

# RECLAIMING EFFICIENCY

## GNSS technology enables efficient as-built surveying for a \$100 million wastewater treatment and reclamation plant addition.

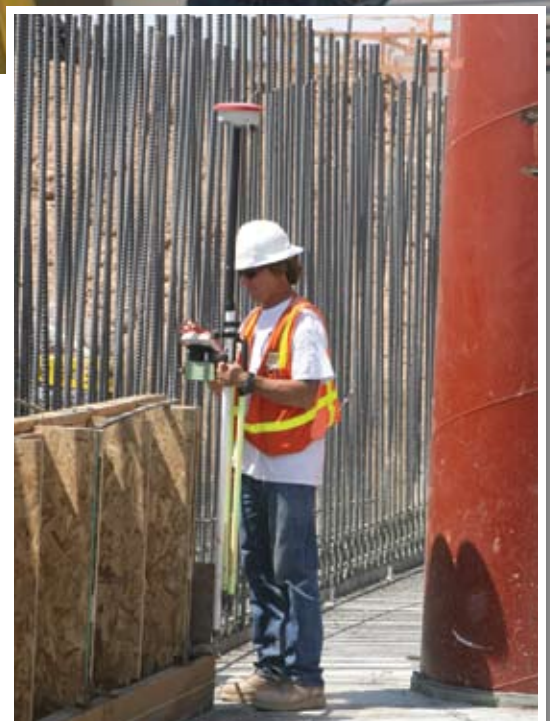
BY DANIEL C. BROWN

**Field engineer John Simms levels his Leica robotic total station at the wastewater treatment and reclamation plant's \$100-million addition. Inset: Simms uses his Leica GPS system to collect as-built shots at the plant.**

**H**ow many surveyors are needed to stay ahead of 75 to 100 construction workers building a \$100 million wastewater treatment and reclamation plant addition? Using traditional total stations and data collectors, such a project might normally require four or five people to handle the construction survey work. However, new-generation surveying equipment is enabling field engineer John Simms to complete all of the work by himself.

The expansion site occupies 15 acres. Construction will include four new secondary clarifiers, each 140 feet in diameter; four new aeration basins, typically 95 feet by 185 feet; a new reactivated sludge pump station; a switchgear station; a new blower building; an electrical building; an electrical building transformer pad; inlet structures; and other buildings.

To manage the project, Simms uses a newly acquired Leica PowerTracker robotic total station with automatic target recognition capabilities, a Leica PowerAntenna GNSS receiver, a Leica MCP 950C data collector and vari-





**Collecting an as-built shot on the center line of a 54-inch sewer pipe requires careful footwork.**



ous accessories. “We will easily pay for the system on just this project by not having to pay a full surveying crew,” Simms says.

### **As-Building Aeration Basins**

A substantial part of Simms’ work involves using the GNSS equipment to collect as-built observations of existing treatment plant works. However, after surveying the existing aeration basins at the plant, Simms noticed a problem: His as-built survey didn’t match up with the design engineer’s plans for the new aeration basins. A tunnel that carries wastewater into the existing aeration basins (AB 9, 10, 11 and 12) will also serve the new aeration basins (AB 13, 14, 15 and 16). Inside the tunnel are 30-inch-diameter pipes supported on racks that are housed in below-grade structures.

Simms’ measured center line of the tunnel was 0.75 foot long on AB 11 to 0.25 foot short on AB 10. “I needed to verify the center line of the existing tunnel from AB 9 to AB 12 to ensure that the new aeration basins would be aligned correctly and that the new piping would have adequate clearance,” Simms explains.

Simms returned to the site. Beginning inside the tunnel near AB 9, he established the center line of the structure using a tape measure and plumb bob and transferred those measurements to the top deck of the structure. He repeated that process for AB 12. The resulting center line passed through AB 9, 10, 11 and 12.

Simms then used the robotic total station to stakeout the center line from the top deck of the structures. Since the total station communicates with the data collector through a radio connection, Simms was able to monitor and control the total station operation from the rod.

