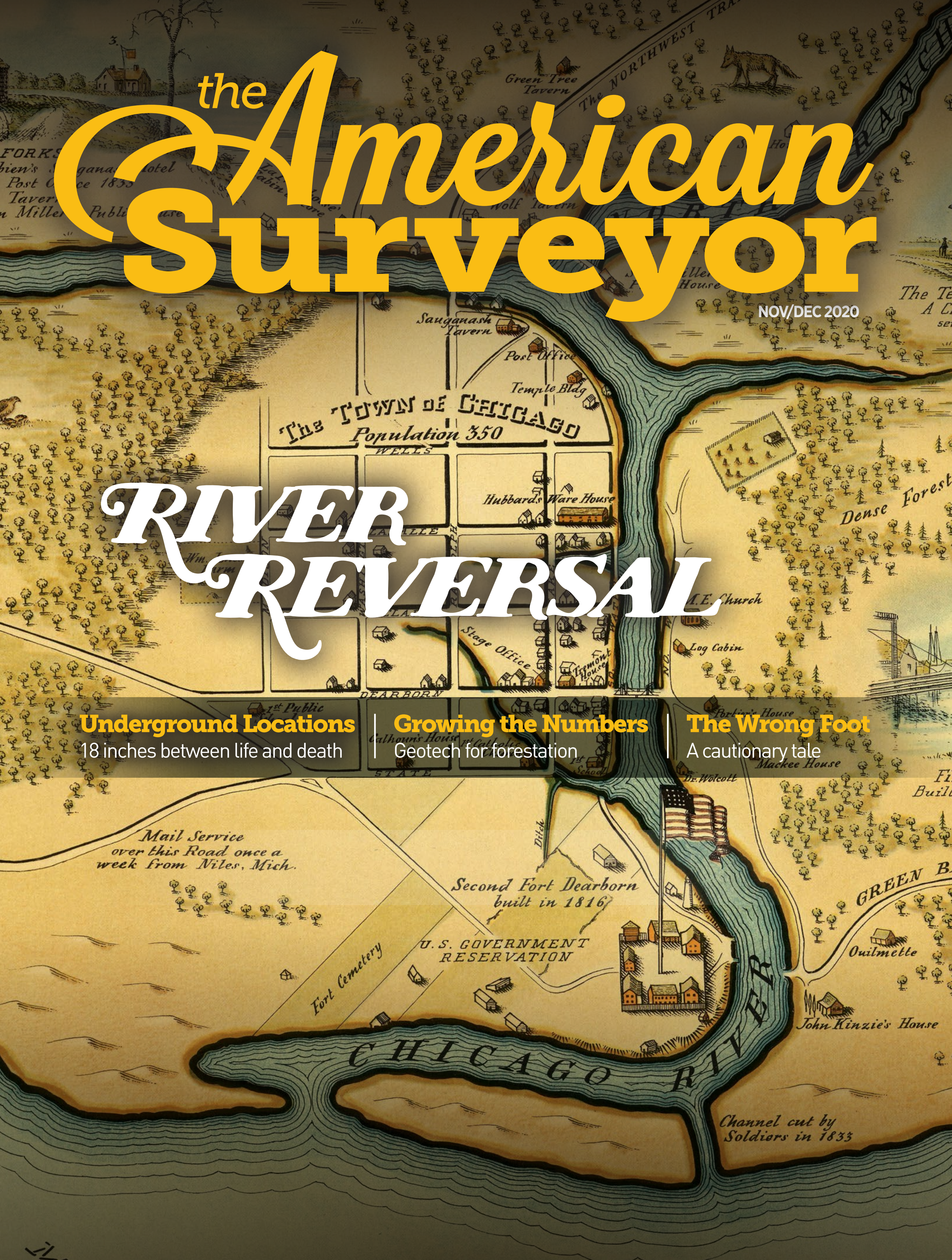
the American Surveyor

NOV/DEC 2020



River Reversal

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18 inches between life and death

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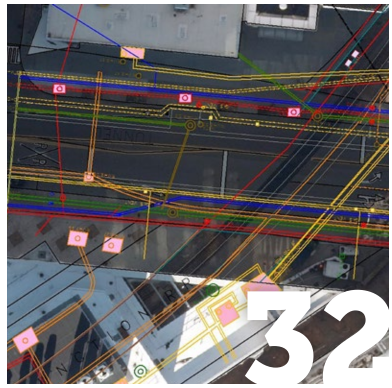
ON THE COVER

An engineering feat involving the Chicago River led to an interstate environmental lawsuit



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editorial

National Test

Different states license surveyors to provide different services relevant to each respective jurisdiction. Our common function in every state is focused on boundary surveying. Where some states include photogrammetry within the practice of surveying others license it as a unique discipline. Roughly a third of the states include some detailed practice with grading and drainage. Of course, there's the colonial states, along with Kentucky, Tennessee, and Texas that are not part of the USPLSS, followed by Ohio which encompasses the USPLSS, colonial lands, and the Western Reserve among its nine major land systems. Some USPLSS states are regulated under Tiffin's instructions, and others are bound to a particular edition of The Manual of Surveying Instructions for Public Lands. Most of us in USPLSS states are retracing under state law but the Alaskan surveyors are glued to the federal directions under the latest manuals. Suffice to say professional land surveying has its nuisances.

The state boards cooperate through the NCEES to establish a benchmark of minimum competence via the Fundamentals of Surveying and Principles & Practices test battery. The NCEES delivers rigorous psychometrics defining that benchmark consistent with a broad and collective definition of practice. The member boards are legislatively empowered by their state to ensure the benchmark represents their local standards. Each member board under its own law further administers a unique state test. Currently state tests range from intense all-day affairs to simple mail home tests.

> "A detailed national test vetted by judicial subject matter experts (SME) may offer a measure of proficiency across state lines."

The profession itself is organically evolving to a point where the metrics of competence are being redefined. For example, we have seen mapping standards addressed on a national platform. The fact is that mountains, rivers, watersheds, highways, railroads and natural disasters exceed state boundaries. The scientific

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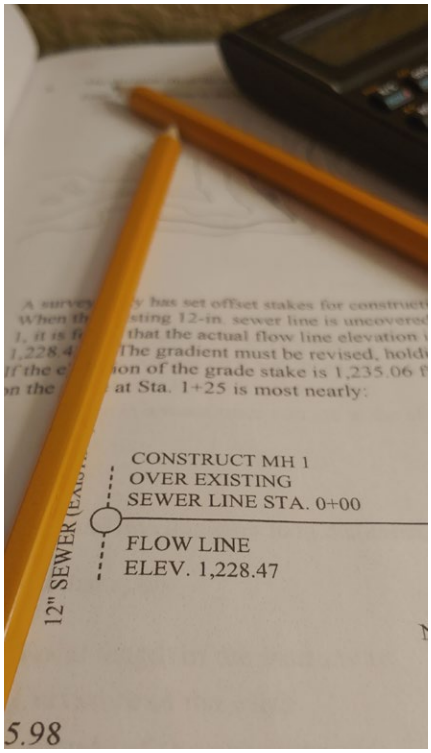
practice of mapping itself translates extremely well across jurisdictional boundaries ergo a common level of competence can be readily packaged for every jurisdiction. Conversely, roughly one third of the states empower surveyors to provide grading and drainage services. This presents a psychometric imbalance in states where the practices are irrelevant or perhaps even illegal within a local definition of surveying. Then we have the artful debate over colonial vs. USPLSS content. The relevant issue to the state courts is a fundamental understanding of the difference between retracement and original survey methods. Very few of us perform original USPLSS surveys under the current manual however the Alaskans are working "in the manual" and are a clear front runner for that type of content in a test. For most of us the manual is a reference for retracing competitive land grants governed under common law. Move four time zones toward Greenwich and the understanding of USPLSS content in the colonial states becomes mostly irrelevant.

Recently the member boards of NCEES requested and voted to authorize the formation of a land surveying test module task force. The charge was a feasibility analysis offering specific test content modules. The results of the analysis suggested a core test coupled with a combination of modules intending to replicate the current national standard along with targeting specific jurisdictional content. Not a bad concept from my perch.

Could we pull off an effective national test and protect the public in all 50 states? Let's hear it. "No way!" "Why not?" "I don't know?" What are the reasons? The PLSS is too square? The Colonial Systems are too irregular? There are fifty different legislatures? Ohio State beat Michigan, again? Or is it that the other 49 states can't possibly know how to stretch rope in your holler? Ironically, California has perhaps the most stringent state test, but a California court can appoint an expert witness land surveyor without a California license.

Let's identify subject matters that are consistent with every state. 1.) Geodesy, 2.) State plane coordinate projections, 3.) topographic mapping, 4.) photogrammetric control surveys, and 5.) construction layout. These are most certainly portable subjects in any jurisdiction. Yeah, sure there are local



nuances, but these topics are governed by the same science regardless of the jurisdiction. They also layout well in a textbook, on a test form and flow freely among academia.

I know from first-hand experience that the NCEES does a very good job of assessing minimum competence among the scientific aspects of land surveying. NCEES is the best game in town when it comes to bulletproofing a fair, accurate, and secure test. Every state accepts the NCEES test credentials as a basis of competence for the portable subjects. So, we've got that part of the machine built and running well.

The traditional challenge for NCEES has been its fifty-plus member boards asserting individual requirements of state mandated survey tests. Local regulations and bodies of law differ between states to the extent of requiring a supplemental test demonstrating that a practitioner is familiar with the law. State tests vary from a simple mail home form to a full day proctored affair with all the pomp, ceremony, and associated costs.

Colonial and PLSS States routinely divorce themselves from each other because of that blue book known as The Manual of Surveying Instructions for Public Lands. The Colonials have no genuine use for it whereas the PLSS crowd seems to misinterpret their own role under state authority and promote that book as the ultimate adjudicator in a boundary dispute. Well, it's not, nor is that the book's fault. The facts are 1.) most of us will not actually work in the federal arena under Congressional authority and, 2.) the lion's share of patented sections are already subdivided and noticed by deeds. That leads us to a national test addressing the common elements of boundary surveying under every state's authority.

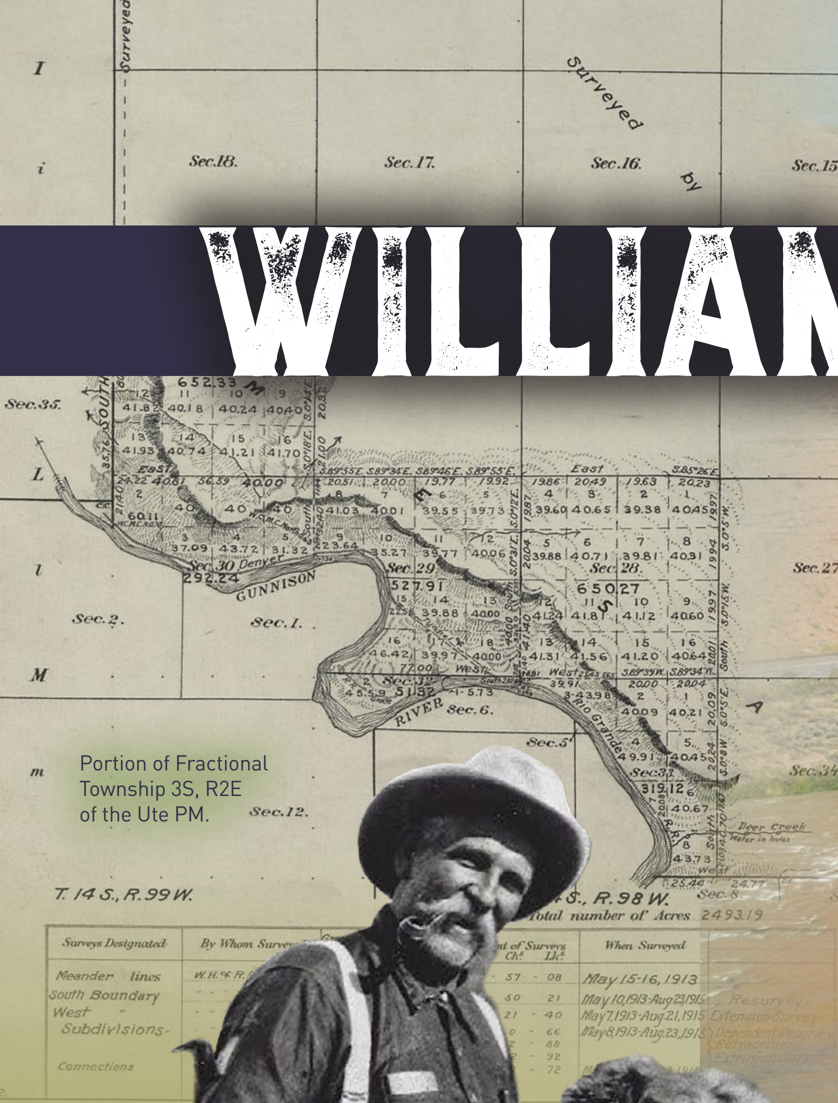
We have spent the last five years "reviewing the game films" in the Decided Guidance column. What have we learned? Despite legislative differences the judicial expectation of the surveyor is just about the same in all states. It was summed up very nicely by Chief Justice Cooley. Practicing surveying to some national courtroom standard may be a key to providing a meaningful and successful national test.

I think we are 90% of the way there with the NCEES. The scientific, mathematical, and mechanical facets are well covered. However, the courts of every state need an assurance that the surveyor is proficient in understanding lawful topics. A detailed national test vetted by judicial subject matter experts (SME) may offer a measure of proficiency across state lines. An NCEES implementation featuring juris doctors and judges in the mix of SME's evaluating a boundary law principles test may ease states' concerns with portability. Formulating test content from a strong handful of exemplary supreme court decisions and leading land boundary law publications may provide fair access to test content and background materials.

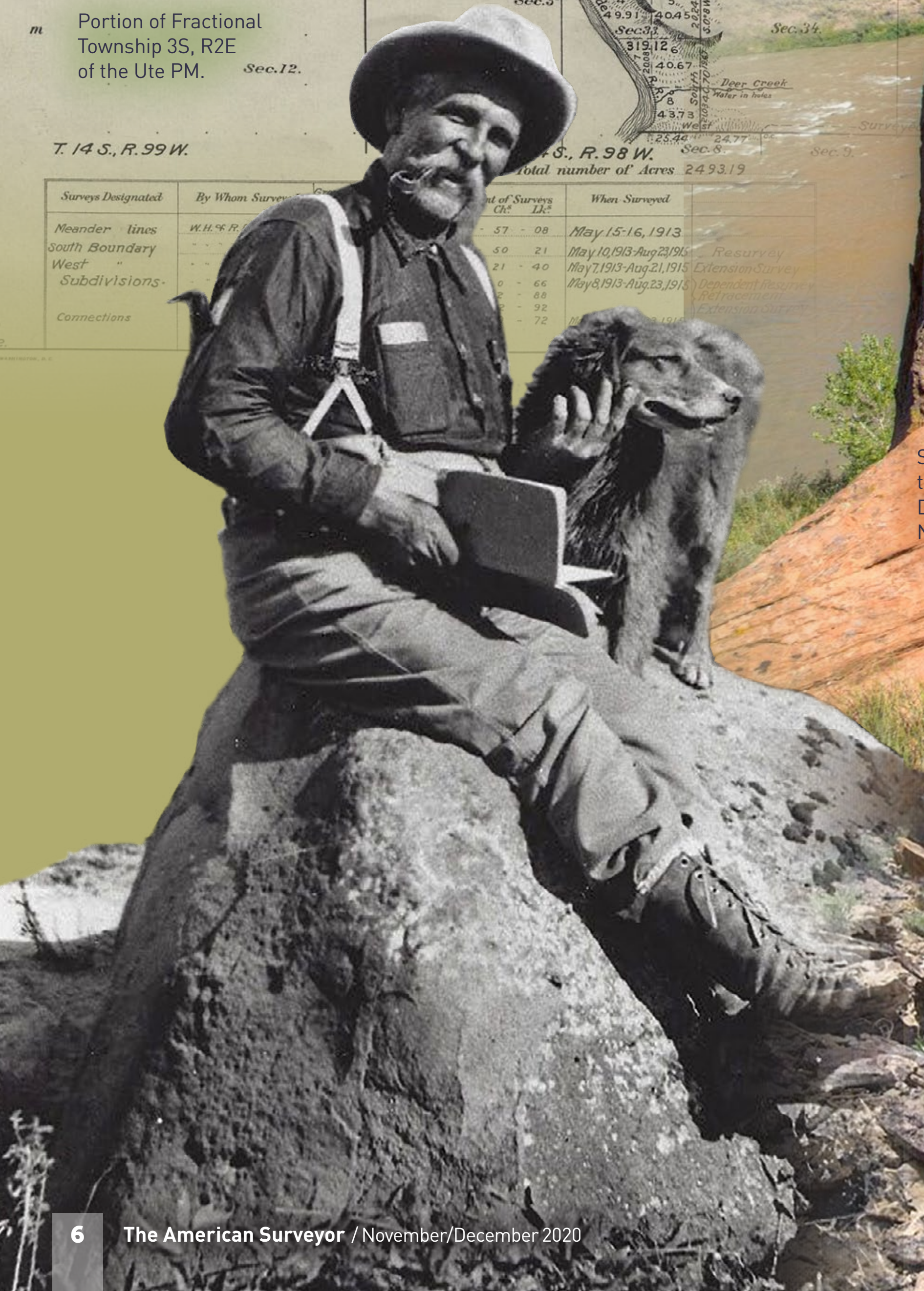
We are all experts capable of retracing a boundary under a specific body of law. A look at numerous court decisions reveals fundamental elements across every state when it comes to retracement surveys. I'm not so sure that the courts see much of a functional difference between retracement surveys whether in colonial or PLSS states. The purpose is to recover evidence leading to an accurate reconstruction of the lines as originally marked on the ground. A bigger challenge lies in demonstrating our proficiency through a nationally appealing test of our judicial role as surveyors. ■

