RFID

Utility Mapping Only as Accurate as Your GPS

/ BY MATT MCLAUGHLIN

For more than two years, the Virginia Department of Transportation's Northern Virginia District has experienced great success with a pilot program that uses RFID marker balls, GPS receivers and GIS-based software to map the locations of buried utility assets. As the application has gained in popularity, it has become clear the overall accuracy of the created maps is only as good as the GPS receivers used to make them.

As described in the fall 2011 issue of ***Damage Prevention Professional*** (pp. 30-31), VDOT's Construction Project Control group deployed the technology after facing years of frustration with inaccurate as-built utility maps. The group, which is responsible for identifying underground telecommunications, gas and water lines so they can be moved prior to new transportation construction projects, routinely found major location discrepancies in asset maps provided by the utilities.

In the rapidly growing Northern Virginia area outside of Washington, D.C., as-built errors occur in many ways. Often, the locations of new pipes and cables are poorly mapped when they are installed, or the details of modifications made in the field never get back to designers in the office. And sometimes, the design drawings just haven't been updated with as-built information before the next construction project begins.

In the worst case scenario, the result of an inaccurately-mapped underground asset can be deadly. More often, however, the consequences are less dramatic, but can still be very expensive. Construction crews may have to be idled at enormous cost when an unmapped pipe or cable is found and relocated. In some cases, fines may be levied on project participants if road closures encroach on Northern Virginia's legendary rush-hour traffic.

The first part of the solution to the buried utility mapping problem came to VDOT from 3M Corporation. It has developed a line of inexpensive Electronic Marker System (EMS) marker balls, about the size of a softball, which can be buried along with old or new utility assets. Each marker ball contains an RFID chip that can be programmed with a computer-based, handheld locator device also made by 3M. A major advantage of the marker balls is that they require no batteries because their RFID chip is energized by a signal from the locator device.

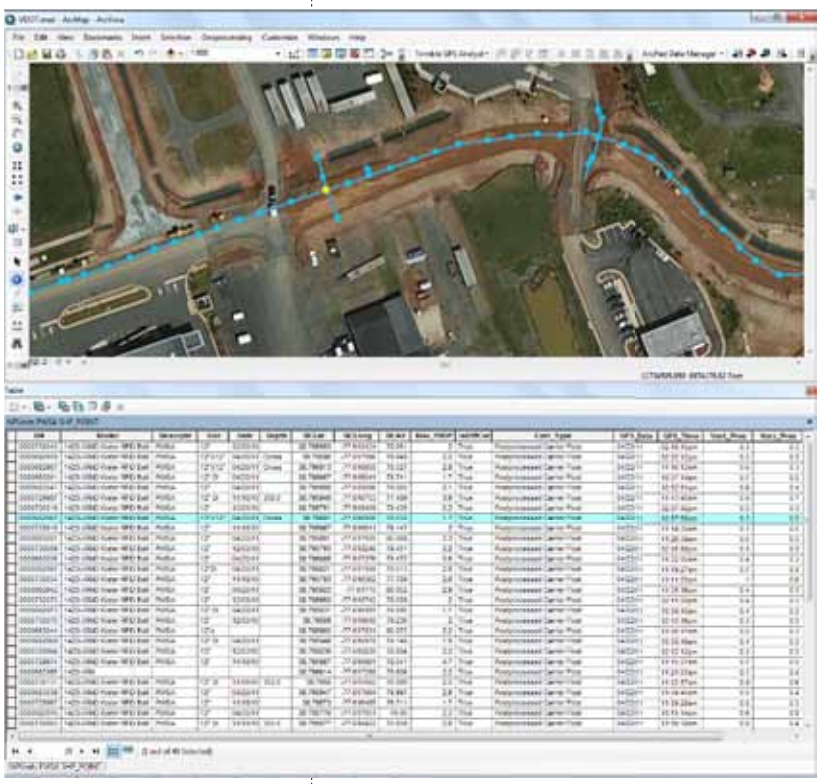
In a typical implementation, a VDOT field technician downloads utility asset description templates to the mobile computer on the locator device. As the pipeline or cable is laid in the ground, the technician drops a marker ball into the excavation trench every 25 linear feet. The technician then uses the locator keypad to enter important asset information into the template for each ball, including its identification number, asset description, geometry, ownership details, and – most importantly – depth of utility below marker. Held within 12 inches of the marker ball, the locator device transfers this data to the RFID chip.

