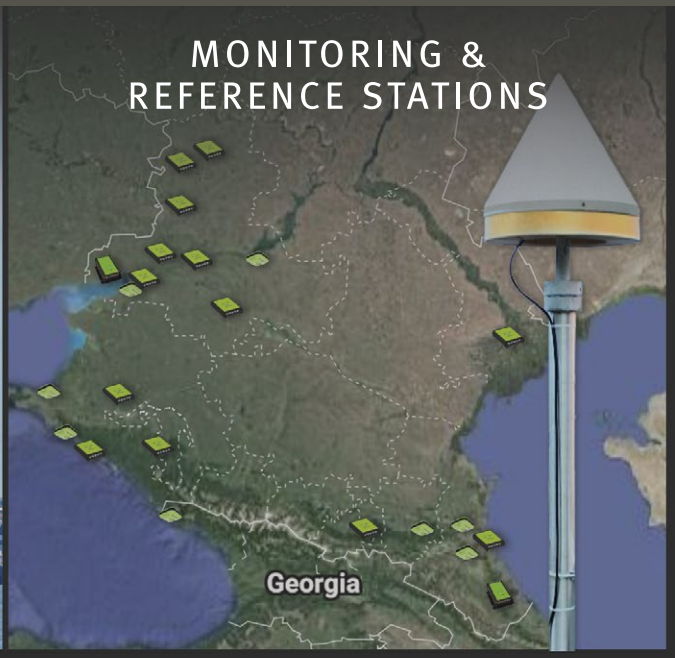
the American Surveyor

NOV/DEC 2021

GNSS Update

GNSS AND RADIO/MODEM SOLUTIONS

JAVAD



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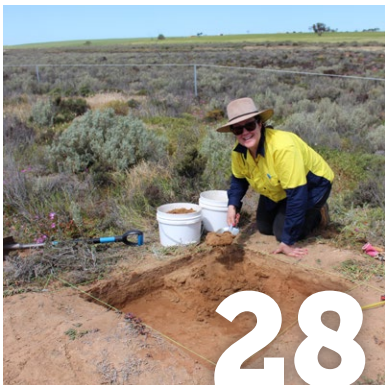
ON THE COVER

You've come a long way, Survey! Review of the new Javad Triumph LS Plus while hearkening back to our survey history.



features

AmeriSurv To Go!
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departments

in this issue

editorial

Sustainable Practice

Do you like the magazine? If so, please consider supporting us by subscribing at amerisurv.com. We would like to continue providing you with interesting content, but it will require your support. The new issue contains more great content, and several cool articles are in the works for 2022. But we need your support. Thanks to all of you who have supported us!

The lead feature in this issue pertains to GIS, but as you know, without adequate control, GIS is just a cartoon, so it behooves us to stay up to date on our portion of that discipline. As we know, individual trees are an important part of our discipline, but forests are an important part of our world. As our world warms, we see the results of improperly managed forests and the resultant fires, so it's important that we use all the tools at our disposal to protect them in a sustainable way.

Continuing with that theme, an Australian surveyor relates how he is using GNSS to strike a balance between land development and the preservation of our heritage. As surveyors we depend on development to provide us with work, but as the author points out, both are not only possible, but critical. Incidentally, for those of you who don't work in cities, the tool he uses allows him to work in remote places.

Also continuing with the theme, the CEO of an Australian company discusses how drone technology can be used in sustainable construction. Over the years I've had anti-development types criticize me for playing a part as a surveyor. I always inform them that the #1 reason why most folks go into surveying is to work outdoors, and why would we want to do anything that would harm our environment? This would be like defecating in our own living room!

Speaking of emerging technology, Joe Fenicle relates his experiences in using ground penetrating radar at the annual Surveyors Rendezvous. Due to excessive moisture in the soil the results were inconclusive, but the survey program Joe runs at the University of Akron will continue its investigation of the use of GPR so look for future articles about the subject.

Brian Fisher provides an in-depth look at the latest offerings from JAVAD GNSS. Brian cut his GPS teeth on Ashtech equipment, so he has closely followed the work of the late Javad Ashjaee. The company continues its development work and has made several recent hires. We will continue to follow the company as it charts its path into the future.

Wendy Lathrop provides a look at a New Jersey sand and gravel company who almost got away with claiming adverse possession against the state. Common knowledge says adverse possession can't be used against government property, but Wendy has provided at least one instance where it has. As surveyors it is our responsibility to stay current on the law and over the years Wendy has done an excellent job of sharing legal issues that pertain to land development.

Finally, Dave Lindell provides us with another Test Yourself. See if you can work the problem! The answers to all Dave's problems can be found on our website.

I hope you enjoy the issue, and again, please consider supporting our efforts by subscribing at amerisurv.com. ■

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November/December 2021 / Vol. 18 No. 6

The American Surveyor (ISSN 1548-2669) is published bi-monthly by Cheves Media LLC. Editorial mailing address: 7820-B Wormans Mill Road, #236 • Frederick, MD 21701. Tel: (301) 620-0784.

The American Surveyor is a publication of Cheves Media LLC, 7820-B Wormans Mill Road, #236 • Frederick, MD 21701 .

Subscription prices per year, six issues: U.S. $25; Canada $50; International $75 (Airmail). Visit the website to pay online. Back issues (subject to sufficient stock) $5 plus S&H.

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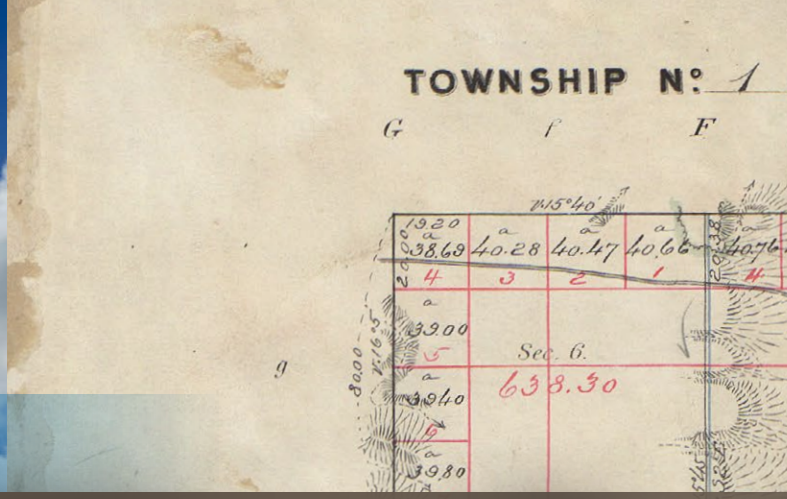


GLO RECORD OF THE WEEK

Rapid City, Sout

This week's GLO Record features a survey plat displaying Rapid City, South Dakota. Rapid City, named for the limestone spring stream that passes through it, was founded in 1876 by a group of disheartened prospectors that had come to the Black Hills in search of gold. John Brennan and Samuel Scott, along with a small party of men, laid out the site of present-day Rapid City.

Survey Plat

The city can be seen in the northeast part of this township plat for Township 1 North Range 7 East of the Black Hills Principal Meridian, which was approved on November 15, 1879.

Black Hills Expedition

The Black Hills Expedition, led by Lt. Col. George Armstrong Custer, was a United States Army expedition in 1874 to explore the previously uncharted Black Hills of South Dakota and investigate their natural resources.

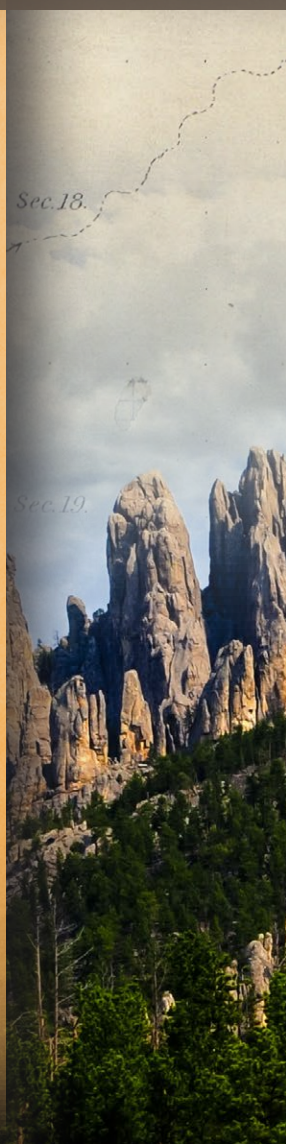
It was during this expedition that gold was discovered in the region. This 1874 discovery of gold in the Black Hills brought droves of settlers to the region, each hoping to strike it rich.

Founding and Growth

Not everybody who came to the Black Hills region was lucky enough to strike gold, but one group of failed prospectors found another opportunity in the large river valley situated between the Black Hills and the plains. Its central location made it a good place to sell supplies to the area's miners and homesteaders.

