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POB

POINT OF BEGINNING

SURVEY-GRADE GIS

*Streamlining projects with
integrated mobile technology*

THE SPEED OF INTEGRATION

BY ANN HOVLAND

Integrated mobile GIS streamlines project completion by combining in-the-field GIS capabilities with survey-grade accuracy.

When the CH2M HILL survey crew set out to bid on a project to map 1,500 sewer manholes for Oregon's City of Woodburn, the challenge was to gather and organize a diverse group of data with a limited budget. The city's wastewater collection and transmission system had been under continual expansion since it first entered service. There was concern about localized areas, and city officials needed to evaluate the long-term condition and capacity of the system. A detailed map would enable them to make sound investment decisions.

Existing data about the collection system were stored in two separate databases and were known to be inaccurate and incomplete. The goals for mapping were to consolidate system asset data into a single GIS database and dramatically improve the accuracy of the spatial data. For each manhole, the city wanted the pipe invert elevation, pipe size and type, documentation of condition, amount of debris, and photos.

CH2M HILL's surveyors met to discuss how to go about the proposed project. "While brainstorming for our approach, we had the usual discussion about cost versus accuracy," says Tony Brooks, PLS, survey and mapping manager at CH2M HILL. "We talked about what competitors might propose. Many would likely suggest low-cost options that could not achieve the requested accuracies. Others would probably fulfill accuracy requirements and blow the budget. We wondered how we might find the middle ground."



The CH2M HILL survey crew used a Leica TCRP1201 (part of the TPS1200+ line) in conjunction with an Xplore Tablet loaded with Leica MobileMatriX Version 3.0. Inset: Adam Casalegno, survey technician at CH2M HILL, reviews data on the Xplore Tablet. All photos by Jason Bittick.

Successful integration of existing data and data integrity was crucial to the project's success because initial data acquisition and ongoing maintenance would otherwise become a time-consuming process. A traditional approach would have generated an inordinate amount of notes that would have been difficult to organize and deliver within budget. The crew began to discuss the possibilities of a mobile GIS approach.

Mobile GIS Defined

Mobile GIS literally moves GIS technology from the office into the field. It is designed to streamline file data collection and field-to-office communications by integrating such technologies as field PCs, total stations, GNSS equipment and levels. While each of these tools could be used separately, they have not traditionally been used together at the same time, particularly not in a "field-to-finish" approach. In-office GIS professionals need tools and processes to bridge the gap between technical disciplines in order to efficiently inte-

grate diverse data sets and convert them into an enterprise database.

The traditional GIS workflow generally involves 10 steps:

- Set up or check the primary survey control.
- Collect field data.
- Process survey fieldwork in the office.
- Manage the quality of office work and fieldwork.
- Export survey data to GIS as a points list.
- Generate a GIS import and edit the points list.
- Conduct a GIS review of new versus existing information.
- Conduct a GIS edit of existing information to surveyed location.
- Combine the GIS surveyed data and client data.
- Conduct a GIS review of surveyed data for quality-control flow issues.

While the traditional GIS survey workflow requires a large number of processing steps in the office, mobile GIS technology



combines a number of these steps and offers a field-to-finish solution.

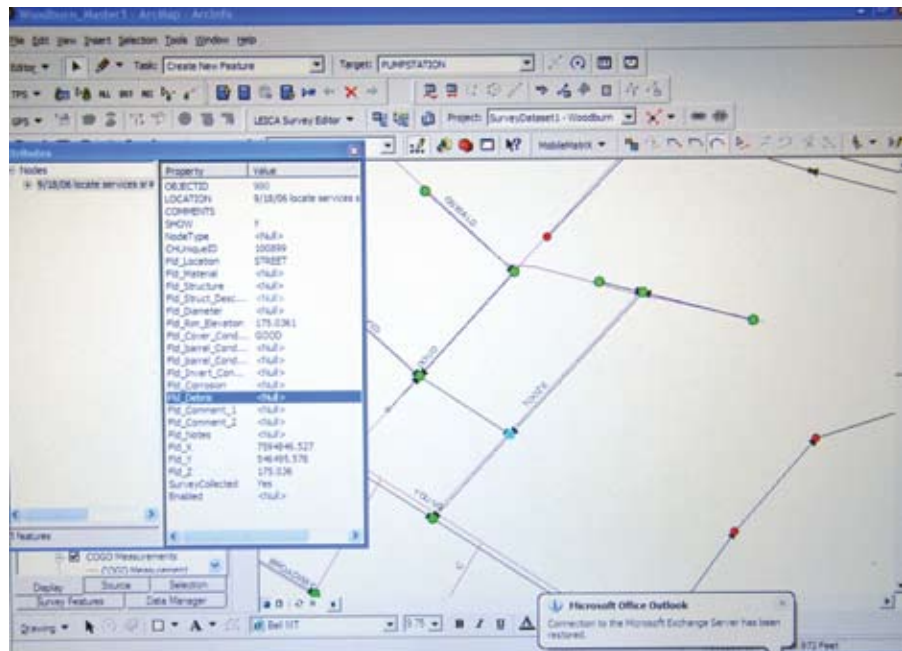
The CH2M HILL crew decided that an integrated GIS/survey approach would allow them to meet the client's accuracy and budget requirements. After considering various products, the crew chose Leica MobileMatriX on ArcGIS, a mobile GIS software that runs inside of ESRI ArcGIS. The survey software would provide the crew with both in-the-field GIS capabilities and survey-grade accuracy. By processing data in the field rather than in the office, the crew could review and address any data conflicts on the spot. "We estimated that we could significantly reduce the workflow and reduce costs by going directly from point collection to end product in one step," Brooks says. The city awarded CH2M HILL the project.

