Esri News
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Fall 2026

Hudson County Creates a Rider-Centered Transit Experience

Hudson County, New Jersey, sits at the heart of one of the most heavily traveled transit regions in the northeastern United States. Located directly across the Hudson River from Manhattan, the county functions as a vital connector for residents, workers, students, and visitors moving through a dense network of buses, regional rail, ferries, and express services operated by multiple agencies. For many people, transit in Hudson County is not optional. It is how they get to work, attend school, access health care, and maintain daily routines that shape their lives.

Takeaways

- Hudson County reframed transit information to reflect how riders actually move across buses, rail, and ferries.
- A unified web application simplified a complex, multiagency network into an intuitive, rider-centered view.
- The GIS-based approach supports future routes, regional connections, and evolving rider needs without starting over.

Yet the experience of navigating that system did not always reflect the importance of those trips. Until recently, there was no single, interactive transit map or unified view that helped riders understand how services connected across the region. Riders often had to piece together information from disconnected sources, each representing only one part of the journey. A bus stop map showed one segment. A rail app filled in another. Ferry schedules lived on separate websites. For riders trying to get to an appointment on time or make it to a shift, the process added unnecessary stress. For visitors or occasional riders, it could make an already complex trip feel overwhelming.

Hudson County and the Hudson County Transportation Management Association recognized that the problem was not a lack of information, but how that information was delivered. Transit journeys are personal, shaped by where people live, where they need to go, and the time constraints they face. That realization became the foundation for rethinking how transit information should work and who it should serve.

Designing Transit Information Around Real Journeys

Previously, the Hudson County Transportation Management Association utilized a printed foldout map. The map offered a clear systemwide snapshot of routes and services and worked well as a reference tool in offices and public spaces. It helped planners and stakeholders understand the network at a high level and served as a dependable resource for general orientation.

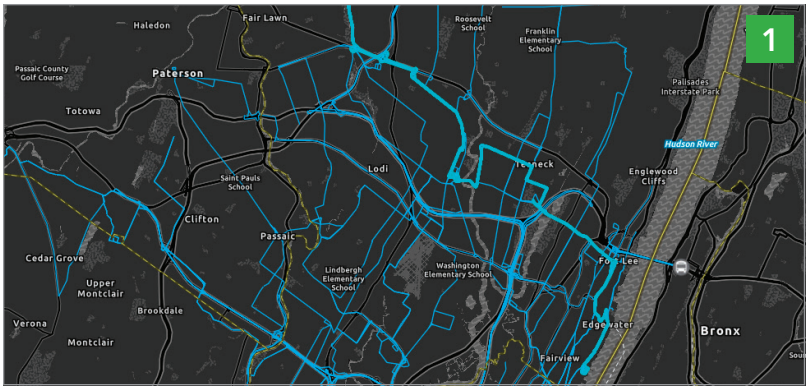
Over time, the map became a routine deliverable, updated periodically and used primarily to understand transit at a macro scale. When it came time to refresh it once again, the team paused. Instead of asking how often the map should be updated or how it should be designed visually, they asked a more fundamental question. Who was the map really for?

"Static maps are great for hanging up and understanding the system at a high level," said Daryl Krasnuk, director of the Hudson County Office of Digital Information. "But when we asked ourselves who the target audience really was—our residents, commuters and

continued on page 4

Inside This Issue

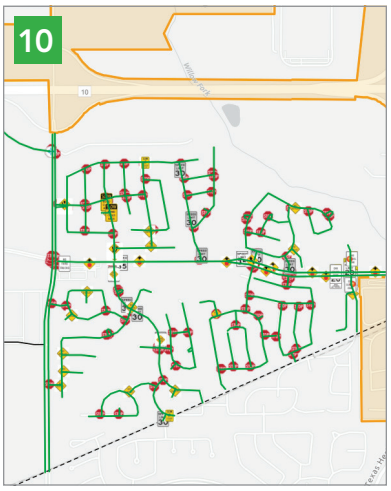
Fall 2026



1 Hudson County Creates a Rider-Centered Transit Experience

6 Denver Airport Digitally Transforms with Indoor GIS for the Vision 100 Plan

8 Esri SAG Award: Special Achievement in GIS



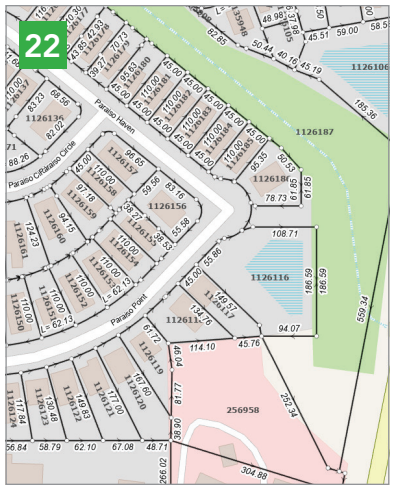
10 How Waller County, Texas, Built a Trustworthy Road GIS During Rapid Growth

13 Utah DOT Modernizes Winter and Street Operations with ArcGIS Velocity

16 MetroConnects Modernizes Permitting and Development with ArcGIS

18 How Bend, Oregon, Tackled the Housing Crisis with Enterprise GIS

22 Bexar County Appraisal District Modernizes Parcel Management with ArcGIS Pro



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Hudson County Creates a Rider-Centered Transit Experience continued from cover

visitors—we realized that approach was not ideal."

That shift in perspective changed the direction of the project. The team began to look at transit through the eyes of riders who rely on it to reach essential destinations. A trip to a doctor's appointment may require a bus and a ferry. A daily commute might involve local service paired with regional rail. A student's journey could change depending on time of day or service disruptions. Each trip is personal, and each rider needs information that reflects their specific situation.

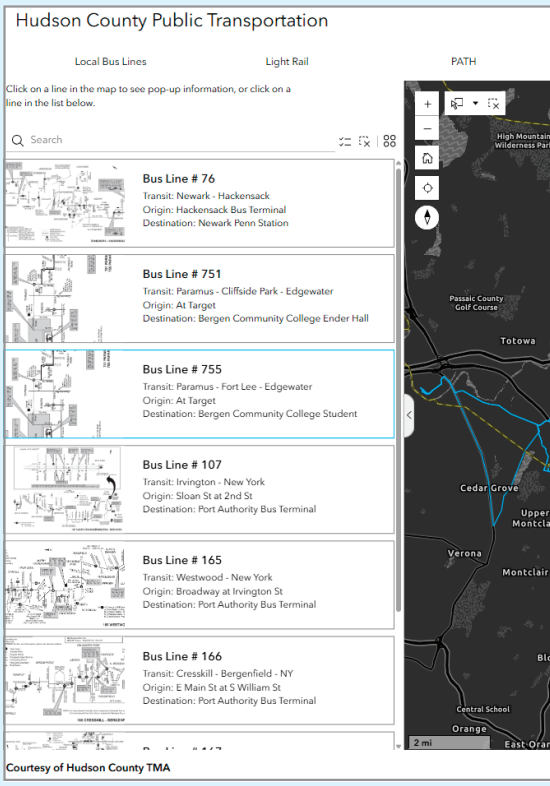
This reframing made one thing clear: Riders did not need more static maps. They needed an experience that matched how they travel, one that supported decision-making before and during a trip. That insight laid the groundwork for a public-facing transit application built around real travel behavior rather than agency boundaries or individual modes.

Moving from Static Maps to an Interactive GIS Experience

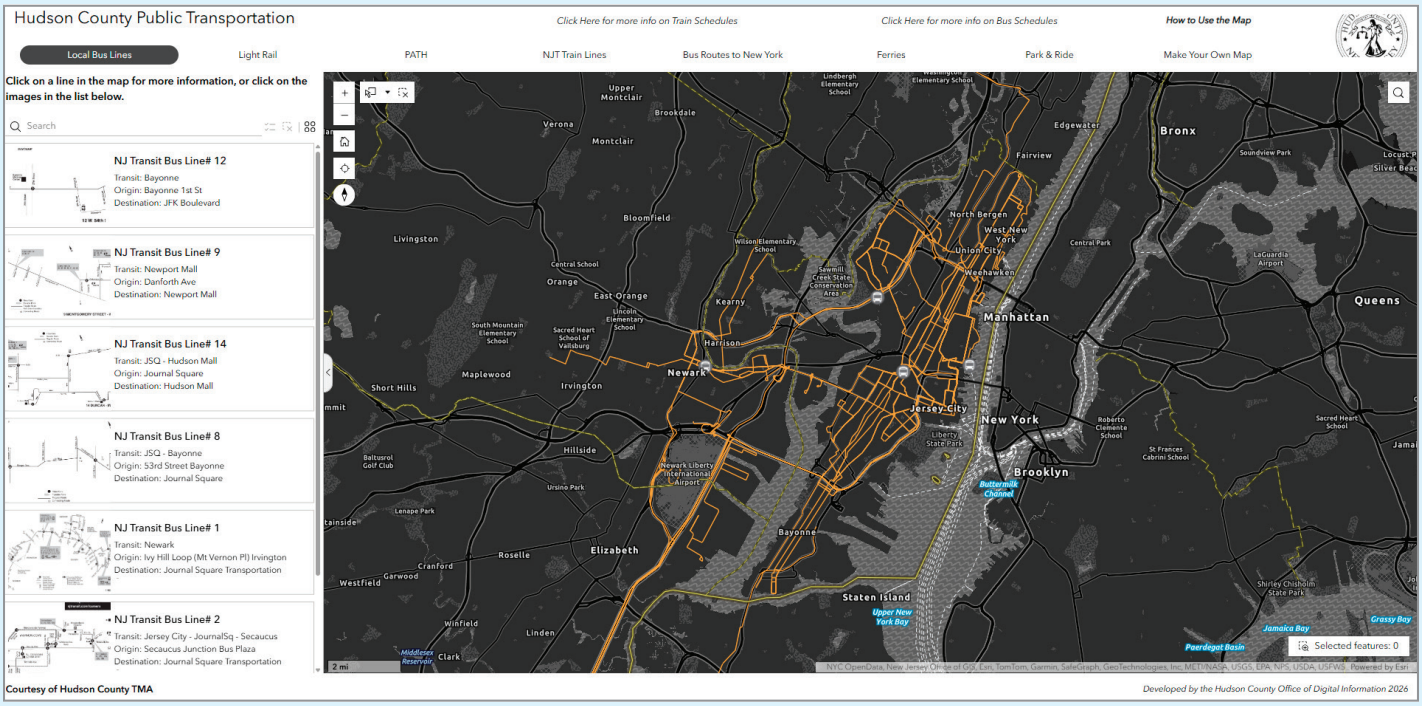
With a clearer understanding of rider expectations, the county and the Hudson County Transportation Management Association collaborated across agencies to build an interactive web application that presents buses, trains, and ferries in a single connected view. The team turned to geographic information system (GIS) technology to bring the vision to life, publishing transit data in ArcGIS Online and using ArcGIS Experience Builder to organize those maps into a rider-friendly web application.

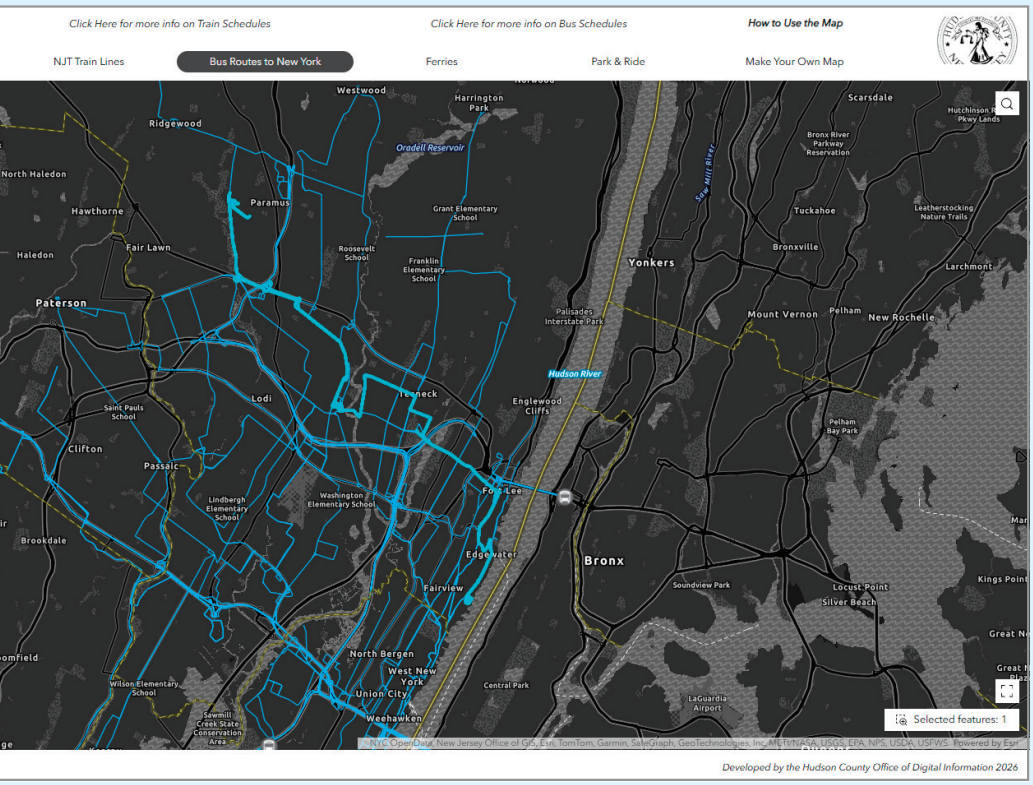
The goal was not to replace existing agency tools, but to create a unifying layer that helps riders understand how services connect across the county and beyond. The application brings together transit data from multiple providers while allowing users to explore the network based on their own needs.

