

GIS & DIGITAL WATER

*The Foundational Role of GIS in
Digital Water Transformation*

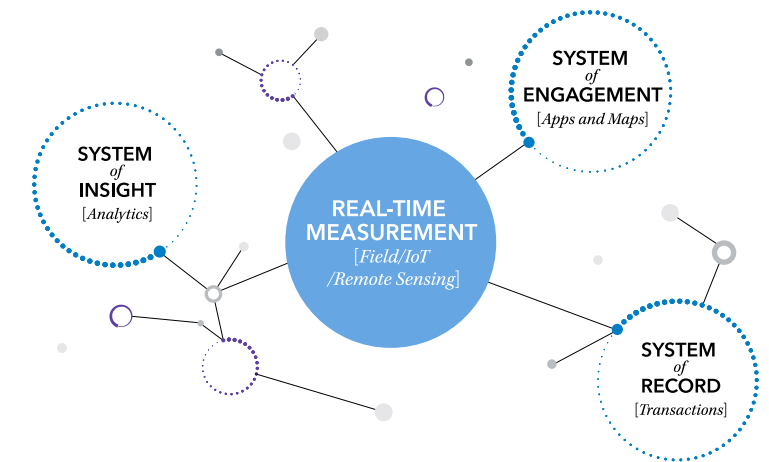
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THE *big* PICTURE

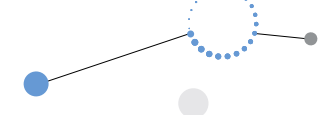
*Defining GIS and Its Role in
Digital Water Transformation*

A Complete GIS



WHAT IS GIS, and WHAT DOES IT HAVE TO DO WITH WATER?

Location is everything in the water industry. Utilities' core function is the timely, orderly movement of flows of water, wastewater, and stormwater from location to location—from the plant to the tank to the tap, and back to the plant for treatment and discharge. Utility staff are highly mobile, operating and maintaining a vast network of remote assets across service areas, which span hundreds or thousands of square miles. Utility data, too, is fundamentally spatial. Though a utility's various datasets are typically housed in separate systems or silos and used by different teams for different purposes, most share a common link to location—they are tied to specific customers, assets, system events, or processes in discrete, identifiable places.



SO WHERE DOES GIS FIT IN?

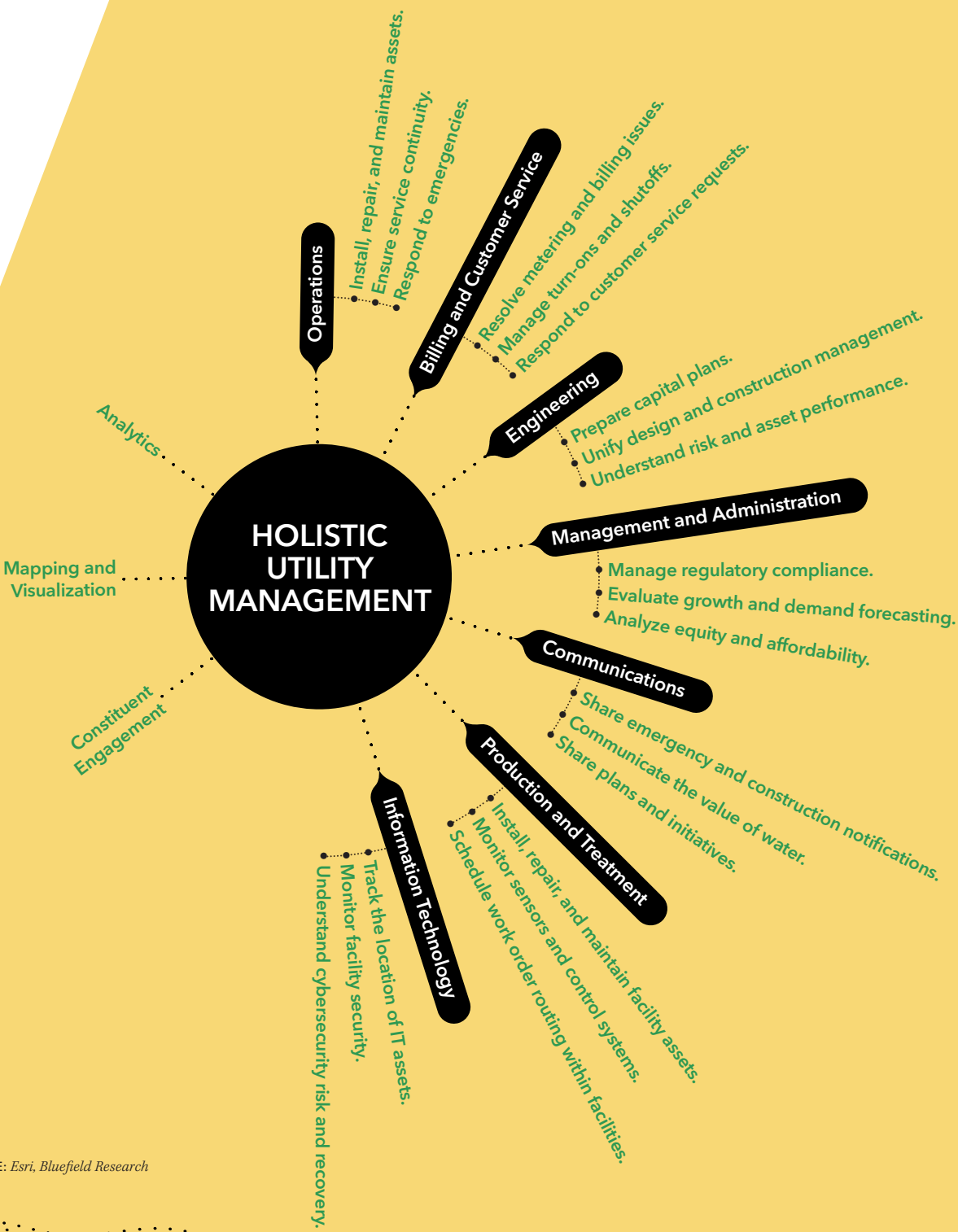
WHAT IS GIS, *and* ——— WHAT IS IT NOT?

- A geographic information system (GIS) is a technology originally developed in the 1960s for recording and analyzing geospatial or locational information.
- GIS is a tool for location intelligence—for helping organizations of all types and sizes, including water, wastewater, and stormwater utilities, make better decisions using locational data.
- GIS is an ideal foundation for digital transformation in the water industry. GIS facilitates integration, coordination, and analysis of disparate hardware and software, workers and processes, and departments and datasets across space and time, laying the groundwork for more advanced digital initiatives such as big data analytics, artificial intelligence, and digital twins.
- GIS is not just a system of record for storing data about a utility’s assets—the age and material type of a certain pipe segment, for example, or the maintenance history of a specific valve. GIS also serves as a system of engagement (enabling staff to access core asset data from any location, on any device) and a system of insight (facilitating advanced analysis of key data trends over space and time to support better operations and investment decisions).
- GIS is not just for horizontal assets, like distribution and collection pipe networks. GIS technology has moved indoors, making it equally suitable for managing complex three-dimensional vertical assets like treatment facilities and pump stations.

- GIS is not just for experts. Though GIS professionals play a crucial role in building and maintaining a utility’s GIS database, GIS is designed to be used by nonspecialists. Field crews can use it for accessing and updating asset maintenance on-site and in real time, for example, while customer service representatives can use it to identify and communicate with affected households in the event of a main break or network outage.

COMMON PATTERNS OF GIS USE

by Utility Department



SOURCE: Esri, Bluefield Research

{ DEFINITIONS }

Digital Water An ecosystem of data and analytics solutions, including hardware, software, and services, which are used to support more informed decision-making across water, wastewater, and stormwater management	Geographic Information System (GIS) A framework for gathering, managing, and analyzing data, rooted in the science of geography, which analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes	ArcGIS® The market-leading GIS platform launched by US software company Esri in 1999 and used widely in the water, wastewater, and stormwater industry	Horizontal Assets Network assets, such as system pipes and appurtenances, which are represented as points, lines, and polygons on a GIS map	Vertical Assets Buildings and facilities, such as treatment plants and pump stations, which are represented as lines, points, polygons, and 3D features on a GIS map
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WHY NOW?

Drivers for Digital Water Transformation

Today's water utility leaders must navigate an unprecedented array of challenges—financial, demographic, environmental, and technological. Aging infrastructure is becoming ever more costly to operate, maintain, and rehabilitate, requiring utilities to optimize limited capital and operating budgets. The water workforce is aging as well, with roughly a third of the industry's 1.7 million professionals becoming eligible for retirement in the next decade, taking crucial institutional knowledge with them. A changing climate produces more acute shocks and stresses for utility infrastructure, with the US seeing an annual cost average of \$12 billion due to climate disasters in the last decade, up from just \$3 billion per year in the 1980s. Finally, a rapidly evolving technology landscape puts greater pressure on utilities to stay up to speed, requiring a thoughtful technology strategy to maximize the value of digital investments, enable integration and data sharing across teams and platforms, and maintain cybersecurity.