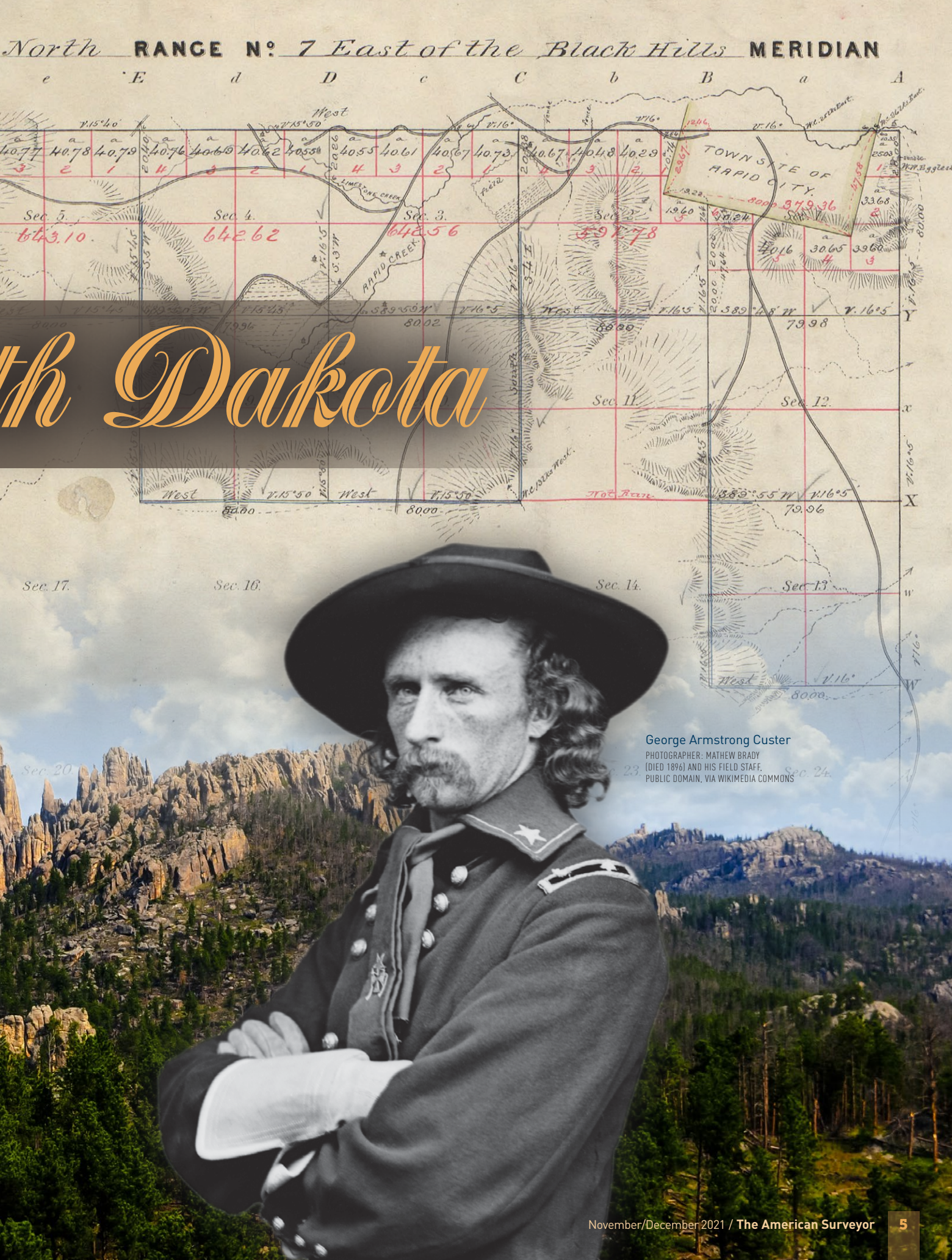
The city's prime location made it a convenient transportation hub. Initially for wagons and stagecoaches, the settlement became a waypoint for rail traffic following the completion of the Fremont, Elkhorn, and Missouri Valley Railroad in 1886. The city's founders advertised their community as the "Gateway to the Black Hills," a moniker still in use today as Rapid City is a destination for tourists drawn to the region's natural beauty.

» BUREAU OF LAND MANAGEMENT/ GENERAL LAND OFFICE



The Pinnacles, a rock formation at Custer State Park, South Dakota

th Dakota

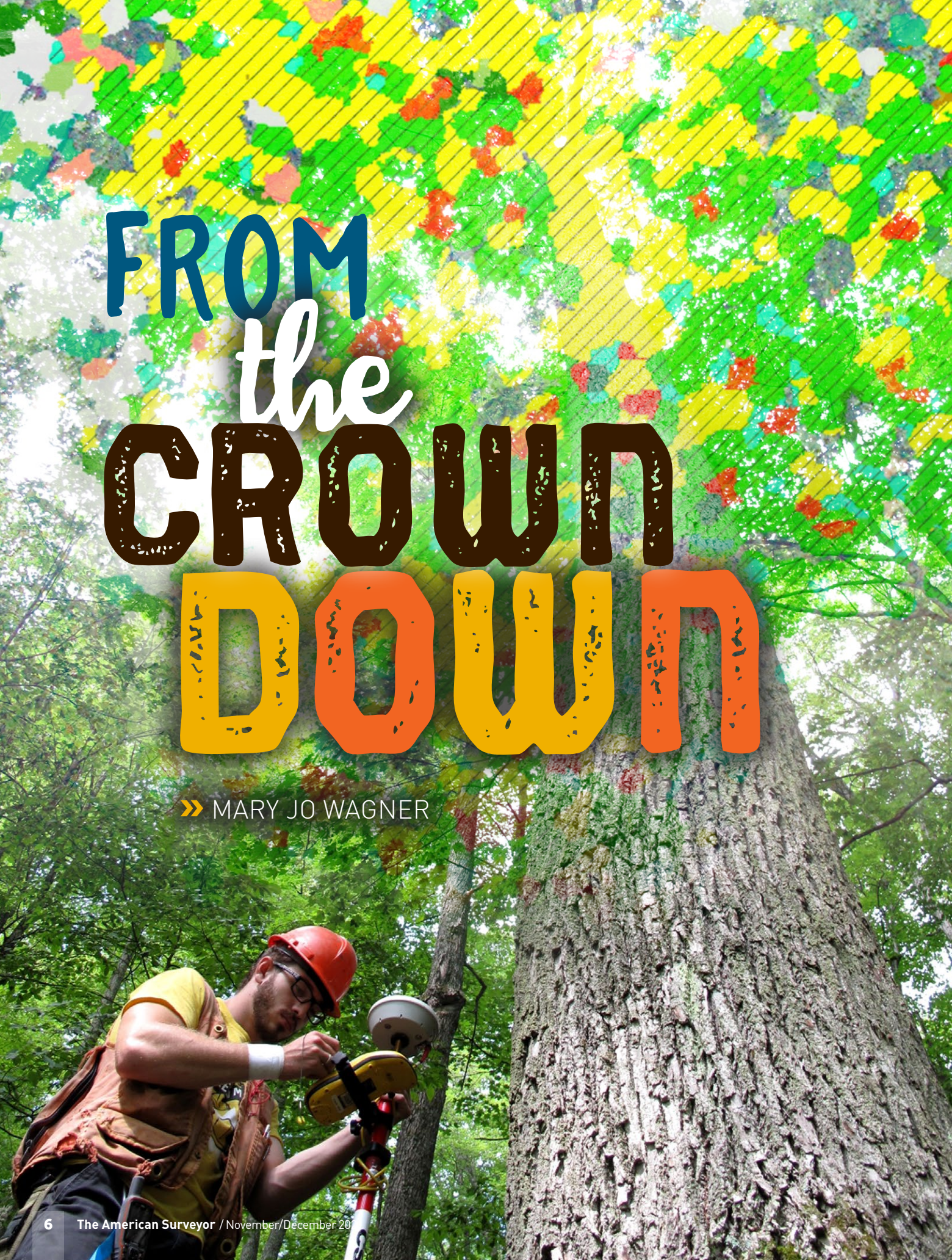


George Armstrong Custer

PHOTOGRAPHER: MATHEW BRADY (DIED 1896) AND HIS FIELD STAFF. PUBLIC DOMAIN, VIA WIKIMEDIA COMMONS

FROM the CROWN DOWN

» MARY JO WAGNER

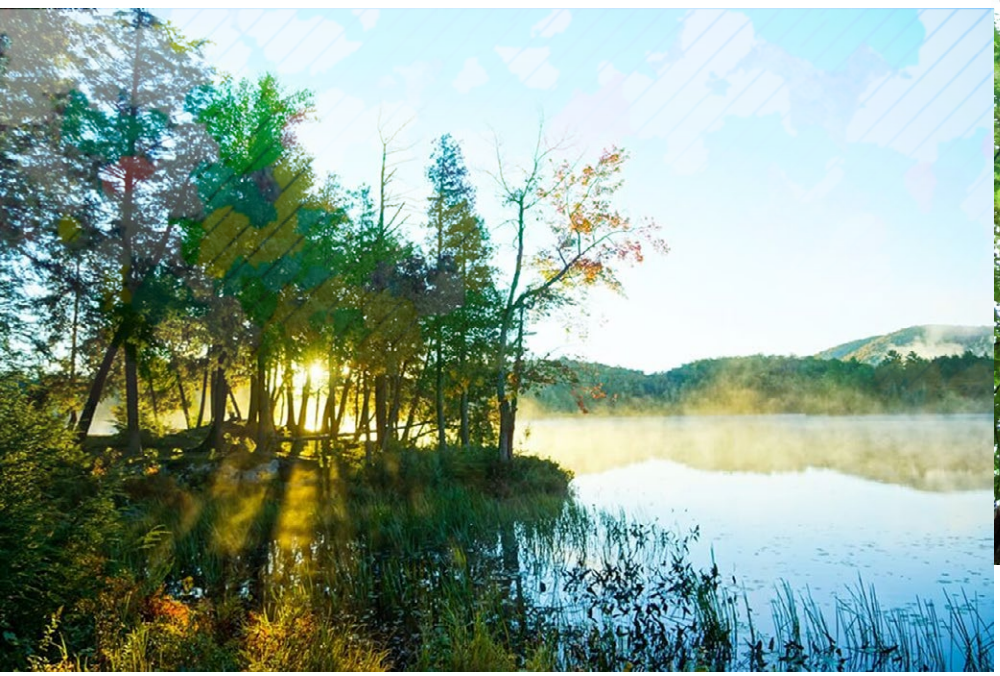


Trimble technology helps researchers get to the root of classifying individual trees

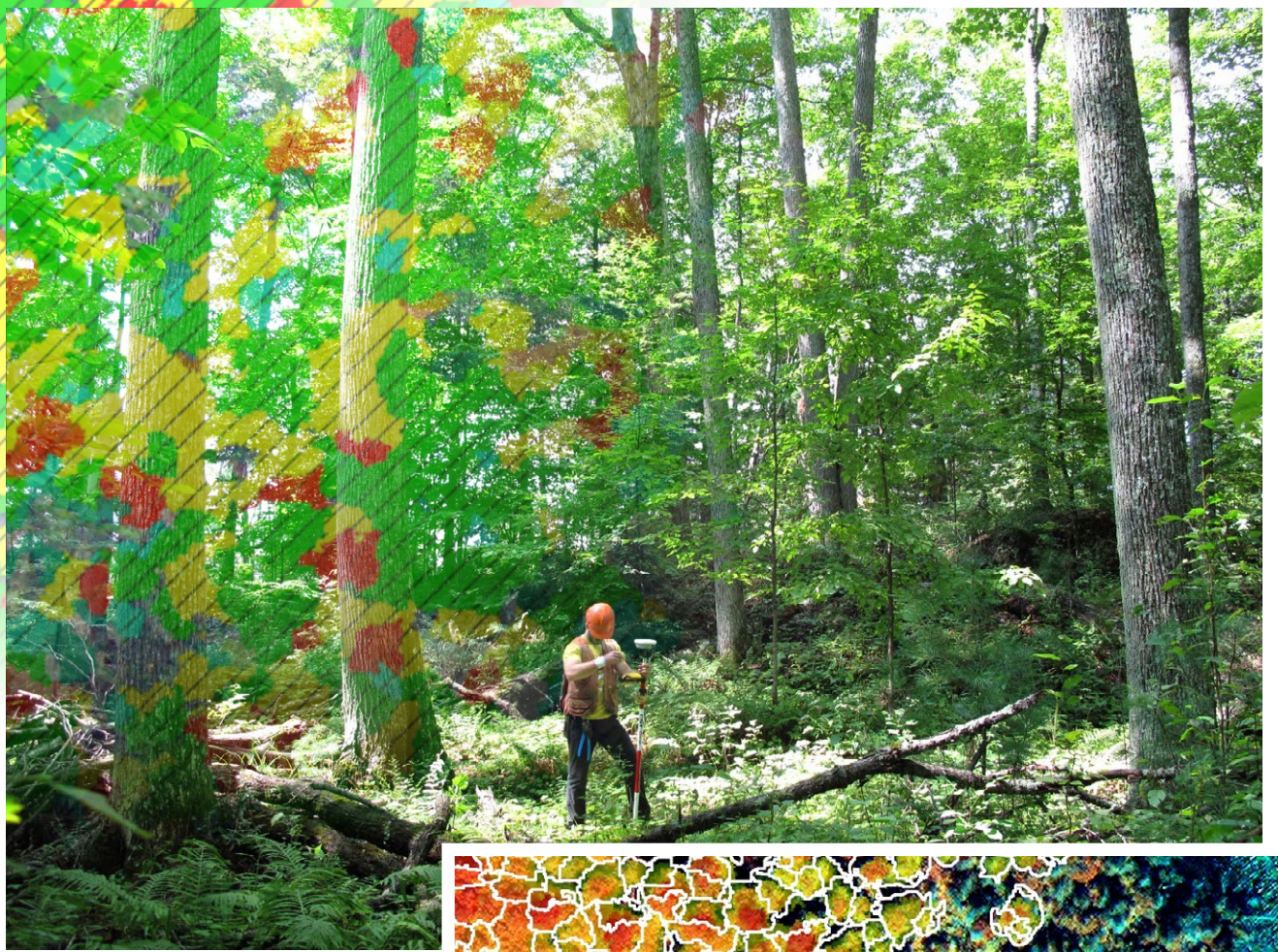
Forest management in the Canadian province of Quebec is serious business. With forest landscapes that cover an area twice the size of Sweden, Quebec's forest industry is valued at around $10 billion CAD ($7.8 billion US)—the second largest amount of any Canadian province—and employs about 65,000 people. Managing Quebec's forests is also serious business.

