the American Surveyor

JUNE 2020

MAPPING DEEP TIME

Retracing Nevada
A jackpot in Henderson

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Ancient survey records

Data Rich Orthophotography
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Pin Cushion Corners

I recently saw a social media post showing an image of an emerging pin cushion. It's a "two of a kind working on a full house" scenario. So barely a pin cushion on the old Jeff-Luc-ometer. Of course, everyone has their own opinion based on a single photograph as to which pin is better. The debate and camaraderie were thought-provoking, so I broke editorial code and chipped in my two cents. The underlying question is what binds us to calling any particular object evidence? I like to think I rely on evidence that will lead to facts supporting the original grant. Thus, I need an authoritative basis for accepting evidence. All of you old dogs know this. I'm willing to assume that you understand because you were mentored. Our profession is working if our folks can say they earned this wisdom through mentoring rather than hard knocks. The mentoring process is designed to pass second-hand knowledge so that we don't have to reinvent the wheel or take any lumps to the forehead. The artful craft of sorting evidence is learned through experience. Retracing and substantiating the authoritative grant should keep us from stabbing that pincushion like a worn-out voodoo doll and lead us to the real egg in the basket. There may be a path to cleaning up the other fiddle sticks but we're gonna have put on the mommy/daddy pants and be willing to communicate with the owners and lawn archers. Can we measure, document and remove foul markers under the authority a boundary agreement? If you think so, then would you be willing to yank your foul corners under the terms of a boundary agreement? Sounds counterintuitive to remove marks but the end result is a single point of notice under a documented agreement. I'd need to see some really strong "before, during, and after" documentation of this rigid and abrupt event. There could very well be some conveyancing involved too. At some point we have to fess up to the cause and relieve our profession of this nuisance. How about implementing a standard of care that requires any newly set monument to be accompanied by a certified mailing of notice to all impacted parties? If you fear it will jack up the price of your survey, then use what's already there and save your client a few bucks. If you fear that you'll lose billable time from not replacing corners, then you're probably not charging enough in the first place. I have come to believe that the reason we see these shenanigans is two-fold. Number one we're not digging around enough and number two the offensive surveyor is not required to face the folks we're impacting. There's no such thing as a secret survey so why don't we feel the need to engage the common owners when the lawn darts start piling up? I boil it down to this. Laying out a new subdivision is a mechanical exercise done under a single authority. Johnny Ironpusher can play all the games he wants out in the barren plains of a brand-new subdivision. The developer hired his outfit by the hour to mark it as they see it. Heck, the courts even give them a free pass if they mess up on that first shot. On the other hand, the courts have set a higher bar for the retracement surveyor. This function constructs authoritative evidence of multiple grants independently marked in time. So, back to my questions. Can we offer a legally sound process to pull the lawn darts? Do you possess the professional skills to engage the people you are impacting? ■

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JASON E. FOOSE, PS

decided guidance: case examinations

Practical Repose

This month we are grazing on several cases united by the theme of practical location. We have a few caveats right up front. First and foremost, cherry picking case citations is a dangerous game for a surveyor. There is more to every case than just a drive by quote. It helps to understand the whole body of evidence before we go hanging our drawers out on the laundry line. Secondly the actual decisions in these cases may contradict the valuable points made by the examining justices. Courts frequently detail the concepts that support or refute an argument. Respectively good practical suggestions become apparent regardless of the decision. We also can gain a better understanding of standards by looking at these discussions. As I see it, a boundary decision as a unique blend of evidence, actions and standards with the latter theoretically being the most consistent. So if you're looking for a golden goose egg to set your iron just remember that the duck billed platypus is also oviparous.

As retracement surveyors we are the students of Practical Location. We see this phenomenon routinely. Let's eliminate a few concepts that may not support a practical location. For starters laziness, tightwaddery, and impatience are not necessarily the basis for a practical location. If a legal description is capable of being retraced it should be regardless of an owner's ignorance or no pun intended desire to cut corners. The Courts have repeatedly expressed that owners are bound to the original grant. The term "acquiescence" should not be tossed around like a nerfball either. It is a matter of law and means a whole lot more to the lawyer folk than it does the rope stretchers. We've seen various cases where acquiescence was supported without both parties knowing it. We've seen at least one case where it had been stipulated then usurped by a subsequent adverse possession claim. It's worth saying that the terms "practical location" and "acquiescence" are not always synonymous. There's a foundation that realizes a property

There's little doubt these boundary lines were fixed in years 1878, 1879 & 1880 as stamped on fascia of these Victorian bastions. The stable behavior over the last century and a half of ownership is the active evidence of the original survey marks.

PHOTO COURTESY OF JOEL D. FOOSE

Based on the cost and effort of installing miles of rock fence posts it's reasonable to consider that the Kansas pioneers set these with extra care and attention to the survey marks.

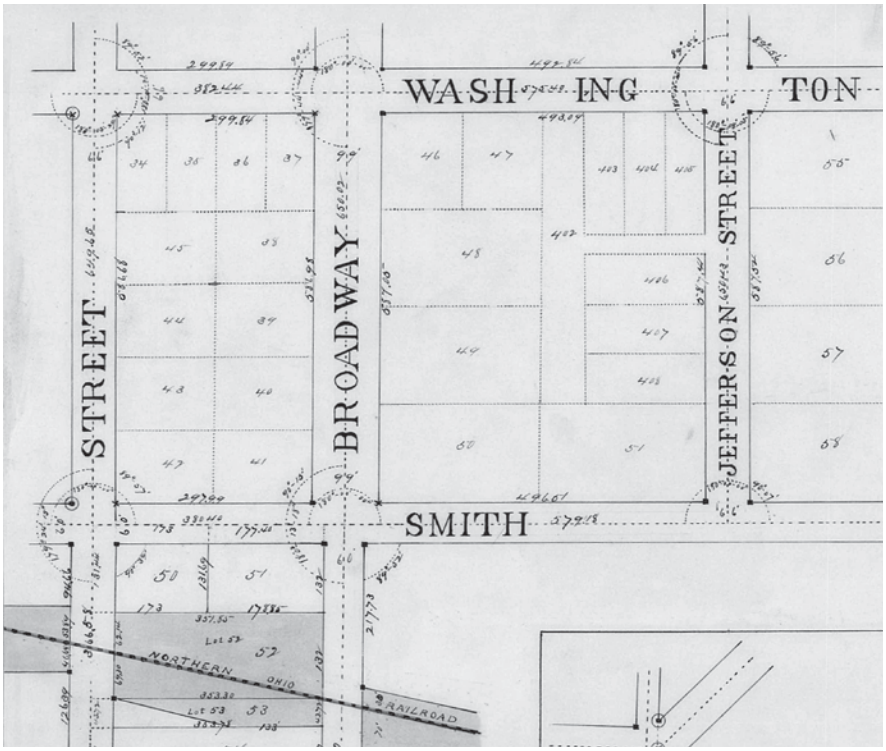
PHOTO USED WITH PERMISSION OF JERRY PENRY

transfer under the doctrine of acquiescence. It requires the law to sort out the details. Conversely what we routinely see are the ground marks that folks have accepted as being consistent with the original grants. Loose conformance with precise numbers is normal and repose toward those existing marks is a doctrine in itself. So, where does this doctrine of repose come from and why do we practice it in retracement surveying?

We're going to start with Chief Justice Cooley in Michigan circa the 1870s. He was compelled to write *The Quasi-judicial Functions of the Land Surveyor.* We all know it and abide by it, for the most part, but how did Chief Justice Cooley get there? We're going to peek at *Diehl v. Zanger* 39 Mich. 601 (Michigan Supreme Court) decided October 31, 1878 and work or way back and forth. We see Cooley make some familiar statements in Diehl but draw our attention to *Stewart v. Carleton* 31 Mich. 270 (Michigan Supreme Court) which was decided shortly prior in January 1875. An interesting highlight from Stewart is "*The law recognizes (surveyors) as useful assistants in doing the mechanical work of measurement and calculation, and it also allows such credit to their judgment as belongs to any experience which may give it value in cases where better means of information do not exist. But the determination of facts belongs exclusively to courts and juries.*" Diehl bridges the gap between the PLSS and the Colonial land systems with references to the precedent New York cases of *Baldwin v. Brown* 16 N.Y. 359 (N.Y. 1857) and *Reed v. Farr*, 35 N.Y. 113 (NY 1866). The Reed Court wrote "*Baldwin v. Brown (16 N.Y., 359) is not unlike this case, and quite decisive of it. It was there held that practical location and long acquiescence in a boundary line are conclusive, not upon the notion that they are evidence of a parol agreement establishing the line, but because they are themselves proof that the location is correct, of so controlling a nature as to preclude evidence to the contrary.*" In Baldwin Justice Selden touched on some familiar concepts. "*...It is undoubtedly a general rule that, where the lands conveyed are described by courses and distances, and also by reference to natural objects or fixed and permanent monuments, if there is a discrepancy between the two, the former description must yield to the latter. The reason is, that mistakes are deemed more likely to occur with respect to courses and distances than in regard to objects which are visible and permanent. This, however, is by no means an inflexible rule...It is obvious, too, that the reason for relying upon monuments, in preference to courses and distances, applies with much greater force to such as are natural and permanent than to those which are artificial, especially where the latter were erected as the result of a survey by courses and distances.*" Both of these cases refer back to *Jackson v. Dysling* (2 Caines id., 198) and Baldwin specifically references Adams v. Rockwell (16 Wend., 285). Adams begins with "*There was no evidence in this case of a deliberate settlement of the erroneous line by express agreement, founded upon a bona fide attempt to ascertain the true boundaries by actual survey according to the courses and distances of the older deed: both parties having derived their title from the same source.*" We see two things here. One, if it can be surveyed, it should be surveyed. Two, there's a call for the common grantor which is typical for courts to establish in boundary disputes. A principle is stated by the Chancellor in this case. "*...and as the true line had been actually run and marked upon the land long previous to that time, there is no principle of law or justice which can take from Adams the land which actually belongs to him under his deed, and gave it to those who never owned it, and lost nothing by his mistake as to the true line.*" I might be telling tales out of school, but it sounds like the Chancellor is saying the Court shouldn't alter the integrity of an original grant and survey just to settle a dispute of location. I see a parallel logic limiting our role to retracing the best evidence of the original grant. It seems fitting that some conveyancing would accompany this scenario.

> "...not because it passes title, but because it determines the location where the estate of each is supposed to exist...."

Okay, going back to Michigan and Cooley we return to *Diehl v. Zanger* and find a reference to *Smith v. Hamilton* 20 Mich. 433 Michigan Supreme Court (May 1870).



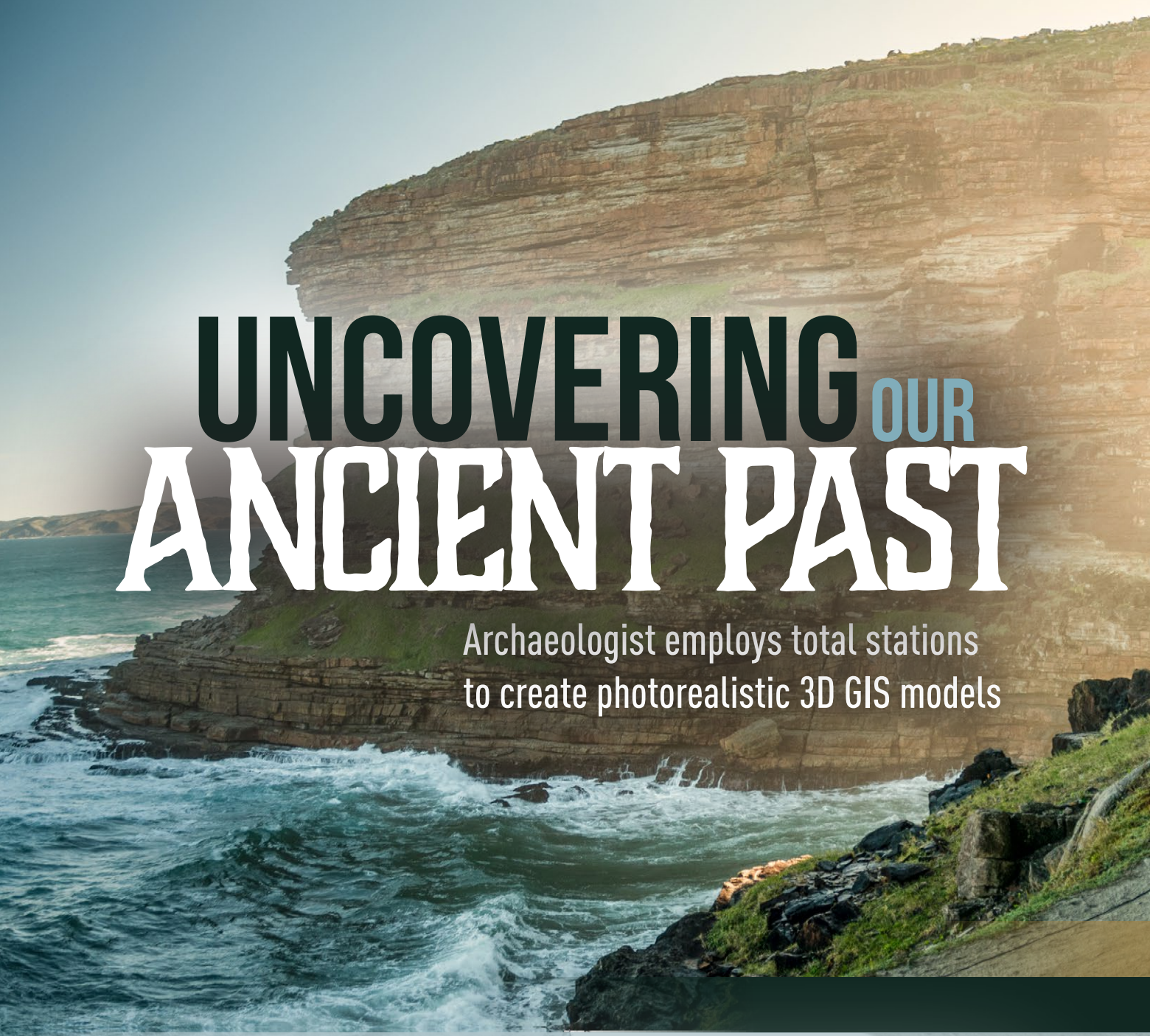
Beginning in 1879 the owners of lots 34-37 have unassumingly perpetuated boundary evidence through the preservation of those conjoined structures. The street view photo reveals the owners' interpretation and mutual partitioning of this original plat.