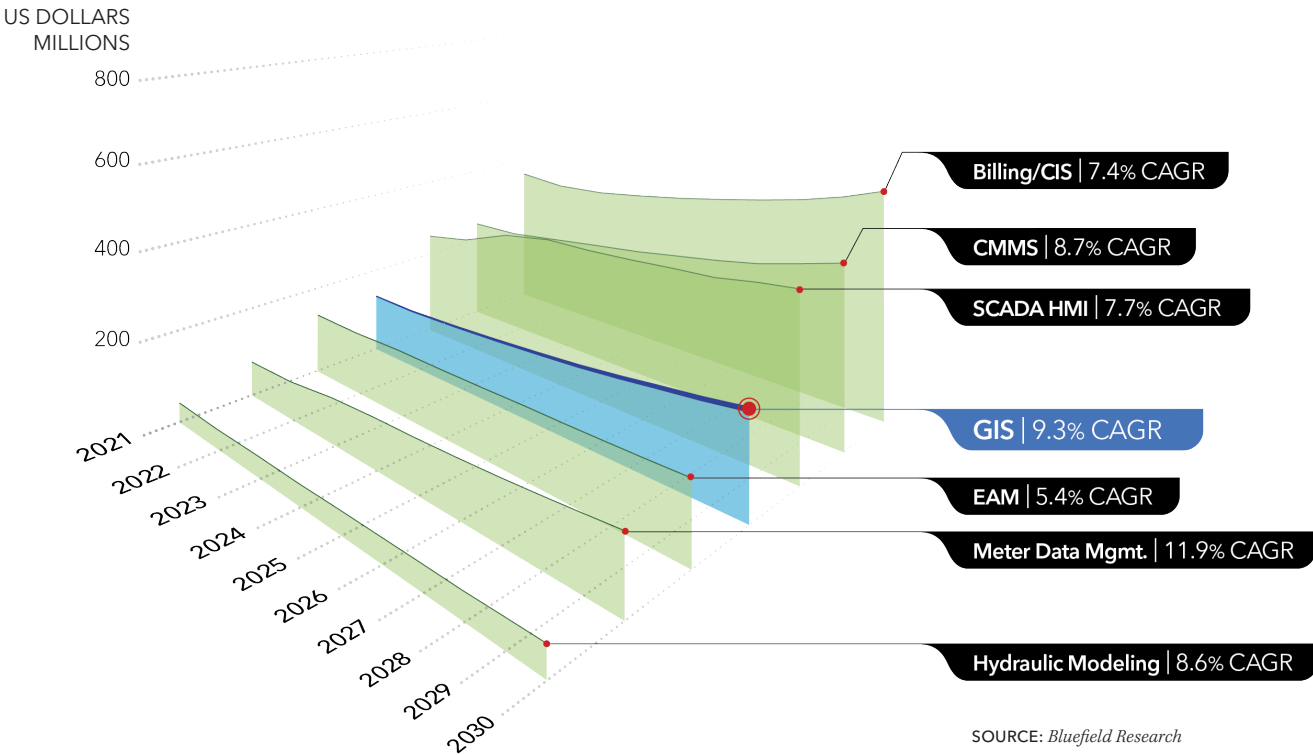
Savvy utility leaders also recognize the opportunities inherent in these challenges—opportunities to tangibly improve customer and stakeholder communication and satisfaction; make their communities more sustainable and resilient; maintain the safety and security of their workers and operations; and maximize the efficiency and productivity of their people, processes, and technologies. But to fully harness these opportunities, utilities need to undergo a digital transformation of their operations and infrastructure. They need

to put data at the heart of their decision-making, adopting systems and equipment for collecting and communicating, storing and managing, and visualizing and analyzing that data—in other words, for making that data accessible, actionable, and meaningful.

GIS is uniquely suited to serve as the foundation for digital water transformation for a number of reasons. GIS is built to be used by anyone, from anywhere, and on any device across a utility organization. GIS can take in, display, and analyze data from all manner of digital hardware and software, from flow meters and water quality monitors to billing and work order management systems. Finally, GIS is already in use at most water, wastewater, and stormwater utilities around the world, making it an ideal point of departure for new digital water investments and initiatives. Whether you are with a large urban utility serving millions of people or a small rural or suburban provider serving thousands, GIS can support your journey of digital transformation at every step of the way.

Water industry analysts Bluefield Research view GIS as one of the top growth areas for digital water investment, on par with other key segments such as SCADA HMI, enterprise asset management, and hydraulic modeling. Water utility investments in GIS software are projected to see near double-digit growth annually over the next decade, as utilities around the country and the world harness GIS as the bedrock of their digital transformation initiatives.

US UTILITIES' PROJECTED DIGITAL WATER SOFTWARE INVESTMENTS BY PRODUCT TYPE 2021-2030



DEFINITIONS

Customer Information System (CIS)

Software platform for managing key customer data, including account and billing information

Human-Machine Interface (HMI)

Software component of a SCADA system, which enables operators to monitor and control devices and processes

Computerized Maintenance Management System (CMMS)

Software platform for managing maintenance programs, with functionality related to scheduling maintenance tasks, managing work orders and inventory, and facilitating communication around maintenance activities

Enterprise Asset Management (EAM) Software

More advanced software for managing enterprise assets, which often includes CMMS modules and draws from CMMS data, but extends into predictive maintenance, asset life cycle planning, and financial analysis

plotting

A COURSE FOR THE DIGITAL WATER JOURNEY WITH GIS

MAPPING THE POINTS OF OPPORTUNITY

The sections that follow highlight several ways in which a robust, well-configured GIS can be used as the cornerstone for ambitious digital transformation initiatives. With pioneering US water, wastewater, and stormwater utilities as your guides, you will learn how GIS can be harnessed for three key digital water project types:

- **Network Management**
Updating and integrating network data to better model and manage network performance and behavior and the relationships between disparate network assets
- **Coordinated Operations**
Putting utility data in the hands of all staff members—field crews, customer service representatives, engineers, and financial planners—to ensure that every member of the organization has access to up-to-date information when, where, and how they need it
- **Real Time**
Integrating, visualizing, and analyzing real-time data from various sources—SCADA systems, Internet of Things (IoT) devices, weather forecasts, even social media—to help utilities understand what is happening at all times and all places in their service areas

In the process, you will learn about Esri® ArcGIS technology's cutting-edge features and advanced functionality, which support data-driven decisions and sustainability planning now and into the future. These include the following:

- **Digital Twin**
Providing a framework for creating and integrating digital twins—dynamic digital replicas of physical objects, processes, relationships, and behaviors—which are grounded in precise, up-to-date, real-world data
- **Location Intelligence/Analytics**
Leveraging embedded, industry-specific analytics to help utility staff make data-driven operational, planning, and investment decisions
- **Facilities and Vertical Assets**
Extending GIS mapping, modeling, and location intelligence capabilities to indoor facilities—like treatment plants and pump stations—to enhance utilities' vertical asset management programs

You will also learn how GIS has evolved from a system of record to a system of engagement and a system of insight. These interlocking, interoperable capabilities make GIS an indispensable part of digital transformation for utilities of all types, shapes, and sizes.

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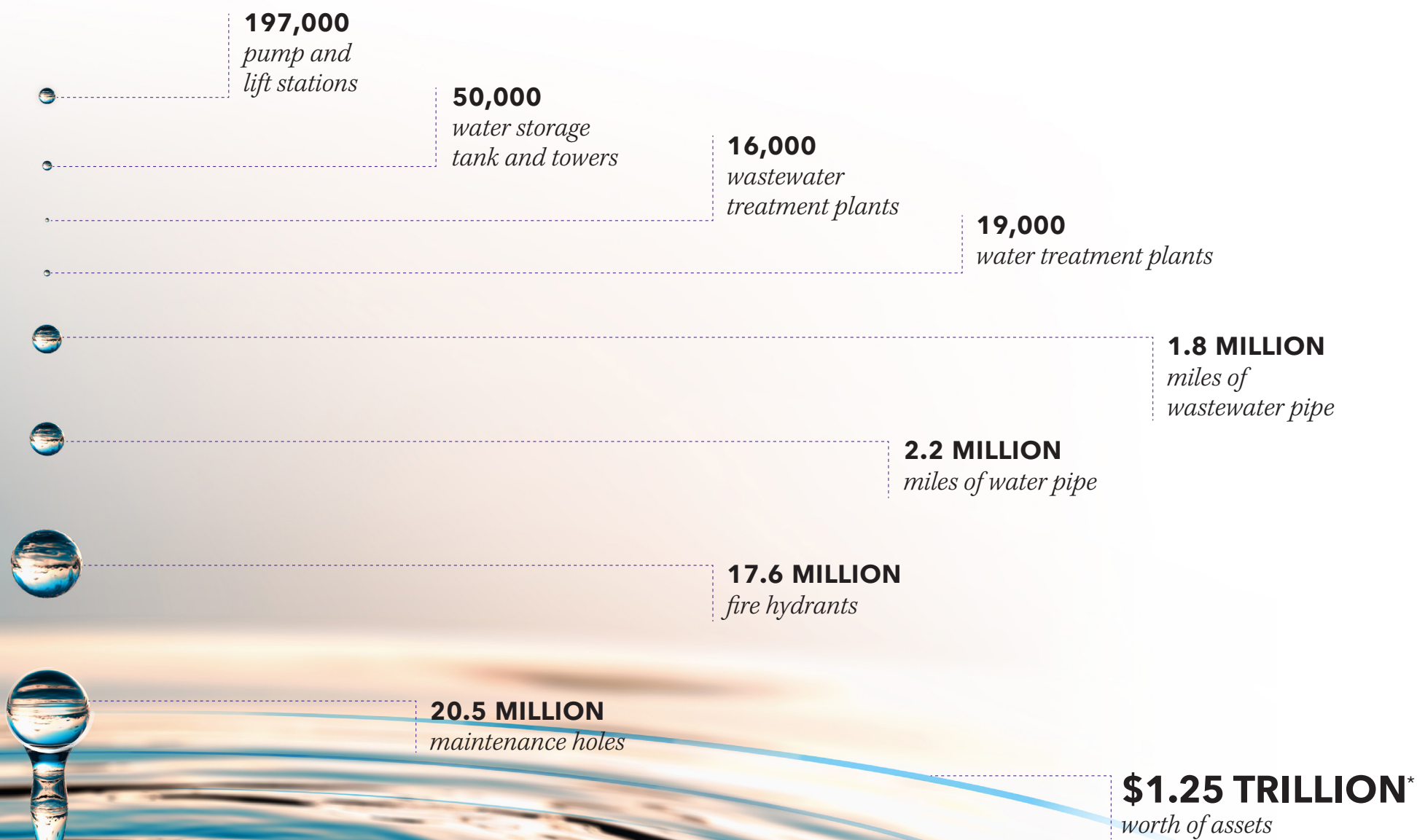
Internet of Things (IoT)

A network of internet-connected objects and devices embedded with sensors and software, which collect, process, and transmit data on their physical surroundings

Digital Twin

A virtual representation of the real world, including physical objects, processes, relationships, and behaviors (GIS creates digital twins of the natural and built environment and uniquely integrates many types of digital models.)