Although forest managers have used geospatial tools such as aerial photography, optical satellite imagery and GIS software to assess their properties, the process of classifying forest land and delineating forest stands, i.e., a contiguous group of trees that are sufficiently homogeneous in species, density and size, has typically been a laborious combination of photogrammetry and drawing features by hand.

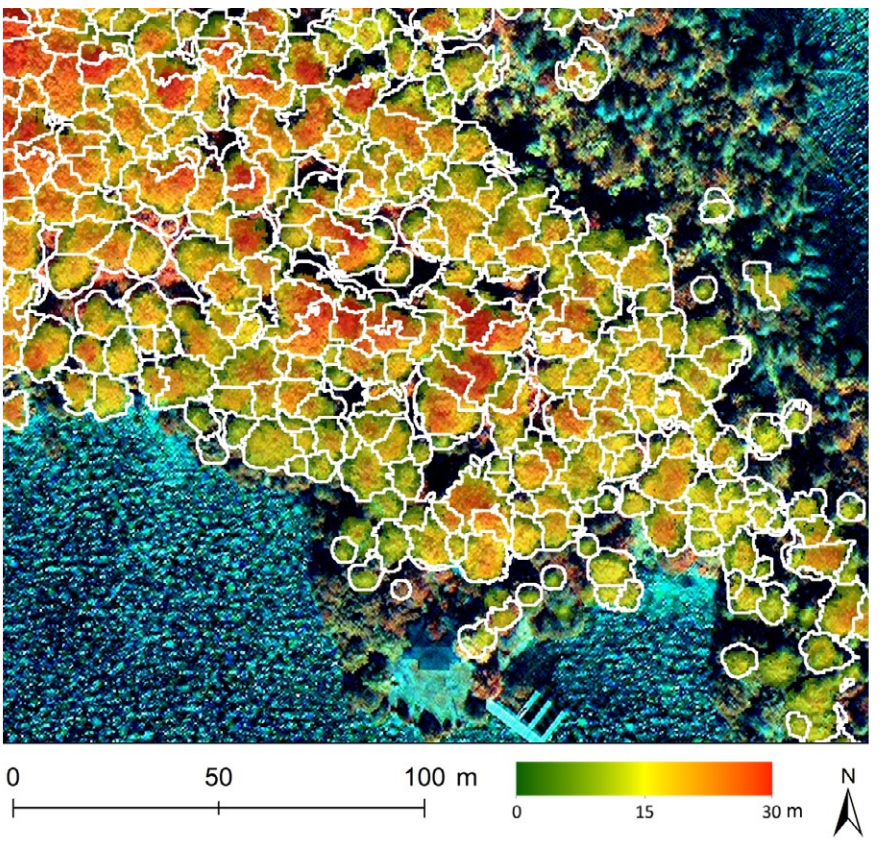
Looking skyward at a 31-m-high Yellow Birch.



The Kenauk Nature preserve is one of the largest private nature reserves in North America. Located in the southwest of Quebec, the property encompasses 26,000 ha (65,000 ac) of heterogenous forest.



Antoine Desrochers stands with his Trimble GPS receiver in a cluster of American Basswood trees.



Individual tree crown segmentation based on lidar (canopy height model) and WorldView-3 imagery. The background image displays WorldView-3 in true colors.

"Standard practice is to manually delineate forest species at the stand level, which is time consuming and subject to mis-interpretation," says Mathieu Varin, head of the Centre D'enseignement et de Recherche en Foresterie de Sainte-Foy (CERFO) remote sensing laboratory. "Automizing that process and scaling it down to classify individual trees would allow managers to individually oversee specific tree species and develop targeted silviculture and harvesting plans."

As an applied research center, Quebec City's CERFO has been a key supporter of the forestry business. Working with partners and forest managers, CERFO develops tools to help owners better manage, assess and inventory their present-day holdings in order to develop long-term operational strategies.

In his work at CERFO, Varin has spent considerable focus on using satellite

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imagery and object-oriented image analysis (OBIA) technology to build an automated forest classification and mapping solution that would target mapping trees at the individual tree level.

His recent research has centered on using very high-resolution satellite imagery, Lidar data, and Trimble's eCognition OBIA software to study the ability to automatically identify individual Broadleaf and Conifer trees in dense, complex forests—trees that are especially challenging to classify.

"Identifying and delineating Broadleaf trees are difficult because their branches are interlaced and the individual tree crowns are not always pure," says Varin. "It is particularly difficult to classify them in stands that contain trees of the same height and age. And in Broadleaf-dominant forests, Conifer trees like Balsam Fir are challenging because they are generally small and they'll be in the Broadleaf's shadow. However, the analytical intelligence of OBIA software makes classifying and mapping these tree types possible."

Based on the promising results, Varin may be cultivating a new path for efficient, targeted tree management.

Antoine Desrochers collects data on an American Basswood with his Trimble GeoXH 2005 GPS receiver.

Into the woods

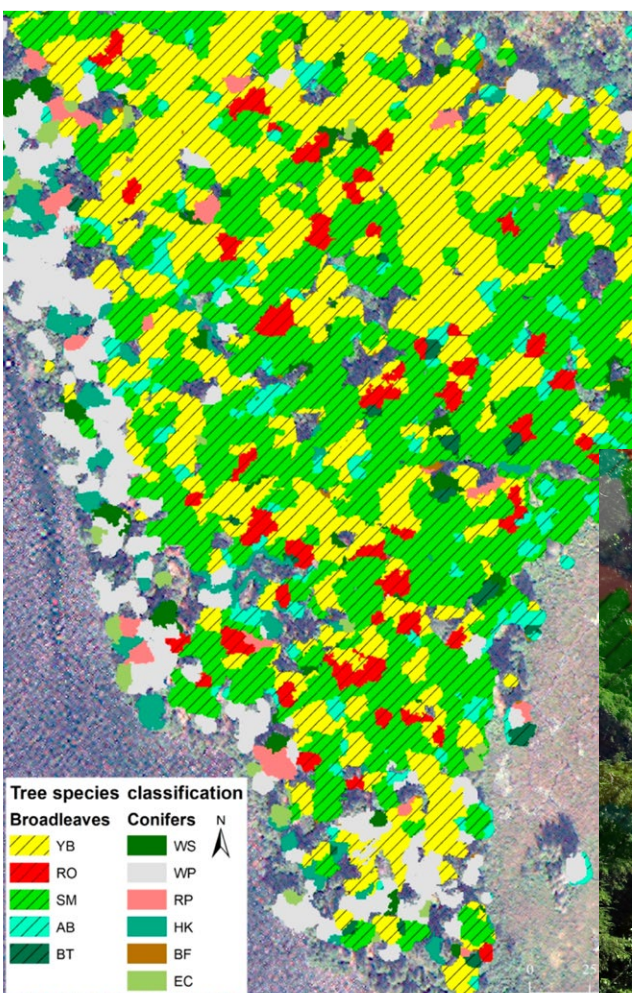
Varin and colleagues not only wanted to test the automated classification method on Broadleaf and Conifer species, they wanted to test it in a complex forest. They chose three areas of interest (AOI) totaling 26 square kilometers in the Kenauk Nature preserve, one of the largest private nature reserves in North America. Located in the southwest of Quebec, the property encompasses 26,000 ha (65,000 ac) of heterogenous forest.

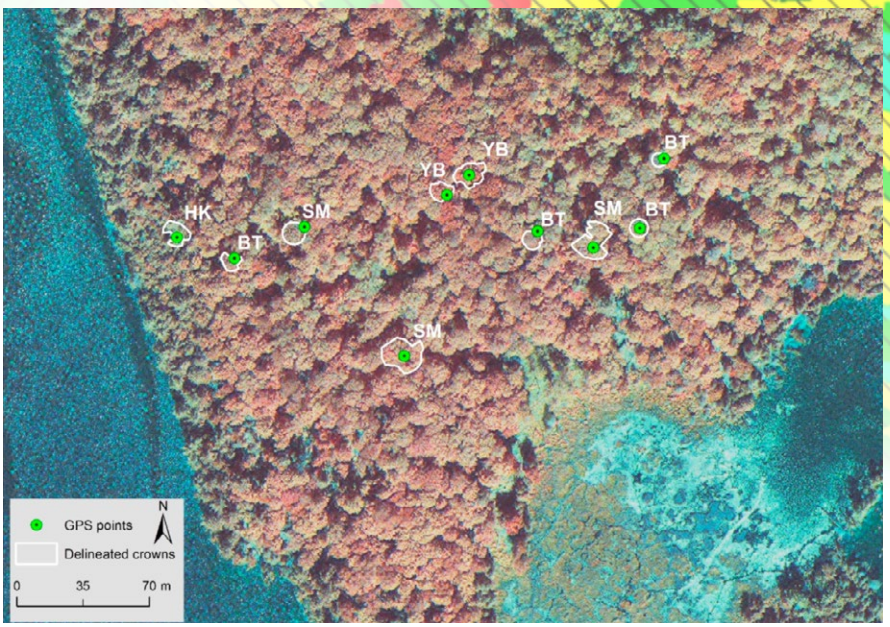
For the data analysis and classification they acquired two 30-cm WorldView-3 satellite images, orthorectified them with a 5-m Lidar DEM and then mosaicked them. The Lidar data was also used to create a canopy height model (CHM) which they overlaid on the mosaic.