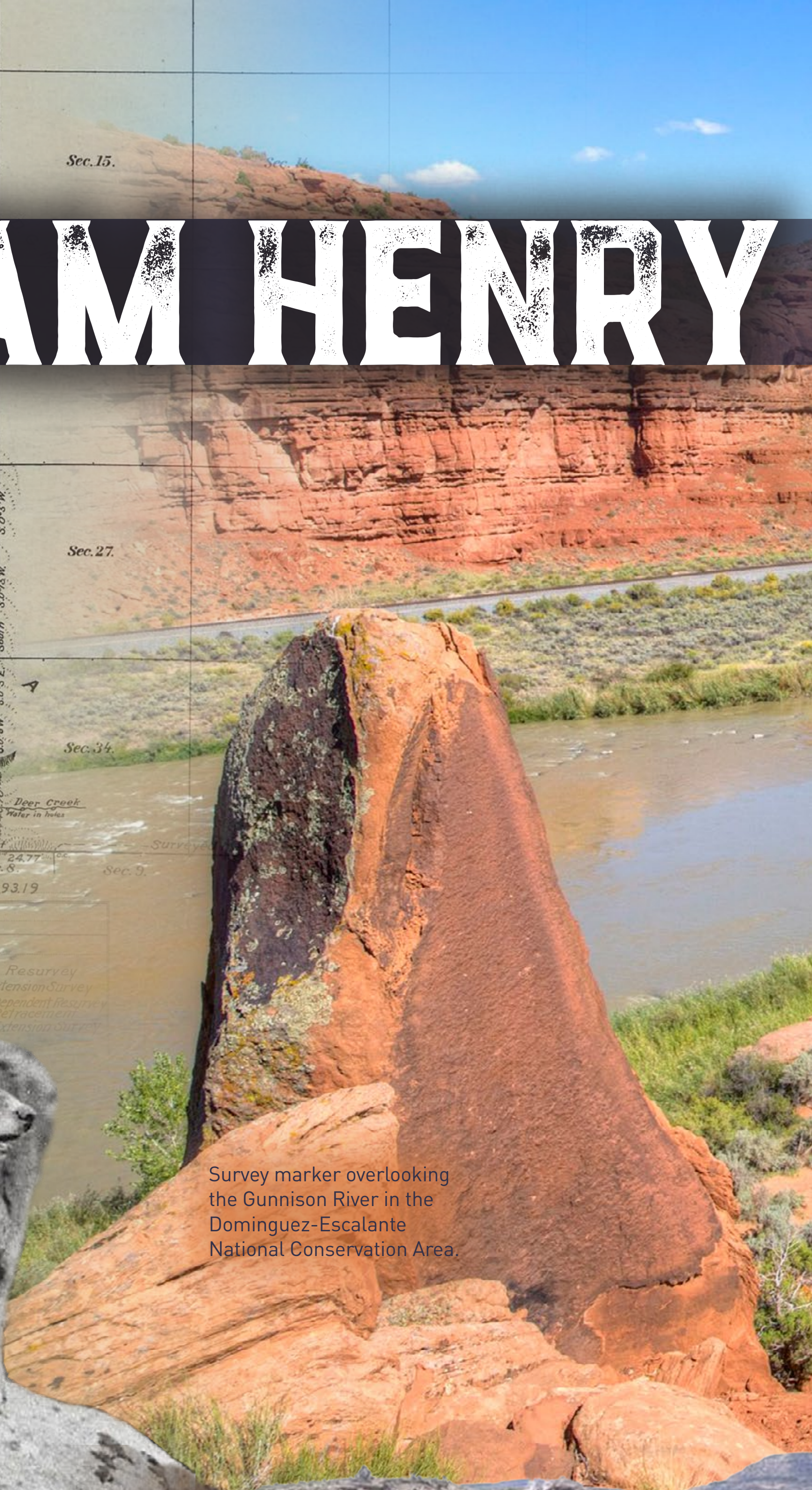
Jason Foose is a Professional Surveyor licensed in multiple jurisdictions.

WILLIAM HENRY



Portion of Fractional Township 3S, R2E of the Ute PM.





Survey marker overlooking the Gunnison River in the Dominguez-Escalante National Conservation Area.

Katie Steele, William H. Clark's great-granddaughter, with survey marker.

CLARK

» BUREAU OF LAND MANAGEMENT/ GENERAL LAND OFFICE

EARLY SURVEYOR OF THE DOMINGUEZ-ESCALANTE NCA

This GLO Record of the Week is about William Henry Clark (W.H. Clark), one of the first surveyors in what is now the Dominguez-Escalante National Conservation Area (NCA), administered by the Bureau of Land Management (BLM) south of Grand Junction, Colorado.

About W. H. Clark

Clark was born in Iowa and moved to Rio Blanco County, Colorado, in 1880. He studied civil engineering and used his professional knowledge to assist in cadastral surveys in undeveloped Meeker, Colorado, and adjoining counties.

In July 1881, Clark was named Deputy Land Surveyor for Colorado. During President Warren Harding's term in October 1921—a full 40 years later—acting Secretary of the Interior E.C. Turner appointed Clark to be the Surveyor General of Colorado.

A Mystery Unfolds

Between 1913 and 1915, W. H. Clark and U.S. Transitman Robert E. Clark resurveyed a portion of the south boundary of Township 3 South, Range 2 East, Ute Principal Meridian and meandered the right bank of the Gunnison River, resurveying and completing subdivisional lines.

Over a century later, a mystery developed when in 2018, Clark's great-granddaughter, Katie Steele, noticed that a survey marker set by him was now missing.

Photo of survey marker

Katie contacted the BLM NCA Manager and with the help of BLM cadastral surveyors, they discovered that the monument in question was not of record. It had never officially been recorded on the survey plat or in field notes approved by the General Land Office (GLO) on August 30, 1916.

During the official resurvey approved on November 22, 2017, the old monument was buried and the record amended. The 2017 resurvey corrected this defect from the GLO Survey of 1916—which had taken place almost exactly 100 years earlier!

Two legitimate land corner monuments set by W. H. Clark and Robert E. Clark are located about a quarter mile west of this other marked stone.

Dominguez-Escalante NCA comprises 210,172 acres of protected public lands, and includes the 66,280-acre Dominguez Canyon Wilderness. The NCA was designated through the 2009 Omnibus Public Lands Management Act and is managed as one of the BLM's National Conservation Lands units.

A Local Connection

Katie Steele grew up in Grand Junction and still lives in the area. She is actively involved with our public lands, having served on the Advisory Council for the Dominguez-Escalante NCA Resource Management Plan and currently serving on the Colorado Southwest Resource Advisory Council—one of 37 boards that provide invaluable recommendations on proposed BLM management actions leading to sustainable outcomes with broad public support. ■

Survey marker in the Dominguez-Escalante National Conservation Area.

JASON E. FOOSE, PS

Hill v Richey

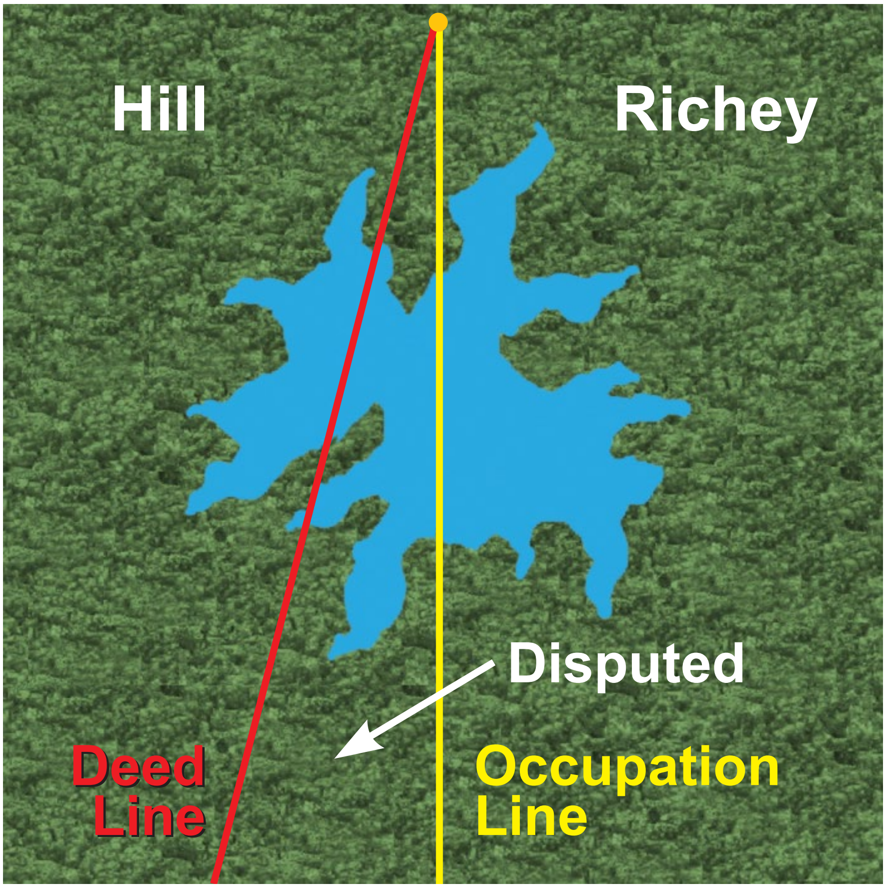
The 1952 Louisiana Supreme Court case of Hill v. Richey (59 So. 2d 434 221 La. 402) reinforces some elementary concepts but also offers us a few new things to knit pick at. Ultimately this case is now just a ghost on the battlefield. The resulting line resolved by the court became irrelevant when the private land rights were later merged and erased under a blanket of some public taking. Unrelated to our focus it appears that CLECO Power subsequently acquired the land and created Lake Rodemacher for a cooling water reservoir. The lake is locally known as CLECO Lake and offers some great warm water bass fishing.

This case was born out of a third-party wraparound deal involving the sale of timber. In a nutshell the adjoining neighbors had no dispute and treated a historic line as the boundary for nearly half a century. The defendant offered his timber for sale and the logging company thought it was duly diligent in having the property surveyed before cutting the timber. The conflict materialized when the legally described property lines missed the accepted lines by a tune of about 85 acres. If we tally damages in 2020 dollars the record retracement led to trespass and an unauthorized harvest amounting to $60K worth of timber.

As typical the court builds its chain of title to the common grantor. That appears to take us back to 1898 for a senior tract and 1910 for a junior tract. I'm not sure if Jr./Sr. rights came into play here but I always try to make a marginal entry in my notes calling out the relationship. The court focused on both parties' longevity in title and noted a few mesne conveyances following the original grants. I've said this before and believe that knowing the duration of title is an important aspect of retracement surveying. I'm not sure if there's a "legal" basis propping up the notion but longevity sure as hell incubated the heap of parol evidence we see in this case. I also recall old Joe Arnold testifying to the Oregon Court about his family land from childhood. This is our Stop, Drop and Roll right here folks. Find out what the owners know so that you can help them sort out discrepancies before you finalize your opinion!

"What constitutes possession in any case is a question of fact, and each case depends upon its own facts."

Okay, the court identified the conflict by a "red line" reflecting the deed calls and a "yellow line" expressing the possession line observed by both the plaintiff and defendant as long-term adjoining landowners. It seems like the court is comparing two equally weighted items doesn't it? We're talking about a record line vs. possession line so apples to apples, right? Well, in this case we might say the red line was just a stock photo of an apple marked "exhibit" and the yellow line was a big basketful of juicy ripe Fujis, Honeycrisps, Ambrosias, and probably an iPhone too. Sometimes placing a record line in the left basket of the scale can outweigh a mere claim of possession in the right basket. It's not until testimony is added on the right side that the hollow weight of "record" becomes apparent. This case might be a bit atypical in that the testimony regarding the possession line is clear and overwhelming.



Let's run the totals on evidence starting with the yellow line.

1. The defendant told the timber surveyor that he only owned up to the yellow line.
2. The defendant filed a suit against the timber folks indicating he did not know he owned the land.
3. The yellow line is composed of blazed timber, fence lines and fence remnants.
4. The 76-year-old plaintiff testified that a fence marked the yellow line since he was 10 years old.
5. The current fence on the yellow line was built some 15 plus years prior and continually maintained by the plaintiff.
6. The defendant built portions of fence along the yellow line.
7. Fence was present thirty years prior when the defendant's father purchased the property.
8. Both plaintiff and defendant terminated cross fences at the yellow line.
9. Both the plaintiff and defendant posted no trespassing signs in their names on blazed timber in the swampy portions along the yellow line.
10. The blazes were understood to mean that the yellow line was surveyed at some time in history.
11. The plaintiff showed 35 years of continual and uninterrupted use.

And now the tally on the redline.

1. It is presumably a record description.
2. This is the first time in known history that anybody is hearing of an alternate position of the line.

So, there we have it. The yellow line has eleven attributes, and the red line has two. Things are not feeling so even-steven, now are they? Who knows, maybe the timber company was willing to roll the dice and hold the red line based on some loss/profit analysis? I'm willing to bet the third-party employer opted for the most advantageous opinion their money could buy. Regardless we have a case of a surveyor ignoring salient evidence of a boundary. For god's sake the owner himself flat out rejected the surveyor's bonus acreage promised by this surveying bonanza.

The court goes through some legal questions about time and quality of possession. They traveled back 100 years and found a precedent interpreting Louisiana's possession laws in Article 49. The court humbly offers that it had to do a little bit of homework on the topic of possession. After the citation from Ellis v. Prevost, 19 La. 251 the court said "*Now, we understand the expressions, real and actual possession, contained in this law, as used in contra-distinction with the possession which is purely civil and legal…*". That small statement speaks volumes about the dignity of a court. There's no pretense that the reviewing court is a subject matter expert in boundaries. However, this is the end of the line and the high court was going to do as much research as it took to resolve the matter.

Another term that came into play with possession was "enclosures". This is a bit long-winded, but it exemplifies the reasonability of law. The court said "*We recognize also that under the jurisprudence a person claiming by possession alone and without title is required to show an adverse possession by enclosures, and that his claim will not extend beyond such enclosures. But, when this jurisprudence is considered with the articles of the Code announcing the law applicable to such cases, we do not think that a strict interpretation should be given to the word "enclosures"…What the court means by "enclosures", as that term is used in the numerous cases found in the jurisprudence, is that the land actually, physically, and corporeally possessed by one as owner must be established with certainty, whether by natural or by artificial marks; that is, that they must be sufficient to give definite notice to the public and all the world of the character and extent of the possession, to identify fully the property possessed, and to fix with certainty the boundaries or limits thereof. To say that the term means "enclosed only by a fence or wall"* *would be giving it a very strict and narrow construction, not justified or supported by the articles of the Code, as we have hereinabove pointed out, and would lead to absurd consequences in some cases."*

A definition of "boundary" was cited as well. "*Further, Article 826 provides: "By boundary is understood, in general, every separation, natural or artificial, which marks the confines or line of division of two contiguous estates. Trees or hedges may*

be planted, ditches may be dug, walls or enclosures may be erected, to serve as boundaries…But we most usually understand by boundaries, stones or pieces of wood inserted in the earth on the confines of two estates." I believe that's the best definition of a boundary that I've ever seen in print. Now keep in mind I'm relating two separated statements in the decision. Despite the stretch they simply go together like beans and cornbread.

Possession was important in this case and we as surveyors fundamentally need to identify evidence of possession. This court lays it out quite eloquently citing McHugh v. Albert Hanson Lbr. Co., Ltd., 129 La. 680, 56 So. 636 *"What constitutes possession in any case is a question of fact, and each case depends upon its own facts."* That's as elementary as it gets. It's also the reason that a definition of possession is not psychometrically suited for a multiple-choice test question format.

The time elements of possession are extremely difficult for us to understand or convey in our survey and are generally revealed in the courtroom through testimony and perhaps other evidence. I can't imagine how I would effectively express the following conditions in my survey *"In the instant case plaintiff has established and proved beyond all question that he had actually, physically, and corporeally possessed as owner the property between the two lines, and, within the meaning of Article 49 of the Code of Practice as interpreted by this court, his possession continued to the moment of the disturbance."* That's far beyond the scope of retracement surveying. Think about that as you try to self-adjudicate possession through cunning notes or narratives on your survey. I've seen too many failed attempts at that stunt down at the State Board Office.