US WATER AND WASTEWATER *Asset Base*



*US DOLLARS
SOURCE: Bluefield Research

NETWORK MANAGEMENT

US utilities collectively manage over US\$1.25 trillion worth of water, wastewater, and stormwater assets, including an estimated four million miles of distribution and collection pipe, 77.5 million network assets (valves, hydrants, maintenance holes), and nearly 300,000 vertical assets (treatment plants, storage tanks, pump and lift stations). Mapping these assets and recording their key attributes—size, age, material type, etc.—are among the core functions of a GIS platform.

Effective management of utility infrastructure requires operators to think holistically about their networks as a whole rather than individual assets alone—they need to understand not just where their critical assets are but also the connections and relationships between those assets. In the event of a water main break, which valves should be closed to ensure that service disruptions impact the fewest customer households and businesses? In the event of a power outage at a wastewater lift station, which maintenance holes are at greatest risk for a sanitary sewer overflow? When catastrophic weather impacts a water treatment plant, how do the power, communications, heating, and water networks interact and influence each other to help head off cascading effects?

/ PERSPECTIVES /

“[ArcGIS Utility Network] represents a significant upgrade to our data quality—ensuring that we have a full representation of our water network that is fast and scalable.”

— **Tim Cover**

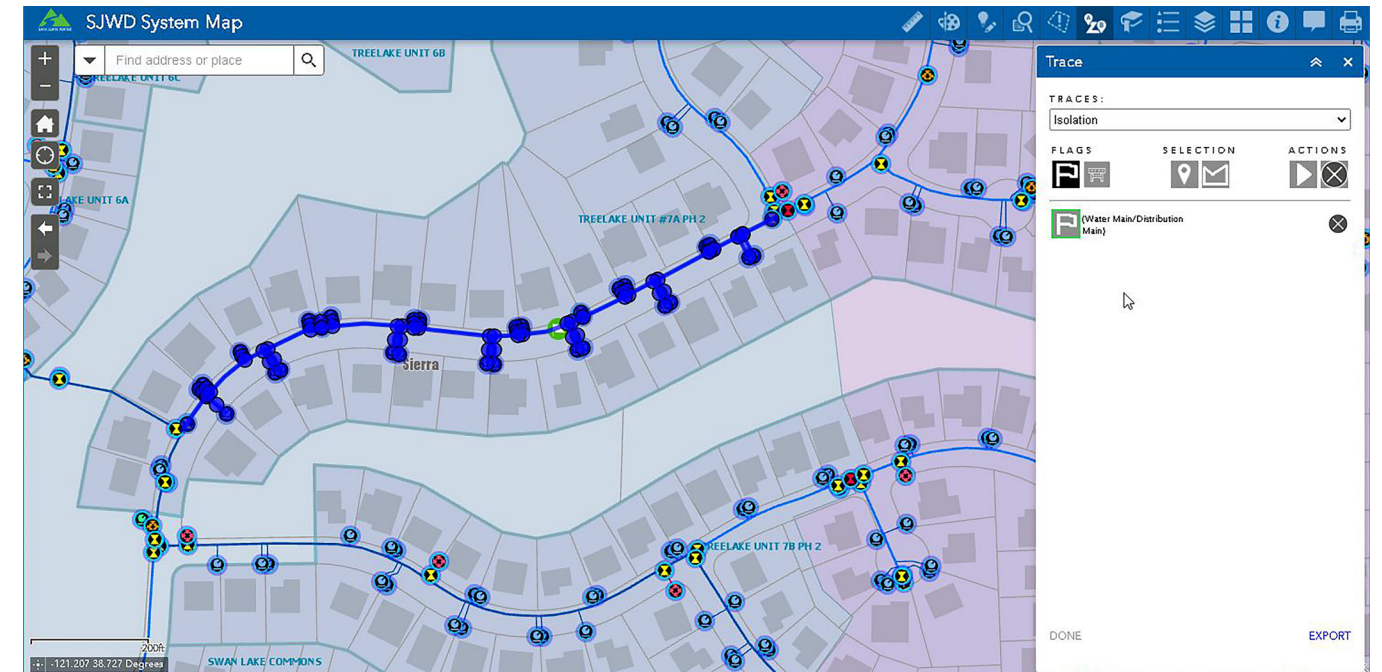
ICT Project Manager | North East Water (Australia)

This is where Esri’s advanced network management and modeling tools come into play. Web-based networking capabilities are available via the desktop and accessible from mobile devices. With ArcGIS, utilities have access to a dynamic system of record, which fully captures the intricacies of real-world water networks, using both industry-standard and utility-specific logic to model, visualize, and analyze the performance of individual assets, groups of related assets, and the network as a whole. These tools extend to complex infrastructure with multiple subcomponents, such as pump stations, which contain several pieces of interrelated equipment that must be operated and managed in tandem. ArcGIS network management tools are designed to work as well on a field supervisor’s smartphone as they do on a GIS professional’s desktop computer, enabling access by anyone, from anywhere, in the organization.

For example, the San Juan Water District (SJWD) in Granite Bay, California, needed a new solution after losing support for its legacy open-source GIS platform, which made data sharing across systems and departments more difficult and forced a return to costly, inefficient paper map books. With the help of Esri partner HDR, SJWD

implemented ArcGIS, using existing CAD data and county parcel drawings to build an accurate and robust system of record for the utility’s water distribution network assets.

Esri’s advanced network modeling, management, and tracing capabilities allow SJWD operators to identify system and customer impact during outage events and help engineering and operations teams be proactive in determining areas exposed to potential vulnerabilities. This has saved countless hours compared to manual, paper-based processes. SJWD has built GIS-based repositories that bring together distribution and treatment asset data, customer and work order data, and county parcel and demographic data, leveraging integrations with asset management and customer information systems to ensure that key organizational information is accessible to all staff members when, where, and how they need it. Improved communication between different business groups and integrated work processes have increased SJWD’s engagement and awareness and enabled the district to quickly react to the needs of the system and its customers, improving the work being done today and preparing SJWD for the future.



Valve isolation trace identifies customers and assets impacted by an outage.

/ PERSPECTIVES /

“The new Esri GIS system has increased the district’s operational performance by eliminating paper maps and providing field staff quick access to digital interactive maps, as-built drawings, and system information. This has increased efficiencies in the field for maintenance and emergency response.”

— **Tony Barela**

Operations Manager | San Juan Water District

COORDINATED OPERATIONS

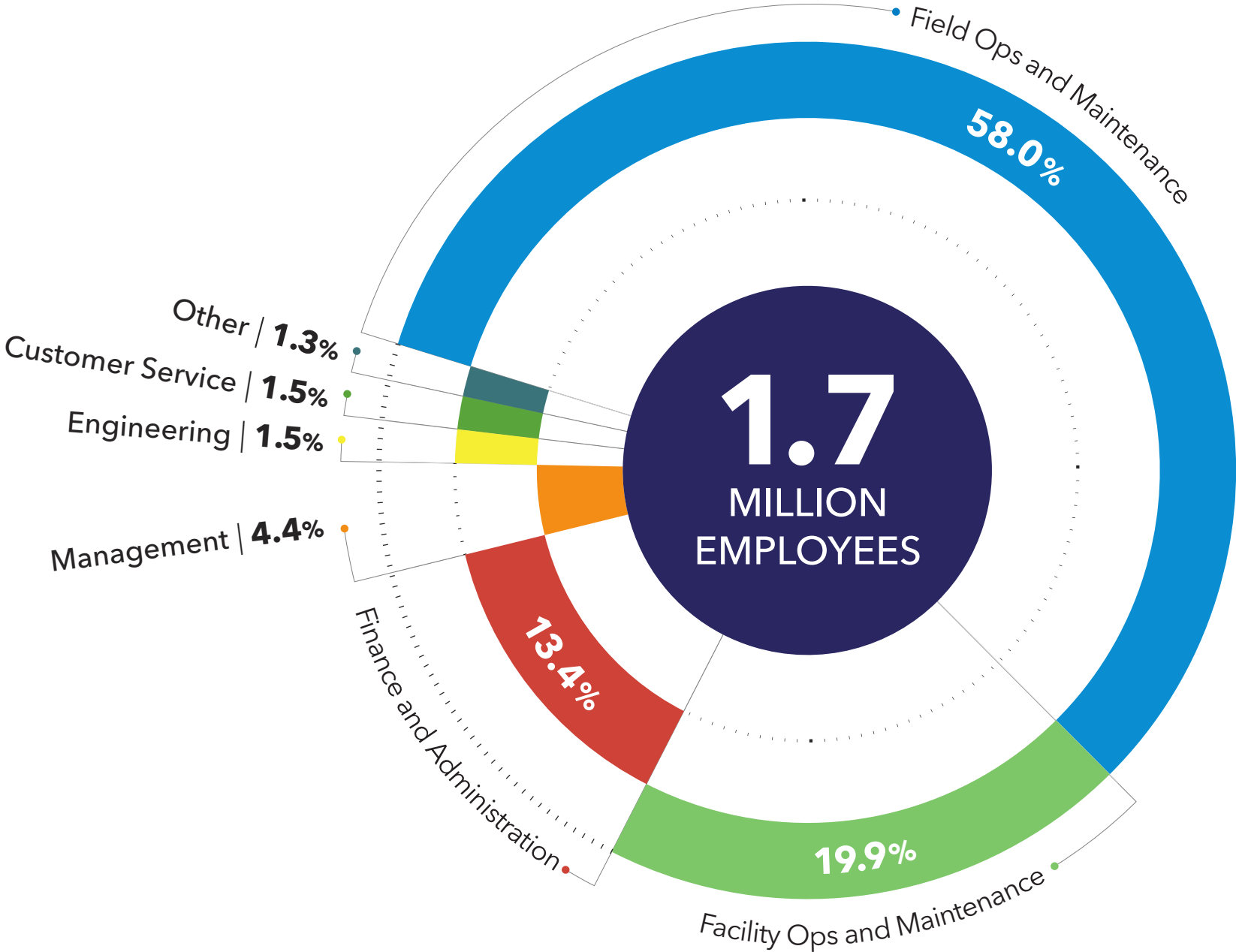
Roughly 75 percent of the 1.7 million total employees of US water utilities serve in on-site or field-based roles, with only a quarter working in office-based positions. Such a mobile, distributed workforce makes communication and coordination a significant challenge. How can utility managers ensure that all of their staff members have the same access to accurate, up-to-date, authoritative organizational information—as-builts, maintenance records, open work orders, etc.—regardless of whether they are in the back office or working at a jobsite?

