



THE American Surveyor

A FOOT IN THE PAST... AN EYE TO THE FUTURE

September 2007

Magic Monuments

From Lasers to GNSS

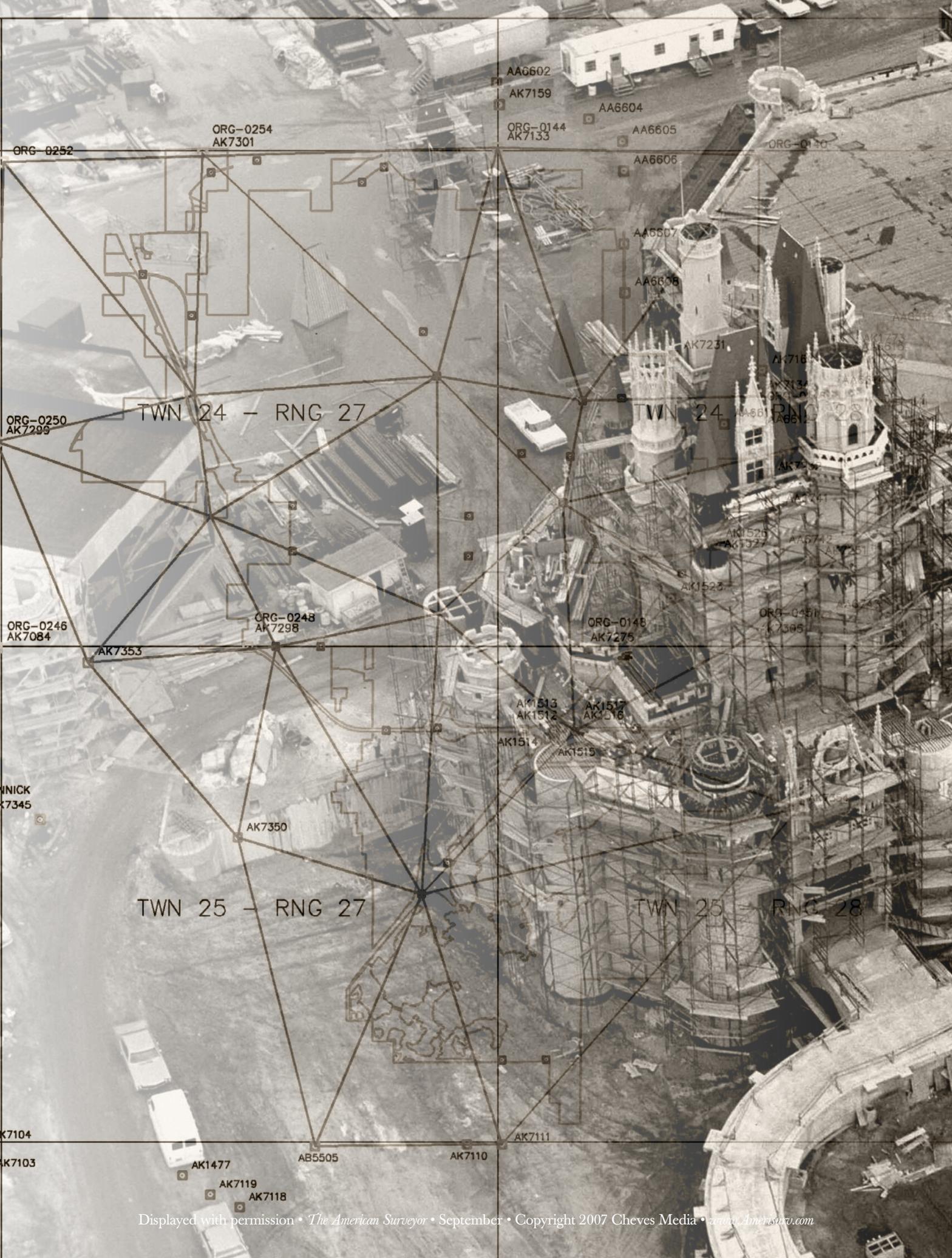
An interview with Ray O'Connor

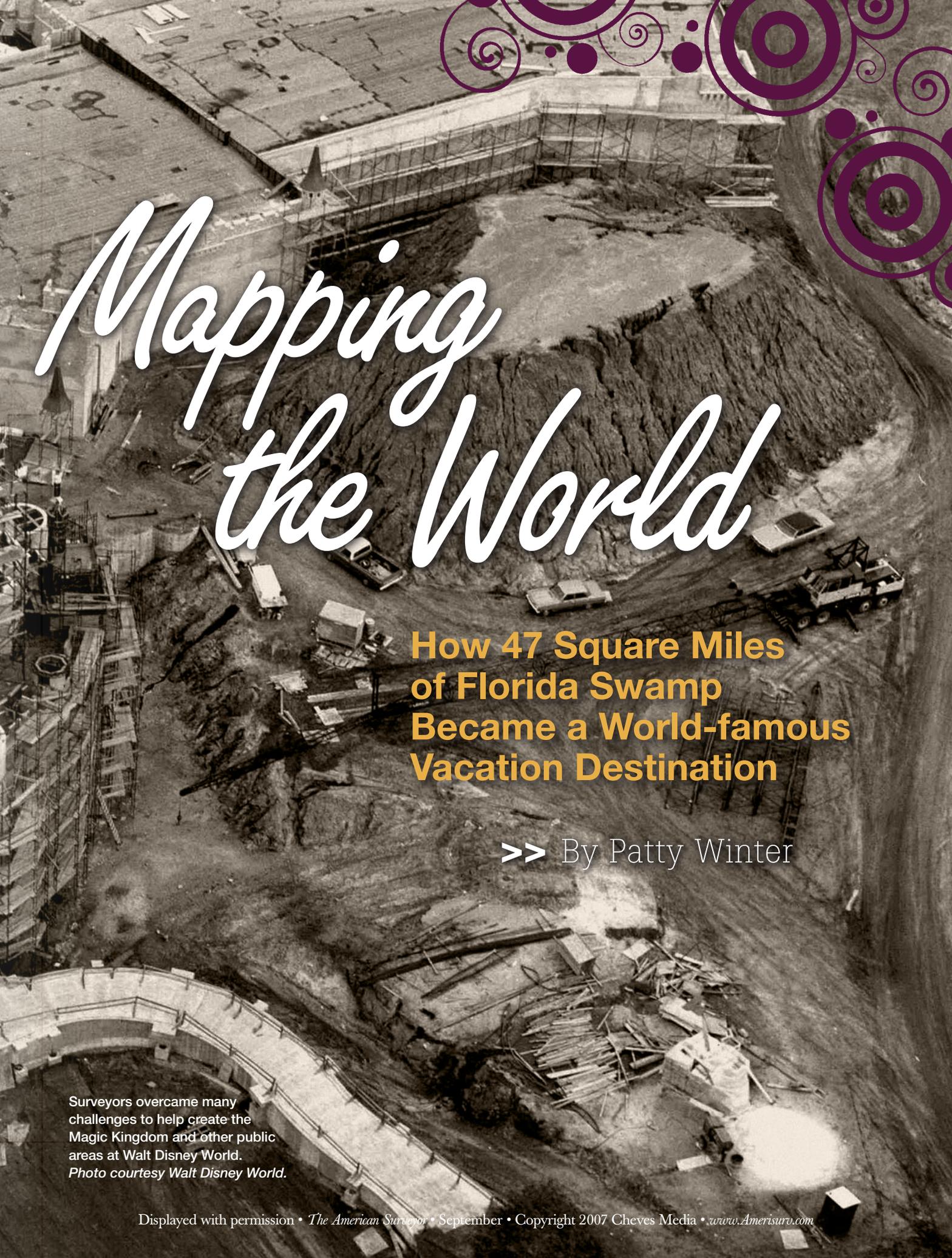
Conference Recaps

ESRI and Bentley show the way

Equipment Review

Sokkia's new robot gets a workout





Mapping
the World

**How 47 Square Miles
of Florida Swamp
Became a World-famous
Vacation Destination**

>> By Patty Winter

Surveyors overcame many challenges to help create the Magic Kingdom and other public areas at Walt Disney World.
Photo courtesy Walt Disney World.



Surveyor Bill Hart (left) with Walt Disney and other Disney executives as they plan the development of Walt Disney World.
Photo courtesy Bill Hart, Jr.

Bill Hart had seen the type before. In 1964, land speculation in central Florida was bringing guys like this one out of the woodwork.

Judging by his stylish clothes, he was a developer. Or maybe a lawyer working for a developer. Either way, he was almost certainly involved in yet another get-rich-quick land scheme – one that would go bad and leave Bill Hart’s survey crew unpaid.

