SUE Solves As-Built Deficiencies, Gathers Accurate Risk Assessment Data

Photo #1: Field crews completing test holes during winter conditions.

How confident are you in the spatial data relating to your underground infrastructure? Is it based on 50-year-old as-built records, or worse? An asset management database is only as good as the data with which it is populated. Do you feel confident relying on the information in your database?

The Regional Municipality of Niagara (RMN) - Water and Wastewater Services recently asked itself these same simple questions and concluded that the spatial data it had available for its water and wastewater underground infrastructure lacked the level of accuracy required to manage its network. RMN decided to look for a better method of populating its database with reliable information that could be used for years to come. The solution to the problem was subsurface utility engineering or SUE, which is a proven method of identifying, locating, and mapping underground utility infrastructure. RMN felt the SUE process would provide an excellent, cost-effective method of obtaining reliable information with proven results. The ability to collect data at a variety of quality levels would allow RMN the ability to balance future risks with project costs. In order to test the effectiveness of the process, RMN conducted a pilot project to locate and map approximately 12.1 km of watermain, which previously had no as-built records showing their location (see figure #1 for summary of project areas included in the pilot). The goal of the pilot was to provide a good base for the future collection of additional subsurface infrastructure data.

TSH/TBE Subsurface Utility Engineers Joint Venture (TSH/TBE) was awarded the contract to complete the pilot project in November 2002. TSH/TBE followed the basic principles laid out in CI/ASCE Standard 38-02 as a guideline for the completion of the project. Using the quality levels defined in the Standard, the goal was to map as much of the project as possible to quality level "B," as well as gather quality level "A" information at key locations.

TSH/TBE began the field collection of data in November 2002 in the St. Catharines section, an area with two parallel watermains running down Riverview Boulevard, a residential street in the city. Following the Region's records, the crew began looking for two separate 24" diameter watermains separated by approximately 5m. However, through detailed investigation it was eventually discovered that the two watermains were actually running together stacked one over the other. The position of the watermains was also found to be significantly different from what was first thought; in some areas, they were on the opposite side of the road.

The collection of field data continued throughout the winter despite temperatures at record-setting lows. The deep frost conditions slowed progress on test holes, but didn't affect the electromagnetic cable-locating devices used to do the majority of the designating. The major factor in the performance of the locating devices was the depth of the watermains and the fact that many of them were ductile or cast iron. The ductile and cast iron produced a weak signal when using the electromagnetic instruments. Varying the frequency helped, but only short sections could be traced at a time before a test hole was required to verify that the signal being picked up was still from the watermain. Other sections, including parts of the Niagara-on-the-Lake watermain, were made of PVC with a tracer wire. These sections produced strong signals, allowing the work to proceed much faster.

In total, 47 test holes were installed at key locations to give precise horizontal and vertical location data. As can be seen in photo #1, the test holes were installed using air-based vacuum excavation equipment, which raised the RMN staff's comfort level, considering the sensitive nature of excavating directly above large-diameter distribution mains, particularly in cold weather. The spacing between test holes was dependent on the specific site conditions and the confidence that the field crew had in the signal that they received from the designating instruments.

Project Section	Length	Pipe Material	Depth (based on QL-A)
St. Catharines	2600 m	Cast Iron	0.951 m to 3.262 m
Thorold	3415 m	Cast Iron	1.204 m to 4.668 m
Niagara-on-the-Lake	4719 m	T / PVC / DI	1.416 m to 2.124 m
Welland	680 m	DI/ CI / CPP	1.121 m to 2.089 m