VDOT and many utilities in the Northern Virginia area have formed a collaboration to purchase the marker balls in bulk. They calculate that each one adds only $0.60 per linear foot to the average utility installation or relocation project. As a result, the department uses them extensively, often mapping abandoned assets that are unexpectedly found during new excavation projects. VDOT provides as-built maps to all utilities that are participating in the collaboration.

Putting Assets on the Map

As noted, the marker balls solved only half the underground asset location challenge faced by VDOT and the utilities with which it works. While the balls marked and identified the pipe or cable, the assets still had to be mapped accurately.

Location of a water main that was mapped by GPS, using RFID data points and overlaid inside ESRI ArcMap. How valuable is this to a field locator?



This part of the solution was provided by Tri-Global Technologies, developers of GPS-based mobile mapping applications. One of the firm's most popular products is UtiliMapper, a software tool that runs on GPS-based mapping devices and integrates wirelessly with many common underground utility locators. Working with VDOT, Tri-Global modified its commercially available UtiliMapper software to communicate with the 3M locators to capture information from the RFID chip.

VDOT typically performs the mapping component of this solution immediately after the excavation has been backfilled. In this implementation, the VDOT technician walks the trench equipped with the 3M locator and a Trimble handheld GPS-based mobile data collector running the UtiliMapper program. A wireless Bluetooth connection is established between the two handheld units so that information can be transferred between them.

Operating in the data-read mode, the locator activates the embedded RFID chip on the buried marker ball from a vertical distance of up to three to five feet. As the locator reads the RFID data, the Bluetooth transfers it to the mapping software on the mobile GPS device where the information is stamped with accurate horizontal location coordinates. As the marker location and related information are captured for each marker, the software literally connects the dots, creating a map of the buried pipeline, fiber or cable.

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It should be noted the UtiliMapper software solved another nagging problem for VDOT – the lack of standardized mapping formats within the transportation industry. MicroStation, AutoCAD, SmallWorld, and ArcGIS are used for mapping purposes by the various engineering, construction and utilities involved in any given relocation project. Fortunately, the Tri-Global software can output maps on the fly in any of these formats, as well as Google Earth, in the desired state plane coordinate system.

As VDOT prepared to deploy this solution, it realized the selection of the mobile GPS device was critical. The UtiliMapper software runs on a variety of field computers and integrates location data from many different brands and grades of GPS receivers. Although the price of a recreational or smartphone device equipped with GPS was tempting, it was not seriously considered because the 10-20 meter horizontal accuracy of such devices is essentially worthless in mapping underground utilities.

For VDOT, which traditionally uses Trimble GPS equipment, the only real choice was between a handheld unit with sub-meter or sub-foot accuracy. Considering that most underground utility installations are multi-million-dollar projects and the cost of a severed cable or ruptured pipeline can cost many times that figure, VDOT saw the decision as an easy one. Accuracy was the highest priority.

The cost of the sub-foot GPS receiver was insignificant in the overall scope of the project, especially since the device can be used repeatedly to enhance the accuracy of numerous types of mapping jobs. VDOT now routinely maps its underground utility assets with a horizontal accuracy of about six inches using the Trimble® GeoExplorer® GeoXH™ 6000 and differential post-processing data from a fixed GPS based station. These units offer the added benefit of having built-in cameras that take photographs with GPS coordinates, time and date stamped on them. DP