This is an estoppel case that catapults us back to New York and Terry *v. Chandler*, 16 N.Y. 354, 346-54 (N.Y. 1857). Terry speaks for itself "…*The validity and legal force of parol agreements and submissions to settle disputed boundary lines was long resisted upon the ground that, in effect, they passed the title to real property without the solemnities required by the statute. The courts however held, upon very substantial reasons, that such agreements and submissions did not affect the title. If they were confined to the sole object of ascertaining the true line of separation, they gave effect to the title which the parties to such agreements really had and left the statute of frauds in full force. Neither their purpose nor their effect was to pass real property from one person to another, but simply to ascertain the line to which their respective lands extended. The boundary of A. was also that of B., which was often undefined, obscure and uncertain; and when the agreement proposed and resulted in nothing more than to establish and mark where that boundary was, the provisions of the statute of frauds were not invaded. It was never thought that the judgments of the courts in actions of ejectment, where the subject was a question of boundary, divested the title of one person, and vested it in another; and yet the parol agreement, the submission, and the award under it, effect the same identical object and perform the same office as the judgment of a competent court. Both ascertain, by the means at their command, where the true line is, and establish it for all future time. In Jackson v. Dysling (2 Caines, 198), Mr. Justice Spencer says: " An agreement by parol to a settlement of a boundary line appears to be effectual, and not liable to any objection on the score of the statute of frauds and perjuries;"…* ". Once again, we see a foundation in *Jackson v. Dysling*. Coincidentally in the April and July 2019 installments of *Decided Guidance* we reviewed the 1937 Illinois case of *Kandlik v. Hudek*. Guess what case shows up in the special concurrence from Justice Stone? Spoiler alert, it's *Jackson v. Dysling*. *"The rule recognized in this State since the very early case of Crowell v. Maughs, 2 Gil. 419, is there stated as follows: "It is a familiar doctrine of law, that title to real estate cannot be transferred by parol. * * * It is settled, however, that proprietors of adjoining tracts of land may, by a parol agreement, settle a disputed boundary line between them. Such an adjustment of the boundary, if followed by corresponding possession, may be binding on the parties, not because it passes title, but because it determines the location where the estate of each is supposed to exist. — Jackson v. Dysling, 2 Caines, 198; Kip v. Norton, 12 Wend. 127."*

We're seeing that many roads point back to *Jackson v. Dysling*. This is a good crossroad to stop and ponder from. I'll leave you in New York with Stevens v. Webb 576 decided in 1886. We'll need to do some homework to fully understand the context of these citations. Give it a google and see what you come up with.

"The doctrine underlying the term "practical location" has been discussed in a great number of cases...It was first announced in November, 1803, in the case of Jackson v. Bowen (1 Caines 358), by Judge Thompson...A year later (November, 1804), in the case of Jackson v. Dysling (2 Caines, 198), Judge Spencer made an application of the doctrine, introducing the new idea of a parol agreement. He Said:"... An agreement by parol to the settlement of a line appears to me effectual, and not liable to any objection on the Score of the Statute of Frauds and Perjuries...". In February 1809, the Supreme Court, in the case of Jackson v. Ogden (4 Johns 140), indicated the conditions under which the doctrine might be applicable, showing that it was not confined to cases of doubtful or disputed boundary. Says Judge SPENCER: "...In November, 1810, Chancellor (then Judge) KENT recognized the doctrine, applying it in a case of doubtful and disputed boundary, but the only doubt arising from a contradiction between a map and a survey, both of which were referred to in the patent and deeds, the source of title; and it is the learned Chancellor who then introduces the phrase, "practical location"...Judge KENT says: "And when the question of location was thus rendered ambiguous and uncertain by the contradictions between the map and the survey (and both were referred to in the patent and early deeds), a PRACTICAL LOCATION and construction given by the parties, and acquiesced in through a series of transfers and for a great number of years, until the lands had become cultivated and had grown into value, cannot but operate with great if not with decisive force." ■

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.



UNCOVERING OUR ANCIENT PAST

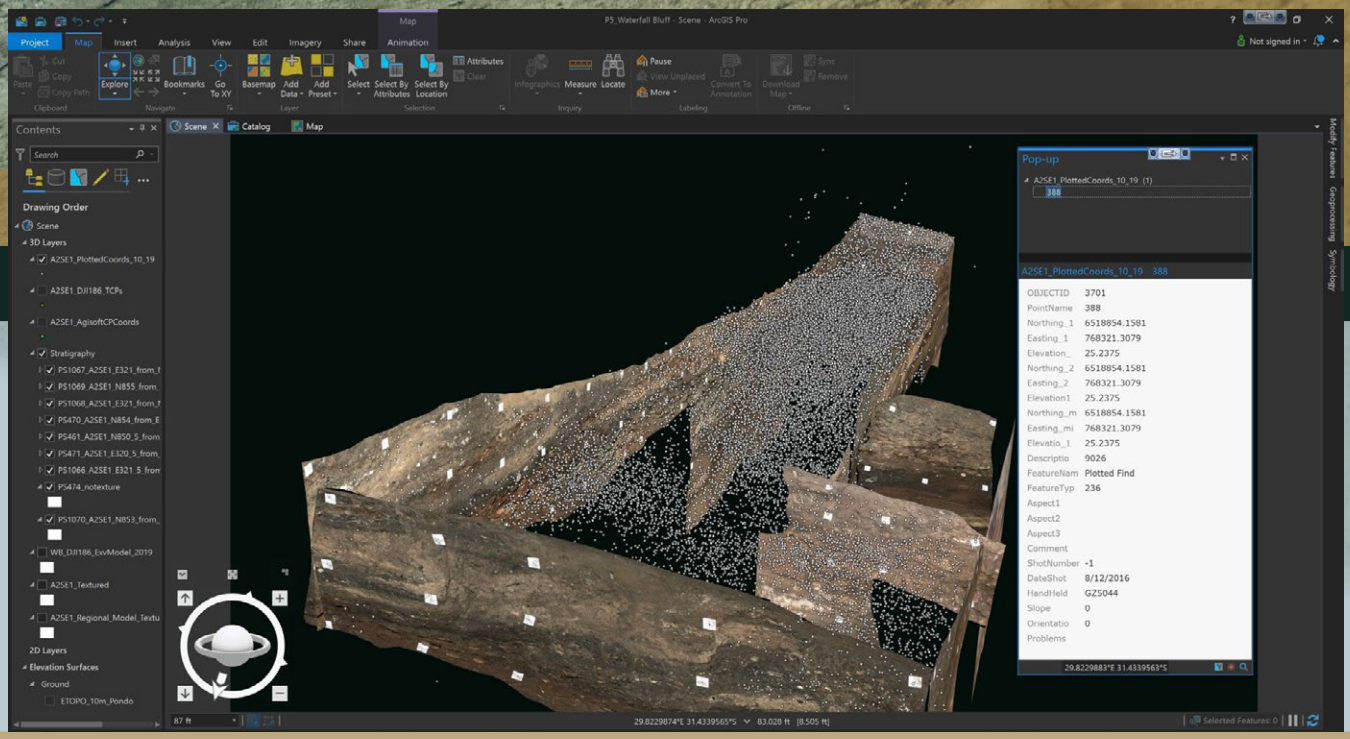
Archaeologist employs total stations to create photorealistic 3D GIS models

Part of being human is to grapple with big questions such as who am I and where did I come from? In the hollow of the day… that quiet time away from the chatter, ringing phones, daily demands, and obligations, the human mind can roam freely into a reflective state.

For some who like to know, to understand, and to reflect, the study of archaeology can satisfy the basic human need to know where we came from, and understand our own human nature. For them, the discipline of archaeology has two of the greatest advantages. For them, the discipline of archaeology is uniquely suited for these pursuits. Archaeology is the study of past people through the objects and places that they made and influenced. These artifacts and places are tangible windows into how our ancestors behaved in the past long eons after thoughts and memories have faded.

» JEFF WINKE

Excavations by the P5 Project at Waterfall Bluff rock shelter with the Mlambomkulu waterfall in the distance.



The Waterfall Bluff 3D GIS showing the 1 mm pixel resolution georectified photomosaics that line the main excavation area where every white dot represents a single artifact—piece of bone, stone, or other material—left from human occupations. The spatial patterns of these finds tell archaeologists how humans used the site in the past and how site use changed through time.

Above: Aerial image of Waterfall Bluff
Left: The P5 Project Carlson BrX5 base and rover on mapping assignment along the rugged coast around Waterfall Bluff.

Archaeologist Dr. Erich C. Fisher has been adding to the knowledge base through his research of prehistoric hunter-gatherers who lived on the eastern coast of South Africa. Fisher is a research scientist with the Institute of Human Origins, School of Human Evolution and Social Change at Arizona State University. He started the P5 Project in 2011 and now runs the sprawling international and multidisciplinary research team with three other co-Directors. Dr. Hayley Cawthra, the chief scientist for marine geology at South Africa's Council for Geoscience, Dr. Irene Esteban, an archaebotany expert at the Evolutionary Studies Institute at the University of the Witwatersrand, and Dr. Justin Pargeter, a specialist in stone tools and hunter-gatherer behaviors at New York University.

"Scholars have long studied how people interact with their environment," Fisher stated. "Like modern people, prehistoric hunter-gath-

Above: Mapping artifacts.
Left: University of the Witwatersrand student Didintle Ramisode and University of Cape Town student, Patricia Groenwald, conduct a GNSS survey mapping outcrops of stone used to make stone tools.

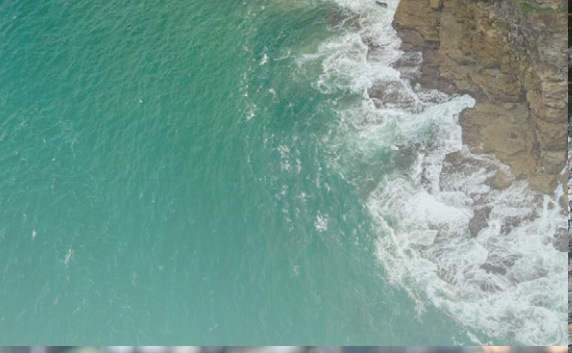
erers are known to have adapted to changes in their local environments, influencing, among other things, what they ate, where they lived, what kinds of tools they made, and even how they interacted with each other."

"The archaeological sciences are ideally suited to studying the relationship between people and their environment over long timespans—spanning millenia—because these kinds of behavioral changes can be detected in archaeological records."

Coastal zones intrigue scholars because their abundant, diverse, and predictable foods and other resources may have shielded people living in these places from the effects of rapid climatic and environmental changes. By understanding how humans adapted to coastal zones over long a time frame provides insights into the ways that people have coped. It also gives the broader scientific community a greater understanding of human impacts on coastal environments, which can help design conservation strategies.

In 2011, Fisher and his team began archaeological fieldwork in eastern Pondoland located in South Africa's Eastern Cape Province. The P5 Project is an international multi-disciplinary project studying the origins and development of coastal foraging and the impact these resources may have had on the evolution of modern humans.