Based on existing aerial imagery, researchers first identified relevant trees for field data collection. Using Trimble Pro 6H GPS receivers, teams navigated to the pre-selected trees in each AOI to capture their position, height, diameter and species type. In total, they surveyed 515 trees, which they further processed into 338 reference samples for both training eCognition and validating the results.

With the data sources prepared, Varin and his team were

In total, it took eCognition about two hours to classify 11 tree types including Red Oak, Sugar Maple, Balsam Fir, Eastern Hemlock and White Spruce.





Based on GPS positions, a team used photo interpretation to manually delineate tree crowns to fit the crown to the correct tree on the WorldView-3 images. The background image displays WorldView-3 in false colors (infrared, green and blue).

ready to test the eCognition classification workflow. Using advanced artificial intelligence and machine-learning algorithms, the software focused only on trees higher than 17 meters and used the WorldView mosaic and the CHM to first segment the whole AOI into individual tree crowns. From there it considered pre-defined object thresholds and textural indices to identify and delineate Broadleaf trees from Conifers, and then it targeted the individual species within those two groups. In about two hours, eCognition classified 11 tree types including Red Oak, Sugar Maple, Balsam Fir, Eastern Hemlock and White Spruce.

"The delineation process was surprisingly quick and precise," says Varin. "The overall accuracy for Conifers was 94 percent. That is very good considering the complex heterogeneity of the AOI."

The CERFO team shared the results with forest managers, many of whom can already see the potential value in having a tree-specific data layer in their GIS for developing targeted harvesting or planning. They also recognize the value of this OBIA-based approach as a viable enhancement to the traditional classifying and mapping methods using photogrammetry.

Supported by that positive feedback, Varin and colleagues are furthering their eCognition work to refine the approach and provide forest managers with new seeds of information for their management operations.

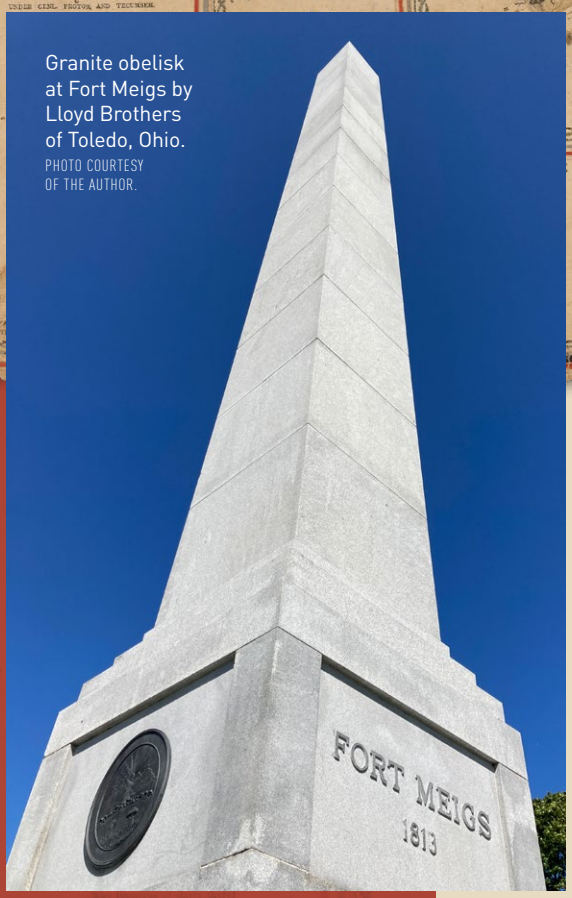
"A significant research and development advantage with eCognition is that it's incredibly teachable," says Varin. "Through this project we developed a workflow with which we can repeat the same process, or we can challenge the software to extract a whole new set of details that we haven't produced before. Because it absorbs various forms of data, strictly follows rules and adapts when the information or rules change, it really is an ideal student."

Such a learning environment could lead to exciting new branches of tree analysis for the serious business of forest management. ■

Mary Jo Wagner is a Vancouver-based freelance writer with 25 years experience in covering geospatial technology. She can be reached by phone at: +1 604 221 4583; or e-mail: mj_wagner@shaw.ca

Navigating along one of the 60 lakes that ring and cut through Kenauk Forest.

Surveying at FORT MEIGS



Granite obelisk at Fort Meigs by Lloyd Brothers of Toledo, Ohio.
PHOTO COURTESY OF THE AUTHOR.

The annual Rendezvous for the 2021 Surveyors Historical Society (SHS) was held in Perrysburg, Ohio between September 22-25. Not only is Perrysburg an iconic landmark in Northwest Ohio, but it is also home to Fort Meigs. Almost directly centered on the Twelve Mile Square Reservation (originally centered on Fort Miami across the river), the Fort played a major role in the War of 1812. Unfortunately, with that title comes loss as the fort also holds the remains of over eight hundred interred soldiers, only some of where the locations are known. With the combination of the SHS and our newly acquired Ground Penetrating Radar

» JOSEPH D. FENICLE, PS

Left: 1813 "Plan of Fort Meigs' and its environs..." by William Sebree.
COURTESY OF THE LIBRARY OF CONGRESS.

(GPR) Unit at the University of Akron Surveying & Mapping Program, the opportunity was taken to scan the grounds for unmarked graves while gaining some positive media attention at the same time.

The War of 1812 is often considered the second war of independence. The British were trying to restrict our trade and a young America was looking at expansion. The Native Americans were unsettled after the 1811 Battle of Tippecanoe and the Shawnee Chief Tecumseh joined with the British to prevent further territorial expansion. America went on the defensive and signed a declaration of war on June 18th and immediately attacked Canada. Soon thereafter British Sir Isaac Brock, Tecumseh, and his Natives, defeated and took control of Detroit—the then Territorial Capitol of Michigan. When battles continued South it was Fort Meigs who stood strong under multiple sieges and then the pivotal battle of Lake Erie as led by Commodore Oliver Hazard Perry turned the tides. Unfortunately, the White House was burnt before the Treaty of Ghent was signed ending the War. Those who attended the Rendezvous had the option to go to Put in Bay on South Bass Island and feel the spray of water and think about those critical moments in our history.

The original construction of Fort Meigs started in February of 1813 and was completed a couple of months later in April. The first major siege soon thereafter took a toll of almost 600 men but still ended in a victory. The second siege in July, of the same year, was more of tomfoolery by the Natives than a real battle. The mischief didn't work and of all things a thunderstorm drew the British and the Natives away. As the enemy retreated North the fort was torn down and rebuilt as a supply depot. After the end of the War the depot was then abandoned and then once again torn down. Similar to Fort Michilimackinac and Fort Mackinac farther North in Michigan, the forts were later completely rebuilt and today stand as living history museums.

In 1908 the 81 feet, 8-inch granite obelisk was constructed at a cost of $14,000 to memorialize, commemorate and preserve Fort Meigs forever. According to

The entrance to Fort Meigs in Perrysburg, Ohio.
PHOTO COURTESY OF THE AUTHOR.

One of many reconstructed blockhouses at Fort Meigs.
PHOTO COURTESY OF THE AUTHOR.

the literature for the dedication, the monument "…is symbolic of the patriotic spirit of the people of today and their deep and lasting love and gratitude for the hardy men of 1812-1813". Ironically, the monument was constructed by Lloyd Brothers, the same company who held the contract for the nearby granite Michigan/Ohio State Line boundary monuments. A 6.2-million-dollar renovation, started in 2000, reconstructed the forts blockhouses, constructed the 14,000 square foot Museum and Education Center and funded other much needed improvements. The fort employs five full time employees and is under the guidance of the Ohio History Connection. Even today though, the estimated 825 soldiers in various unmarked mass graves continue to be searched for—and on this September day GPR would be the search tool.

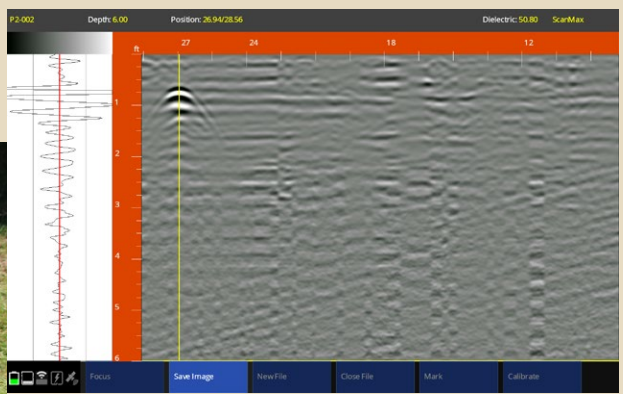
GPR is an amazing instrument, completely harmless and non-invasive. According to Geophysical Survey Systems Incorporated (GSSI), the technology "… works by sending a tiny pulse of energy into a material and recording the strength and the time required for the return of any reflected signal. A series of pulses over a single area make up what is called a scan." These are high frequency electromagnetic waves passing through the ground. I often explain GPR as "…a sophisticated and super expensive fish finder. But while a fish finder uses sonar (sound navigation and ranging based on acoustic waves), GPR uses radar (radio detection and ranging) …." The most challenging part of running a GPR scan is estimating the dielectric constant. The scale for dielectric ranges from 1 to 81 with 1 being the constant for air and 81 being the constant for water. GPR signals work very well in clean dry sand and very poorly in heavy wet clay. When I did my scan at Fort Meigs the ground was completely saturated in heavy clay and my dielectric constant was calibrated at 50.80 to get a decent scan, and even that was very shallow.

The results on the screen do not show up like they portray in Hollywood. You can't see the outline of a gun, or a skull, or bones on the screen. What you see is a hyperbola, an open curve with two branches. This hyperbola is the reflection off a material and is defined in the GPR world as an anomaly. Depending what you are searching for this anomaly might be an isolated object, linear object, or a void—all showing different results on the screen. The true talent of using GPR is being able to read the scans and interpret what lies beneath the surface. GPR has many applications beyond SUE and surveying. The most common application is scanning concrete with a fist sized 2600 MHz High Resolution Antenna. This is used for locating conduit, rebar, and post tension cables and only scans about 12 inches deep. The much larger 100 MHz Antenna would be pulled

behind a utility vehicle and can scan depths up to 100 feet in the right conditions. This unit would be best suited for geotechnical and environmental applications. The most average, most multi versed antenna fall in the 270—900 MHz range.

