioration. But Indiana chose a distinctive path. Rather than simply mandating asset management through legislation, the state authorized the creation of a permanent institutional center—the Indiana Water Innovation and Infrastructure Center (IN-WIIC)—to make that mandate achievable, consistent, and durable. This article traces the story of how that decision came to be, and what it means for utilities, vendors, contractors, and visionaries across the industry.

## 1. The Problem That Wouldn't Go Away

This story didn't start with a new idea. It started with a problem that wouldn't go away. By 2015, the Indiana Finance Authority (IFA) had completed an evaluation of water utility planning across the state, and the findings confirmed what many already suspected: Indiana's water and wastewater infrastructure was aging faster than it was being replaced.

The replacement rates were well below sustainable levels. Utilities were managing rates year to year, focused on keeping water flowing today rather than planning for the systems of tomorrow. Long-term planning existed on paper, but not in practice. The gap between what the infrastructure needed and what was being invested was growing wider every year. No single institution had the authority or the mandate to close it.


*Locations of Selected Communities and Associated Utility Service Areas in Indiana.*

*Everyone could see the gap growing. Rates were being managed year-to-year. Long-term planning existed on paper, but not in practice. No one thought the system was sustainable, but no one actor had the authority to fix it alone.*

## 2. Everyone Was Doing Their Job

What made this problem especially difficult was that no one was failing at their job. Regulators were protecting affordability. Utility leaders were keeping water systems operational. Legislators were exercising due diligence, asking for data before making commitments. Vendors and contractors were responding to projects as they were scoped and funded. Everyone was behaving rationally within their institutional mandates.

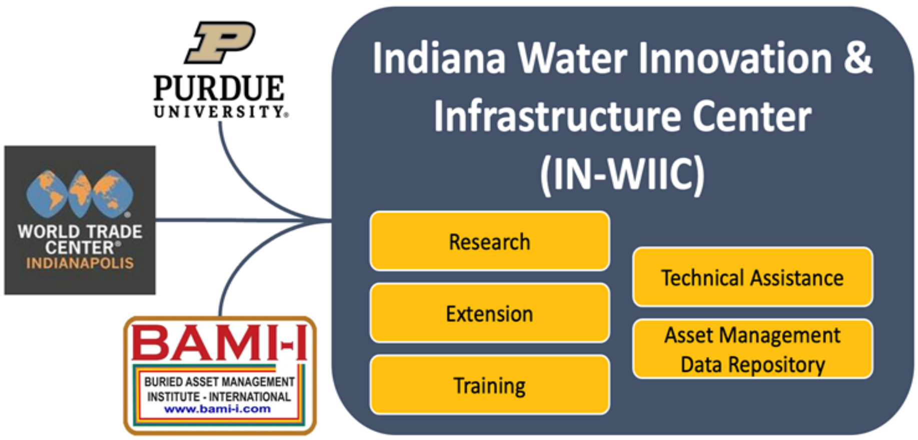
The problem was that the mandates didn't align. The system incentivized short-term decisions—affordable rates now, deferred maintenance later—even when every participant understood the long-term consequences. Fragmented responsibility across institutions meant that rational individual decisions were collectively producing unsustainable outcomes. No single actor could break the cycle alone, because no single actor owned the whole problem.

## 3. Indiana Changed the Rules

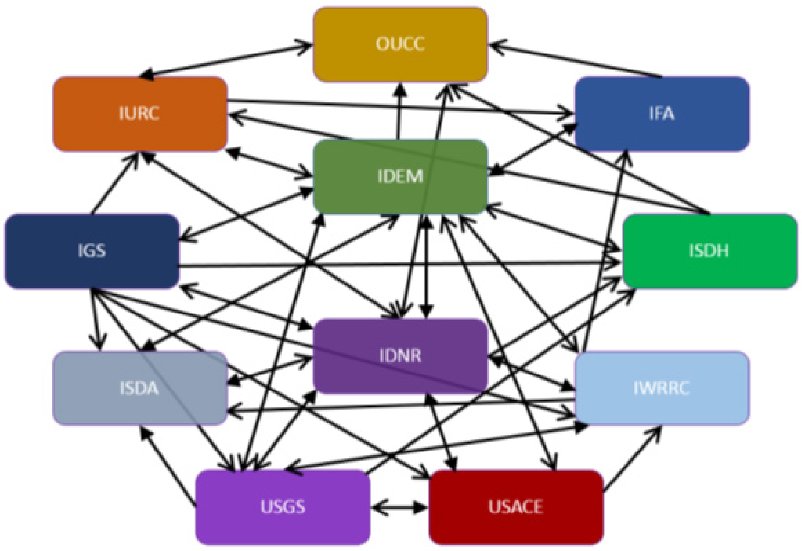
That is when Indiana made a decision that changed the direction of the conversation. The state didn't mandate specific projects or technologies. It mandated planning. With the passage of SEA 272 in 2022, asset management became a statutory requirement for water utilities. The legislation established that utilities seeking access to State Revolving Fund (SRF) dollars had to demonstrate that they understood what assets they owned, what condition those assets were in, what level of service they owed their customers, and how they planned to pay for maintenance and replacement over time.

This was a fundamental shift: from voluntary guidance to required planning. Asset management was no longer an industry best practice to be adopted at each utility's discretion. It was now tied directly to the funding mechanisms that utilities depended on. Then, in 2025, HEA 1459 expanded that statutory authority further, authorizing the establishment of a statewide center to support the mandate with institutional infrastructure.

*The state didn't mandate projects or technologies. It mandated planning. If a utility wanted access to SRF dollars, it had to demonstrate that it understood what it owned, what condition it was in, what level of service it owed, and how it planned to pay for it.*



*Organizational Framework and Core Service Pillars of IN-WIIC*



*Inter-agency Complexity and Operational Constraints in Infrastructure Compliance*

## 4. A New Requirement, Old Constraints

For utility leaders, the new requirement landed with mixed emotions. On one hand, it validated what many had been saying for years: that long-term planning was necessary and that the status quo was unsustainable. On the other hand, it raised an urgent practical question—how do you comply meaningfully when you are already stretched thin?

The burden fell disproportionately on small and mid-sized utilities, which often lacked the staff, data, and technical capacity to develop asset management programs from scratch. There was a real risk that compliance would become "paper compliance"—checking boxes without changing behavior or improving outcomes. For vendors and contractors, the mandate signaled a coming shift in how projects would be defined and funded, but the market was not yet organized around it. The rules had changed, but the support systems had not.

## 5. The State Knew the Risk

The state understood that risk. A law without institutional support turns into paperwork. Mandates alone do not build capacity, and compliance without understanding does not produce better infrastructure. That is why the legislative authorization did not stop at requiring asset management.

It also authorized the creation of something new: a statewide center whose purpose was not to regulate, not to sell, and not to replace local responsibility, but to make asset management achievable, consistent, and durable across Indiana. The legislature recognized that consistency, continuity, and institutional neutrality were essential. Asset management needed to be framed not as a one-time regulatory burden, but as governance infrastructure—something that would outlast any single election cycle, funding round, or administrative turnover.

## 6. IN-WIIC Comes Into Being

That is how the Indiana Water Innovation and Infrastructure Center—IN-WIIC—came to be. Built as a partnership between Purdue University, BAMI-I (the Buried Asset Management Institute—International), and the Water Technology Center in Indianapolis (WTC-Indy), IN-WIIC was designed as shared infrastructure for governance.

Its functions span five core areas: research, to advance the knowledge base for asset management practices; extension, to translate that knowledge into practical tools and methods for utilities across the


**Shared Success: A Vision for Collaborative Infrastructure Management**
Key Stakeholder Benefits

state; training, to build human capacity at all levels; technical assistance, to provide hands-on support for utilities developing their programs; and a central data repository, to house asset management data and guidance in a consistent, accessible format.

IN-WIIC doesn't solve problems for anyone. It makes it possible for people to solve their own problems without working in isolation. It ensures that a utility in a rural county and a utility in a metro area are working from the same standards, the same language, and the same institutional memory.

## 7. What This Means for the Industry

**For Utility Leaders:** The point of this story is not that IN-WIIC will fix your system. It will not. The point is that it gives you the support to do the right work, with better information, clearer expectations, and a longer time horizon. Accountability remains local—you still answer to your board, your council, and your ratepayers—but you are no longer making those arguments alone. IN-WIIC helps turn long-term thinking into something practical rather than aspirational, and provides defensibility for decisions that may not pay off for years.

**For Vendors and Contractors:** The point is not that the rules got tighter. It is that they got clearer. IN-WIIC helps align planning, funding, and delivery so that good solutions have a fair chance to succeed. When utilities plan consistently and define projects upstream, the result is a healthier, more predictable market—one where performance is judged against shared standards rather than shifting interpretations. That is how better projects, better outcomes, and more stable business environments emerge over time.

**For Visionaries:** Indiana proves something that many assume is impossible. This initiative did not start with a movement or a broad coalition. It started with one person who carried the idea forward for fifteen years—through studies, legislation, partnerships, and persistence. IN-WIIC exists because someone refused to let go of the vision, even when the timeline stretched far beyond what most would tolerate. Institutional change can start with one person, if that person is willing to stay with it.

## 8. The Resolution

What Indiana ultimately resolved was not a technical problem but a governance problem. The state now has a place where long-term infrastructure thinking can live—between election cycles, between funding rounds, and between individual careers.

IN-WIIC exists so that asset management is no longer a special initiative or a one-time requirement, but a normal part of how water systems are planned, discussed, and defended. It does not replace local leadership, regulators, or the market. It connects them. And as long as Indiana cares about affordability, reliability, and public health, there will be a role for an institution whose only job is to keep the long view in focus.

*IN-WIIC exists so asset management is no longer a special initiative or a one-time requirement, but a normal part of how water systems are planned, discussed, and defended. It doesn't replace local leadership, regulators, or the market. It connects them.*


### Author

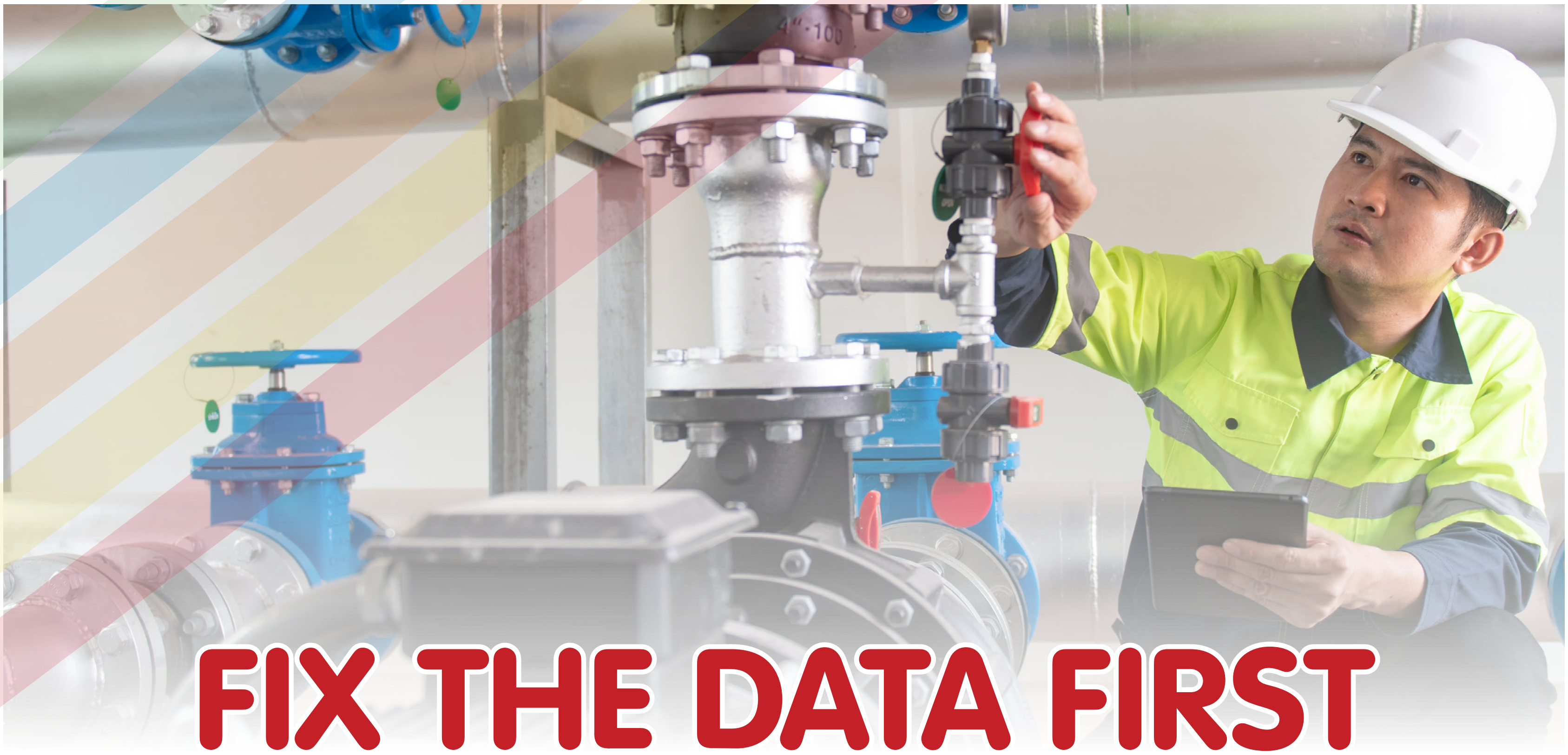
**Charles Burtron**

Burtron is Director of Organizational Excellence at Waggoner Engineering, a multidisciplinary firm with deep roots in infrastructure planning, design, and program management across the southeastern United States. He serves on the Board of BAMI-I (Buried Asset Management Institute–International), bringing leadership and organizational management expertise to the asset management discipline.

### Author

**Tom Iseley**

Tom Iseley, Ph.D., P.E., Dist. M. ASCE, PWAM, is a Distinguished Professor at Purdue University's Lyles School of Civil and Construction Engineering and Chairman of the Board of BAMI-I (Buried Asset Management Institute–International). He has spent over two decades advancing underground infrastructure asset management through research, education, and legislative engagement.



# FIX THE DATA FIRST

## Why Asset Data Quality Is the Foundation of Better Asset Management

*By Tacoma Zach, P.Eng.*

Many water and wastewater utilities look to strategic asset management plans to improve reliability, reduce risk, and make better investment decisions around their physical assets. These goals often lead to conversations about analytics, risk models, capital planning, or advanced maintenance strategies. But there is a more fundamental question that must be answered first:

### Can you trust your asset data?

In practice, many asset management challenges—missed risks, inefficient maintenance, or poorly justified capital spend—can be traced back to poor asset data quality. Incomplete, inconsistent, or inaccessible asset data undermines even the most sophisticated asset management programs. Before utilities can manage assets well, they must first fix the data that describes them.

This article serves as a primer on why asset data quality matters, what "good" asset data looks like, and what organizations unlock when they get it right.

### What Do We Mean by Asset Data?

Asset data is the structured information that describes physical assets and their condition, context, and performance. As part of broader asset information management, this data typically includes:

- Asset identification (what it is and where it is)
- Physical characteristics (type, size, materials, age)
- Condition information (inspection results, observed defects)
- Operational context (duty, environment, loading)
- Maintenance and failure history

In water and wastewater utilities, this asset information often lives across multiple systems—CMMS or EAM platforms, GIS systems, inspection tools, spreadsheets, and historical reports—and is collected over many years by different teams for different purposes. The result is usually siloed asset data that exists but isn't fully usable for decision-making.

### Three Characteristics of Healthy Asset Data

To support effective, risk-based asset management, asset data must meet three core criteria: completeness, confidence, and usability.

#### 1. Asset Data Completeness

Completeness answers a basic question: Do we have the asset data we actually need?

Common gaps in water and wastewater asset data include missing install dates, unknown pipe materials, inconsistent asset hierarchies, or incomplete inspection coverage. For example, a utility may not know which water mains are cast iron versus ductile iron or PVC. Pump stations may lack consistent condition data across similar assets, and treatment facilities may have incomplete records of equipment age or rehabilitation history.