The man was reluctant to give details, but said that he needed thousands of acres surveyed right away. Still wary, Hart prepared a work proposal. But he asked for a \$10,000 retainer before starting the job, and made it crystal clear that he would pull his team out if they didn’t get paid within five days.

Figuring that would be the last he’d see of the stranger, Hart headed back to an ongoing job on the Florida/Georgia border. But before he left, he mentioned to his wife and office manager, Judy, that if by some chance the job came through, he’d need a Geodimeter to do it.

Much to Judy’s surprise, the next day the man returned with a cashier’s check for \$10,000. That was on a Friday, and he expected the Harts to have a survey crew

on-site on Monday. This was long before cell phones, so Judy had no way to reach Bill in his remote work location to tell him what had happened. When Bill returned to Orlando a couple of days later, he swung by the office before going home and saw a Geodimeter sitting on the floor. On the blackboard was a note from Judy: “Geodimeter training Monday 8:00 a.m.”

swamps and the creatures in them. Current Walt Disney World chief surveyor Bud Joiner declares, “I don’t know how to emphasize enough how remote this area was at the time Bill first surveyed it. Everything was woods for miles.”

On top of the physical difficulties of the job, Hart was working for an employer who was well known for

Like most other Floridians, Bill Hart didn’t know at first who really owned the huge property he’d been asked to survey.

It wasn’t until much later that Bill Hart – and the rest of the world – found out the truth about this secretive project: The buyer of 47 square miles of central Florida was Walt Disney, and his plans to build a super-sized version of Disneyland would change this area forever.

Beginnings

The early working conditions in central Florida were brutal, including hip-deep

demanding perfection – and in nearly impossible timeframes. In order to meet the aggressive schedule for the still-secret project, Hart spent Christmas Eve of 1964 making solar observations to develop a basis of bearings. Despite these challenges, Bill Hart and his crews managed to carry out an extremely accurate survey, establishing a Cartesian coordinate system for the property that is still used today.

The Evolution of Disney Survey Disks

Walt Disney's plans for central Florida were made public in late 1965. In 1969, a contract surveyor who had helped build Disneyland was asked to become the first chief surveyor of Disney World. When he came on board, Don McKinney was greatly impressed by the work that Bill Hart had done. "He did such a beautiful job on that survey. I still don't know how he did it in the time frame he did, particularly way down in the south property. I grew up in Florida, and I've been in the woods all of my life; it's primeval down there."

Disney World was the biggest private construction project in the world at the time: the initial development included a theme park, two resort hotels, two golf courses, a campground, and two monorail loops. McKinney thought he would need 10 to 12 survey crews to tackle the job. He actually ended up with 21 in-house teams, plus a few contract crews. Because they couldn't find enough experienced surveyors in the Orlando area, the core group of Disney surveyors actually had to train crews themselves.

Snakes and Swamps

Besides the lack of local surveyors, the abundance of local snakes was a major issue during the initial surveying for Walt Disney World.

In addition to being crucial surveying tools, the Disneyland and Walt Disney World survey markers are fun for visitors to find. Photo courtesy Berntsen International.

In 1980, Disney's surveying efforts became more evident to the public with the installation of custom disks at Walt Disney World, and later at Disneyland. Those disks also represent an era of dramatic progress in manufacturing survey monuments.

In the late 1970s, the U.S. government contacted Berntsen Cast Products and asked whether the company could create some survey disks for a project in Saudi Arabia. The catch was that the disks needed to include Arabic text and the country's coat of arms, a palm tree and crossed swords. In those days, the lettering on survey disks was primarily done with zinc letters glued to a wooden pattern. No Arabic zinc letters were available, and there was no way to include artwork on a disk without going through an expensive and time-consuming engraving process.

Drawing upon his experience in magazine publishing, Berntsen general manager Bill Rushing got the idea of adapting paste-up and letterpress printing processes to metalwork. He thought it might be possible to use rub-down alphabets and line art to create the artwork for the sand molds into which molten metal was poured. "We tried it, and it worked. It allowed us to break away from the standard practice of gluing these little letters on, and do something that was more like art."

