water writes

Safe Water on Tap for Missoula Residents

By Jennifer Wicks, Mountain Water Company

In This Issue

Do you know where your water comes from? Increasingly, people are encouraged to question and think about the basic essentials of life. Where does your food come from, and who controls it? What sort of carbon footprint do you leave? How can you clean your home without harmful chemicals? The list of questions grows. Why not also think about one of the most basic of life's necessities: water? Where does it come from, and who supplies it?

For the majority of the residents of Missoula, Montana, water is supplied by Mountain Water Company, and it comes from the Missoula Aquifer. The mission of Mountain Water Company states that the company is "dedicated to providing quality water and dependable service to the Missoula community at a reasonable price." If it continues to succeed in accomplishing that mission, many of Missoula's residents most likely will not have to give much thought to where their water comes from. They turn on the tap, and safe, reliable water flows for their consumption 24 hours a day, 365 days of the year.

Maps and geographic information systems (GIS) help enable Mountain Water Company's employees to carry out their mission of delivering water to the residents of Missoula. The utility maintains 295 miles of main, 35 wells, 24 storage facilities, 1,400 hydrants, and 5,600 valves. Employees need to know where the water comes from via all the facilities. Maps and GIS are among the several tools used to answer questions related to the daily operation of Mountain Water Company's water system.

In 1998, a full-time cartography/GIS position was created. Initially, the task was to convert all the old paper maps into a digital format. This was completed at the beginning of 2000 using AutoCAD Map. Corrections, additions, and improvements to the water system are still made to the original set of system maps created using AutoCAD Map. The primary reason for using AutoCAD is to print map books annually for each field employee as well as to share data with consultants, who primarily use AutoCAD for design drawing.

The maps created in AutoCAD certainly help answer the basic question of where the water system is located. A person can simply open a map book or view the maps digitally to find the location of any facility as well as determine basic information such as main size, pipe material, type of valve, and unique numbers that identify each feature. Nevertheless, AutoCAD could not answer all the water company's questions.

In 2003, Mountain Water Company purchased ArcGIS software to take advantage of the additional functionality GIS offers. The company adopted and modified Esri's Water Utility Model and populated it with water

Val Dowell uses GPS to record data for a hydrant.

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Follow the Esri water community on Twitter

Keep up with the latest GIS news, especially as it relates to the water industry, by following Esri on Twitter:

@esriteamwater

Access the Water Utilities Resource Center

This website is for the ArcGIS water, wastewater, and storm water utility community. It provides useful templates and best practices information, enabling you to implement ArcGIS to manage your water utility data, perform daily operations, and support long-term planning.

Visit resources.esri.com/waterutilities.

Be sure to visit the Water Utilities Blog while in the Resource Center to read about the most recent events, activities, and updates:

blogs.esri.com/Dev/blogs/waterutilities/default.aspx

Join a discussion about how GIS meets today's challenges

Pull up a virtual chair at the spatial roundtable and join the conversation of GIS thought leaders as they address topics requested by the geospatial community. Topics have included remotely sensed data, how spatial analysis helps utilities manage risk, and what Realtors really need to know.

Visit spatialroundtable.com.

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system data converted from AutoCAD Map. Around the same time as the GIS data conversion, the company implemented a new fixed asset management system.

Using GIS, the utility was able to combine location information from AutoCAD with attribute data from fixed assets into one system. This opened a whole new world of possibilities and applications.

One of the first things Mountain Water Company did was link the GIS database to the customer information system (CIS). Montanans are fortunate to have available a cadastral layer provided by the state. Each parcel is assigned a unique identifier, a geocode number. The utility matched many of the addresses in its CIS to addresses in the state's cadastral layer and assigned geocodes to accounts in the CIS.

Customer service representatives and meter readers are able to utilize GIS to improve routes, making reading meters more efficient and faster. A few simple queries quickly high-

Jason Martin flow-tests a hydrant.

