

# Precise Pipelines

BY TIM RAND



**GNSS equipment speeds surveying work for natural gas exploration and drilling projects.**

be recovered. In 2008, more than 8,000 oil and gas drilling permits were issued by the state, and the pace of permitting is expected to increase substantially in the coming years as the Marcellus Shale exploration continues. This exploration could create as many as 50,000 to 100,000 jobs in the state over the next few decades.

## **Tapping Into the Flow**

The natural gas industry is fueling work for Tri-County Engineering & Surveying in Greensburg, a hilly town in western Pennsylvania. Started more than 30 years ago by land surveyor and professional engineer Stephen Pilipovich, the firm has worked on more than 3,000 well projects along with other work in the residential and commercial sectors. Today, a significant portion of

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**N**atural gas production has long been a part of the Pennsylvania economy. The state ranks third nationally for the number of active oil and gas wells with more than 79,000 wells currently producing. The end of new drilling is nowhere in sight. In fact, it may be entering a new beginning.

A pocket known as the Marcellus Shale is located on the west side of Pennsylvania and extends into West Virginia, New York, and Ohio. It was recently estimated to contain as much as 400 trillion cubic feet of natural gas—enough to supply the gas needs of the entire United States for 14 years if all of it can

Tri-County's business is focused on gas companies. Although the downturn in the economy has hurt the residential side of the business, Pilipovich is not complaining. He has work for his 16 employees. In fact, last year, Pilipovich added two crews to help with the increased gas business—each with a Topcon HiPer Ga GNSS system.

Pilipovich first turned to GNSS technology to speed up his survey work six years ago. "When I started looking at GNSS, I went up to a surveyor conference, and I took my chief of surveys and one party chief," he says. "I told them to look at all the



**Above and left: Modern gas wells might contain six to 10 wells with one pad. Each unit may be 1.5 miles wide and anywhere from 2 to 4 miles long. Photos courtesy of Range Resources.**

have that before on their equipment. They were surprised to get the readings and pick up what we did," he notes. According to Pilipovich, Glonass combined with the GPS constellation of satellites has virtually eliminated downtime from lost signals because more signals are visible to the receivers, which makes the firm more efficient at completing gas well projects.

### Controlling Vast Projects

Until the last few years, all wells were vertical shallow wells (2,000 to 3,000 feet deep) that captured the gas released from a single hole. Now, most wells are drilled vertically and then horizontally at depths of 6,000 to 7,000 feet, and multiple horizontal legs go out 3,000 feet within a pocket of earth that contains gas. This method provides a much faster rate of return. The deep wells have pads that are at least 400 feet by 400 feet and may be as large as 400 feet by 800 feet. Such large pads require level ground. "Once they [the gas companies] came in and started making sites this large, they learned that they had to find a better location to put the stakes in because you can't build it on a hillside. [If they did], they would have to have a cut on one end and a fill on the other to make it flat," Pilipovich says. "Now they try to find flat areas."

### Control from the Air

When working on natural gas wells or land development sites larger than 10 acres, Tri-County Engineering & Surveying incorporates aerial control to develop detailed 3D topography of the site. "We have airplanes fly over and take photographs of the site using digital stereo photography," Pilipovich says. "They will pick spots on the photos like the corner of a sidewalk or driveway ... different points in the photos. They have to overlay the photographs to get the three-dimensional layout. Once they have two views in stereo, they can plot out the three-dimensional contours." The horizontal and vertical coordinates of these points allow the surveyors to make adjustments on their maps, he explains.

Flying works best when there are no leaves on the trees so the ground can be captured in the photograph by an airplane flying at an altitude of 600 feet. "A little dusting of snow helps because it lightens it up," Pilipovich says. "February is the best time."

equipment—pick it up, push the buttons, get a feel of it. They picked Topcon." More specifically, they chose the Topcon HiPer system (an earlier instrument in the HiPer series). According to Pilipovich, the surveyors liked the system's ability to receive signals from multisatellite constellations—GPS and Glonass—and they opted for this upgrade from the beginning. "It's great," Pilipovich said regarding the Glonass capability. "We used to do mission planning when we started. We'd look with and without the Glonass satellites, and you can tell a lot of difference. You always have coverage."