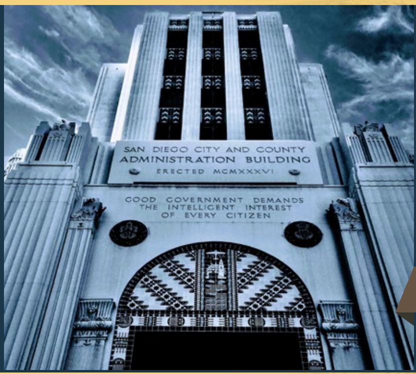
There are some good physical features from this evidence pool that could, maybe should be prominently called out in a survey. " *The fences, remains of old fences, blazes and hacks on the trees evidently made by a surveyor, and the "No Trespassing" signs were sufficient under the facts of this case to establish with certainty and to give definite notice…"* I'm breaking the quote here to make a point. That's a good handful of evidence and in fact amounted to "definite" notice of the line. Ironically, a so-called expert surveyor hacking for a hungry timber outfit didn't get the memo beforehand. The Court carries on with the statement and it gets better *"…and to give definite notice to the public and all the world of the character and extent of his possession, to identify fully the property possessed, and to fix with certainty the boundaries or limits thereof, especially when we consider the type of land between the lines and the nature of the property."* I guess the conflicting deed doesn't seem so strong in hindsight.

My hero in this case is Richey. He took a play right out of the King James Bible and held to the truth.

Citing Deuteronomy 19:14 "*Thou shalt not remove thy neighbor's landmark, which they of old time have set in thine inheritance, which thou shalt inherit in the land that the LORD thy God giveth thee to possess it.*" Now I didn't shepardize that citation through the old Luc-o-meter but any preacher man worth his salt will tell you this is good advice. Heck, Richey even packed this ethos along with him into court sans the hallowed citation.

The real question for the retracement surveyor is not the adjudication of this case, or its authority. It's learning how to improve our discovery methods and deliver complete evidence if and when the court needs it. I contend that's the best shot we have at keeping folks out of court. ■

Jason Foose is the County Surveyor of Mohave County Arizona. He originally hails from the Connecticut Western Reserve Township 3, range XIV West of Ellicott's Line Surveyed in 1785 but now resides in Township 21 North, Range 17 West of the Gila & Salt River Base Line and Meridian.



LAW. LAND. LINES.

Legal Analysis by

Lloyd Pilchen, PS, Esq.

WATERWAYS & Earth Days

PART 1

About a month into our pandemic lockdown was the 50th anniversary of Earth Day, an event its founders called a nationwide "teach-in on the environment." 1970 saw the creation of the Environmental Protection Agency and began an era of environmental legislation that transformed our landscape and society.

In the spirit of a teach-in, let's look back to a time before modern environmental laws. In 1900, a lawsuit brought by the State of Missouri against the State of Illinois was argued before the U.S. Supreme Court. While the boundary between the states, per se, was not in dispute, Missouri claimed that the crossing of that line by polluted water constituted a public nuisance.

» LLOYD PILCHEN, PS, ESQ.

"Map of Chicago" published by Walter Conley & O.E. Stelzer, 1933, to commemorate the city's centennial.

WIKIMEDIA

Detail from map by Jacques Bellin, "Partie Occidentale de la Nouvelle France ou du Canada," 1755, showing Chicago Portage. The depiction and description of ruins and "Pots à fleurs" where the Illinois R. joins the Mississippi R. apparently refer to the resemblance to inverted flower pots of the abandoned Cahokia Mounds.

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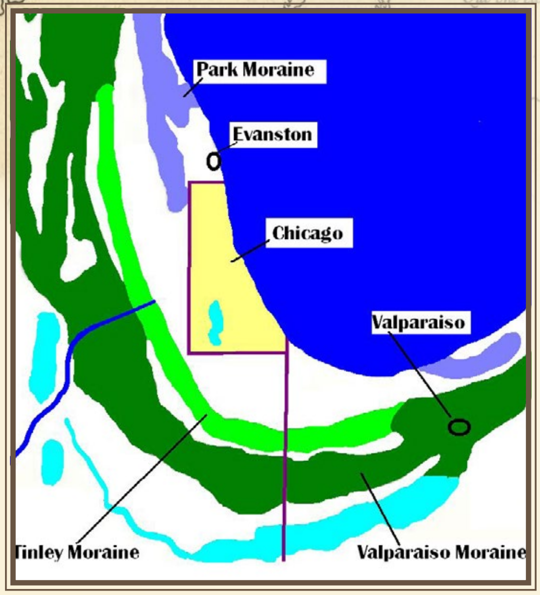


Map of glacial features of Illinois and Indiana, based on Indiana Geological Survey.

CHRIS LIGHT/WIKIMEDIA

The circumstances that led to that case involve a public health crisis, the growth of cities, and an engineering wonder that must have mobilized a battalion of surveyors. Part 1 of this article recounts a partial history of a nineteenth century waterway that connected the country, and Part 2 will discuss *Missouri v. Illinois*. Current environmental law will provide contrast, including an ongoing lawsuit by Native American tribes that captured worldwide attention (fitting for Native American Heritage Month).

Prehistory

We begin at the end of the Ice Age, when the Wisconsin Glaciation that had carved out the Great Lakes retreated and filled them with fresh melt water. The glaciers left behind ridges of debris—geologic moraines—that still ring Lake Michigan and the outskirts of Chicago. The broadest of these is the Valparaiso Moraine, named after the town on that ridge's loop around the lake.

Relevant to our story, this subtly elevated landform divides two natural watersheds. The area inside the loop empties into nearby Lake Michigan, while the outer watershed drains a huge swath of central Illinois into the Mississippi River via its southwesterly-flowing tributary, the Illinois River. This separation of ecosystems was the natural state before humans intervened.

Since the earliest agrarian civilizations, rivers have equated with fertile land, transportation and trade. A thousand years ago, a teeming interregional marketplace, later called Cahokia, flourished at the union of three rivers: the Mississippi, Missouri and Illinois (John Kelly, 1991).

Chicago Portage

Picture indigenous people journeying to Cahokia from Lake Michigan and points north on the highways of that time. Leaving the lake, they glide up the Chicago River and then portage their canoes across the moraine to a stream that soon forms the Illinois River. Centuries later, French explorers and fur-trading voyageurs also negotiated this overland divide, labeled "Portages de Chekagou" on a 1688 map by Venetian cartographer Coronelli.

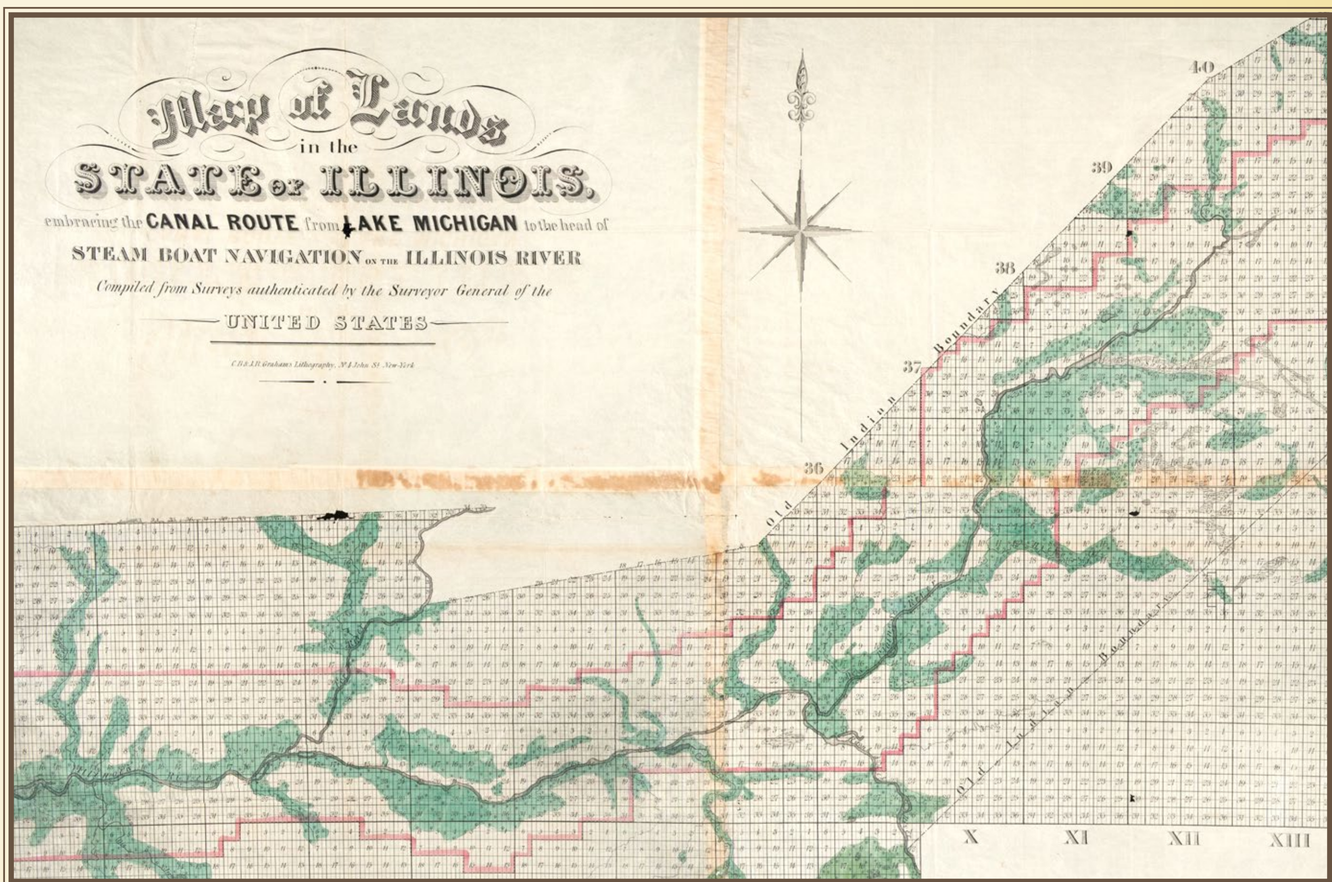
Cahokia (ca. 1000-800 BP), painting by Michael Hampshire.

COURTESY OF CAHOKIA MOUNDS STATE HISTORIC SITE

Just as ancient cities depended on transportation to thrive, nineteenth century New York needed a waterway to exchange goods with the continent's interior. In 1825, the Erie Canal linked the Hudson River to the Great Lakes, allowing New York City to claim its place as a world-class port. A similar channel in Illinois would complete the internal course from the Atlantic Seaboard to the Mississippi River Delta.

A canal through the Chicago Portage had been imagined a century and a half earlier by Louis Joliet. By 1816, the U.S. Army Corps of Engineers moved toward its realization on lands of the Potawatomi, Chippewa (Ojibwe), Ottawa and other nations. Beyond the Army's Fort Dearborn foothold at the mouth of the Chicago River, Major Stephen H. Long performed a topographic survey of the proposed canal route within a strategic 20-mile-wide strip of land "coercively purchased from the Indians" (Miller, 1996). Maps by the Surveyor General indicate "Indian Boundary" along this strip, whose traces remain on the streetscape in the angular Rogers Avenue and the names of neighborhood parks.

We are only touching upon the overarching government policy of Indian Removal. Integral to our story, in the first decades of Illinois statehood—and following skirmishes and conflicts over land between Native Americans and European-American



"Map of Lands in the State of Illinois Embracing the Canal Route from Lake Michigan to the Head of Steam Boat Navigation on the Illinois River," C.B. & J.R. Graham's Lithography, 1835. "Old Indian Boundary" defines the original canal corridor.

COURTESY OF THE NEWBERRY LIBRARY

Lock 8, Illinois & Michigan Canal National Heritage Area, near Morris, IL.
PHOTO BY JOSEPH BALYNAS

settlers—the United States compelled local tribes to sell their ancestral lands and move west of the Mississippi. "This sordid transaction" formed "the legal basis" for the development of Chicago and the canal that would advance trade and settlement across the region (*id.*).

The I&M Canal

Along the 96-mile canal route towns were platted and laid out, including Chicago and Ottawa at opposite ends and Joliet in between. (James Thompson's 1830 plat and surveyor's compass are on view at the Chicago History Museum.) In 1848, mules began towing barges through the Illinois and Michigan (I&M) Canal, which was engineered with locks to navigate the 140-foot net gain in elevation from the Illinois River to Lake Michigan. The I&M Canal was the first cut through the Valparaiso Moraine, but it wouldn't be the last.

With the canal and the advent of railroads, Chicago's population jumped from less than 5,000 in 1840 to more than 100,00 at the start of the Civil War, to half a million in 1880. The rapid growth intensified public health conditions. In the canal's first year, the city was struck by a deadly cholera epidemic caused by bacteria carried by an unwitting canal passenger (Vasile, NIU Lib.). Further outbreaks in the ensuing decades were precipitated by poor sanitation and contaminated water.

"For Succeeding Generations"

Could the I&M Canal have been built under today's environmental regulations? The answer is: not so fast. A basic tenet of environmentalism is to anticipate and avoid adverse consequences, rather than react after harm occurs. Prevention is part of the value known as the "precautionary principle" (Rio Declar., 1992).

Preventing harm requires identifying risks, and the law creates a structure for this. A large public works project like a canal would be subject to the National Environmental Policy Act (NEPA), signed into law by President Richard Nixon the same year as the first Earth Day. The law aims to "fulfill the responsibilities of each generation as trustee of the environment for succeeding generations." (42 U.S.C. § 4331.)

The law carries out this purpose by requiring federal agencies to conduct an environmental review prior to taking certain "major Federal actions," a term that includes private projects requiring a federal permit or funding. In addition to analyzing a project's potential impacts on air, water and protected species, environmental review under NEPA also covers aesthetic topics (e.g. the effect on views of wind turbines) and cultural and historic resources (e.g. damage to ancient rock art after opening public lands to off-road vehicles). (40 CFR § 1508.8.)

Notably, NEPA does not compel the denial of projects based on their adverse impacts; the law merely strives for decision-making that is not oblivious to consequences. NEPA provides a forum, including public input, for identifying environmental concerns and considering less harmful alternatives.

River Reversal

Unabated filth in the streets of mid-century Chicago required action, which the city undertook with an elaborate project of sewer installation. The sewers managed the raw wastewater, however, by discharging into the Chicago River, which flowed into Lake Michigan, the source of the city's drinking water. The system was ill-conceived and unsustainable.

Lateral canal of the Illinois & Michigan Canal, 1880, at Ottawa, IL.

COURTESY OF LEWIS UNIVERSITY

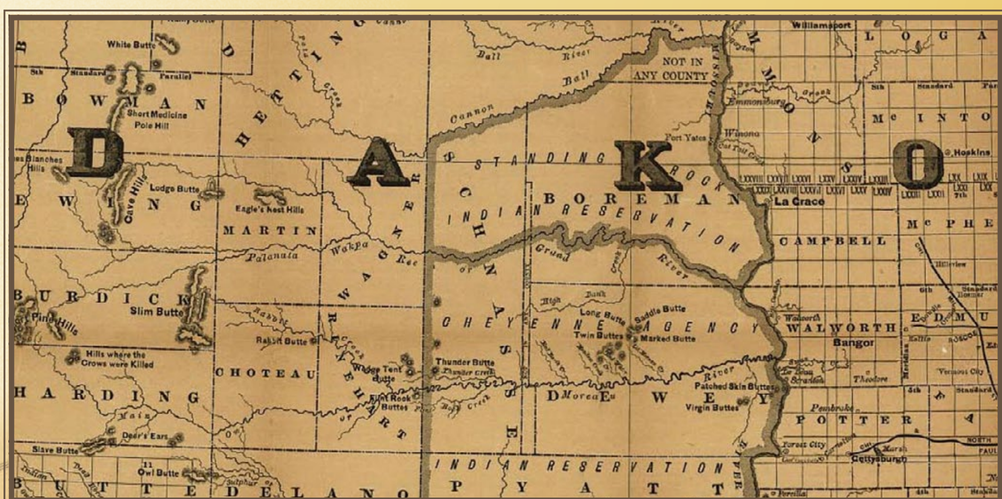
To fix the problem and protect water quality, some “progressive health officials” pushed for enforcement of anti-dumping laws (Miller). Instead, the city opted for a “radical measure”: to repurpose the I&M Canal as a sewage channel. The plan entailed sending sewage away from the city, flushed by clean water from Lake Michigan. In 1871, the city modified the canal by completing a “deep cut” through the Valparaiso Moraine. The deepened channel obviated the particular locks previously needed to overcome that rise, and allowed gravity to reverse the flow of the Chicago River.

But in reality, the river was ineffectually sluggish such that it “appeared stagnant” (Ill. State Arch.). As a result, the canal amounted to an open “monster sewer” that afflicted downstate communities with “overpowering smells” (Miller).

Standing Rock, 2015-2020

When Chicago resolved to send its wastewater downriver, no statute required the city to consider health risks. Today, in contrast, Native American tribes are engaged in a legal battle that presents NEPA in action in *Standing Rock Sioux Tribe, et al. v. U.S. Army Corps of Engineers*. The case is linked historically to the 1848 California Gold Rush (the year the I&M Canal opened). To ensure safe passage for “forty-niners” on the Oregon Trail the United States and eight Indian Nations signed the Fort Laramie Treaty, which recognized vast Indian territories. Among their remnants are the Standing Rock and Cheyenne River Indian Reservations in North and South Dakota.

The plaintiffs in *Standing Rock* are Indian tribes whose members live downstream from a company’s oil pipeline crossing the Missouri River. While the case raises larger debates such as reliance on fossil fuels, and involves environmental organizations, protesters, and two White House administrations, our focus here is on NEPA and judicial review.



Detail from Railroad Map of Dakota by Rand McNally & Co., 1886, showing Cheyenne and Standing Rock Indian Reservations.