His next step was to use the GNSS system to verify control points by tying into the original surveyor’s coordinates, which were supplied by the plant owner as a rough CAD drawing that needed to be scaled to size. The GNSS receiver uses Bluetooth connectivity for cable-free communication to the data collector, and it processes Glonass signals as well as GPS for improved satellite coverage. Simms used a Leica GPS base station (part of the public Spider Network in the region) owned by the water reclamation district overseeing the project. “I verified northing and easting and the elevation of control point 411, one

of my original controls, within 0.015 foot horizontally and 0.005 vertically,” Simms explains. “My measured center line was within 0.03 foot vertical on elevation and within 0.02 foot on horizontal.” Simms then used the GNSS system to observe the positions of the as-built outside corners of AB 9 and 10, the four outside corners of AB 11 and 12, and the center line.

The observations confirmed that the center line of the existing tunnel was off by 0.375 foot from the given coordinates of the planned aeration basins. Proceeding with the existing engineering design for the new structures meant that either the new piping might not fit on the racks or there might not be enough room to fit larger bore pipes into the existing tunnel.

The solution was to establish a new center line reaching 550 feet from the inside face of AB 9’s east wall to the inside face of the west wall on AB 12. “That was my longest shot,” Simms explains. “Once [the design engineer] approved the new baseline and variations from the existing design, we could just rotate the new structures, AB 13, 14, 15 and 16, and the reactivated sludge building to match the new center line from AB 9 through 12.”

Simms downloaded the new points to his data collector and went to the field to lay out the grid with the Leica robotic total station. North-south grid lines were 31 feet apart due to the constraints of the existing structures, and east-west grid lines were set at 25-foot intervals. He then gave construction crews 5-foot offsets so that they could set their batter boards for footings and walls.

### **A Flexible Setup**

Simms also uses a combination of the GNSS equipment and robotic total station to give earthmoving crews cut and fill information for rough grading and to take measurements in duct banks. According to Simms, the flexibility of the Leica system enables him to connect the prism for the total station, the data collector and the GNSS antenna onto the survey rod all at once. By mounting the PowerAntenna to a 5/8 x 11-inch screw at the top of the 360-degree prism, Simms can simply select which equipment he wants to

**Simms takes a backsight with the Leica PowerTracker robotic total station.**



use and then switch radios. For example, if he is staking out building corners with the robotic total station and a construction crew has an urgent need for an as-built of a pipe in another corner of the site, Simms can quickly do the as-built with the GNSS system and then return to his task of staking out the building—all with the same integrated equipment.

When construction crews are ready to excavate for a new building, Simms gives them the building lines, the bottom of footers and the cuts and fills for rough grade. He gives the crews offsets and a cut sheet with an AutoCAD drawing. On lath stakes, he marks the point identification, the distance of offset, the point number and the elevation of the established point.

Staking out a new structure, such as the activated sludge building, takes Simms about an hour and a half using the advanced technology. In his AutoCAD drawing, he selects the four building corners and the bottom of the footer elevation and downloads the points from the software into his data collector, which contains a localization file (the northing, easting and elevation control points used to lay out the plan). He then goes to the field to lay out the building. Using the Leica robotic total station, Simms occupies a known control point, backsights to another known control point, and proceeds to take foresights for the new building. “The nice thing about the Leica ‘gun’ is, it will take two shots and compare the shots to each other,” Simms says. “And it has an automatic correction

for temperature and barometric pressure. I really like that about that gun.”

Not only is Simms a one-person crew in the field, but the latest office software has also reduced the number of people required in the office process. “I do all the CAD work myself,” Simms says. To double-check his work, Simms uploads his collected data/assess into Carlson software and inserts them into the existing AutoCAD drawings. “If the points don’t line up, then I’ve got problems,” Simms says.

Collecting as-builts with the GNSS system is quick and easy. “I’m able to do the work myself, check the work myself, and I’m able to turn it in to the engineers in either PDF format or .dwg format, and the engineers will accept that,” Simms says.

It’s a far cry from the way such projects used to be handled. The increased efficiency is undoubtedly saving both time and money for the contractor, and it’s allowing Simms to stay on the cutting edge. 🌐

*Daniel C. Brown is the owner of TechniComm, a communications business based in Des Plaines, Ill. For more information about Leica surveying equipment, visit [www.leica-geosystems.us](http://www.leica-geosystems.us).*

**Seventy-five to 100 workers are employed in the construction of the wastewater treatment and reclamation plant.**