Craig Yonce uses GPS to record data for a hydrant.

lighted accounts scattered around town. These accounts were reassigned to different routes, thus cleaning up the system so that meter readers worked in one part of town at a time rather than driving back and forth across town.

The accounting department is using GIS to help determine the costs related to older mains in the system. Attributes such as size, type, and year installed are analyzed to determine the costs associated with fixing or replacing older mains. Along those same lines, the utility has also used GIS to help answer requests and questions posed by the Montana Public Service Commission.

In general, Mountain Water Company uses GIS to answer routine questions from different departments within the company. Some examples include identifying all 12-inch and larger diameter PVC pipe or determining the location of sample sites in relation to wells for the Department of Environmental Quality. The

Jason Martin uses GPS to record data for the hydrant.

Val Dowell turns a valve.

GIS data is also used to help build a model of the system the engineering department uses for planning future additions to the system.

Mountain Water Company recently moved its data from a personal geodatabase to a SQL Server database. This has opened up basic access to GIS data to all employees in the company. Using ArcGIS for Server, the team created a basic web application that allows employees to view the entire system using an Internet browser, thus eliminating the need to install special software on every computer. Local staff can also now share data more easily with employees at the corporate office in California.

Another benefit of using ArcGIS for Server is having the ability to create versions, allowing multiple editors to work on the attribute data at the same time. A special web application was created to allow editing of water main attributes by multiple employees at once. The task of making basic changes to the attribute data is now shared rather than relying on just one person to perform all the edits.

Future plans include expanding the web application to include query and search capabilities customized for each department within the company. The utility also hopes to make GIS available to employees in the field, allowing them to view, query, and make basic edits to the GIS data.

As long as there are questions about water, Mountain Water Company will continue to find new uses and applications for GIS.

For more information, contact Jennifer Wicks at jennifer@mtnwater.com.

Opelika Utilities Implements Fire Hydrant Flow Logging Solution

By Alan C. Lee, Opelika Utilities Project Manager, and Kevin Stewart, GISi Business Development Manager

Opelika Utilities in Alabama recently faced a challenge. The company needed to implement a mobile GIS fire hydrant flow logging solution that would allow the fire department to record flow data in real time from the field or via the Internet.

Early in 2008, Opelika Utilities adopted GIS for a geodatabase modeling, implementation, and field GPS data translation project. A utilities data model and corresponding geodatabase were developed, as well as automated tools to streamline the translation of GPS data into the geodatabase. The success of that project created a demand to provide GIS access to a broader audience and integrate GIS into more workflows. In coordination with the then-recent release of ArcGIS Server and the enhancements around mobile technology, Opelika quickly zeroed in on the fire hydrant flow logging workflow as one that could leverage this technology to be more efficient.

The seed to build the mobile solution was planted at the Esri International User Conference, according to Dan Hilyer, general manager at Opelika Utilities.

"We were watching the ArcGIS mobile demonstration," Hilyer said. "Esri had dispatched a team to go outside the conference center and start collecting assets—hydrants, trees, trash cans. The data was being synchronized in real time and showing up on a web application. We looked at each other at the same time and said, 'fire department.' We knew right away that ArcGIS was the technology we needed to revolutionize our fire department's fire hydrant flow logging workflow."

Opelika Utilities identified a specific workflow within the fire department that could be improved specifically for fire hydrant flow. The fire department is responsible for flowing hydrants and recording flow pressures