The Surveying & Mapping Program at UA wrote a requisition for a GPR unit in late 2020 to use in Boundary Surveying, Topographic Surveying (Subsurface Utility Engineering) and to collaborate with Civil Engineering and Geosciences. After researching various vendors, the choice of GSSI was a simple one. We chose the UtilityScan 350 MHz unit. This system works well for SUE as well as the search for stone survey monuments. The GPR technology itself has not changed that much since the 1980s but the associated controller component and software sure has.

The software, from GSSI, now gives you the ability to see the oscilloscope, gain and focus your scans, but most importantly



A screen shot of of the UtilityScan in the ScanMax Data Collection Mode showing the oscilloscope and the associated anomaly.

calibrate the dielectric with programming technology called Hyperbolic Shape Analysis or Migration. This has always been a guessing game with the various soil types and fill materials, but GSSI has made this feature one of the best I have ever seen. GSSI is the world leader in GPR technology, where they research, design, build and train in their award-winning facility in Nashua, NH. The training was a big selling point, as they play you through multiple scenarios for two days both in the classroom and in the field running and interpreting scans. By the end of the training, we met new friends around the Country and felt confident in our ability to run the equipment. We also left a few pounds heavier as they catered lunch to our liking.

The combination of the SHS and the GPR at Fort Meigs grabbed the local media's attention. It gave us an outlet to explain what the rendezvous was all about, explain what GPR does, but most importantly explain what land surveyors do every day. Although technically we don't look for unmarked graves every day, we do scan the subsurface for survey monuments and utilities. Tony Geftos from 13abc in Toledo was very interested in the technology and interviewed us multiple times throughout the day. He is a 2-time Emmy award winning journalist and has over seven thousand followers on his Tony Geftos TV Facebook Page helping to spread the word.

We are collaborating with the Ohio Department of Transportation and the State of Michigan for their remonumentation programs. We are building case studies to bring into the classroom to help educate and train our students, so they also feel comfortable using GPR equipment, consequently building up their resumes and making themselves more marketable.

Although the weather was picture perfect, the soil underneath was heavy and saturated. The GPR scans were mostly inconclusive, but the search for interred soldiers drew much needed, encouraging, media attention for the Rendezvous and the surveying profession in general. We will continue to build solid case studies of GPR technology and with any luck turn a strange looking hyperbola on the screen, an anomaly in the ground, into a "lost" survey section corner stone. A stone that has always been there, but now located and not calculated with modern technology and wrongly proportioned. As always, some of the best tools in our truck are the shovel, spud bar, and in rhythmical fashion, GPR. ■

A view of Fort Meigs including a reconstructed blockhouse and the granite obelisk.
PHOTO COURTESY OF THE AUTHOR.

Joseph D. Fenicle, PS is a Professor at the University of Akron for its award-winning Surveying/Mapping program. Immediately prior, he was the Chief Surveyor at the Office of the Fulton County Engineer in Wauseon, Ohio for 15 years. He also owns Angular By Nature, LLC, a company specializing in Continuing Education for Surveyors and Engineers. Joseph has a BS in Surveying/Mapping at UA, and is working on his PSM at the University of Maine. He obtained his FAA license in 2019.

BRIAN FISHER // PS

product review

JAVAD Triumph LS Plus and Triumph 3

You've come a long way… Survey! That's the first message you see when you turn on the screen of the Javad Triumph LS Plus, and boy are they not kidding. First a little history about me. I first purchased GPS equipment for myself and my burgeoning independent private land survey practice some twenty years ago. I wasn't rolling in the big profits just yet, so I wanted to get as much bang for the buck as I could. This meant two things. First, I was shopping the used market and second, I wanted the most versatile equipment I could afford from a company that had the best products. Enter into the story, my longtime friend John Bergeson, a local survey equipment vendor, now retired, but more on him later at the end of this article. The gear I got back then included two Ashtech Z-Survey receivers, one as a base the other as a rover.

As time went on, I added several receivers to my kit of equipment, but I stuck with the "blue" brand, and had a Z-Extreme and several Pro-Mark receivers in a few years. I was impressed then by all the innovations that Javad Ashjaee was doing, and his legacy truly lives on in the company's latest offering: the Triumph 3 (T-3) and Triumph LS Plus (T-LS+) base rover combo.

This is a powerhouse set of gear with some truly unique configurations. First it includes a fully integrated touchscreen on the T-LS+. I've been told that Javad always had an affinity for the innovations Steve Jobs brought to the world, and much like Apple's I-Phone, the touch screen on the T-LS+ lets you peer in through the window and see right into the heart of this equipment. Everything, quite literally, is at your fingers with this interface.

Even in a desert city like Phoenix AZ, there still can be a surprisingly large amount of trees and buildings to work around in the "urban canyons." Tracking multiple GNSS consolations really helps in those channeling spots with less than ideal sky visibility.

Like pretty much every manufacturer has done, the receiver, batteries and antenna are integrated in a single box on the top of the pole. What is different is the built-in data collector, right on the side. When I first spun this on my tried and true fixed two-meter rod I was initially skeptical because the screen was over my head, but after a fast rework of the rod to cut about a cubit (aka a foot and a half) I was off to the races with the screen right at eye level and easy to use. I've heard a lot of others talk about using collapsible rods and the full Javad kit comes with a very nice telescopic pole that is about this 5-foot length and very light weight. I guess I'm a bit old school, and if I'm hiking up a steep slope, my rover rod doubles as a walking stick, so I do tend to ask a lot of this equipment and prefer the heavier setup. As for the onboard screen, I ended up really liking it and think if I had to pick between an external device and this, I'd score the Javad higher.

Technical Specification

The Triumph LS Plus tracks all the GNSS constellations, GPS, GLONASS, Galileo and BeiDou. It tracks 874 channels combined with three powerful processors and program memory in a single chip which uses less power and makes the total system less expensive. It also has four "Super Engines" RTK that mix and match different combinations of these constellations in real time for simultaneous comparison. This is a great feature and gives the field operator that warm and fuzzy feeling right as the data are being collected. It offers some really powerful wireless options such as Bluetooth and WiFi while still functioning in a low power consumption/long battery life (25 hour). There is built in CoGo, feature coding, attribute tagging, voice recording and two cameras. The camera can even be used to calculate offset points photogrammetrically. There's even a downward pointing built in flashlight. These are just the highlights of what this receiver comes with.

The shot above is right between two houses and has more than half the sky blocked. I was impressed with how well the T-LS+ is able to work even in this challenging environment.

Above is a newly constructed "geometric geodetic control station." It differers from points of the past in a few ways because we observe them with different equipment. This new "bedrock" station has easy access, but is also off the beaten path for security. It also has a commanding view (read as radio coverage) of the landscape it provides control for.

A survey tied to the NSRS always benefits from a check shot on historic "benchmarks"

Unboxing, getting started and my first job

One of the first things that I interacted with when unboxing the receivers was to get all the software and profiles updated by Javad technical support. From me cutting the packing tape to being online with Matthew Sibole, PLS. from Javad's staff was very literally in just minutes. It took me longer to type in my own WiFi password than it did for Matt S. to log into my receivers and start working. I was very impressed with this feature, and while performing my field tests and review, I called back in several times for help. Every time proved seamlessly quick. Only caveat is this requires an internet connection. While I was at the home/office this was no problem. Out in the "field" this could be solved using a hotspot on a cell phone, but here in the wild west of Arizona, we still

View of a typical Sonoran desert job far from paved roads, cell coverage and human occupation. Great view of the BLM Saddle Mountain dispersed camping area in the distance.

have 80% of our land mass well outside cell coverage. The second of the two jobs I did with this equipment I was "off grid" so to speak, as I was well outside cell coverage. Driving a few miles back to the interstate for cell coverage still beats going all the way back to town to try to get help, however. The software is amazingly intuitive, so even though some questions came up, I pretty easily figured it out on my own.

I did look through the printed manual, and it is organized well, but honestly, Matt walked me through enough of the configuration to get me going in less than an hour (with part of that time being used to get a Bluetooth radio paired, so I probably shouldn't count that in the "training" time). I created a job, oriented my base location, started broadcasting and was tying in the block corners of a subdivision boundary (my house) right away. I coded the found evidence easily and even modified my code list right in the field to add a few codes that Matt didn't have. It was easy to add photographs to each point collected. When the boundary was done, I was just a few configuration clicks away from transitioning into topography collection. The T-LS+ has an interesting feature that automatically senses when the rod is held static and plumb and starts the shot. To end the shot, you just walk away and it knows you're moving and stores it automatically. Changing codes between shots is easily done with one click on the screen while holding the rod at an angle (so it doesn't start taking a shot). I easily grabbed a few hundred shots on all the site walls, fences, utilities and concrete work. I was pretty impressed also with my ability to get in and around trees and buildings. It's still intrinsically satellite surveying, so no going under a bridge to work, but I was pretty impressed with how far I was able to push the limit.

Finishing the job, post processing and reporting

The T-LS+ has a bunch of built-in software capability. I was able to edit codes, batch fix a rod height error I made on about a dozen shots in one command and delete a few erroneous topo shots where I forgot going "plumb" and "holding still" starts the shot! I remember calling that kind of rookie mistake a "beer leg," meaning you set the tripod leg up on-line for taping (chaining) off a point. Maybe we need to rebrand the saying and call it a "beer point" when you accidentally take a topo shot. Exporting all the data was a simple process as well. In just a few keystrokes you can fully transfer your job to archive and export out just about every useful file format you can think of: text csv; drawing dwg; google kml; a full point by point PDF report that includes all the shot statistics, screen captures of the collection screen; photos, codes and notes. This can be done to a USB drive or to the "cloud" using Google Drive (internet connection depending).

Stakeout and searching for calculated positions

The T-LS+ has internal tilt/compass sensors so the screen knows what way you're facing. A very handy feature when staking out a point is the screen (like a mini virtual dashboard) points you in the correct direction to face the point you're looking for. It has all the other normal information: azimuth, distance, delta north and east; a map with the point and you on it, etc., but this moving arrow in the screen pointing in the correct direction is very intuitive and easy to use. There is also an additional accessory called the J-Tip that basically puts a magnetic locator at the bottom of your rod. One less item to carry when hunting for ferrous boundary corners is always a plus.

Geo-referencing and real-world position

At the beginning of the job I had started on an "unknown" autonomous point. Not really as I already had an OPUS derived position from another time, but I held that back for blind comparison. The Triumph 3 base can be configured to log static data (and also has the capacity to perform static during RTK collecting as an additional check if you configure it to do so, but that could be an article in and of itself). Javad has a web service called DPOS

that allows you to upload static files right from the T-LS+ using an internet connection in as little as an hour after you finish the job. Javad processes the file (again a process worthy of its own article to unpack everything) and on the user side it comes back as a "CORS" tied position. It's just a few clicks to reprocess all the raw observed vectors and voila, your job is fully georeferenced to the National Spatial Reference System! I independently checked this in two ways. First against a previous OPUS observation and second by using the Javad JPS2RIN software to convert the base file into an OPUS consumable static RINEX file. Everything checked within several millimeters as one would expect.