GIS is an ideal solution, serving as a system of engagement, which facilitates coordination, collaboration, and data sharing in real time across all teams and departments—from field crews and plant operators to customer service representatives and financial planners. Esri’s synchronized mobile and desktop applications open a two-way channel of communication between the field and the office. Field staff can quickly and easily collect or update data while they work via a smartphone or tablet, with changes immediately reflected in back-office maps and operational dashboards. Meanwhile, office-based dispatchers and

customer service representatives can push assignments out to field teams with the click of a button, leveraging either Esri’s internal task management tools or its deep integrations with third-party work order management software platforms (e.g., EAM, CMMS), many of which are built directly on top of ArcGIS.

The benefits of better coordination and data sharing across functional areas are clear. With all the data they need at their fingertips, field crews can eliminate frequent trips back to the office to review paper maps and files, saving significant time—not to mention labor and fuel costs. Functioning as a single source of truth, GIS can empower utility staff, contractors, and other external stakeholders to make better, more data-driven decisions in the field and avoid costly or even dangerous mistakes resulting from inaccurate or out-of-date information. Esri’s ArcGIS is also an ideal repository for the institutional knowledge of veteran operators, making nuanced information about the condition and performance of network assets readily available for the next generation of utility staff. Built-in data visualization and analytics capabilities give utility managers greater visibility and transparency into their teams’ performance,

US WATER AND WASTEWATER WORKFORCE *by Functional Area*



SOURCE: US Bureau of Labor Statistics, Brookings Institution, Bluefield Research

/ PERSPECTIVES /

“For the transfer of historical knowledge, there’s nothing like GIS to do that, without a doubt.”

— **Chris Stephan**

North Shore Interceptor Operations Chief | Hampton Roads Sanitation District

enabling them to track progress against key organizational targets, goals, and key performance indicators (KPIs).

For example, more than a thousand SUEZ North America employees rely on ArcGIS to coordinate their response to customer service inquiries, such as water quality complaints, across multiple departments. Customer service representatives use GIS maps to view information about system events—hydrant flushing, construction projects, main breaks, etc.—in real time, giving them the information needed to respond to a customer inquiry about a water quality issue in their area and enabling them to resolve most issues with a single call or email. In the event that a cause cannot be determined, ArcGIS automatically triggers an investigation by a water quality specialist, with a closed-loop workflow to ensure

customer follow-up. An ArcGIS technology-based operational dashboard summarizes active events, giving senior leadership and engineering teams a clear, concise view of exactly where and what the outstanding issues are in the system.

Since rolling out this solution, SUEZ has seen a decrease in the time it takes to resolve a water quality complaint, from an average of 24 hours to less than 3—significantly improving the customer experience. SUEZ has also seen an increase in communication across departments and collaboration needed to resolve these issues quickly. In the past, different departments did not have access to the same information, and data could be lost or duplicated. Now, ArcGIS provides a one-stop shop for knowledge about all major events that are going on across the utility in

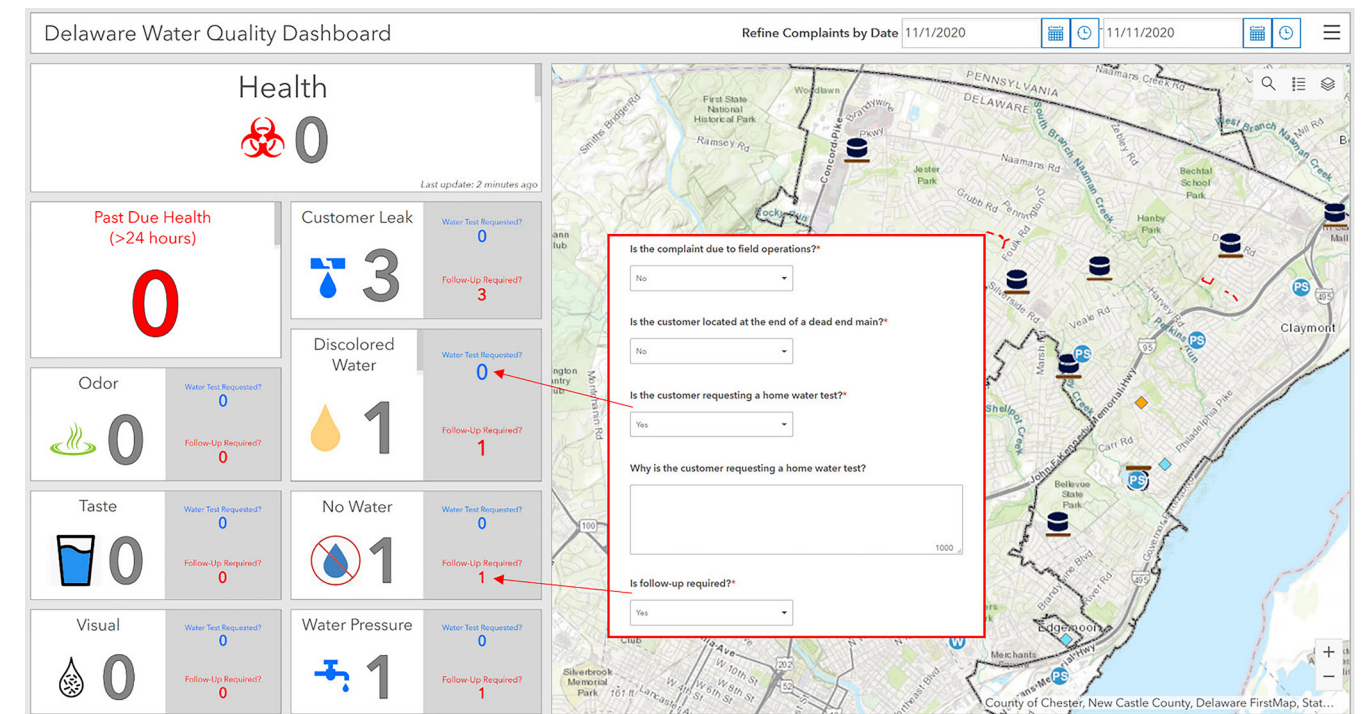
real time, empowering customer service representatives to respond confidently to any customer inquiry and ensuring that all departments are kept informed and know what the status is at all times. The use of dashboards not only enables SUEZ’s leadership team to see the big picture at any given time, but it also helps utility engineers understand where the recurring issues are, which guides the planning of future capital projects.

/ PERSPECTIVES /

“[ArcGIS] has created a level of efficiency for customer service representatives that we haven’t seen before. Whether pulling data/information for a service order or speaking with a customer, we can provide much more comprehensive, up-to-date information faster, improving the customer experience and making our jobs easier.”