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Lock 14, Illinois & Michigan Canal exit to Illinois River at LaSalle, IL.
PHOTO BY UTKAN SENYUZ

The grant of an easement to allow the pipeline river crossing was the proposed "federal action" that triggered NEPA in *Standing Rock*. Accordingly, the Army Corps was required to make an initial assessment as to whether "significant environmental impacts" might result from the crossing. (*Grand Canyon Tr. v. FAA* (D.C. Cir. 2002).)

Under NEPA, if no such potential impacts are found, then after documenting its finding the agency may proceed without further environmental review. Conversely, if the agency finds that significant impacts might result from the action, then it must prepare a detailed environmental impact statement (EIS). This threshold determination by the agency is subject to judicial review.

Significant Impacts

The Tribes in *Standing Rock* challenged the Army Corps' determination that the pipeline easement would have no significant impact after certain mitigation efforts, and therefore no EIS was required. Such decisions must be supported by more than "a cursory nod" to potential effects. The legal standard requires that agencies "take a hard look" at environmental concerns and "make a convincing case" for their conclusions. (255 F.Supp.3d 101.)

In 2017, the district court found that the Corps had inadequately considered, among other things, the impact of a potential oil spill on the Tribes' rights to water, hunting and fishing promised by the Fort Laramie Treaty, and required the Corps to conduct additional analysis. Despite these flaws, the court did not cancel the easement or block the use of the pipeline through which oil had already begun to flow, citing the "possibility that the Corps will be able to substantiate its prior conclusions." Since the analysis should have preceded the pipeline's placement, the court warned against simply "treat[ing] remand as an exercise in filling out the proper paperwork *post hoc*."

In 2020, the court rejected the Corps' remand analysis and decision not to conduct further environmental review. The court found that "too many questions remain unanswered," including "unrebutted expert critiques regarding leak-detection systems, operator safety, … and worst-case discharge." (440 F.Supp.3d 1.) Regarding safety, the court said, "In this case, the operator's history did not inspire confidence."

The court vacated the easement, ordered the Army Corps to prepare an EIS, and ordered the pipeline shut down. A statement by the Tribe captures the value of NEPA: "[H]ealth and justice must be prioritized early … if we want to avoid a crisis later on." The law gave the affected communities in *Standing Rock* a voice.

The Army Corps has appealed the ruling, and also sought an emergency stay of the district court's orders. The Court of Appeals let stand the orders to prepare an EIS and void the easement, but allowed oil to continue flowing pending the appeal. (Case #20-5197, D.C. Cir. August 5, 2020.)

A Sanitary Canal for 1900

As the 1800s drew to a close, Chicago's population swelled with a surge in immigration that would continue into the next century. (My grandparents were among that wave of Russian Jewish immigrants.) The city modernized and reinvigorated itself after the Great Chicago Fire, and made plans for a new canal to effectively deliver the city's sewage downriver. This time, the State of Missouri protested. In Part 2 we will explore Missouri's lawsuit. ■

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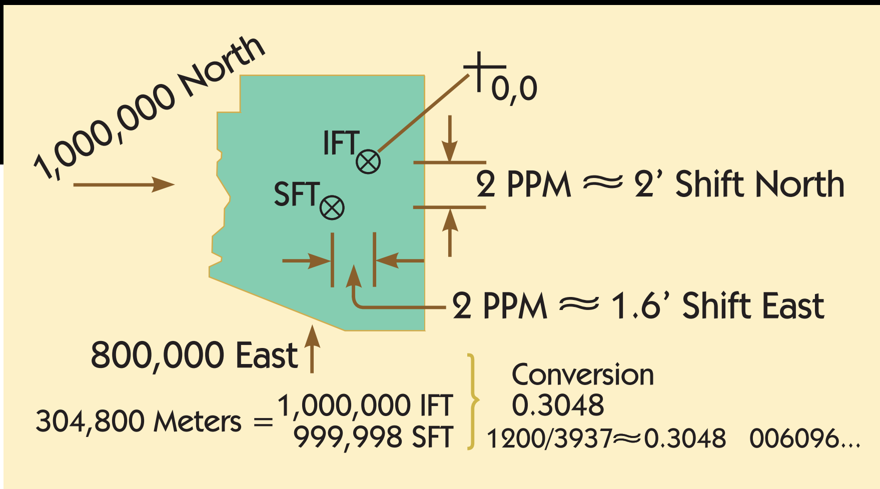
LOGO PHOTO BY THE AUTHOR

Getting Off on the Wrong FOOT

The long overdue sunset of an outdated conversion

Below is a classic surveying horror story that revolves mostly around the confusion of the Survey Foot (SFT) and the International Foot (IFT) definitions. Dr. Michael Dennis, PS, PE, the project manager for NGS's 2022 State Plane Coordinate System (SPCS) project originally asked for stories about how SFT in an IFT state caused problems. This story was originally shared anonymously, and most of the details were left out, but because of public interest and so many follow up questions about how such a thing was technically possible we decided to tell more details about what happened. As with many stories of disaster, there isn't exactly a single culprit, but more over a culture of behavior and sequence of several events that results finally in calamity. Some of them, in hindsight, are obvious, but please consider that at the time, they were probably unknown to the participant as even a source of potential danger.

» BRIAN FISHER, PS



Just like another great engineering and technical disaster, the sinking of the Titanic, in this story, the SFT is the iceberg, as it were, but looking deeper reveals several other underlying problems that certainly set the stage for the final outcome. Thankfully in this story, there is no loss of life, but there was a permanent financial impact to a high-rise building that exists to this day. This story happened a few decades ago, and because it involved so many firms and because there were settlements and financial loss, most specific details about firm names or even where this project is located are being kept anonymous. We, as an industry and society can learn from our mistakes, but only if we bring them to light and make conscious decisions about them in the future. So let's dive right in and see where it all began.

The premise

The project, a twenty-story high rise building in an anonymous City downtown center only some 12,000 feet from the end of an anonymous international airport runway.

The workforce

Five companies, one project and a sequence of compounding errors and miscommunications that result in a permanent economic impact to the final product, the loss of an entire floor on a twenty-story building.

The participants

First, an out of state company aggregates data from multiple sources. We'll call them company 'A'. The aggregated data included the east-west FAA runway approach glide path data, county data with local platting and geographically referenced section corner data, and the building's architectural concept. Company 'A' also contracted with a local firm, Company 'B' to perform an ALTA survey of the future building parcel. Some assumptions were made, and some rules were followed, most notably that the FAA mandates their survey data is reported in SFT. The assumption was that it would be obvious that all data was on this system, as it had FAA calculations on it.

> "FAA mandates their survey data is reported in SFT."

This unfortunately has been quite common in states where the IFT is legislated and firms following agency guidelines or from SFT states come in to interact. The underlying geodetic reference implicitly was the FAA survey PAC/SAC control. Again, this was by FAA policy. It was also assumed that the PAC/SAC data would match exactly with the FBN data, as they were both in the NGS IDB.

Company 'B's parcel boundary had a misclosure, probably from a scrivener's error on the south line of the parcel. That will come to play later, but for the moment was unnoticed. The magnitude of the error was 0.15 feet. They also performed the work with terrestrial equipment and the only tie to geodetic control was to section corners that had previously been tied to geodetic control by a County survey. This is principally how Company 'A' was able to correlate the ALTA survey (using county section corner positions) to the FAA data.

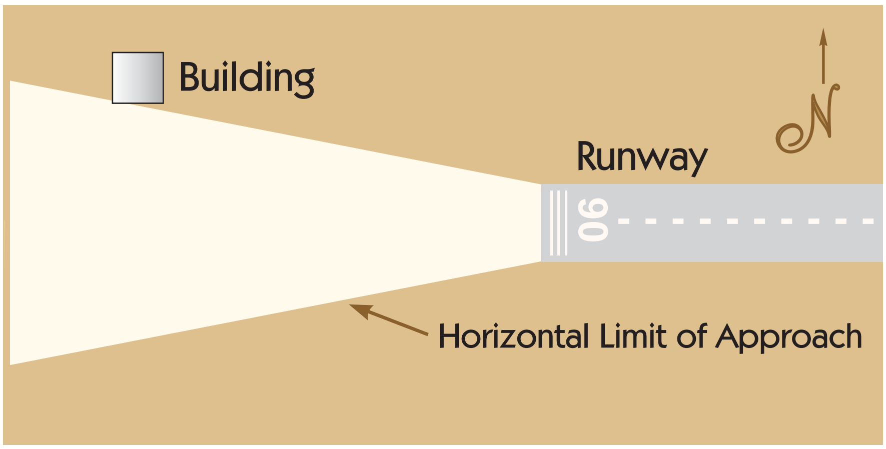
Next, another local State company continues the project for final design and construction layout. We'll call them Company 'C'. Again, assumptions are made, and local rules are followed, most notably State statutes reference the use of IFT for reporting SPCS as does the county. The assumption is that the data provided by Company 'A' is all in IFT. For this story we are also going to make the assumption that the meta data (the information about the coordinate system definition and control) was either sparse or simply non-existent form Company 'A' to Company 'C'.

Some of the details of this account have been lost to posterity, but in this era, having high quality survey reports and meta data were very much not the norm. You were lucky just to get a CADD file to make sense of the design, let alone knowing where the coordinate base was for the file. Also, the likelihood of having the geodetic control in the same CADD file as the design was basically nonexistent, as a norm. So, the only data provided by Company 'A' to Company 'C' are absolute positions of the building corners so that they comply with FAA glide path limits. The data was only given in SPCS northing and easting and a linear unit was not specifically stated other than to simply call it "feet". Company 'C' chose to use the County FBN control as the underlying geodetic for their construction control.

Again, this is by State statute and County policy. It is also reasonable practice that one could argue is a typical standard of care in the industry. Why would a company go through all the hassles of airport access to points that are some 20,000 plus feet away, when there is a County control point within

a few thousand feet of the project? In the last step of this story, there was a measured variation in the FBN versus the PAC/SAC control, but the magnitude probably wouldn't have caused a problem by itself, but it does accumulate and contribute as we will mention later in the conclusion.

Next, a City surveyor who we'll call Crew 'D', performs utility/ROW work adjacent to the project, and uses immediately adjacent cadastral control (road centerline monuments delineating the block of the parcel where the building is located). This was work done in accordance with City and State policies and procedures. The work was not georeferenced to any part of the NSRS and was performed using terrestrial equipment. The ROW work identifies that the building was out of position on the parcel and a potential encroachment into the easement existed. This was further compounded by the fact that only the underground garage was over the building setback line (BSL), making it even more complicated to observe at street level. From street level only a mass of concrete was able to be observed in the bottom of a trench, and the structural question became "how thick is the wall" that can only be observed from inside the structure?



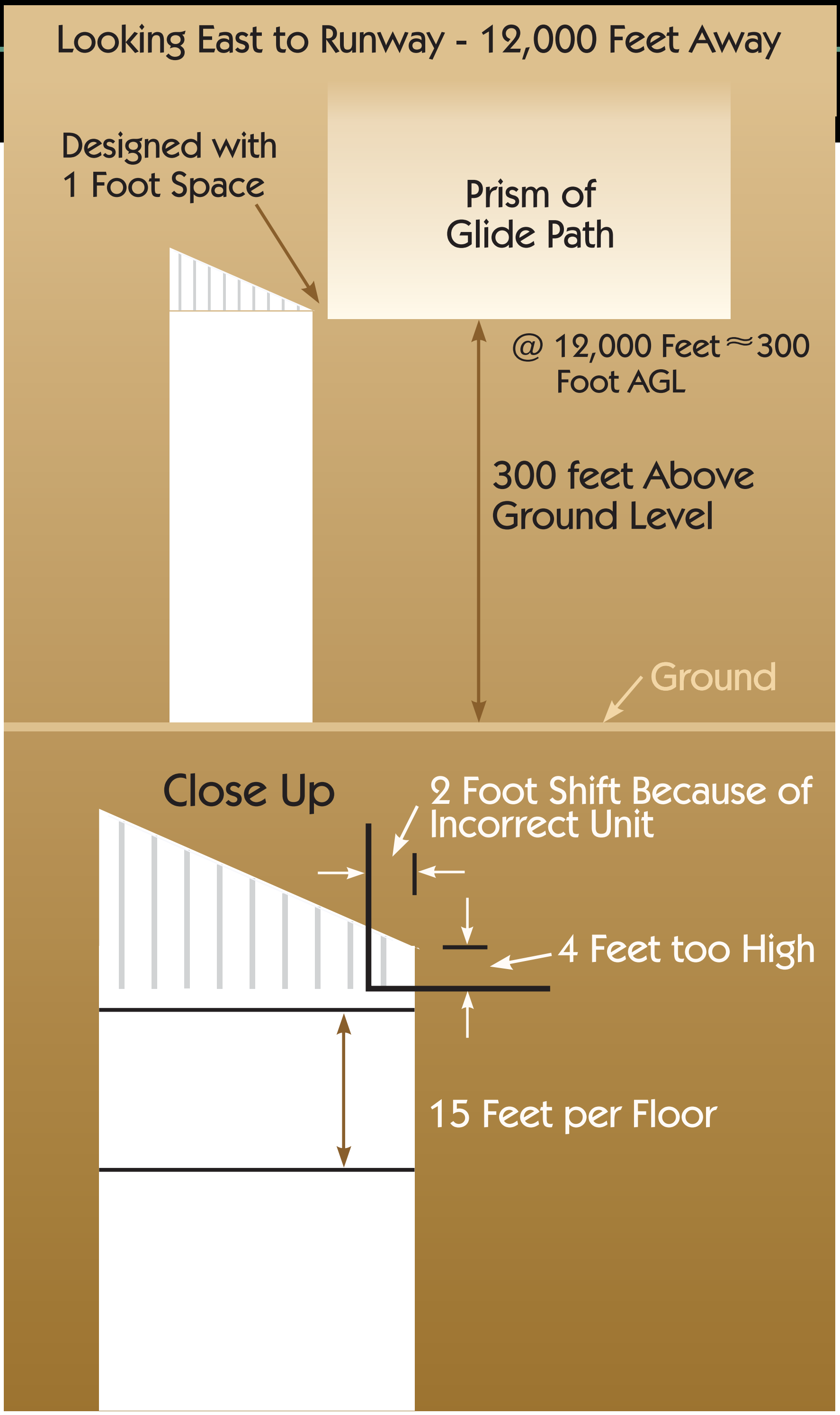
Lastly, a final local survey firm, we'll call them Company 'E' was contracted to forensically evaluate all of the data and make determinations as to what was going on with this project. All the survey control, both County FBN tied control and the FAA PAC/SAC control was tied in a single GPS control survey. The current evidence for the section corners and remaining local block corner monuments were also tied into this survey as were the mapping control points used to topographically scan the above and below ground features of the building construction project, now underway. A 3D map and BIM was created and all the governing spatial limits to the building project were overlaid. These include the ROW and parcel boundaries, the BSL and the FAA glide path.

Final analysis

It became immediately apparent that not only different (and subtlety variant) control was used for all parts of the project, but also different equipment and lastly, different computational parameters including the linear unit SFT v IFT. Also, each phase of the project was separately constrained in some way. Company 'A's survey was tied to the FAA PAC/SAC control and reported in SFT, again this was by FAA policy. Company 'B' tied their survey to section corners, did not specify linear units and were not using SPCS, again in compliance with ALTA procedures. The County had previously tied the section corners to FBN control and reported the SPCS in IFT, again, following State statutes. Company 'C' used FBN control principally to control the absolute position of the building and with a lack of documentation otherwise assumed the SPCS to be reported in IFT. Crew 'D' used local monuments to position their work on the street but were unable to detect if they had an absolute error to the overarching georeferenced County cadastral survey in the area.

The analysis also revealed that all of the control had subtle, but measurable variations. Some compounding, some compensating (just to keep all of this interesting). The PAC/SAC data did not match exactly with the FBN data at around the 0.1-foot level of magnitude. The Section corners were not perfectly aligned with the FBN data and it was probable that one or more marks had been rebuilt in a slightly alternate location at the 0.3-foot magnitude. Lastly the parcel corners were obliterated at the time because of construction and it was highly probable that the road centerline monuments were both new and also in slightly different locations compared to previous survey work, again at the 0.3-foot magnitude. This of course was further compounded by misclosure on the ALTA on the south line. End result after all of this is comingled, Crew 'D' shows the building to be about a foot or so south of the "correct" location (remember they are measuring to an irregular concrete mass in a trench that represents the outer limits of an underground structure.

Arguably, Company 'B' and Crew 'D's surveys, being terrestrial in nature, were not impacted by the linear unit variations as much (or at all) as the georeferenced surveys were. We will explain why in a moment. The variation in SFT to IFT is only 2 Parts Per Million (PPM). A terrestrial measurement of a few hundred feet, or even a slope calculation of 12,000 feet is

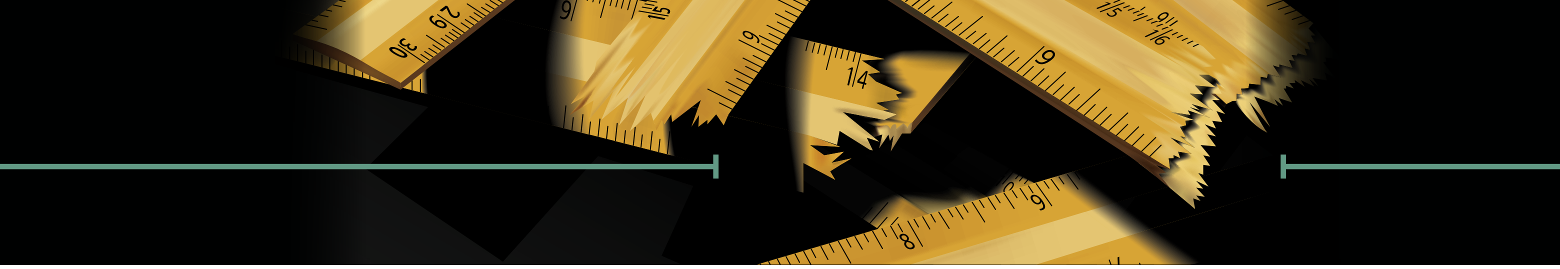


hardly impacted in magnitude, and often is a number that is far less than the error of the measurement in the first place. A 2 PPM error in 12,000 feet is only about a quarter inch and certainly is negligible when compared to the inch size error tolerance in this same distance when using terrestrial equipment. The first two surveys were impacted however because they were using SPCS coordinates with magnitudes in the millions of feet (the distance back to the "calculated origin of the zone" millions of feet away).