Overall impressions

I'm super impressed. When I first saw the screen on the side of the receiver I said, "who moved my cheese," if you're familiar with that book about change and resistance to it. After using the T-LS+ for a couple jobs, I loved it. I found that the "top heaviness" you might anticipate really isn't an issue. For control and boundary mark measuring, I usually have a rod with some sort of bracing (bipod or tripod) and that evened out the weight very well. For Topo, the five-foot rod balanced just below the receiver, and I was able to walk easily with it slanted near horizontal. Back in the early days of satellite surveying, not losing an initialization (view and "lock" on the sky) was nothing short of an art form. The T-LS+ gains initialization so quickly and holds lock so well, this is really a thing of the past and procedures where you try not to lose lock are probably going to go by the wayside just like constellation visibility planning did once there was a full constellation. How long ago was that, fifteen or more years now? I actually can't remember. Technical support dialing right into my screen and even being able to hit the buttons was unmatched by anything I've seen on other brands of gear. Lifetime firmware and software updates is also a plus. Most importantly though, I got up and running right away. Within an hour I was surveying and that same day I had confidence in my data and delivered the job. Bottom line, I can't beat that.

So, back to the story of my friend John Bergeson. John's been in the industry in one form or another since 1969. Officially he retired in 2008, but he's still enjoying the golden year and gets out to rockhound and recover the odd survey mark. A bunch of years ago John asked me if I could name a survey mark after him. I agreed, but you know how one thing leads to another and time gets away from you, so it never seemed to happen. I've come to realize that if you don't sit down with a specific intention to get something done, it just never will happen. When Allen Cheves came to me with the idea to review this equipment, we were brainstorming ideas on how to put a human side to a technical review. The idea popped into my head to incorporate my first and now most recent experience with equipment inspired by Javad Ashjaee. That's where the survey mark for John came in too. John sold me my first Ashtech, with financing terms that were, well, unheard of in the industry. I learned early on that people that bend the rules and push the envelope, to write their own script to the part they play, are the ones you want to associate with most of the time. It was a well-received idea for us in the Arizona Professional Land Surveyors (APLS) association to nominate John Bergison to be an "Honorary Member" for life. Gifting him a survey mark named after him is just a small token of thanks that we all have for his years of dedication.

This mark was constructed by the Arizona Professional Land Surveyors to honor lifelong surveying advocate John Bergeson (left) and presented by Brian Fisher (right). We thank him for his decades of dedication and hope that this mark will serve as an enduring reminder of his excellence in service. Thanks also to Surv-Kap in Tucson AZ for creating a great looking brass cap!

As part of this equipment test I used the T-LS+ and the T-3 to observe static data and accessory objects (swing ties) for references to the control station. You can see John's mark by searching the NGS database for PID BBHN29. Using Javad DPOS is a very efficient way to reference your data and using NGS OPUS-Share is the next logical step to archiving your control data for further public benefit. To quote the NGS, "Your data helps maintain local ties to the National Spatial Reference System (NSRS). Your shared solutions will also help your community prepare for the NSRS modernization." More information is on the NGS website: geodesy.noaa.gov/OPUS/about.jsp#FAQ. ■

Brian Fisher is a professional land surveyor in Arizona. He is also the volunteer Arizona State Geodetic Coordinator for the National Geodetic Survey.

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DRONE TECHNOLOGY

Makes Sustainable Construction Possible

The construction industry is preparing for a significant increase in investment with the passage of President Biden's historic infrastructure bill. With $110 billion set aside for roads, bridges, and other major infrastructure projects, contractors and surveyors will no doubt be in high demand to manage a range of civil developments across the country.

Even though the current administration is determined to fund these critical projects, they simultaneously have their sights set on tackling the climate crisis. In fact, the President has explicitly stated that the investment in new roads and bridges will focus on "climate change mitigation, resilience, equity, and safety" for all. He's even set a new target for the United States to achieve a 50-52 percent reduction in net greenhouse gas pollution from 2005 levels by 2030.

These two goals may, at first glance, seem at odds. For example, reports have shown that building materials and construction account for approximately 11% of global greenhouse gas emissions. Further, almost all construction activities require the use of diesel equipment, which is known to cause adverse effects on the surrounding environment.

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However, we simply can't afford to abandon these new developments at the risk of hindering long-term environmental goals. Especially in rural areas, building bridges and roads in the immediate future will be essential to improving the safety of communities as many still rely on very limited roads to transport basic resources and emergency supplies.

So, how can we ensure that this increase in construction doesn't move us farther away from our climate goals? We can start by implementing sustainable practices on every worksite and using new technologies as the cornerstone of this transition.

Tech to the Surveyor's Rescue

Contractors today are highly open to how tech can play a key role in their projects. In recent years, drones, and drone surveying tech specifically, have been instrumental in streamlining large-scale developments—deployed during the pre-planning and estimating phases, as well as used throughout the project.

Although the industry has primarily relied on tools like theodolites to manually conduct land surveys, this method is tedious and can take weeks to complete for large-scale construction projects. And even after initial data collection is complete, it can take teams weeks to aggregate and process this information before they can start the building process.

> "Drones can launch from almost anywhere, meaning that the surrounding environment is not disrupted unnecessarily."

Alternatively, drone surveying provides a certain level of efficiency and accuracy that is not always possible when using traditional surveying methods, and this efficiency naturally lends itself to expedited project timelines and less wasteful, more sustainable worksites.

In terms of mechanics, drone surveying typically entails using aerial drones with downward-facing sensors to capture images of the worksite from different angles. Each image is tagged with corresponding coordinates, so surveyors have a quick point of reference for the duration of the project. Drones also can capture up to thousands of topographical survey points on a large worksite, equipping contractors with comprehensive data sets to expedite the planning process.

In addition to fast-tracking the actual surveying timeline, using drones to collect and aggregate site information means that this data can be quickly shared with and easily accessed by the entire site planning team.

Efficiency Drives Sustainability

While developers are already saving time and money with the latest surveying technologies, they can use this tech to effectively reduce their project's impact on the environment and preserve surrounding resources.

Minimizing the Impact on Unspoiled Environments

Traditional surveying processes require construction teams to not only cut sight lines, but also make room for larger surveying crews and additional equipment. Alternatively, drones can launch from almost anywhere, meaning that the surrounding environment is not disrupted unnecessarily.

In turn, contractors can reduce their project's impact on trees, plants, and other wildlife, and effectively comply with land use regulations. This kind of precision has not always been easy or possible when moving large amounts of earth, but drone surveying has paved the way for preserving unspoiled environments without overburdening individual crew members.

Reducing Rework

When work is done incorrectly on construction sites—whether it be a result of miscommunication, changing regulations, or other factors—firms must push out project timelines and allocate even more money and resources to rework. In fact, studies have found that more than 30% of construction work on an average project is likely related to rework, compromising efficiency, wasting resources, and increasing costs.

With the use of drone technology, field engineers can track job progress and monitor for these inconsistencies much more efficiently. This allows them to catch problems early on, reduce overall rework, and conserve materials and fuel burn.

Tracking job progress is traditionally a labor-intensive endeavor, with contractors having to conduct manual walks around the worksite to catalogue progress in physical logs or individual devices that may not allow for easy sharing with project stakeholders. Because drone data is designed to be shared widely, communication among teams can be streamlined. Research shows that miscommunication and poor project data account for 48% of all rework on US construction sites, and both of these issues can be mitigated with the use of drone technology.

> “Contractors can use drone data to efficiently dispatch heavy machinery on the worksite.”

Reducing Fuel Burn

Diesel use and fuel burn from construction equipment can have a significant impact on the environment, increasing greenhouse gas emissions and potentially polluting the surrounding area. For example, an excavator burns up to four gallons of diesel an hour on average, while scrapers can burn up to 16 gallons per hour. Not to mention fuel costs are typically the second highest expense on worksites, only after wages. Further, even just one bulldozer can produce as much particulate matter as more than 500 cars.

To minimize the environmental impact from fuel burn, contractors can use drone data to efficiently dispatch heavy machinery on the worksite. Because drones can accurately measure different zones for a project during the planning process, contractors are able to prevent earthmoving equipment from making unnecessary trips across the worksite or from sitting idle with engines running for too long. This way, firms can lower carbon emissions and simultaneously reduce overall fuel costs.

Identifying Potential Hazards

In the same vein of streamlining workflows and boosting efficiency, drones can enhance worksite safety by identifying risks and hazards even before the team’s first day on the job. By integrating this step into the pre-planning process, crews can come fully prepared to work around these hazards and prevent projects from being delayed down the road.

Locating potential hazards, like underground utilities, not only ensures the safety of individual employees during the construction stage, but also helps eliminate any rework, reduce wasteful fuel burn, and preserve much-needed materials.

The Future is Bright

It’s no secret that even more progress can be made toward improving sustainability in the construction sector, but the good news is that new technologies are available that can have a significant impact when it comes to preserving resources, eliminating environmental impacts, and improving efficiency. Deploying drones and drone surveying technology is just one of the many ways in which contractors can work toward aligning their development projects with environmental goals, as well as play a key role in protecting the planet. The time is now to implement these technologies, and the industry is just getting started. ■

Rory San Miguel is the Sydney-based CEO and co-founder of Propeller Aero, which provides cloud-based data visualization and analytics to worksites. Every day, thousands of professionals in mining, aggregates, waste management, and construction operations worldwide rely on Propeller to capture, analyze, and share accurate data about their worksites and assets.

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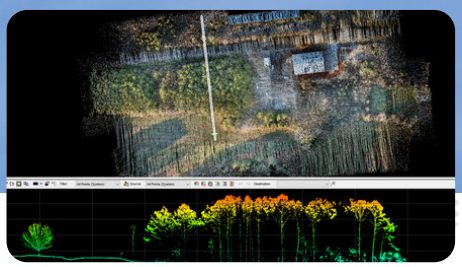
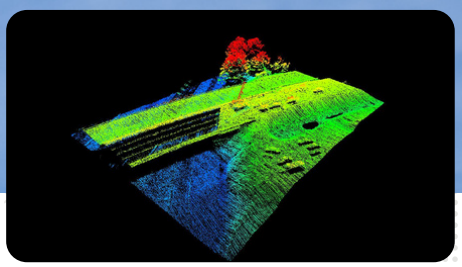
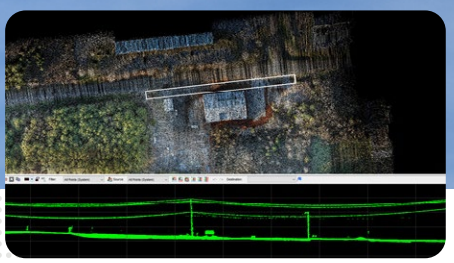

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Between Progress & Preservation

» NICK KLENSKE

With Trimble Catalyst, Cooper says surveying out in the field, such as at Australia's Lake Tyrell, is really easy.