The success of the Saudi Arabia disks led Berntsen managers to think about

which other customers – or potential customers – might want their logos on survey markers. Bill Rushing recalls, "One day, one of our salespeople came back from a trip to Florida with a bumper sticker that had the Walt Disney World logo on it. We decided to speculate and make some samples. So we used the artwork from the bumper sticker for the graphic, and rub-down lettering for the Walt Disney World name, and tried some."

Soon thereafter, Disney ordered their first batch of custom survey markers. Interestingly, the resort's logo at that time featured a Mickey Mouse head representing the world – complete with latitude and longitude lines. It made a perfect disk design to represent both Disney and surveying. Berntsen even aligned the logo so that the center point of the disk was right where the central meridian and parallel meet.

In 1986, Berntsen adopted a cold-forming manufacturing process called orbital forging that allows them to do much more finely detailed artwork than is possible with casting. In orbital forging, a piece of brass or aluminum bar stock is crushed under thousands of tons of pressure until it flows around a metal die. This process was ideal when Disney built a second theme park in California and created a more intricate logo for what they were now calling the Disneyland Resort. The new survey disks feature multiple fonts, plus artwork of both Sleeping Beauty Castle and Grizzly Peak (the signature structures of the two parks). The Walt Disney World disks have also gotten more sophisticated over the years, and now incorporate a font that emulates Walt Disney's handwriting. Today, geocachers, "hidden Mickey" enthusiasts, and other Disney theme park visitors have fun finding these disks. Even professional surveyors get caught up in the Disney magic. As Berntsen president Rhonda Rushing notes, "For years, these have been the most popular logo cap we've taken to conventions. People right away say, 'I want to see the Disney marker!'"





In this photograph from approximately 1970, the Contemporary Resort rises behind Bay Lake, with the Magic Kingdom taking shape at the upper right. Photo courtesy Walt Disney World.

One of the scariest stories happened in the southern part of the property – the area that Don McKinney called “primeval.” One of Bill Hart’s crews was working at a site so remote that it wasn’t feasible for them to come out for lunch. So they would typically work straight through lunchtime, then end the day early.

But one day, they kept working until dusk. As they were walking back through the swamp, they began hearing strange sounds: plop...plop...plop...plop. The surveyors eventually realized that they were hearing cottonmouth snakes rolling off the banks and dropping into the water. Between the surveyors and the nearest dry land was

nearly a mile of swamp – and it was increasingly full of poisonous snakes. The crew chief later said that it was the longest mile of his entire life, but everyone made it back safely.

One time, a surveyor encountered a seven-foot rattler at the building site for the Palm golf course. He got so skittish that he began seeing “snakes” everywhere he turned. McKinney took pity on the shell-shocked surveyor and transferred him to a less stressful job.

A few years later, the same surveyor was assigned to map the site of the planned Pirates of the Caribbean ride in the Magic Kingdom. One day Don McKinney got a phone call from the project supervisor asking him to come

to the site to handle a problem. When McKinney arrived, he discovered that the unfortunate surveyor had encountered a nest of cottonmouths and was refusing to continue his work. In fact, he told Don, “Boss, you can fire me if you want to, but I’m not goin’ back in there!” McKinney didn’t fire the traumatized surveyor, but he did take him off the Pirates job.

In another incident, a surveyor came across a cottonmouth in what is now the middle of Disney-MGM Studios (one of the four theme parks at Walt Disney World). Today’s park visitors who think that the Twilight Zone Tower of Terror is frightening have no idea how *really* scary this area was 40 years ago!



Surveyor Gus Hart (Bill's brother) wades through a swamp with his equipment during the initial surveying for Walt Disney World. Photo courtesy Bill Hart, Jr.

The Monorails

One of the most daunting projects the Walt Disney World surveyors ever worked on is also one of the most visible: the resort's monorail system. Don McKinney notes that surveying the monorail line would have been easy with today's equipment, but in the late 1960s, the situation was very different. Laying out the footings was terribly critical, but the piers that hold the overhead track segments had to be positioned precisely.

"We didn't have any way of doing it except with a steel tape," McKinney recalls. "Trying to do precision steel tape work using a thermometer and a spring balance is really tough. As a matter of fact, I'd been a surveyor for a good many years before I came here, and I'd never done it before. But it worked pretty well, because that monorail did seem to work when we got it all put together." (To say that the monorail system "did seem to work" is an understatement. It now has three loops totaling nearly 14 miles, and its trains successfully transport an average of 150,000 passengers per day to various Disney World locations.)