From the outset, usability guided every design decision. Rather than displaying every route at once, which can overwhelm users, the application organizes services into clearly defined sections. Riders can explore local bus routes, regional rail lines, ferries, or express connections into New York City individually, while still understanding how those services fit into a larger system.



↓ Passengers can view local bus lines, including origins, destinations, and total stops, within a geographic context.





← Extending across county borders, riders may view the different transit locations that lead into New York.

This structure reduces visual clutter and helps users find relevant information more quickly.

"The goal was to make the application easy to use, even for someone without a GIS background, while still giving people access to detailed transit information when they need it," said Finn Hagerty, GIS specialist for the Hudson County Office of Digital Information.

Search tools, filters, and interactive layers work together to support how people plan trips in real life. Riders can focus on specific neighborhoods, identify nearby services, and explore alternative routes as conditions change. Rather than duplicating information that changes frequently, such as fares or schedules, the application connects users directly to authoritative sources like NJ Transit and ferry operators. This approach keeps information accurate while maintaining a streamlined experience centered on rider decision-making.

By designing the application around how people move through the county, Hudson County created a tool that respects the personal nature of each journey while simplifying the complexity of a multiagency network.

Supporting Access, Mobility, and Confidence on the Move

Because many riders access transit information while already traveling, mobile usability was a priority from the beginning. The application was deliberately configured to adapt across devices, ensuring that routes, filters, and search tools function consistently on desktops, tablets, and phones. The objective was to support confident decision-making wherever a rider happened to be.

That focus translated directly into everyday value. Hagerty recalled moments when the GIS transit application proved useful in unscripted situations. "I had the app open on my phone and was able to guide someone to the bus they needed in real time. That is when you realize how useful it can be in the real world."

Accessibility was addressed in parallel. The team evaluated visual contrast, map styling, and layout choices to align with guidance provided through the Americans with Disabilities Act (ADA) requirements. Basemaps were selected for clarity and legibility, and routes and stops were styled to be easily interpreted at a glance, even as lighting conditions and screen sizes varied.

Community feedback played a key role as the interactive transit map evolved. Riders emphasized the importance of ferries as an essential part of the regional transit network, particularly during rail disruptions. By incorporating ferry routes, the application reflects how people adapt their journeys when conditions change.

The team also made a deliberate choice to look beyond county borders. Major routes extending into New York City and across New Jersey are clearly represented, acknowledging Hudson County's role as a link between the regions.

"Hudson County is a major regional connector, so it was important to show not just what happens inside the county, but how transit connects people into New York City and across New Jersey," said Krasnuk.

Today, the interactive transit map serves as a foundation for future public-facing transit tools across the county. As new routes come online, travel patterns shift, or special events change demand, the county can build on a proven approach rather than starting from scratch. For riders, that flexibility means clearer choices, fewer surprises, and a transit experience that better supports the personal journeys they take every day to reach work, school, health care, and home.

To learn how to deploy rider-centered transit at scale, please visit **link.esri.com/TransitInsights**.

Denver Airport Digitally Transforms with Indoor GIS for the Vision 100 Plan

Denver International Airport (DEN) is one of the largest in the US. An economic engine for the nation's western states, it is a major hub for travel, cargo, and tourism. The airport itself spans more than 53 square miles and is consistently ranked as one of the busiest in North America, having served over 82 million passengers in 2025. With this volume of traffic, plus 140 concessions and businesses supported by the airport, DEN management launched two strategic initiatives—Vision 100 and Operation 2045, with the aim of positioning DEN as the nation's preeminent aviation thought leader. These initiatives have several goals: increasing the workforce, building integrated systems, growing sustainability efforts, improving durability, predictability, and maintenance of DEN's assets, and expanding flights to underserved destinations in the Middle East and North Africa.

Achieving this requires a complete rethinking of how the airport manages its operations, assets, and data. Spread out into two phases, Vision 100 focuses on the immediate future of DEN's mission to serve 100 million passengers in the next decade. With 2045 marking the airport's 50th anniversary, Operation 2045 serves as a strategic goal preparing for 120 million annual passengers by that year.

To achieve these strategic and ambitious goals, the DEN geospatial technologies team collaborated with Esri partner HNTB Corp, a US-based architecture, engineering, and construction (AEC) firm, focused on transportation infrastructure. With decades of deep experience in geographic information system (GIS) tools and enterprise technology platforms, HNTB works with clients on civil engineering, planning, inspections, program management, construction management, sports architecture, and emerging digital transformation maturity needs. But specifically within the US transportation market, the firm serves departments of transportation, tollways, airports, and rail/transit organizations.

Bringing BIM and CAD Data into a Modern Enterprise GIS

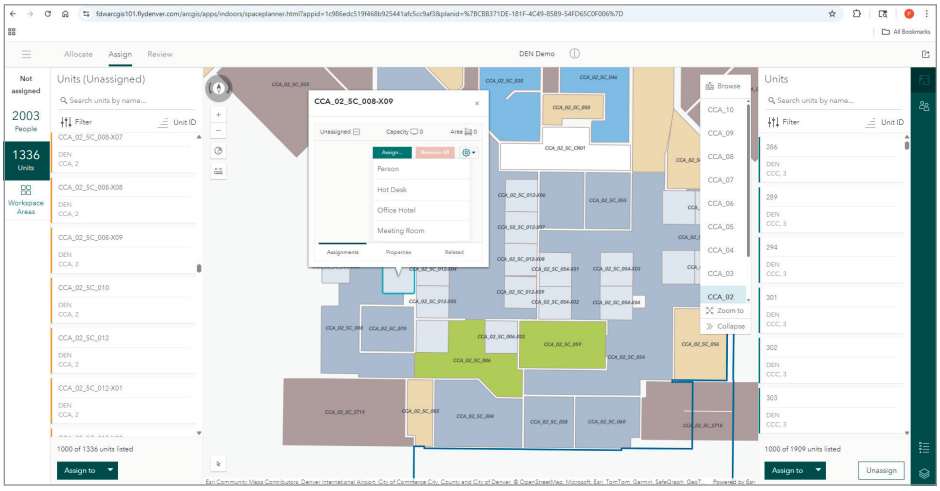
HNTB was awarded an on-call contract to help DEN migrate its GIS data to a modern, online portal. It accomplished this with Esri's ArcGIS Enterprise—a powerful enterprise geospatial platform that enables organizations to manage, analyze, visualize, and share spatial data.

For DEN, the journey to a GIS-based platform wasn't just technical. "I've been talking about this for years," said Chelsea Seiter-Weatherford, DEN's geospatial manager. "It's patience with getting buy-in from the teams—getting them to understand what GIS is and why it's important." Seiter-Weatherford knew she had to lead a cultural shift to digitally transform the airport. "The concept that GIS serves as the authoritative platform for spatial data, and system of reference for other agency data, is a new concept."

Considering its projected business goals, DEN staff knew their technology needed a major update. For over a decade prior to Seiter-Weatherford joining the geospatial team, airfield information and building occupant data was managed in BIM and CAD software by the digital facilities and infrastructure (DFI) team. Information maintained in BIM and CAD files wasn't as comprehensive because some operational attributes—like occupants and department names of indoor assets—were not all housed together. But with a growing workforce and increasing passenger traffic, DEN personnel wanted more concrete building asset data covering the entire airport campus, including more than 7,000 rooms.

ArcGIS Indoors: A Foundational Layer for Indoor Digital Twins

Esri's ArcGIS Indoors was chosen for its ease and compatibility with DEN's already-established enterprise GIS



→ Assigning spaces using ArcGIS Indoors Space Planner Application.

system. The geospatial technologies team imports CAD and BIM data into ArcGIS Indoors, creating floor-aware maps that contain points of interest, meeting rooms, assets, and safety and security equipment on a digital indoor map. "ArcGIS Indoors is a leader for indoor data, and that's why we chose it," explained Seiter-Weatherford.

Indoor geospatial data powers a spatial operations platform for managing airport buildings and spaces. With ArcGIS technology, DEN brings together BIM, GIS, assets, and operational data into one living system that supports daily decision-making. For indoor workflows, ArcGIS Indoors provides the foundational layer that connects floor plans, rooms, and other spaces to this operational environment.

Darin Welch, director of digital transformation solutions at HNTB, noted the benefits of implementing ArcGIS Indoors for clients. "It's still fundamentally all about the data," said Welch. "If your data is sound [and] can be trusted; if it can be organized and presented in a way that every audience needing to leverage it for decision-making—if you're an executive at an airport, or a maintenance and operations person, or a passenger—you can create the most ideal experience possible for each member of your audience."

The deployment of ArcGIS Indoors allowed DEN to build an 18-million-square-foot Indoors database that leveraged the strong data standards already in place and established by its DFI team. "Pulling DEN's data into the out-of-the-box tool was one of the most successful I've experienced to date," said James Van Schoick, national geospatial manager at HNTB. "A good foundational hierarchy in your dataset removes a lot of barriers, which DEN has been establishing for more than a decade."

In one business day, Patrick Gahagan, aviation GIS delivery manager at HNTB, took BIM files and transformed them into GIS data within the ArcGIS Indoors database. "It made a serious impact when I showed that to senior leadership," said Seiter-Weatherford.

By rapidly converting design and construction model data into operational intelligence, DEN can now move from digital as-built information to usable insights in days instead of months. Requiring these practices from early design stages preserves data integrity throughout the project life cycle and delivers immediate value to operations, maintenance, and safety teams as soon as spaces open. This kind of data discipline has prepared DEN for the incorporation of major upcoming capital projects like the C West and North Terminal expansions, where integration of BIM deliverables to ArcGIS Indoors ensures DEN receives operational-ready data. It reduces rework, speeds commissioning, and allows new facilities to update the digital campus almost immediately.

A Continuously Evolving Airport for the Future

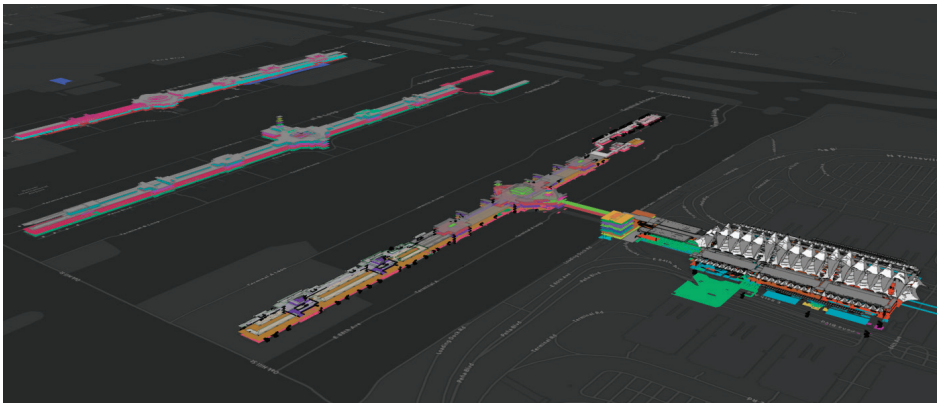
Today, DEN's completed database provides a full digital view of its indoor assets. For other airports looking to modernize their data management with ArcGIS Indoors, Welch advises, "Implement it with the future in mind and make sure you don't have to go back and redo or completely rearchitect. Understanding the ArcGIS Indoors information model, its full potential with the rest of the Esri ecosystem, and how it rolls into your hierarchy is critical."