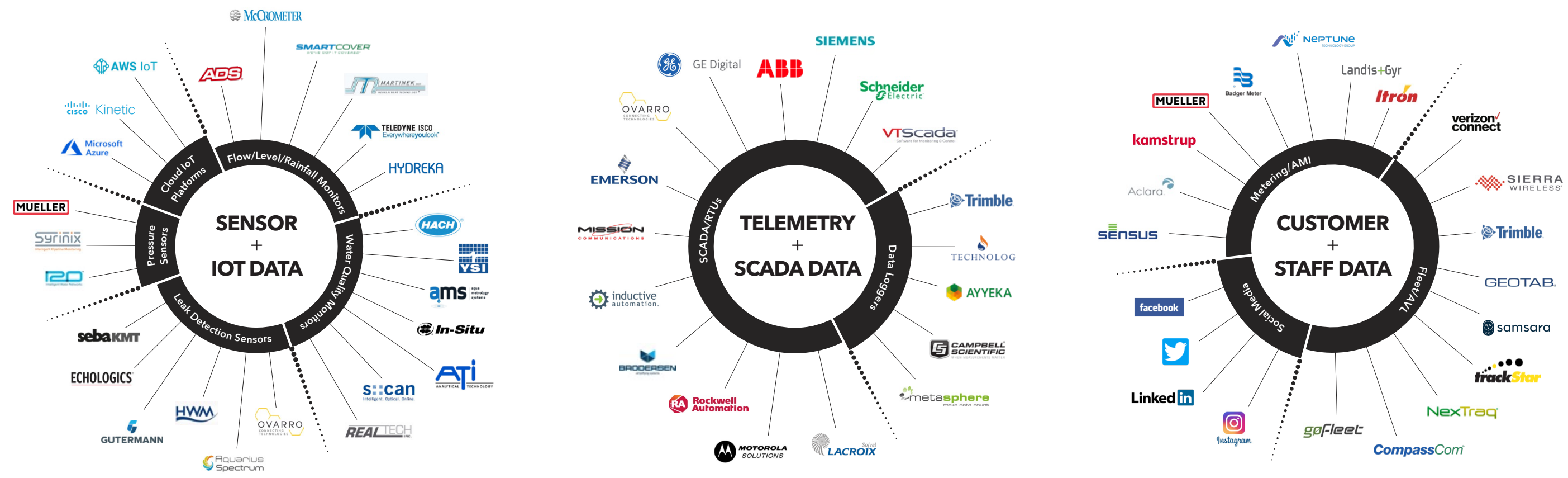
— **Katie Colonna**

Customer Service Representative | SUEZ North America



Coordinated operations provide immediate visibility into system events and activities.

REAL-TIME DATA PROVIDERS *by Type*



REAL TIME

In our increasingly digital world, utilities have greater access than ever to real-time information on the operating conditions, performance, and health of their infrastructure, enabling more efficient operations and planning decisions, more proactive response to network events, and more preventive or predictive maintenance of critical assets. This data can come from a wide range of sources—SCADA platforms,

Internet of Things devices, automatic vehicle location systems, weather forecasts, and social media. For example, between 20 and 30 percent of the US’s 100 million total metered water connections are equipped with advanced metering infrastructure (AMI) radios, generating hundreds of millions or even billions of time-stamped data points each day.

This deluge of data can be overwhelming, quickly becoming “dark data,” which is gathered and stored but not used in any meaningful way—particularly when it is generated from multiple sources or systems and stored in departmental silos, which do not communicate with one another. Esri’s real-time data integration capabilities are designed to bridge this gap, adding a crucial locational component to utilities’

/ PERSPECTIVES /

“With [ArcGIS], data turns into shareable knowledge and live visuals, promoting awareness and understanding of projects by [utility] staff.”

— James Galley

Senior Financial Analyst | St. Johns County Utilities

time-based data. Functioning as a powerful system of insight, ArcGIS allows operators to visualize and analyze real-time data across both time and space, regardless of source, providing an at-a-glance view of where individual data feeds are in relation to each other, customers and assets, and network processes and events. This much-needed context, in turn, makes previously dark data more meaningful and actionable.

The value of a dynamic, holistic view of network conditions cannot be overstated. During outages, extreme weather events, and other emergency situations, ArcGIS can serve as a crucial platform for monitoring conditions in real time and mounting a proactive, coordinated response. Meanwhile, Esri’s embedded analytics capabilities and third-party partner machine learning applications can be trained on the real-time and historical data feeds captured by ArcGIS, providing robust optimization and prediction tools to support operations, maintenance, and investment planning decisions. In all cases, Esri’s ArcGIS Living Atlas of the World provides a valuable enhancement to a utility’s own data generated across its service territory. ArcGIS Living Atlas of the World is the foremost collection of geographic information from around the globe. It includes maps, apps, and data layers to support your work. Utilities can take advantage of demographics to support equity initiatives, soils for corrosive analysis, and real-time weather and traffic for planning activities.

For example, the Hampton Roads Sanitation District (HRSD) in Virginia Beach, Virginia, has taken advantage of ArcGIS technology’s real-time data integration capabilities for its master metering program. A regional wastewater authority, HRSD provides wholesale wastewater treatment services for 18 cities and counties across a 3,100-square-mile service area in southeastern Virginia. Starting in 2016, HRSD began integrating real-time data from its OSIsoft PI data historian and Telog data logger fleet, which transmit live readings from approximately 200 flow meters, 200 pressure sensors, and 70 rain gauges, into its ArcGIS office and field applications. Operations and maintenance staff can access up-to-date information on network conditions from anywhere in the field to monitor and manage critical infrastructure during wet weather and high tide events, while office staff can access and analyze historical data on system performance over time.

As a regional authority, HRSD is also thinking big about the future of its real-time GIS data. HRSD staff hope to start sharing their data more broadly with their member localities, other regional bodies, and the public, as well as national organizations like the National Weather Service—all of which will improve interagency planning, coordination, and response, making the Hampton Roads region safer and more resilient for its 1.7 million residents.



Hampton Roads Sanitation District visualizes real-time data from its OSIsoft PI data historian, Telog data logger fleet, and ArcGIS.

/ PERSPECTIVES /

“Pressures, flows, rainfall amounts—any of the information that’s available in our system, we have live links in our GIS so that our operators can pull up this information any time they choose in the field.”

— Chris Stephan

North Shore Interceptor
Operations Chief |
Hampton Roads
Sanitation District

{ DEFINITIONS }

Automatic Vehicle Location (AVL)

A system for tracking and monitoring a fleet of vehicles, including location, speed, and stops, using GPS satellite technology

Machine Learning

A subset of artificial intelligence in which machines use algorithms to analyze and learn from data to make predictions or improve decision-making

Dark Data

Data that is collected and stored by an organization but is beyond the organization’s capacity to process, interpret, use, or make actionable in any meaningful way

ArcGIS Living Atlas of the World

A vast geospatial database of geographic, demographic, and real-time information, such as flood gauge readings and soil maps, which is available to all ArcGIS users

DIGITAL TWINS LEVERAGE NETWORK MANAGEMENT FOR COORDINATED OPERATIONS

Though it has a long history in other industries, the concept of the digital twin has recently become popular in water, evoking ideas of futuristic monitoring and control platforms used by highly sophisticated, tech-savvy organizations. In reality, most utilities already have a strong foundation for a digital twin of their critical infrastructure in the form of their GIS. GIS is an ideal framework for creating and integrating the various digital models at the core of a utility digital twin, including models of assets and networks, buildings and facilities, and cities and landscapes. ArcGIS also incorporates real-time data from a wide range of sources, turning static engineering and design models into dynamic replicas of real-world objects and processes, which can in turn be used for optimizing asset management and investment decisions, monitoring real-time operational performance, and simulating network events and scenarios for planning and training purposes.

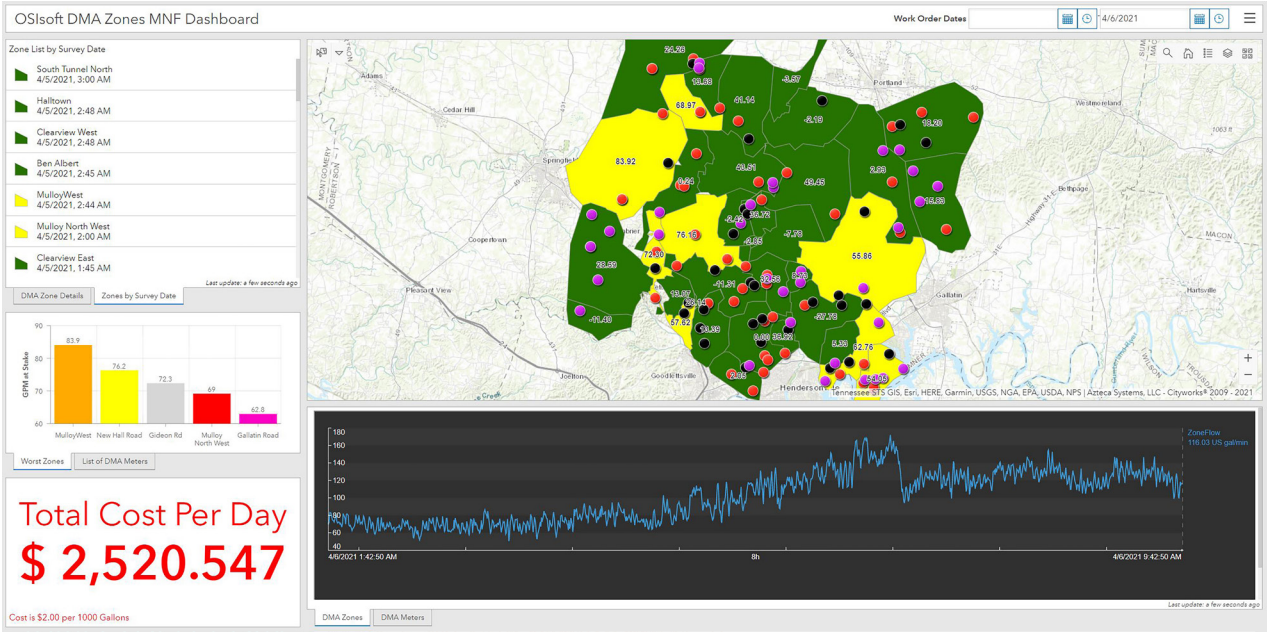
An Esri client of nearly 30 years, the White House Utility District (WHUD) in White House, Tennessee, has put its GIS to use in tackling a wide range of challenges and pain points, but one of the most impressive is its real-time water loss tracking program. After reaching rates of nearly 50 percent for nonrevenue water (NRW) 15 years ago, WHUD experimented with several technologies to help the utility find and fix leaks more effectively, including acoustic leak detection; step testing with temporary flow meters; and, finally, implementation of district metered areas (DMAs). With DMAs, WHUD staff were able to make more progress on reducing leakage than in the previous 10 years combined, reaching an infrastructure leakage index (ILI) of below 1.0 for the first time ever in 2020.