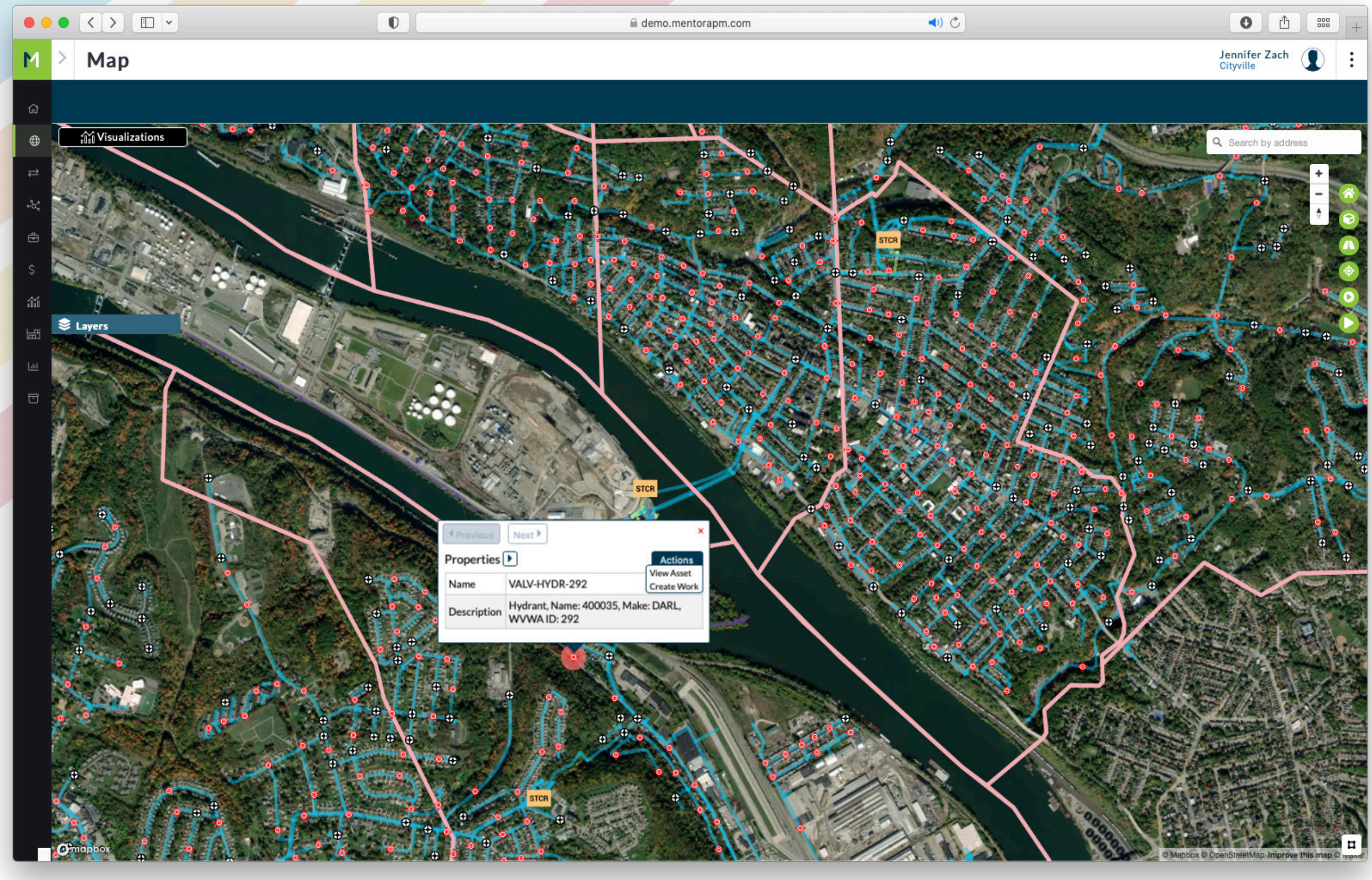
These gaps force teams to rely on assumptions, averages, or subjective judgment—introducing hidden risk into asset management and capital planning decisions.

Complete data doesn't mean perfect data. It means having clear minimum asset data standards that support risk assessment, prioritization, and long-term planning. Improving asset data completeness is often one of the first steps in advancing asset data maturity within a utility.

#### 2. Asset Data Confidence

Confidence addresses whether the asset data can be trusted. Even when asset data exists, utilities often struggle with:

- Outdated condition information
- Conflicting values across CMMS,




GIS, and planning datasets

- Subjective inspection ratings without supporting observations
- No clear link between observed defects and condition scores

For example, a pipe condition rating may be based solely on age rather than inspection results. Pump condition scores may not reflect recent vibration analysis or maintenance findings. In treatment facilities, condition assessments may vary depending on who performed them and when.

Low-confidence asset data leads to hesitation. Engineers override models, planners re-check assumptions, and leadership questions whether recommendations reflect reality.

High-confidence asset data is defensible and traceable—collected using consistent condition assessment methods, supported by inspection evidence, and governed through clear asset data standards.

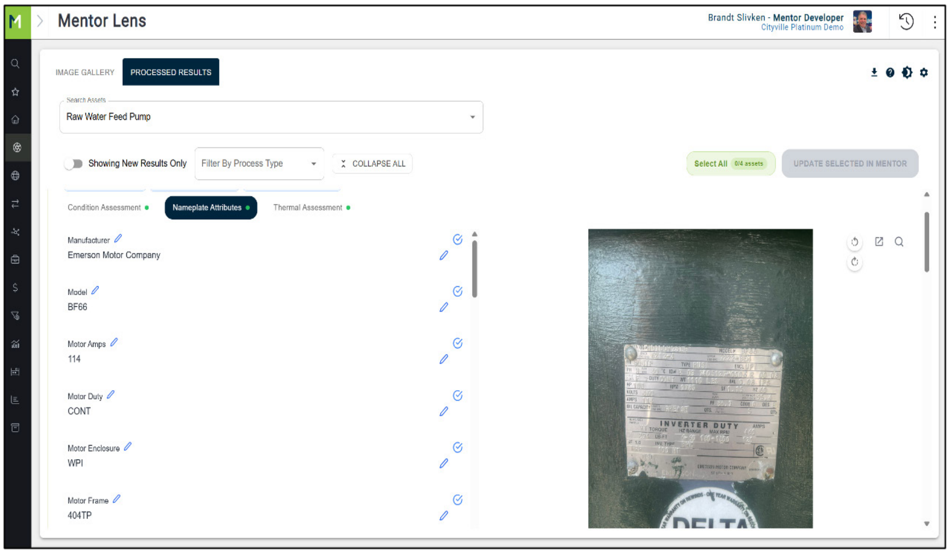
## 3. Asset Data Usability and Accessibility

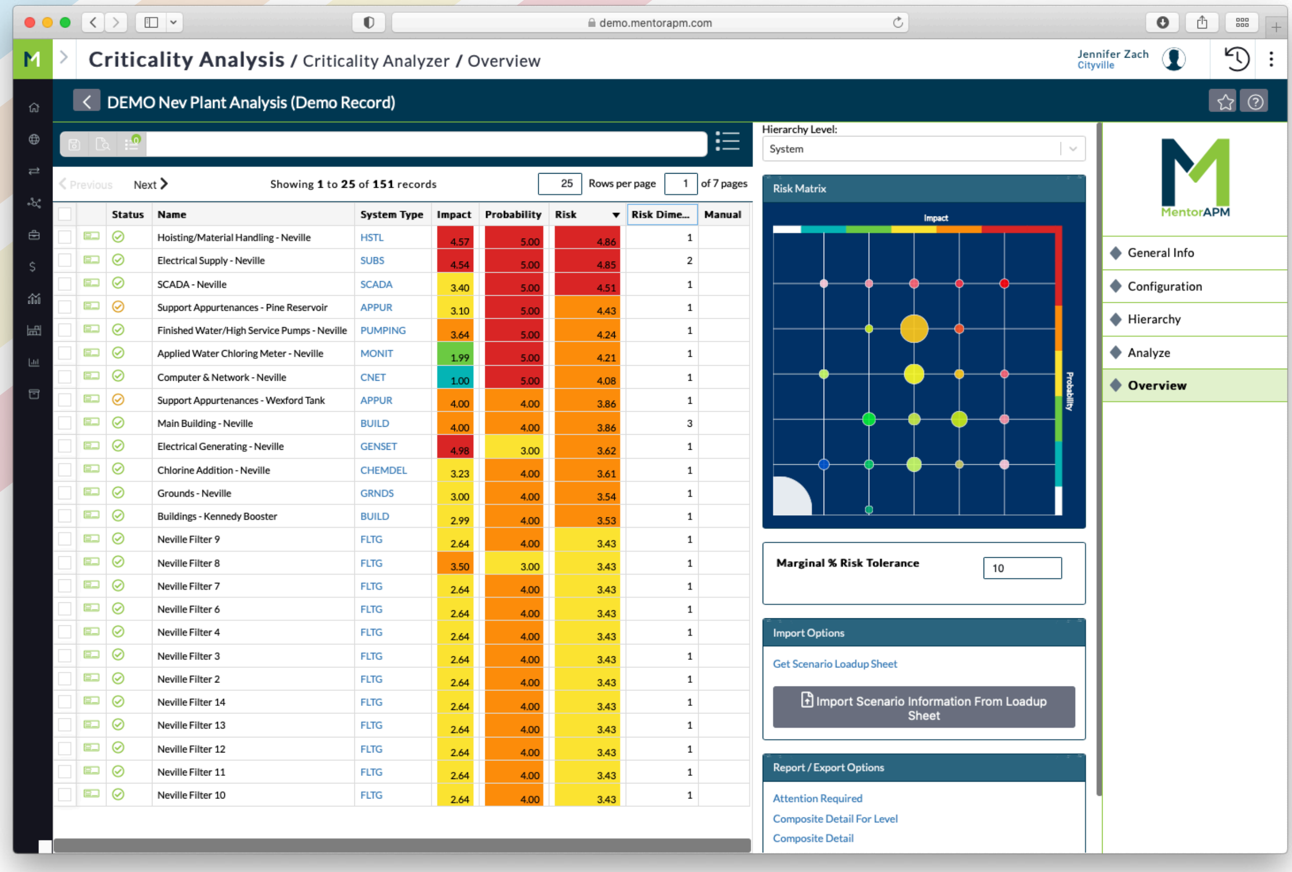
Usability asks: Can the right people actually use the asset data when they need it?

Asset data locked in PDFs, disconnected systems, or inaccessible formats limits its value. Even utilities with robust CMMS or EAM platforms often struggle with data usability. When engineers, planners, operators, and leadership cannot easily access or interpret asset information, decisions default to experience rather than insight.

For example, field crews may not see the inspection history or failure patterns of a pump or valve. Planners may struggle to compare condition data across multiple plants or service areas. Leadership may receive high-level summaries without transparency into underlying asset risks.

Usable asset data is structured, connect-






ed, and accessible—supporting shared understanding and consistent decision-making across the utility.

## What Fixing Asset Data Enables

When asset data is complete, trusted, and usable, it becomes more than a record—it becomes the foundation for risk-based asset management.

## Trusted Risk and Criticality Analysis

Risk models are only as good as the asset data behind them. When data is incomplete or uncertain, criticality rankings can become distorted—masking high-risk assets while elevating others unnecessarily.

Solid asset data allows utilities to directly connect observed asset condition to likelihood of failure and to apply consequence in a consistent way across the portfolio. As a result, risk rankings are no longer driven by intuition or assumptions, but by evidence that can be explained, reviewed, and defended with confidence.

## Better Capital Planning and Investment Decisions

Capital planning often suffers when projects compete based on urgency narratives rather than transparent condition and risk drivers. When asset data is incomplete or inconsistent, investment decisions can feel reactive, making it difficult to explain why one project advances while another is deferred.

Reliable asset data changes this by grounding capital planning in measurable risk reduction rather than anecdote. With consistent condition and performance information, utilities can evaluate renewal and rehabilitation options using common criteria, compare alternatives more objectively, and forecast long-term renewal needs with fewer surprises.

Whether planning a pipe replacement program, rehabilitating pump stations, or upgrading treatment process equipment, strong asset data supports more confident, defensible, and explainable asset lifecycle decisions.

## More Effective Maintenance and Daily Work

Maintenance teams make dozens of decisions every day—what to inspect, what to defer, and what to repair immediately. Without trusted asset data, these decisions rely heavily on tribal knowledge.

High-quality asset data supports:

- Condition-based maintenance instead of time-based assumptions
- Better prioritization of work orders
- Clear feedback loops between inspections and maintenance actions

This results in fewer unplanned outages, more targeted maintenance, and better use of limited operational resources.

## Why Asset Data Quality Is Especially Critical for Water and Wastewater Utilities

For utility directors, asset data quality directly affects regulatory compliance, public accountability, and system resilience.

## Regulatory Compliance and Defensible Decisions

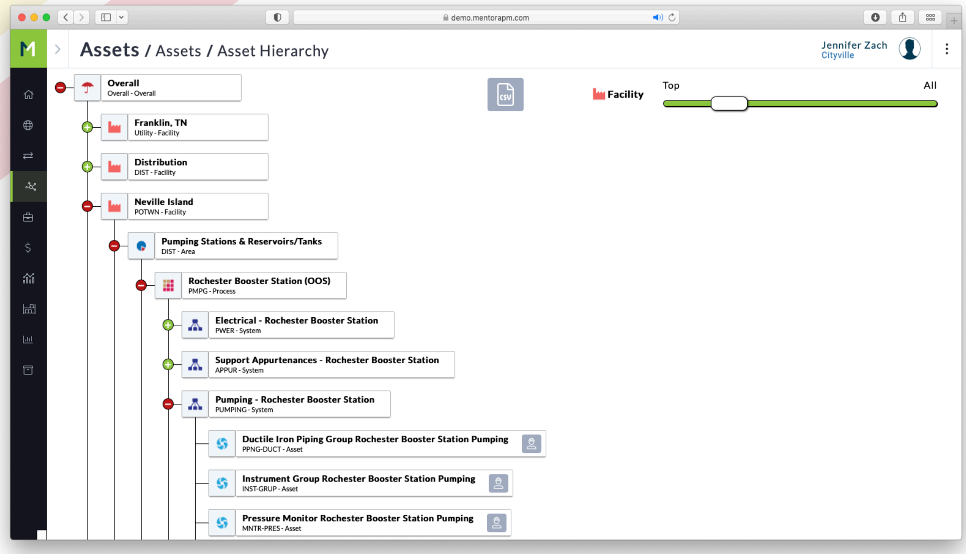
Water and wastewater utilities are increasingly expected to demonstrate structured, risk-based asset management practices to regulators and oversight bodies. When asset data is incomplete or inconsistent, it becomes difficult to clearly explain why certain assets were renewed, rehabilitated, or deferred—especially when those decisions are questioned after the fact. In these situations, even technically sound decisions can appear subjective if they are not supported by documented evidence.

Strong asset data changes this dynamic. When condition information, risk drivers, and inspection results are consistent and traceable, utilities can confidently defend renewal timing and investment priorities. Reliable asset data also supports compliance with asset management and reporting requirements, providing a clear line of sight from observed asset condition to management decisions. During audits, inspections, or consent decree reviews, this defensibility allows utility leaders to respond with confidence rather than reconstruction.

## Capital Planning Under Rate and Budget Constraints

Water and wastewater utilities must justify capital investments not only on technical merit, but also to boards, councils, and ratepayers—often within tight affordability constraints. In this environment, capital plans built on assumptions or generalized asset age curves are increasingly difficult to defend, particularly when funding requests compete with other public priorities.

High-quality asset data enables a more transparent and credible approach to capital planning. When investment decisions are grounded in documented condition and risk, utility leaders can clearly link capital spending to service reliability and risk reduction. This clarity makes it easier to explain tradeoffs between renewal, rehabilitation, and deferral, and to demonstrate why certain projects must move forward while others can wait. Over time, consistent asset data supports capital improvement plans that are not only technically sound, but also understandable and defensible to stakeholders.




## Emergency Response and System Resilience

Asset failures are inevitable in water and wastewater systems. What matters most is how prepared an organization is when those failures occur. Incomplete or unreliable asset data often becomes most visible during emergencies—when crews lack clarity on pipe materials, valve locations, pump configurations, or previous failure history, and critical decisions must be made quickly.