Looking ahead, DEN is set to elevate its digital twin to a next-generation system by adding real-time asset tracking, Federal Aviation Administration (FAA) compliance workflows, AI integration, and passenger-facing kiosks to deliver a smarter, more connected airport experience in partnership with HNTB.

Seiter-Weatherford remarked that the success of ArcGIS Indoors as an authoritative system of reference has opened new possibilities for the airport's continuing digital transformation. "Eventually, we would like to have wayfinding so you can figure out where you need to go from a different part of the airport office building to a meeting room on a concourse, and leverage that same underlying indoor positioning system (IPS) to support our operations and maintenance activities."

DEN's digital transformation journey illustrates how airports can prepare for dramatic growth while improving operational efficiency and the passenger experience. By building a solid foundation of trusted geographic data and thoughtfully adopting emerging capabilities like AI, DEN is well-positioned to achieve its Vision 100 goal and continue serving as a model for airport innovation.

↓ 3D view of units across each terminal.

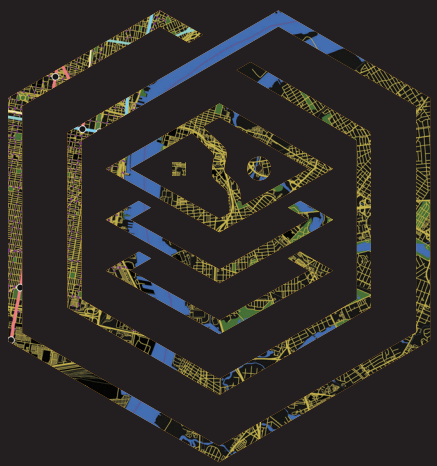


To learn more about how ArcGIS can help with airport compliance, please visit **link.esri.com/Airports**.

esri SAG AWARD

SPECIAL ACHIEVEMENT IN GIS

Esri acknowledged the achievements of several domestic and international organizations with the Special Achievement in GIS (SAG) Award ceremony at the annual Esri User Conference (Esri UC) in San Diego, California. The SAG Awards recognize innovative and intelligent applications of GIS technology. Esri users are nominated by Esri leaders and distributors, and finalists are selected by Esri president Jack Dangermond. These organizations set new standards throughout the GIS community. Organizations from around the world are honored at Esri UC. They span industries including agriculture, public works, economic development, education, transportation, health and human services, law enforcement, emergency response, and utilities. "The SAG Awards highlight extraordinary achievements and efforts to improve our world," said Dangermond. "Each year, I look forward to being part of this ceremony. It is a tradition that means a great deal to Esri and to GIS professionals." Here are the US state and local government users recognized this year. See the full list of SAG Award winners at **link.esri.com/SAGAwards26**.



Organization

- Alaska Satellite Facility (ASF), AK
- Matanuska-Susitna Borough, AK
- Alabama Department of Transportation and State of Alabama, AL
- City of Springdale, AR
- City of Chandler, AZ
- California Health & Human Services Agency, CA
- Los Angeles Department of Water and Power, CA
- Orange County Fire Authority (OCFA), CA
- City of Thornton, CO
- Children's National Hospital, DC
- US Bureau of Land Management—Cadastral and S&P Global, DC
- US Health and Human Services—Office of Inspector General, DC
- Delaware Division of Substance Abuse and Mental Health, DE
- Manatee County, FL
- Forward Pinellas, FL
- City of Decatur and InterDev Technologies Inc, GA
- State of Hawai'i—Hawai'i Emergency Management Agency, HI
- City of Marion, IA
- Idaho Department of Lands, ID
- City of Rockford, IL
- City of Goshen, IN
- State of Kansas DASC, KS
- Wheatland Electric Cooperative, Inc., KS
- Planning and Development Services of Kenton County, KY

- St. Landry Parish Communications District E-911, LA
- City of Somerville, MA
- Massachusetts Department of Transportation, Aeronautics, MA
- County of Baltimore, MD
- Montgomery Parks, MD
- Town of Brunswick, ME
- City of Warren, MI
- County of Wright, MN
- UnitedHealth Group, MN
- Central States Water Resources, MO
- Missouri State Emergency Management Agency and Missouri OGI, MO
- State of Mississippi Department of Environmental Quality, Office of Pollution Control, MS
- County of Chatham, NC
- Town of Wake Forest and Houseal-Lavigne Associates, NC
- Metropolitan Area Planning Agency, NE
- NH Department of Natural & Cultural Resources, Division of Parks and Recreation, Bureau of Trails, NH
- Pennichuck Water Works, NH
- County of Ocean, Office of Information Technology, NJ
- Clark County Water Reclamation District, NV
- Las Vegas Metropolitan Police Department, NV
- City of Syracuse, Office of Analytics, Performance & Innovation, NY
- Port Authority of New York and New Jersey, NY
- County of Geauga, OH
- City of Oklahoma City, OK
- Oregon Department of Transportation, OR
- Municipality of Monroeville and Gateway Engineers, PA
- City of Newport, RI
- Department of Public Utilities, City of Orangeburg, SC
- Chattanooga-Hamilton County/North Georgia Metropolitan Planning Organization, TN
- City of Chattanooga, TN
- Houston Public Works IT, TX
- The Texas Comptroller of Public Accounts (TX CPA), TX
- City of Santa Clara, UT
- Utah Office of Governor Cox and UGRC, UT
- Utah Transit Authority, UT
- County of Roanoke, Virginia, VA
- City of Seattle, WA
- Pierce County, WA
- Puyallup Tribe of Indians, WA
- Town of Grand Chute, WI
- State of West Virginia, Department of Transportation, WV
- County of Teton, WY

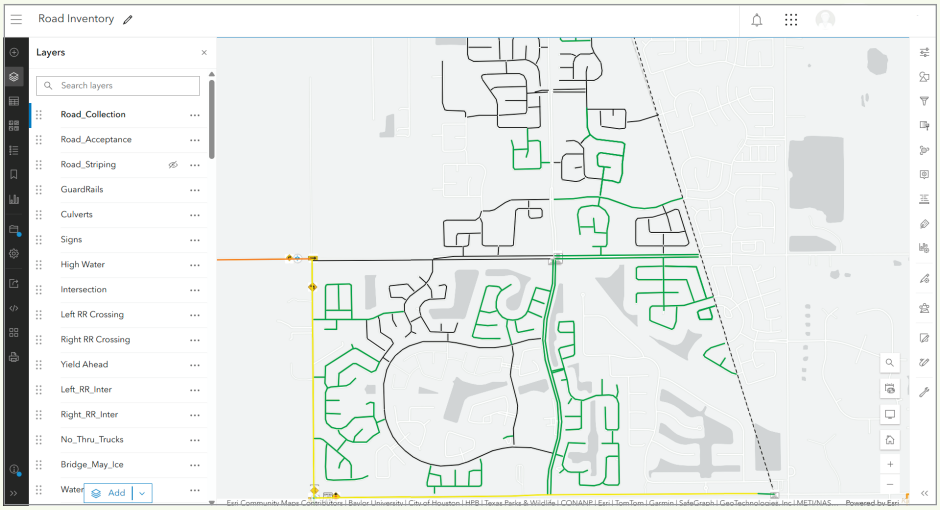
How Waller County, Texas, Built a Trustworthy Road GIS During Rapid Growth

America's second-fastest-growing county recently upgraded its road inventory to a high-accuracy GIS

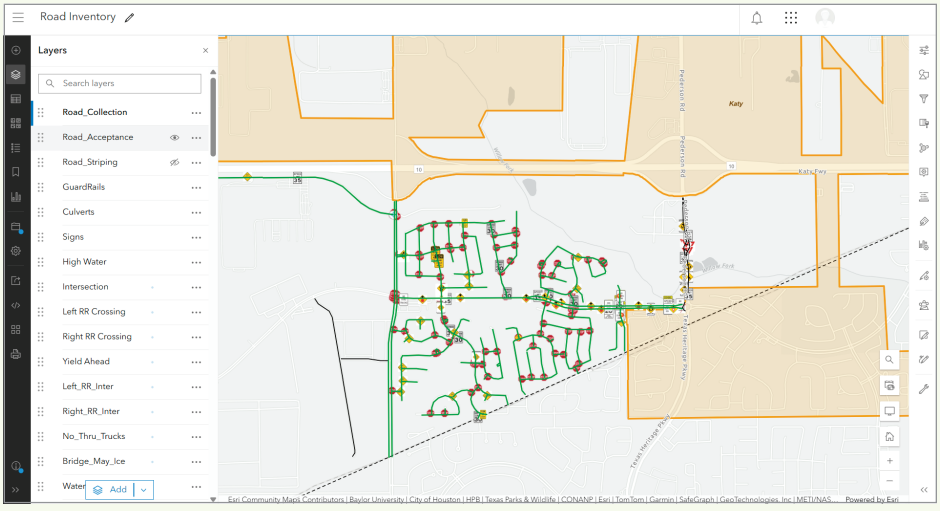
An hour northwest of Houston, Texas, Waller County is the second-fastest-growing county in the US. According to the *Texas Tribune*, it's added over 13,000 residents between 2020 and 2025.

At the same time, the county added a three-person GIS/911 addressing team, starting with GIS manager and 911 coordinator John Murrell.

Today, Waller County adds ~25–50 county roads per year. Road maintenance requires staffing, budgeting, and planning. The results impact everything from 911 dispatch and driver safety to budget allocation and culvert performance.



↑ Field-mapped road centerlines appear in the web GIS with submeter-level accuracy. (Credit: M. Wojslaw, Waller County Road and Bridge Department)



↑ The team mapped thousands of county road signs, thereby creating a complete inventory. (Credit: M. Wojslaw, Waller County Road and Bridge Department)

The Challenge: GIS Was Basic, but Unverified

When Murrell came to Waller in 2023, the 911 addressing team had just one license for ArcMap. Road data came from digitized plats. Having managed a robust road GIS at his previous county, Murrell saw an immediate opportunity to improve Waller's GIS for not only 911 addressing, but also maintenance, budgeting, compliance, and growth management.

Murrell wanted to migrate to ArcGIS Pro, and he wanted the new road GIS to be as accurate as possible. A field survey was in the cards.

The Solution: The Road to An Accurate GIS

At his previous county, Murrell had used Global Navigation Satellite System (GNSS) receivers to map assets, but those devices had been costly. He wanted something that fit Waller County's budget, provided the best accuracy possible, worked with ArcGIS, and most importantly, respected taxpayer dollars.

After discovering Esri partner Eos Positioning Systems at a GIS conference and testing its receivers, he acquired an Eos Arrow 100 for handheld data collection and Eos Arrow 100+ for vehicle-mounted data collection. Both models provided an average accuracy of 5 to 18 inches, though the plus model was able to connect to multiple phones and tablets at a time.

"When I took the Arrow 100 out and hooked it all up, I was getting close to five inches of reported estimated accuracy," Murrell said. "It was perfect. It was what I needed. And it was at a cost point we could afford."

Murrell next configured a tablet with ArcGIS Field Maps to map road centerlines and paint striping into a web map. Because the Arrow 100+ could Bluetooth connect to two tablets at once (a feature called "multiplexing"), Murrell mounted this receiver to the county buggy and connected it to two tablets. One tablet mapped centerlines; the other mapped road striping—each into

specific feature layers in ArcGIS Field Maps. With vertices dropped every two to three feet, the result was a true-to-ground geometry that closely reflected real roadway curvature.

"When you hand-draw something versus actually driving it and streaming its location, you can see a significant difference," Murrell said.

County inspector Vincent Hensen drove while Murrell assessed road conditions. Murrell scored each road on a scale of one to four in ArcGIS Field Maps. A score of four meant a road was brand new and would appear green. A score of one, two, or three would appear red, orange, or yellow, and it meant a road required varying levels of attention. They also removed roads in the GIS that were no longer accessible, including washed out and dead-ended roads.

"On the 911 map, some roads were never closed," Murrell said. "Now, we were able to eliminate miles that didn't exist."

Murrell and Hensen then drove each road a second time to map street signs. Hensen drove Murrell close to each sign, and Murrell held the handheld Arrow 100 out the window and mapped each sign in ArcGIS QuickCapture, an app designed for high-speed data collection. In this way, they created a complete sign inventory of over 4,000 signs.