> "The real-time logging of flow data will help Opelika maintain or improve its rating, which will result in direct savings to our citizens."
>
> Dan Hilyer, general manager at Opelika Utilities.
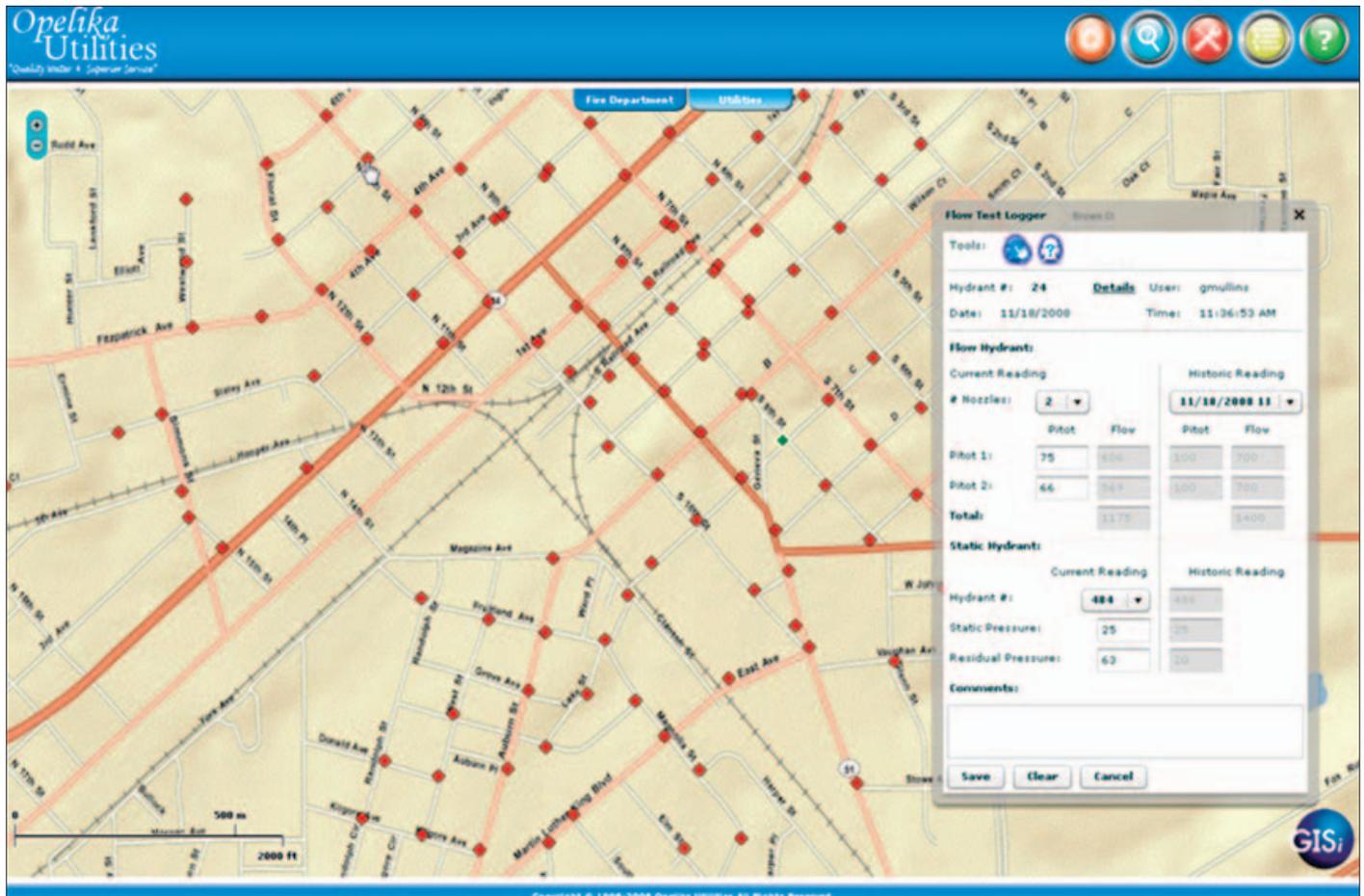
Opelika Utilities uses ArcGIS for Server to view and edit geospatial data via the web.
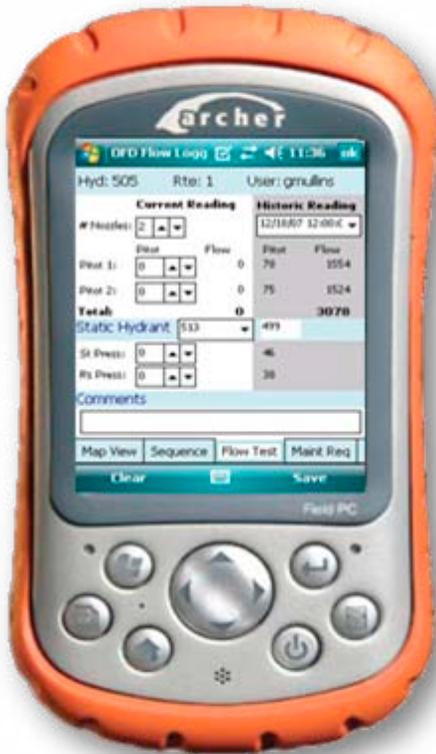
Opelika Fire Department uses ArcGIS on a mobile device to view geospatial data and collect/edit hydrant flow data in the field.