GIS plays a critical role in WHUD’s real-time water loss program, providing the foundation for what is essentially a dynamic digital twin—a virtual model of its sectorized distribution network, which

replicates and reflects real-world network conditions and events as they unfold. The utility uses ArcGIS to integrate all critical information, including real-time flowmeter data and field crew updates, with custom configured office dashboards and field applications that consume the central geodatabase information on any device, anywhere. Every morning, WHUD’s water loss analysts consult these dashboards for up-to-date readings from their DMA flowmeters, with potential problem areas identified on a color-coded GIS map of their service area and dollar values of lost water displayed for each DMA in the district.

Whereas it used to take WHUD staff days to find each leak, they can now usually pinpoint a leak within hours on the same day they identify it, a drastic reduction in time, cost, and water loss. In fact, WHUD’s engineering team estimates the total direct savings of the program to be US\$1 million per year, with more than US\$200,000 of that coming from early leak detection, or as much as US\$37,000 per leak. Meanwhile, through better capital improvement expenditures that led

The WHUD dashboard visualizes DMA zones, water loss in each zone, and cost of water loss in dollars.



/ PERSPECTIVES /

“In the last decade, GIS has become our database of record, enabling us to build and visualize an intricate network of data and completely transform our daily operations. We now have access to a continuous flow of information that allows us to make sound operating decisions in an instant.”

— **Bill Thompson**
General Manager | White House Utility District

{ DEFINITIONS }

Nonrevenue Water (NRW)	District Metered Areas (DMAs)	Infrastructure Leakage Index (ILI)
Water that is pumped or produced but not billable, due primarily to leakage, inaccurate meter readings, or unauthorized consumption	Sectorized or partitioned sections of a water distribution network, which are individually monitored for supply, consumption, and leakage	A metric for measuring distribution network leakage, which compares actual leakage rates to unavoidable leakage rates

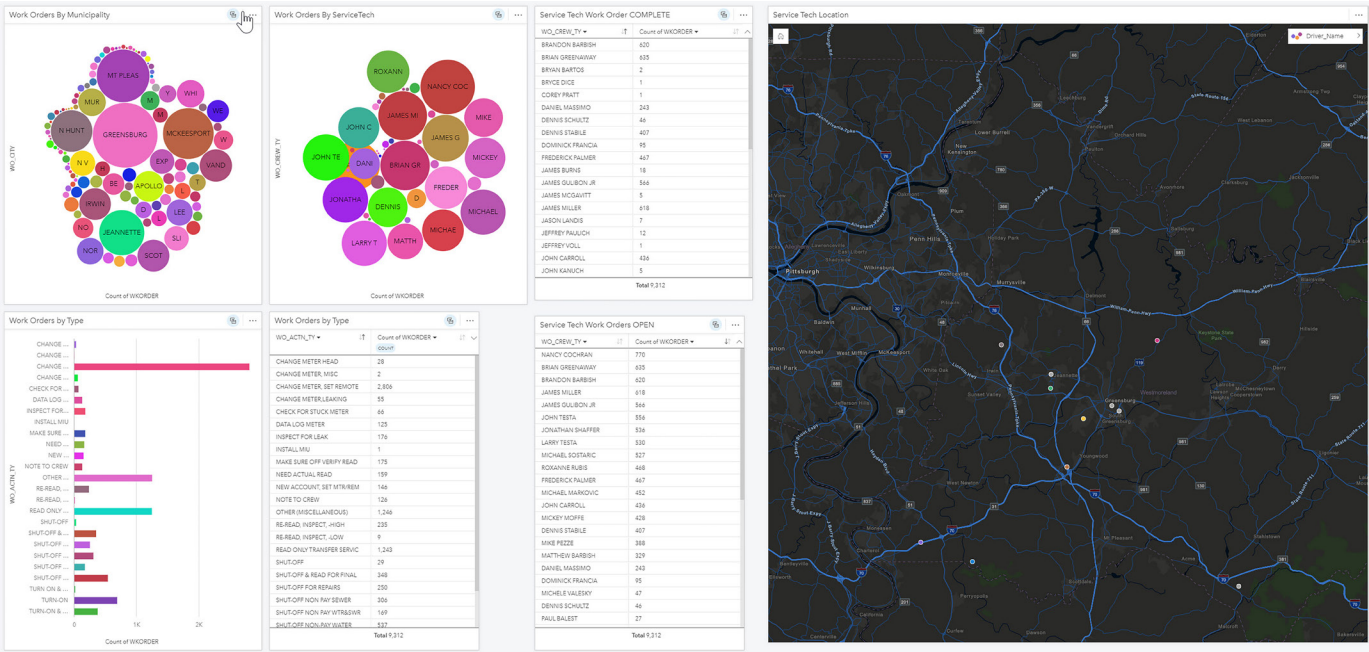
VISUALIZATION AND ANALYTICS LEVERAGE REAL TIME FOR DECISION SUPPORT

The advancement of digital water technology has provided utilities with ever more data—on the needs and behaviors of their customers, the condition and performance of their critical assets and systems, and the day-to-day problems and pain points they face in operating and maintaining their networks. For that data to be truly valuable, it needs to be accessible, understandable, and usable. GIS broadens operational awareness by integrating customer, climate, and other datasets with a utility’s own data on infrastructure health and performance, providing utility professionals with a clear picture of patterns and trends over space and time to help them find better solutions to enduring problems. ArcGIS technology’s spatial analytics capabilities, built on deep industry-specific domain knowledge, take the analysis a step further, guiding utility operators and managers to the insights they need to make the right operational, planning, and investment decisions for their customers and communities.

The Municipal Authority of Westmoreland County (MAWC) in New Stanton, Pennsylvania, recently began using ArcGIS technology’s embedded data visualization and analytics tools for financial analysis of maintenance and capital projects. Prior to implementing the new system, MAWC managers relied on a legacy AS400 platform, which provided only a simple list of transactions by date and type. For monthly reporting and in-depth financial analysis, managers would need to manually copy the transaction data line by line into a spreadsheet, a time-consuming and error-prone process.

With ArcGIS, MAWC managers can instead extract a complete list of transactions automatically in a matter of minutes, simplifying their monthly reporting workflows substantially. Moreover, Esri’s business intelligence capabilities provide a far more nuanced,

user-friendly, and meaningful view of the data, enabling more insightful and actionable analysis that goes above and beyond monthly reporting requirements. Now, MAWC managers use analytical tools and dashboards to see, at a glance, where their maintenance and capital dollars are going—with transactions organized by project, location, date, vendor, employee, and type, all clearly and intuitively displayed on interactive real-time maps, bar charts, and bubble charts. Best of all, each dashboard takes only an hour or two to build, enabling MAWC managers to create their own custom views of the data they need to make better operational and organizational decisions.



ArcGIS InsightsSM transforms work order data from MAWC’s AS400 system into easy-to-understand, interactive, real-time maps, bar charts, and bubble charts.

/ PERSPECTIVES /

“In just six months, ArcGIS technology’s data visualization and analytics tools have taken MAWC from the Stone Age to the Space Age.”

— **Tom Ceraso**
Assistant Manager | Municipal Authority of Westmoreland County

OPTIMIZING FACILITY AND VERTICAL ASSET MANAGEMENT

GIS has traditionally been used to manage two-dimensional linear assets, like water, wastewater, and stormwater pipe networks. Esri is taking ArcGIS inside facilities as well, with a suite of tools for mapping, modeling, and managing three-dimensional vertical assets, such as treatment facilities and pump stations. By integrating design and engineering models (e.g., CAD, BIM) and real-time sensor and control system data, providing easy access to maintenance records and wayfinding guides, and delivering lifelike visualizations of facilities and their interconnected assets, GIS enables better understanding of complex 3D systems, structures, and assemblies at any point in the vertical asset life cycle, from design and construction to operations and maintenance.

Gwinnett County Department of Water Resources (GCDWR) in Lawrenceville, Georgia, recently started requiring all engineering designs for its vertical assets—treatment plants, pump stations, etc.—to be submitted in a 3D building information modeling (BIM) format. In an effort to better understand how these models could be leveraged for the county’s asset management program, GCDWR

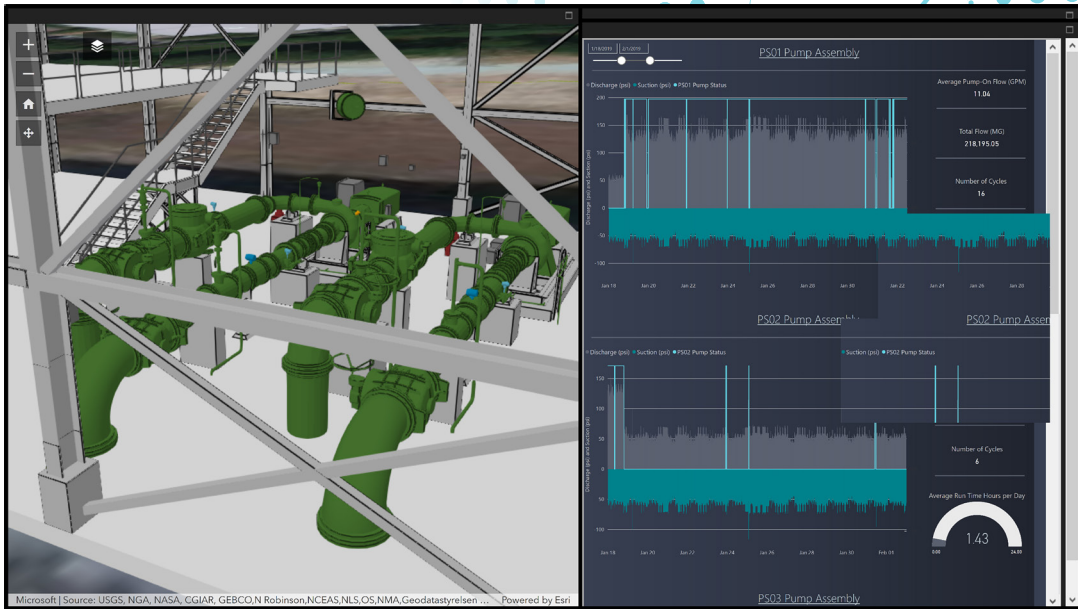
collaborated with Esri partner KCI Technologies for a pilot project at the Beaver Ruin Pump Station. KCI performed lidar scanning and surveying of the pump station, including the structure and mechanical, electrical, and wastewater assets. KCI then developed a 3D BIM of the facility, with assets attributed with unique IDs and relevant data such as make, model, and serial number. The model was converted to a 3D GIS format, and relationships were established between assets, sensors, and functional systems, resulting in a precise, real-world model with an easy-to-navigate 3D vertical hierarchy not present in most asset management systems.

