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# SMART METRO

## Broward Metropolitan Planning Organization

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Metropolitan Planning Organization

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**Project Summary:** Broward County, Florida (“Broward”) is experiencing rapid population growth, which is accompanied by challenges related to safety, traffic congestion, rising costs, and infrastructure demands. These factors complicate efficient planning and investment. The Broward Metropolitan Planning Organization (BMPO) and its regional partners face obstacles in coordination and modeling, reducing their effectiveness. Addressing these issues requires the integration of multiple regional systems and models. **SMART METRO** is a scalable prototype platform designed to tackle these challenges through advanced systems integration. The platform enables comprehensive transportation and land use planning by leveraging the following capabilities:

- **An Integrated Digital Twin Platform:** SMART METRO serves as a scalable prototype that unifies transportation, land use, demographic, and extreme weather data within a single interface.
- **Advanced Analytics and AI:** The platform utilizes data science, geospatial analytics, artificial intelligence (AI), and simulation tools to support detailed analysis and scenario modeling of infrastructure.
- **Data-Driven Decision Making:** SMART METRO empowers stakeholders to evaluate and compare strategies, ensuring that resources are allocated to the most effective solutions.

**Key Partners:** City of Miramar, New York University (NYU) GovLab, University of Florida, Google, UrbanSim, and Deloitte.

**Stage 1 Scope & Results:** Stage 1 delivered a digital twin through robust systems integration, enabling comprehensive planning and effective evaluation of transportation challenges. The prototype achieved several notable results. SMART METRO demonstrated the potential for a 50% reduction in overall timelines for BMPO’s core planning processes by implementing unified systems that streamline data collection, reviews and approvals, scenario modeling, statistical analysis, and report generation. These efficiencies can lead to reduced contracting costs and earlier project delivery, maximizing resource utilization. Planning was further enhanced with SMART METRO’s automated reporting, advanced analytics, and scenario modeling. BMPO validated these benefits through two use cases: a redevelopment program in Historic Miramar and an effort to align transportation and housing investments (“Development Coordination”). Demonstrating significant scale, these use cases engaged 26 regional and national partners and supported 14 active users, underscoring broad collaboration and adoption.

**Stage 1 Lessons Learned:** SMART METRO must reflect the priorities and challenges of future Broward stakeholders. Budget constraints required significant internal investment from BMPO and consultants, highlighting the need for careful financial planning. The prototype also underscored the importance of establishing long-term operating model. Stakeholder engagement presented hurdles, especially in coordinating schedules across regional and national partners. Additionally, the complexity of systems integration with both new and legacy systems posed further challenges. Data acquisition and preparation were also demanding.

**Stage 2 Recommendations:** Stage 2 will focus on enhancing systems integration for scalability, reliability, and security. Incorporating additional data sources and simulation tools will support unified workflows and improve overall functionality. Advancing SMART METRO into an AI-powered agent with adaptive learning capabilities will enable more sophisticated transportation modeling, analytics, performance metrics, and 3D visuals. Establishing a consortium to oversee data governance and operational management is essential for effective oversight and coordination. A proposed use cases for roadway safety, leveraging additional capabilities and data from the Florida Department of Transportation (FDOT), will analyze the Killed or Seriously Injured (KSI) metric and identify appropriate proven safety countermeasures and predictive capabilities to prevent crashes before they occur. Congestion management and streamlining environmental documentation (e.g., National Environmental Policy Act (NEPA)) and other mandated MPO products are also Stage 2 use cases. This collaborative approach will support successful, at-scale implementation across the nation.

### 1. Provide a description of your project, including:

#### Project Summary

SMART METRO is focused on enhancing planning efforts in Broward by leveraging advanced systems integration. This forward-thinking prototype is designed to foster more comprehensive regional planning, bolster mobility, and strengthen the vital connections between jobs and housing for Broward's residents as population levels grow.

By leveraging data science, geospatial analytics, AI, and simulation, SMART METRO delivers actionable insights to address key regional challenges. Through its integrated digital twin platform, SMART METRO combines transportation, land use, demographic, and extreme weather data, enabling users to simulate real-world processes and planning scenarios. This approach supports more informed investment and planning decisions.