that Opelika Utilities uses for demand and consumption modeling. This workflow is a paper-driven process and often leads to a 6–12-month lag before the data is entered into the flow database.

To streamline this process, Opelika hired a GIS consultant to adopt an enterprise architecture strategy based on Esri's ArcGIS technology. The strategy included expanding the existing geodatabase to support the fire department as well as migrating to an enterprise geodatabase SQL Server environment. Data residing in the geodatabase was then published to both a mobile application and a web application from which authorized personnel could view and edit the data.

A web application was developed, powered by ArcGIS, serving map documents (MXDs) authored by Opelika. This application enables authorized fire department users to view and edit hydrant flow data,

stored in the enterprise geodatabase, from an Internet browser. The application also allows Opelika Utilities to support other users who need to view geospatial data.

"Our vision for the web applications was twofold," said Alan Lee, GIS/survey manager at Opelika Utilities. "First, we wanted it to serve the fire department and support the fire hydrant flow logging workflow. Second, we envisioned it as the perfect entry point to GIS for our front-office personnel who are constantly being asked to find an address or asset. The web application built with ArcGIS API for Flex provides a very intuitive, rich Internet experience for both user bases."

Furthermore, a mobile solution, also powered by ArcGIS, was developed to provide authorized users with the ability to view and edit hydrant flow data, stored in the geodatabase, from a handheld device while working in the field.

Embracing an enterprise GIS strategy has allowed Opelika Utilities to provide GIS access to other organizations and streamline workflows both in the office and in the field. The mobile fire hydrant flow logging solution has revolutionized a workflow for the fire department. The fire department and Opelika Utilities now have access to real-time water flow data such as pressure—a very important piece of information for fire response and consumption analysis.

"The real-time logging of flow data will help Opelika maintain or improve its rating, which will result in direct savings to our citizens," said Hilyer. "The mobile flow logging application has also enhanced our ability to respond to requests from prospective developers concerning fire flows in growing areas of our city."

Contact Kevin Stewart at kstewart@gisinc.com.

Esri Publishes Book on GIS and Hydraulic Models

Written by water industry professionals, *Hydraulic Modeling and GIS* specifies the steps necessary to effectively integrate hydraulic models with a GIS. The book offers best practices and explains how to navigate challenges.
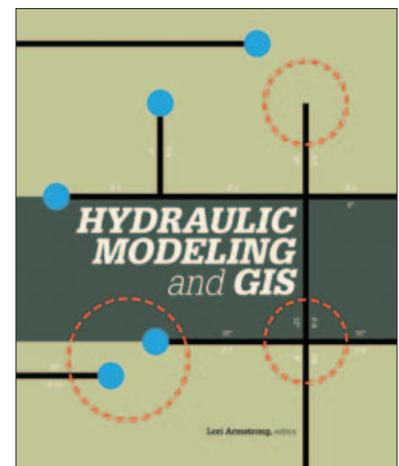
The well-designed integration of a hydraulic model with GIS provides ready access to mission-critical data for water/wastewater professionals. As a result, risk-of-failure analysis, repair and replacement, capacity assessment, capital improvement planning, and numerous other water utility applications run more efficiently and more effectively.