The addition of the Epcot monorail loop a decade later was just as stressful. In 1978, the same year that Bud Joiner became a member of the Walt Disney World surveying team, plans were announced for the resort's second theme park. Don McKinney assigned Bud to oversee the surveying for the monorail



A surveyor works on Main Street, U.S.A. during the construction of the Magic Kingdom, the first theme park at Walt Disney World. Photo courtesy Walt Disney World.

extension. It was a big job for the young surveyor, because the monorail system required high-precision surveying. Specifically, the survey control on the two-and-a-half-mile Epcot loop had a horizontal repeatability of only three-hundredths of a foot. After two years of calculations, the construction of miles of monorail footings and columns, and some sleepless nights, all of Bud's work was proven correct with the setting of the first monorail beams, and the monorail loop opened right on time with Epcot in 1982.

Unusual Requests

Of course, plenty of surveyors have had to plan transportation systems or work in swamps. But Don McKinney observes that, in a compliment to the

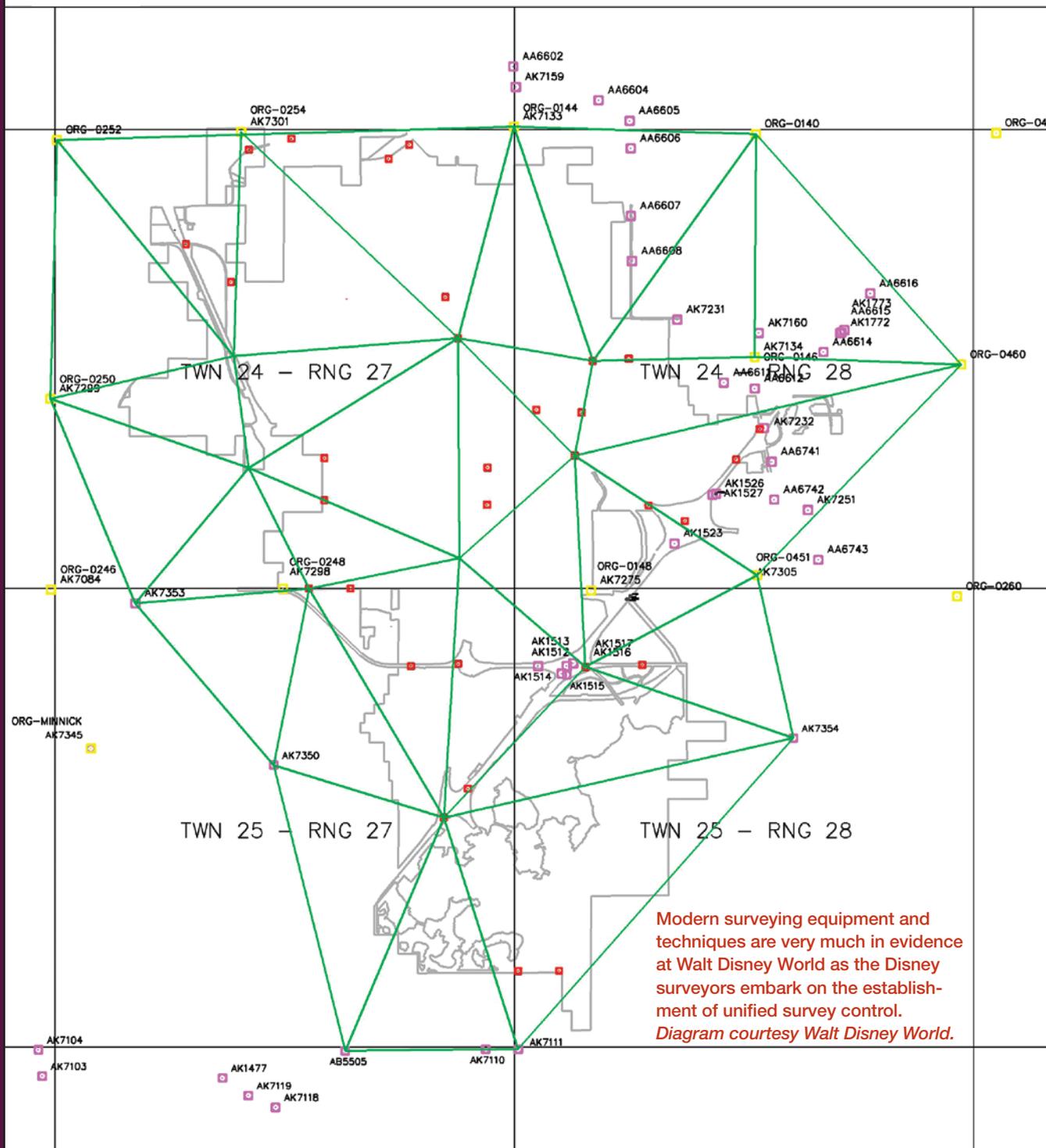
ingenuity of the survey department, the attitude around Disney World seems to be, "If there's any kind of a problem, just give it to the surveyors. They can figure it out!"