Strong asset data supports faster and more informed emergency response by reducing uncertainty in the field. When system vulnerabilities are well understood and asset information is accessible, crews can isolate failures more efficiently, prioritize response actions, and reduce service impacts. Over the long term, this same data supports better planning for extreme weather and other disruptive events, strengthening overall system resilience rather than simply reacting to the last failure.

## Public Trust and Organizational Credibility

Ultimately, asset data quality affects trust.

When utilities can clearly explain infrastructure risks, investment priorities, and service disruptions, they build confidence with customers, regulators, and governing bodies. When they cannot, even technically sound decisions are questioned.

Reliable asset data underpins credible communication and reinforces public confidence in how critical water and wastewater infrastructure is managed.

## From Data to Outcomes: The Bigger Picture

Fixing asset data is not a technology exercise—it's an asset management discipline. It requires clear asset data standards, consistent condition assessment practices, and a deliberate focus on how asset information will be used.

When thinking about strategic asset management it's tempting to focus on ambitious initiatives. But lasting improvement in asset management starts with a simpler step:

## Fix the data first.

Complete it. Build confidence in it. Govern it. Make it usable. Everything else—from regulatory confidence to capital planning to daily operations—depends on a strong asset data foundation.

## Author

**Tacoma Zach, P.Eng**

Tacoma Zach, P.Eng., is Co-Founder and CEO of MentorAPM, an asset intelligence platform helping infrastructure owners optimize risk, capital, and operational performance. A chemical engineer with 30+ years' global experience, he serves on the US TAG for ISO 55000 and is the author of Criticality Analysis Made Simple.

AI-Powered Rapid Manhole Inspection:

# BRIDGING THE GAP BETWEEN SPEED AND PRECISION

*By Jinwu Xiao*

This research presents a novel approach to manhole inspection that integrates high-speed 360° scanning technology with artificial intelligence to deliver comprehensive asset assessments. The methodology addresses critical challenges in underground infrastructure management by combining rapid data acquisition with AI-powered analysis for accurate, standardized condition reporting. The system employs a specialized 360° camera that captures complete manhole interior data in approximately 15 seconds. Unlike traditional inspection methods requiring heavy equipment and stable mounting systems, this technology operates effectively despite camera movement and rotation, demonstrating robust performance under field conditions. The captured video data undergoes 3D reconstruction to create comprehensive digital models of the manhole interior, which are then processed to generate "unfolded" images—flattened representations of the entire manhole wall surface that provide optimal viewing angles for defect detection and measurement. The unfolded images serve as standardized inputs for trained large language models specifically developed for underground infrastructure assessment. These AI models identify and classify structural defects including cracks, corrosion, and deterioration, recognize and catalog infrastructure components and their conditions, provide calibrated measurements of defects and components, and generate reports in standardized formats compliant with industry standards.

## Introduction: The Infrastructure Crisis and the Triangle of Inefficiency

Underground infrastructure constitutes the lifeline of modern civilization, yet it remains one of the most challenging assets to manage effectively. As sewer systems across North America and the globe continue to age, the need for frequent, accurate, and actionable inspection data has never been more critical. However, the industry is currently facing a bottleneck. The sheer volume of assets—specifically manholes—that require inspection vastly outpaces the capacity of traditional inspection methodologies.


Asset owners and engineers have long been forced to navigate a difficult compromise, which we classify as the "Triangle of Inefficiency." This triangle is defined by three competing constraints: Time, Consistency, and Safety.

In the current paradigm, optimizing for one of these factors often degrades the others. For example, a thorough structural inspection (optimizing for Consistency) typically requires a crew to open a manhole, set up heavy tripods and lighting rigs, and deploy a CCTV camera or a laser scanner. This process is labor-intensive and keeps the crew exposed to traffic and hazardous gases for extended periods (compromising Time and Safety). Conversely, a rapid visual inspection, where a worker simply looks down the hole with a flashlight or snaps a quick photo, saves time but results in highly subjective data that lacks the detail necessary for long-term rehabilitation planning (compromising Consistency).

Furthermore, the human factor introduces significant variability. Two experienced inspectors looking at the same corroded bench or cracked chimney might code the defect differently based on their subjective interpretation or level of fatigue. This inconsistency makes it nearly impossible for municipalities to run accurate predictive models or allocate rehabilitation budgets effectively.

## The "Missing Middle": Redefining Inspection Levels

The underground utility industry generally categorizes manhole inspections into three distinct levels:

**Level 1: Visual Screening.** This is a qualitative, rapid assessment. It is fast but superficial, often failing to capture structural nuances or measurements.

**Level 2: Documentation.** This involves standard recording, usually via CCTV, to provide a video record. While better than a visual check, it still relies on manual review and does not typically offer structural dimensional data.

**Level 3: Structural Assessment.** This is the gold standard, often utilizing LiDAR or advanced photogrammetry to build 3D models. It provides accurate, quantitative data but is slow, expensive, and computationally heavy.

There has long been a desire for a solution that sits in the "Missing



Middle"—a technology that delivers the granular detail and accuracy of a Level 3 assessment but operates at the operational speed and cost-efficiency of a Level 1 screening. Our research at Purdue University, utilizing advanced computer vision and Large Language Models (LLMs), aims to fill this gap. By automating the data capture and interpretation phases, we can achieve Level 3 detail at Level 1 speed.

## Methodology Step 1: Rapid Capture Technology

The foundation of our approach is the decoupling of data capture from data analysis. In traditional methods, the inspector analyzes the asset while they are at the site. In our workflow, the goal is to capture reality as quickly as possible and leave the analysis to the machine.

We utilize a lightweight, consumer-grade or prosumer-grade 360° camera (such as a GoPro 360 or similar Insta360 hardware). This choice of hardware is deliberate. Unlike specialized crawlers or heavy scanning rigs that require dedicated trucks and power supplies, a 360° camera is portable, battery-powered, and can be mounted on a simple pole.

The operational workflow is drastically simplified. A field technician opens the manhole, lowers the camera on a pole to the invert, and raises it back up. The camera captures the entire 360-degree environment in high definition video during this vertical transit. Because modern 360° cameras possess excellent internal stabilization, the system is robust against motion blur and rotation. The entire capture process takes approximately 15 seconds per manhole.

This speed has profound implications for field productivity. We have validated in field tests that a single crew can inspect approximately 100 manholes in a standard 4-to-6-hour shift. Furthermore, because the crew spends less than a minute at each open manhole, their exposure to traffic risks and potential falls is minimized, significantly enhancing safety.

## Methodology Step 2: The Digital Transformation

Raw video footage from a 360° fisheye lens is difficult for humans to review efficiently. It requires the viewer to constantly pan, tilt, and zoom to see defects, meaning the review time often exceeds the recording time. Furthermore, raw video frames are inconsistent; the perspective changes constantly as the camera spins or tilts. This inconsistency makes raw video a poor input for Artificial Intelligence models, which thrive on standardized data.

To solve this, we employ a geometric transformation technique that "unfolds" the cylindrical interior of the manhole into a single, flat 2D image, often referred to as a "strip" or "unrolled" view.

Imagine the manhole wall as the label on a soup can. Our software virtually slices this label and lays it flat. This process transforms the 3D reality into a standardized 2D plane. In this "unfolded" format, the vertical axis represents the depth of the manhole (from the rim to the invert), and the horizontal axis represents the 360-degree circumference.

This transformation is critical for two reasons. First, it allows a human engineer to view the entire condition of the manhole—from the chimney and corbel, down the walls, to the bench and channel—in a single glance without scrubbing through video. Second, and more importantly, it standardizes the data for the AI. Regardless of the manhole's diameter or depth, the output is always a consistent, flat image where defects are presented in a predictable orientation.

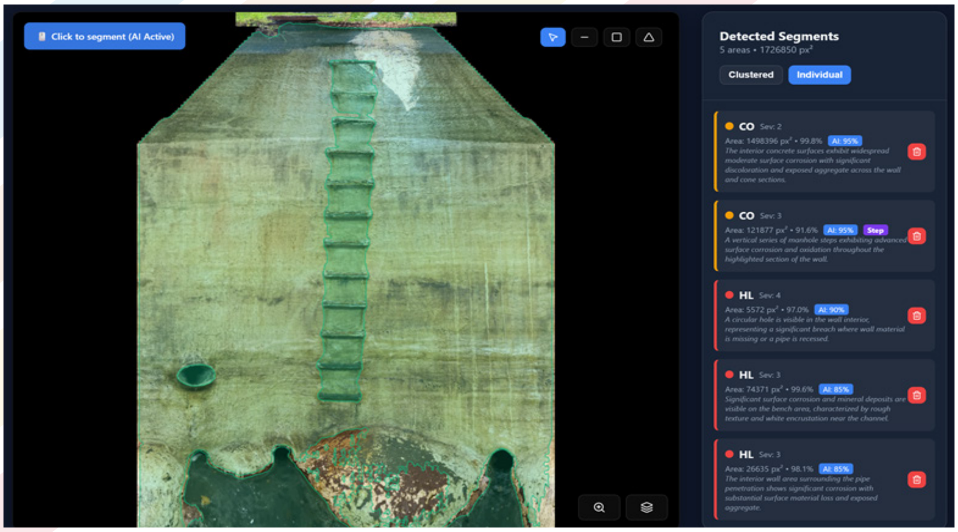
## Methodology Step 3: The AI Engine and Multi-Modal Analysis

Once the image is unfolded, the "Brain" of the system takes over. We utilize a sophisticated, multi-stage AI architecture that moves beyond simple object detection. While traditional computer vision might simply draw a box around a crack, our system aims to understand the context and severity of that crack, much like a human expert would.

The architecture relies on a combination of open-source segmentation models (SAM) and Google's Gemini Large Language Models (LLM).

**Segmentation (The "Where"):** First, the system scans the unfolded image to identify regions of interest. It segments out distinct


Raw Video Frames (Fragmented & Variable)  Unfolded Image (Structured & Consistent)




components, such as steps, pipe inlets, the bench, and the channel. It also identifies anomalies that resemble defects, such as fractures, roots, or infiltration staining.

**Interpretation (The "What"):** Identifying a blob on an image is not inspection. Inspection requires interpretation. This is where the Gemini Vision model is applied. We feed the AI the specific image segments along with contextual data. The AI analyzes the visual texture, color, and shape of the defect. For instance, it can distinguish between a harmless shadow and a severe fracture. It can differentiate between light surface rust on a step and deep corrosion that compromises structural integrity.

**Clustering and Context:** One of the challenges with AI is that it might identify a long crack as ten separate small cracks. Our system employs clustering algorithms (like DBSCAN) to group proximal detections. If the AI detects multiple fracture points in a vertical line, the system understands this is likely a single, continuous vertical fracture. This mimics the cognitive process of a human inspector who sees the "whole picture" rather than isolated pixels.

## Methodology Step 4: The Rules Engine and Compliance

A common criticism of Generative AI is its potential to "hallucinate" or provide inconsistent results. In civil engineering, accuracy is non-negotiable. To address this, we do not rely solely on the AI's output. Instead, the AI's findings are passed through a strict validation filter—a "Rules Engine"—based on NASSCO's MACP (Manhole Assessment Certification Program) standards.

This Rules Engine acts as a logic gate that enforces engineering constraints. For example, if the AI detects a defect and classifies it as a "Cover" defect, but the location data places it at the bottom of the manhole, the Rules Engine flags this as a logical impossibility and rejects or reclassifies the finding. Similarly, the engine ensures that the severity ratings (1 through 5) align with the visual evidence based on the strict definitions provided in the MACP codebook.

This hybrid approach—using the creative power of AI for detection and description, but constraining it with a rigid, logic-based Rules Engine—ensures that the final data is not only descriptive but also compliant with industry standards and ready for integration into asset management software.

## Results: From Data to Actionable Insights

The output of this workflow is a comprehensive Asset Intelligence Report. This report is generated automatically, reducing the office processing time from hours to minutes.

The system delivers on the promise of the "Missing Middle" through several key performance indicators:

**Speed and Efficiency:** Field capture time is reduced to approximately 15 seconds per asset. Total processing time, from upload to report generation, is roughly 5 minutes per manhole. This represents a time reduction of approximately 70% compared to traditional Level 2 or Level 3 inspections.

**Scalability:** The processing architecture is cloud-based and stateless. This means the system can scale horizontally. Whether a municipality needs to process 10 manholes or 10,000 manholes, the system can spin up the necessary computing resources to process them simultaneously.

**Auditability:** Trust is paramount in AI adoption. Unlike "black box" solutions that just spit out a grade, our system provides full auditability. Every defect identified in the report is linked to a specific, high-resolution image segment. A human reviewer can click on a defect code in the report and instantly see the corresponding portion of the manhole wall. This "human-in-the-loop" capability allows for rapid verification and builds confidence in the automated results.

## Future Outlook and Continuous Learning

The integration of 360° scanning and AI represents a paradigm shift in underground asset management. However, the technology is still evolving. During our testing and development, we have identified several areas for future enhancement.

One significant advantage of this AI architecture is its ability to learn continuously. As the system processes more manholes across different geographies and conditions—brick, pre-cast concrete, block—the underlying models become more refined. The segmentation masks become tighter, and the defect descriptions become more nuanced. We are effectively building a global knowledge base of infrastructure conditions that grows smarter with every inspection.

We are also expanding the application of this technology beyond vertical manholes. Early tests indicate that similar unfolding and AI analysis techniques can be applied to large-diameter pipes and culverts, providing a unified solution for sewer system assessment.

Furthermore, we are addressing the challenges of absolute measurement. While the current system provides excellent relative positioning, integrating Lidar or photogrammetric depth data into the 360° video stream will allow for sub-millimeter measurement accuracy in the future, further cementing this technology as a true Level 3 equivalent.

## Conclusion

The aging infrastructure crisis requires solutions that are exponential, not incremental. We cannot solve a 21st-century problem with 20th-century tools. By combining the accessibility and speed of consumer-grade 360° cameras with the analytical power of modern multi-modal AI, we are moving closer to a future where underground infrastructure assessment is not just faster and cheaper, but fundamentally more intelligent. This technology democratizes advanced inspection, allowing municipalities of all sizes to obtain the data they need to protect their communities and the environment.

## Author

**Jinwu Xiao**

Jinwu Xiao is a Ph.D. student and Research Assistant at Purdue University whose research focuses on AI-driven 3D scanning, digital twins, and intelligent infrastructure asset management, bridging academic innovation with next-generation industry applications.

# LESSONS LEARNED THROUGH THE SWITZ CITY ASSET MANAGEMENT PLAN

## A Real Story from a Real Project: How a Small Indiana Town Built Its Path to Sustainable Infrastructure

*By Wei Liao & Adam Hershberger*

Across America, thousands of small utilities face the same fundamental challenge: aging infrastructure, limited resources, and a reactive "fix it when it breaks" approach to system management. While large metropolitan water systems have access to dedicated engineering teams, sophisticated data platforms, and diversified funding streams, small communities often struggle with bare-bones budgets, skeleton staff, and infrastructure that was installed decades ago with little documentation.

Switz City, Indiana, is one such community. With a population of just 268 residents within city limits and a water service area covering approximately 870 people, this small Greene County town operates both water and wastewater systems that face challenges identical in nature—if not in scale—to those of the nation's largest utilities. Their daily water demand is approximately 120,000 gallons, served by 28 miles of water mains with 348 connections, a single water tower, 5 miles of wastewater mains, 79 manholes, one treatment plant, and 4 pump stations.

This article documents the lessons learned through the development of a comprehensive Asset Management Plan (AMP) for Switz City, a project that began with zero budget and evolved into a $650,000 funded initiative. It offers practical insights that other small communities can adapt to their own contexts, while making a critical argument: state-level support is not optional—it is essential for small utility survival.

*Switz City Wastewater Treatment Plant*

*Switz City Water Tower*

*Volunteer phase: fieldwork, planning, and collaboration in Switz City.*

## Project Genesis: From Zero Budget to Funded Initiative

### 2.1 The Volunteer Phase (January 2023 – July 2024)

The Switz City AMP project began not with a grant award or a contract, but with a decision to act despite having no funding. For 18 months, the project operated entirely on volunteer effort. During this phase, the team accomplished three critical tasks that laid the foundation for everything that followed.