Esri's global water/wastewater industry manager Lori Armstrong edited Hydraulic Modeling and GIS, which was written in collaboration with the American Water Works Association, Water Environment Federation, and International Water Association. The book is recommended for water, wastewater, and storm water professionals, including engineers, managers, data managers and modelers, technicians, and water industry consultants.

Hydraulic Modeling and GIS (ISBN: 978-1-58948-301-9, 82 pages, US $11.95) is available at online retailers worldwide, at esri.com/esripress, or by calling 1-800-447-9778.

Outside the United States, visit esri.com/esripressorders for complete ordering options or visit esri.com/distributors to contact your local Esri distributor. Interested retailers can contact Esri Press book distributor Ingram Publisher Services.

For additional information on Esri's GIS solutions for water and wastewater, visit esri.com/water-wastewater.

Real-Time GPS Networks and Water Utilities

By Jerry Cordova, GIS Analyst, City of Fountain

The historical legal land descriptions of the 100th meridian west have challenged mapping professionals since the inception of the State Plane Coordinate System. Advances in GPS technology have added to the confusion instead of clarifying discrepancies. To foster better communication between professional surveyors, CAD designers, and GIS professionals, mapping professionals must learn to decipher language barriers and strive to learn new mapping techniques.

Understanding the relationships between geodesy, GPS, and GIS can be difficult. Traditionally, GIS practitioners receive a basic understanding of coordinate systems and spatial reference systems, while other mapping professionals may not fully understand the complexities and power of GIS.

If the language barrier is to be overcome, one must have an education in geodesy and an understanding of GPS hardware/software and its relationship to GIS. The City of Fountain, Colorado, has taken up this challenge and is working to better understand relationships within mapping professions and share the results of GPS accuracy in real-time networks (RTN) by reviewing the GPS and GIS practices within the city's water department.

Accuracy and Precision

Beginning with GPS data collection tools, one must ask, Which tool is right for the task? The answer should be determined by accuracy requirements—backhoe accuracy (meter), shovel accuracy (submeter), or garden trowel accuracy (decimeter). These accuracy requirement questions must first be addressed to successfully plan a project.

The next question is one of software and postprocessing. The City of Fountain chose Leica's decimeter-accurate GPS equipment in 2001 and then joined the SmartNet Colorado Reference Station Network in 2007. At that time, the city purchased and mounted a reference station antenna on top of Fountain's city hall to minimize the baseline distance in the real-time kinematic (RTK) GPS collection. The city utilizes the Leica GPS 1200+ Surveying System, Leica's Geo Office

Operators identify ground control points in Fountain Valley.

The SmartNet coverage area is approximately 730 square miles.

**Real-Time GPS Networks and Water Utilities**

(LGO), and Leica's MobilMatriX on an xPlore Tablet PC and processes the data in real time through the use of Leica's Spider Network. GIS needs are met by ArcGIS software.

The Power of the Network

RTK GPS technology has significantly improved over the last 20 years. Previous limitations to short baselines and subfoot accuracy have been overcome by RTK and RTN that achieve centimeter accuracy within a 30-kilometer radius almost instantaneously. The SpiderNET coverage area is an estimated 730 square miles located along the Front Range that extends from Chugwater, Wyoming, to Pueblo, Colorado. Submeter GPS units provide data accuracies from one to six feet in two minutes of observation 90 percent of the time. Therefore, the network coverage area provides complete coverage of the City of Fountain's water distribution infrastructure. SpiderNET is hosted by Hixon Manufacturing & Supply Company in Denver, Colorado, and is an authorized Leica distributor.

The City of Fountain's Water Department started using GPS technology to locate its fire hydrants in mid-2006, water valves in 2007–2008, and curb stops and meter pits in 2009. Since that time, a respective 1,100 fire hydrants, 3,400 valves, 4,200 curb stops, and 700 meter pits/vaults have been located to within centimeter accuracy. This has made return visits by water operators and inspectors extremely easy, especially once the landscape has changed. The city began placing and locating GPS ground control point (GCP) monuments, now covering an estimated 20 square miles and utilizing 82 aluminum cap GCPs. The 82 GCPs consist of the City of Fountain's own caps as well as those from El Paso County and the National Geodetic Survey (NGS). The GCPs are routinely captured to test the validity of the network and create a historical log of the monuments.