The northing in this example was right around one million, so the difference "on the ground" equates to right around two feet in absolute position. In other words, a single geographic position (like the calculated corner of a building in relation to the bounds of the FAA glide slope) represented using a single SPCS zone definition, but two different linear units, results in two different "points on the ground". Those two points are located north-south of each other by two feet. The building, being east west from the airport, was designed to be just north of the glide slope boundary, thus was teetering right on the line of encroaching into that prism of approaching planes. It also put the building over the BSL lines and encroached it into the utility corridor. This was further compounded by the fact that only the subterranean parking garage encroached, where the above ground "walls" were well back from the roadway.

Where does the blame lie and who made the mistake? The highest culpability, in my opinion, is with Company 'C'. They should have further verified that the absolute position of the south end of the building stated by Company 'A' with SPCS was indeed in IFT as they assumed. Company 'C' could have further verified the BSL relation to the walls and caught the error before construction. In reality everyone was partially to blame: Company 'A' for lack of metadata, Company 'B' for closure exceeding ALTA standards and for not calling out the positional variations in the section corners when compared to the County survey, and I'll assign some blame too to the City for not having a modernized policy in place for their field crews to at least uncover that the local perpetuation of the road centerline monuments are not in original locations.

Ironically, we, as the final firm, were called in to resolve the boundary and setback problems at ground level, which we, to my recollection were able to do with some effort (variances, rewriting easements, etc.) but we also uncovered the problem that the building was principally 2 feet south of



where it was "intended" to be on the first design, relating to the FAA glide slope. The intent also was to have the building just north of (my memory seems to think it was half a foot) and slightly above the flightpath (I think it was 4 – 6 feet above).

In reality it was within the flight path and was solidly a vertical encroachment because it was several feet—not fractions of an inch—as one might initially assume from such a small 2 PPM variation in units. So, we resolved all the "on the street" issues of the project and uncovered the "in the air" problem that no one was initially aware of. There was no revising this as the rooftop fixtures, equipment and architectural elements were "set in stone" so the only other outlet for correction was to eliminate an entire floor and shorten the building by fifteen or so feet to eliminate the multi foot vertical encroachment at the top caused by the horizontal shift, directly attributed to the SFT error.

In brief, this was mostly a horizontal problem from a million feet away and not a vertical calculation problem of a slope that was only a few thousand feet long. The final and long lasting 5% loss of real estate came from the "ice burg" of the SFT in an IFT state.

Parting thoughts

Recent I attended a companywide safety meeting. Our safety director was reporting on a rash of fender-bender accidents we as a workforce were starting to have. Whereas a fender-bender isn't much of a major problem by itself, it is however a cultural indicator of potential complacency or misunderstanding of underlying threats. These canaries in the coal mine can be the harbinger of much worse things to come, such as a vehicular accident resulting in a fatality. We as responsible professionals need to take heed of warning signs and plan our future actions to be on a better trajectory. Deprecating the SFT form the National system is a long awaited and necessary action but there are other cautionary tales to be taken away from stories like this one as well. Missing meta data or non-existing survey reports are equally as problematic as using an incorrect definition of a foot. Also non-standard actions of Federal, National and State level agencies can cause conflicts and problems as well.

The real moral of this story is that there were several survey groups, all with a mixture of equipment, local knowledge, basic skill, etc. Ironically it was the least skillful/advanced guys that brought the problems to light in the first place by holding local road monuments and discovering that the building was "off".

Only after very diligent, comprehensive and somewhat costly analysis by the final firm did the reality of the situation fully come to light. The adage that if you don't have the time to do it right in the first place, you better have the time (and money) to do it over, unfortunately comes to mind.

As a final thought, the so-called grid-to-ground problem of SPCS (often measured in 100 – 400 PPM magnitudes in the taller western states) has historically caused many times the problems on projects when compared to the 2 PPM incorrect foot. I'm so happy that LDP designs in the forthcoming 2022 SPCS "could" eliminate this, but I'll bet there are still 20% of surveyors that will insist on scaling a project to get rid of that last 15 ppm of linear distortion on their 660 foot long lines (for perspective, that's a difference of only an eighth of an inch in the length of that line, but 15 feet of horizontal translation to the so called "ground" coordinate, at the one million foot magnitude).

Let's just hope that we all can learn the lessons and necessity of documentation. I am thankful that NGS and NIST are finally addressing the SFT and instilling only the IFT for future use by all agencies. I am also thankful for the great work that NGS is doing regarding the 2022 datum and all the data products associated with it. I am hopeful that we as an industry can additionally implement standards to go along with all these wonderful tools we are getting so we can get to the root of our professional function, the commerce and safety of the public we are here to support.

"Let's just hope that we all can learn the lessons and necessity of documentation. I am thankful that NGS and NIST are finally addressing the SFT and instilling only the IFT for future use by all agencies."

A takeaway that I personally implemented in all my current work is to never simply report the SPCS northing and easting in a report or on a survey. I report both the geographic and Cartesian coordinates for at least two points on the survey (usually the primary control) and I follow that with all the parameters of the coordinate zone, including the linear unit. I've been teased occasionally for my over exuberance in detail, but it is horror stories like the one above that put it in most perspective for me. ■

Brian Fisher, PS, is a surveyor for the Central Arizona Water Conservation District and is in charge of geodetic and structure deformation surveys. He is also the Arizona State Geodetic Coordinator for the National Geodetic Survey.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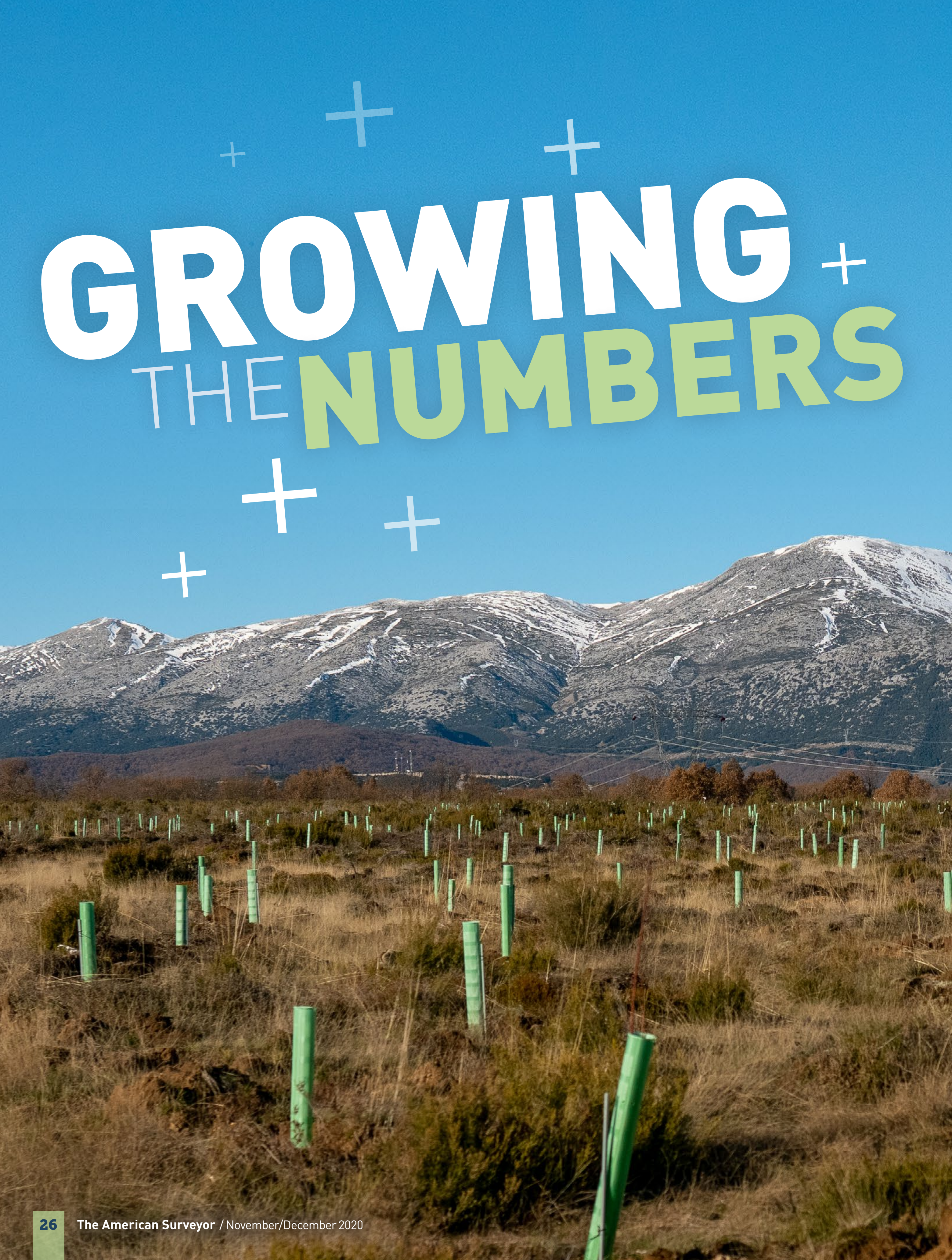


How geospatial technology boosts efforts to restore degraded land and create new forests

Imagine planting enough new trees to cover a plot of land the size of Switzerland. Now do it again and again, nearly 500 times, until you've covered two billion hectares. It's a huge, seemingly overwhelming effort. Yet a Dutch company is using advanced geospatial technologies to make it happen.

From its base in Amsterdam, Land Life Company works to restore lands degraded by natural or human activities such as wildfire, desertification, agriculture and urbanization. It's one of a small handful of companies capable of large-scale tree planting services needed to reestablish forests and create productive landscapes. With projects in 25 countries on five continents, Land Life clients include governments and corporations seeking to reinvigorate damaged land and soils or to offset carbon released by commercial activities. Since its founding in 2013, Land Life has planted nearly 1.3 million trees.

Successful tree planting comes in bunches. At each project location, new trees are planted in groups to provide protection against the wind. The young trees spread naturally

» JOHN STENMARK, PS

Standing in a future forest, a Land Life technician inspects newly planted trees. The green tubes protect and support the seedlings.
PHOTOS COURTESY OF LAND LIFE COMPANY

Technicians measure a tree height and record data on a smartphone. Monitoring is an essential part of successful high-volume tree planting.

to fill in and enlarge the new forest. Eventually the soil improves to support new plant life and further aid in carbon capture.

But it's difficult to plant trees successfully on a large scale and Land Life plants trees by the thousands. Logistics are complex and costs for sapling trees, supplies, labor and equipment add up quickly. To optimize the cost-to-benefit ratio, Land Life needs to achieve a high rate of success for the trees it plants; the young trees need to grow and remain healthy in order to produce the long-term benefits.

Data-driven Forests

To reach and maintain success, Land Life monitors the new trees through periodic visits to measure parameters such as height and health. Combined with information on the tree species, location, soils and environmental conditions, the data supports informed decisions in planning the next round of planting and enables Land Life to adjust variables such as soil amendments and watering approaches.

"We are gathering as much data as we can," says Tom Janmaat, a data scientist at Land Life. "We're shaving costs in the operations and using our knowledge to optimize performance. The next steps will be ecological gains: making sure that you plant the right trees in the right spot at the right time. Scientific knowledge is available and we think we can get even better. We can help improve our knowledge base by gathering data on how our trees grow: Learning what works and what doesn't."

A Land Life technician uses a QR code reader to identify a tree. By replacing the QR codes with accurate GNSS positioning, Land Life produced a four-fold increase in monitoring productivity.

A Land Life technician holds a smartphone and the Trimble R1 GNSS receiver while entering data. The R1, commonly carried in a pocket, provides sub-meter accuracy via Bluetooth connection to the phone.

Janmaat explained that Land Life records as much data as possible on factors that could influence the trees' growth and survival rates, then analyzes how the various parameters influence each other.

Thanks to its rigorous statistical practices, Land Life needs to monitor only a fraction of its trees. On a planting of a hundred thousand trees, they typically monitor a few thousand to produce a good sample of every combination of tree species and treatments in a given field.

Monitoring tree performance is a labor-intensive process. To control costs, the company is working to improve productivity in its monitoring efforts. For example, it developed an in-house smartphone app to guide users through the capture of information on a tree's species, height and health. In order for the information to be useful, field teams must be sure that they visit the same tree every time. When dealing with thousands of nearly-identical trees, it's not a simple task. That's where GNSS comes in.

For years, Land Life attached small paper tags with unique QR codes to the trees selected for monitoring. While the codes ensured accurate identification of specific trees, they required the monitoring personnel to carry a separate QR reader and crawl on the ground to reach and scan the tag. The method was further compromised by the fact that some QR tags were torn off and lost each year. So, Land Life turned to satellite positioning using the GPS receivers built into the team members' smart phones. That decision led to a new challenge: accuracy.

In open fields and with access to a cellular network, a smartphone's built-in GPS can provide positions accurate to roughly three meters. The accuracy is worse when working in treed areas or locations where cellular signals are not available—conditions where Land Life does much of its work. With trees spaced three to four meters apart, the smartphone GPS can't provide the accuracy needed to confidently identify and return to the same tree repeatedly. Land Life needed the ability to measure to within one meter.

Accurate Positioning Produces Accurate Information

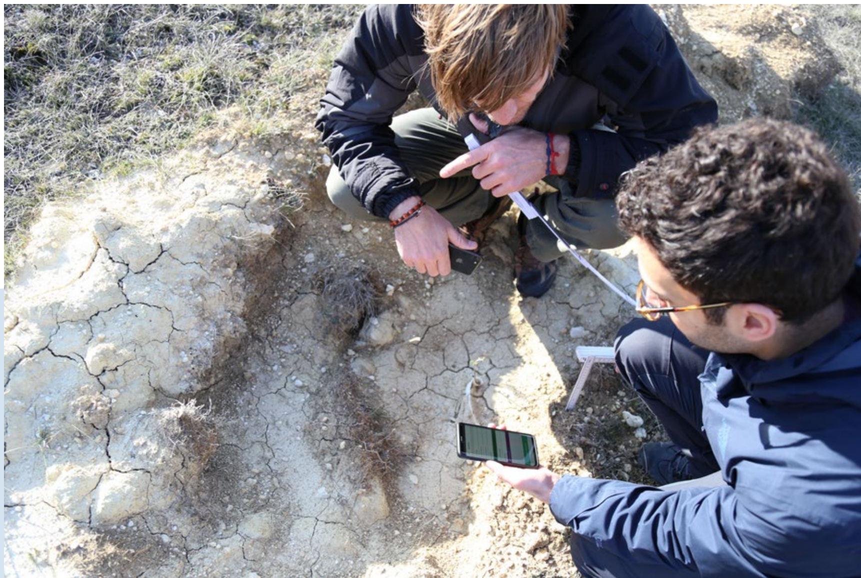
Professional-grade GPS or GNSS (Global Navigation Satellite System) receivers could easily meet the sub-meter requirements, but Land Life was concerned about the cost and complexity of those solutions. They had already invested in writing software for data collection and their field teams were familiar and efficient with those in-house apps. Land Life needed a way to blend higher accuracy positioning into their existing workflows and Bring-Your-Own-Device (BYOD) approach to locating and monitoring the trees.

Land Life selected the Trimble R1 GNSS receiver, a device roughly the size of a pack of playing cards that can provide real-time positioning with sub-meter accuracy. Using a Bluetooth connection, the R1 can stream position data to apps running on iOS or Android smartphones, making it easy for field workers to carry and use. Land Life software developers incorporated the high-accuracy positions into their in-house monitoring apps. With the position data in their familiar apps, workers could use existing workflows and smartphones; they needed very little training on the new device.

Land Life can also mount a R1 onto its tree planting machines, enabling field teams to capture the location of each new tree when it is planted. For monitoring, the app can then guide users to specific trees. "When you have that sub-meter accuracy flowing from the R1, it's easy to find your way back to a tree," Janmaat said. "You walk towards the tree, you look on your phone and say, 'Oh, yeah. I see the dot of my location on my screen next to the tree that I'm looking for.' It works quite well."

Building on its experience with the R1, Land Life is also using Trimble Catalyst, which combines a small GNSS antenna with software running on an Android-based tablet or smartphone. By turning the smartphone into a GNSS system that can produce up to centimeter accuracy, the Catalyst technology further reduces the cost and complexity of accurate positioning. Like the R1, the Catalyst solution uses GNSS correction data from the Trimble RTX service to produce the needed sub-meter positions; Catalyst functions as an all-in-one GNSS positioning service that can be subscribed to on a monthly or even hourly basis.

