

TAKING THE OFFICE INTO THE FIELD

A WATER COMPANY IN THE US HAS DEVELOPED A PROGRAMME THAT INTEGRATES SURVEY DATA INTO ITS GIS IN REAL-TIME TO MONITOR THE CONSTRUCTION OF 240KM OF PIPELINE.

MARY JO WAGNER REPORTS

Sometimes a project comes along that changes everything. For the Tarrant Regional Water District (TRWD), in Fort Worth, Texas, US, that project was the integrated pipeline project (IPL), the largest water transmission system of its kind in the state.

Built in partnership with the City of Dallas Water Utilities (DWU), the IPL will consist of 240km of pipeline, three new lake pump stations and three new booster pump stations, built to deliver 350 million gallons of water per day (MGD) (1.3 million m³).

Although pipelines, reservoirs and floodways have been a natural part of TRWD's business for 90 years, the IPL would redefine business as usual – particularly for the geospatial services group. TRWD developed a real-time as-built programme (RTAB) that not only integrates survey data into its GIS in real-time, it parallels the field activities outside so managers inside can monitor construction as it's happening, ensuring both the horizontal and vertical accuracy of the assets being placed and the real-time responsiveness to any issues needing attention.

RTAB started from a spontaneous question that was a little radical at the time. It was 2010 and managers were highlighting the need for more efficient data-processing and sharing of GIS-based construction information. They needed to ensure all infrastructure assets were being placed according to design specifications and with the magnitude of the IPL, they couldn't afford even a single day's delay in as-built data. That's when Eddie Weaver, TRWD's IPL deputy programme director, asked,

"What if we could get the as-built survey data into the enterprise GIS in real-time?"

"Historically, as-builts have been an afterthought on construction projects," says Weaver. "They often weren't collected and if they were, they were hand-drawn on paper and weren't always accurate or complete. But as-built data is critical to ensuring quality control on the IPL design and for giving us a detailed inventory of our installed assets.

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That made me wonder, 'Can we develop the technical capability to collect as-built data ourselves and tie it into our existing GIS and asset management systems, to give us a real-time record of what we installed, where it was installed and when it was installed?'"

No one had an immediate answer.

"Eddie's thinking was definitely outside the box," says Lauren Tijerina, co-manager of TRWD's geospatial services group. "At the time, the technological options for that kind of seamless, real-time interoperability didn't exist. And very few, if any, organisations were routinely integrating high-precision as-built information into their GIS."

Initially, they focused on assembling

the survey technology that would meet their high-accuracy data requirements. As long-term users of Trimble technology, they chose a collection of Trimble R8 and R8s GNSS receivers to acquire real-time-kinematic (RTK) survey data and a set of Trimble Yuma 2 rugged tablets to store and export the field data. The Yuma tablets would be particularly beneficial because they offer Trimble Access survey field

software, a user-friendly operating system and mobile communication technology.

In addition, the geospatial services group created and set up for each data collector a detailed data dictionary template for acquiring 30 pipeline assets and attributes and outfitted all crews with a standard operating procedure (SOP) document that clearly shows what features to collect and how to collect them. A data dictionary and an SOP ensured teams would collect

all required IPL assets at the required sub-decimetre accuracy and reduce user error.

The right solution

With the survey and GIS elements set, TRWD focused on the most challenging piece: finding a solution to bring the GNSS data automatically into their Esri Enterprise GIS. In 2013, TRWD gave that puzzle to engineering consulting firm Halff Associates to solve.

Halff first capitalised on the existing mobile technology of the Yuma tablet and installed cloud-based file sharing software. With this approach, crews could transfer the field data to the office via a cellular connection. The Halff team also took advantage of Esri ArcGIS Server's REST services, which allowed them to create the web-based framework to automatically process and move the Trimble survey data into the GIS. From there, they developed a customised 'listener' tool that would detect new IPL-related files uploaded to the cloud, quickly analyse them and, using the pre-defined ArcGIS REST services, automatically move the information into the correct data layers and attribute fields in the GIS.

Readied for the field in January 2014, the RTAB programme would run on a combination of seven Trimble R8s and R8 receivers and Yuma tablets for the IPL project.

Mark McGuire, co-manager of TRWD's geospatial services group, says: "Our survey technology provides the precise as-built data we need and the RTAB programme ensures that we can monitor and verify that every pipeline segment and asset is being placed according to the design in near real-time. In terms of efficiency and potential cost savings, that is priceless."

As-builts in real time

The IPL is being constructed in five distinct phases. Phase one construction began in

May 2014 and is expected to be completed in the spring of 2019. When finished, crews will have laid 113km of 2.1m to 2.7m pipeline, built a 350MGD booster pump station and constructed a 450MG balancing reservoir and ancillary facilities. When the entire IPL is built, it will give DWU and TRWD an added 350MGD of water supply to serve both its nearly 4.5 million existing customers and to meet the estimated population growth of the region.