Figure #1: Summary of each Project Section

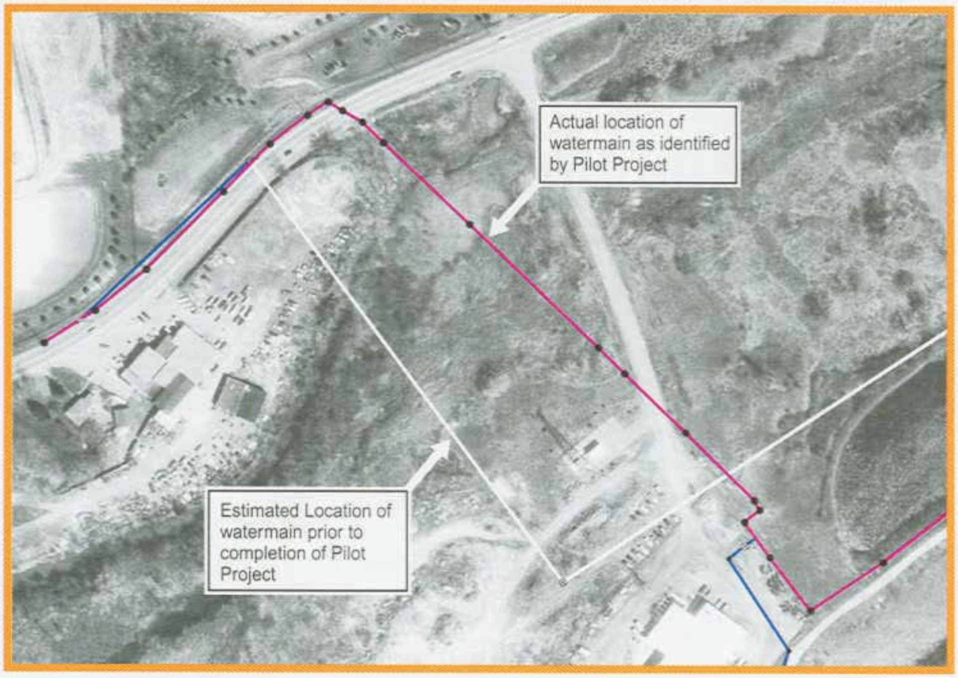

Figure #2: Screen shot from the Region's GIS Database showing "before and after" detail of watermain location.

For watermains such as those in the Thorold section where the cast-iron pipe was a poor conductor and provided limited signal strength, the test holes were spaced closer together than for those sections of watermain such as in Niagara-on-the-Lake, which had a strong signal strength because of the use of tracer wire.

After the SUE field crew completed the designating and test holes for each area, they were followed by the survey crew, who used total station survey equipment (TSS) to precisely survey all the field assets and tie the points to the local coordinate system (UTM). The survey data was forwarded to the CAD operators who converted the information into watermain utility drawings using the Region's digital ortho imagery (DOI) raster files as a background for the vector (watermain lines) work. The drawings were also converted into ESRI shape files for inclusion in the Region's geographic information system (GIS) geodatabase. The shape files, seen in Figure #2, allow a user to see the location of the watermains and click on them to obtain details such as size, material type, and depth (at test hole locations). The Region plans to pilot handheld GIS/GPS technology with operations staff to ascertain the effectiveness of this tool. With mobile GIS/GPS technology the information gathered through the SUE process would then be available to field crews.

Overall, the pilot project was very successful. Using SUE principles the project successfully replaced the Region's "poor" spatial information with information that is reliable and accurate. During a recent watermain break on a section of main that was included in the investigation, the information proved invaluable for quickly identifying the location of the watermain and the valves to shut down the affected section. The SUE process also provided depth information for repair crews that proved to be highly useful, since the watermain break was located in a swampy area. In addition, the actual location of this section of watermain turned out to be over 100m from where it was thought to lie prior to the investigation. The information from the SUE project was vital in drastically reducing the time required to repair the watermain.

The Region of Niagara has now established a method of confidently designating and mapping the location of its existing water and wastewater infrastructure. Using the SUE process allows it the flexibility to collect the appropriate quality level of information for each section. Their progressive approach to this common problem should be applicable in all areas in Ontario and throughout North America.

For more information on this project contact Kyle Moate, Region of Niagara, at kmoate@regional.niagara.on.ca; or Lawrence Arcand, TSH/TBE, at larcand@tshtbe.ca.

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