First, the team developed an inspection strategy, determining what assets to inspect, how to inspect them, and in what order. Second, the team defined the project scope—identifying what could be included immediately, what could wait, and what absolutely could not be deferred. Third, the team built partnerships with industry, academic, and individual contributors who donated their time and expertise.

During this phase, the team built a risk-based methodology that was simple and practical for small systems. They gathered all available recor ds, built GIS maps, created an asset inventory, and conducted preliminary fieldwork including acoustic screening using SLR technology. When high-risk pipes were identified, industry partners were invited to perform CCTV inspection at no cost. The project was also integrated into Purdue University's asset management course, where five student teams developed complete AMPs as course projects, turning Switz City into a living laboratory.

The volunteer phase proved a powerful principle: nobody got paid, but everyone got value. Industry partners gained field demonstration opportunities, students gained real-world experience, and the community gained a foundation for its infrastructure future.

### 2.2 Transition to Full Execution

The volunteer phase culminated in an interim plan that was presented to the Indiana Finance Authority (IFA), resulting in a $650,000 funding award. This funding was divided into two categories: $250,000 for AMP development and $400,000 for urgent repairs and system upgrades.

With funding secured, the team expanded significantly. Technical partners including ADS.

Environmental Services, ACE Pipe Cleaning, Kurt Wright Consulting, and USG Water Solutions joined the effort. Financial expertise was brought in through Glenn Barnes of Water Finance Assistance (WFA) and Heather Himmelberger. Critically, Smart Views LLC was engaged for independent data review to ensure reliability and accuracy—a decision that proved invaluable.

## Building the Data Foundation

The second phase focused on building a comprehensive data foundation for the asset management plan. This involved creating a complete system inventory, conducting condition assessments across all assets, and confronting the reality of data management limitations in a small utility environment.

Comprehensive inspections were conducted across the entire system: flow monitoring, CCTV inspection of the complete wastewater system, manual manhole inspection, smoke testing for infiltration detection, and elevated tank interior and exterior assessments. A hydrant flushing exercise was also completed.

The data management reality, however, was sobering. While GIS served as the spatial backbone, operations and maintenance records, inspection data, and financial information all existed in separate files and platforms. Quality control relied on external review rather than built-in system rules, and data updates required manual coordination. The team did not have a true integrated data management system—a common reality for small utilities across the country.

*Full Execution Phase Fieldwork*

## Critical Infrastructure Challenges Revealed

The data collected during the assessment phase revealed the true scale of Switz City's infrastructure challenges—numbers that were, in the project team's words, "shocking."

On the water side, the system showed a 78.6% increase in water loss, with non-revenue water costs rising from $60,428 in 2019 to $107,941 in 2023. The Infrastructure Leakage Index stood at 16.86—far exceeding the industry benchmark of less than 3.0. Multiple hydrants and valves were inoperable, and aging cast iron mains were actively failing during the project period.

On the wastewater side, the infiltration and inflow (I&I) rate reached 46%, causing severe hydraulic overload. According to flow monitoring data, daily flows exceeded the treatment plant's capacity on 102 of 110 study days—a staggering 93% exceedance rate. Critical assets including the effluent outfall, valves, and key pipe segments required immediate replacement.

These numbers, while alarming, are not unusual for small utilities. The difference is that most small towns simply have not collected the data to quantify their problems. Switz City now had the numbers—and with them, the ability to make informed decisions.

## From Data to Decisions: The Continuous Loop

A fundamental lesson from this project is that asset management is not a one-time project—it is a continuous cycle. The team developed a decision framework built around four interconnected elements: Inspection & Data collection, Risk & Priority scoring (using Probability of Failure × Consequence of Failure = Risk Score), Decision-making (repair vs. replace, maintenance vs. capital), and Financial Impact analysis (rates, funding, and phasing).

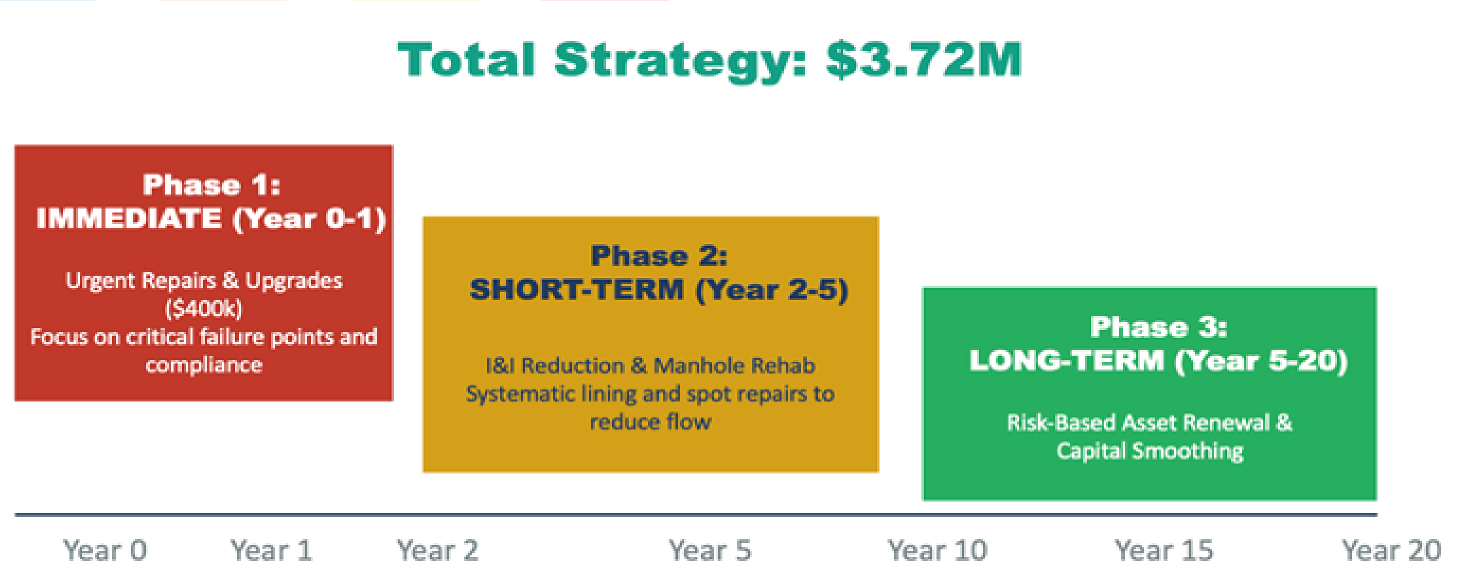
This framework ensures that as new data comes in—from ongoing inspections, operational events, or system changes—the plan adapts accordingly. The capital improvement list generated in year one will inevitably change as conditions evolve, and the AMP must be treated as a living document rather than a static report.


*The continuous asset management loop — inspect, prioritize, decide, fund, repeat*

## A 20-Year Investment Strategy

Based on the comprehensive assessment, the team developed a phased 20-year capital improvement strategy totaling $3.72 million. The strategy was designed around a critical principle: capital smoothing. Rather than allowing all infrastructure needs to accumulate and hit at once, investments are spread across three phases to maintain affordability.

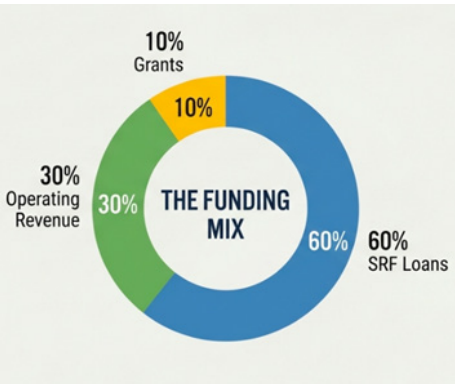
Phase 1 (Immediate, Year 0–1): $400,000




*The three-phase, 20-year investment strategy totaling $3.72M*

allocated to urgent repairs and upgrades, focusing on critical failure points and compliance requirements. Phase 2 (Short-term, Year 2–5): I&I reduction and manhole rehabilitation through systematic lining and spot repairs to reduce excess flow. Phase 3 (Long-term, Year 5–20): Risk-based asset renewal with capital smoothing to prevent investment spikes.

Affordability is fundamentally a financial decision. The best engineering plan means

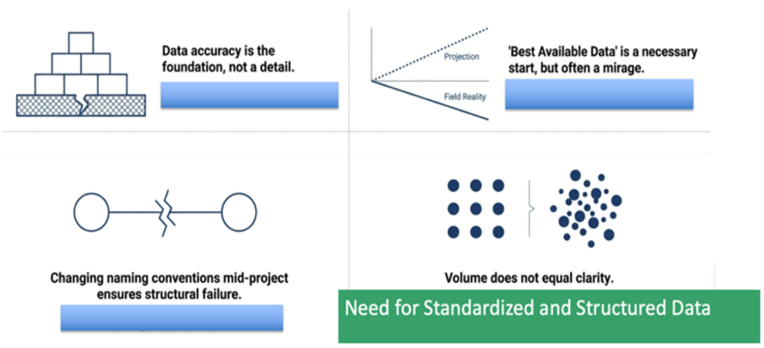



*The funding mix and affordability strategy*

nothing if the community cannot afford it. The project team worked with financial experts and grant partners to balance technical needs with community capacity. The funding mix was structured as approximately 60% SRF loans, 30% operating revenue, and 10% grants, with a phased rate implementation to reduce customer shock.

## Lessons Learned

The Switz City AMP project yielded eight critical lessons that are applicable to small utilities nationwide. These lessons span the domains of data management, technology adoption, governance, and policy.




*Four data reality lessons — accuracy, field truth, naming conventions, and standardization*

### 7.1 Data Reality

Lesson 1: Data accuracy is the foundation, not a detail. Wrong data leads to wrong decisions and wrong priorities. The transition from the interim plan (based on best available data) to the comprehensive plan (based on field-verified data) fundamentally changed the project's direction. What appeared to be a manageable situation turned out to be far more severe when actual conditions were measured.

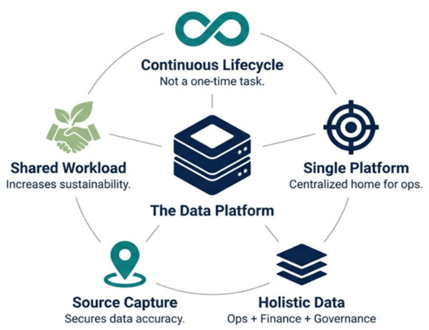
Lesson 2: 'Best available data' is a necessary start, but often a mirage. Initial estimates and projections diverged dramatically from field reality. The water loss numbers and I&I rates shocked the team because they were so far removed from what the existing records suggested.

Lesson 3: Changing naming conventions mid-project ensures structural failure. With multiple vendors working on the system, each applied their own naming rules to newly discovered assets. This created enormous reconciliation challenges and made it difficult to cross-reference with historical records. A firm naming convention must be established at the outset of any asset management initiative.

Lesson 4: Volume does not equal clarity—data must be standardized and structured. More data without standardization can create chaos rather than insight. The emphasis must be on data quality, consistency, and format standardization from the beginning.

### 7.2 Data Platform Reality

Lesson 5: Small utilities need a simple, unified data platform. Different types of data—operational, financial, inspection, compliance—were stored separately across spreadsheets, GIS, and paper files. Some small utilities, like the Town of Reno, Indiana, still rely entirely on paper records for daily operations.




*The data platform vision — continuous lifecycle, single platform, holistic data, source capture, and shared workload*

The ideal platform for small utilities is fundamentally different from what serves large systems. It must be a single, centralized platform that is easy to use with a minimal learning curve, connecting everything from financial data and operations records to inspection results and compliance documentation. When data lives in one accessible source, operators eliminate transcription errors, reduce delays, and can update information in real time. Most importantly, a unified platform allows the utility to own its data and its future, reducing dependence on outside consultants.

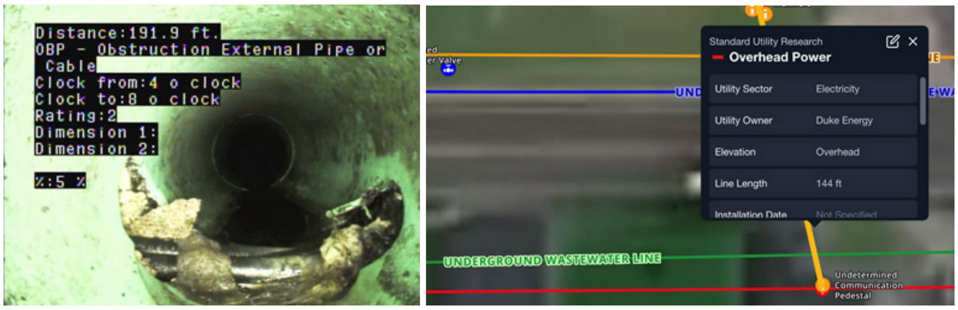
### 7.3 Technology as a Management Multiplier

Lesson 6: Technology is the management multiplier. A small town with one or two staff members can manage their system like a utility ten times their size—but only if they embrace technology. Technology in asset management is not about automation; it is about enabling timely decisions, making hidden risks visible, and supporting the execution of the asset management plan with better data.

Two case examples from the Switz City project illustrate this principle powerfully.

Smart Metering (Kamstrup): When old meters were replaced with smart meters, the technology not only simplified data reading but also detected abnormal consumption patterns through its analytics dashboard. The system identified a major hidden leak in an abandoned backyard. After repair, daily water demand dropped from 130,000 gallons to 80,000 gallons—a 38% reduction that directly supported the asset management schedule.

Asset Mapping (4M Analytics): During CCTV inspection, the team discovered a bore hole through a wastewater pipe. Using 4M Analytics' comprehensive utility mapping, they could immediately identify the intersecting infrastructure—determining that the crossing line was a Duke Energy power line. This real-time cross-system visibility dramatically improved field decision-making efficiency.




*Real-time cross-system visibility through 4M Analytics mapping*

*Kamstrup water meter*

### 7.4 Key to Sustainable Asset Management

Lesson 7: Asset management should be a living system, not a static report. Without governance buy-in at every level—board, operations, staff, and community—the asset management plan becomes a shelf document that is filed away and forgotten, while operations continue as before.

Sustainable asset management requires understanding that it is a long-term, phased process that must deepen over time. Transparency with stakeholders is essential. Governance determines success: board approval, education, joint implementation planning, and addressing the reality that many small utility boards lack technical or economic utility backgrounds are all critical factors.

### 7.5 Small Utilities Cannot Do This Alone

Lesson 8: This is the most important lesson for policymakers. Small utilities fundamentally lack the staff, time, and technical depth required for independent AMP execution. Developing a comprehensive asset management plan independently is cost-prohibitive for small systems. Personnel and knowledge gaps—in engineering, financial analysis, GIS, and asset management—are the primary bottlenecks.

The Switz City project required the coordinated effort of numerous industry partners, individual experts, educational contributors, financial specialists, and data quality reviewers. Expecting small systems to replicate this effort independently is, as the project demonstrated, both unrealistic and unfair.

The hard truth: Policy mandates without support mechanisms will fail. Indiana's SEA 272 (2022) requires utilities seeking IFA funding to have asset management plans—a positive policy step. But without corresponding support structures, the mandate becomes an unfunded burden on the communities least equipped to bear it.

## The Solution: State-Level Pooled Support

The Switz City experience points toward a clear solution: state-level integration of resources and support through a shared services model. This approach has two pillars.

Pooled Funding: Coordinate agencies such as IFA, USDA, OCRA, and FEMA so that small towns do not have to navigate five separate bureaucracies to secure funding. A single coordinated funding pathway dramatically reduces the administrative burden on resource-constrained communities.

Pooled Expertise: Create a statewide shared services model for technical assistance—providing engineers, financial analysts, GIS specialists, and asset management professionals as shared resources that small utilities can access without bearing the full cost independently.

State-level integration is not just helpful—it is a sustainable path to preventing future infrastructure collapse. The concept of a Water Asset Management Center, as introduced by Dr. Tom Iseley, embodies this vision: a centralized support structure that enables every small utility in the state to develop and maintain viable asset management plans.

## Conclusion

The Switz City Asset Management Plan project demonstrates both the possibility and the complexity of bringing proactive infrastructure management to America's smallest utilities. Starting with zero budget and growing into a $650,000 funded initiative, this project transformed a reactive, crisis-driven approach into a data-informed, strategically phased 20-year investment plan.