Finally, they mapped all the culverts. Murrell mapped each culvert's center point, then took its diameter, material, condition, and blockage status. The county went from a notepad with 20 culverts written on it to over 1,800 in the GIS. "This inventory helps us save roads before they collapse," Murrell said.

The Results: No More Phantom Mileage, Streamlined 911 Response, and Targeted Maintenance

In just four months, Murrell personally drove, mapped, and assessed nearly 600 county roads, over 4,000 street signs, and 1,800 culverts. He tracked data collection in ArcGIS Dashboards.

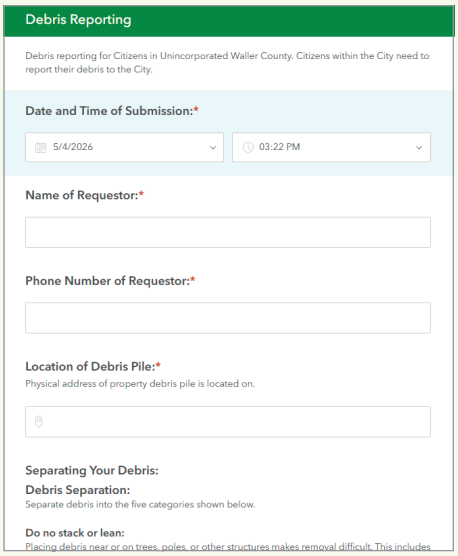
"Now, we can pull up a dashboard and say, 'This is what we have,'" he said.

In October of 2024, Murrell's team took over 911 addressing. By eliminating phantom roads from the GIS, first responders can now route more accurately to incidents.

The reduction in phantom mileage also improved budgeting, auditing, and long-term maintenance. "If we have less mileage to maintain, that means we can focus more budget elsewhere," he said.

The work-order management system, Asset Essentials, integrates with the GIS and lets crews immediately see a road condition, whether it needs work, and whether it is county-owned or not.

↑ Murrell assessed the road conditions as he mapped them, so every county road has a color indicating its condition in the GIS. Green roads are in good condition, while yellow, orange, and red indicate varying levels of maintenance prioritization. (Credit: M. Wojslaw, Waller County Road and Bridge Department)



↑ The form required location and photos, which streamlined jurisdiction validation, helped emergency management respond more quickly, and enabled the county to provide FEMA with an accurate report for reimbursement. (Credit: M. Wojslaw, Waller County Road and Bridge Department)

This saves time and fuel by not having maintenance crews drive around looking for roads in poor condition and verifying at a later time if the road in question is county-owned.

"I've already driven them," Murrell said. "Now maintenance can go in and fix the road, and we update the condition in the GIS."

The culvert inventory provides drainage staff with similarly targeted maintenance. They can easily see which culverts are partially blocked and change them out before they cause bigger issues down the road.

Finally, the street-sign inventory provides the county with higher-confidence replacements. They can put a sign back to exactly where it had been before. Sometimes, they can also validate that a request to replace a sign is for a sign that never existed.

"When someone says, 'There was a speed limit sign here,' we can pull up the location in our inventory and know that there was never a speed limit sign there," Murrell said.

continued on page 12

 continued from page 11

Looking Ahead: An Increasingly Valuable and Visible GIS

During the summer of 2024, the historic "Houston derecho" and Hurricane Beryl swept through the region. They caused widespread damage to southeastern Texas, about a month apart. Murrell published an ArcGIS Survey123 form for the public to submit requests to pick up debris on county roads. The form allowed the maintenance team to verify that a road was county owned, and it also provided a paper trail for eventual Federal Emergency Management Agency (FEMA) reimbursement.

"It made emergency management's life a lot easier being able to get this information from the public rather than driving around looking for debris piles," Murrell said. "And I was able to screen them, validate county versus private roads, and avoid wasting fuel."

In 2025, Murrell hired GIS analyst/911 addressing Michaela Wojslaw and GIS/911 addressing technician Ashton Fells. Wojslaw and Fells help map the new roads being added every year in new subdivisions. They maintain a separate GIS layer called "Road Acceptance," which streamlines the addition of high-quality data on new roads to the core GIS.

They're also making sure the data is visible to stakeholders. The team has built an Open GIS Data Portal that provides third parties with the ability to search, visualize, and download GIS data. It has eliminated manual shapefile requests. "We get requests all the time from engineers," Murrell said. "Now, it's all in the website so they can find it."

They also built road and subdivision indexes in Safe Software's FME. This allows developers to see if names are already taken before submitting their names to the county for approval. Duplicate names can cause issues with 911 response, so they're regulated. For Murrell, who used to work in law enforcement, ensuring first responders have the best ability to do their jobs is always a high priority.

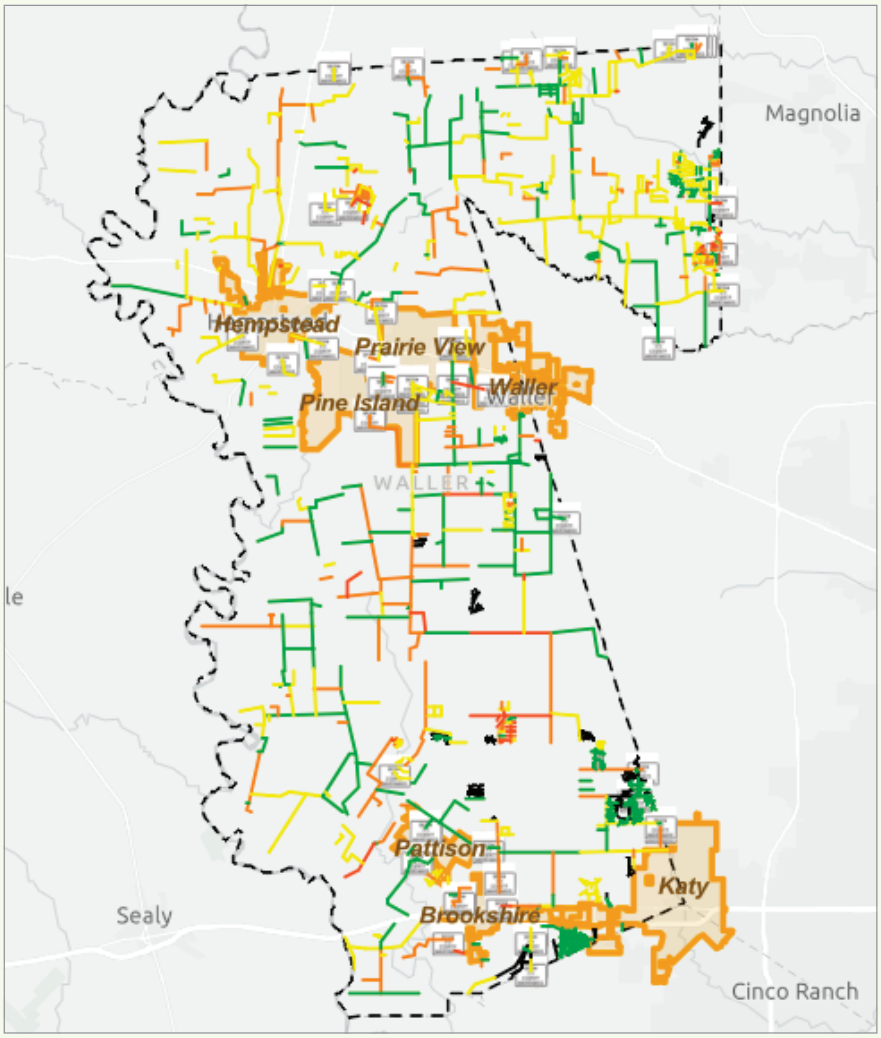
Wojslaw has started to use drones, ArcGIS StoryMaps, and social media to share the county's projects with the public. She documents and promotes the county's road and bridge work in a variety of ArcGIS StoryMaps stories on the county's website and in its new Instagram account.

"I want citizens and other companies to know that there's a lot of really great things going on in Waller County," she said.

As Waller County continues to grow, the GIS/911 addressing team is prioritizing the best possible service to their constituents with intentional infrastructure management made smarter through a robust GIS and public-facing tools.

"When you work for the county, if you're not showing progress, you're not doing your job," Murrell said. "Now we can show the public our progress and keep them informed of what's going on."

To learn more about GIS for roads and highways, please visit **link.esri.com/RoadsandHighways**.

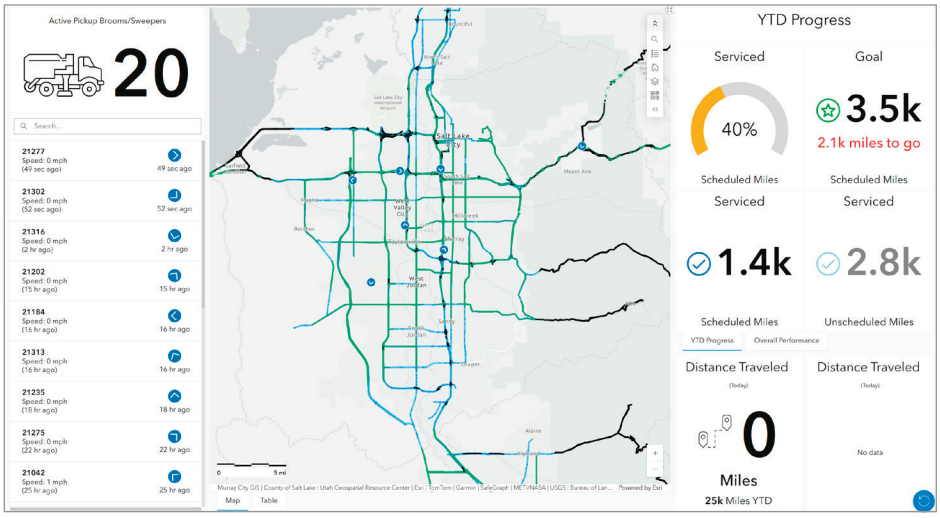


↑ This map provides an overview of Waller County roads. At a glance, the map provides a host of valuable information, including county road locations and conditions. It also allows the team to more easily report total mileage, prioritize maintenance, and determine when a road is not county-owned, thereby falling outside their jurisdiction. (Credit: M. Wojslaw, Waller County Road and Bridge Department)

Utah DOT Modernizes Winter and Street Operations with ArcGIS Velocity

Transportation agencies rely on accurate, up-to-date information to keep highway, rail, pedestrian, and other transit systems running smoothly. For the Utah Department of Transportation (UDOT), that means tracking vehicle fleet activity, understanding roadway conditions, and supporting programs that operate not just during major weather events, but year-round.

Using ArcGIS Velocity, UDOT has built a real-time geographic information system (GIS) that brings together live data to support transportation operations in one connected view. By integrating vehicle location and telemetry data, weather feeds, and business systems in ArcGIS, UDOT has improved visibility across multiple programs, reducing system complexity and creating a foundation that supports both daily operations and long-term planning.



↑ UDOT's street sweeping operational dashboard monitors active street sweepers, tracks real-time vehicle speeds, and visualizes year-to-date route coverage and mileage goals.

Disconnected Systems and Limited Operational Insight

UDOT's technology and innovation group's central GIS division supports a wide range of internal teams, including maintenance, environmental services, emergency management, and risk reduction. According to Ben Teran, GIS administrator at UDOT, the group is responsible for maintaining the core systems that staff rely on across the agency. "We develop and maintain the systems that all of our users use, including GIS professionals," said Teran. "We have different enterprise portals that help various areas manage the services and apps they provide."

Before adopting ArcGIS Velocity, UDOT relied on a combination of ArcGIS GeoEvent Server (an ArcGIS Enterprise extension for ingestion and analysis of streaming data) and FME workflows to ingest vehicle location data through APIs. While functional, the approach required constant monitoring, and data updates involved delays. "It wasn't exactly real time, but it was as close to it as we could get at the time," Teran explained.

These limitations made it difficult for UDOT to support the operations critical to year-round transportation management, particularly those with reporting requirements or a need for precise tracking.

A Cloud-Based Shift

When ArcGIS Velocity became available, UDOT saw an opportunity to simplify their real-time architecture while expanding what was possible with live data. As a software as a service capability, ArcGIS Velocity eliminated the need to manage servers and reduced the complexity of maintaining real-time feeds.