P5 stands for Pondoland Paleoclimate, Paleoenvironment, Paleoecology, and Paleoanthropology Project, which is a



Excavations at Waterfall Bluff rock shelter, Eastern Cape Province, South Africa, May 2020

Honors student (Univ. of Queensland) Josh Giesken teaches another student, Tatenda Tavingeyi from Great Zimbabwe University use Carlson SurvPC on a tablet to operate a total station

mouthful to say out loud. Paleo refers to the study of the past.

"The primary objective of our P5 research is to understand how hunter-gatherers lived in persistent coastal contexts during glacial and interglacial phases," Fisher said. "So, we are testing questions about coastal ecological variability across glacial and interglacial periods and how these changes impacted hunter-gatherer food-choice patterns, social networks, settlement patterns, and technology. Secondarily, we are situating these data within the broader southern African paleo landscape to bring renewed focus on hunter-gatherer's use of coastal and inland resources across glacial and interglacial cycles, which will provide a more nuanced understanding of human evolution and social complexity across broad bio-geographical contexts. The project's interdisciplinary datasets, therefore, provide detailed insights into past human behavior, humans' long-term impacts on coastal ecology, local environmental changes that influenced various biotic communities, and new methods to conserve these resources for future generations."

To reach the remote Pondoland site, Fisher and his crew take a two-day drive from East London, South Africa to get to the area and then camp. They then must hike 1.5 miles to the site (and back!) every day carrying all their research computers, survey equipment, excavation equipment on their backs over rivers, up cliffs, and along the coastline.

As Fisher stated the archaeological record is, by nature, a highly fragmented and biased insight into past human behavior: "This is because any one record might only preserve a brief snapshot of people's lives in the past and the environmental conditions but also because many of the most fragile remains, like plant foods, and even people's thoughts do not preserve! So, what we are left with is highly fragmentary to begin with and made even more difficult to understand because natural processes like wind, water, animals, and even people have inevitably disturbed the sediments too. That anything has preserved over 1000 years much less 10,000 or 100,000 years is amazing, to be honest. And yet, with every scoop of our trowel those records are similarily destroyed, albeit in the name of science. Archaeology is unforgiving and there are no second chances. So, if we do not record everything at the moment it is discovered then unique and invaluable records may be lost completely. Thus, when we are excavating

deposits that are, say, 25,000 years old we use the most exhaustive techniques possible because 1) it is ethically the right choice considering that our science is a destructive science and 2) maximizing data recovery allows us to answer more detailed questions about past humans and their worlds."

Fisher is an archaeoinformatics specialist. Archaeoinformatics is a relatively new subdiscipline that uses the integrative framework that computing provides via analytical, visualization, and communicative tools to build intellectual bridges between researchers across disciplinary lines to tackle complex research questions using multi-pronged research strategies.

Fisher has experience surveying. During his PhD at the University of Florida, he took numerous classes in geomatics, cartography, and GIS. From there, he adapted that knowledge to his archaeological work (though, he admits "I am in no means on par with professional surveyors!").

In the field, Fisher and colleagues now train students to run all of the survey equipment. Fisher also teaches classes in archaeoinformatics, which include GNSS and total station survey techniques in the field and in classroom.

"Our excavated point-plot data have all been integrated into a high-resolution and photorealistic 3D Geographic Information Systems model using ArcGIS Pro 2.1 and to a lesser extent, ESRI ArcGIS 10.6," Fisher said. "The models allow our team to make detailed observations about the rock shelter, excavated archaeological deposits, cliffs, and surrounding coastal shelf to understand site formation processes and, ultimately, the context of the archaeological deposits."

Fisher uses a very wide array of technology that is often not found in archaeology.

"For the surveying equipment, we have established a long and very close relationship with Carlson Software," stated Fisher. "We use their software to run all total stations and GNSS, plus post-processing GNSS data, and we use their Carlson BrX5 for establishing geodetic control at sites."

The P5 Project's current research is focused on the site of Waterfall Bluff in Pondoland, where excavations have found evidence of Stone Age human occupations dating from the end of the last ice age during the Pleistocene, ca. 35,000 years ago, and the complex transition to the modern era, known as the Holocene. These records contain the first direct evidence of people eating marine seafood, like line fish and shellfish, during a glacial maximum, which has never been found in southern Africa. The well-preserved archaeological deposits also contain numerous records showing changes in climates, environments, and plant and animal resources for food and other daily necessities

that includes almost perfectly preserved, and very rare, 11,000-year-old leaves.

The exceptional quality of these records has allowed P5 scientists to create the first record of paleoenvironmental changes from a single archive that integrates plant pollen, plant phytoliths, archaeological charcoal, preserved plants tissues, and plant wax carbon and hydrogen isotopes. The long and detailed record of occupation at the site, which spans 20,000 years, also provides evidence that inhabitants at the site were either connected to other groups living in inland, highland, regions via trade or they were seasonally moving into these places themselves.

The P5 Project uses a robust catalog of modern techniques to document and reconstruct what life was like for hunter-gatherers at the end of the last ice age.

"Our geospatial mapping, for example, uses a combination of techniques to map our study region down to individual artifacts within the site itself," Fisher stated. "We map our sites and surrounding areas using a combination of reflectorless total stations (Topcon ES- Series and Northwest NTS02S), RTK GNSS (Carlson BrX5), and forward facing geo-rectified parallactic[1] photography via a DJI Mavic 2 Pro. At Waterfall Bluff, we used a Carlson BrX5 GNSS with a Carlson Surveyor 2 to establish geodetic control in front of the rock shelter. These data were post-processed using Carlson Survey GNSS 2016 and then we used those points for a closed-traverse into the rock shelter where we used side-shots to set up a network of interior control points within the UTM coordinate system. These control points now allow our team to resection anywhere within the rock shelter, supporting our archaeological and scientific activities therein.

"We plot all excavated archaeological remains, like stone artifacts, bone, charcoal, and other debris from human activities in 3D using our reflectorless total stations. These total stations are operated from Bluetooth-enabled Windows tablets running Carlson SurvPC 6, which we have configured to use handheld barcode scanners to record vital tracking information about the provenience of everything within the excavations. All these data are subsequently integrated into a high-resolution and photorealistic 3D Geographic Information Systems model using ArcGIS Pro 2. These models allow our team to make detailed observations about the rock shelter, excavated archaeological deposits, cliffs, and surrounding coastal shelf to understand site formation processes and, ultimately, the context of the archaeological deposits. To date, we have mapped over 25,000 artifacts at the site."

But beyond the diverse research at the coast, the Eastern Cape Province, where the project is located, suffers from a lack of teachers and resources resulting in one of the lowest college matriculation rates. Nationally, the situation is not much better with only 9% of black South Africans attending college compared to nearly 40% of white South Africans. To offset some of these issues P5 now advertises fieldwork directly to indigenous African students and covers their travel and living expenses. In 2019, for example, the field team included students from all major research institutions in South Africa, as well as as well as representation from the Kingdom of Lesotho, Zimbabwe, and Cameroon. Each of these students participated in excavations and many learned how to use Carlson software and to run the mapping equipment, giving them unique experiences and skillsets to aid their own careers. P5 is also engaged in grassroots efforts to support education and cultural and natural heritage preservation.

"Since 2015 we have also run an indigenous cultural heritage training program in partnership with the East London Museum, South African government agencies, and local amaPondo communities. The program supports local economic development through eco-tourism, creating liaisons with government officials to manage and preserve cultural heritage in Pondoland."

Clearly, the efforts of P5 are contributing in productive ways from adding to the archaeologic record, to pushing the bounds of the new discipline of archaeoinformatics, to contributing to the Pondoland community, and, hopefully, giving additional insights to the eternal questions of who and why. ■

1 **Editor's Note:** We were unfamiliar with the term parallactic mapping so we asked Dr. Fisher: "Yes, I would absolutely agree with you that the most correct term is photogrammetry. In my experience most archaeologists associate photogrammetry with either orbital or suborbital images of the Earth's surface, but specifically facing down [nadir] or having a very low angle of the camera [oblique]. I got into the habit of saying "forward facing parallactic mapping" simply to reiterate to other archaeologists that don't realize you can apply the same principles of parallax to derive 3D surfaces from overlapping images in a camera that is oriented in any way, including facing forward.

Jeff Winke is a business and construction writer based in Milwaukee, Wisconsin. He can be reached through *jeff_winke@yahoo.com*.

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TOWNSITE RETRACEMENT SURVEY

Above: City of Henderson survey crew party chief, Brian Witzel. He is setting a monument well extension tube at the deepest found monument, 3 feet below the asphalt.

Left: The Townsite and BMI Plant area, middle to center-top of photo.

THE 2011 PHOTO COURTESY OF AEROTECH MAPPING.

The genesis for the retracement survey for the Henderson Townsite was a previous project in the area of the 1931 Plat of Sierra Vista City. This subdivision is about two miles northwest of the Henderson Townsite. If there were any remaining original monuments from the 1931 plat, this would help resolve a roughly five-foot discrepancy in the area of the center quarter of Section 1. The search recovered 4 original monuments from the 1931 plat.

In the past, some surveyors working in Section 1 resorted to defining a center quarter corner for the east half of the section, and a different center quarter for the west half of the section. The recovery of four

» MICHAEL KIDD, PLS

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Electronic documents are much faster to publish. Publishing an electronic document only takes a few seconds, but publishing our advertisements to reach our readers via print magazines can take at least one week.

Electronic documents are much less expensive to publish. Instead of spending thousands of dollars on the cost of print publications, publishing electronic documents costs almost nothing.

Electronic publications have no adverse effects on the environment but print publications require cutting, shipping and processing trees.

Fact 2:

All of the Younger generation (people less than 30 years old) are primarily interested in digital media, electronic documents and internet searches. Even the books that they read are read on tablets and smartphones, meaning that they have little interest or need for print media.

The Middle generation's (people between 30 and 60 years old) focus is split, half on digital media and half on print.

Nearly all of the Older generation depended on print media.

COVID-19 changed many things in a span of few weeks. The COVID-19 virus forced Middle and Older generations to learn how use electronic connections, video conferencing and communicating via computers and smart phones. This is something that we were not able to achieve after many years of promotion.

No more on print media!

JAVAD GNSS will stop advertising in print media and will work towards benefiting from the electronic communication and promotion tools provided by the magazines that we previously used to communicate our message through their print media. They have far reaching e-blast services and electronic messaging.

In addition, we will be working on

- **Audio/Video tutorials**
- **Online publications**
- **Remote Group Video conferences (we have tool for up to 400 participants)**
- **Spreading the news through our sales channels**
- **Local State shows**
- **Words of mouth from happy users**

See us at www.javad.com

TRIUMPH-LS Plus & RTPK

PATENTS PENDING

Major good news for surveyors:

- **TRIUMPH-LS Plus combines RTK and RTPK**
- **RTPK is "Real Time Postprocessed Kinematic" Which can post process the RTK data in parallel and in real time.**
- **RTPK can verify your RTK results in Real Time!**
- **If RTK fails, RTPK comes to rescue in a fraction of a second.**

Price for the current TRIUMPH-LS remains at $12,990 and can be purchased as before.

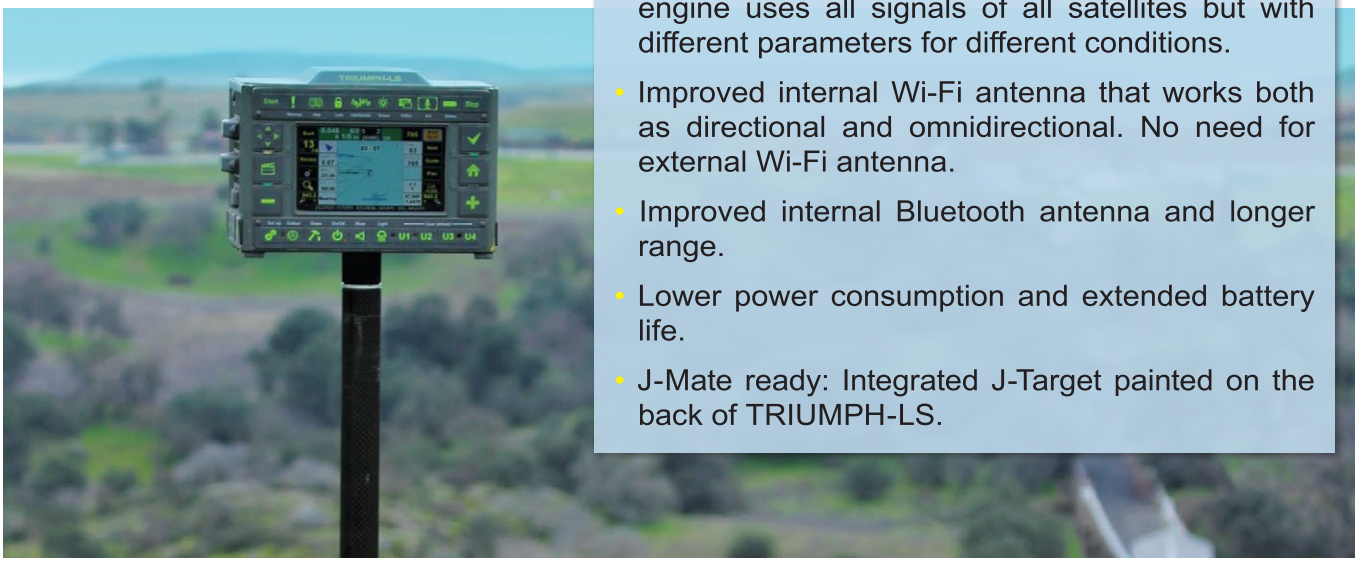
Price of the improved option is $4,990 ($12,990 + $4,990 = $17,980).