The collection time of 10 seconds per GPS point is acquired by collecting 10 positions that are averaged to produce 1 GPS point. On average, the process produces horizontal accuracies of +/- one-third of an inch and vertical accuracies of +/- two-thirds of an inch. Ellipsoidal heights are
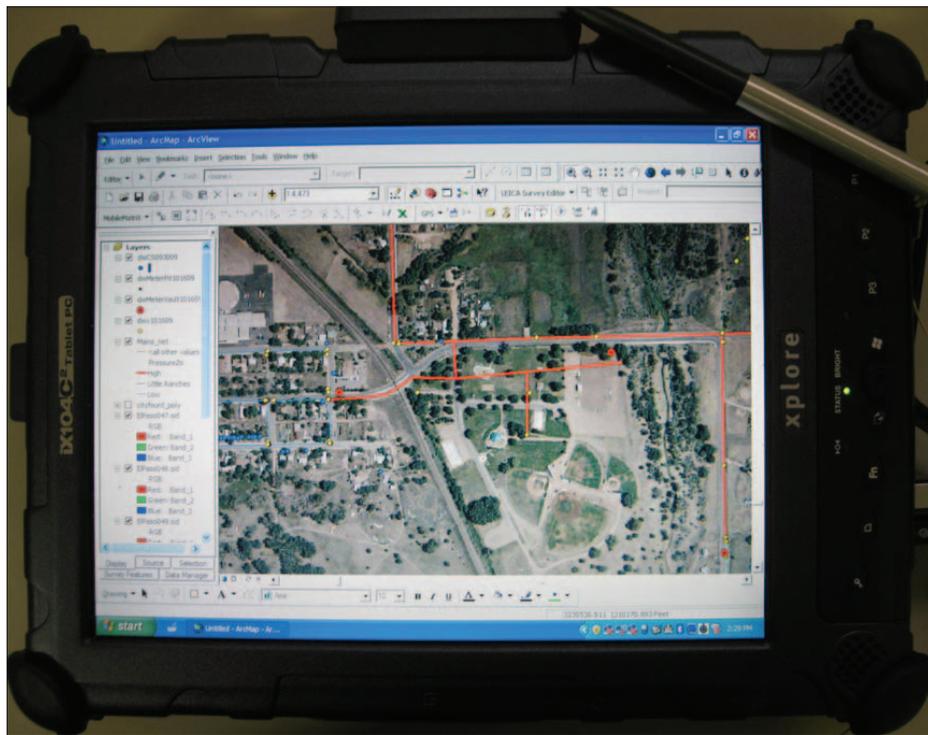
High-precision GPS and the entire geodatabase provide staff with the best of both worlds.

captured in the field, and orthogonal heights are calculated in LGO. Utilizing Leica's robust office suite has allowed the city to communicate with surveyors, engineers, and other consultants in a much more efficient and clear manner. The complexities within geodesy, state plane coordinates, projections, datums, elevations, and heights have been greatly simplified. By incorporating a wider use of geospatial tools, the city incorporates a spatial reference system (datum, projection, and coordinate system) into all the GPS points that are collected and can easily incorporate and modify GPS data.

Integration Is the Best of Both Worlds

Leica's MobilMatriX software integrates the xPlore Tablet PC with Esri's ArcGIS for Desktop software. The Tablet PC can be Bluetooth tethered to the Leica 1200 antenna, thereby creating a high-precision GPS/GIS device.

The MobilMatriX application has allowed the city to capture GPS points at centimeter grade and allows the user to update attributes directly to the geodatabase while in the field. More advanced users can also perform editing tasks on the fly.