According to Jasper Schurr, the commercial manager for Geometius, a Trimble distributor in the Netherlands, receiving correction data is essential. "The RTX service is important for users like Land Life," he said. "Many GNSS correction services provide corrections



Technicians assess a seedling tree and record observations on a smartphone. Analysis of the data guides decisions based on soils, tree species and moisture.

using cellular phone connections. With RTX, cellular coverage isn't needed. The correction data can be delivered via both phone and communications satellites, so users can get accurate performance 24/7, even in remote locations."

Similar to their experience with the R1, Land Life developers used Catalyst to deliver the positions into their monitoring software. "It was easy to integrate Catalyst into our work," Janmaat recalls. "The accuracy from Catalyst is displayed in combination with field data in our Android app."

Increasing the Value of Monitoring Data

Land Life is already reaping the benefits of the accurate GNSS systems for monitoring. Janmaat described a project in Spain where they could compare the new and old approaches. "Two of us were there for two full days doing close to 20 hours of work each to monitor a thousand trees. With the Trimble system, you can do a thousand trees by yourself in one day, which has sped up monitoring by at least a factor of four."

As the forests grow, the monitoring will transition from ground-based measurements to using drones to capture data over larger areas. By using accurate GNSS to locate the trees during planting and to maintain tight georeferencing for the drone flights, Land

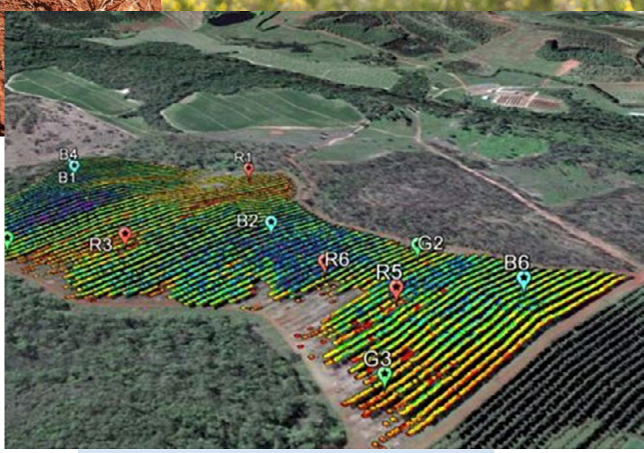
A Land Life invention, the "Cocoon" protects young trees and automatically delivers a measured flow of water and nutrients. The Cocoon eventually disintegrates and further enhances the soil.

Life will be able to identify and monitor individual trees from the aerial images.

Janmaat used data plots from a planting project in Texas to illustrate the contribution of accurate positioning to Land Life's data-driven methods. Trees planted using accurate GNSS appear in neat rows, while those planted using only a phone GPS are uneven and more scattered.

The accurate positioning also enabled direct comparison of different treatments and watering methods to specific trees over time, including use of an automated watering solution in dry areas. The data enable Land Life to improve the performance and survival rates, effectively reducing the cost per successful tree.

A Land Life team works on a site in Spain. With most monitoring performed on foot, small, lightweight GNSS and recording equipment is essential.



Data from on-site monitoring can supplement satellite photos to help analyze performance over large tracts of new trees.

Looking forward, Land Life expects to use its GNSS capabilities to assist operators in guiding the planting machines, ensuring consistency and proper placement of trees. But monitoring will remain a core effort and a driver for increasing productivity and tree success rates.

Janmaat is keen to share his enthusiasm and knowledge gained about technology in forestry and agriculture in general. He believes it provides an interesting and exciting challenge for young professionals to implement technology that enables a for-profit company to contribute to society and the Earth, while having a positive effect on our environment.

"We are doing technologically challenging stuff that we apply towards a sustainable goal," he said. "We are confident this will reduce costs in the future and make us more effective in planting trees. Apart from the cost aspect, it also enables us to reforest parts of the earth that would otherwise be more difficult to recover. By developing our knowledge, we have greater understanding on which trees grow well in the various conditions. It enables us to work in areas where other companies might not succeed."

John Stenmark is a writer and consultant working in the geospatial, AEC and associated industries. A professional surveyor, he has more than 25 years of experience in applying advanced technology to surveying and related disciplines.

CULVER CITY
PREVIOUS BLAST AS A

How One Explosion Opened the Door for Surveyors in Underground Damage Prevention

On June 16, 1976, the community of Venice Boulevard in Culver City, California, was humming with construction for a street-widening project. But then, with one fatal excavation, gasoline shot up and a wall of fire formed. The howling eruption was the result of a front-end construction material loader striking a high-pressure petroleum line.

» MICHAEL A. TWOHIG

The deadly cloud, filled with petroleum spewing from the ruptured pipeline, rained down, pouring over 16,000 gallons of low-lead gasoline over businesses, residential properties, and unsuspecting citizens passing by. At first, bystanders and motorists remained fixated on the growing clouds of black smoke in the sky, until moments later when the hot exhaust turned the once bustling, sunny block into a giant hazardous fireball. The disaster took nine lives and left 14 others severely injured in what was later, in reports, reduced to an 18-inch utility location error.

CATALYST FOR CHANGE

In 1976, an explosion in Culver City initially left nine dead and 26 injured. The explosion was caused by excavators striking a gas line, due to an 18-inch error in information about the utility line's location.

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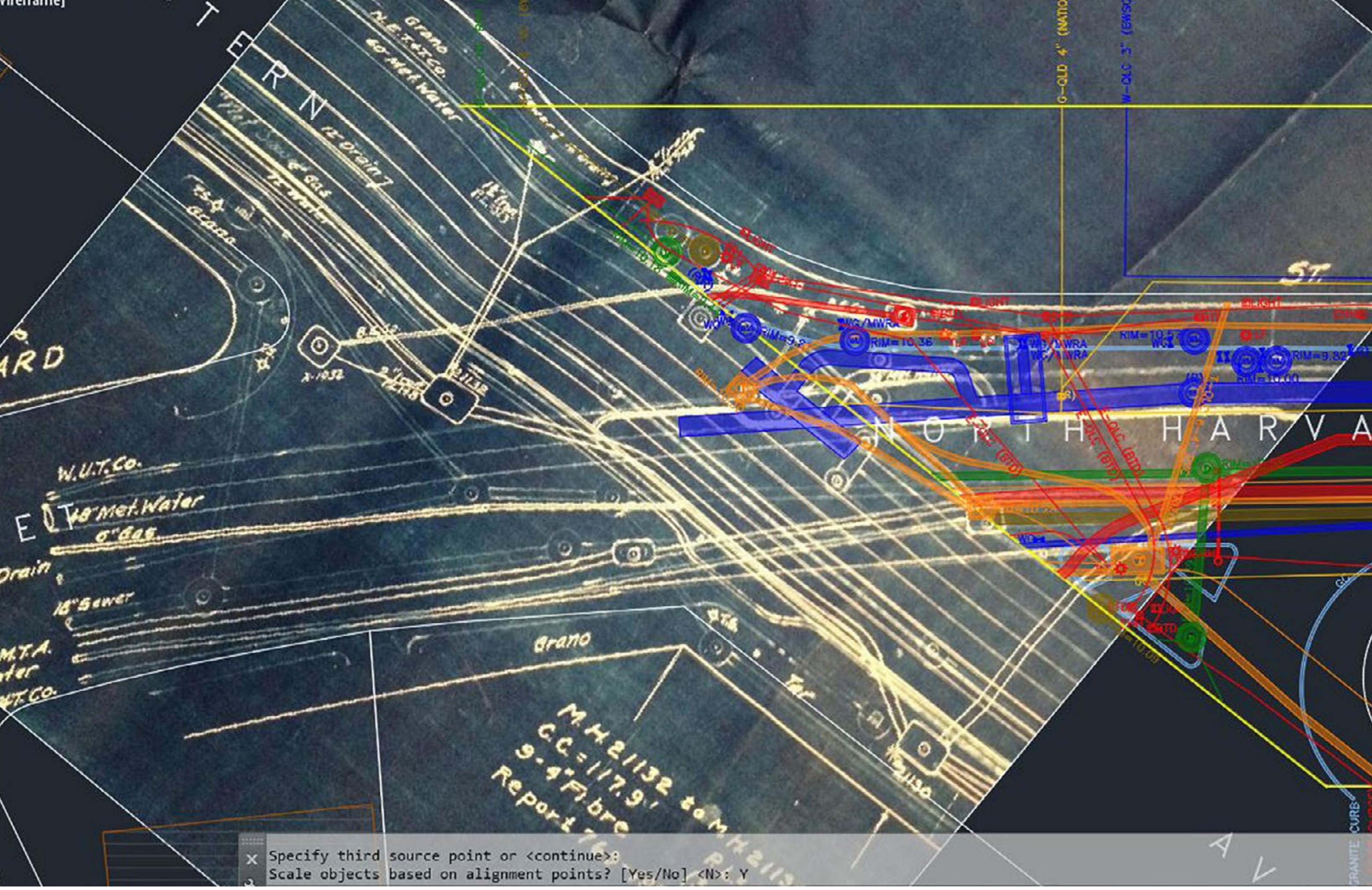
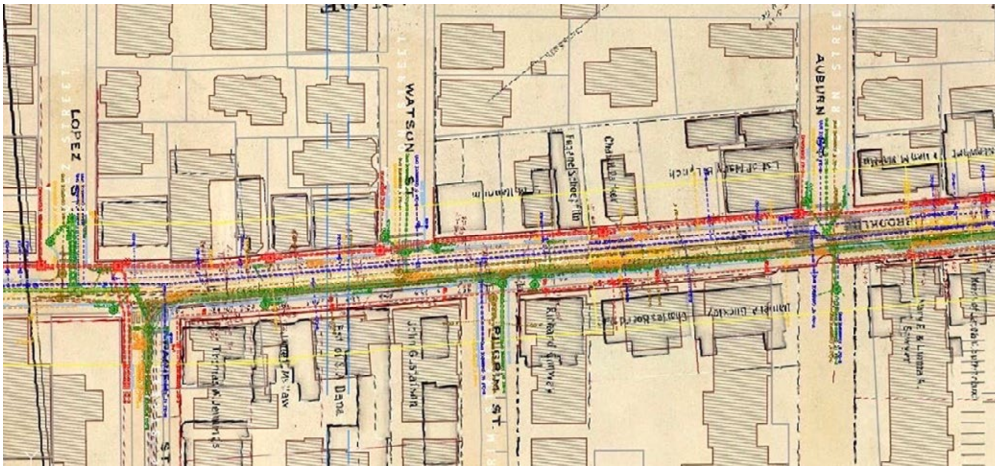


The map above produced by the DGT Associates SUM team superimposes underground data from remote sensing technologies with the original underground blueprint, combining 100 years of history in one place.



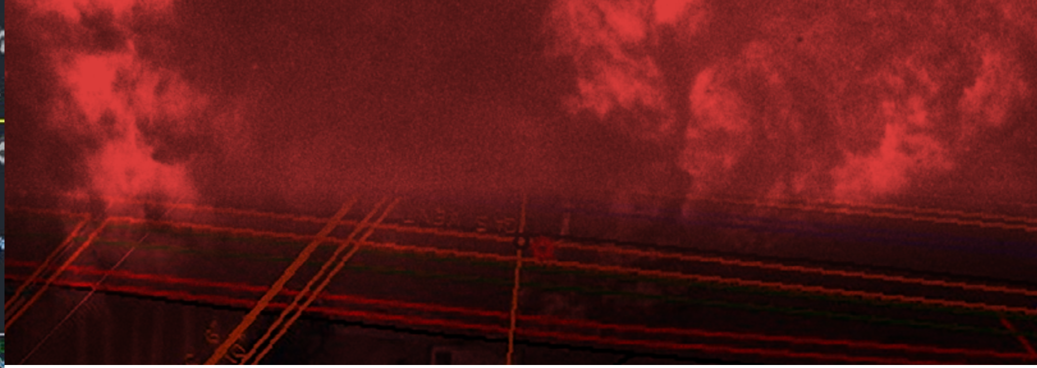
A critical aspect of Subsurface Utility Mapping (SUM) is utilizing legacy data as well as new data to maintain the integrity and authenticity of all of the data presented.

Today, not many surveyors or utility industry professionals know about the Culver City gas line explosion; after all, it was nearly 45 years ago. But from the ashes of the Culver City tragedy came necessary changes in industry best practices for locating utilities, color-coded markings, excavation practices, site inspections, utility coordination, and even One-Call notification programs. Moving forward, Culver City and its industry impact shed light on the path forward for the development of best practices and how surveyors can lead the charge in protecting underground, and thus aboveground, assets.

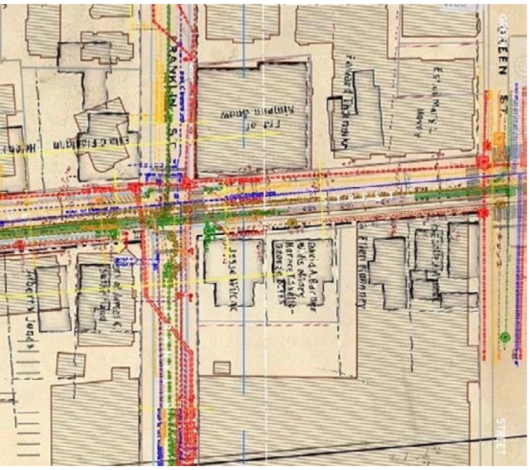
Flaws Acknowledged: Investigations and Reports

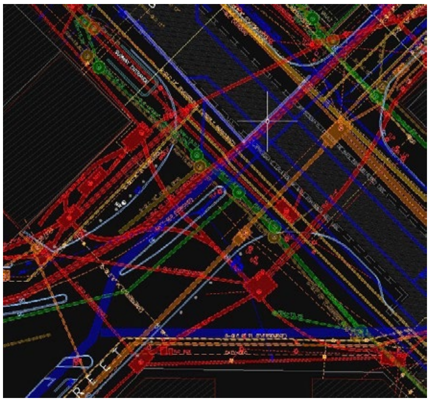
In the aftermath of the Culver City explosion, investigators discovered troubling circumstances that contributed to the event. The initial shock turned to outrage at the apparent inadequacies in planning, design, and construction practices, identified as the cause of the accident. The chairman of the *National Transportation Safety Board (NTSB), Webster B. Todd Junior stated*, “Someone should make damn certain exactly where that pipeline is located. You don’t fool around in a situation like that.” The final investigations and subsequent reports identified several key factors that lead to the event.

First, the project owner and design team failed to locate the exact position of the underground facilities—two high-pressure product lines—and accurately depict their locations on the construction plans. Instead, the owner used contractual language in the project “Standards and Specifications” requiring the winning contractor to work with the underground asset owners to determine the location of underground lines. As stated *in the contract*, “The contractor shall ascertain the exact location of underground main or trunk lines whose



Michael A. Twohig, Director of Subsurface Utility Mapping for DGT Associates, scans for underground utilities on airport grounds using electromagnetic induction (EMI). Many handheld devices now incorporate GPS-connectivity to allow the uploading of the information live into GIS environments.





To go beyond paint on the ground in marking utilities, DGT creates composite utility plans for underground infrastructure, using APW color-coding.

presence is located on the plans or in the special provisions." While the winning contractor did contact the pipeline operator and other underground asset owners, only a few test holes were performed in the early phase of construction and the nearest survey location of the pipeline was positioned 300 feet from the accident site. Essentially, for months, no one on the project knew the exact location of the high-pressure lines.

Next, while the records indicate the pipeline owner worked with the contractor to communicate the approximate location of the pipeline, the final report also suggests the pipeline owners could have done more to protect the integrity of the pipeline. Little effort was made to monitor the construction site, and no attempt was made to verify the pipeline depth. What was most troubling to the NTSB was no one disputed the fact that the high-risk pipeline was known to be shallow and in conflict with the proposed work. As concluded in the *NTSB report*, "No attempt was made to verify the pipeline depth at the accident site, even though 700 feet of the pipeline, near the accident site, had previously been lowered because of insufficient depth. Although the line was known to exist, its precise depth and location were not known by the pipeline operator, the construction contractor, the subcontractor, or the Department of Transportation."

Best Practices Rise from Tragedy

Following the *Culver City explosion*, federal and state organizations aimed to better protect civilians and underground assets by establishing what is now known as the Common Ground Alliance (CGA). The CGA eagerly worked on developing methods for every contractor or project owner to notify other stakeholders about their intent to break ground in hopes of sparking consistent and reliable communication about underground asset location. Born out of this idea was One-Call centers.

By 1994, there were 71 individual One-Call centers across the United States. Receiving a staggering 15 million calls per year, it was clear that communication was improving between asset owners. However, all the One-Call centers were operating with different 10-digit numbers. To gain even higher participation, the federal government in 2002 strengthened its support for the One-Call program by requiring the Department of Transportation (DOT) and Federal Communications Commission (FCC) to establish a three-digit, nationwide toll-free number that unified the 71 individual centers. Today, 8-1-1 is the universal "Call before you Dig" number.

While 8-1-1 has helped to establish communication regarding the intent to dig, it has not solved the problem of communicating in real-time on project sites. At sites, project owners often rely on paint marks on the ground—*urban hieroglyphics*—as an on-site communication method of underground utility locations. But the only true, accurate way for project owners to perform proper risk assessment at a project site—relating to underground utilities—is by implementing an integrated system for locating, mapping, and communicating underground information.