Please see our website for additional available options for the TRIUMPH-LS.

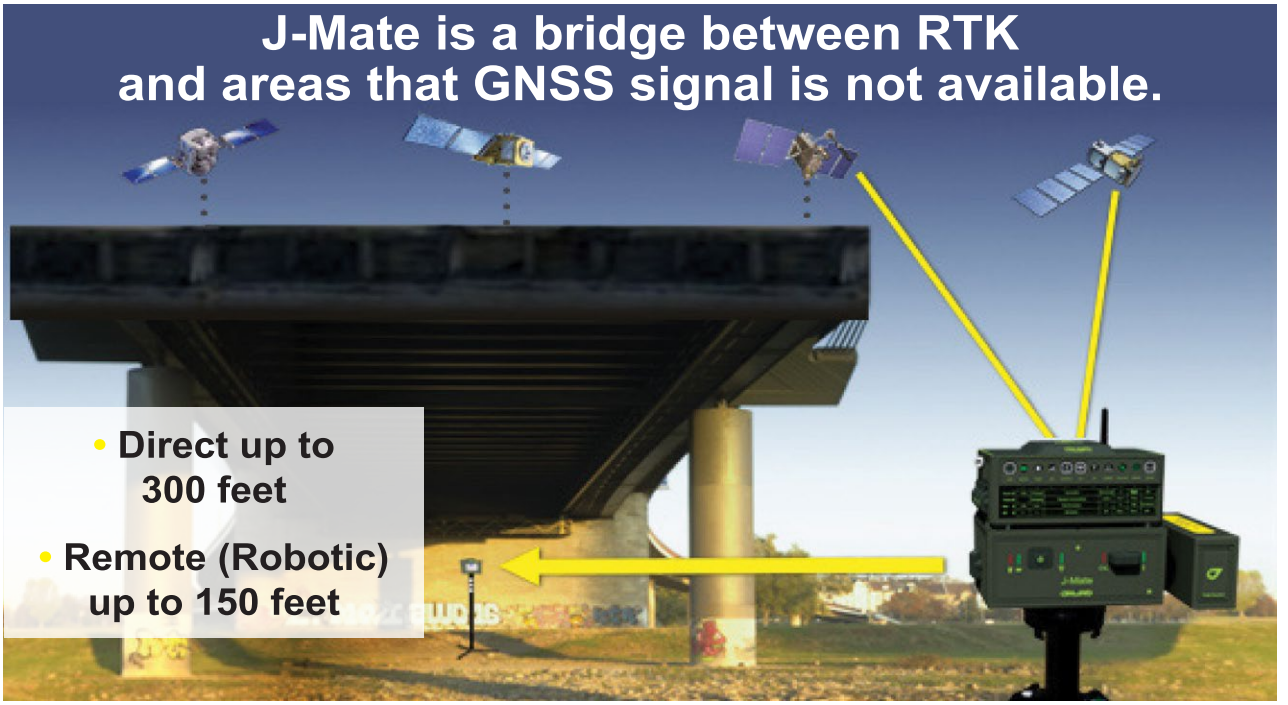
Owners of current TRIUMPH-LS units (in working condition) can upgrade their units to the improved option at $5,450 and for $5,700 we will also install a brand new set of batteries.

Option available for the TRIUMPH-LS with the following features, using the new ASIC:

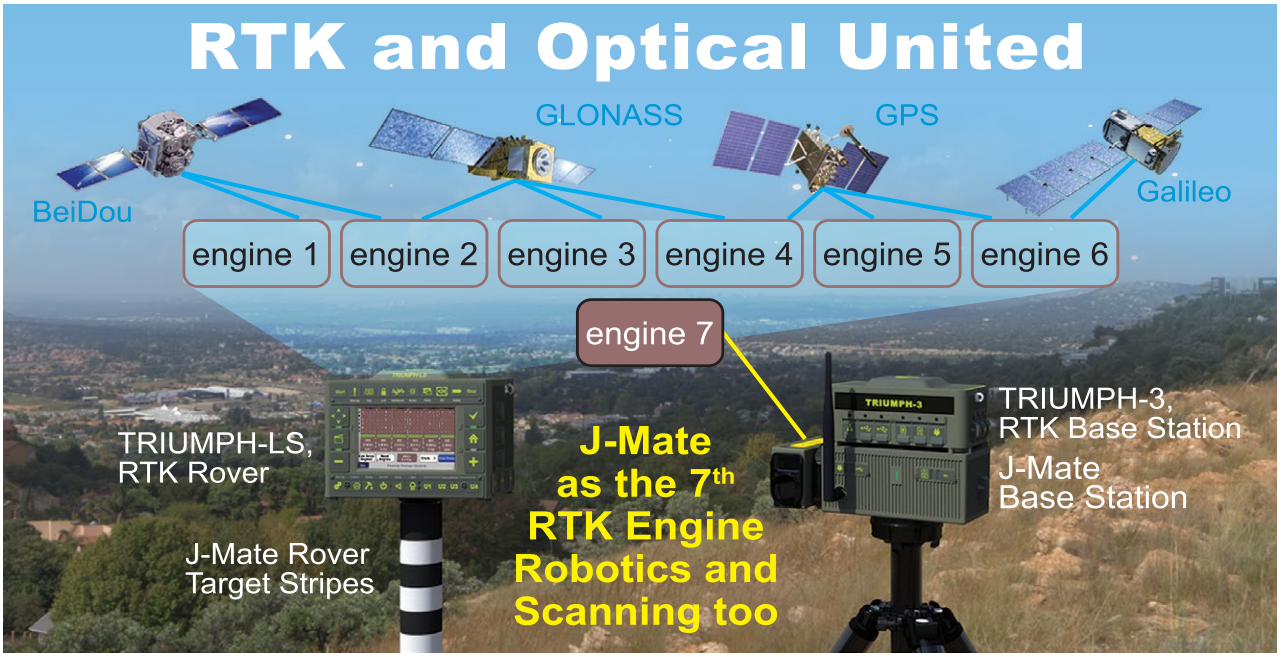
- Improved signal tracking and signal processing (wideband tracking) and adding Galileo and BeiDou L6 bands and Galileo AltBoc and BeiDou AltBoc signals.
- Improved multipath reduction due to wide band tracking.
- Improved spectrum analysis to show and reject spoofers and jammers option.
- Improved RTK with four "Super Engines". Each engine uses all signals of all satellites but with different parameters for different conditions.
- Improved internal Wi-Fi antenna that works both as directional and omnidirectional. No need for external Wi-Fi antenna.
- Improved internal Bluetooth antenna and longer range.
- Lower power consumption and extended battery life.
- J-Mate ready: Integrated J-Target painted on the back of TRIUMPH-LS.



J-Mate



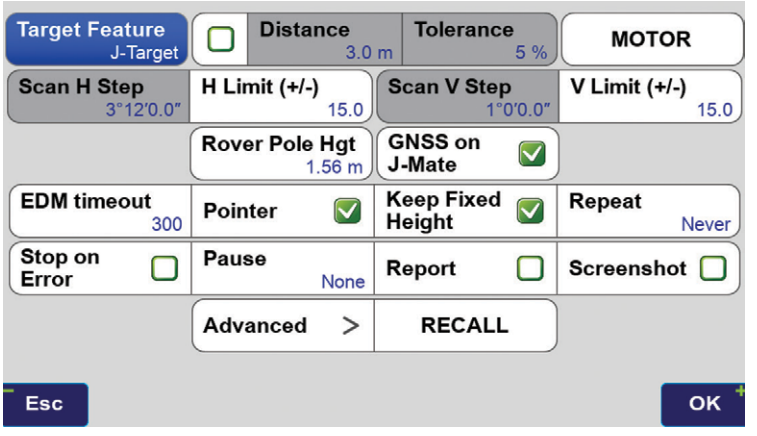
J-Mate is not a total-station. J-Mate and TRIUMPH-LS together make the "Total Solution" which is a combination of GNSS, RTK, camera, angle encoders and laser range measurements that together do, conveniently and cost-effectively, a lot more than a total station. For long distances, you use GNSS and for short distances (maximum of 300 feet in Direct mode and 100 feet in Remote/Robotic mode), you use the J-Mate along with the TRIUMPH-LS. Together they provide RTK level accuracy (few centimeters) in ranges from zero to infinity.



Searching and finding objects by laser and by Optics

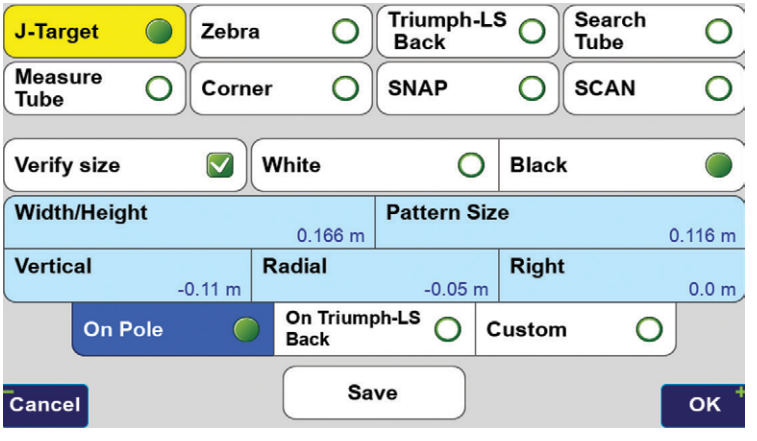
J-Mate has the unique feature of searching for objects by laser and by optics (camera).

Click button and select "Target Feature" to see the setup screen for target selection and parameters. If you know the approximate distance to the target, click the check box and enter the distance and accuracy percentage. This will help J-Mate to ignore targets that are outside the range.



Horizontal and Vertical Limits are the limits that J-Mate will search around the starting point to find targets.

"Keep Fixed Height" check box, scans horizontally on fixed target height. You may rarely need to use this feature. It will reduce the scanning speed by a factor of 2.



"Laser time limit"

The time that it takes for a laser measurement depends on the reflective surface of the target and weather conditions (dust and moisture in the air).

On a good white reflective surface and in clean air, it takes about 50 milliseconds to have a laser reading. If there is no reflective surface, or the reflective surface is black, it may take up to 4 seconds to have a laser reading.

If the surface of the object that you want to scan is a good reflective surface, limit the laser time to a fraction of a second. This will cause the laser to skip points that do not reflect enough energy in the time limit that you specified. This will significantly increase the scan speed and will ignore points that are not possibly your target and reduces the chance of identifying a wrong object.

Target Features and its offset from the top of the pole are shown in the "Target Features" screen. You can change the parameters by selecting the "Custom" button.

TRIUMPH-LS Back: You can use this feature to search for the back of TRIUMPH-LS and measure to its center to make sure laser range measurement is not from an unintended object.

GNSS Signals in the improved TRIUMPH-LS with the new chip

1130	1140	1150	1160	1170	1180	1190	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300
GPS		L5		A			P2, L2C		B								
GLN					L3		C		CA2, P2		D						
GAL	E5A		E			E5B		F									
	E5-altBOC							G					E6		H		
Bei	B2A		I			B2B		J				B3		K			
	B2-altBOC							L									

1535	1540	1545	1550	1555	1560	1565	1570	1575	1580	1585	1590	1595	1600	1605	1610	1615	1620
GPS			CA, L1C, P1					M									
GLN								CA1, P1					N				
GAL			E1					O									
BEI			B1C					P									
	B1					Q											

GNSS bands for GPS, GLONASS, Galileo and BeiDou signals are depicted in the above figure.

There are total of 22 signals in 17 frequency bands labeled “a” to “q”. Note that GPS C/A, L1C and P1 are in the same band (m) and GLONASS CA/L2 and P2 also are in the same band (d) of the same satellite. In selecting signals for RTK processing, as an option, we may choose to select only one of such signals in the same band. We label this option as “No Same Frequency” option in signal selection strategy screen, discussed later.

