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PAUL BEACH, SAULT STE. MARIE INNOVATION CENTRE

Technology

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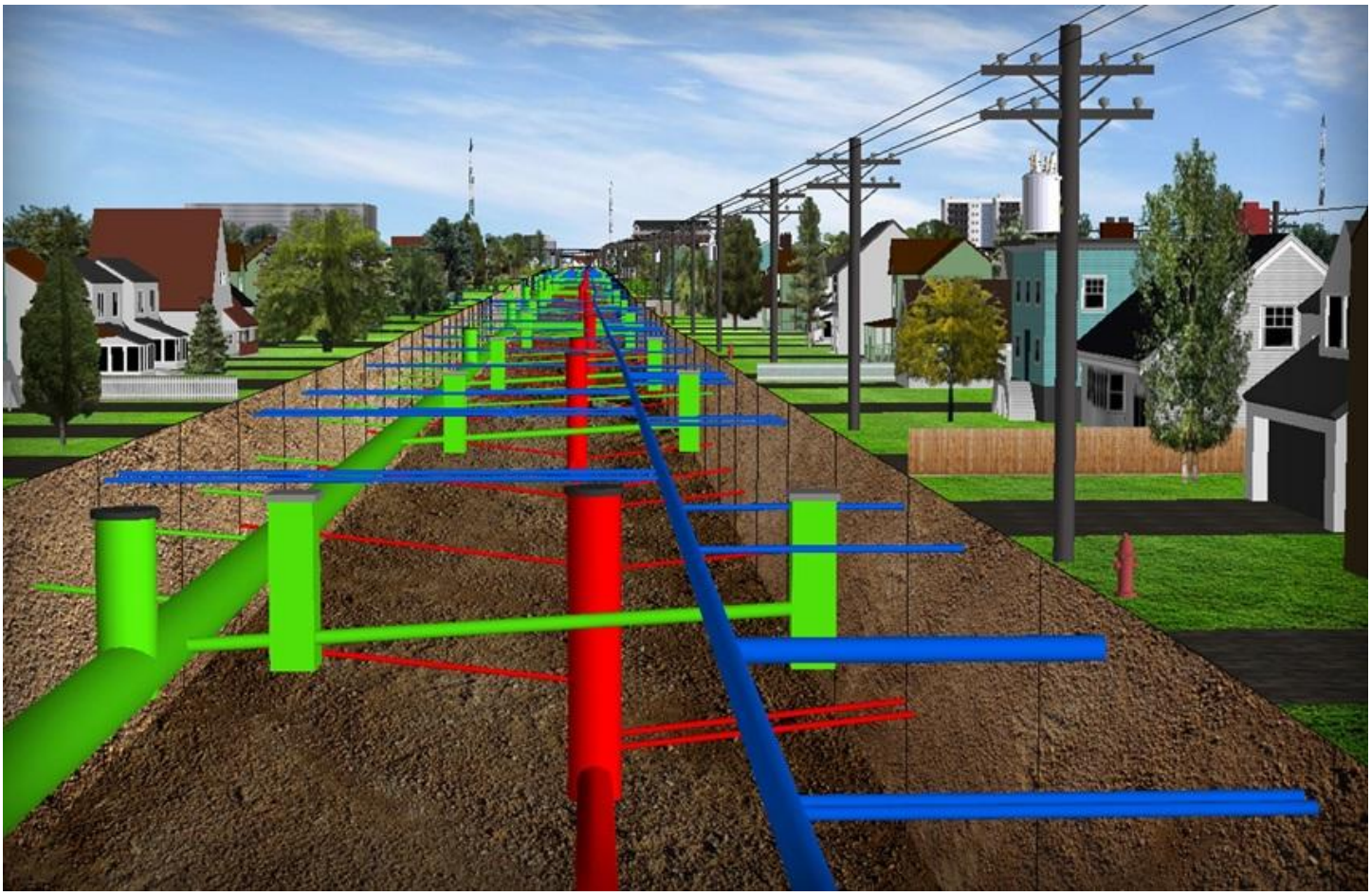

TECHNOLOGY

ADVANCED GIS FOR WATER AND WASTEWATER INFRASTRUCTURE MAINTENANCE

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During the 1990s, the Municipality and Public Utilities Commission (PUC) of Sault Ste. Marie Ontario were both evaluating the potential benefits of GIS. By the late 1990s, both organizations were prepared to move forward with request for proposals to implement GIS solutions. During this time, the economy in Sault Ste. Marie was not faring well and Algoma Steel, the major employer in the community, was about to lay off several thousand people. The economic climate of this Northern Ontario community initiated the creation of the Sault Ste. Marie Innovation Centre (SSMIC).