"We were looking for a more cloud-based solution that was simpler and easier to run and maintain," said Corey Unger, GIS program manager at UDOT. "With Velocity, we're more or less just taking the data and adjusting it straight into our ArcGIS platform."

Direct integration with data providers also made it easier to get started. One of the first integrations UDOT implemented was with Verizon Connect Reveal, which provides automatic vehicle location (AVL) data. "That was very intriguing for us, and was one of the first use cases that we employed with ArcGIS Velocity," Teran said.

Managing Street Sweeping in Real Time

One of UDOT's continuous operations is street sweeping, which is carried out across the state to support environmental compliance, roadway maintenance, and public safety. Keeping

continued on page 14

Takeaways

- UDOT uses ArcGIS Velocity to bring live fleet, weather, and public data together for a unified view of transportation operations.
- A cloud-based real-time GIS replaces complex workflows and enables faster, more accurate operational insight.
- Real-time analytics improve street sweeping and winter operations by supporting tracking, reporting, and decision-making.

Utah DOT Modernizes Winter and Street Operations with ArcGIS Velocity continued from page 13

track of where sweeping has occurred, what remains, and how work progresses toward annual targets and regulatory compliance goals requires timely and reliable information.

To support this work, UDOT used Esri's Street Sweeping Operations solution, part of the ArcGIS Solutions collection, as a starting point to build a street sweeping operations application powered by ArcGIS Velocity.

ArcGIS Velocity ingests and processes live sweeper data to provide precise tracking of where work has occurred. Analytics determine when a sweeper's broom is actively engaged, ensuring that only true sweeping activity is recorded.

"It wasn't as accurate before as it is today," Teran explained. "If the broom is down, that's when it's recording that it's sweeping."

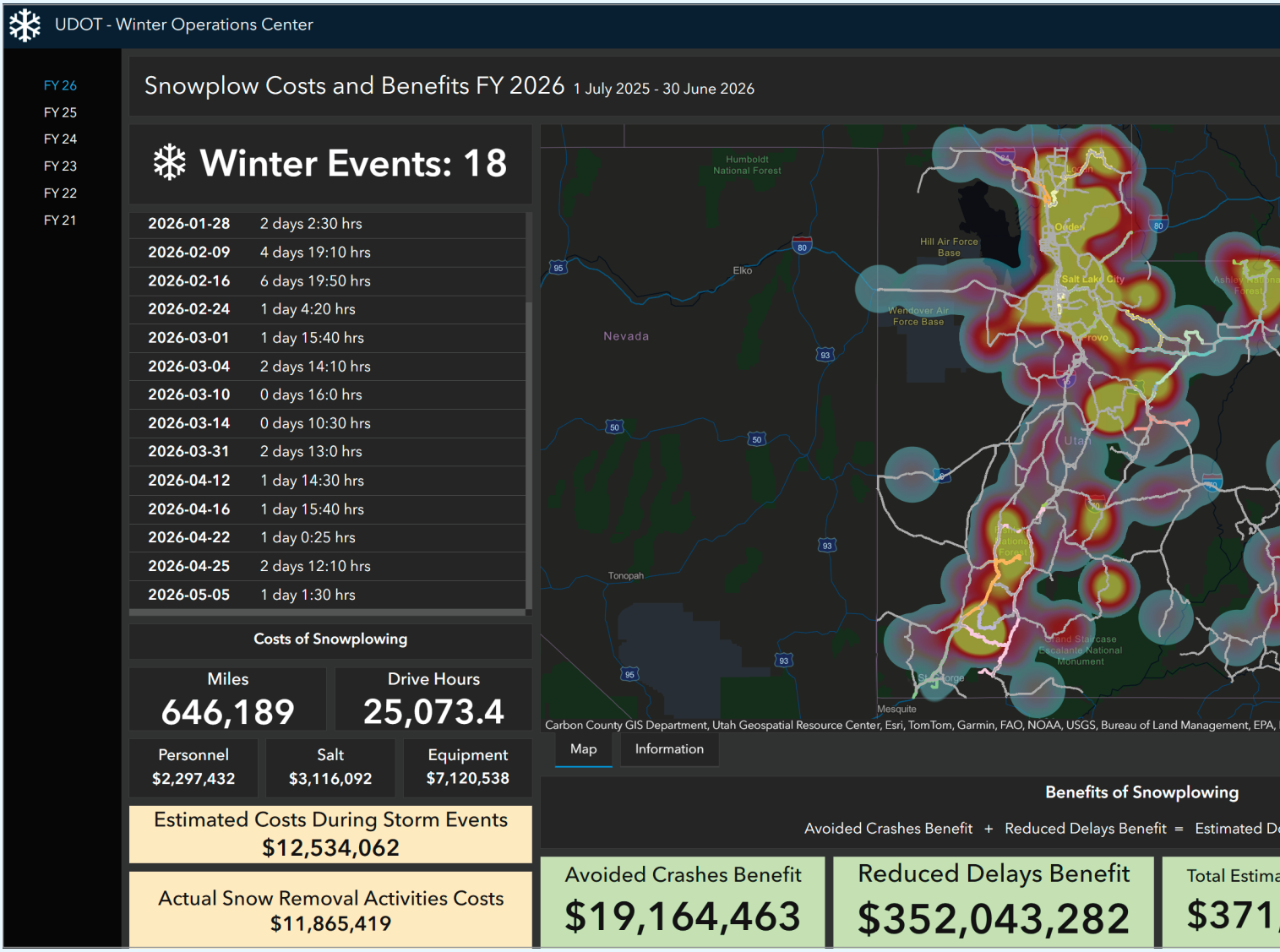
Critically, the system also connects GPS data to the correct side of the road, allowing UDOT to track sweeping at a more detailed level on highways and interstates.

Supervisors can filter the data by maintenance stations, known as sheds, to see progress within their assigned areas and track miles swept toward annual goals, helping the agency meet reporting requirements more efficiently.

Integrating Fleet, Weather, and Public Data

Beyond street sweeping, UDOT uses ArcGIS Velocity to bring together data from multiple systems that support day-to-day operational awareness. Rather than working with each data source in isolation, the agency relies on Velocity to ingest and manage real-time and near real-time information in a single environment.

These feeds include fleet data from Geotab for additional vehicle assets, road weather information system (RWIS) data that provides temperature and road



> Velocity has really allowed us to integrate these multiple data feeds together to create better analytics.
>
> **Corey Unger**
> GIS Program Manager,
> UDOT

condition information via JSON, and SeeClickFix submissions that capture issues reported by the public.

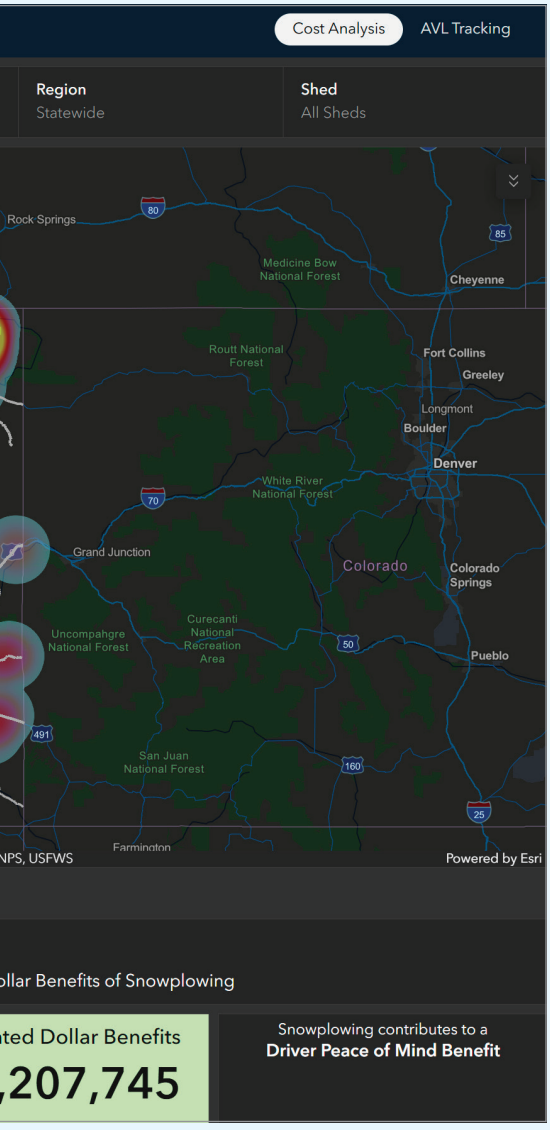
ArcGIS Velocity also allows UDOT to combine streaming data with tabular business systems and other extract, transform, and load (ETL) outputs. This makes it easier to analyze operational information in context and across programs, rather than managing disconnected datasets. "Velocity has really allowed us to integrate these multiple data feeds together to create better analytics," Unger said. "It helps bring department-wide data together into one location to enable analytics that we wouldn't have had otherwise."

While ArcGIS Velocity supports many year-round programs, it also plays an important role during winter weather events. Using Velocity and Esri's Winter Weather Operations solution, UDOT developed a winter operations dashboard that shows snowplow locations, recently plowed routes, storm events, and estimated costs. "It started as two separate projects that merged into one," Unger said. "We had a public-facing map that showed where our snowplows were, as well as where they had recently plowed."

By combining live fleet data with financial systems, UDOT can better explain the realities of winter operations to leadership and legislators. "We've seen the snow, we can see it piling up," Teran said. "But how do we quantify and show and tell the story of what that really looks like, and what it means for residents?"

ArcGIS Velocity has helped UDOT simplify infrastructure processing, minimize manual monitoring, and tailor dashboards to specific audiences. The same real-time architecture is now supporting a developing equipment tracking application designed to improve fleet utilization statewide.

"UDOT manages about $227 million of equipment," Unger said. "So having an application that allows us to track and help with the maintenance of those vehicles is very important." Improved fleet management and tracking of fleet resources not only reduce overall expenses but assist in the process of requesting additional resources when necessary.



← UDOT's live snowplow tracking dashboard visualizes equipment locations and last-serviced route activity.

Extending Real-Time GIS Across Operations

As they expand use of ArcGIS Velocity across multiple programs, UDOT has been able to simplify how operational data is managed and shared across teams. Bringing real-time and near real-time information into a common GIS framework has reduced the need for separate systems and manual processes, making it easier for staff to focus on the information most relevant to their roles.

That same approach is now supporting additional efforts beyond street sweeping and winter maintenance. UDOT is developing an equipment tracking application that uses the same real-time foundation to improve visibility into fleet usage across the state. By understanding where equipment is located at a given time and how it is being used, the agency can make faster, more informed decisions about sharing resources between maintenance stations.

Rather than building one-off tools for each new need, UDOT has established a repeatable way to bring in live data, analyze it alongside existing business systems, and apply those insights across different programs.

Starting with a focused set of operational requirements and extending from there has allowed the agency to adapt its GIS environment as needs evolve, supporting both daily work and future projects.

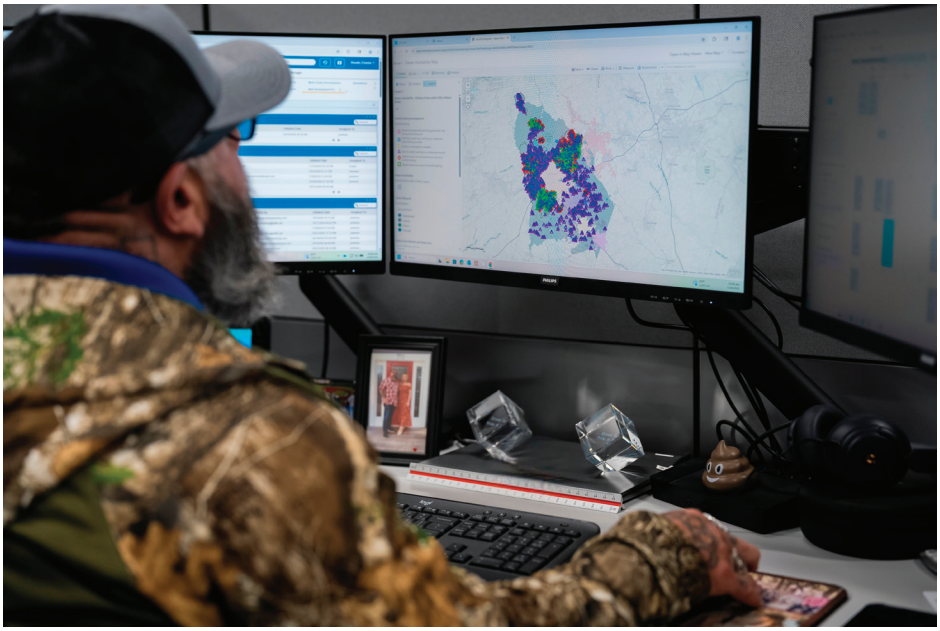
Is your organization running on real-time insight? If not, please visit **link.esri.com/VelocityInsights**.