GPS				GLN				GAL				BEI			
C/A M	1.0	8	8.0	C/L1 N	1.0	8	8.0	E1 O	1.0	6	6.0	B1C P	1.1	8	8.8
P1 M	0.8	8	6.4	P1 N	1.2	8	9.6	E5B F	1.2	8	9.6	B1 Q	1.0	9	9.0
L2C B	1.0	8	8.0	C/L D	1.0	8	8.0	E5A E	1.2	7	8.4	B2B J	1.2	9	10.8
P2 B	0.8	7	5.6	P2 D	1.2	7	8.4	Eboc G	1.5	6	9.0	B2A H	1.2	8	9.6
L5 A	1.1	5	5.5	L3 C	1.2	2	2.4	E6 H	1.1	8	8.8	Bboc L	1.5	8	12.0
L1C M	1.1	8	8.8									B3 K	1.1	10	11.0

We categorize the GNSS signals as shown in the above figure. The first column is the name of the signal and its designated signal letter (e.g. GPS C/A m). Signals with the same color are those that we discussed earlier as being in the same frequency band of the same system.

The second column is the quality indicator of that signal. Because GPS P1 code, for example, is encrypted and in recovery we lose about 10db of its signal strength we give this signal the quality indicator of 0.8. GLONASS signals also get lower score because of their FDMA signal structure which results in inter-channel biases, even though we reduce such inter-channel biases in our signal processing techniques. Galileo AltBoc and BeiDou AltBoc signals get quality score of 1.5 because of their wide band and signal quality.

The third column is the number of available signals for RTK.

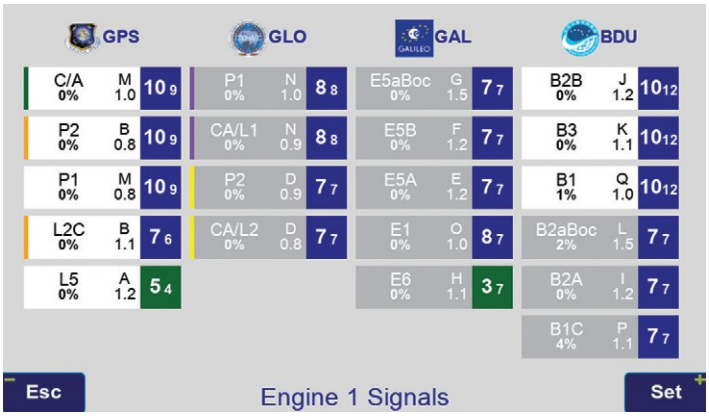
The multiplication of the second and third column is shown in column four, which is an indication of the value of that signal for RTK.

The four super engines

This screenshot shows the four super engine screens. Each engine shows the signals that are used for that engine.

The numbers below each engine are:

- First line is the GDOP of the selected satellites for each engine.
- Second line is the number of signals used / number of signals rejected.
- Third line is epochs since the last reset.
- Fourth line is the solution difference from the first engine.
- Fifth line is the total run time.
- Clicking on each engine, restarts the RTK fix process.
- Long click on each engine to select signals for that engine manually as shown in the figure below.



This screen shows all signals tracked by the TRIUMPH-LS which is real-time indication.

For each system, the name of the signal and its designated signal letter and quality indicator (e.g. GPS C/A M 1.0) are shown. GPS and GLONASS Signals with the same color sideband are those that we discussed earlier as being in the same frequency band of the same system.

Next to the signal name, the top number in each cell is the number of signals tracked by the Rover and the number below that is the number of signals tracked by Base. The smaller number of the two represent the number of common signals between base and rover.

You can long click on the signal name to change the quality indicator of that signal.

Each system is sorted by the number of common signals multiplied by the signal quality indicator.

The number below the signal name is the percentage of noise in that band. Numbers above 30% hint possible spoofing in that band. In case of jamming the original signal and adding a spoofed signal, this percentage may raise to even 200%.

"Auto Setup Engine" button selects signals for each engine automatically according to the strategy option selected by user.

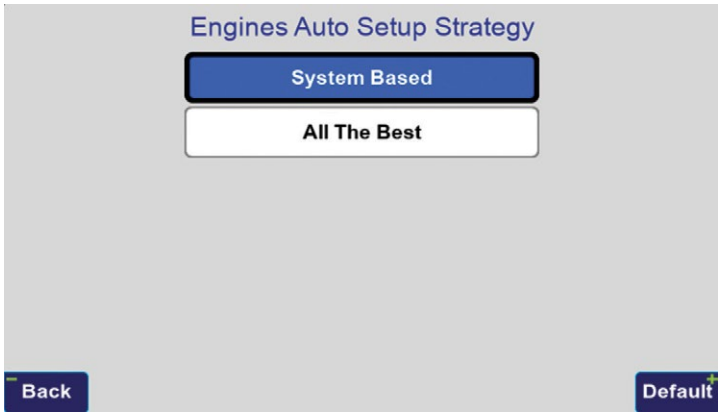
For selection strategy, hold the "Auto Setup Engine" which leads you to the following screen.

"Maximum Signal" box allows you to limit the number of signals used for each engine. Numbers above 60 limits RTK solutions to one per second. Numbers below 30 allows 5 Hz RTK.

The "No Same Frequency" check box selects only one of the GPS and GLONASS signals in the same band as explained earlier.

Click "Strategy" button to select the strategy for automatic signal selections for each engine.

You can long click on each engine and select signals for that engine manually.



In "System based" strategy, for the first engine all GPS signals are used (subject to the check box and Maximum Signal parameters) and then complemented with the best other signals up to the "Maximum Signal" limit. The other three engines are similarly selected by giving preference to GLONASS, Galileo and BeiDou, respectively

In "All the Best" strategy, the best signals among all systems are selected and identical signals are given to the four engines (subject to the Maximum Signal number and the No Same Frequency Check box).

No signal type will be selected unless at least four satellites transmit that signal.

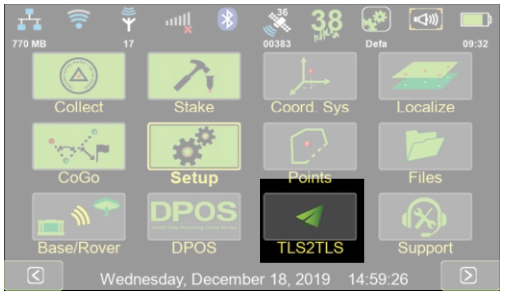
Each engine can accept maximum of 8 signal type. And each signal type can have maximum of 10 signals.

Clicking the "Reset Engines" button, resets all engines.

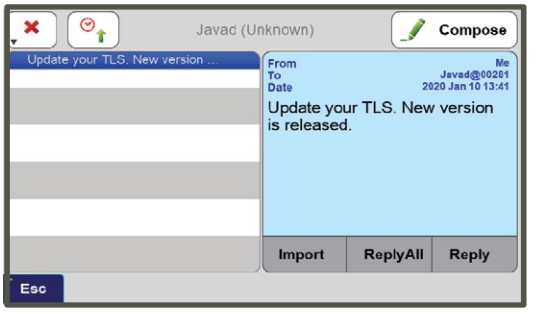
You can switch between "Convention Tracking" and Independent Tracking by clicking on this button. Conventional tracking users information from the L1 band to help other bands.

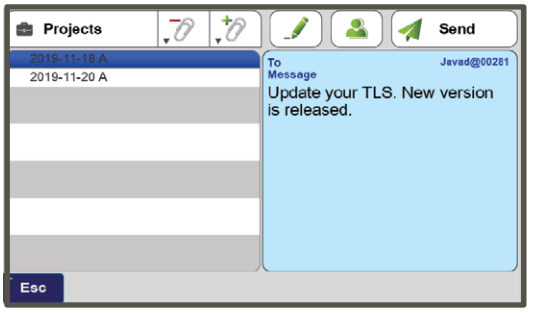
The number of the bottom right of the Figure 3 is the number of lost data from the base since the last reset. Long click to reset it to zero.

TLS2TLS



You can send and receive text messages and files from and to other TRIUMPH-LS units. In the Main screen click TLS2TLS and then in the "Compose" screen, click and enter names and serial numbers of the TRIUMPH-LS units that you want to communicate with. You can attach Projects, Screenshots, Images, Audio, GNSS RAW files to your text messages and send to the selected TRIUMPH-LS units.





The received messages are shown in the first screen. You can "Import" the attached files, if any, to your local unit. Click "Reply" to reply to a message.

You can reply to received messages by clicking the "Reply" (only to sender) or "ReplyAll" (to all recipients) buttons.

You may receive "Public" messages from JAVAD GNSS team. You do not to reply to them.

TRIUMPH-3

The new TRIUMPH-3 receiver inherits the best features of our famous TRIUMPH-1M.

Based on our new third generation TRIUMPH chip enclosed in a rugged magnesium alloy housing.

The TRIUMPH-3 receiver can operate as a portable base station for Real-time Kinematic (RTK) applications or as a receiver for post-processing, and as a scientific station collecting information for individual studies, such as ionosphere monitoring and the like.

It includes options for all of the software and hardware features required to perform a wide variety of tasks.

- UHF or Spread Spectrum Radio
- 4G/LTE module
- Wi-Fi 5 GHz and 2.4 GHz (802.11 a, b, g, n, d, e, i)
- Dual-mode Bluetooth and Bluetooth LE
- Full-duplex 10BASE-T/100Base-TX Ethernet port
- High Speed USB 2.0 Host (480 Mbps)
- High Speed USB 2.0 Device (480 Mbps)
- High Capacity microSD Card (microSDHC) up to 128GB Class 10;
- “Lift & Tilt”
- J-Mobile interface

Ideal as a base station

monuments from the original plat helped to resolve where and how the center-section error was created. The original search methods utilized in the initial project were not practical on a larger scale because of the destruction to the pavement.

This small success, along with the 2011 article in Point of Beginning (POB) "What Lies Beneath" by Joseph D. Fenicle, PS and also the 2012 article in The American Surveyor "A Reckless Path of Destruction" by Michael J. Pallamary, PS both get credit for intensifying the City of Henderson's efforts to search for any remaining original Townsite survey monuments prior to roadway pavement maintenance projects.

As part of any survey retracement, it helps to know physically what was set for monumentation, what depth the monuments were typically set and if the monument gives a reading with a metal detector. The monuments set with this plat were 6" diameter, 12" long concrete cylinders with a small brass tag stamped RE 428. Unfortunately, these monuments did not provide any signal with a magnetic locator. The depth of the monuments recovered with this retracement were typically 1 foot below the asphalt. The shallowest was recovered in a residential back yard with only 0.2' of cover and was in near perfect condition. The deepest monument recovered was 3 feet below the asphalt in the Convention Center parking lot.

One interesting side benefit of this effort was the evolution of the search procedures for the original monuments below the existing roadways within the Townsite area. The first-generation search

THE History OF Henderson

The City of Henderson is currently Nevada's second largest city with a population slightly over 300,000 and the Townsite is the core of the City's downtown area which is currently experiencing a good amount of growth and redevelopment. The city was incorporated in 1953; however, the spark for what was to become the City of Henderson was created two decades before with the discovery of the world's largest magnesium-rich ore deposit on the west slope of the Paradise range in northwestern Nye County, near Gabbs, Nevada.

Prior to the beginning of World War II, Congress was having discussions about strategic materials and magnesium quickly became an important topic. The stories of German and Japanese aircraft performance in combat, gave way to fears that the United States was lagging in warfighting capabilities. These fears were confirmed with the inspection of slightly damaged enemy aircraft that were shot down and the discovery of weight-saving magnesium alloys. This accelerated America's need for greatly increased magnesium production. In the 1930s, Germany, Japan and Russia kept their magnesium production a military secret. Therefore, it

George Von Tobel—sometime in the 1950s.

The Townsite and BMI Plant, 7 months after groundbreaking.

Below: The first successful recovery of one of the 1931 Sierra Vista City Plat monuments, about 1.8 feet below asphalt. This was somewhat typical for the 1930s, a 6" x 12" concrete cylinder. There was no visible brass tag or copper wire in the center. However, a magnet would stick to the center of the monument. It did not take long to figure out the dig bar makes a much different sound when contacting a concrete cylinder. The survey crews doing the search work learned to really enjoy the sound of success.