The eight lessons learned—spanning data accuracy, naming conventions, data standardization, platform simplicity, technology adoption, governance sustainability, resource reality, and pooled support—provide a practical roadmap for any small community facing similar challenges. But the most critical lesson is systemic: the current model of expecting small utilities to independently deliver comprehensive asset management is structurally flawed.

The path forward requires a fundamental shift from individual burden to collective capacity. From crisis to opportunity, from reactive to proactive—this is the future of utility asset management.

Switz City Project Hub: bami-i.com/projects/switzcity

## Author


**Wei Liao**

Lead Research Engineer at Purdue University

**Adam Hershberger**

Environmental specialist at Alliance of Indiana Rural Water

# BEYOND TRADITIONAL NDT

## CPM Pipelines and Acquarius™ Deliver Deep Insight into Marshfield's 20-Inch 2 Mile Ductile Iron Forcemain


*By CPM Pipelines team*

The City of Marshfield, Wisconsin has actively maintained the local environment for over 140 years. Located in central Wisconsin, Marshfield has provided wastewater collection and treatment services since 1880 and currently serves a population of 19,478 residents.

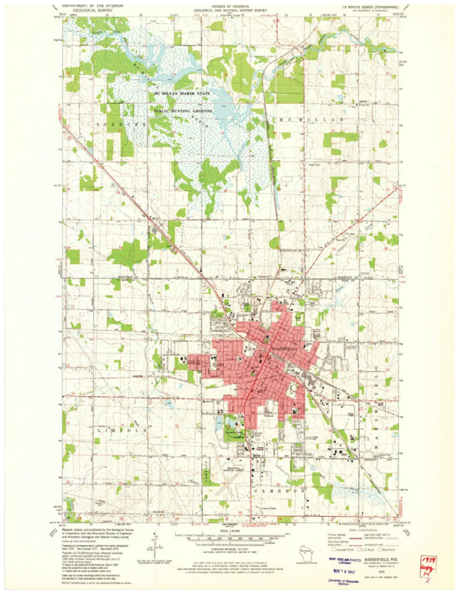
There are over 138 miles of sanitary sewer lines in the city that convey wastewater to the treatment plant. This system includes approximately 2,500 manholes spaced at 200–600 ft intervals to facilitate inspection, cleaning, maintenance, and sampling. Wastewater that cannot flow by gravity to the treatment plant is pumped from four lift stations located on the north and west sides of the city. Pumps at these stations convey flow through forcemains to higher elevations, where gravity flow resumes.

One major concern in the proper operation of the collection system, and ultimately the wastewater treatment facility itself, is infiltration of clearwater (rain, snow melt, and groundwater) into the system. This clearwater causes excessive flows and hydraulic stress at the wastewater treatment facility and within the collection system. In the worst cases, infiltration can exceed the gravity pipe's capacity and cause sanitary sewer overflows. Most wastewater utilities have active gravity sewer inspection, maintenance and rehabilitation programs to minimize infiltration sources. A portion of the wastewater collection system often left unchecked is the condition of forcemains. A forcemain can incur damage from corrosion, erosion, hydrogen sulfide attack, excavating and directional drilling. A breach of a forcemain will cause an immediate exfiltration of wastewater and likely a Sanitary Sewer Overflow.

On November 8, 2023, staff in Marshfield noticed the wastewater treatment plant was receiving approximately 1 mgd less flow than normal. This discrepancy was traced to a leak occurring from the Northeast Lift Station's forcemain. This forcemain is a 20 inch diameter cement lined ductile iron pipe that runs 2 miles in length. The leak occurred under a street and was discharging to the surface from a severely rusted, corrugated metal stormwater culvert. The location was obvious when the upstream side of the culvert was compared to the downstream side. The creek on the upstream side had a minimal flow of clear water while the downstream side had an increased flow of tainted water.

When the pipe was excavated the cause of the exfiltration leak was evident. A 4-inch hole had formed due to severe exterior corrosion at this portion of pipe. Although the exact cause of the corrosion is unknown, it was likely influenced by acidic soils or chloride contamination from winter road de-icing. Notably, the first mile of the forcemain—passing through undeveloped land—showed fewer defects than the second mile located in a developed residential area. The damaged section was repaired using an external repair coupling.

This incident made it clear that a full evaluation of the forcemain was necessary. Key questions included whether this corrosion was an isolated defect, one of several localized problems, or indicative of widespread deterioration along the entire two-mile length. At the time of the SSO, a lift station upgrade project was already in the design phase, so forcemain evaluation methods were added to the engineering firm's scope of work. All feasible inspection methods required inserting a Pipe Inspection Gauge (PIG) device inside the forcemain. Because the lift station lacked the necessary infrastructure to launch



such a device, a launch vault and associated piping were incorporated into the upgrade design.

The engineering firm identified four contractors capable of performing in-pipe forcemain inspections. Three expressed interest in providing services. After interviews with city staff and the engineering firm, CPM Pipelines was selected and used the Acquaint Acquarius™ inspection tool to assess the condition of the forcemain.

In August 2025 the inspection was carried out by CPM Pipelines utilizing the Acquarius™ NDT inspection technology. The inspected pipeline is a 20" Ductile Iron pipeline with cement lining and some PVC sections at the end of the alignment where it outfalls to a gravity manhole. The main objective of the inspection was to gain insight into the overall condition of the pipeline and identify potential failure mechanisms. Additionally, the materials used and the pipeline's location are mapped out. The NDT tool is an intelligent Pipeline Inspection Gauge (PIG)


and has been developed together with various wastewater utilities and drinking water companies. The tool measures various properties of the pipeline. It utilizes, among other things, ultrasonic sensors and advanced inertial measurement unit sensors (IMU). The analysis revealed several findings including measured wall thickness, pipeline deviation from the provided trajectory, angular displacements at joints, joint gap widths, delamination, sulfate attack, cement lining deterioration and other anomalies. Damage to the cement liner has been observed along nearly the entire pipeline length. In addition, numerous locations exhibiting delamination and external wall damage were detected.

The inspection revealed a number of critical and important issues with the pipeline. From a location perspective, none of the pipe sections were found to be more than 6 feet from the location identified on the as-built drawings and the city's GIS. Having an accurate location of the pipeline will assist the city in the future when additional work is required on this forcemain. The depth profile indicates a gradual upward slope of the pipeline. This is important because it indicates that there will be few gas pockets and limited internal defects due to hydrogen sulfide buildup.

The next parameter measured was angular displacement or joint deflection. Joint displacements greater than 4 degrees for PVC pipe and 5 degrees for DI pipe are deemed to be extreme. These are calculated based on the IMU sensor on board the inspection tool. A total number of nine joints exceed the thresholds of the materials. These include six joints that exceed the thresholds in the horizontal plane and three that exceed the threshold in the vertical plane. It is possible that these connections are deliberately installed with excessive angular displacement to make a curve over multiple pipe sections.

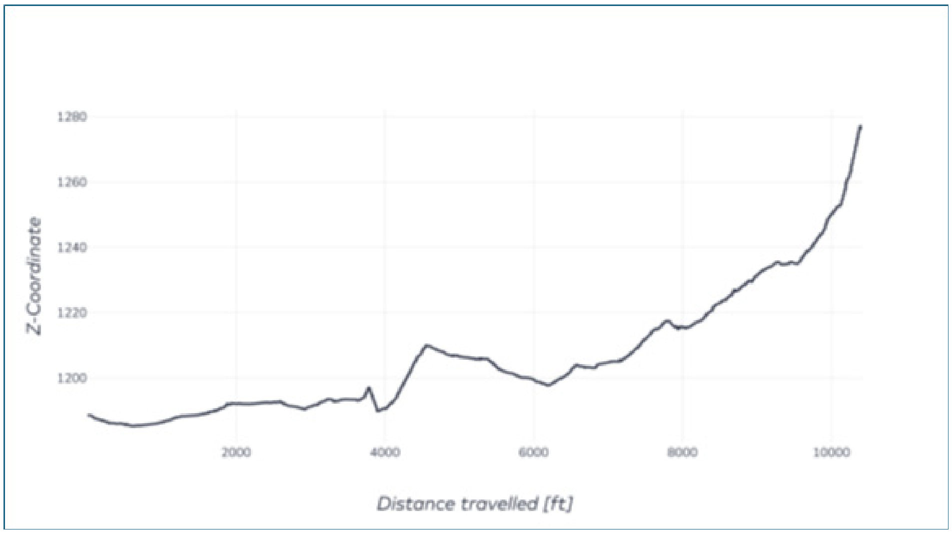
Next, the issue of gap widths was analyzed. Gap widths in excess of 1.4 inches is deemed to be excessive. A total of two joints with extreme gaps were identified within the DI pipeline. For both joints, the type of connection used is unknown so it is important to assess whether the joint gaps indeed exceed the critical limits. Continued monitoring of these joint gaps is advised to track any potential worsening over time.

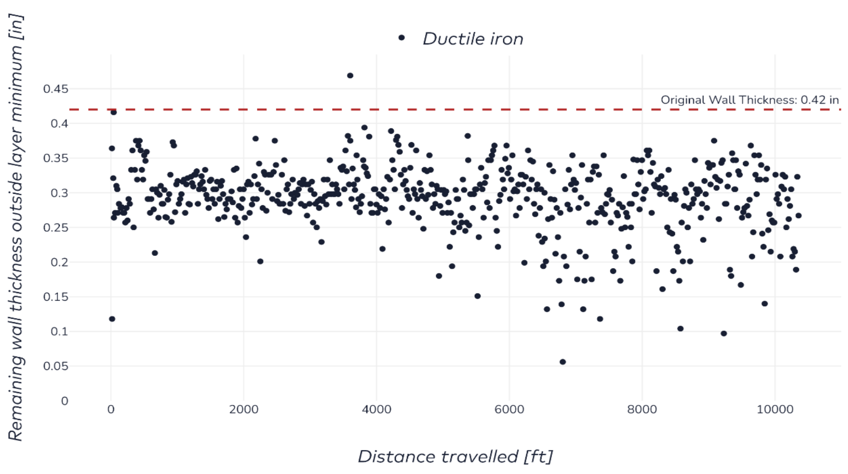
One of the most important condition assessment parameters that the inspection device analyzed is wall thickness. Both for the cement lining inner layer and the ductile iron outer layer. With the UT data, it is possible to determine the wall thickness of the pipe materials in the inspected section based on thousands of measurement samples. These large number of measurements determine both the average remaining wall thickness and the minimum remaining wall thickness per pipe section. The wall thickness is based on the speed of sound for the used materials in the trajectory. This allows the wall thickness to be determined for every pipe segment. The ductile iron pipeline was assumed to be AWWA Class 52 based on the information given by the client prior to the start of the inspection. This corresponds to an original ductile iron thickness of 0.42 inch. Furthermore, the pipeline has an internal cement liner with original wall thickness 3/32 inch. For both the ductile iron and cement liner the wall thickness could be analyzed due to the variation in thickness of each material type. The wall thickness of the cement liner and the ductile iron together form the wall thickness of the entire wall. Following the analysis, it has been determined that the average remaining wall thickness for the majority of the ductile Iron pipe segments (iron + lining) falls within the range of 0.52 to 0.60 inches. The PVC pipe segments at the end of the trajectory have an average wall thickness of 1.18 inches. The 20" PVC pipe segments with a wall thickness of around 1.2 inches correspond to the DR18 pressure class 235 psi.

The minimum wall thickness detailed in the graphic below show that a significant number of the pipe segments in the second half of the pipeline contain localized regions where a significant amount of the wall has deteriorated. In all of these cases this is caused by significant corrosion on the outside of the pipe.

To illustrate the condition of the pipe in these impacted segments the figure below shows that the reduction in pipe thickness is primarily due to corrosion from the outside of the ductile iron pipe. The cement liner is intact and healthy in this location. The ductile iron has significant lengths where corrosion has seriously impacted the integrity of the pipe.

In pipelines consisting of multiple layers, delamination might occur. With de-






lamination, the cohesion between the different layers reduces, resulting in the layers separating from each other. A total of 4,361 instances of delamination were identified where the cement liner is separating from the DI pipe. Leakages are detected using a hydrophone. The results show that there was no noticeable increase in the sound signal in this pipeline. This indicates that no leakages have been detected in the inspected pipeline by means of the hydrophone. Sulfate attack (H2SO4) can occur in the concrete and asbestos cement pipe segments of wastewater pipes and can cause the pipe to deteriorate into a critical condition. At only one location along the inspected pipeline, $H_2SO4$ attack was observed. The attack is in an early stage; the material is still present, but the integrity of the cement is beginning to deteriorate.

Due to several causes, such as corrosion of the material layer, sulfate attack or erosion of the cement, deterioration in cement liners can occur. Along nearly the entire pipeline alignment, a suspected defect in the cement liner was observed at the invert (6 o'clock position) and may be caused by calcium leaching from the cement matrix. The resulting loss of calcium weakens the cement. Or, it may be due to erosion from settled grit or rolling sediment in the conveyed sewage causing deterioration at the invert location.

This is one of a number of projects analyzing sewer forcemains that have been undertaken over the last few years in the United States using this NDT technology. The defect results identified in this study were similar to the other efforts. In addition, there are some universal observations that can be made over and above the defect analysis that can provide valuable insights to utility and pipeline operators and managers.

The NDT identifies exact location of the pipeline underground in a three-dimensional manner. This knowledge is critical. As-builts are relied upon when planning, designing and conducting underground construction projects. They are not always accurate. Having exact locations of underground infrastructure alleviates uncertainty in planning and design and cost extras due to unforeseen circumstances.

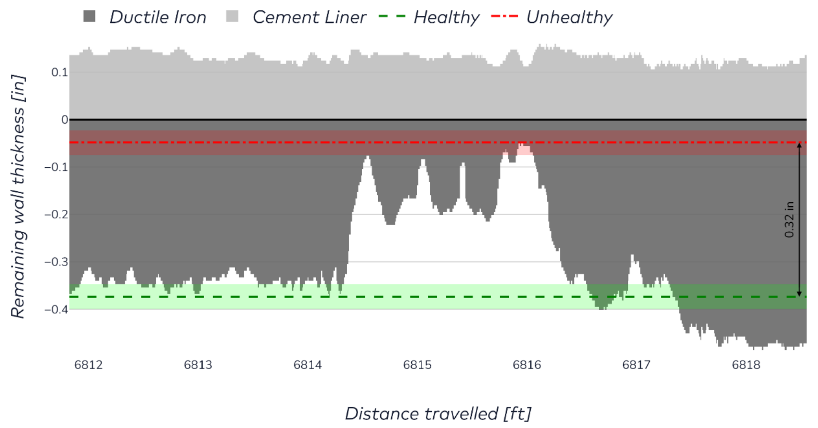
The tool is able to identify previous repairs and note them as anomalies. By overlapping anomaly detection with known repairs, the veracity of the analysis can be confirmed. This adds certainty to the decisions made based on test results.

Another value of the data is that surface activities can be correlated with subsurface pipe defects. The use of salt for ice removal on roadways was correlated with increased corrosion of the metal pipeline in areas where it ran under streets, and not where it ran over land. This information allows the utility to make operational decisions and understand the impacts of those decisions on all underground infrastructure, not just the pipeline being inspected.

The data collected by the tool identifies defects and anomalies with high locational precision. This means a utility can determine which stick of pipe is most negatively impacted. It also provides information on where the pipe segment is most impacted. The results show that defects and impacts are not evenly distributed throughout the pipeline, but are clustered. This assists the utility in planning rehabilitation or replacement capital programs in a more targeted manner with a less costly result. Targeted pipe lining or cathodic protection installation can be used to minimize cost, surface impacts and maximize pipeline life.

Performing the NDT inspection over time can provide valuable insights into the overall health profile of the pipe and the trends it is experiencing. It can also inform the operator about the impact of improvements made so that the asset management program can be refined.

The NDT program provides more than just defect identification information. It provides operational insight which in turn provides the utility with actionable knowledge to make the best decisions from a cost effectiveness, asset life and reliability perspective.