How Surveyors Can Further Improve Subsurface Utility Mapping

Subsurface Utility Engineering (SUE) is the most common approach today to gaining a comprehensive view of underground assets beyond One-Call centers and paint mark-outs. SUE gained the seal of approval from the Federal Highway Administration (FHWA) in 1991, and shortly after, the *Purdue study* demonstrated its cost-effective nature. The study found that 71 projects observed a total of $4.62 of savings for every $1.00 spent on SUE. This study validated SUE as a valuable technological practice with the ability to reduce costs, as well as increase project safety, and should

New wearable LiDAR technology, like the one seen above by NavVis, allows capturing of the built environment aboveground, including paint markouts, so that it can be merged with subsurface information to give a more complete depiction.

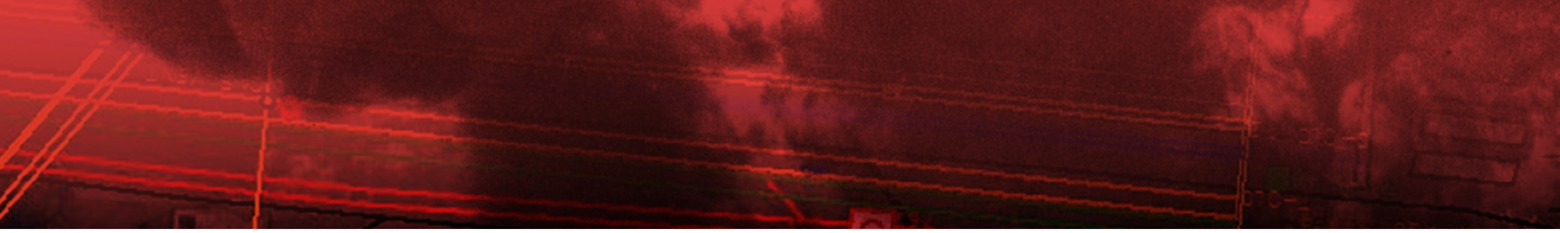
be used across the industry. With this, the American Society of Civil Engineers (ASCE) National Consensus Standard titled *ASCE C-I 38-02, Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data*. These progressions built on CGA's work and further solidified a regulated process of breaking ground.

Under these ASCE 38-02 regulations stem four levels of service. Level D consists of locating underground assets by reviewing as-built plans and existing documentation. This method is the most fundamental level of accuracy. At the highest accuracy, Level A uses existing records in combination with noninvasive underground mapping techniques to present the most comprehensive and clear-cut details of what lies belowground. When reflecting on the Culver City tragedy it's clear to see that test-holing, while a common utility locator practice, left a large margin of error—a margin of error that surveyors, guided by a principle of accuracy, would never allow.

At DGT, we believe that the best method for capturing a complete picture of the underground environment consists of comparing as-built records—a surveyor's tool—with the findings from what we call Subsurface Utility Mapping (SUM) investigations. Rather than excavating test holes, creating greater risk of exposure and damage, SUM employs sophisticated technology to locate underground assets while leaving them undisturbed. Building on the surveyor's principle of accuracy, SUM data can be gathered with tools such as electromagnetic utility locating devices (EMI) and ground-penetrating radar (GPR) systems. Today, Ground Penetrating Radar (GPR) can be used to map out and profile a pipeline. You can never perform enough test holes to obtain the level of accuracy you get with SUM technologies.

SUM, building on SUE, goes beyond just underground data acquisition, focusing equally on data storage and delivery for optimal usage by any stakeholder on a project site. Mapping underground assets adds value, quality, and accountability to the project, therefore creating a safer environment. SUM constructs color-coded 2D and 3D digital files that illustrate the exact location of vital underground utilities. This information is then transformed into Computer Aided Design (CAD), Building Information Modeling (BIM), or GIS models.

Subsurface Information Modeling (SIM) is another technological evolution we see emerging in underground mapping. Established by Michael A. Twohig, DGT's Director of Subsurface Utility Mapping, SIM blends the best practices of SUM with the model-based processes of BIM. With SIM, utility surveyors utilize terrestrial LiDAR in the design phase of the project and use the data gathered to identify any possible utility conflicts. In the future, industry practitioners will likely use the data gathered from LiDAR to build a "Digital Twin" for Dilapidation Surveys and One Call line markings. This technique will propel the industry to new heights. Additionally, with the use of 3D modeling, project managers will be able to compare site mark-outs in real-time with the data gathered from SUM



techniques. Using these practices, projects will avoid costly mistakes, stay on schedule, and create a safer environment for both workers and the public.

Usable—not just Viewable—Data

Using SUM and SIM to gather data and protect assets is pivotal, but the ability to import and store this data in the cloud is also crucial for future use—beyond a single project—in billing, sharing, and querying. Over the past decade, a technological revolution has swept the industry improving information retrieval and data storage.

Recently, new equipment has been designed to include GPS functionality that can be used in tandem with the precise SIM and SUM utility location data. These new excavation tools combine the effectiveness of heavy equipment with the finesse of accurate soil removal that comes from GPS, enabling jobs to be performed quickly and accurately, therefore saving time and money. Another benefit is GPS integration into pipe-locating systems. This technology makes it possible to trace, locate, and map the precise horizontal and vertical location of underground facilities. What's even more important is the ability to access the metadata from the office, the field, or even in an excavator's handheld device, and see the precise location of underground systems. With a greater number of people accessing data at their fingertips, successful collaboration and informed decision making is increasing.

Land Surveying in a Modern World

While land surveyors were traditionally focused on assessing the land above ground, their role in underground surveys has increased as technology advances in SUM/SIM practices and cloud-based solutions. Although the CGA, and numerous construction industry organizations, have made strides to mitigate underground infrastructure damage following Culver City, surveyors bring a level of spatial accuracy and expertise to underground infrastructure that is needed to better protect underground assets. By implementing a tactical utility locating and mapping program, led by surveyors, leaders throughout the ASCE community—utility locators, civil engineers, construction managers, GIS technicians, LiDAR specialists and more—will be able to grow the industry together as allies.

In the instance of Culver City, 18 inches was the difference between life and death. Had the team communicated, developed meaningful processes, and utilized equipment, this story of tragedy may have been one of triumph. Today, we must use the techniques, resources, and experts available to us to move the industry forward and prevent repeating the mistakes of those who came before us. ■

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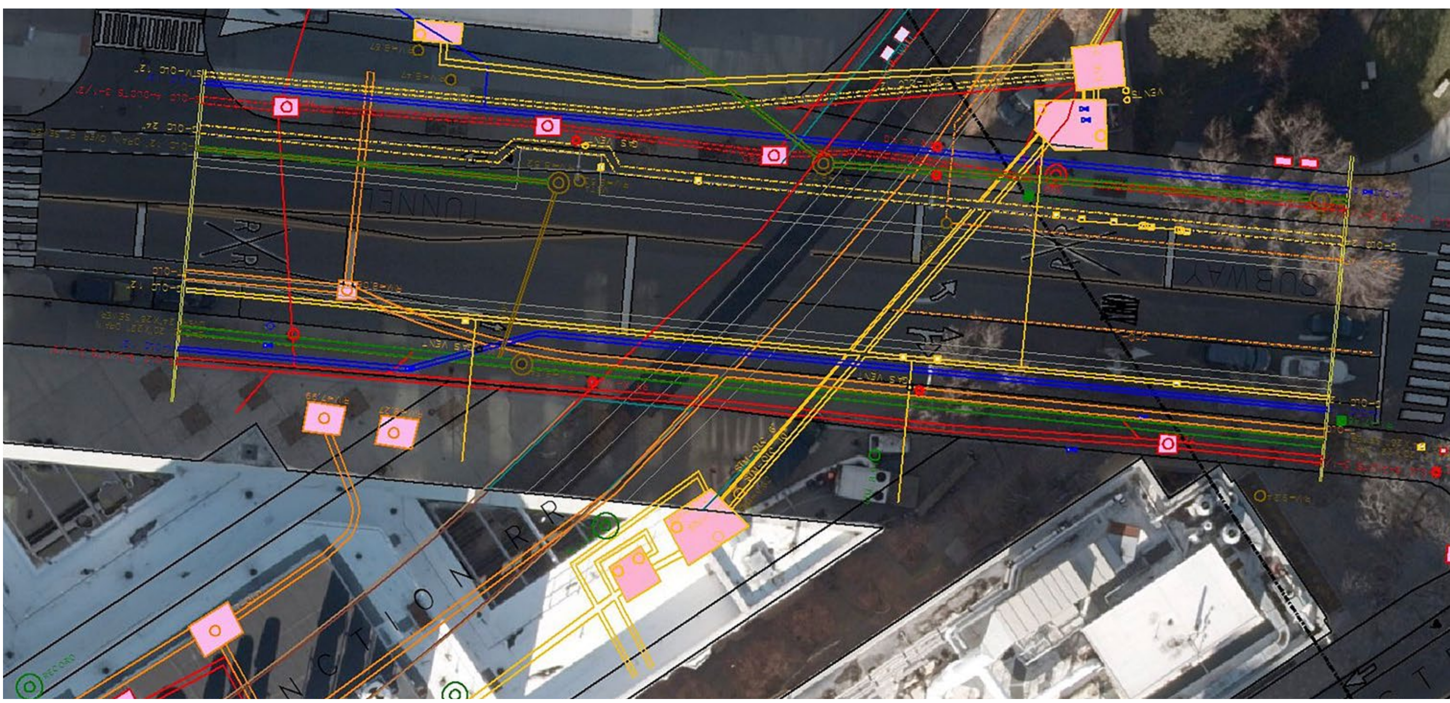
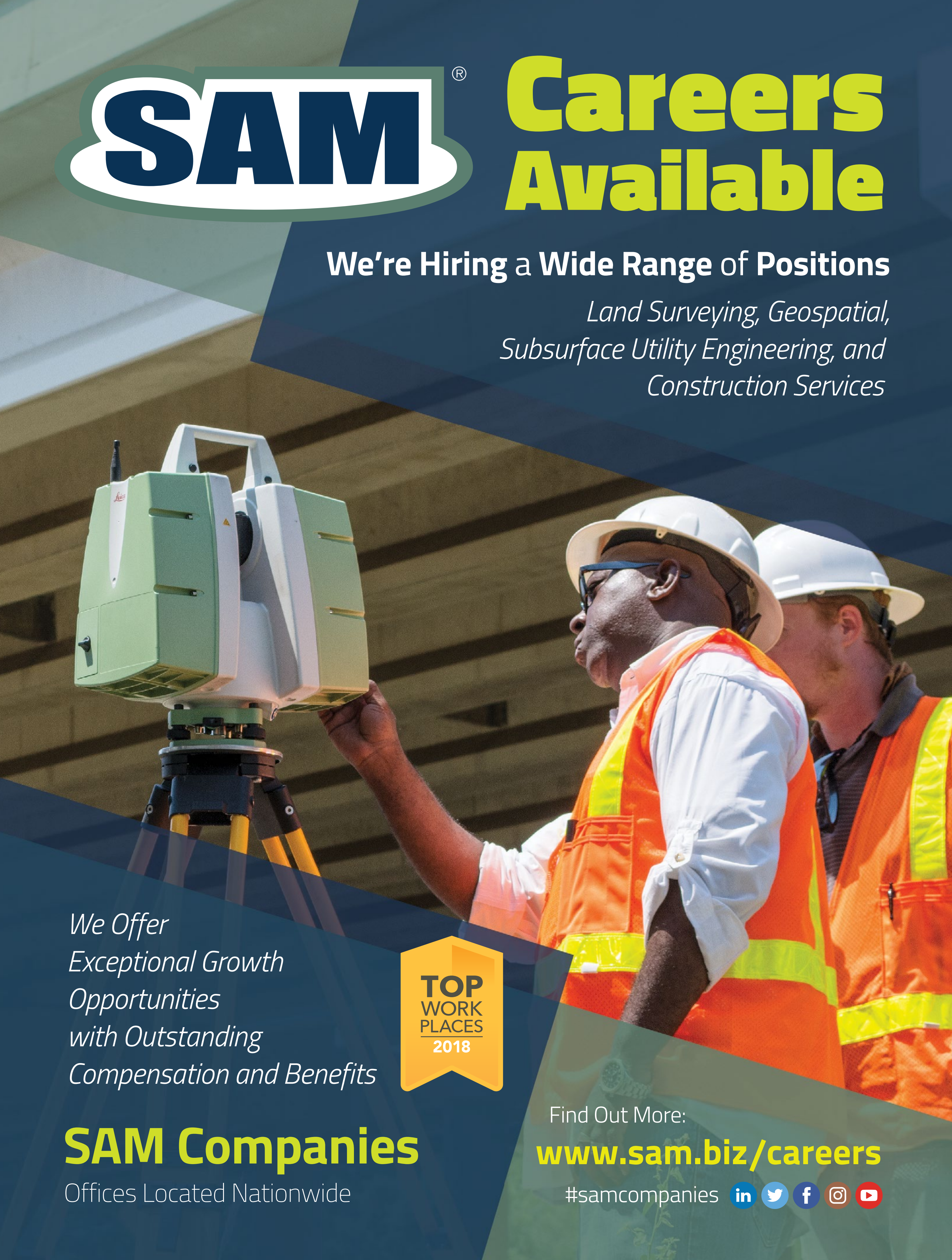


This DGT map shows GIS representation of subsurface utility information in an urban environment. The product of SUM/SIM work is a detailed map that not only locates utilities, but also includes metadata about the type, age, and more to help provide comprehensive information to avoid accidents like Culver City.



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Has Lidar Viz Come of Age?

The nice thing about hardware is you can pick it up, feel its heft, move it around in your hands, scare the booth folks who think you are about to drop their only sample,… Not so in our new covid age: now we experience *virtual* everything. Among the product buzz of the recent virtual Intergeo conference is the new DJI Zenmuse L1 lidar/camera system shown in **Figure 1**. The L1 features a MEMS lidar scanner from DJI subsidiary Livox, a 1" mechanical shutter RGB camera and an intriguing grayscale camera used for aiding inertial measurement. The entire package is mounted in a three-axis gimbal. The L1 is currently compatible only with the also relatively new DJI M300 RTK drone. Official pricing has not yet been released but rumor is a list price of US $18,000 (sensor only). The primary question from folks who have looked over the L1 specs has been, "What can you do with this type system?"

Figure 1: DJI Zenmuse L1

My company, GeoCue Group Inc., is a DJI Enterprise dealer but demo deliveries to dealers of the L1 are not slated to occur until the end of this year. Thus I can only speculate on the system at this time. I think DJI themselves are struggling a bit with the operational characteristics of the system. In a recent presentation, I saw three different numbers for network accuracy (erroneously referred to as "absolution" accuracy). Given our own experience in evaluating Livox scanners, I am thinking the numbers I saw, 10 cm network accuracy at 50 m above ground level, are probably in the ball park. We do not yet have sample data, so I cannot comment on the precision of the system (i.e. the planar hard surface deviation).

DJI have agreed to work with GeoCue to integrate the L1 into the True View EVO ecosystem as a "guest" sensor (we already support the Phantom 4 RTK in this mode). I think it may fit quite nicely at the entry level in our 3D Imaging Sensor (3DIS®) product line. Of course, that is fine, but it still does not answer the

Figure 2: Construction site 3DI

question of applications for which this sensor will be suited.

For the past two years, I have been evangelizing the value of RGB colorized 3D point clouds or "3D Images" (3DI). High-accuracy 3DI are incredibly valuable in traditional lidar processing workflows for identifying features during classification. But 3DI are also an extremely useful tool for simple visualization tasks. Suppose I want to monitor a construction site on a periodic basis. I can use photogrammetry but this means I face hours of "image to point cloud" post-processing and, when this is complete, I have a point cloud that does not model a lot of construction features very well (wires, pipes, beams, etc.). 3DI from a lidar sensor with a matched camera system (and, of course, good post-processing software) is the answer. As a side note, it is important to appreciate that 3DI are not lidar points colorized from an orthophoto: these would be "2.5 DI" since an ortho can represent only a single Z color at each X, Y point. A true 3DI has to be constructed by ray-tracing each lidar point to the "best" image that sees that point.

An example of a 3D image collected using a GeoCue True View 410 system is shown in **Figure 2**. Not only does the colorized lidar approach provide a much more detailed scene depiction than photogrammetry, but the post-processing occurs in minutes rather than hours (it takes about 10 minutes to post-process a 15-minute flight).

Up to now, the ubiquitous use of 3DI for inspection has been hampered by the high cost of fused lidar/camera systems. We (the folks building these systems) have been so concerned about meeting a minimum threshold of network accuracy and high precision that we have not enabled systems aimed at inspection rather than higher accuracy survey. The new DJI L1 is clearly filling that gap.

I truly do believe that this sensor (and others sure to follow) will change the way we do inspection operations. Look for a host of new downstream applications that consume these data as the foundation of visualization and inspection products. Of course, we will provide a review in *LIDAR Magazine* as soon as we have our hands on the Zenmuse L1. ■

This article originally appeared in LIDAR Magazine.

Lewis Graham is the President and CTO of GeoCue Corporation. GeoCue is North America's largest supplier of lidar production and workflow tools and consulting services for airborne and mobile laser scanning.