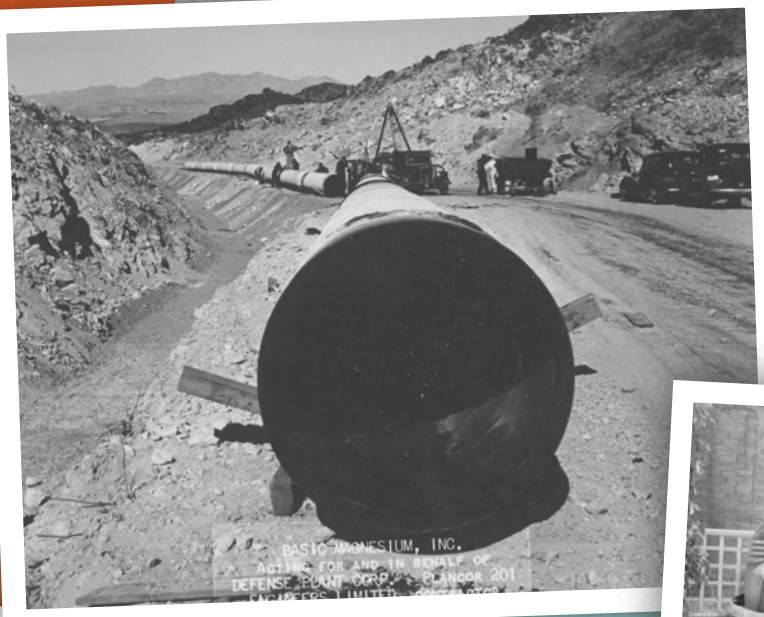
City of Henderson survey crew member, Nathan Wardle. He is getting ready for a survey shot on a found original monument. Note the core hole has been expanded to the right. At times, this was required to center the rod over the found monument.

method was to open a 12-inch square hole in the asphalt and dig with a standard shovel. This worked initially because the search was conducted a few weeks before a complete remove and replace roadway project started. However, this level of destruction is usually not an option for most search locations.

With a few of the original Townsite monuments found, the search coordinates could be calculated much more accurately. By scaling down the process of utilizing a Vactor truck to pothole and locate utilities, the City's survey crews evolved to coring a 4-inch to 6-inch hole in the asphalt and then using a dig bar and shop vac to hand-dig the search hole. This combination of hand digging and use of a shop vac to remove the material, provided a more precise and efficient way to excavate and evaluate findings.

A core bit with a diameter large enough to accommodate a hand is used to penetrate the asphalt. A dig bar and shop vac can then be used to quickly remove material up to a depth of three feet and, by angling the dig bar, the search hole below the asphalt can easily grow to twelve inches wide. A flat-topped dig bar or a shovel handle can then be used to replace and compact the material previously removed. Finally, the asphalt disc can be removed from the core bit and put back in place. From an asphalt esthetic perspective, it will typically be difficult to notice anything was done at the search location.

City of Henderson survey crew party chief, Brian Witzel. The first unsuccessful search hole is in the foreground of this photo. The 2nd search hole, closest to the truck, was the first successful recovery of one of the 1931 Sierra Vista City Plat monuments. What is not seen in the photo, is the look on the survey crews face when asked to dig the 2nd search hole. Until this point, there were no successful finds.



Above: 40" water main installation, March 1942

Below: RE 428 George Von Tobel's survey rig.

This procedure has been used over the last decade and the City's survey crews have been able to recover 70 of the 132 monuments set with the Townsite Plat. In addition, approximately two dozen other monuments were found that had been destroyed or hit by a blade, laying sideways under the asphalt.

When comparing the overall cost of a roadway maintenance paving project, whether it is a mill and overlay or a complete remove and replace, the cost of the land surveying effort to properly perpetuate historic survey monumentation is pennies on the dollar. A small amount of attention to detail while compiling the scope of services for the design contract and the plans and specifications executed for construction, will go a long way to preserving all property definition associated with historic survey monuments. The different professional land surveying organizations in your states may not realize the power they have, as these organizations are the perfect tool to ensure the municipalities are taking proper precautions with respect to survey monument preservation. If you are fortunate enough to have a Statute, Code or Ordinance to support this monument preservation, even better. Nevada has the benefit of NRS 625.550, shown below.

became clear the United States would need to greatly increase their production of magnesium and magnesium alloys used for lighter aircraft parts and more volatile munitions.

The thirst for magnesium, combined with the magnesium-rich ore in Nevada and the following four factors were key to the Basic Magnesium Incorporated (BMI) Plant site selection in the area below Black Mountain: The availability of power from Hoover Dam completed less than a decade before, ample water from Lake Mead, desirable public lands and the United States Army order that the plant must be located at least 250 miles inland from the coast.

To give some perspective on the monumental effort involved with the construction of the BMI Plant, Henderson Townsite and all associated infrastructure, the following timeline and accomplishments are amazing:

- **September 15, 1941**—Ground-breaking
- **March 30, 1942**—Water flowed into the Townsite reservoirs supplied by 15 miles of new 40" water main
- **August 31, 1942**—Power switched on, supplied from the newly constructed 35 miles of 230 KV power transmission lines, and the first magnesium ingots were produced
- Also completed in support of the BMI plat operations were 18 miles of permanent railroad track and 27 miles of roadway, of which 13 miles were paved

The trucking operation to support hauling material from Gabbs, Nevada to the BMI plant was just another of the huge undertakings. At the peak of magnesium production, there was a truck delivering material to the plant every 74 minutes, with a round trip distance of 668 miles. As reported in the BMI newspaper, The Basic Bombardier "It's the biggest trucking operation of its kind in the United States—longest haul ever undertaken on a continuous basis, largest equipment, heaviest payload, widest variation in temperature—and a pioneering venture into an entirely new field".

The peak daily work force during the construction of Hoover Dam was a little over 5,000 workers. By the end of 1943, BMI had a workforce of 13,000 workers. During peak construction, there were 90 surveyors working on the project and throughout the project, on average, there were 10 survey crews supporting construction activities. The plant closed on November 15, 1944 after 166,322,685 pounds of magnesium and magnesium alloyed material were produced.

City of Henderson survey crew member, Jonas Hulslander, now survey crew party chief. This was a successful find at the intersection of Magnesium Street and Manganese Street.

Modern grading equipment working the BMI site, September 1941.

Construction of the Townsite began in February 1942 in order to provide housing for some of the BMI workers. The total Townsite area is about 400 acres and the original plat included 1,016 residential lots, a school site and a commercial area. Although the Townsite was constructed in the early 1940s, the plat was not completed and didn't record until 1952 due to the war asset disposition process. During this interim period, families continued to live in the Townsite homes.

The surveyor that surveyed and completed the plat for the Henderson Townsite was George Von Tobel, Nevada Registered Engineer No. 428. George was born and raised in Las Vegas and left temporarily to earn his degree in Civil Engineering from the University of Santa Clara in California. The five land surveying classes he completed as part of his degree, in addition to his experience in the Army during World War II, building airfields in the south pacific, all contributed to a solid base of knowledge in land surveying. ■

NRS 625.550 Intentional removal or defacement of monument unlawful; exception; penalty.

1. *Except as otherwise provided in subsection 2, a person who intentionally removes, changes or defaces any monument that has been properly established and marked by a professional land surveyor as required by this chapter, is guilty of a public offense, as prescribed in NRS 193.155, proportionate to the value of the loss resulting therefrom, but in no event less than a misdemeanor.*
2. *This section does not apply to a professional land surveyor who acts in accordance with NRS 625.380.*
3. *As used in this section, the "value of the loss resulting therefrom" means the cost of restoring or replacing the monuments which have been removed, changed or defaced.*

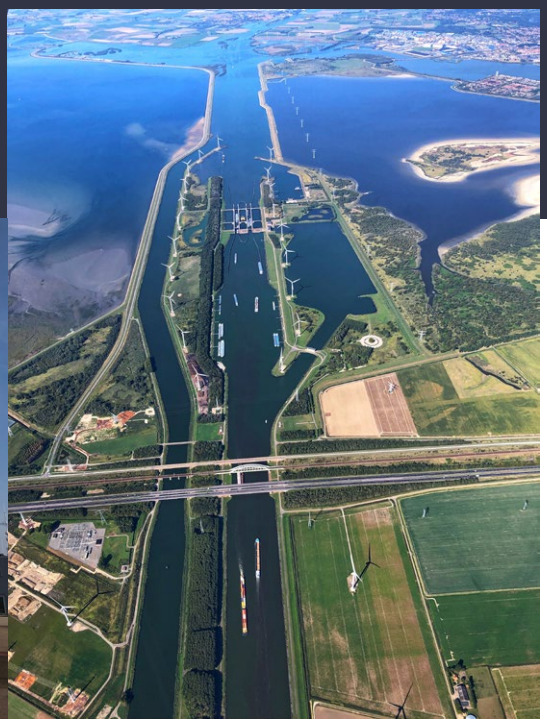
[Part 13:198:1919; added 1947, 797; A 1949, 639; 1955, 391] — (NRS A 1967, 639; 1989, 789; 1999, 964) ■

Author's note: I would like to extend a thank you to the Von Tobel family and the Special Collections Library at the University of Nevada Las Vegas. All comments, feedback and other opinions are welcome. *michael.kidd@cityofhenderson.com.*

Michael Kidd is currently the City Surveyor for the City of Henderson, Nevada. Michael's entry into the land surveying profession began with the U. S. Air Force in 1985. He is currently the Vice Chair on the Nevada Board of Engineers and Land Surveyors, he also served as a member of the NCEES Professional Surveyor Exam Committee.

Pavement & monument preservation success.

Repeated Imaging Success in SCHIPHOL



The Kreekrak locks in the Scheldt-Rhine Canal, which runs from Antwerp to the Volkerak and is part of the Scheldt-Rhine connection, the shipping route between Antwerp and Rotterdam.

In 2018, Schiphol Airport in The Netherlands recorded 499,444 commercial air flight movements, an average of about 1,350 take offs and landings per day. That quantity makes the airport an impressive third in busiest airports in Europe for passenger volumes, but it's not a great statistic if you're a geodata provider that needs to conduct an airborne survey near that crowded air space.

Geospatial services company BSF Swissphoto knows a thing or two about that kind of air-traffic challenge. Since 2016, it has had to learn how to be nimble and flexible in order to successfully deliver on an annual aerial photo campaign north of the airport.

"Roughly 85 planes are landing or taking off at Schiphol every hour, so flight control is incredibly strict," says Sandra Beckmann, a project leader with BSF Swissphoto's German office in Schönefeld. "When

» MARY JO WAGNER

The famous Molen van Piet round stone flour mill in the Dutch city of Alkmaar. Located in North Holland, Alkmaar is a popular tourist destination well known for its traditional cheese market.

we are given a flight window, we have to be ready to go at a moment's notice and we can't afford any mistakes in collecting our photos because it puts meeting our delivery deadline at risk. It's an added level of complexity in a project that's already challenging."

Indeed, in addition to working around potential weather delays and air traffic restrictions, the company has also had to meet unforgiving technical specifications and deadlines. They've had to produce homogenous, seamless orthomosaics with a ground sample distance (GSD) of 4 cm for a 900-square-kilometer area of interest (AOI)—about the size of Madrid—in 11 weeks.

However, Beckmann and her team have successfully shown that a smart flight plan and robust and efficient photogrammetry software are the right combination to navigate and land a complicated aerial survey and secure a route to repeat flights in the future.

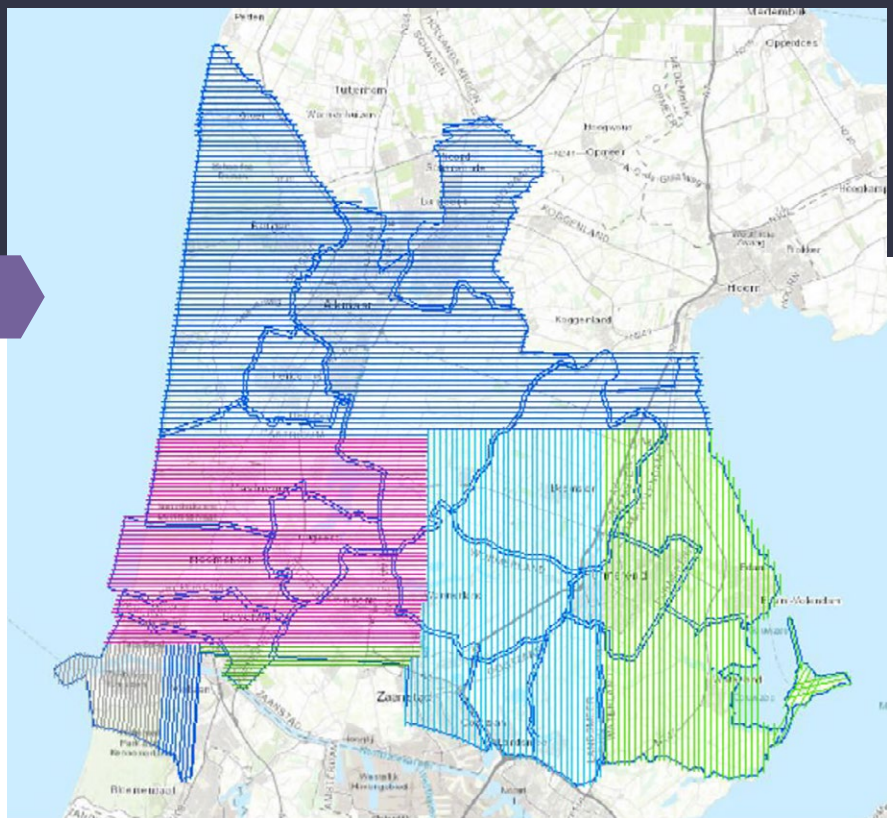
A routine exercise in coordination

Flying the skies and photographing the ground underneath their wings has been at BSF Swissphoto's core since it was first established in Switzerland in 1930. The company took on its first aerial survey and photogrammetry flight in 1960 and steadily grew its business by offering multi-sensor solutions with millimeter accuracy.