## About CPM Pipelines

CPM Pipelines is a U.S.-based infrastructure services company specializing in pressure pipe condition assessment and trenchless rehabilitation solutions. The company supports municipal, industrial, and utility clients by delivering advanced inspection technologies and innovative repair systems that extend pipeline life and improve long-term asset performance.

Contact: marketing@cpmpipelines.com

SMARTPHONE-BASED

# RTK Mapping for GIS-Compliant Utility Documentation

By PIX4D team

Uhe Undocumented or poorly documented underground utilities remain a hurdle for safe construction and long-term asset management. Traditional reliance on incomplete as-built records often leads to utility strikes and operational inefficiencies. As asset management evolves, institutions are increasingly adopting Geographic Information Systems (GIS) to manage spatial data in a standardized, centralized manner. However, the shift from manual data collection to GIS-compliant datasets requires precision, structured metadata, and integration from capture and processing into GIS software.

## Why GIS compliance is important

For a dataset to be truly GIS-compliant within an engineering framework, it must meet specific quality standards:

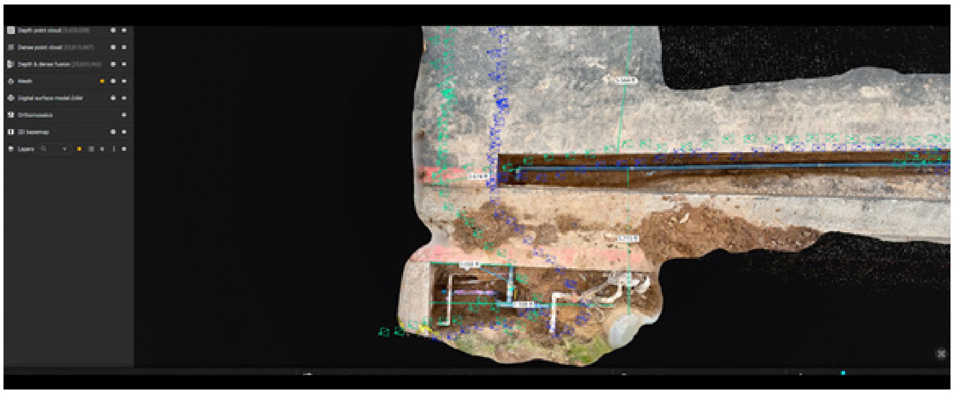
- Georeferencing: data must be tied to accurate spatial coordinates within a global GNSS reference frame.
- Descriptive metadata: beyond physical location, the data must include attribute information regarding the asset's characteristics.
- Integration: the format must allow for direct integration into GIS platforms to ensure data sharing across contractors and departments.
- Precision: documentation must meet legal or institutional standards to reduce the risk of utility strikes.

Achieving GIS compliance typically requires survey-grade tools, time-consuming workflows, or specialized skills. But with advances in mobile mapping and RTK positioning, it's now possible to capture compliant data with a simple, handheld setup, including a smartphone.

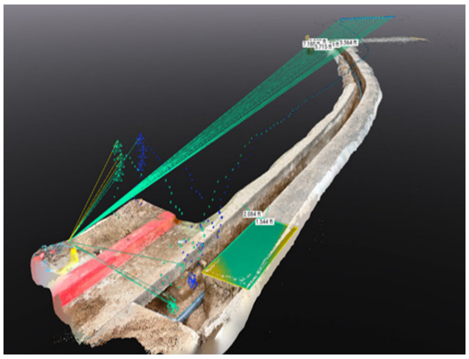
## Testing GIS-compliant utility mapping via smartphone with RTK

Pepperdine University in Los Angeles County, California, provides a "proof of concept" for the industry: testing whether digital documentation captured via smartphone with an RTK device can meet the strict legal and technical standards required for GIS compliance.

Led by Gabriel Armas, Asset Systems Development Manager, the team implemented this pilot to document critical subsurface utilities, specifically irrigation and water lines, and ensure every asset is accurately georeferenced during the window of active maintenance and new construction.



*Top-down view of the project site in PIX4Dmatic, displaying the dense point cloud, image alignment, and measurement annotations of buried utilities*



*3D reconstruction of a utility trench captured with PIX4Dcatch and RTK, showing measured distances and camera positions used for photogrammetry*

## Technical workflow & methodology

The team used a setup consisting of an iPhone 15 Pro Max paired with the PIX4Dcatch application and an RTK-enabled GNSS receiver.

The workflow followed a four-stage process:

1. Field capture: capturing high-resolution imagery and LiDAR data of open utility trenches using the smartphone app with an RTK device for accuracy.
2. Processing: Using PIX4Dmatic for reconstruction and dense point cloud generation.
3. GIS integration: the outputs were imported into QGIS to align the newly documented assets with existing site features and campus basemaps.

## Efficiency and regulatory compliance

The pilot project demonstrated that high-fidelity 2D and 3D subsurface data could be collected and processed in a fraction of the time required by traditional surveying methods.

- Time savings: the entire process, from data collection to the production of a final printed map, was completed in approximately 6 hours, with an additional hour to produce a final printed map.
- Regulatory alignment: In jurisdictions such as California, where GIS shapefiles are mandated for newly discovered or installed utilities, this workflow ensures that contractors and engineers remain fully compliant with local standards.

The goal was to test the ability to map a newly installed utility, and the team succeeded—producing a GIS-compliant dataset suitable for long-term use. By eliminating the "as-built information gap", organizations can significantly mitigate future risks.

## A large-scale infrastructure case study

*Overlay of the processed utility trench model on a QGIS basemap for geospatial context and alignment with existing site features*


*Final printed map showing the documented irrigation line at Pepperdine University, complete with asset details, coordinates, and collection metadata for compliance and archival*

*The project orthomosaic, captured with a Matrice 350RTK, was processed in PIX4Dmatic and imported to PIX4Dcloud to overlay design files. Zooming up on the orthomosaic in PIX4Dcloud shows the high resolution and detail of the map; the lines represent DXF files of reworked utilities*

While using a smartphone with an RTK device to document assets can meet legal GIS standards, the practical challenge for many subsurface utility engineering (SUE) professionals is maintaining that accuracy over time and across vast project areas.

## Maintaining situational awareness at scale

In Justice, Illinois, a major roadway construction project spanning over 300 acres, intersected by a primary interstate, presented significant logistical hurdles. The scale of the site and the sporadic nature of the construction schedule meant that traditional physical utility markings were constantly being worn away by weather and heavy machinery.

For the city and the contractors involved, poor decisions made due to a lack of real-time data can lead to catastrophic utility strikes and project delays. We spoke with Brian Layhew, a geospatial mapping specialist.

## Integrating ground and aerial data

To maintain a persistent record, Layhew integrated aerial photogrammetry with ground-level scans:

- Aerial mapping: A Matrice 350RTK drone to create an expansive orthomosaic of the 300-acre site.
- Terrestrial capture: For high-stakes subsurface assets, an iPhone 15 Pro Max paired with PIX4Dcatch and an RTK rover was used to scan open holes and exposed pipes, providing an “astounding digital twin” of the underground infrastructure. With 1447 images captured in total.
- Orthomosaic: 7000 images were captured for the entire map

This ground-level data was then integrated into PIX4Dcloud, allowing office-based engineers to overlay design files (DXF) directly onto the high-resolution maps to verify utility locations against engineering schematics.

Field verification with augmented reality (AR)

Because the project is so large and slow-moving at times, utility markings were constantly being worn away. For example, the team needed to find an underground water main, and having a digital map of its exact location to be re-marked regularly was invaluable.

Because the digital documentation was GIS-compliant and accurately tied to the global GNSS reference frame, Layhew could use PIX4Dcatch’s AR features to “see” the water main through the earth as he walked the site.

This allowed for re-marking the utility with extreme accuracy even after the physical flags had disappeared. This capability transformed the GIS record from a static

*The water main was captured with PIX4Dcatch as seen in the top image. Brian was then able to add an image of this point of interest right from the field in the Pix4D mobile-to-cloud workflow. The water main was captured with PIX4Dcatch and immediately displayed in PIX4Dcloud as an annotation for personnel at the office or future reference*

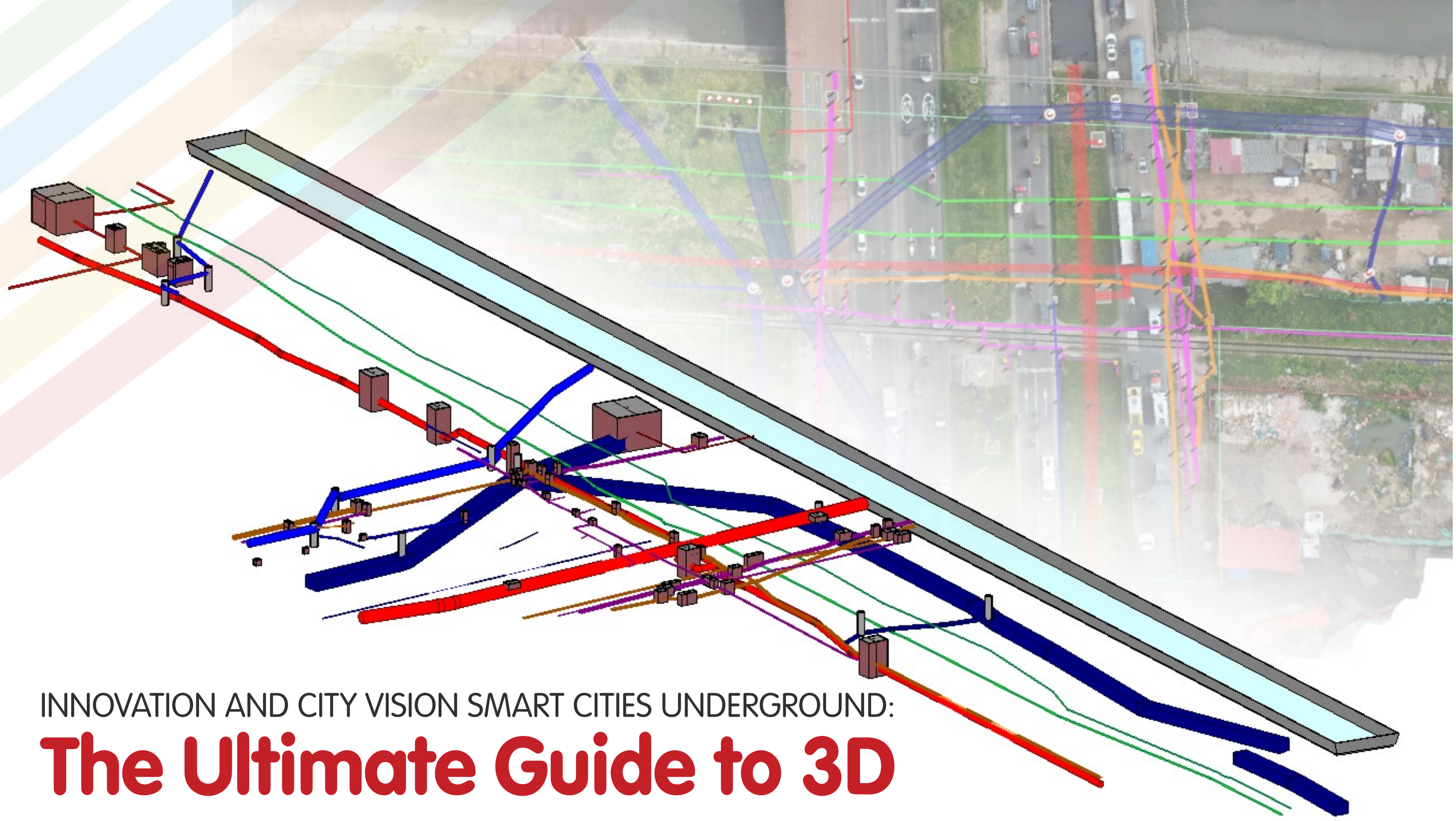
office document into a dynamic field tool, significantly reducing the risk of accidental damage during excavation.

Beyond simple monitoring, using PIX4D-catch, Brian integrated engineering DXF files into his models, using the app's AR features to verify and update both project schematics and city utility records in real time.His main challenge was ensuring full coverage of the remote site, two hours from the office, with a smartphone. To avoid revisits, he captured extra images from multiple angles, ensuring completeness on the first attempt.

The findings from both the Pepperdine University pilot and the Illinois infrastructure project highlight the successful integration of smartphone capture with professional GIS standards. By validating that smartphone-based RTK documentation meets the data integrity and georeferencing requirements for GIS compliance, these cases prove that digital twins are no longer restricted to specialized survey crews.

## About PIX4D

PIX4D is a Swiss software company and global leader in photogrammetry and mapping solutions, providing tools that convert aerial or ground images into precise georeferenced maps and 3D models for professionals in surveying, construction, agriculture, and infrastructure. The company's products automate image processing workflows and enable actionable spatial data across desktop, cloud, and mobile platforms.



INNOVATION AND CITY VISION SMART CITIES UNDERGROUND:

# The Ultimate Guide to 3D Mapping of Underground Infrastructure

*By Alberto Florez*

Beneath the asphalt of our bustling cities lies an invisible metropolis: an incredibly complex network of pipes, cables, and conduits supplying water, gas, electricity, and data, and managing our waste.

This underground labyrinth is the circulatory system of modern urban life. However, in much of Latin America, we operate almost blindly regarding this hidden world. The "utility cadastre" (the detailed record of this infrastructure) is often inaccurate, obsolete, or simply nonexistent. This lack of vision is one of the biggest obstacles to developing smart, safe, and sustainable cities.

Every time new construction begins or a road is repaired, a dangerous and costly lottery is unleashed. What lies beneath? At what depth? In what condition is it? The inability to answer these questions with certainty generates cost overruns, delays, safety risks, and negative environmental impact.

Today, a technological revolution is bringing this hidden city to light. 3D mapping of underground infrastructure, combined with intelligent models, is becoming the indispensable tool for building the cities of the future, starting from their invisible foundations.

### 1. The Problem: Building Blind

Beneath our cities lies an "***invisible metropolis***" of utility networks which, being undocumented, pose significant risks.

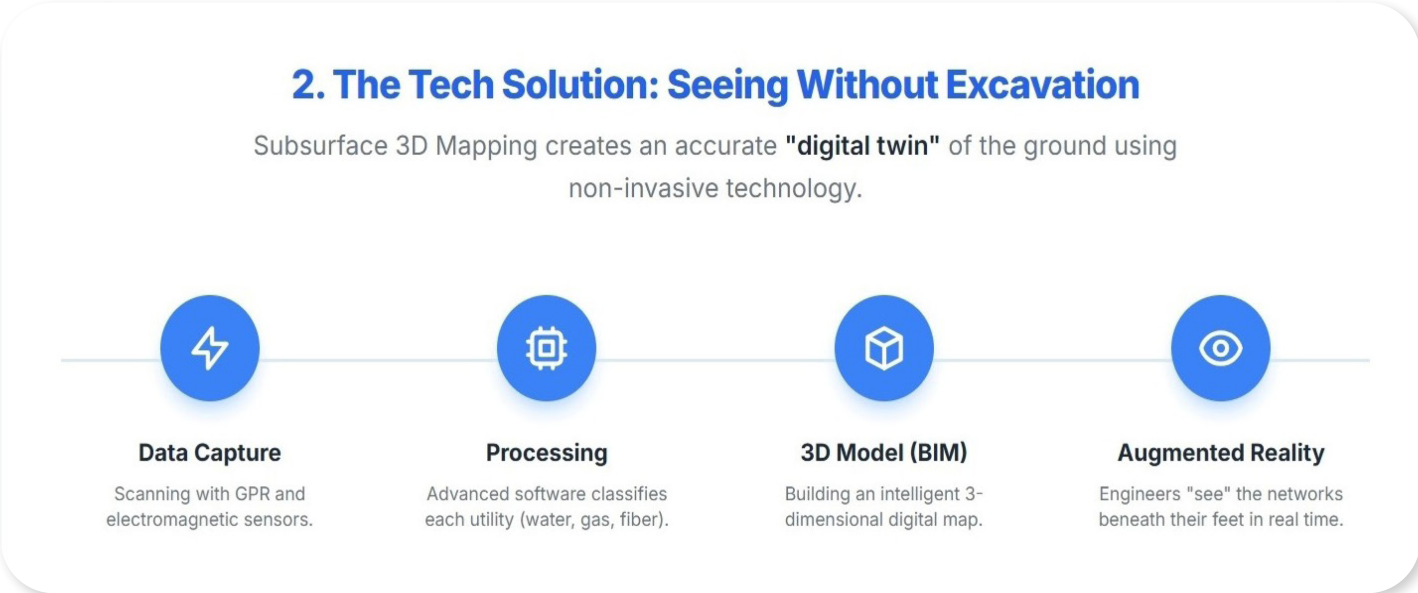
| 30% - 50% | 30% | 3 Million |
|---|---|---|
| COST OVERRUNS IN INFRASTRUCTURE | WORKPLACE ACCIDENTS DUE TO DAMAGE | PEOPLE MOVE TO CITIES WEEKLY |

## The Challenge: Accelerated Urban Growth on Unknown Foundations

The driver of this problem is massive urbanization. Global migration toward urban centers is relentless. According to Google Earth data, three million people move to cities every week, and in the last 35 years, the world population has increased by more than 2.3 billion people. This explosive growth exerts immense pressure on existing infrastructure and demands constant expansion.