Accurate, Cost-Effective Solution

Although there are a variety of GPS survey techniques, the RTN approach provides the most accurate, productive, and cost-effective solution because of the reliability of the hardware/software and consistency in the network, all of which allow repeatable results. The RTN solution allows GPS points to be captured in seconds rather than in minutes and produces accuracies of 0.03 foot rather than 1–6 feet. These factors, combined with the power of a mobile geodatabase, explain why the City of Fountain has been successful in managing its GPS and GIS data collection time. The technological advances in GPS accuracy and precision will assist mapping professionals in overcoming data discrepancies. The language barriers between mapping professionals will be overcome through various forms of integration and one day allow the mapping community to formulate a mapping standard that will address the historical mapping challenges that we face today.

For more information, contact Jerry Cordova, GIS analyst, City of Fountain, at jcordova @fountaincolorado.org.

Wachs Water Services Presents Water Distribution System Solutions

Wachs Water Services is the leading provider of water distribution system solutions that dramatically improve the efficiency and operability of water networks. Crews work throughout North America and Canada on water distribution system projects both large and small and are capable of mobilizing efficiently and in force almost anywhere.

Formed from the E.H. Wachs Company, which has been in business since 1883, Wachs Water Services was officially incorporated in 1999 and is headquartered in Buffalo Grove, Illinois. The company has 200 dedicated employees located in strategic hubs throughout North America and Canada and has completed over 200 infrastructure renewal projects, including the largest known projects in Baltimore, Maryland, and Atlanta, Georgia.

Wachs Water Services addresses the condition and operability of aging water distribution system assets such as pipelines, valves, hydrants, and critical GPS mapping and computer maintenance management system (CMMS) information. The expertise, equipment, and personnel are available to locate, assess, operate, and document any water asset. The company's specialized approach combines condition assessment and rehabilitation services with the capture and integration of critical water distribution system information.

Wachs Water Services distribution system services include the following.

Valve Management Services

Wachs Water Services valve condition assessment programs incorporate proven processes to identify and prioritize critical valves within a water distribution system. Proprietary pipeline inspection systems, such as the Investigator and LDS1000, enable nondisruptive testing of valves and associated assets, avoiding the high cost and complexity of dewatering a pipeline and excavating buried system assets or roadway surfaces.

Hydrant Management Services

Fire hydrant repair and rehabilitation services from Wachs Water Services are the most cost-effective way to retain and extend the operational life of thousands of fire hydrants in a typical water distribution system, saving utilities millions of dollars in unnecessary replacement expenses and enabling utilities to redirect those funds and resources toward capital investments needed for revitalizing other water infrastructure assets.

Pipeline Management Services

Discover the true condition of water mains with pipeline condition assessment services from Wachs Water Services. Water main condition assessment services proactively assess the condition of water transmission systems, helping water utilities and pipeline operators locate water main leaks; reduce water main breaks; ensure environmental compliance; and make informed decisions regarding water main repair, rehabilitation, or replacement.

Information Management Services

Streamline workflows, reduce costs, and boost operational intelligence. Integrating detailed asset data with precise water GIS geospatial information enables informed management decision making that sharpens situational awareness, mitigates operational risk, and enhances system control. Information management from Wachs Water Services delivers the crucial data needed for efficiently planning, scheduling, and performing maintenance, rehabilitation, and replacement projects and accelerating the revitalization of an organization's entire water distribution system.

For more information, visit www.wachsws.com or contact info@wachsws.com.

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• Water focused and field trained GIS team	• Proven track record on large valves up to 108"	• Inspected over 6,000 miles of distribution & transmission mains
• Largest GISP certified team	• Successfully operated valves installed in 1800's	• Introduced Investigator™ and LDS1000™ condition assessment systems
• Proprietary web based tool sets	• Restored operability in 88% of frozen valves, eliminating need for costly replacement	• Simplified inspection of in-service pipelines
• Strategic partnerships with key GIS vendors	• North American leader in large, multi-year assessment and rehabilitation programs	• Commercialized pressurized water main CCTV systems for distribution and transmission pipelines

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