"The GIS was used to identify homes with suspected lead service piping based on original service installation records. Although the municipal portion would have been replaced in most cases during road reconstruction projects, homeowners would not necessarily have replaced their portion of the service pipe. "

The SSMIC is a not for profit organization created in 1998 with a mandate to diversify the local economy with an emphasis on Information Technology. The SSMIC started out with several business lines including developing an IT related business incubator, supporting IT related companies, and implementing market development projects. When it came to light that both the City and PUC of Sault Ste. Marie were about to hire Southern Ontario GIS consulting firms to implement a multi-year GIS solution, the SSMIC stepped forward with an interesting alternative. Why not hire the Southern Ontario GIS consulting firms to provide knowledge transfer to seed local GIS expertise in Sault Ste. Marie and implement one GIS solution for both the City and PUC?

In 1999, EDS Canada, ESRI Canada, Terra Viva Inc. and J.D. Barnes were contracted for a two-year period to initiate the GIS implementation and provide training and knowledge transfer to locally hired staff. The mayor of Sault Ste. Marie and the president of the PUC mandated the GIS solution from top down. This solution was to be shared by all departments of both organizations.

The GIS implementation was a five year, five million dollar project that involved creating a central data warehouse for both the City and PUC. Data capture included a complete inventory of all water, wastewater, electric, transportation, telecom, land base, and administrative features. About two years into this project, the external consultants were phased out and the project went forth with local SSMIC staff.

After the initial five years, the GIS implementation led to the creation of the Community Geomatics Centre (CGC). The mission statement for the CGC was to promote partnerships among community organizations and establish the technological means to efficiently share geospatial data, tools, technology, and knowledge to create a safer, healthier, and more prosperous community. The CGC expanded to serve the Economic Development Corporation, the Fire and Police Departments, Algoma Public Health, the local Conservation Authority, and about fifty other community agencies. Additional partners came on board for a very reasonable monthly fee and no up-front cost. The City and PUC were paying the majority of the costs and allowing other organizations to benefit from the GIS solution. The vast majority of the data and GIS tools were being shared between the organizations.

I. THE POWER OF GIS

The GIS solution has brought great benefits to the community of Sault Ste. Marie. The real power of the system is the comprehensiveness of the data and its real-time capabilities, with most layers being at most no more than thirty days out of date. Additionally, about 99 percent of the data is shared between all of the partners.

Two of the key areas of focus for the GIS solution in Sault Ste. Marie included water and wastewater infrastructure. The solution integrates all features to adequately manage water distribution from filtration plants to service meters, as well as wastewater features from collection to treatment plants. The GIS solution has the built-in intelligence to analyze water main breaks and identify valves that need to be closed, the customers affected, and the hydrants that would no longer have water pressure. For wastewater, traces can be done in the GIS to determine where a contaminant in the storm water system came from or may end up.

The GIS has been utilized to find locations for many new businesses in Sault Ste. Marie, including one billion dollars in alternative energy projects. Municipal and economic development staff receive many requests from companies looking for properties that have specific servicing requirements. Often these requests are time sensitive and many municipalities are pulling together data to find appropriate locations. The Sault Ste. Marie GIS can determine locations in a matter of minutes with all water, wastewater, electric, zoning, and transportation data available within one system from multiple agencies and departments.

II. GIS & WATER

Lead in drinking water became an issue attracting attention in 2007 when a number of homes in London, Ontario were found to have elevated levels of lead despite flushing or running the tap for several minutes. This was alarming as lead can contribute to significant health issues, particularly for young children and pregnant women. Children are still developing and are therefore more sensitive to the neurological effects of lead. Exposure to excessive quantities of lead can cause damage to the nervous system and impair mental development.

During this same time period, the Ontario Government introduced the Water Filter Fund to assist low income families with the cost of end-of-tap filters. An end-of-tap filter would be provided if water tests showed unacceptable lead levels in low income households in which children 0 to 6 or a pregnant woman resided. This would include people on Ontario Works, the Ontario Disability Support Program, and those with annual incomes of less than $20,000.

The identification of homes likely to have lead service pipes, identification of persons at risk, and persons qualifying for the

Water Filter Fund was a daunting task for most municipalities. A unique solution was developed in Sault Ste. Marie through the initiative of the CGC, the PUC, Algoma Public Health (APH), and the District of Sault Ste. Marie Social Services Administration Board (DSSAB).

The GIS was used to identify homes with suspected lead service piping based on original service installation records. Although the municipal portion would have been replaced in most cases during road reconstruction projects, homeowners would not necessarily have replaced their portion of the service pipe. Original installation records were used to identify addresses where the homeowner's portion of the service pipe may not have been replaced.