MetroConnects Modernizes Permitting and Development with ArcGIS

A thriving utility modernizes permitting and asset management to handle rising demand and improve service delivery.

MetroConnects, a special-purpose district in Greenville County, South Carolina, plays a central role in managing wastewater collection across a rapidly growing region. The county experienced an 8.6 percent population growth since 2020 with around 28,000 new housing units built or permitted during a five-year period. Development continues to expand outward from the urban core while projections indicate the addition of more than 250,000 residents over the next two decades.

MetroConnects was founded in 1969, and its geographically distributed system spans multiple drainage basins and service areas. As permitting and development activity accelerated, the organization needed a more scalable approach to support both expansion and service delivery.



↑ MetroConnects in Greenville, South Carolina, uses Trimble Cityworks Unity Maintain and Esri's ArcGIS to track permitting geographically from initial request to work order and execution.

↑ MetroConnects workers use Trimble Unity Maintain and Esri's ArcGIS in the field.

To accomplish this, the organization implemented a modern, geospatially driven system using ArcGIS technology—including ArcGIS Enterprise and ArcGIS Pro—integrated with Trimble Cityworks enterprise asset management system (AMS) and its permits, licensing, and land management (PLL) software solutions, now known as Trimble Unity Maintain and Trimble Unity Permit, respectively. This approach connects permitting, asset management, and operational data within a unified spatial environment, supporting efficient operations at scale.

Rapid Growth and System Consolidation Strain MetroConnects Workflows

MetroConnects' operational challenges emerged as a direct result of expansion and consolidation. The organization merged seven wastewater collection districts into a single system, growing from around 40,000 customer accounts and 600 miles of gravity sewers to over 100,000 customers and approximately 1,500 miles of main sewer lines. At the same time, sewer connection permitting demand rose sharply, and MetroConnects faced increasing pressure to manage a higher volume of housing developments.

Staff handling permitting and development workflows relied heavily on paper records and manual work order creation. Communication often required multiple handoffs, while tracking project status depended on fragmented systems, including emails, phone calls, and work order tasks. This legacy approach limited transparency for customers and depended on manual tasks that could be automated—and as demand continued to increase, the gap between workload and process efficiency became increasingly obvious.

Leadership at MetroConnects recognized the need to evolve the permitting intake process to accommodate the drastic growth. The utility needed a more connected, scalable solution that could support both current demand and future expansion.

Automating Permitting Workflows with a GIS-Driven Architecture

To modernize its operations, MetroConnects worked with Esri partners Timmons Group and Trimble Inc. to design and implement a geospatial permitting solution. With their assistance, MetroConnects deployed Trimble's PLL solution in 2024, connecting it to Trimble's AMS and integrating it with Esri's ArcGIS Enterprise and ArcGIS Pro. This approach aligned permitting, asset management, and geospatial data within a single environment.

The new workflow introduced a digital permitting platform that replaced hybrid workflows relying on paper records and AMS work orders with a structured, automated system. Through the Timmons Group PLL Portal, customers and developers can submit applications, upload supporting documents, pay fees, and track progress without calling or visiting an office.

ArcGIS technology serves as the operational backbone of the solution. When users select a parcel or address, the platform captures accurate location data and connects it directly to permitting workflows. Each permit is tied to real-world infrastructure, and asset information remains consistent across multiple systems. Updates made in ArcGIS are reflected in Unity Maintain in real time, improving both accuracy and coordination.

"We use the geospatial database to conduct capacity analysis when a developer proposes new subdivisions," said Jennifer Franz, GIS manager at MetroConnects. "We can quickly see how many people are on each gravity main and determine if the system can accommodate a new development based on current flow and predicted flow."

Automation further strengthens the process. Rather than relying on manual coordination, workflows advance through defined steps supported by integrated data. Permit cases can automatically generate inspections and work orders, while notifications guide tasks through each stage of review.

"The sewer is the first utility installed for a new development, so the developer community pushed for online permitting to speed up the process," said Jake Tittle, CIO at MetroConnects. "The implementation of PLL [software] was a logical next step following the ramp-up of ArcGIS and Cityworks AMS capabilities, as it helped us handle the larger workload."

MetroConnects Increases Permitting Speed and Scale

The transition to a digital, integrated platform produced measurable improvements across MetroConnects' operations, particularly in processing speed and overall productivity.

Permitting throughput has increased significantly alongside regional growth. Historical data shows a 55 percent increase in permits over a three-year period, from FY 2020–21 to FY 2022–23. Despite this sharp rise in demand, MetroConnects has achieved operational success through automation and system integration.

On average, MetroConnects processed 208 permits per month in 2025, supporting a service area experiencing about 25 new residents per day. This sustained volume—equating to roughly 2,400 permits annually—is handled without a proportional increase in administrative burden, demonstrating the scalability of the system.

Time savings have been realized across all stages of the workflow. Permitting timelines have shortened because customers can submit applications, access documents, and review inspection results through the portal—eliminating delays tied to in-person visits and manual processes. Engineering review cycles have also accelerated, with plan submissions, markups, and approvals now handled online rather than requiring a physical document exchange and multiple office visits.

Work order creation has also improved, with inspections and CCTV work orders now generated automatically by the PLL software and tied to permits. This reduces manual data entry and allows operations staff to act immediately upon notification.

Automation has reduced administrative effort, allowing staff to shift from manual permitting tasks to higher-value activities such as review, compliance, and decision-making.

Field productivity has improved through ArcGIS integration. With access to accurate, survey-grade asset data via mobile devices, crews spend less time locating infrastructure and verifying information—reducing delays and repeat visits. This increased confidence in asset data directly translates to faster inspections and more efficient maintenance operations.

Customer experience has improved in parallel. The shift to a self-service model allows applicants to submit permits, upload documents and track progress online, reducing back-and-forth communication and increasing transparency.

By combining Trimble's AMS and PLL solutions with ArcGIS technology, MetroConnects scaled permitting operations to support rapid growth. The result is faster processing, reduced administrative effort, and improved service quality for both staff and customers.

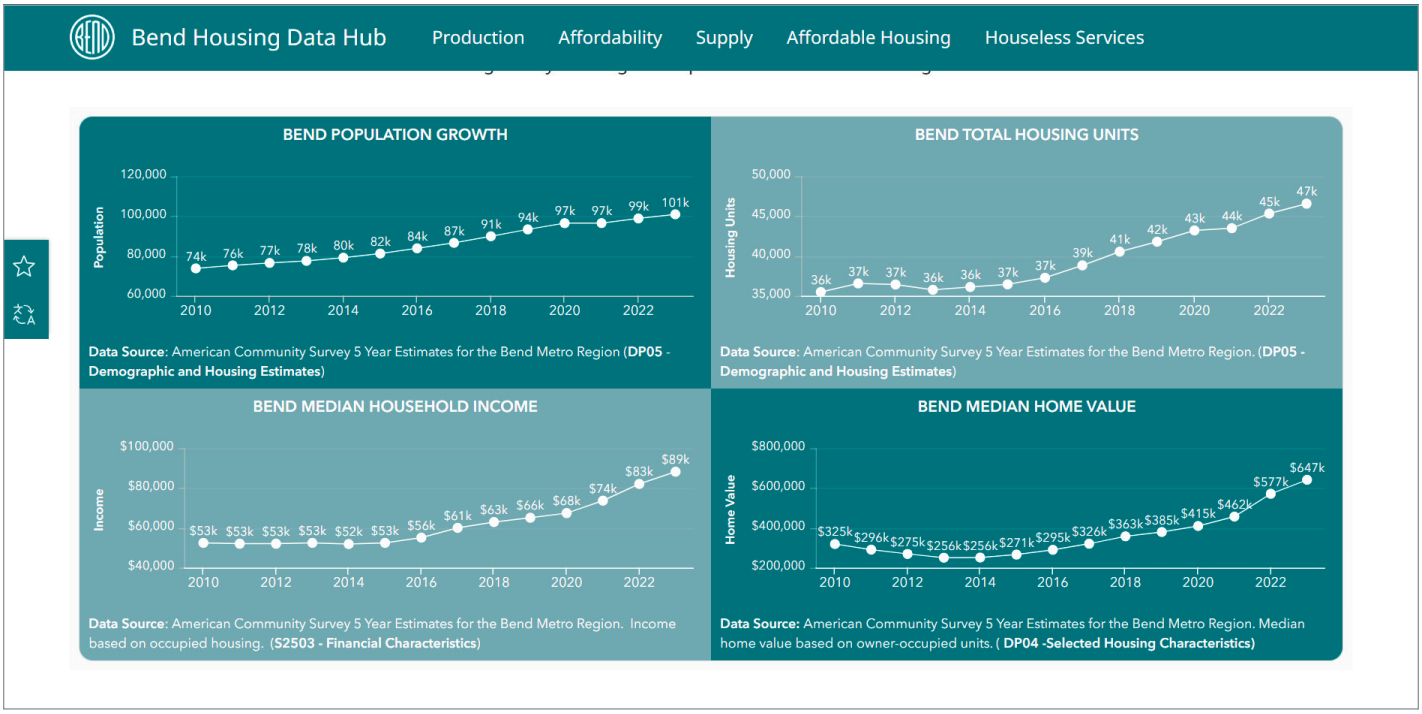
To modernize permitting and development workflows, please visit **link.esri.com/PermittingEbook**

How Bend, Oregon, Tackled the Housing Crisis with Enterprise GIS

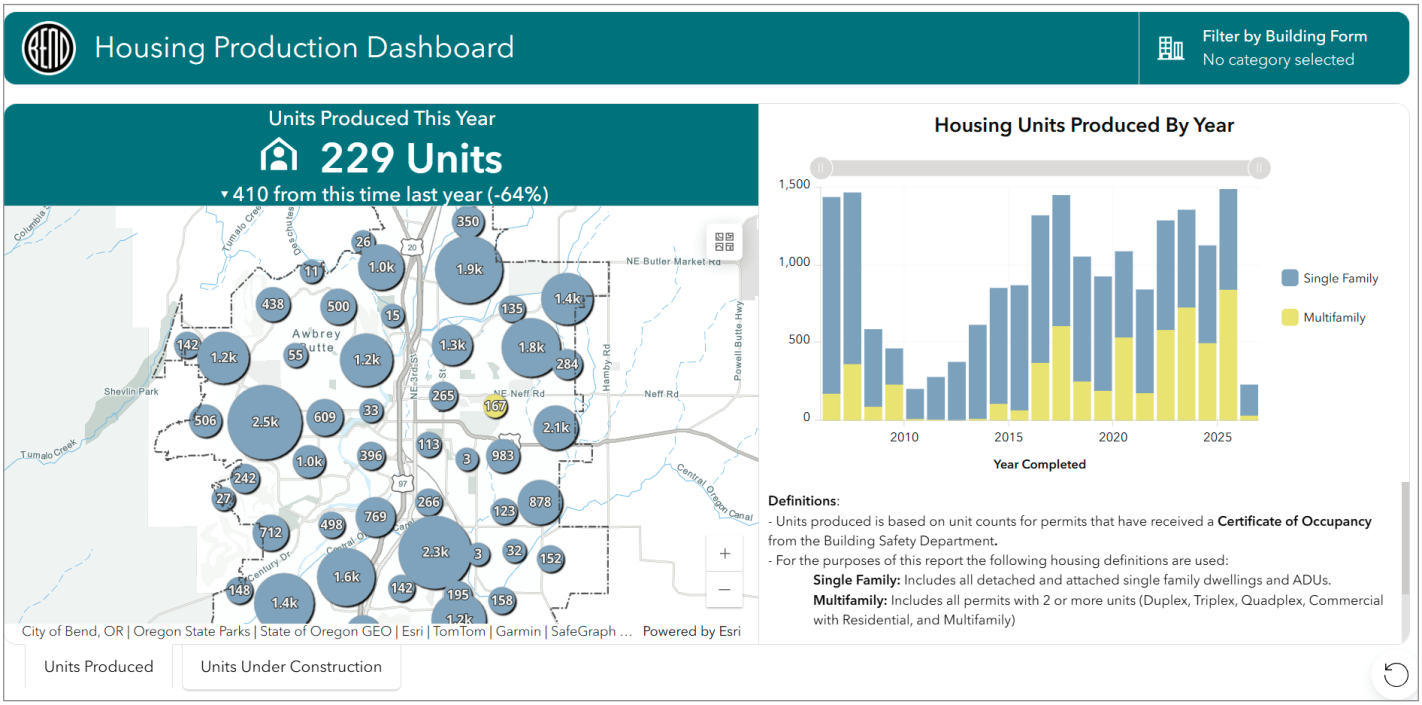
The City of Bend is a fast-growing municipality in central Oregon. With the second-lowest tax rate in the state, an outdoor lifestyle, growing businesses, and a community-oriented feel, the city has experienced recent sustained population growth, placing new pressure on the housing market. Leaders knew the city was undersupplied by several thousand units and lacking in diversity of housing types. And while there were plenty of permit approvals for construction, many new homes were priced far above what the median household income could support. This mismatch made it evident that permit counts alone couldn't explain the truth on the ground. To respond effectively, planners needed a clearer view of where housing was being built, what types were being delivered, the length of the review process, and what barriers were preventing more attainable options from moving forward. City staff began pulling reports to answer these questions.