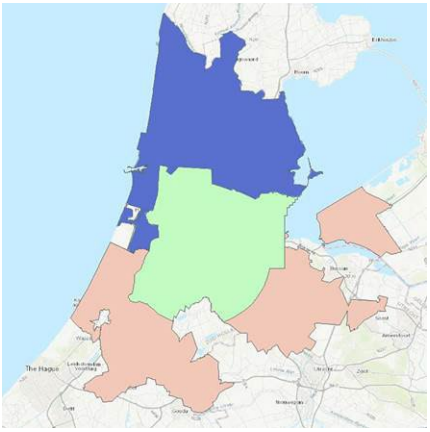
With a record for successfully delivering on surveying projects near Schiphol and other challenging areas around Europe, BSF Swissphoto was in a strong position to respond to the aerial photo needs of the Information & Coordination Centre (ICC)

An industrial area in the town of Velsen-Noord, about 10 kilometers north of Haarlem.

The shore along the seaside resort town of Bergen aan Zee, about 9 kilometers west of Alkmaar.



A graphic of BSF Swissphoto's AOI area including the municipalities. The lines indicate the flight plan.



A map of the complete ICC area split into three parts. The blue parcel is BSF Swissphoto's AOI.

of the Schiphol Region. The ICC represents about 60 government-affiliated organizations, including 47 municipalities, and works to coordinate and provide access to up-to-date aerial photographs and other remote sensing products on a routine basis. Since 2009, it has issued tenders to capture high-resolution photos of the 2800-sq-km Region that extends from Alkmaar in the north, Almere in the east and Zoetermeer in the south. Participating members use the detailed photos to update their large-scale topographic maps, for urban and environmental planning, for security and for monitoring land-use changes.

Depending on the number of ICC participants, the program's total AOI can change year on year, but the delivery requirements are always the same: orthomosaics with a ground sample distance (GSD) of 4cm or less.

In 2016, BSF Swissphoto received a two-year contract to survey one of three AOIs under the ICC's Vertical Aerial Photo program. Proving its capabilities, it was then awarded a subsequent contract for the same 900-sq-km area for 2019 and 2020.

"We are skilled in developing well-crafted and realistic flight plans that not only enable us to be efficient in the air but also in processing the stacks of images we acquire," says Beckmann. "Equally important is our ability to meet the exacting technical requirements. With Trimble's Inpho® image processing software we have the tools we need to meet the orthophoto precision and the delivery timeline the project demands."

Collecting the aerial component

For the 2019 campaign, BSF Swissphoto's AOI included 17 ICC municipal territories in the northern part of Schiphol, each of which required its own seamless orthomosaic. In addition to the very high resolution specifications, the orthomosaic had to be precisely color-balanced—no dark shadows or excessively bright spots—geometrically accurate, completely clear with distinct contrast, and aesthetically pleasing.

The aerial campaign began in February in order to acquire images of bare trees and to ensure they capture as much ground detail as possible.

Considering the restrictive and complicated air traffic regulations, BSF Swissphoto split the whole AOI into seven sub-areas, delineating smaller fly zones near the airport and larger sections further north. The smaller sections were carefully chosen because the team knew they'd collect a significant volume of photos and they wanted to ensure

A view of the Stad van de Zon housing and building project in Heerhugowaard, The Netherlands. Heerhugowaard is one of the 17 municipalities included in BSF Swissphoto's AOI.

the orthophoto production would go as smoothly and efficiently as possible.

To coordinate with the flight plan and to achieve consistently high accuracy over such a wide area, BSF Swissphoto used a base station, GNSS receiver and differential GPS (DGPS) technology to establish control for each sub-area, and they set out a network of ground control points (GCPs).

For the GCPs, teams used a combination of colored, physical targets and painted markers on hard surfaces at set intervals within each sub zone and measured the center points of each with a GNSS receiver. They set GCPs in groups of two, each placed close together for point redundancy, and laid out a total of 164 GCPs with a horizontal accuracy of better than 3 cm.

After setting control, BSF Swissphoto dispatched their flight crew to collect aerial imagery. Flying at altitudes of both 335 meters (1,100 feet) and 427 m (1,400 ft) at speeds between 120 to 155 km/h, they covered the entire AOI in 30 hours over six days. They flew 261 flight paths and collected 30,000 images with their large-format digital camera. The images had a 60 percent endlap and the average sidelap between the flying strips was about 30 percent.

"Flying at such low altitudes is risky because the slightest deviation—like movement from a sudden gust of wind—can impact our defined overlap or clarity in a photo," says Beckmann. "We were fortunate to have good weather for the flights."

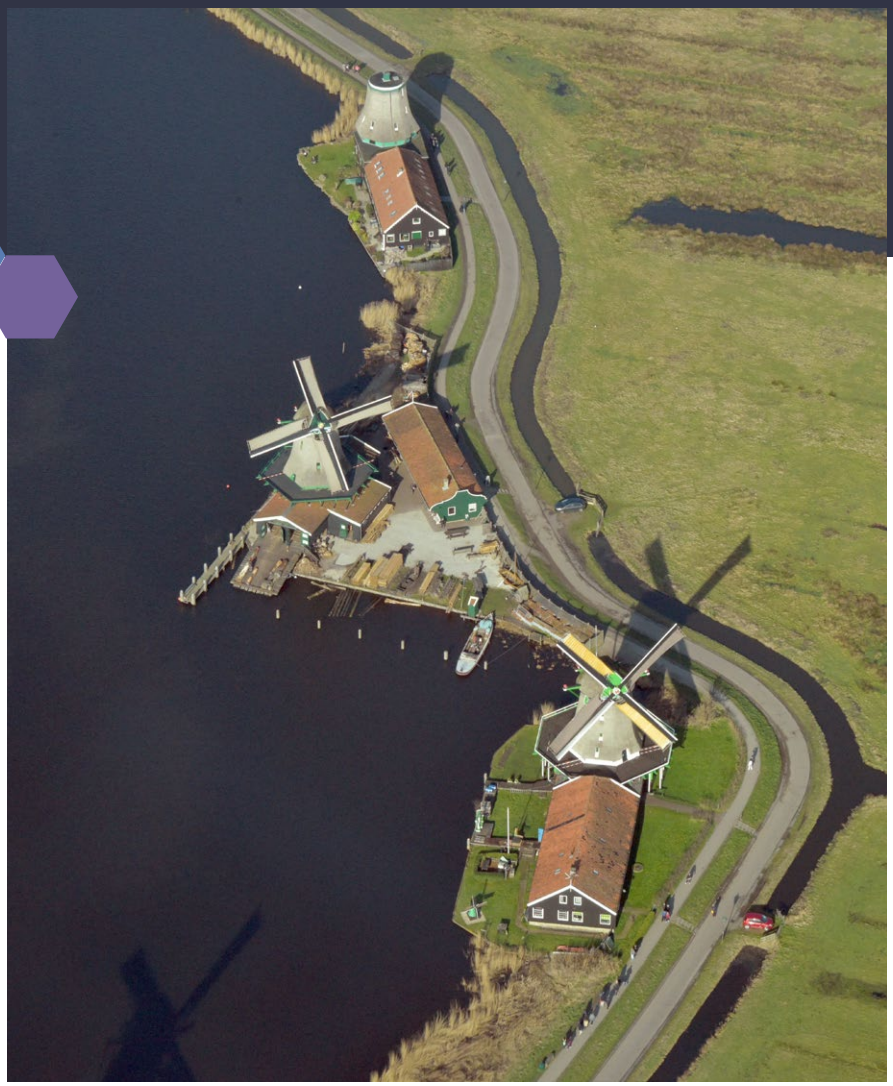
Orchestrating the orthophotos

After downloading and processing the aerial images and aircraft trajectory data, Beckmann and colleagues imported them together with the GCPs into the MATCH-AT georeferencing module of Inpho to automatically triangulate the images. The software processed the 30,000 images in batches and automatically pinpointed 254,000 common features or tie points (TPs) with multiple connections across the images. The precisely surveyed GCPs were measured in MATCH-AT, and in a second quality control step, the team used MATCH-AT's Stereo module to manually verify and measure all the GCPs in stereo. After that the imagery was precisely oriented automatically.

"The automatic triangulation and tie-point identification capabilities in Inpho are very good and give us the essential foundation for creating precise orthophotos and orthomosaics," says Beckmann. "You can't build an accurate result from an inaccurate base."

After the final triangulation was done, the team downloaded an existing LiDAR-based digital terrain model (DTM) of the entire AOI and analyzed it for land-cover changes that needed to be corrected or updated. The DTM was then integrated into the Inpho software.

Schiphol Airport recorded 499,444 commercial air flight movements in 2018, making it the third busiest airport in Europe for passenger volumes.



A shot of Amsterdam taken in flight.

With the Inpho OrthoMaster module, the software used the DTM to automatically orthorectify the individual images with a ground resolution of 4 cm. Switching to Inpho OrthoVista, the photogrammetry tool for creating seamless orthomosaics, each orthophoto was stitched together to create a 2D orthomosaic of the entire AOI. Experienced BSF Swissphoto operators then performed quality control checks on each orthomosaic and flagged any potential issues such as incorrect seam lines. They could then use editing tools such as the OrthoVista Seam Edit tool, in coordination with ancillary data like building outlines, to manually check the seam lines and ensure they didn't intersect buildings or cross objects like bridges that would be distorted in the mosaic. Any imperfections were fixed to create seamless, color-balanced and geometrically correct orthomosaics of the 900-sq-km AOI.

"We've been using Inpho technology since 2005 and so far, we haven't found any solution better than OrthoMaster and OrthoVista for creating ortho products," says Beckmann.

After completing all the orthomosaics, BSF Swissphoto personnel then prepared the customized deliverables. Per the ICC's requirements, they not only finalized all 17 orthomosaics, but for each city, they selected all the ortho tiles belonging to each city's territory and formatted each as a TIFF file, enabling them to provide both the seamless mosaic and the corresponding individual tiles to each customer. Within 11 weeks of completing the aerial survey, each of the ICC cities had received their up-to-date orthomosaic for 2019.

"We wouldn't have been able to process and transform 30,000 photos into real-world, color-balanced and seamless 2D orthomosaics in 11 short weeks without the automation and accuracy of the Inpho software and a strong team," says Beckmann. "The clarity and detail these orthomosaics provide will be a valuable geospatial dataset for ICC participants."

Indeed, with the routine procurement of airborne imagery, the ICC members are living proof of the benefits of one of the organization's mottos: "Acquire aerial photos once, use them multiple times."

"The need for up-to-date, fit for purpose geo-information has steadily grown in recent years," says Leon Hendriks, the ICC's program manager. "Historically, this data hasn't been easy to obtain for individual organizations in the Schiphol Region because of their proximity to the airport and access restrictions. Since 2009, the ICC has been able to coordinate one aerial campaign to serve multiple users within the Region. With these brilliant, accurate and data-rich orthophotos our members have the spatial intelligence to better plan for city and rural development, monitor their landscapes, respond to permitting requests and appeals and communicate to the public. It's been a very successful program and one we plan to continue for the foreseeable future."

That future has already begun. BSF Swissphoto took to the skies in mid-February to initiate the 2020 Vertical Aerial Photo campaign, and will again be producing seamless orthomosaics for the participating ICC members in its AOI. Anchored by its smart approach to flying in combination with its image processing software, BSF Swissphoto may have the tailwind to land more airborne surveys in the future. ■

Mary Jo Wagner is a freelance writer who has covered the geospatial industry for 25 years. Email: *mj_wagner@shaw.ca*.