Since phase one began four years ago, TRWD field teams have been collecting sub-decimetre horizontal and elevation data of features as crews build the required infrastructure. Although the need for survey-grade as-builts has depended on construction, at least two TRWD teams have been routinely on-site for pipeline construction, with up to nine crews at peak times.

With the Trimble R8 and R8s receivers, crews use a combination of Trimble VRS (virtual reference stations) technology, hosted by AllTerra, to provide RTK GNSS corrections to meet their sub-decimetre accuracy requirements. As each pipe segment is set, TRWD pipeline inspectors follow the specific SOP to collect all required asset and attribute data such as pipe-segment joints, valves, centres of manways and pipeline centrelines. Once a pipeline section has been buried, teams return to collect as-builts of surface feature assets such as fences and crossings.

"Typically, we only have a half-day or a one-day window before a pipe segment is buried," says McGuire. "With this real-time system, we can determine immediately if a pipeline alignment is deviating from engineered plans, or if assets are not located in the original design locations.

A pipeline section hangs at the ready



We can then alert crews to the error and rapidly 'course correct', saving the project from wasteful downtime and the unnecessary redo of pipeline construction."

Once the pipeline assets have been acquired, the team uses the Yuma tablet's Trimble Access software to export their data as a standard CSV file to the cloud. When the RTAB listener tool detects the new file, it parses it and automatically distributes the information into the relevant IPL datasets in TRWD's GIS. Personnel in the geospatial services group then review and verify the accuracy of the newly acquired data, either flagging it for further review or accepting it and making it available for immediate viewing across the organisation.

Successful implementation

To date, TRWD teams have collected nearly 20,000 data points for the IPL project.

"The moment we hit that sync button, the data is live and available to us and all the stakeholders so key decisions can be made



A view of Fort Worth's skyline. Although pipelines, reservoirs and floodways have been a natural part of TRWD's business for 90 years, the IPL is redefining business as usual

in real-time," says McGuire. "In the past, it would take days to weeks to integrate our survey and GIS data, delaying our ability to make informed decisions. Now we can look at it live across multiple devices. It's completely transformed our work patterns on the IPL and has begun to change how we support other divisions across TRWD."

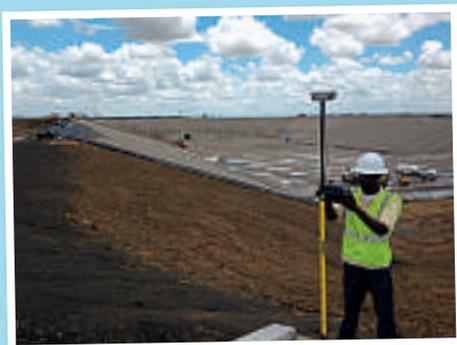
Indeed, based on the success of the RTAB system during phase one of the IPL, TRWD will continue to use its survey technology and RTAB for phase two construction, which will begin in spring 2019 and aims to add 64 more kilometres of pipeline to the IPL.

In addition to the IPL, TRWD has expanded the programme to support traditional and real-time surveying efforts, including flood-control management, existing pipeline infrastructure, floodways and utilities. And it recently began an internal pipe data collection effort with the Trimble SX10.

Similar to the IPL process, geospatial services staff use Trimble SX10 and R8s GNSS units with Yuma tablets to collect a host of location and as-built data on critical infrastructure assets. They then export the data in real-time and the RTAB



Crews use a Trimble R8 receiver to take an as-built of an installed pipeline joint on an existing pipeline during routine maintenance



Rich Haynes, a pipeline resident representative with TRWD, uses a Trimble R8 GNSS unit and a Trimble Yuma 2 tablet to collect as-built measurements of an installed conduit for the IPL project. With RTAB, that data is available in near real-time back in the office

listener identifies to which particular project the data corresponds and populates the relevant GIS datasets in the enterprise GIS.

In addition to the significant operational benefits TRWD is gleaming from seamlessly linking the as-built data to its existing GIS, the integration of the RTAB programme into TRWD's asset management system (AMS) is also providing levels of insight and management opportunities that they've never had before.

"Connecting RTAB with our AMS is so powerful," says Wesley Cleveland, TRWD's integrated pipeline director. "Because we collect so much attribute data, we can better monitor and maintain assets as they degrade or if something breaks down. Now our field guys can accurately navigate to an asset in the field, access the system, isolate the specific asset in question and have all the relevant attribute data in seconds. Once they've

completed their work, they can capture an as-built, update any relevant attribute data and it's immediately saved to both the GIS and AMS. This is far and away better than our paper drawings of the past. We will be using this system on anything we put in the ground."

It appears then that the integrated part of the IPL is not only integrating infrastructure to keep sufficient water flowing to residents, it has helped bring data integration to TRWD in a completely new way. Fostering real-time monitoring, reporting, accountability and decision-making, TRWD's RTAB is creating a geospatial data pipeline across its organisation that is as fluid as the water it provides. In McGuire's words, that is priceless.

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