In developing countries, this growth often exceeds planning capacity. The lack of a precise utility cadastre means that the information engineers and builders have is, at best, an approximation. Existing plans are usually two-dimensional, without precise georeferencing and without crucial data such as network depth. This insufficient information turns every excavation into a risk.

The result is a vicious cycle of inefficiency: projects are delayed by unforeseen damage




to networks, costs skyrocket, the community suffers from prolonged road closures, and the environment is affected by leaks and spills.

## The Technological Solution: Seeing Through the Subsurface with 3D Mapping

The answer to this challenge lies not in digging more test pits, but in adopting non-invasive technology that allows us to "see" underground. Companies like PCM-CLOUD MAPPING are leading this field by developing detailed 3D Underground Mapping. This approach combines multiple technologies to create a precise "digital twin" of the subsurface.

The process involves:

1. Non-Invasive Data Capture: Using Ground Penetrating Radar (GPR), electromagnetism, and other geophysical technologies, the subsurface is scanned from the surface without the need to break pavement.
2. Information Processing: Raw data is analyzed by expert personnel and processed with advanced software to identify the location, depth, diameter, and type of each network (water, sewer, gas, fiber optics, etc.).
3. Construction of Intelligent 3D Models: Processed information is used to build a BIM (Building Information Modeling) Model. This is not just a 3D drawing, but an intelligent model where each element contains detailed information, including point cloud management above and below ground.
4. Augmented Reality (AR) Visualization: These models can be taken to the field. Through a mobile device or AR glasses, engineers and workers can "see" pipes and cables superimposed on the real world, exactly where they are beneath their feet.

## The Impact: The Four Pillars of Underground 3D Mapping

Adopting this technology generates clear and quantifiable benefits organized into four main axes, transforming how urban projects are developed.

THE PILLARS of 3D mapping:


1. Radical Cost Reduction: The main advantage is economic. In Colombia, accidental damage to underground networks generates cost overruns of between 30% and 50% in projects. With prior 3D mapping, these incidents are almost completely eliminated, avoiding costly repairs that can range between $50 and $500 million Colombian pesos for each damaged network. This allows for more predictable financial closing and more efficient use of public and private resources. [1]
2. Optimization of Execution Times: Time is money. Unforeseen damage can paralyze a work site for weeks or even months. By knowing the exact location of all underground infrastructure, projects can be planned and executed without interruptions. Studies indicate that having a comprehensive cadastre can reduce project execution times by between 15% and 25%, benefiting both builders and the community. [2]
3. Environmental Impact Mitigation: Every broken water or sewer pipe is a small-scale ecological disaster. These incidents generate spills and leaks that contaminate soil and water sources, affecting local ecosystems. The cost of environmental remediation can be enormous. 3D mapping is a proactive environmental protection tool that prevents these disasters before they occur, reducing the carbon footprint and potential polluting discharges.[3]
4. Greater Safety for Workers: The most important risk is human. Excavating blindly endangers workers' lives. In Colombia, approximately 30% of workplace accidents in infrastructure works are due to damage to underground networks, especially gas and electricity. Providing field teams with a precise 3D map is a fundamental safe-

## 4. The Future: From Innovation to Mandatory Standard

3D mapping is transitioning from an optional choice to a **global legal requirement.**

**GLOBAL BENCHMARK:**

The **ASCE 38-22** code in the U.S. is now law, directly impacting insurance policies and construction permits.

ty measure that saves lives and prevents serious accidents, in addition to costs associated with compensation and medical care.[4]

[1] "Economic Impact of Damage to Underground Networks in Infrastructure Projects", National University of Colombia, 2018. Report by the Colombian Chamber of Infrastructure, "Average Repair Costs of Public Utility Networks 2020".

[2] Report "Analysis of Delays in Infrastructure Projects due to Network Damage", National Planning Department 2019.

[3] Study "Benefits of Having a Comprehensive Network Cadastre", Colombian Society of Engineers, 2021.

[4] Report "Environmental Remediation Costs for Underground Network Incidents", National Authority of Environmental Licenses. Report "Workplace Accidentality in Infrastructure Works", Ministry of Labor, 2021.

## The Horizon: An Inevitable Standard for Latin America

The potential market for these services in a country like Colombia is enormous, estimated between $250 billion and $1.6 trillion pesos annually, considering that between 30% and 40% of infrastructure projects involve underground interventions.

Beyond the market, adopting these technologies is becoming a global standard. In countries like the United States, compliance with the ASCE 38-22 code (American Society of Civil Engineers) is law. The adoption of methodologies such as those from BAMI-I (Buried Asset Management Institute International) represents the way forward toward developing underground Smart Cities and managing buried assets sustainably.

This standard establishes the quality of underground information that must be obtained before starting any project. Non-compliance not only invalidates insurance policies but also carries legal penalties.

It is only a matter of time before these regulations are adopted in Latin America. The need to guarantee citizen safety and efficiency in resource investment will make 3D mapping a requirement, not an option.

## Conclusion: The Smart City Begins Underground

Underground infrastructure 3D mapping is not a simple innovation; it is the backbone of modern urban planning. It is the tool that allows utility companies to shield themselves against failures, designers to project with confidence, and builders to execute safely.

In a world where efficiency, sustainability, and safety are crucial, having a prior three-dimensional cadastre not only reduces costs and times but makes the difference between improving and building with a vision of the future. The city of tomorrow is being built today, and its smartest foundations are the ones that are not seen.


## Author

**Alberto Florez**

Mechanical Engineer and Director of Communications for LAMS, brings 22 years of underground utility mapping experience. He led the launch of the Latin American Trenchless Technology Magazine and supports cross-regional collaboration between North and Latin America.

# WHAT UIS AND UIC CHANGED IN MY PRACTICE

## How the BAMI-I scholarship experience at UIS and UIC helped shape a more proactive approach to utility investigation, documentation, and BIM-informed practice

*By Karen Ortega*

The challenge of underground utility risk is not new, but its significance often becomes fully clear only through direct field experience. My perspective began with civil engineering practice in Colombia, where I developed a strong respect for field construction, practical decision-making, and the reality that many projects move forward with incomplete information. In road infrastructure work, crews often rely on experience, observation, and caution while still trying to keep production moving. That early foundation shaped how I understand construction today and taught me a lesson that has remained constant through later field engineering internships in Atlanta, survey work, and graduate studies in Construction Management Technology at Purdue University: plans matter, but field conditions have the final word, and the gap between what is documented, what is assumed, and what is actually present underground can define project risk.

Later, during my internships as a field engineer in road infrastructure in Atlanta, I experienced this reality at a much higher level of pressure, especially while working in an airport environment. Airport work is already complex because of safety, operations, access restrictions, and schedule demands. But one of the biggest challenges was underground utilities. Not all utilities were clearly located, and in some areas the information available to us was limited or intentionally restricted for valid reasons related to security and operational sensitivity.

In practice, this meant we were often working very carefully, very slowly, and with constant tension. It felt like working with our eyes partially closed, doing everything possible to avoid a strike while knowing that the consequences of hitting something underground could be severe. On that project, despite our efforts, we hit utilities twice. Even when the direct impacts on money and time were not always as catastrophic as people might assume, the incidents triggered a much larger chain of concerns: safety alarms, operational concerns, internal escalation, and even public attention and news alerts. In an airport, utility damage is never just a field issue. It can quickly become a public issue.

That experience stayed with me. It made me think more deeply about the gap between what we know in the office and what crews face in the field. I moved into the survey world, and that is where many things started to connect for me. Surveying taught me to see the project differently. I began to understand the rhythm between records, control, field verification, and constructability. I saw how survey can act as the link between documentation in the office and what becomes truly possible for crews in the field. Survey is not only about points and coordinates. It is about confidence, interpretation, and translating information into something that people can build from safely and efficiently.

That perspective became even more powerful when I started my master's degree in Construction Management Technology at Purdue University, where I have focused on the use of technologies to manage projects. At Purdue, I have been especially interested in how BIM and digital workflows can support construction, not only for buildings but also for linear infrastructure projects. This is important to me because linear projects often move fast, cover long distances, and involve underground uncertainty across many changing conditions. In fast-tracked projects, we are expected to mobilize quickly, execute efficiently, and leave the site ready for the next phase, often while the underground conditions remain only partially known.

As I started developing my ideas around the use of BIM in these environments, I found myself returning to the same concerns I had in the field: utility uncertainty, incomplete records, risk exposure, and the disconnect between design information and actual conditions. I had many ideas, but I needed structure. I needed a framework. That is when I knocked on Dr. Iseley's door.

Meeting Dr. Iseley was a turning point for me. He introduced me to a body of knowledge that was organized, practical, and directly connected to the questions I had been carrying from my

field experience. Through his guidance, I learned more deeply about ASCE 38-22 and ASCE 75-22, and I immediately recognized how relevant they are to the concerns that have shaped my work. For me, this was not just academic knowledge. It was an answer to real problems I had already seen in practice.

Through BAMI-I, I was then offered a full scholarship to attend the Underground Infrastructure School (UIS) in San Antonio, Texas, along with the Underground Infrastructure Conference (UIC), which took place at the same convention center at the same time. I am sincerely grateful for that opportunity, because attending UIS and UIC at this stage of my professional development was exactly what I needed.

UIS was especially valuable because it gave me the chance to organize many concepts that had been living in my mind in a scattered way. I arrived with field experience, survey experience, and BIM interests, but UIS helped me connect them into a more complete system of thinking. It was not only about learning definitions or standards. It was about understanding the chain of processes, where the conventional process tends to fail, and what resources we actually have to improve outcomes.

One of the things I appreciated most about UIS was the people. We came from different backgrounds, but we were connected by the same need to understand and improve underground infrastructure practice. I found the group to be very open, engaged, and genuinely committed to learning. That made the experience even stronger, because the conversations in class, between sessions, and during activities helped reinforce the technical content in a practical way.

Another major strength of UIS was the hands-on component. Getting out of the convention center to investigate utilities ourselves helped create a full-circle learning experience. It was one thing to discuss utility engineering concepts in a classroom setting. It was another to apply observation, interpretation, and investigation thinking directly in the field. That combination made the lessons stick.

At the same time, attending UIC allowed me to expand beyond the classroom and see where the industry is heading. Between UIS sessions and class breaks, I was able to attend conference presentations, case studies, and exhibits. I found this to be an excellent way to learn because the presentations did not only show successful outcomes. They also discussed the challenges, limitations, and decisions involved in solving real problems. That kind of honesty is extremely valuable.

I also had the chance to explore the exhibits and speak with many industry partners and technology companies. Those conversations were important to me. They were not just company pitches. Many turned into meaningful one-on-one discussions about practice, expectations, innovation, and how we can realistically bring better workflows into the field. For someone like me, who is preparing to graduate and step into the industry full-time, this was the perfect place to connect technical learning with industry application.

UIS and UIC came at the right time in my life. I am close to graduation, and I am preparing to contribute at a high level in underground infrastructure work. These experiences helped me see more clearly how I can bring value to the industry and to the company I will work for: by helping move us away from the old mindset of "hit and fix" and toward a smarter approach based on investigation, documentation, coordination, and better use of available resources.

For me, the future is not only about locating utilities more accurately. It is also about becoming better producers of information ourselves. That includes improving as-builts, strengthening field-to-office communication, and applying core BIM concepts to underground infrastructure processes in ways that are practical and useful. If we combine utility investigation principles, proper standards, survey discipline, and BIM-based information management, we can reduce uncertainty and make underground work safer, more efficient, and more predictable.

I am grateful to BAMI-I for this opportunity, and especially grateful to Dr. Iseley for recognizing how meaningful UIS would be for my professional path. UIS and UIC did not just give me more information. They gave me clarity, structure, and direction. They showed me that what is underground does not have to remain a mystery, and that our industry already has the knowledge, tools, and people needed to do better. Now the responsibility is to apply it well.


## Author

**Karen Ortega**

Karen Ortega is a civil engineer from Colombia and is graduating this summer with a master's degree in Construction Management Technology from Purdue University. Her background includes road infrastructure, field engineering, surveying, and BIM, with a growing focus on underground utility investigation, linear infrastructure, and technology-driven project delivery.


DR. TOM ISELEY NAMED RECIPIENT OF THE

# 2026 UCA Outstanding Educator Award

***By Wei Liao***

On February 17, 2026, the Underground Construction Association (UCA) of SME announced that Dr. Tom Iseley, Beavers Heavy Construction Distinguished Fellow and Professor of Engineering Practice at Purdue University, has been selected as the recipient of the 2026 UCA Outstanding Educator Award. The award will be presented on June 16, 2026, at the North American Tunneling Conference (NAT) in Anaheim, California.

## "I Just Focus on Doing the Work"

When Dr. Iseley received the notification letter from UCA Awards Committee Chair Mike Bruen, his first reaction was surprise. "I had no idea I was even nominated," he said. But he quickly added that this is nothing new – every award he has ever received came without his knowledge. From Trenchless Technology Person of the Year (1993), to the ASCE John O. Bickel Award (1995), to ASCE Distinguished Member (2015), to induction into the National Academy of Construction (2016) and the NASTT Hall of Fame (2017) – none were sought or expected.

"I have never thought about winning awards," he said. "I just focus on doing the work. Serving students is both my responsibility and my calling."

## Building Purdue's Underground Infrastructure Program

Since joining Purdue in 2020, Dr. Iseley has built one of the nation's most active undergraduate programs in underground infrastructure. He established the UCA of SME Student Chapter at Purdue – the third in the world after the Colorado School of Mines and the University of Illinois at Urbana-Champaign – and serves as its Faculty Advisor. The chapter has grown to more than 60 student members.

The program is anchored by two flagship courses. The Development of Underground Space (DUS) course covers tunneling, microtunneling, trenchless methods, and subsurface construction, bringing in industry leaders from Stantec, Mott MacDonald, Keller, AECOM, COWI, and other leading firms to lecture and guide real-world project simulations. The Asset Management of Underground Infrastructure (AMUI) course covers the full asset management life-cycle – condition assessment, level of service, criticality, life-cycle cost, and funding – connecting students directly with real utility projects.

> "I never knew I was being considered – I was just doing what needed to be done."

Beyond the classroom, Dr. Iseley founded the Underground Infrastructure Team (UIT) and the Future Underground Construction Leaders (FUCL) Development Program, with a singular mission: to give students maximum exposure to the industry through hands-on workshops, tunnel tours, site visits, and sponsored conference participation.

> “I have never thought about winning awards,” he said. “I just focus on doing the work. Serving students is both my responsibility and my calling.”

### Five Years of Taking Students into the Field

The numbers tell the story of Dr. Iseley’s relentless commitment:

- **2022:** 25 students attended the UCT Conference in Fort Worth, Texas. 22 students visited the 3RPORT CSO Tunnel in Fort Wayne, Indiana. A delegation represented Purdue at NAT in Philadelphia.
- **2023:** 32 students attended UCT in Orlando, Florida. 33 students visited the $5.7 billion Gordie Howe International Bridge construction site in Detroit, Michigan. A team attended RETC in Boston.
- **2024:** 11 students attended the Underground Infrastructure Conference (UIC) in Oklahoma City. The DUS course entered its fourth year. 8 students attended Global Buried Asset management Congress in Indianapolis
- **2025:** 14 students attended UIC in Houston, Texas.