The equipment also gets good readings under canopy, Pilipovich says. "Other people came to work for me that didn't

His crews start with staking out the wells. "We tie it to existing wells and tie to property lines to make sure we are on the property. From there, we tie into other offset wells. We also topo the sites so we can do the grading plan for permitting." They also survey in the road location. They stake out where the pipeline will go and show the gas company what properties the line will cross. The company then verifies it has all the properties under lease.

Each well takes three to four weeks to complete. After the pipeline is built but before it has been covered with dirt, Pilipovich's crew comes back and does an as-built survey. They mark every weld in the 40-foot-long sections of steel pipe.



**Stephen Pilipovich, owner of Tri-County Engineering & Surveying in Greensburg, Pa., invested in GNSS equipment to speed his firm's surveying work.**

**Right: Using advanced GNSS technology, surveyors can complete work on large gas wells in a matter of days.**

The record of each weld joint is valuable; if there is a problem in the future, the joints can easily be located.

One of the main gas companies Tri-County Engineering & Surveying works with is Range Resources. The company has massive projects that might contain six to 10 wells with one pad. Each unit may be 1.5 miles wide and anywhere from 2 to 4 miles long. The survey crew has to tie into the top and bottom location of each hole, which can extend almost 2 miles underground. Running the survey over such a large area would take weeks if done with conventional methods. Using advanced GNSS technology, the surveyors can complete the work in days.

Another challenge is tying multiple pads together, and these pads are also a couple of miles apart. The survey work details where the horizontal drilling extends and indicates where the pipelines run between pads. The surveyors used to do everything with localized coordinates off a random base point. The vastness of



the current projects has been controlled by converting everything to state plane coordinates using the OPUS system, a government-controlled base station that facilitates real-time kinematic (RTK) readings when combined with satellite technology. "We know exactly where we are with the well and pipelines and can tell you the distance between anything," Pilipovich says. "You download your point readings and e-mail the information to OPUS, and their computers will send you back the coordinates."

The use of two receivers in the Topcon HiPer Ga system also facilitates setting stakes or marking joints. The surveyors use one of the receivers as a base station on a known point and transmit an RTK signal. The other receiver takes that signal and combines it with the satellite signals to achieve subcentimeter accuracy. Pilipovich says that his crews have been able to receive good signals from the base in excess of three miles.

## **Staying on Top of Technology**

Pilipovich runs five crews. Or, as he tells it, sometimes they run him. "One Saturday, I went out with one of my party chiefs to stake a couple of thousand feet of roadway. I said 'I'll pop the stakes in,' and he had me running to keep up behind him," he says. Pilipovich is proud of his crews. Several employees have been with the company a long time. Donald Hixson, PE, PLS, is the operations manager and has been with the company 15 years. Crew Chief Wade Fleming has 12 years of service. Ryan Jones is also a crew chief with a year under his belt. John Vozel, PLS, is chief of surveys. He has been part of the team for 24 years. Pilipovich's wife, Peg, serves as the business manager.

In addition to his staff, Pilipovich counts on people like Randy Miller with Productivity Products and Services Inc. in Saxonburg, Pa. Miller is the person from whom he buys his Topcon equipment, can get any questions answered about installation or operation—and find out about the latest technology.

Everything has changed in the last 30 years. Pilipovich has a display in his office of the equipment he has used in his career. He started with a transit and tape. When he first began using a total station, Pilipovich says it probably doubled the amount of work he could do. Right now, his GNSS equipment and the crews who use it are working for gas companies most of the time. There is plenty of work to go around for surveyors, and there are good-paying jobs available for people wanting to work in the gas industry. Because he has chosen to embrace modern technology, Pilipovich is getting a respectable share of the surveying work "For what we are doing today, it would be impossible to compete without GNSS equipment," he says. "We use it for just about everything." 🌱

*Tim Rand is a freelance writer and photographer based in Paragould, Ark. For more information about Tri-County Engineering & Surveying, call 724/832-8814. More information about Topcon GNSS equipment can be found at [www.topconpositioning.com](http://www.topconpositioning.com).*