From farm fields to subdivisions, cultural heritage sites tend to turn up in the most unexpected of places. And when they do, these artifacts can bring development and construction to a screeching halt.

Helping balance the sometimes-competing needs of developing the future and preserving the past are archaeologists like those with Cooper Heritage Management.

"If a planned road or building project could put Aboriginal cultural heritage at risk, they call us," says Abby Cooper, a director, principal heritage advisor and historian at Cooper Heritage Management.

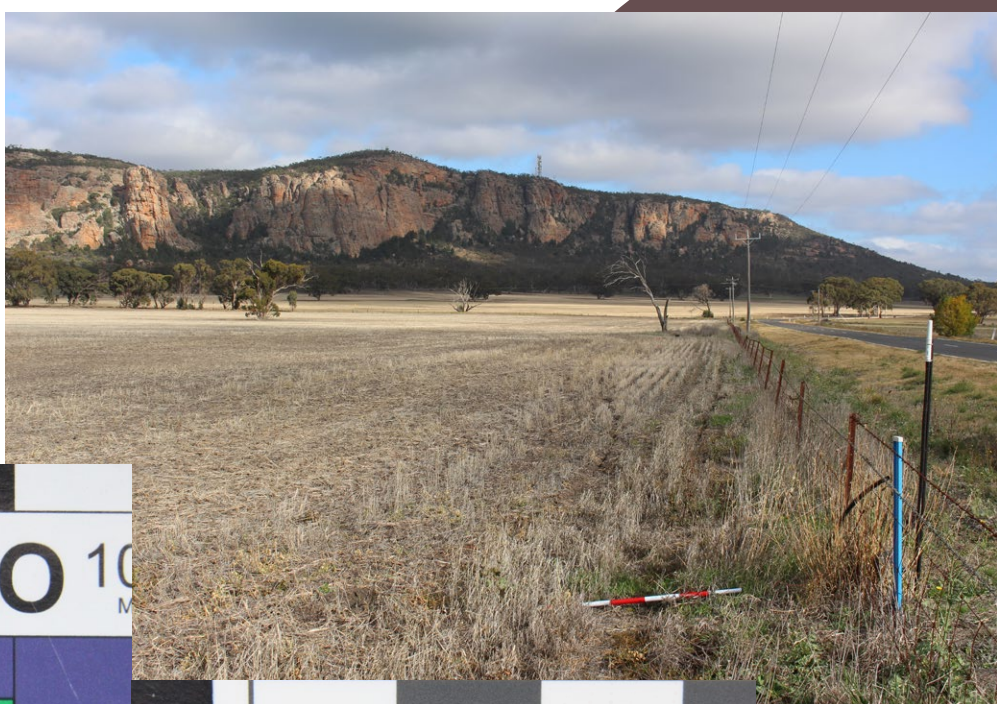
An archaeological management consultancy company based in Western Victoria, Australia, Cooper Heritage Management specializes in Aboriginal cultural heritage. This includes preserving such tangible assets as scarred trees (a tree that has had its bark removed to make, for example, a canoe, shield, or dish), stone artifacts, and quarry and meeting sites, along with such intangibles as songs, dances and stories.

The company tends to work for local and state governments, private developers, extraction companies, and Aboriginal traditional owner groups. A typical project involves ensuring that a new development complies with the Victorian Aboriginal Heritage Act and Regulations. "Our job isn't to stop a development," explains Cooper. "We want to ensure that a project can move forward in a way that maintains the integrity of the cultural heritage."

For this, she depends on Trimble Catalyst.

Flexible for the Field

Trimble Catalyst is a subscription-based GNSS solution offering precise (1—2 cm) positioning for the location-enabled workforce. With Catalyst, Trimble delivers professional-grade positioning as an



Surveying near Australia's Mount Arapiles.

An example of a stone artifact recovered from an excavation site.

Stone artifacts such as this one can bring development and construction to a screeching halt.

Cooper Heritage Management specializes in Aboriginal cultural heritage, including preserving such tangible assets as scarred trees.

The Cooper Heritage Management team working in the field.

Cultural heritage sites tend to turn up in the most unexpected of places, including here, where artifacts indicate human occupation as early as 32,000 cal BP.

on-demand, easy-to-use service. It's simple, lightweight, plug-and-play USB antenna—with a simplified set-up when compared to more traditional hardware receivers—makes it convenient for the in-the-field work that Cooper Heritage Management does.

For Cooper, one of the key benefits of Catalyst is that it is quick and easy to use. Before going out on a job, she simply uploads the project area and any previously registered Aboriginal sites onto the Trimble Connect collaboration platform, and syncs the data to Trimble TerraFlex, Trimble's GIS data collection software.

"Out in the field it's really easy," she says. "I just connect up to Catalyst via the Trimble Mobile Manager app on my phone and attach the Catalyst DA antenna to either a 2-meter rover rod or Trimble backpack, depending on the terrain I'm working in."

Prior to using Catalyst, Cooper did much of her field work using Trimble's Juno handheld system. But once she had the opportunity to try Catalyst, there was simply no turning back. "I was immediately drawn to the color graphics and its simplicity, especially how it lets you upload an entire activity area directly," she adds.

Catalyst also provides Cooper with the right amount of accuracy. "While the Victorian archaeological standards require 1 meter accuracy, for most jobs I use the 2-cm level," says Cooper.

However, some jobs don't require such precise accuracy. For example, when working under a dense tree canopy, Cooper tends to use decimeter accuracy as this allows her to conduct the survey faster, which saves money.

"I like the flexibility that Catalyst offers, giving one the option to have centimeter-,

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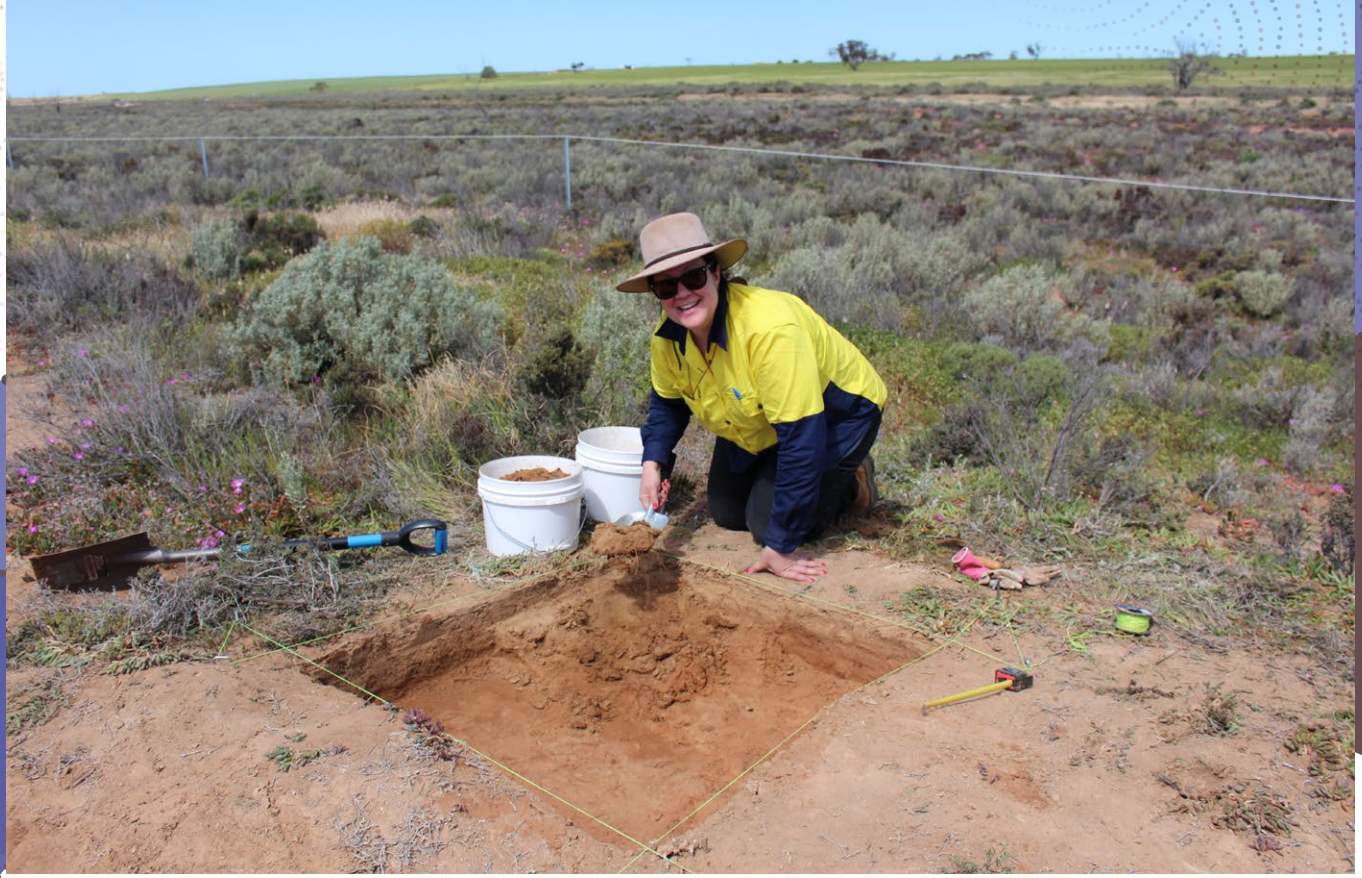

Cooper in the field, excavating a site in Western Victoria, Australia.

decimeter-, or meter-level accuracy depending on need," says Cooper. "This is a great feature."

An Accuracy for Archeology

Cooper recently used Catalyst to record a stone hut, part of a World Heritage Site, made from basalt lava that dates back 6,600 years. The remnants, which are laid out in a C shape, were recorded at 1- and 2-cm level accuracy.

"Using Catalyst, my phone, and a rover rod, I could go around and record the inner and outer circumference, which gave us a very good indication of the shape and size of the hut," explains Cooper. "Without Catalyst, we wouldn't have had the accuracy needed to do this."

The company is currently working with a local council on a tourism trail that will run along a local river. Using Catalyst, the Cooper Heritage Management team has recorded 16 scarred trees, one shell midden—a heap predominantly composed of Mollusk shells—and an artefact scatter, a place that holds material remains of past Aboriginal people's activities. At the time of writing, the team was heading into the field to undertake excavations to determine whether any sub-surface artefact or shell midden deposits exist along the river.

"Its 1-to-2-cm accuracy makes Catalyst particularly ideal for recording these types of in-situ archaeological deposits," adds Cooper.

No Need to Reinvent the Wheel

Prior to using Catalyst, these types of projects would require Cooper to record every site on an individual recording form. "These forms could range anywhere from three to five pages in length," she says. "When you're in the field for days or even weeks on end and finding many sites, this can quickly add up to a lot of paperwork to carry around and keep track of."