In partnership with the GCDWR team, KCI also incorporated real-time SCADA data—pressure, flow, temperature, vibration, and volume—into the 3D GIS model and developed a Microsoft Power BI dashboard to provide a dynamic display of the performance of each asset, revealing valuable insights that can be used to reduce maintenance issues, extend life cycles, and achieve new levels of optimization. Hosting the information on the Esri cloud allows any county staff member with security permissions to navigate and interact with the 3D GIS on their platform of choice, including desktop, tablet, or mobile devices, giving them 24/7 access to up-to-date information on the Beaver Ruin facility and its assets. Throughout the pilot project, GCDWR staff learned important lessons about the value of 3D GIS for their asset management programs—in particular, the ability to improve safety and maintenance efficiency through expanded situational awareness and increase asset knowledge with accurate data, measurements, and the ability to view an asset’s relationship to the overall processes.

/ PERSPECTIVES /

“The model that was produced by KCI Technologies during this project proved that this type of information is not just for design engineers anymore. The model, as detailed and as complex as it is, can be made available in the field to frontline employees who benefit from it the most.”

— **Charlie Roberts**
Deputy Director |
Gwinnett County
Department of
Water Resources



3D vertical assets are integrated with SCADA.

{ DEFINITIONS }

Computer-Aided Design (CAD)
A computer-based system for the design, drafting, and display of graphical information to support engineering, planning, and illustrating activities

Building Information Modeling (BIM)
Software used for creating and managing 3D representations of physical structures (e.g., buildings, infrastructure) and their functional characteristics

Light Detection and Ranging (lidar)
A remote sensing method that uses laser pulses to generate precise three-dimensional data about the shape and makeup of physical objects

TAKING
THE

next steps

ON THE DIGITAL WATER JOURNEY

YOU ARE HERE:

Getting Started on the Path to Transformation

Recent industry surveys suggest that time, rather than cost, is the biggest barrier to digital transformation in the water utility sector. Utility managers fear getting entangled in long, arduous digital initiatives, which will monopolize their team's time, attention, and budget for months or years before producing any tangible benefits for customers and staff.

It doesn't have to be this way. Many of the most successful digital water innovators in the industry are those that have learned one simple but essential lesson: the best place to start is where you already are. Most utilities have already made significant investments in data and digital systems across departments and functional areas, and starting from scratch or trying to tackle everything at once is both unwise and unnecessary. The key is to find ways to maximize the value of existing investments first and build incrementally from there—learning, adjusting, and improving as you go.

GIS plays a key role in this process. Esri's ArcGIS is uniquely designed to integrate with a wide variety of devices, business systems, and data feeds across all corners

of the water industry, providing crucial locational context that gives value and meaning to dark and disparate data. Likewise, ArcGIS is built to be used by anyone, regardless of role or location—providing everyone in the organization with the tools and information they need to make better operational and planning decisions; communicate and collaborate with one another more effectively; and solve problems more efficiently for their customers, coworkers, and communities.

So get out there, find your first problem, and see firsthand what GIS can do as the foundation for digital transformation at your organization.

/ PERSPECTIVES /

“GIS is the foundation for our digital transformation. It's our building block that can branch off into different areas of the organization, from customer care and operations to finance and administration to external stakeholder engagement.”

— **Mark Bowen**
GIS and CMMS Manager |
Lehigh County Authority

/ PERSPECTIVES /

“When it comes to implementing new technology, your attitude determines your altitude.”

— **Anthony Pologruto**
GIS Analyst | Municipal Authority of Westmoreland County

RECOMMENDATIONS AND BEST PRACTICES FROM UTILITY PIONEERS

STILL NOT SURE WHERE TO BEGIN?

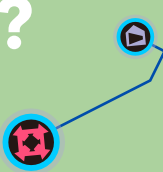
Leading Esri water, wastewater, and stormwater utility clients offer these words of wisdom to their peers:

- Be clear about your goals and vision for your GIS program—focus on the *why* before the *what* or *how* and align your objectives with your organization's core values and strategic priorities.
- Put yourself in your team members' shoes—try to understand staff's key objectives, workflows, and pain points and find ways to leverage GIS and other technologies to make their lives easier.
- Start with quick wins and low-hanging fruit to better showcase the value of GIS to your team—if a picture is worth a thousand words, a useful, functional application is worth a million.
- Find a champion in each department who can help demonstrate the value of the system to friends and colleagues.
- Make sure your GIS staff have access to the resources and training they need to get the maximum value out of your GIS and other digital investments.
- Democratize your organization's data—let your team members see their own data and give them the tools to update and maintain it over time.
- Patience and positivity are key for success in communicating the value of the new technology.



WHO IS *Esri* IN THE WORLD OF DIGITAL WATER?

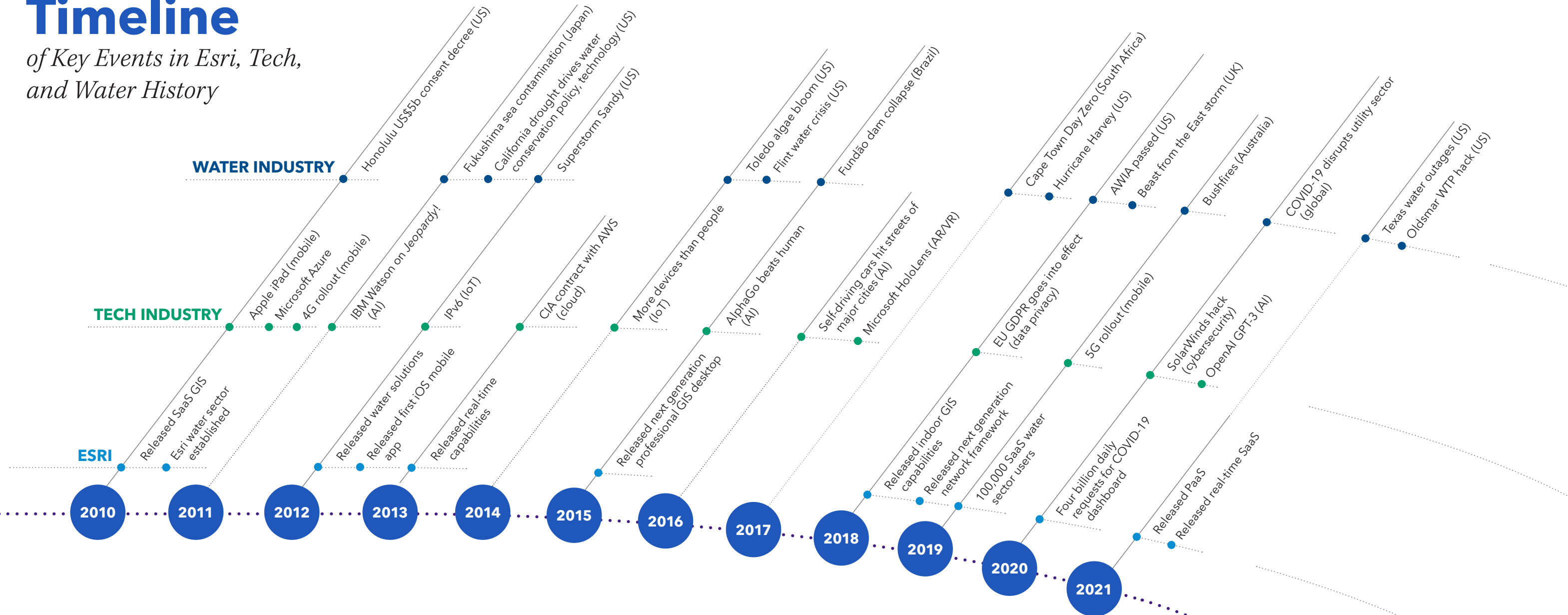
You may not be familiar with Esri, but chances are you've come across its software. Esri's ArcGIS is the leading GIS platform in use by water utilities around the world. In fact, over 90 percent of the 500 largest US utilities use ArcGIS to manage their water, wastewater, and stormwater infrastructure—including, most likely, your utility!



Based in Redlands, California, Esri was founded in 1969 as a land-use consultancy and launched the first commercial GIS software program 12 years later. Esri has continued to evolve along with the rest of the tech industry, pushing GIS to new heights with each successive technological revolution.