Through these analyses, SMART METRO provides a robust, data-driven decision-making platform, empowering Broward's stakeholders to evaluate and compare investment and planning strategies, ensuring that resources are allocated efficiently and effectively to positively impact Broward's residents both now and in the future.

“Planning the development of cities is really database-driven...and that dataset needs to be accurate. The challenge is how to get all of the data together and analyze it in a way that provides efficiency. SMART METRO can take real-time data from multiple sources like Google to help planners be more efficient when it comes to planning.”

~ **Greg Stuart, Executive Director Broward MPO**

#### The real-world issues and challenges that would be addressed with at-scale implementation.

Most existing planning models are static and calibrated to a specific year or timeframe. While these models can estimate the impact of multiple factors, such as mobility or land use, they are limited by a lack of coordinated data ingestion, or data import, that would enable them to better account for how different aspects of the region interact simultaneously.

These models depend on separate datasets, many of which are not updated regularly. As a result, it is difficult to test scenarios that reflect recent disruptions, changing travel patterns, or the effects of storm events on floodplains, coastal erosion, and access to jobs, housing, and transportation. This also limits the ability to assess and improve roadway safety, such as identifying high-risk areas, evaluating the safety impact of new developments, or planning emergency responses during extreme weather.

When models and data are siloed or static, it becomes challenging and time-consuming for decision-makers to visualize solutions, communicate them to stakeholders, and implement them efficiently. This fragmentation also makes it harder to conduct thorough safety analyses, gather all necessary information, compare alternatives, and prioritize investments that will most effectively improve roadway safety and protect road users.

SMART METRO addresses these challenges by providing more dynamic access to disparate data sets simultaneously, reducing planning timelines and resulting in cost savings. One of the most impactful innovations

## SMART METRO

in SMART METRO is the adoption of Google BigQuery as a cloud data warehouse. This advancement significantly enhances systems integration by enabling the harmonization of heterogeneous data sources – a challenge familiar to data scientists working with complex, multi-agency datasets. Leveraging BigQuery’s scalable architecture allows for advanced analytics and the emergence of new insights that were previously unattainable. While peer agencies face substantial barriers due to the sheer volume and complexity of available data, BMPO’s implementation of SMART METRO positions it as a trailblazer in cloud-based data integration and analytics within the public sector.