Unfortunately, there were a number of service lines with unknown materials and unknown install dates. To address this concern, the install dates of all recorded lead service lines were analyzed and it was determined that records of use of lead piping existed only during the period from 1943 to 1948, particularly in war-time housing projects. Copper and iron were in short supply during World War Two, while lead was widely available. Using the municipal assessment data, the CGC was able to query out all properties that had a building that was constructed between 1943 and 1948.

GIS technology can be effective as a risk assessment tool; spatial overlays of data from multiple sources can be used to focus testing efforts on residences most likely to have elevated lead levels. Use of Municipal Assessment data also can be used to eliminate homes built after 1950, even where no records of service materials were available, narrowing the focus of water testing efforts. The potentially at-risk or vulnerable population was also determined using age-sensitivity criteria records of pregnancies and child age.

APH was particularly concerned with newborns in situations where the baby may be completely formula fed and tap water would be used in significant amounts. In an effort to reduce the risk, APH would contact any individual that was pregnant or had just delivered if they were determined to be in a home with the potential of lead. These homes were also identified for priority testing for lead, and the advance notice from APH was intended to achieve better acceptance rates for the testing.

APH supplied the postal codes of all pregnancies and due dates. The CGC used the GIS to look for matches of postal codes of homes that had the potential for lead. The postal code method was initiated to reduce the amount of sensitive data that was dealt with. When there was a postal code match, further data was supplied to determine if an exact address match occurred. The end result was that there were several exact matches and APH contacted these individuals to explain the risks and testing process.

The DSSAB, which operates Ontario Works through the City of Sault Ste. Marie Social Services Department, also supplied the postal codes of clients on Ontario Works and on the Ontario Disability Support Program where there were children aged 0 to 6 present or a known pregnancy. The Social Services Department, who also manages the Social Housing portfolio, provided all addresses of low income housing units to determine if there was any risk apparent from lead for these tenants. The CGC used the GIS to look for postal code matches to again reduce the amount of sensitive data to analyze. Then exact addresses were supplied and exact address matches were made. These addresses were supplied to social services and clients were contacted about receiving free end-of-tap filters.

Using the exact address matches of pregnant individuals, recently delivered babies, and people on social assistance with children 0 to 6, the CGC created a ranked priority list of homes to be tested from the homes with recorded lead or galvanized pipes, or homes built between 1943 and 1948. The CGC ranked the addresses based on health risk criteria and provided PUC Services with a prioritized list that did not display the protected information. Occupants could then be contacted to gain permission to have their water tested.

This GIS system and the cooperative partnerships associated with the CGC enabled a quick and effective response to the issue of lead in drinking water. Potential homes and businesses with recorded or potential lead service pipes, as well as persons at risk, were identified and prioritized for actions to be taken. The confidentiality of all associated data was maintained, as the CGC has confidentiality agreements with all partners, and this allowed for a confidentiality buffer with the CGC in the middle. In the end, Sault Ste. Marie will be confident that all available information was applied to address the lead in drinking water issue.

III. GIS & WASTEWATER

Sewer backups can be a serious and costly incident for home and business owners. During a five month period in 2013, Sault Ste. Marie recorded rainfall amounts that equated to a once in twenty-five year flood, a once in one hundred and fifty year flood, and finally a once in fifty year flood. The drainage water overwhelmed parts of the storm and sanitary sewer system causing backups across the city. Drastic weather situations like this are becoming more and more prevalent.

The wastewater system in any community needs to be kept as clean and functional as possible. For the past two years, GIS has been used to optimize sewer flushing. One third of the city is flushed each year. The GIS is used to determine the flushing schedule and route. Flushing is always started at high end points and elevation divides, and then flushing proceeds downstream. Appropriate end points are selected with GIS that do not coincide with pipe size reductions or high volume connection points.

Much of Sault Ste. Marie's water and wastewater infrastructure is past its expected lifespan. The GIS is a critical tool that is used to optimize where capital works projects and maintenance should be completed. The GIS is also used to enable the combination of diverse data sets with water and wastewater data to protect human life, drive economic growth, and improve overall quality of life. The GIS solution in Sault Ste. Marie is one of the most advanced community GIS systems in the world. The hardware is advanced, the software is advanced, the data is very comprehensive, but most importantly, the data sharing partnerships are exceptional.

PAUL BEACH has 27 years of experience in the information technology field. He began his career with the Ontario government researching new data management technologies. For the last 13 years, Paul has been Manager of the Sault Ste. Marie Innovation Centre's Community Geomatics Centre, a not for profit community information utility. In 2010, Paul was recognized by the Provincial Government for his contribution to the field of GIS in Ontario.