The annual 3RPORT CSO deep tunnel tour – descending 220 feet below ground – has become a signature experience. Over the course of the program, students have produced over 70 reports, interviews, workshops, and company engagements, with consistent positive feedback from students, sponsors, and employers.

The fundraising and logistics behind each trip are grueling – coordinating sponsors, arranging travel, navigating university administration. “Every year after I finish, I say, ‘That’s the last time. I’m not doing this again,’” Dr. Iseley admits. “But then the next year comes, and I start all over again. Because when I see what these students gain – the excitement the first time they walk onto a tunnel construction site, the way their eyes change after talking with an industry leader – it makes everything worth it.”

### Gratitude to the Industry

Dr. Iseley is quick to emphasize that this award does not belong to him alone. “Without the support of this industry, I could not have accomplished any of this,” he said. “Every trip, every student opportunity, every classroom visit from an industry leader – none of it happens without their generosity.”

He expressed deep gratitude to The Beavers, whose funding supports his Distinguished Fellow position at Purdue and whose leadership – Executive Director Dave Woods and Board President John Bollier – have personally visited campus to connect with students. He also acknowledged the collective support of industry partners including CPM Pipelines, Midwest Mole, SAK, Bowen Engineering, Herrenknecht AG, Danby PVC Lining, SAERTEX multiCom, Waterline Renewal Technologies, QuakeWrap, InfoSense, US Hydrovac,Ace Pipe Cleaning, PICA Corp, National Water Main Cleaning, PVC Pipe Association, Plastics Pipe Institute, UCA of SME, NASTT, and ASCE – as well as individual professionals such as Mike Vitale (Mott MacDonald), Mike Traylor (Traylor Construction Group), Paul Schmall (Keller), and Steven Kramer (COWI), who have volunteered as guest lecturers, site tour hosts, and student mentors. He also recognized his colleague Wei Liao and Saleh Behbahani, whose tireless coordination has been essential to every student initiative.

“The people in this industry genuinely care about the future,” Dr. Iseley reflected. “They don’t just talk about workforce development – they invest in it. They show up. They give their time. This award belongs to all of them as much as it does to me.”

The 2026 UCA Outstanding Educator Award will be presented at NAT 2026, June 15–18, Anaheim, California. The achievement will be promoted on the UCA website and in Tunneling & Underground Construction magazine.

Contact: Dr. Tom Iseley, diseley@purdue.edu | Purdue University, Lyles School of Civil and Construction Engineering, 550 Stadium Mall Drive, West Lafayette, IN 47907

# LOCATING UNDERGROUND GAS PIPES

## WITH HIGH PRECISION GPR

*By Screening Eagle USA team*

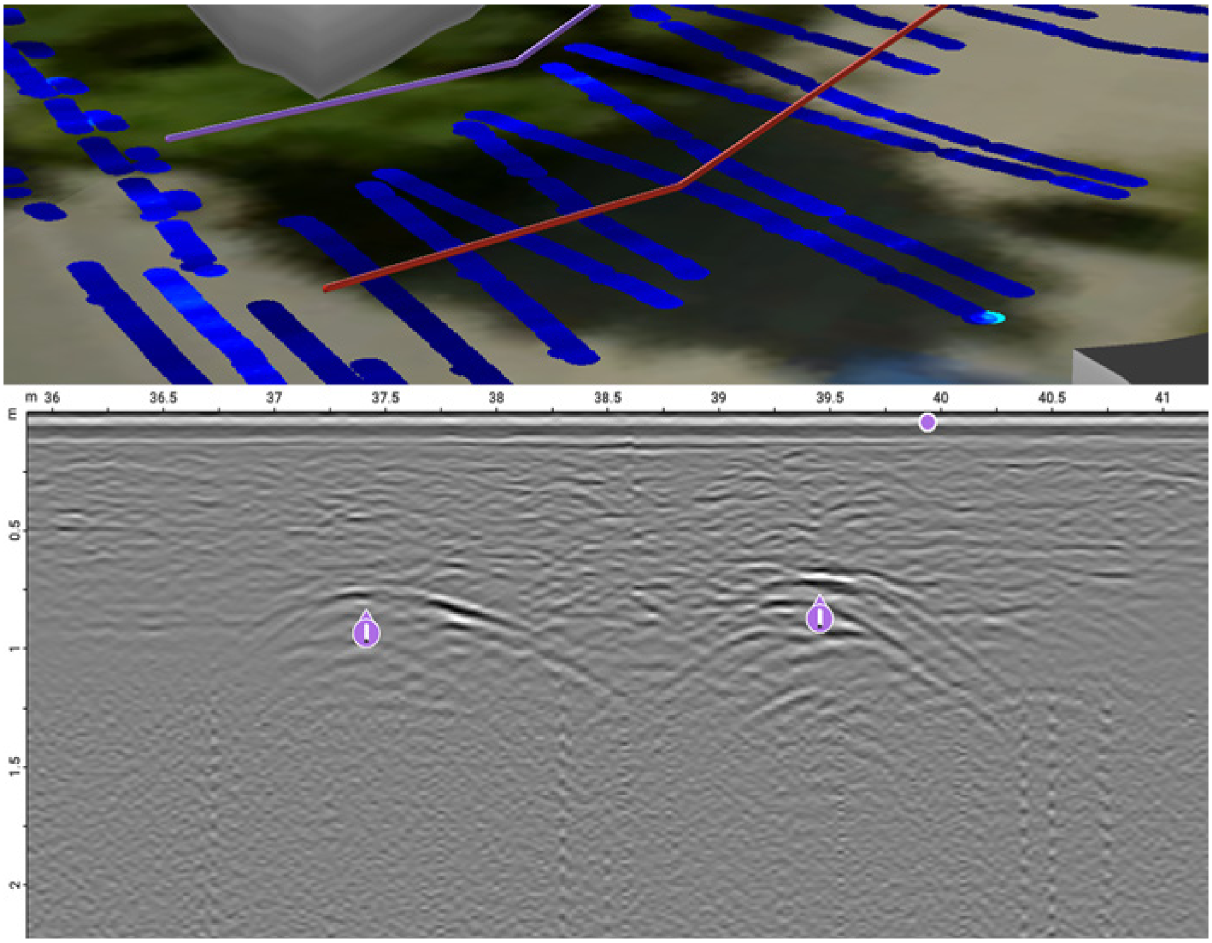
*Discover how District Heating Solutions used cutting-edge ground penetrating radar (GPR) to accurately locate a subsurface gas pipe without costly and disruptive digging.*

*Subsurface utility mapping with real-time data visualization*

## Overview

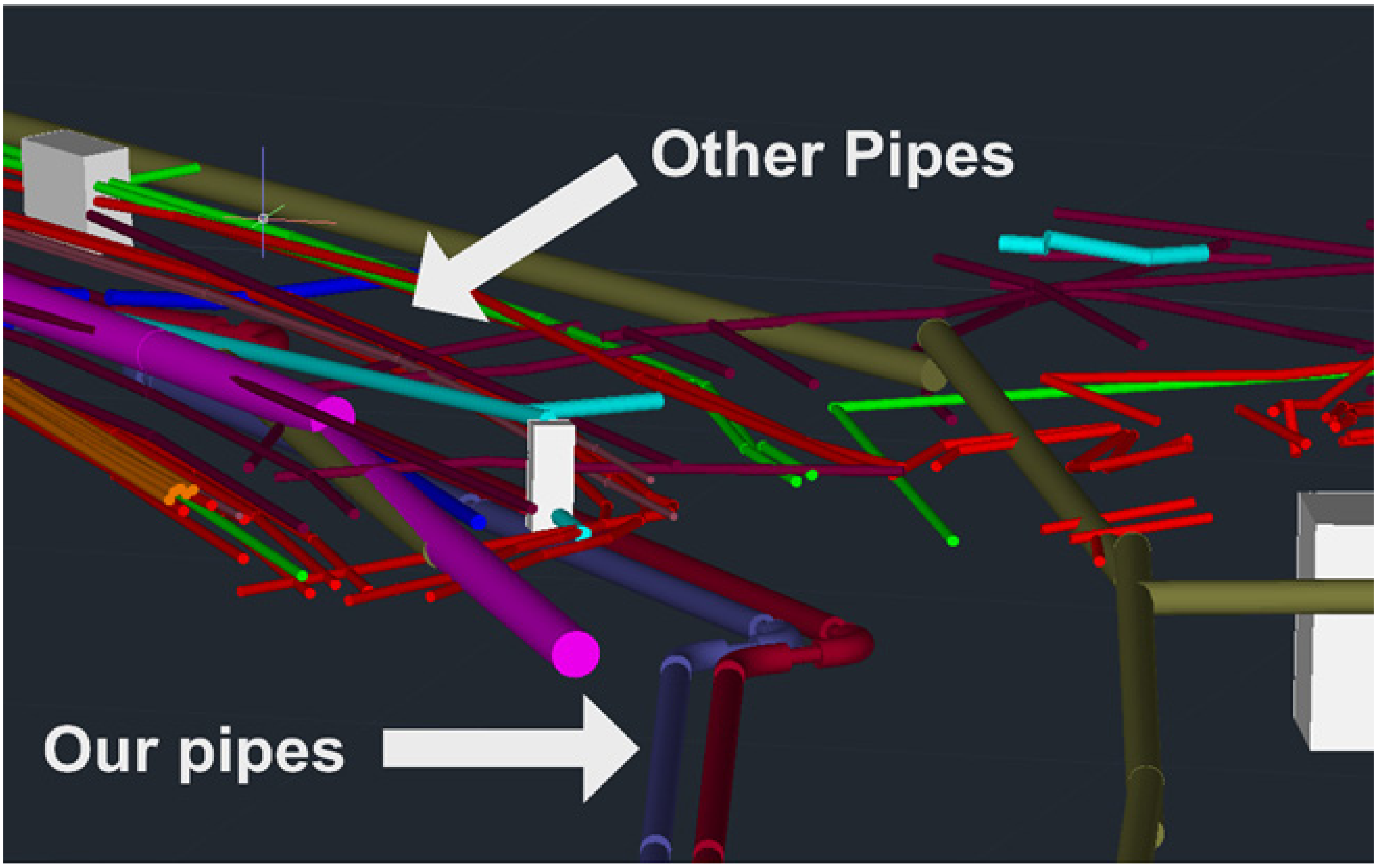
- The team at District Heating Solutions needed to find an aging underground gas pipe in Germany, without causing any damage.
- The GS8000 subsurface mapping GPR was used to scan the area to locate the missing pipe.
- The exact location and position of the pipe was revealed rapidly in 3D with high accuracy

District Heating Solutions provides eco-friendly, cost effective and dependable heating solutions for homes, businesses, and industries as a substitute for conventional heating techniques.




## Challenge

In Europe in the 1980's and 1990's, many underground utility networks were installed with an average lifespan of around 30 years. The time has now come for many of these utilities to be located and replaced. To add to the challenge, many of the networks were also poorly documented over time, so asset owners of-




ten know nothing about what is going on beneath the ground.

In this case, the team at District Heating Solutions were tasked with locating the main underground gas pipe located near a retirement home. There was little documentation of the utilities onsite, so the location was not sufficiently well known. The pipe needed to be cut off from the network fast, so it was crucial to find the exact position.

## Solution

The GS8000 subsurface mapping GPR was chosen to scan the area and locate the exact position of the gas pipe. With its real-time 3D visualization of the underground as you walk, the GS8000 makes a perfect solution for this application. The main advantage of using a ground penetrating radar like the GS8000 is that when no documentation is available, no time and money is wasted on digging up the ground to investigate and filling it back up again. It is simply too expensive to do.

Imagine, each hole can cost around 10k euros, and sometimes three, four, or even more holes may need to be dug to find what you are looking for. This gives an idea just how expensive it can get without using a solution like the GS8000 to give you the exact location.

## Results

The team scanned the area and located the gas pipe in less than one hour. Using the GPR data as guidance, they opened up the ground and the gas pipe was exactly where the data said it would be. Time and money was saved onsite with no need to dig up and refill unnecessary ground.

"With this new technology we are able to optimize our planning processes and make things happen that were not possible before. Being able to localize pipes without digging saves us time and our clients money."

This targeted approach also enables 3D planning for the new pipe networks being installed. First the existing network needs to be located and mapped with the GS8000, then 3D planning for new pipes can begin. This is crucial for successful thermal planning as the pipes must be ordered in a certain way to prevent stresses or snaps.

With the German Government planning huge network expansion and upgrades of current heating works, the demand for subsurface utility mapping is expected to increase substantially.

Luckily with subsurface GPR solutions from Screening Eagle, you can tackle any utility challenge with ease.

Check out our Tech Hub for more customer case studies and application notes on utility detection and subsurface mapping.

## About Screening Eagle USA

Screening Eagle Technologies provides a technology platform for intelligent inspection of the built environment. The company was created through the merger of Dreamlab in Singapore and Proceq in Switzerland with a mission to protect the built world with software, sensors and data. Screening Eagle's full-stack inspection solution combines intuitive software and powerful portable sensors to deliver reliable data for construction and asset maintenance decisions.

# BAMI-I AD INDEX

# HDPE PE4710 PIPE

## *The Best Choice For Water Systems*

| | TOP 10 Features and Benefits | HDPE | D. Iron |
|---|---|---|---|
| 1 | **Applications:** Potable Water (Lead Free), Raw Water, Reclaimed Water, and Wastewater | ✓ | ✓ |
| | ***References: AWWA C901, C906, C151, & NSF 61 + Health Effects of HDPE Pipes and Fittings for Potable Water Applications, NSF 2024*** | | |
| 2 | Open Cut Construction: Design and install per AWWA Standards and Manuals eliminating thrust blocks | ✓ | ✓ |
| | ***Ref: AWWA M55, M41 + MAB-3, MAB-6*** | | |
| 3 | Trenchless Construction: Material of choice for HDD, Pipe Bursting, Sliplining, and Compression Fit | ✓ | X |
| | ***Ref: ASTM F585, F1962, F3508 + MAB-5, MAB-7, MAB-11*** | | |
| 4 | **Fully Restrained Joint-Free System:** Minimize need for fittings to facilitate horizontal and vertical deflections | ✓ | X |
| | ***Ref: AWWA M55, M41*** | | |
| 5 | **Longevity & Corrosion:** Pipes, Fittings, and Joints have the least potential for corrosion or tuberculation | ✓ | X |
| | ***References: Durability and Reliability of Large Diameter HDPE Pipe for Water Main Applications, EPA/WRF/WERF 2025 + Critical Need for*** **Corrosion Management in the Water Treatment Sector, NACE 2019 + PPIPACE.com + Long-Term Aging of Polyethylene Pipes, UKWIR 2020** | | |
| 6 | **Flow Capacity:** New pipes have similar flow capacity per AWWA Standards and Manuals | ✓ | ✓ |
| | ***References: AWWA M55, M41 and PPIPACE.com*** | | |
| 7 | **Water & Energy Conservation:** Fused Joints have zero allowable water leakage and zero infiltration | ✓ | X |
| | ***Refrences: AWWA M55, M41 + ASTM F2620, F3190, F3565 and MAB-1, MAB-2, MAB-8*** | | |
| 8 | **Cost Effective:** Has the lowest initial cost, lowest life cycle cost, and lowest restoration cost for trenchless installations | ✓ | X |
| | ***References: Life Cycle Analysis of Water Networks, CSIRO 2008 + Annual Drinking Water Quality Report for 2014, Kittery Water District, 5/31/15*** | | |
| 9 | **Resilient:** Ability to resist water hammer and ground movements due to droughts, freeze/thaw, earthquakes and hurricanes with the ability for flow control and squeeze off | ✓ | X |
| | ***References: Recent Earthquakes: Implications for U.S. Water Utilities, WRF 2012 + Polyethylene Pipeline Performance Against Earthquake,*** **Kubota 2018 and MAB-9, MAB-10** | | |
| 10 | **Permeation/BTEX:** Pipes and elastomeric joints need to be properly engineered for contaminated conditions | X | X |
| | ***References: AWWA C901/C906 and C111/C151, Sec. 4*** | | |

MUNICIPAL ADVISORY BOARD

Additional information including MAB-3 Model Spec Guide
can be found at www.plasticpipe.org/mabpubs