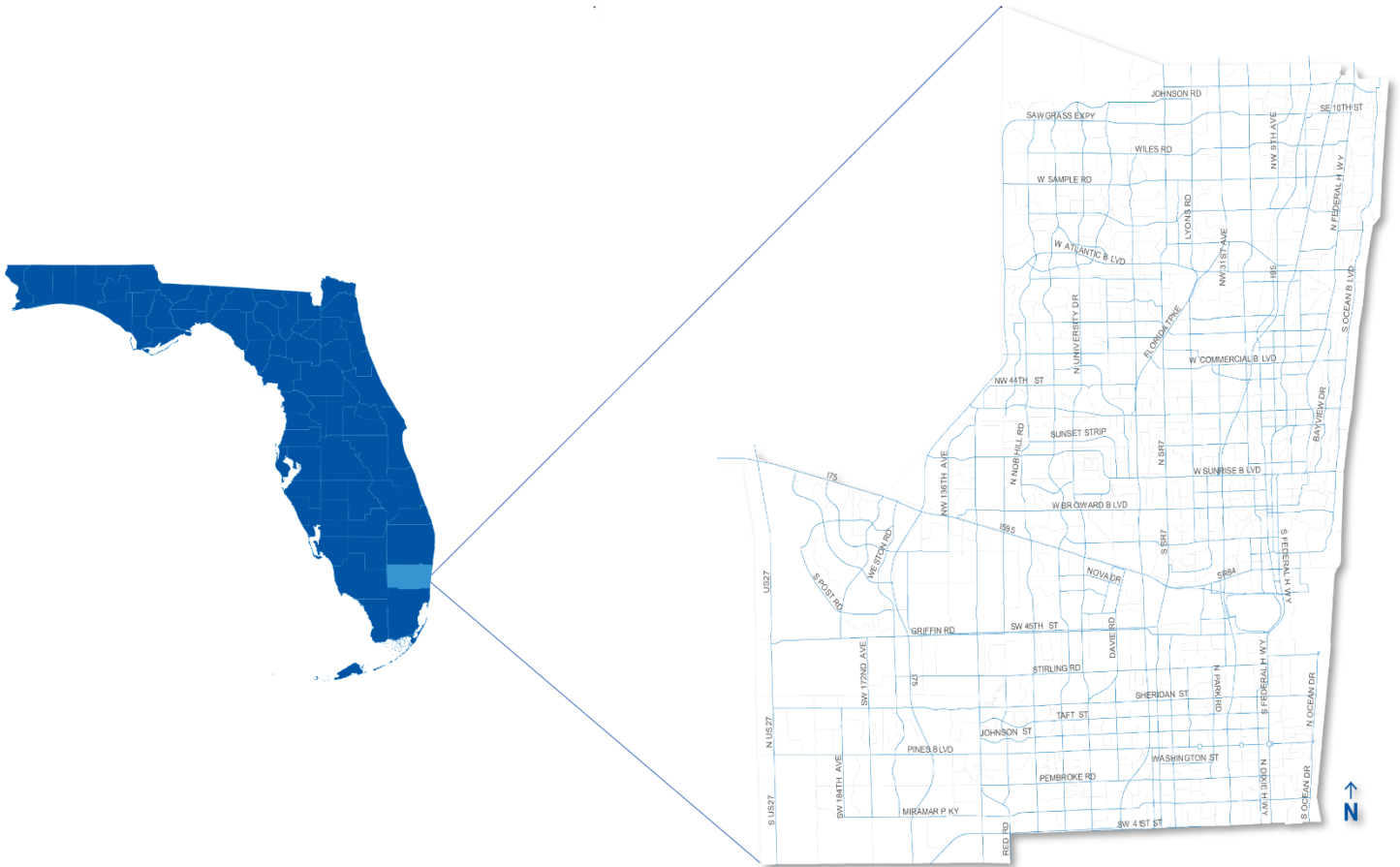
The SMART METRO prototype data is all publicly owned, including trip lists, zoning codes, redevelopment plans, flood projections, demographic insights, and roadway information. A complete list of the data for Stage 1 can be found in the attached Data Dictionary. SMART METRO ingests, processes, and stores data to enable cross-agency data sharing. Data is cleaned, normalized, and transformed, and storage is managed via databases and Google Cloud Storage, increasing data integrity, backup, privacy, and security.

SMART METRO reduces the process time by streamlining the tasks related to data gathering, analysis, modeling, and scenario analysis. It eliminates duplicative efforts to assemble data for a new project, to create templates for analysis and reporting, allowing the planners to focus on more value-added tasks such as using the insights to prioritize projects by testing several alternative scenarios quickly and efficiently.

SMART METRO allows for rapid analysis of possible scenarios, which aids in proactive planning and risk management. Projects can also be assessed from multiple dimensions, ensuring a complete approach to planning and execution. This holistic approach allows planners to conduct in-depth assessments, evaluating how projects are affected by factors such as regional population growth, land use development rates, transportation mode share, housing supply, and the impact of extreme weather events.

### **The geographic area or jurisdiction of the project will service with at-scale implementation.**

Broward is in the center of the Miami Urbanized Area (UZA), which also includes Miami-Dade and Palm Beach County. Over the years, the Miami UZA has grown into the fourth largest UZA in the United States, behind Chicago, Los Angeles, and New York. Broward’s location is vitally important for local, national, and global economies, with Port Everglades, the Fort Lauderdale-Hollywood International Airport, and multinational businesses serving as gateways to Latin America, the Caribbean, and the world. When implemented at-scale, SMART METRO is not limited to a specific region or jurisdiction and is designed to interoperate with a wide range of heterogeneous datasets and models. This flexibility has generated nationwide interest among the National Advisory Panel engaged during Stage 1. Its adaptable design enables deployment in any geographic area at-scale.



*Figure 1: Map of BMPO's MPO Planning Area.*

The technology(ies) being deployed. Please reference the following categories in your description of the specific deployments (as applicable): coordinated automation, connected vehicles, intelligent sensor-based infrastructure, systems integration, commerce delivery and logistics, innovative aviation technology, smart grid, and smart technology traffic signals.