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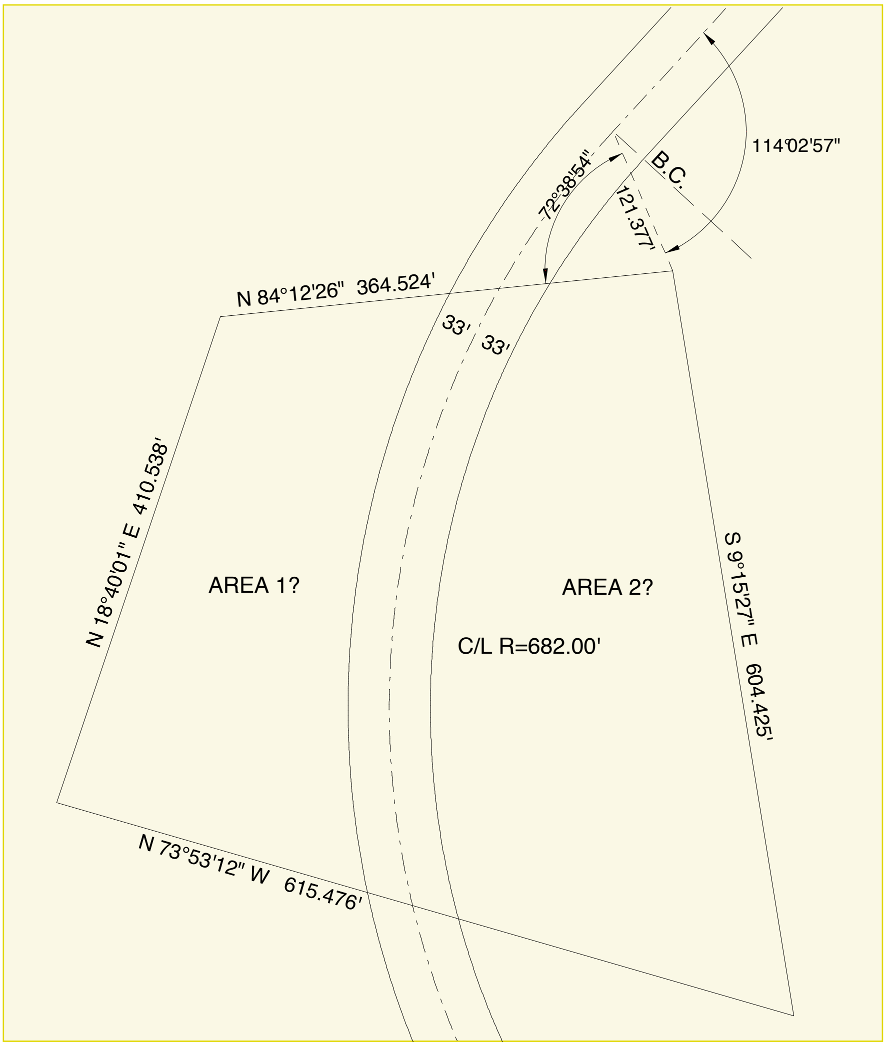
Dave Lindell, PS, retired after 36 1/2 years with the City of Los Angeles. He keeps surveying part time to stay busy and keep out of trouble. Dave can be reached at *dllindell@msn.com*.



JOHN PALATIELLO

the business of surveying

Is Your Survey Practice Planning for Success?

While surveyors are licensed by each state to protect public health, safety, and welfare, in order to be in business a private practice surveying firm must also turn a profit.

The financial success of a firm does not come easily or naturally. It takes planning and execution.

There are several plans a successful surveyor firm should have. Such plans are essential to both a start-up, as well as an established enterprise. These include a business plan, strategic plan, marketing plan, and a succession/ownership transition plan. Regrettably, many surveyors don't have them.

In the coming months, I'll discuss the need for and content of each plan in more detail.

To start, here are two of my favorite "planning" quotes:

"Plan for the future, because that is where you are going to spend the rest of your life."
—*Mark Twain.*

"Failing to plan is planning to fail."
—*Benjamin Franklin*

These pithy quotes capture the importance of business planning.

The aforementioned plans can be separate and individual, or combined into one document. The former may be preferable as each can be used for different purposes. For example, a business plan is useful as a stand-alone document as it is often required by a bank when applying for a business loan. While business, strategic,

and marketing plans should be collaborative efforts, a business owner may wish to keep a succession plan more confidential.

These plans are not etched in stone. They are guides, not hardened rules. They should be periodically reviewed and updated as necessary. They should provide guiding principles to help navigate a firm and prevent lurching from one idea du jour to another on an ad hoc basis.

Throughout my career, I have had the honor of serving as Executive Director of several surveying and engineering related associations. One of my first tasks upon becoming the chief executive of each was to convene a strategic planning session with the organization's leadership. My facilitation and drafting resulted in the adopted strategic plan of the National Society of Professional Surveyors. Moreover, I've also had the privilege of serving as an outside consultant and facilitator to numerous firms. My knowledge of the profession, combined with my independence of any single firm, has permitted me to provide informed, yet objective, assistance to my clients with their planning efforts.

Some planning charettes involve all members of a firm, or at least selected key staff. Rather than being expensive and time consuming, an outside facilitator can help a firm stay focused and complete the process efficiently.

Planning should come easily to surveyors. After all, a survey is a plan. The survey you provide is used by your client to plan future activities, be it design and construction, resources development, environmental protection, sale of real property, or many other applications and activities. The elements of business planning are as important to a surveying firm as a survey is to your clients.

A discussion of these planning elements will be presented in this column in the upcoming editions of *The American Surveyor.* ■

John Palatiello is President of John M. Palatiello & Associates Inc., a public affairs consulting firm based in Fairfax, VA, providing government relations, public relations, association management, strategic planning, event planning, and management and marketing consulting services to private firms, associations, and government agencies with an emphasis on the architecture and engineering; surveying, geospatial, mapping and GIS; information technology; construction; transportation and infrastructure, and land use sectors. This series is based on columns that first appeared in the newsletters of the Maryland Society of Surveyors and Virginia Association of Surveyors, where Mr. Palatiello serves as Executive Director.

No Way Out

The urge was strong to call this "No Exit," but remembrances of Jean Paul Sartre's play of the same name about a hellish afterlife quickly squelched that idea. Instead, the chosen title should better reflect the realm of real property problems that can plague us in the current plane of life: parcels that do not seem to have access. I am currently working with property owners facing a quiet title action by landlocked neighbors claiming a right by "implied easement of necessity" to reach a public road. That made me investigate details of the language and of the chain of title. Problems with some of the plaintiffs' arguments may temper the final decision by the court of equity, but it's hard to say at this early stage.

When we say a parcel is landlocked, it means that it has no direct access to a public road, and owners must cross other people's lands for ingress and egress. There are two parts to this situation: physical access and legal access. When there is legal access, either the parcel abuts a public road (over which the world at large has rights to travel) or there is an easement allowing access between a public road and that parcel over someone else's land. When we speak of physical access, there is a trail, a road, a driveway, or there is an easement over someone else's land allowing access between a public road and that parcel. But physical and legal access may not both be available. A parcel might have physical access but not the legal right to use it, such as frontage on limited access highways or abutting private roads. It might have legal access but not the physical means to exercise that right. And, of course, a parcel can have both or neither type of access.

Title insurance companies look carefully for physical or legal access, and place exceptions from coverage in their policies if a property neither abuts a public road nor has access by easement. That does not prevent people from buying landlocked parcels, though, sometimes with big plans in mind. The land is marketable but not insurable.

The courts may talk about creating landlocked situations as being against public policy and local ordinances may prevent creation of newly landlocked parcels, but there isn't other legal prevention. So, we hear about "implied easements" and "easements by necessity" as resolutions to the problem. "Implication" refers to intent that was never committed to writing, and there are innumerable cases about later owners trying to mindread what the original parties "meant" to accomplish in their transactions.

The general principle of implied easements is that when someone sells part of a parcel, they grant by implication an easement necessary for "reasonable use" of the severed property in the place and to the extent that the grantors already used. This means that if there is a path that was used to access the divided-off portion, that access way becomes the location of the implied easement. The size of the easement is to be consistent with the use, or anticipated and foreseeable use of that subdivided area. So if, at the time of severance, the wooded new lot was used for recreation and there was no development going on in the area, access is based on historic use.

Easements of necessity are those that are considered "indispensable to the enjoyment of the dominant estate" and easements by necessity arise "by operation of law when land conveyed is completely shut off from access to any road by land retained by grantor or by land of grantor and that of a stranger" (thank you, Black's Law Dictionary). This means that there must have been unity of ownership at the time of the creation of the need for access. States and courts vary in how they define the extent of the need, whether it is "strict necessity", "great necessity", or some other level, and also in how this is resolved. Statutes exist in some states to allow landlocked owners to try to negotiate with any and all adjoining owners to secure access, and if these efforts fail, to condemn an easement. Other states have no statutory allowances and require other legal actions to sue for access.

Whatever the legal method, if claiming that initial parties intended (implied) access as necessary to enjoy the land, resolution requires looking back in time for deeds and historical conditions. Was this parcel divided from the land the new owner now wants to cross, and landlocked by that severance? If not, there is no implied easement. But if yes, and the landlocked owner just doesn't like the route the servient estate now offers, preferring a more direct or less arduous means, courts may treat this as an unacceptable argument for mere convenience, although possibly balanced by equity. Furthermore, if the landlocked parcel was used for hunting and timbering, modern desires to create a residential development do not translate to rights for a 50-foot wide roadway conforming to local land use ordinances. ■

Wendy Lathrop is licensed as a Professional Land Surveyor in NJ, PA, DE, and MD, and has been involved since 1974 in surveying projects ranging from construction to boundary to environmental land use disputes. She is a Professional Planner in NJ, and a Certified Floodplain Manager through ASFPM.

Kent, *continued from page 48*

of fact to understand the evidence or to determine a fact in issue; (b) the testimony is based on sufficient facts or data; (c) the testimony is the product of reliable principles and methods; and (d) the expert has reliably applied the principles and methods to the facts of the case.”

And Rule 704 follows with this, *“An opinion is not objectionable just because it embraces an ultimate issue.”*

When considering what those Rules mean in the context of a surveyor’s expert testimony, we need to ask ourselves, what is the plaintiff asking the court to do in a title or boundary dispute? Do they want the court to merely tell them what their *deed* says? Or are they asking the judge to rule on what they *own*? Just as property owners are expecting the *surveyor* to tell them what they own, they are likewise asking the *court* to do the same. They could not care less what their deed says, they want to know what they own (as noted above, they most likely do not even understand the difference anyway).

That being the case, the Rules of Evidence say that—assuming they are qualified pursuant to Rule 702—experts may give opinions on the ultimate issue before the court, which is ownership! And if we look a bit more broadly, what is a boundary survey other than a professional opinion? If you can give an opinion in court as to ownership, what is there to prevent you from opining on ownership with your survey itself?

Curtis Brown, who had spent much of his professional life writing and teaching to the contrary, suggested the following to surveyors in a 1979 paper, “*Nothing in the law prevents the surveyor from deciding who has ownership to encroachments, and he may monument ownership lines rather than written title lines.*” He followed with “*In some circumstances the surveyor may be justified in monumenting the line that he believes to represent [the] true ownership line.*”[3] (Before going further, it is important to note that in the same paper Brown also stated that in cases involving contentious relationships like adverse possession and estoppel, *“the surveyor is probably foolish to try to establish ownership.”*)

What other support is there for taking a more assertive stand on ownership? Dr. John G. McEntyre, LS—lead professor of land surveying at Purdue University in the 1970s, 80s and 90s—wrote along with graduate teaching assistant Darrell R. Dean, Jr., LS, *“[T]here is support for the land surveyor to take an affirmative and responsible position with respect to identifying and making recommendations concerning boundary lines established by unwritten means.”*[4]

There is plenty more including the fact that there are many court cases that also point the surveyor to ownership. But the purpose of this column is to simply raise professional surveyors’ awareness as to possibilities that they may not have heretofore considered. Can professional surveyors be *far* more helpful to their clients than they generally have been? The answer is a resounding, Yes. ■

> “Property owners ... could not care less what their deed says, they want to know what they own.”

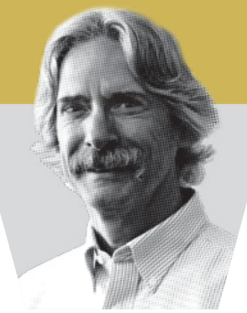
Gary Kent is Director, Integrated Services at The Schneider Corporation in Indianapolis. He is past-president of ACSM and chairs the ALTA/ACSM Committee for NSPS and the Liaison Committee for ALTA. He is on the Indiana Board of Registration and lectures both locally and nationally.

1 *Washington State Common Law of Surveys and Property Boundaries*, Jerry R. Broadus, 2009

2 Check your own state’s Rules of Evidence; most are identical or very nearly so

3 *Land Surveyors’ Liability to Unwritten Rights*, Curtis M. Brown, NMACSM Legal Seminar, January 1979

4 *Establishment of Boundaries by Unwritten Methods and the Land Surveyor*, John G. McEntyre and Darrell R. Dean, Jr., Indiana Society of Professional Land Surveyors and School of Civil Engineering, Purdue University, circa 1976.



The Art of Retracement and the Surveyor's Role

Traditionally, and almost universally, professional surveyors have been taught to survey the written title and to direct their client to seek the advice of an attorney for guidance regarding any potential title or boundary conflicts. Likewise, surveyors have—virtually across-the-board—shied away from giving opinions as to ownership where there are conflicts, other than possibly with regard to junior/senior rights. There are, however, a number of authoritative sources that would tell surveyors otherwise.

Before we explore those sources, however, we first need to consider why the average property owner hires a surveyor. Is it to learn where their written title lines are? Or do they *really* want to simply know what they own? Most surveyors will agree that it is most assuredly the latter. The problem lies in the fact that while surveyors *know* that clients *think* we are telling them what they own, we also know that's *not* what we are doing. But seldom do surveyors explain the difference between written title and ownership in a way that will help their clients understand that difference.

An underlying problem is that the average property owner equates their deed, and surveyor's markers on the ground, with ownership. How many of you have set a monument 6 feet over a fence and had the client ask, "*You mean I own 6 feet on the other side of the fence?!*" And when you explain to them that you are not telling them what they own—you are merely marking where their deed line is—they are left completely baffled because they think ownership and their deed are one and the same. At best the client will later tell her affected neighbor that he needs to move his fence back 6 feet. And we know the *worst* thing that will happen—the client tears the fence down before her neighbor even returns from work that day. The ensuing litigation will engulf both neighbors for years.

How can surveyors help clients and neighbors avoid costly mistakes and the angst of litigation?

> "Clients ... need to understand that there is frequently a difference between what their deed says and what they actually *own*."

If you are wedded to the idea of simply surveying the written title, one very simple thing to do is to make *absolutely certain* that the client understands what you are doing and what you are not doing when you perform a boundary survey. They need to understand that there is frequently a difference between what their *deed* says and what they actually *own;* and how and why that can happen. Surveyors must be confidently knowledgeable about, for example, acquiescence, adverse possession, and practical location—how they operate, what the requirements are, and how ownership can move from the written title line to a line of possession or occupation.

If the client's written title has potentially been affected by one of those doctrines, give them your opinion (but not legal advice) based on your experience and knowledge as to what their situation might be. You should also, as Jerry R. Broadus, Esq., LS, wrote, "*Tell your client in advance what services you can provide and how you can help resolve conflicting evidence, and that in some cases an attorney should be consulted before the survey is finalized.*"[1]

On the other hand, if professional surveyors want to enlarge the scope of their practice, there is plenty of support—at least in some cases—for giving opinions on, *and actually surveying to*, what they believe to represent the ownership line.

What kind of support exists for this sort of practice? We might start with the Federal Rules of Evidence.[2] Rule 702 states, "*A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if: (a) the expert's scientific, technical, or other specialized knowledge will help the trier*

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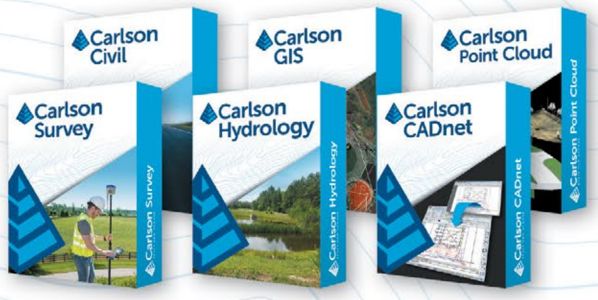

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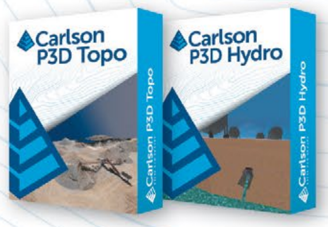

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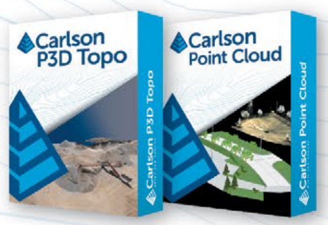

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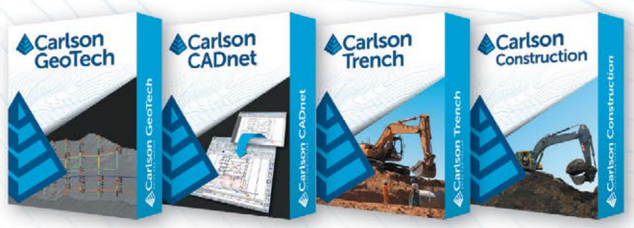

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