To save time on projects like these, Cooper created different templates within TerraFlex that she can use with specific site types, such as scarred trees, artefact scatters and shell middens. This allows her to easily record all the relevant elements for a given site and enter the data directly into Catalyst—no paperwork needed. The feature also allows her to attach photos to the data, which helps with identifying sites when collating data.

"Being able to tailor how we use Catalyst to our needs allows us to streamline the entire operation—and even go completely paperless," says Cooper. "We don't need to have multiple maps in the field or shuffle through papers, everything is there on one device."

Develop the Future, Preserve the Past

According to Cooper, although development is essential to society, it's equally as important to take steps to preserve our past—our cultural heritage. After all, this heritage is what forms our identity as individuals, as communities, and as nations. By giving us a glimpse into where we come from and who we are, it also helps us learn from the past and shape our future.

"Catalyst makes striking this balance between progress and preservation so easy I don't understand why every archeology company isn't using it," notes Cooper.

Thanks to its ease-of-use, the right amount of accuracy and ability to customize, Catalyst gives Cooper Heritage Management a distinct competitive advantage—one they continually use to protect Australia's rich cultural heritage for generations to come. ■

Nick Klenske, based in Chicago, USA, is a freelance writer and editor specializing in science, technology and innovation.

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feedback

John Brown, Abolitionist and Surveyor

Mr. Cheves:

You ask, who knew John Brown was also a surveyor? Well, I did.

John Brown, Surveyor and Abolitionist is buried in my hometown, Lake Placid, New York, at a New York State Historic Site.

John Brown arrived in Lake Placid in or about 1846 to help a wealthy abolitionist, Gerrit Smith, give away 120,000 acres to freed slaves to qualify them for voting rights, in a place called Timbuctoo.

John was executed in December 1859 following the Bloody Kansas Campaign and the raid on Happers' Ferry.

I have a novel by Truman Nelson entitled " The Surveyor" published by Doubleday & Company, Inc. in 1960 and the jacket portrays a saber, a rifle and a transit, but the text says little of his surveys

Not that the USC&GS knew, but there is a triangulation station bearing John's name at the 244 acre farm, position Latitude 44-15-08.88 (N) Longitude 073-58-16.43 (W) which we and others have occupied many times.

Thank you for asking and the trip down memory lane.

Daniel E. Marvin, LS
President, New York State Association of Professional Land Surveyors

Got some feedback?

Contact us via *www.amerisurv.com,* or send a letter to: The American Surveyor, 7820-B Wormans Mill Road, #236 Frederick, MD 21701. We reserve the right to edit letters for clarity and length.


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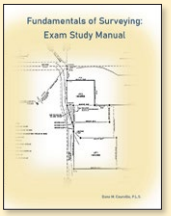

The contents are outlined in a concise and organized manner for use as a quick reference guide and for a solid understanding of common surveying subjects.

The topics included were selected based on the current NCEES Fundamentals of Surveying (FS) exam specifications and recommended knowledge.

The study manual is 125 pages of texts, diagrams, and examples breaking down, simplifying, and explaining each subject.

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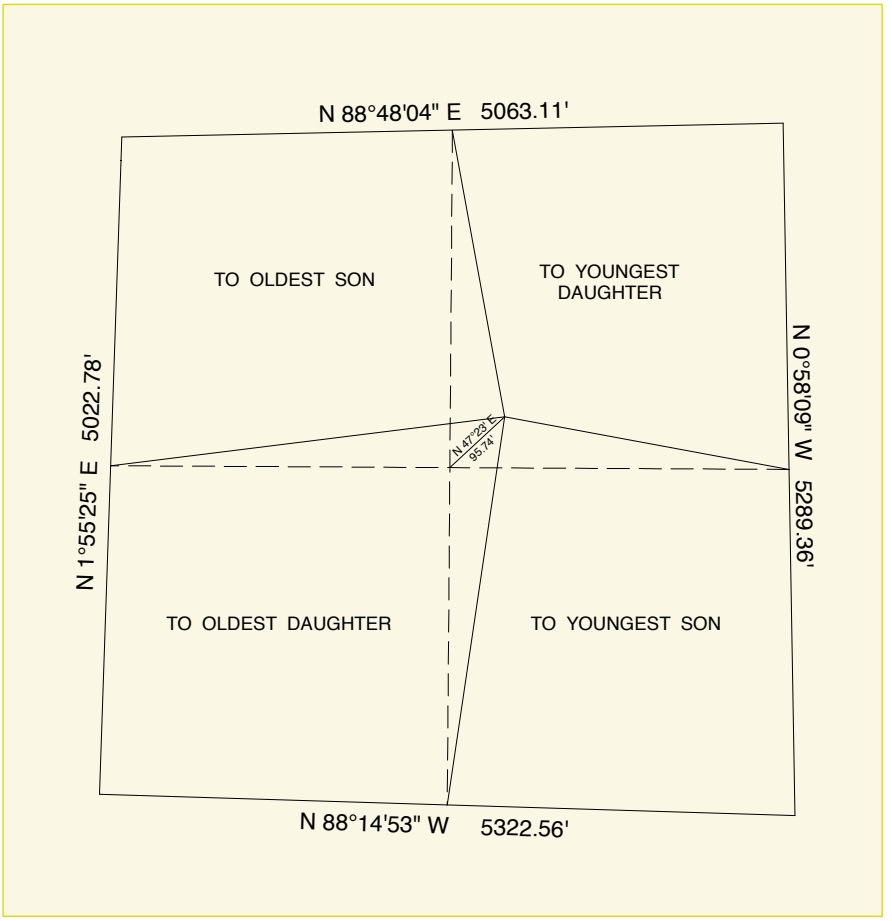
test yourself

Heirs2ya

In the wacky section shown all the original corners and quarter corners were recovered, and the quarter corners were on line and halfway between section corners. The owner bequethed the oldest son the NW 1/4, the youngest son the SE 1/4, the oldest daughter the SW 1/4, and the youngest daughter the NE 1/4. A local surveyor pointed out that an original center of section was set and found to be North 47°23' East 95.74' from the intersection of the lines joining the opposite quarter corners. How much more or less land will the two sons get using the found original center of section instead of dividing by joining opposite quarter corners? (The other 13 children were left out of the will). ■

For the solution to this problem (and much more), please visit our website at: *www.amerisurv.com*. Good luck!

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*.



Lathrop, *continued from page 40*

county provide ample notice to subsequent purchasers? If a deed states four times that it is conveying only ten acres, but repeats a description of 150 acres from the deed into the grantor, what is really transferred? What actions are sufficient to show actual possession, and how does peaceable possession differ from adverse use of someone else's property?

Title insurance proved useless. One of the title companies insuring the State's interests in three properties defended the State for two years before making the business decision to pay the policy limits on all of them to end its responsibilities. Another did the same for the one parcel it insured. The third, insuring the last three parcels for the State, also insured Phoenix's competing title to all seven lots.

If this sounds convoluted, it is. But the case provides a good series of illustrations of the importance of understanding both title and surveying principles and how they work together. It also illustrates how hard it is to educate the court about deeds, title, and surveys. The lower court's reasoning and decisions are hand-wringingly frustrating.

Thankfully, the Superior Court found that Phoenix's actions clearly violated public policy, barring it from any remedy in New Jersey's Chancery court, where land cases are tried in equity rather than in a court of law. Chancery is where this case began as a quiet title action initiated by Phoenix. Appeals and reversal resulted in the present 175-page opinion, which examines when equity is appropriate and when it isn't.

"…Phoenix researched the State's titles, ignored its recorded deeds and surreptitiously acquired hostile interests from the heirs of long-dead record owners for its own purpose of undermining the State's title…" (page 98) Claiming an attempt to return land to the tax rolls was not the moral high ground here.

While not officially published, the case is available online. The full name of the case is *Phoenix Pinelands Corporation v. Harry Davidoff et als*—the list of defendants is about three pages long—issued by the New Jersey Superior Court Appellate Division on April 29, 2021. ■

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.

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Stealing State Land

We already know there are circumstances under which it is possible to adversely possess lands claimed by a governmental entity. That can happen when the land is not used for a governmental purpose but instead as private property (see *Siejack v. Mayor and City Council of Baltimore* for just one example). Is that the first step toward just outright stealing state land? A sand and gravel company in southern New Jersey almost got away with it.

In April 2021, the New Jersey Superior Court foiled appropriation of over 250 acres from the Pinelands National Reserve after the Phoenix Pinelands Corporation (Phoenix hereafter) spent over $1 million on its "nefarious actions" (the Court's branding) as a "title raider." Phoenix owned adjoining land for its quarrying operations and wanted to expand. But rather than approach the State to try to buy its land in this ecologically rare and environmentally sensitive area, Phoenix undertook a "surreptitious two-decade-long quest to undermine and cloud the State's title" to seven parcels, establishing its own competing chains of title on which it based its subsequent actions.

It is true that title in this area is difficult to track and trace, partly because the county in which it is situated has changed after a new municipality was divided off from it, and partly because in this remote and sparsely developed area of Little Egg Harbor Township there are many absentee owners and few living on the land to exercise vigilance over their boundaries. Additionally, many municipalities in the Pinelands area didn't have tax maps until far into the twentieth century; Little Egg Harbor had its first tax map in 1959.

But Phoenix had hired a team of searchers, genealogists, and lawyers to track down possible heirs of ancient owners (tracing title from origin forward, rather than from the present back through time, to avoid State claims, and admittedly making some mistakes along the way) and purchased quit-claims of possible fractional interests. With those deeds in hand, Phoenix approached the Township's assessor, requesting the tax map to be redrawn to consolidate the seven lots in question with other lands Phoenix did own, to be assessed to Phoenix (except for one tract for which it could gain no remote color of title, which it asked to have assessed to Phoenix's president).

The Township—glad to classify the land as taxable again—complied, erasing the boundaries of the State-owned parcels while still collecting Payments in Lieu of Taxes from the State of New Jersey at the same time it collected taxes from Phoenix. Neither the assessor nor Phoenix notified the State of changes to the tax maps or to the tax assessment rolls. Instead, New Jersey found out about them from a local resident who wrote to the State because Phoenix's expansion of a waterway triggered his own investigation into Phoenix's actions that possibly affected his own private rights.

At trial, the State's witnesses included a number of retired employees who had worked on the transactions 25 to 30 years before and could not offer more than general information about the State's process of land acquisition, which includes title searches, appraisals, and surveys. But there was ample past and current expertise on the stand for the State. A surveyor pointed out discrepancies between deed calls and coordinates in Phoenix's deeds. A title expert noted that tax mapping errors created one lot that was really part of a State-owned parcel—to which Phoenix's expert agreed.

Other questions arose. Could foreclosure on a tax sale certificate issued by an adjoining municipality convey title in Little Egg Harbor? Does recording a deed in the wrong

continued on page 38

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