Hardware Setup and Data Collection

To run the MobileMatriX software, the crew needed a computer that could be used in the field. This meant that the computer needed to be rugged and minimize sunlight glare on the screen display. Ideally, the equipment would also have touchscreen capability. For these reasons, the crew opted to use an electronic tablet instead of a laptop.

CH2M HILL purchased an Xplore tablet from Xplore Technologies and loaded onto it ArcGIS Version 9.2 and Leica MobileMatriX Version 3.0. The tablet's Bluetooth technology allowed data to be transmitted wirelessly between the team's Leica GPS and TPS 1200 instruments. The Xplore tablet was purchased with an internal cell modem for Internet access to ORGN (Oregon's real-time GPS network) and the office network.

Once all of the gear was assembled, the crew needed to learn how to use it. The surveyors contacted Leica, and the company assigned a technician to the job of bringing everyone up to speed. After a week of long phone calls and some trial and error, the tablets (and operators) were running smoothly. "Like any new software, Leica MobileMatriX took some



This screen capture of Leica MobileMatriX running inside ESRI's ArcGIS software shows some of the attribute options for the project.

time to learn, but with help from Leica technicians, the team was able to pick it up quickly without much downtime," says Adam Casalegno, survey technician at CH2M HILL.

Once in the field, with a GIS background of the sewer system at their fingertips, surveyors were able to quickly locate the manholes. The field crew collected the data and transferred them to the portable tablet PC device through Leica MobileMatriX, which linked the data to the CH2M HILL office network version of the city's functioning GIS database. The crew could work independently from the city's database for long periods and then synchronize the office database with the updated field database later when a connection to the CH2M HILL office server could be made. (The crew linked up to the office for downloading and uploading at least every other day.) Data changes were then transferred and integrated with the central database using the check-in process from ArcGIS. This approach enabled the crew to manipulate, update and add survey-grade information and synchronize it with office data in the field rather than having to upload data to a survey program and clean it up later.

Using the integrated survey/GIS approach, the crew cut the number of workflow steps in half:

- Set up or check primary survey control.
- Collect field data directly into ArcGIS. (Inconsistencies were corrected in the field, including features, client location to surveyed location, conditions, locations and flow directions.)
- Enter fieldwork into the City of Woodburn database.
- Conduct a GIS review of surveyed data for quality-control flow issues.
- Produce the final product.

In addition, the ability to perform data cleanup in the field when each manhole was measured reduced data cleanup time by approximately 70 percent.

Project Success

The City of Woodburn's decision to let the CH2M HILL survey crew try a new approach to mapping its manholes yielded more-accurate data delivered in less time for less money. The crew's original project plan allowed for 61 field days. Once the crew was in the field, progress increased exponentially as their experience and confidence with Leica MobileMatriX grew. The crew estimated that they spent 25 percent less time per manhole and surveyed 170 percent more manholes per day than planned. The crew finished all fieldwork within 45 days—16 days ahead of schedule. The project was completed 25 percent under budget.



The CH2M HILL crew also used MobileMatriX in conjunction with the Leica GPS 1200 RTK unit.

“Most cities and GIS firms won’t use a combined GIS/survey approach because they don’t have the full equipment package

or survey/GIS knowledge,” Brooks says. “They may be able to acquire the equipment, but not all will be able to incorporate this complete package setup. They do what they are most comfortable with.”

Casalegno adds: “We took a chance with having to learn and use new software on a job that needed a quick turnaround, but that risk paid off in the end. Leica MobileMatriX helped ensure the success of this project.”

The potential of the mobile GIS approach is limitless. Continued process improvements will likely yield even more innovative ways to apply traditionally office-based electronic tools out in the field. “Integrated mobile GIS saves time and money and applies survey-grade accuracy to a GIS database,” Brooks says. “It’s the wave of the future.”

Ann Hovland is a writer at CH2M HILL. For more information about CH2M Hill, visit www.ch2m.com. More information about Leica’s mobile GIS software and survey equipment can be found at www.leica-geosystems.us. Explore Technologies’ Web site is www.exploretotech.com.

Mobile GIS Technology Benefits

Leica MobileMatriX provided full functionality for the CH2M HILL survey crew to finish work in the field. The background maps combined with the immediate map display and labeling of field measurements enabled immediate feedback on the accuracy of measurements. No expensive remeasuring was required. The complete map could be finished in the field, including symbols, legends and north arrows.

The software:

- Provided survey-grade GPS data with a horizontal accuracy of 0.10 foot and vertical accuracy of 0.20 foot.
- Eliminated expensive revisits to sites because of incomplete measurements.
- Allowed modifications of GIS and CAD data in the field.
- Is built on an ESRI ArcGIS platform, which supports efficient project management.
- Stored all survey and GIS data in one geodatabase.
- Eliminated the need to process field-collected data—it easily connects to local area base stations with a wireless AirCard for survey-grade RTK GPS precision.
- Reduced concerns about poor satellite geometry or no access to satellites (due to canopy coverage) by maximizing all the tools within the total station. Field crews could toggle between RTK GPS, total station, laser rangefinders, laser levels, etc., to maximize the efficiency of field data collection.
- Connected multiple tools through Bluetooth (GPS, total station, cameras, laptops, tablet PCs).

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