Fragmented Permitting and Housing Data Undermined Public Trust

To understand the housing shortage, city staff started with some basic questions: How many units were being permitted? What types of housing were being built? How long were approvals taking? Was new development addressing affordability needs? However, these questions revealed inconsistencies. The city's data lived in disconnected systems. Depending on how a question



↑ The Bend Housing Data Hub shows the city's changing population growth, housing costs, and household income across time.



↑ The Housing Production Dashboard illustrates where and how much new housing is being produced over time.

was framed—calendar year versus fiscal year, issued versus in-process permits—the answers could vary widely. This lack of a single, trusted source of truth became increasingly problematic as Bend's housing shortage intensified. Bend leaders faced growing scrutiny from the city council, residents, and the development community, all asking for clearer explanations for delays in housing production and permitting timelines. The State of Oregon also introduced more detailed reporting requirements, including breaking housing data down by income levels rather than broad categories like single family or multifamily.

To move from reactive explanations to proactive planning, Bend focused first on improving data quality. The city underwent major system transitions, replacing both its permitting and financial systems with a comprehensive geospatial platform. Earlier attempts to answer housing questions were slowed by the city's technology history. Bend started with a paper-based permitting process before moving to an electronic plan review solution in the mid-2000s. Eventually, the city outgrew this legacy permitting software. To create a reliable system of record, Bend identified ArcGIS Enterprise as the foundation for unifying authoritative data and making it usable across departments. The city built an integration with geographic information system (GIS) software so staff could connect permits, projects, and inspections to real locations. The new approach made it easier to add and track new reporting fields as state, federal, and local requirements evolved—without rebuilding the entire workflow each time.

Building a Shared Narrative with Open Online Data

With integrated, location-based data in place, the next step was to make that information easy to understand and share. To do this, the city used ArcGIS Dashboards to deploy several dashboards on housing production, permitting activity, timelines, and geographic patterns. These are all accessed using ArcGIS Hub, an extension of ArcGIS Online, in a single, accessible location. Dashboards are updated daily and drawn from the same authoritative datasets used internally, creating a common narrative for staff, leadership, developers, and the public. After establishing transparency around what was happening, the city used the same data to understand why it was happening—and where policy could make the biggest difference.

Within the Hub site, residents and stakeholders can see progress toward housing goals, explore heat maps showing where different permit types are concentrated, and track how production changes over time. Internally, staff use the same data to run operational reporting and spot bottlenecks early—down to whether delays are happening during city review or while applicants respond. Because the dashboards refresh daily, everyone is on the same page. The city can answer questions consistently in meetings, reducing confusion about what the numbers mean, and keeping conversations focused on data-driven solutions rather than speculation.

Linking Permits to Parcels and Zoning in a Single Source of Truth

Beyond monitoring permits, the team began connecting permitting data to parcels and zoning to understand where capacity existed—and where it didn't. By compiling information on which lots were

continued on page 20

realistically available for housing under current zoning and development rules, Bend officials could see gaps between planned capacity and what the market was producing. That spatial lens helped staff identify specific areas and lot types that would require zoning or code changes to better support the kinds of housing the community needed.

While the parcel and zoning analysis supported long-range decisions, the dashboard and supporting reports operationally improved transparency around permitting timelines. By clearly showing how long applications spend in city review versus applicant response, staff can have more productive, data-backed conversations with developers. Instead of debating anecdotes, teams can point to shared metrics that help developers plan their work and help the city demonstrate accountability. Over time, this consistency has helped quiet misinformation and rebuild trust after earlier system challenges.

Clean Data Maps the Way to Clearer Policy

The Bend Housing Data Hub has also become a strategic tool beyond day-to-day operations. The city now uses housing data to evaluate the real-world impact of policy changes, identify trends linked to state legislation, and support discussions at the state level with concrete evidence. This created a feedback loop where the city could test a policy change, monitor the permitting response, and adjust course based on evidence.

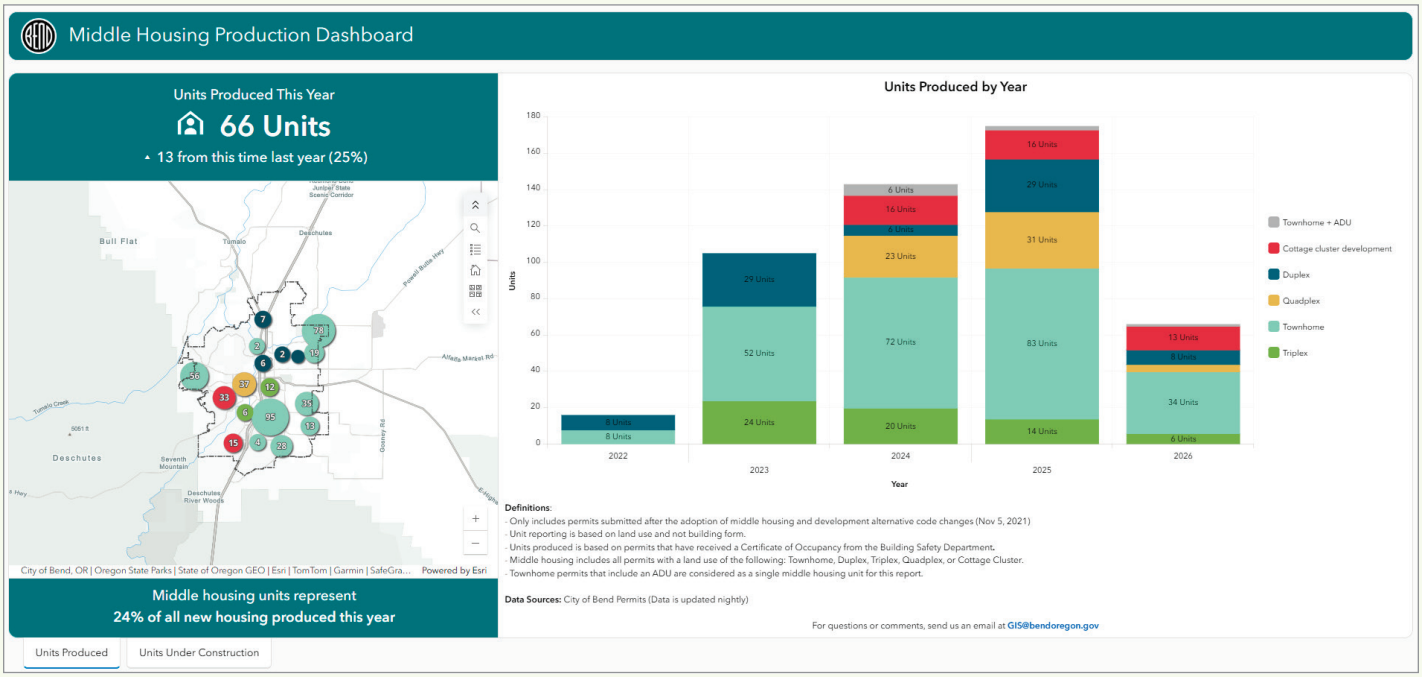
As housing affordability has become both a statewide and national concern, Oregon has also introduced reforms intended to make "missing middle" housing development easier than ever. For example, Bend did not see an increase in production, so planners used permitting data to analyze barriers and identify regulations that were impeding accessory dwelling unit (ADU) development. After making policy adjustments, the team continued tracking ADU permits to pinpoint which changes led to increased production.

Taken together, these improvements gave leadership a clearer, statewide picture of Bend's housing production. Furthermore, the State of Oregon has recognized the city as the example for every other city in the state to emulate, while leadership can use the online hub to reference the exact policies that have created this growth.

Today, the City of Bend can answer questions with confidence and consistency. Leaders can now see year-over-year trends in housing production, understand where permits are coming in geographically, and distinguish between policy changes and their concrete outcomes. This clarity has shifted conversations with elected officials and state agencies from speculation to evidence-based discussion.

"We can confidently say we're producing more housing per capita in the state than most other cities in Oregon and more by quantity than any other city except for Portland,"said Russell Grayson, the City of Bend's chief oprating officer.

To get the guide for urban and community planning with GIS, please visit **link.esri.com/PlanningEbook26**.



↑ The Middle Housing Production Dashboard illustrates where, how much, and what kind of middle housing units are being produced over time.

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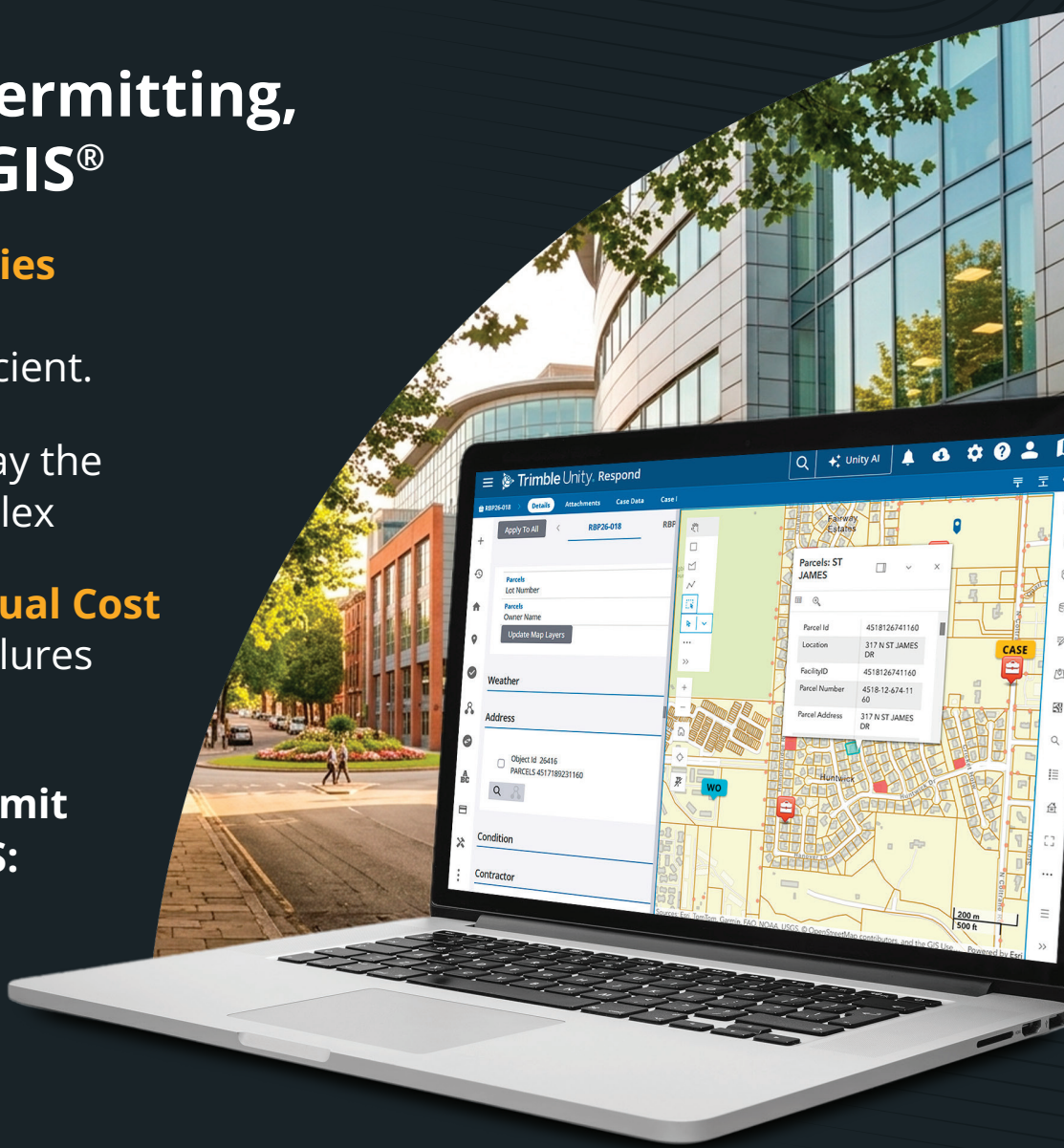

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Bexar County Appraisal District Modernizes Parcel Management with ArcGIS Pro

Serving more than two million residents in one of Texas's fastest-growing counties, Bexar County Appraisal District (BCAD) needed to modernize its geographic information system (GIS) for its parcel management workflows without compromising operational timelines or service delivery. To meet this goal, staff at BCAD turned to Esri partner Sidwell, implementing a staged migration from ArcMap to ArcGIS Pro and ArcGIS Parcel Fabric, which kept staff productive and services running efficiently throughout the transition.