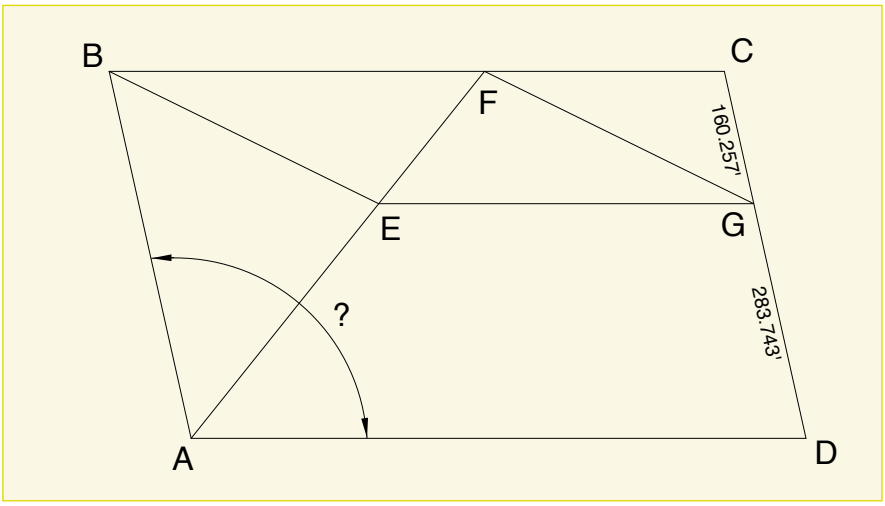
test yourself

...mmm

AF is the bisector of angle BAD in parallelogram ABCD. EBFG is also a parallelogram. What is angle BAD?. ■

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*.



Preserving Survey Records

Hancock Associates, a Danvers, Massachusetts-based land surveying, civil engineering and wetland science firm was founded in 1978. Over the years, it has amassed thousands of its own records as well as those from 24 other firms dating as far back as 1852. These records assist Hancock's staff in performing tasks quickly and efficiently and also help preserve local history.

As you can imagine, the volume of folders, flat plans, rolled plans and field books from 168 years of work requires a substantial amount of physical space; and if not stored correctly, those historical documents could become damaged and even lost forever. Proper cataloging also is paramount for retrieval and use of the documents. The solution was to bring on Travis Yacovitch as a full-time Archivist to digitize and catalog the thousands of historical records as well as the new ones that are continually being created by the firm.

Travis' journey to Hancock Associates and his work there is an interesting story.

» HANCOCK ASSOCIATES & TRAVIS YACOVITCH

I graduated from North Shore Community College in Massachusetts with an associate degree in Liberal Arts but was unsure of what I wanted for a career. Eventually, my fondness for local history from the Salem Witch Trials to the role that Boston played in the American Revolution along with my desire to be immersed in history led me to Philadelphia, the home of the Liberty Bell and Independence Hall, to study history at Temple University. While there, I worked part-time at the Paley Library in the Special Collections Department which handled all of the university's archives and records. It was there that my interest and admiration for archiving began to take root as I learned the ins and outs of the trade thanks to plenty of hands-on work. I then graduated from Temple University with a Bachelor of Arts in American History and a minor in English and was a member of Phi Alpha Theta, a history-based honors society. With recommendations from my supervisor at the library and two other teachers, I applied to Simmons University in Boston, Massachusetts for their Master's program in Library and Information Science.

While I was waiting for classes to start, I interned at the Peabody Essex Museum in Salem, Massachusetts in their Registration Department. I archived exhibition records, assisted with object conditioning, processed loan renewals and updated entries in the museum database. While at Simmons, I worked at Thoreau Institute Library with the Walden Woods Project in Concord, Massachusetts sorting and organizing a collection of materials related to Henry David Thoreau who was a land surveyor for much of his life. Little did I know that land surveying would soon become a key part of my professional career.

While pursuing my Master's degree, a longtime friend of mine who was a land surveyor at Hancock Associates told me that the firm was looking for an Archivist. I left the Thoreau Institute Library to take the position and continued my studies at Simmons University through their online program. I graduated from Simmons with a Master of Science Degree in Library and Information Science with a concentration in Archival Management. All of my education and experience is put to work at Hancock.

You might think that creating a digital copy of a document is relatively simple, but there are many factors to consider before scanning or photographing one. What is the size and format? What is the material and condition of the paper? What kind of equipment are you using? What is the brightness and contrast of the light source? Once you have answered these questions, you can properly light the piece, line up your shot and take the digital copy. From there, file size is assessed. What format will the document be saved and how much computer file space will it need? Can it be compressed to save on the megabytes of file size? These questions also need to be answered on a piece-by-piece basis.

When looking at a large volume of materials, it can be tempting to work as quickly as possible. However, when it comes to archiving, quality and accuracy is far more important than speed. I will scan a piece as many times as I think is needed because I want to be sure that I save the best result possible. It takes time to handle each piece correctly but it's time well spent. An original document will deteriorate over time and is at risk of being damaged or lost starting from the day it was created. With a digital file, the information is captured forever.

Creating the digital file is only part of the archiving process. The organization and storage of files is just as important. The information serves no useful purpose if it is not easily found. This is true for the physical archives and the digital ones. Over the years at Hancock, I have learned a great deal about land surveying which allows me to properly assess and organize materials.

Our files in our physical archive are organized by the name of the company in which they originated, the content and the document format, then stamped with a reference number. The digital archive, which is stored within our in-house computer network and backed up daily, is similarly structured and is easily searchable through a proprietary database. The database uses geotagging whereby common street addresses are converted to longitude and latitude coordinates for maximum accuracy. I also created a searchable satellite map of sites which allows Hancock project managers to easily look up previous surveys to get information. It can easily save hours of field and research work.

I've been Hancock's full-time Archivist for over three years now and have digitized thousands of land surveying and civil engineering records…and counting. If you have questions about preserving history through archiving, feel free to reach out. ■

Travis Yacovitch is a full-time Archivist at Hancock Associates. You can connect with him at linkedin.com/in/travisyacovitch/

Hancock Associates Historical Surveying and Engineering Records

Hancock Survey Associates, Inc.	1978–present
Acton Survey & Engineering	1967–present
Andrysick Land Surveying	1989–present
Thomas A. Appleton	1897–1963
Carters & Towers Engineering Co.	1956–1997
Clipper City Surveying, Engineering & Mapping	1999–2004
Coastal Survey	1991–2003
A.J. "Bud" Crawford	1947–1961
Raymond A. D'Arcy	1945 -1966
Decesare & Lang	1961–1979
Gerald R. Marsella	1977–2014
James Monahan	1943–1985
Charles Morse, formerly Morse & Martin	1924–1970
Noonan & McDowell	1986–present
Oak Engineers	2000–2010
Oculus	2008–2011
Pembroke Land Survey Company	1959–2005
Polaris Engineering	2004–2008
Charles A. Putnam	1852–1899
Kenneth W. Richardson	1944–1973
Guy W. Ricker	1902–1911
Siegrist Land Surveying	1996–2005
Tilton & Chase	1930–1950
Towers Engineering Co.	1944–1956

vantage point

Elevations, Forms, Advice, and Frustration

When trying to keep dry, elevation means everything. When trying to show a site is likely to remain dry during a 1% annual chance flood, elevation still means everything. When trying to reduce flood insurance premiums, elevation remains paramount. When the lowest adjacent grade to a structure and any extensions to it are above the Base Flood Elevation (BFE) and no fill is involved, the site can be removed from the area where mandatory flood insurance coverage applies with a Letter of Map Amendment.

How we report those elevations in making applications to amend Flood Insurance Rate Maps (FIRMs) is a fairly uniform process, but the means of submitting that information may not be. Aside from mailing everything in, there are two web-based means for submitting applications for Letters of Map Amendments (LOMAs) to remove "inadvertent inclusions" from regulated floodplains. If the ground has been elevated by fill since being mapped, the appropriate process is a Letter of Map Revision Based on Fill, with different qualifications for a successful application.

The two online submittal platforms are meant for different purposes and different users.

eLOMA is only usable by licensed professionals, generally surveyors but possibly engineers and/or architects if permitted by their licensing boards to perform certain topographic work. Once that hurdle is passed and an account established, the professional can submit the most basic kinds of applications for quick production of a formal LOMA. These are not for sites with any fill, not for sites in coastal high hazard areas (V-type zones), and not for areas without identified BFE, whether from the FIRM, accompanying study report, or other reliable source of 1% annual chance floodplain study. For areas with detailed studies, the eLOMA process is instantaneous.

For more complicated LOMAs, and for all other kinds of map change applications, the online LOMC platform is available for anyone, licensed or not, to submit data for review by FEMA's contractors. Aside from being the general catch-all alternative to mailing in documents, there are some specific situations requiring application through online LOMC rather than eLOMA.

- If working in an approximate A zone without a BFE, use the online LOMC process to submit cross-sections for FEMA's contractors to determine the BFE for you.
- If your client wants to drive home a point, more than just "Removal" printed in the header of a LOMA for a site outside of the mapped Special Flood Hazard Area, use the online LOMC. The plotting you submit can result in "Out As Shown" in the LOMA header. That language implies something different to non-technical people.
- If you find a discrepancy between data supplied by the maps, profiles, and/or floodway data tables (yes, that does happen!), eLOMA is not for you. Report the most conservative BFE (the one least favorable to your client) in Box B-9 of the Elevation Certificate and explain its source in Section D, along with identification and copies of the conflicting data. The reviewers will not resolve the data discrepancy, but will confirm the proper use of the higher BFE in issuing the LOMA.

On a related note, the new Elevation Certificate is identical to the one that expired in November 2018. It followed a curious route to suddenly bursting upon the floodplain management scene. The usual, and legal, approach is to publish a notice in the Federal Register prior to expiration asking for public comments about the form, FEMA's evaluation of and response to those comments, and the announcement of when a new form will be coming out, well in advance of its mandated use. If a form expires before this process is completed, then official extensions allowing use of the old form keep that form legal. This is what happened before the now overly expired 2016-2018 form came into being; the form expiring July 31, 2015 was extended several times so that insurance agents and local floodplain managers knew they could accept and rely on forms despite being past their "best used by" date. When a new form is issued, notices in the Federal Register and on FEMA's website announce a six-month grace period to transition into using the new version.

Things went a bit awry with the 2016-2018 form. The Federal Register request for comments went out just after the work group providing input to update and revise the form was inexplicably and suddenly told to cease work and disband. The Elevation Certificate expired without any advance notice of extension. No subsequent notices came out, either, and FEMA's website provided no guidance as to when a new form could be expected. Then without warning, a new Elevation Certificate debuted on Friday February 21, 2020, with a statement on FEMA's website that it was to be used immediately, sans grace period to transition from the old form we had been using illegally for 15 months. The sole difference was the date printed in the upper right corner. Perhaps this is a stop gap measure and perhaps some of the suggested improvements will be incorporated at some point (the 2016-2018 form suffered several issuances with upgrades). For now, we can only hope FEMA gets the funding and support it needs for mapping and floodplain management effectively and responsively for the nation's protection. ■

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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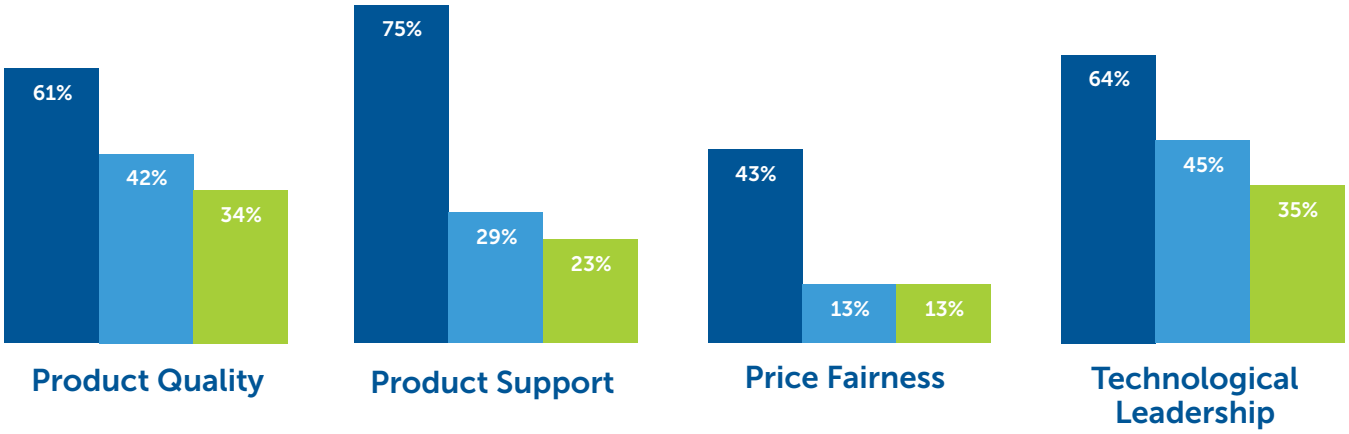

Top Box % Excellent*(among users of CAD software who are aware of CAD software brands and have purchased that brand in the last 12 months). Q7b1-b4. Please rate the following brands of CAD software on how they perform in Technological Leadership / Price Fairness / Product Support / Product Quality. [Select one for each] "Don't know" responses have been removed. * Data shown for brands >10% with an n-value>20. 2018 Surveying & Mapping Industry Software Study Copyright © 2019 by Clear Seas Research. All Rights Reserved.

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