For example, McKinney's team helped decide the best placement of the major branches of the artificial banyan tree holding the Swiss Family Treehouse. Until they were able to train carpenters to do it, they also determined the proper layout of the curved walls and other interior features of Cinderella Castle. And when the Captain EO theater was converted to "Honey, I Shrank the Audience", surveyors plotted where the air lines for the seats should go. (If you haven't been to the show, I'm not going to spoil the surprise by explaining why the theater needed air lines!)



Walt Disney World

GPS Densification Project



Modern surveying equipment and techniques are very much in evidence at Walt Disney World as the Disney surveyors embark on the establishment of unified survey control. Diagram courtesy Walt Disney World.

Speaking of Cinderella Castle, Walt Disney World's most famous symbol has surveying significance. Although it's no longer needed in these days of precise GPS-based coordinates, the 189-foot-high castle was used as a triangulation station for many years. Don McKinney recalls, "It was wonderful, because no matter where you were, you always had a backsight back there."

Then there was the fireworks project. McKinney explains, "The company came to us and said, 'We don't think we're getting the height off our fireworks that we're paying for, and we want you guys to come out here and measure them.' We went, 'Huh?'"

But the surveyors took on the challenge. "We triangulated a point up on top of the Contemporary [a hotel near the Magic Kingdom]. We had two theodolites up there, with two of our best instrument men. Then we got the audio/video people up there with us. The A/V folks took video of the fireworks, and whenever the survey crew said, 'Got it! That one!' they made a note about that burst." Later, back in their offices, the surveyors superimposed the heights calculated by the theodolites onto the images of the fireworks exploding over the Magic Kingdom. "It worked like a charm," McKinney recalls. "It wasn't easy, but it was very, very accurate."

The survey team has even done work indoors. One of the last jobs that Don McKinney worked on before he retired was Spaceship Earth. "They wanted to change it, and all the scenes that you see in there had to be mapped. This had to be



The lone original Disneyland survey marker remains near Pirates of the Caribbean.
Photo by Patty Winter.

done when the ride was inactive, so that meant we were out there in the middle of the night." More recently, the Disney surveyors performed a laser scan of part of the interior portion of Big Thunder Mountain Railroad. The information they obtained was so accurate that, as Bud Joiner notes, "You can generate a readable centerline from this data and come up with the ride geometry."

Into the Future

As you'd expect from a company that prides itself on staying ahead of the curve, the Disney World surveyors are keeping on top of the latest surveying practices and technologies. They have an ongoing GPS densification project, supplementing a survey control network that already has more than 10,000 control points. (That's just the outside points; there are others indoors. For example, during the renovation of

Pirates of the Caribbean in early 2006, workers removing drywall uncovered a number of old control points.)

The department's extensive GIS database includes the locations of all roadway signage, utilities, and the like throughout the property. In addition to the wealth of new data they're collecting, they're also digitizing their old written information, including all 100,000-plus pages of field notes.

Currently, there are just over 20 people in the survey department. With new development always going on somewhere at Walt Disney World, about 1,800 requests for utility locates coming in every year, and each day bringing the possibility of some completely unexpected project, Bud Joiner and his colleagues have their hands full. But they doubtless share Don McKinney's views about the job: "Being a surveyor at Disney is not routine. Those first three years I was here, I can honestly tell you I never worked so hard – or had so much fun." *A*

Patty Winter is a freelance writer from the San Francisco Bay Area. When not working for high-tech clients, she writes magazine articles about geology, amateur radio, the space shuttle, and other topics.



A Mickey Mouse survey disk can be found outside the striking Mission: Space attraction at Walt Disney World.
Photo by Nick Enicks.