Timeline

*of Key Events in Esri, Tech,
and Water History*



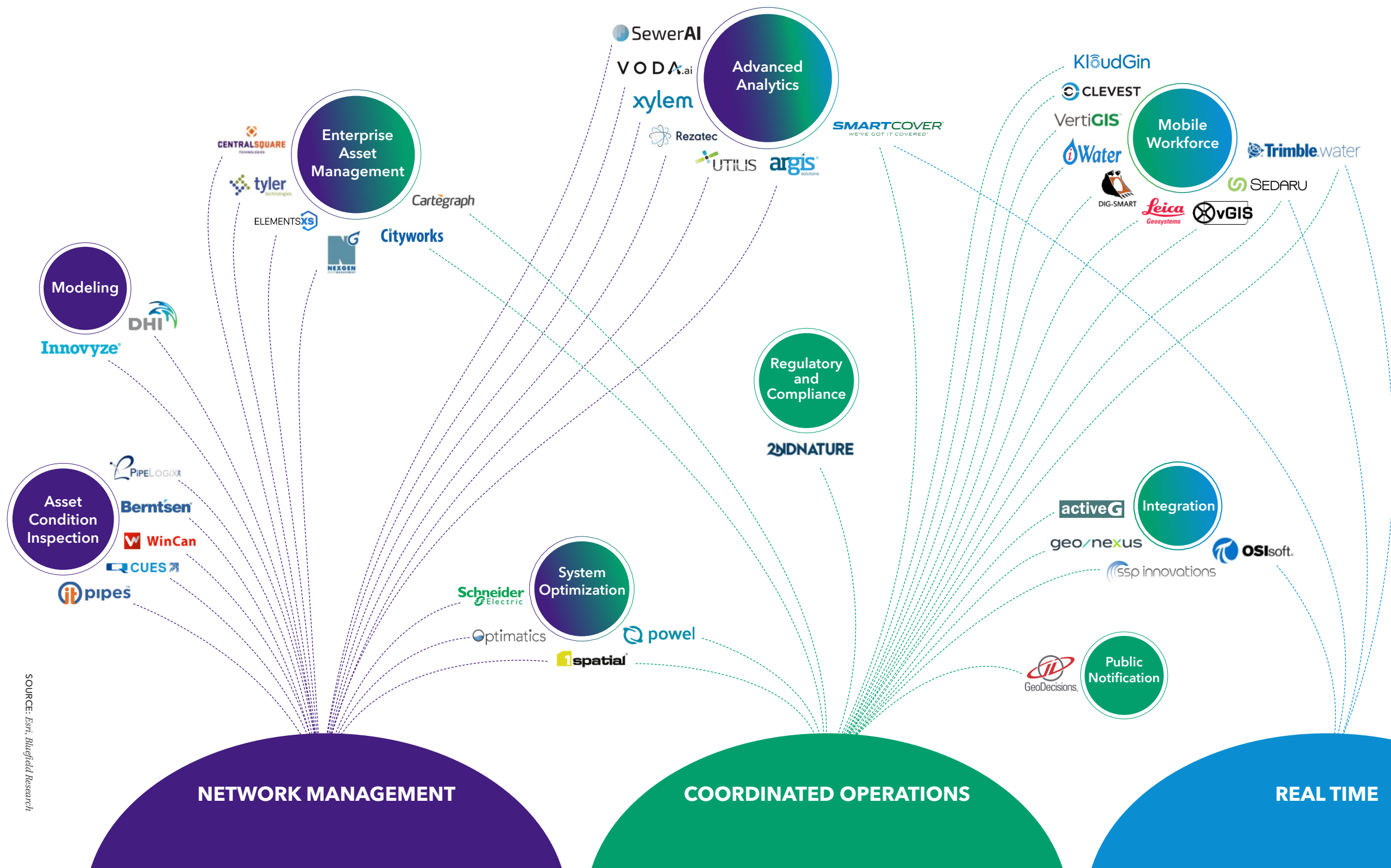
In just the past decade, the world has witnessed mass adoption of cloud computing, artificial intelligence, and the Internet of Things. The water industry, too, has undergone significant shifts during this period, with a series of global water crises underscoring the value of digital water technology. The California drought showcased the potential of smart metering and IoT in promoting water conservation, while Superstorm Sandy highlighted the reliance of mobile devices and cloud-

based systems, which remained operational even as on-premises applications and servers were taken offline by the storm. Meanwhile, the ongoing COVID-19 pandemic has forced a majority of water industry professionals to work remotely, relying on digital technology to stay connected to customers, coworkers, and critical assets and systems.

Esri has been there every step of the way, adapting the ArcGIS system to meet the evolving needs and capabilities of the water industry. After launching a dedicated water team in 2010, Esri released its first suite of water-specific solutions in 2012 and continues to leverage the latest technological advances to deliver GIS solutions when, where, and how water professionals need them—including on premises, on the web, in the cloud, and on mobile devices.

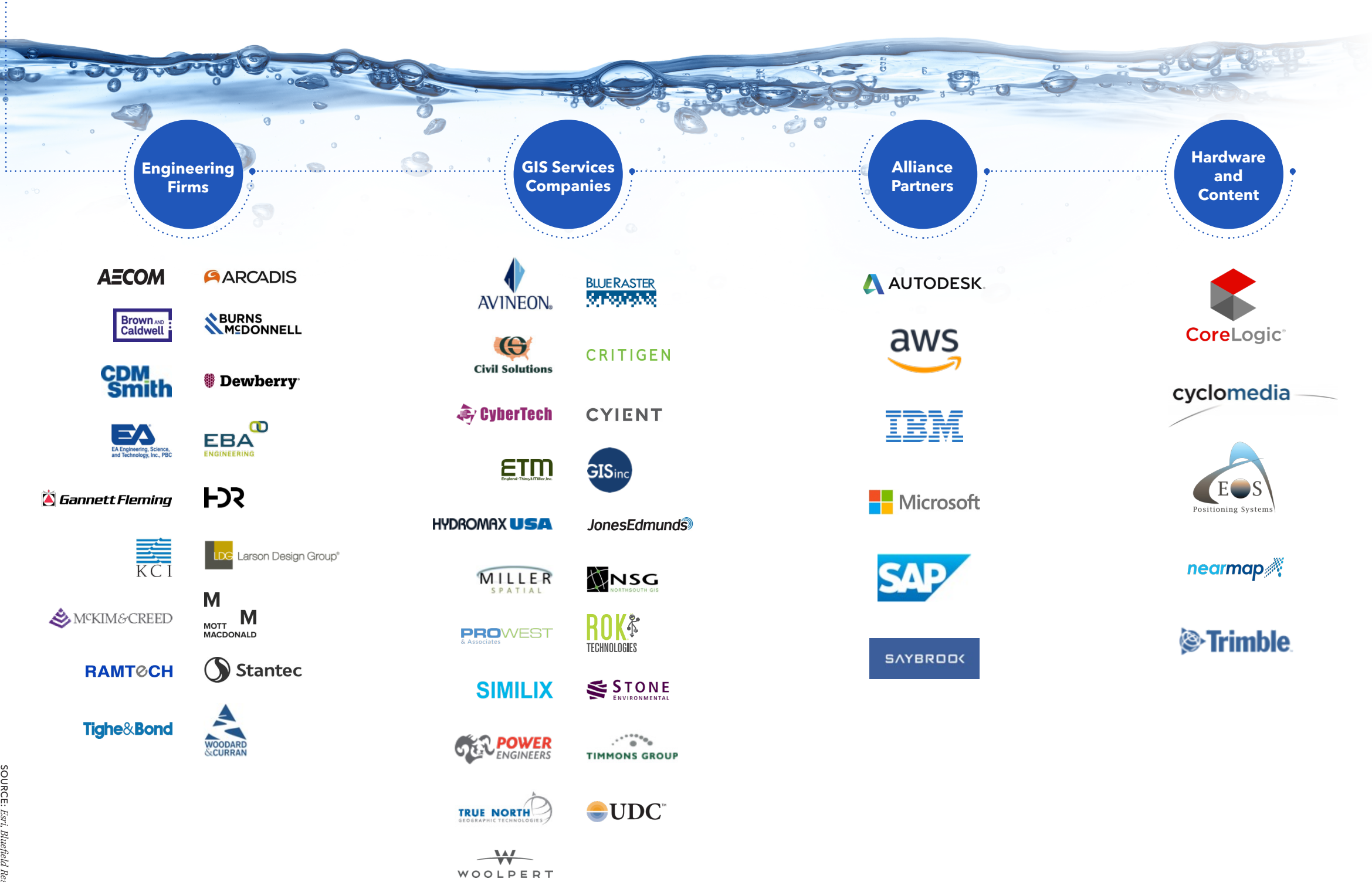
SOURCE: Esri, Bluefield Research

KEY ESRI WATER PARTNERS [Software]



In the process, Esri has also built a robust ecosystem of third-party digital water hardware, software, and service providers whose products are built on top of or integrate easily with ArcGIS. Esri partners with leading technology firms across the water industry to help utilities harness the power of location intelligence across a range of critical applications, including mobile workforce management, regulatory and compliance management, asset condition inspection, and system optimization. Meanwhile, Esri's service partners—both leading global engineering firms and dedicated GIS specialists—can provide utility operators with the technical support they need to integrate their systems and data, optimize their workflows and processes, and maximize the value of their GIS and other digital water investments.

KEY ESRI WATER PARTNERS *[Services and Other]*



In other words, the very same ArcGIS system that your utility has likely already invested in for mapping your water, wastewater, and stormwater infrastructure can do so much more for your organization—from facilitating better coordination and collaboration between field and office staff to visualizing and analyzing real-time data from across your service area to providing more precise, granular models of the performance and behavior of your critical plant and network assets. With a bit of strategic planning and configuration, your GIS platform can serve as the cornerstone for all of your digital transformation initiatives. GIS can help you derive greater value from your new and existing digital water investments across departments and domains, whether they be smart metering rollouts, SCADA modernization projects, or business systems integrations.