Parallel Migration to ArcGIS Pro Supports a Path to Modernization

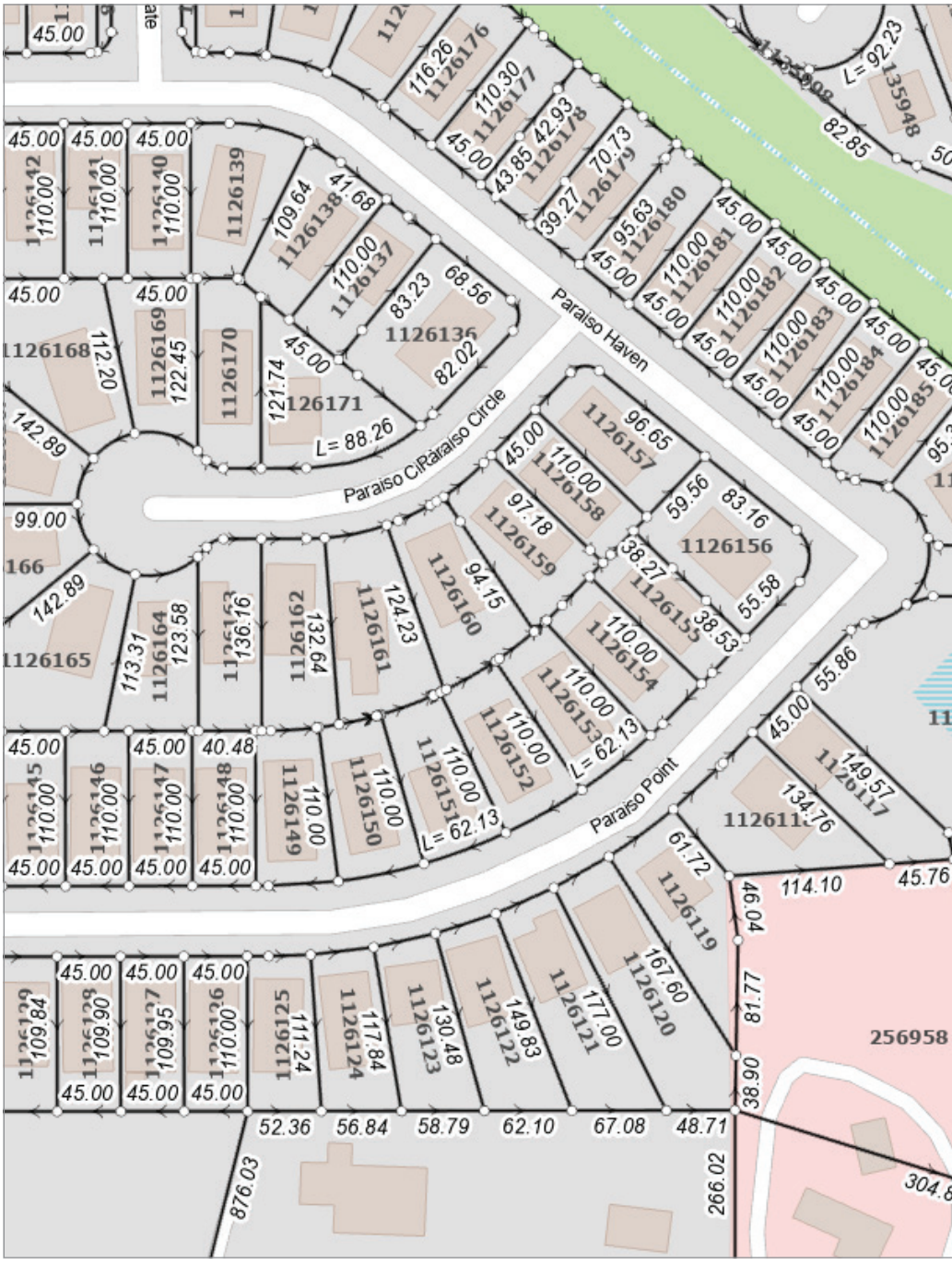
For BCAD, precision and timing are essential. The district operates on a state-mandated appraisal schedule, leaving no margin for prolonged outages or resource-intensive system overhauls. With ArcMap nearing retirement, BCAD needed to modernize its GIS without disrupting daily operations. Limited staff capacity and strict appraisal deadlines left little room for a complex migration.

"Time was the most limiting factor," said Keith R. Dailey, GIS director at BCAD. "We are on a strict appraisal schedule that is dictated by the state, and we needed a third party to do the setup and migration so that we could just transition from ArcMap to ArcGIS Pro as quickly as possible with as little downtime as possible."

The Sidwell team implemented a parallel migration strategy that allowed staff to continue working in their existing GIS environment while the new ArcGIS Pro environment was built and configured behind the scenes. Sidwell staff managed every aspect of the transition, including infrastructure assessment, enterprise deployment, data migration, and service configuration.

"Sidwell migrated our data over to a new, updated server while we were still working in ArcMap and got the services started so that all we needed to do was complete the training and we were ready to use the new fabric in ArcGIS Pro," said Dailey.

This phased transition eliminated traditional "cutover" risks associated with system migrations and, according to Dailey, "allowed us to have as much time as possible training with little to no actual downtime in production."



Training Supports Parcel Management Workflows in ArcGIS Pro

While the underlying parcel management processes remained consistent, ArcGIS Pro introduced a new interface and updated workflows within ArcGIS Parcel Fabric. Recognizing that usability and familiarity would be key to adoption, Sidwell staff developed a tailored training program to bridge the gap between the old and new environments.

"We had to learn new ways of working with the parcel fabric in [ArcGIS] Pro compared to ArcMap," said Dailey. "The core workflows are similar, but knowing where the tools are is different."

The training emphasized hands-on learning, helping staff quickly locate tools and understand how to execute familiar processes within the new system. By aligning training completion with system readiness, BCAD employees were able to transition seamlessly into ArcGIS Pro with confidence from day one.

This thoughtful alignment of technology deployment and workforce enablement ensured that modernization was not only technically successful but also operationally sustainable.

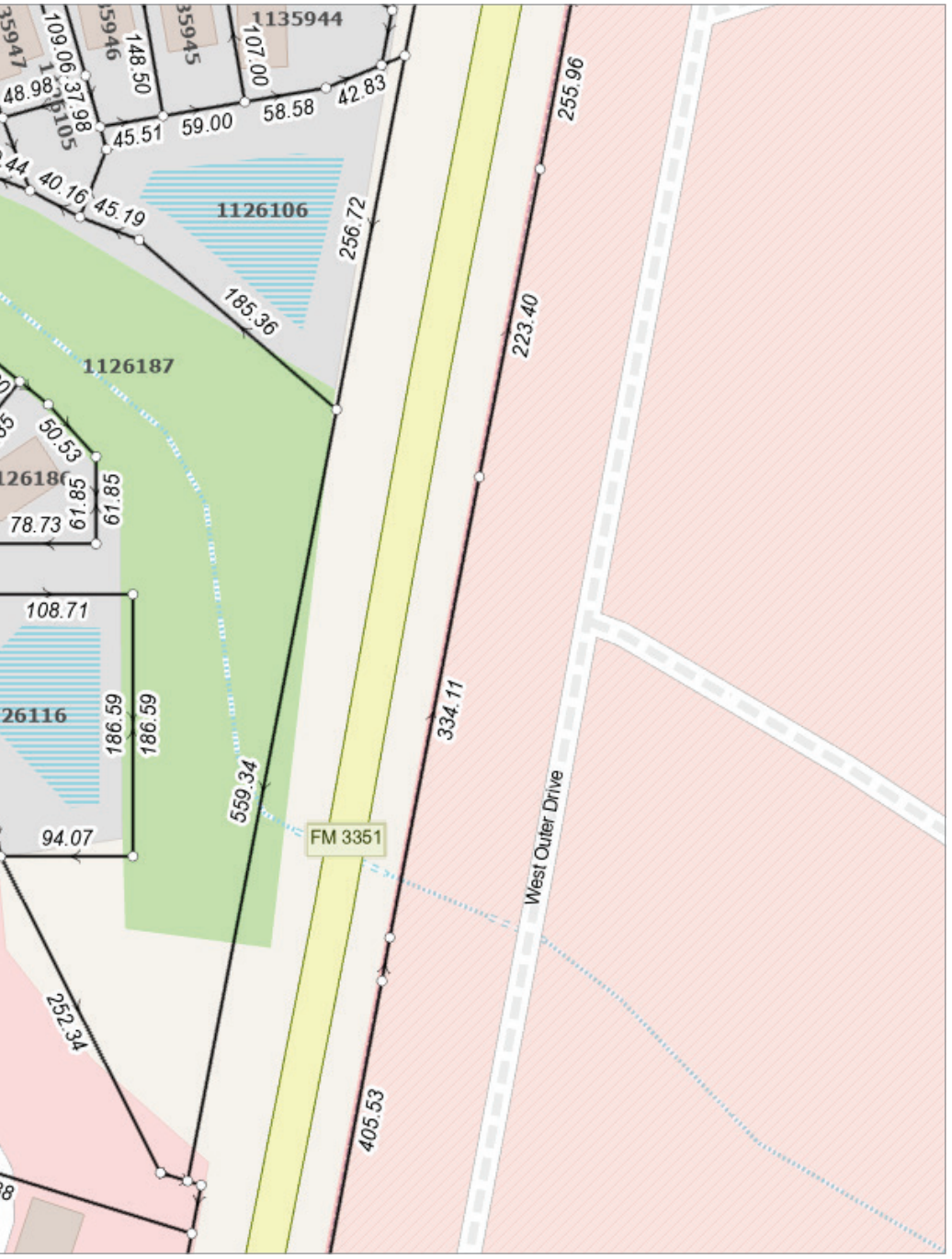
Delivering Continuity at Scale Builds a Foundation for Future Growth

BCAD successfully transitioned to ArcGIS Pro and ArcGIS Parcel Fabric with virtually no downtime, a significant achievement given the scale and complexity of the organization's operations. By executing migration, training, and deployment concurrently, the Sidwell team enabled BCAD staff to maintain productivity levels comparable to previous years and meet its appraisal deadlines.

By partnering with Sidwell, BCAD demonstrated that even the most time-constrained organizations can achieve meaningful transformation without sacrificing performance. Their success underscores the value of aligning technology modernization with operational realities and workforce readiness.

Beyond continuity, the organization is now positioned to take advantage of new capabilities within ArcGIS Pro, including enhanced reporting and dashboard tools that support future operational improvements and transparency. The transition to ArcGIS Pro marks more than a technical upgrade—it represents a strategic investment in BCAD's future. With a modern, scalable GIS foundation in place, the district is better equipped to adapt to evolving requirements, manage continued population growth, and deliver reliable services to the public.

To modernize parcel management with confidence, please visit **link.esri.com/ParcelModernization**.



← BCAD uses ArcGIS Pro and ArcGIS Parcel Fabric to support modern parcel management workflows.

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