Systems integration refers to the process of connecting diverse computing systems and software applications, often from different vendors, into a cohesive, interoperable environment. In the context of data science, systems integration enables seamless data flow, unified analytics, and efficient collaboration across platforms, tools, and data sources. At its foundation, SMART METRO leverages robust systems integration to create a unified data environment capable of handling structured, semi-structured, and unstructured data. This integration brings together transportation models, demographic information, economic indicators, and flood projections, consolidating disparate sources into a single, accessible platform.

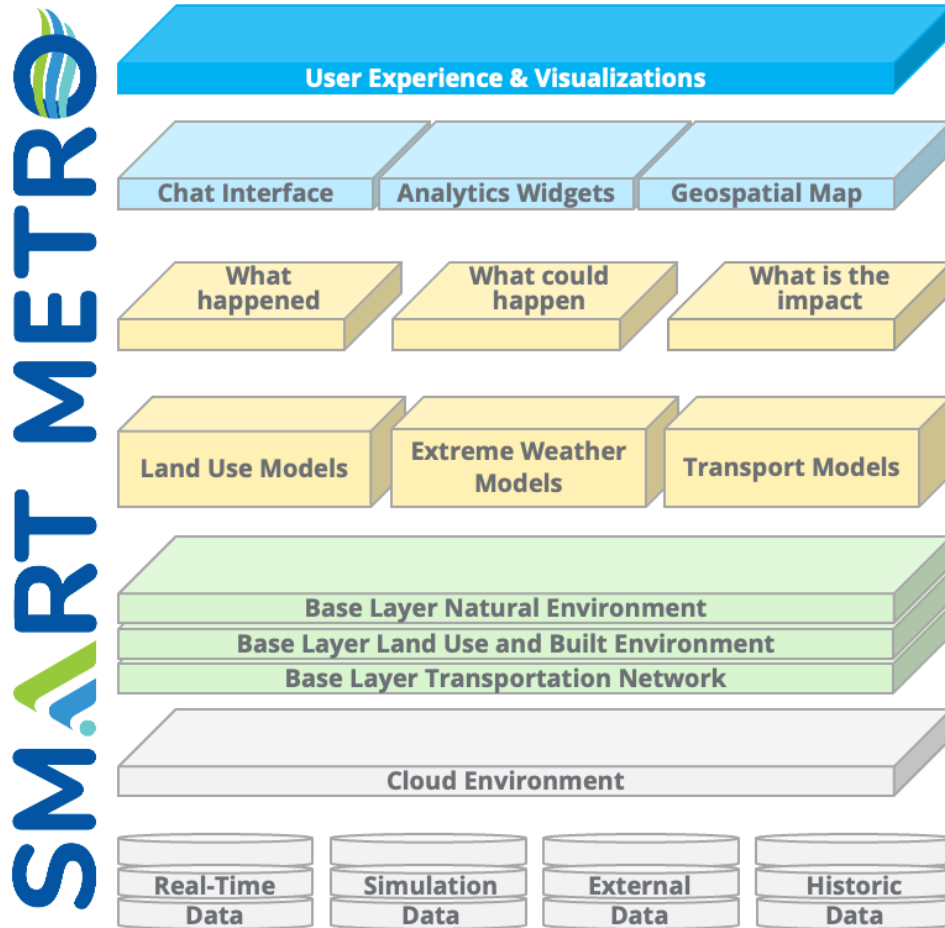


Figure 2: SMART METRO integrates data, models and simulation to support BMPO’s planning processes.

Through advanced *Systems Integration*, SMART METRO delivers a suite of high-level capabilities, including:

**Data Ingestion (Data Import)**

Systems integration enables SMART METRO to ingest and harmonize data from multiple sources. The initial launch incorporated 146 tabular datasets and 37 manual documents from BMPO and regional stakeholders, aligned to prioritized use cases. Indexing of browardmpo.org for Retrieval Augmented Generation (RAG) added 31,536 documents to the digital environment. Tabular datasets were systematically loaded into Google BigQuery as bronze (raw) editions, then cleaned, processed, and joined following the Databricks medallion architecture resulting in 45 gold-level tables. A data dictionary with Source to Target Mapping (STTM) tracked data lineage and transformation across the bronze-silver-gold pipeline. This approach, considered an industry best practice, demonstrates a replicable template for other entities and agencies to embrace along with their technological innovations.

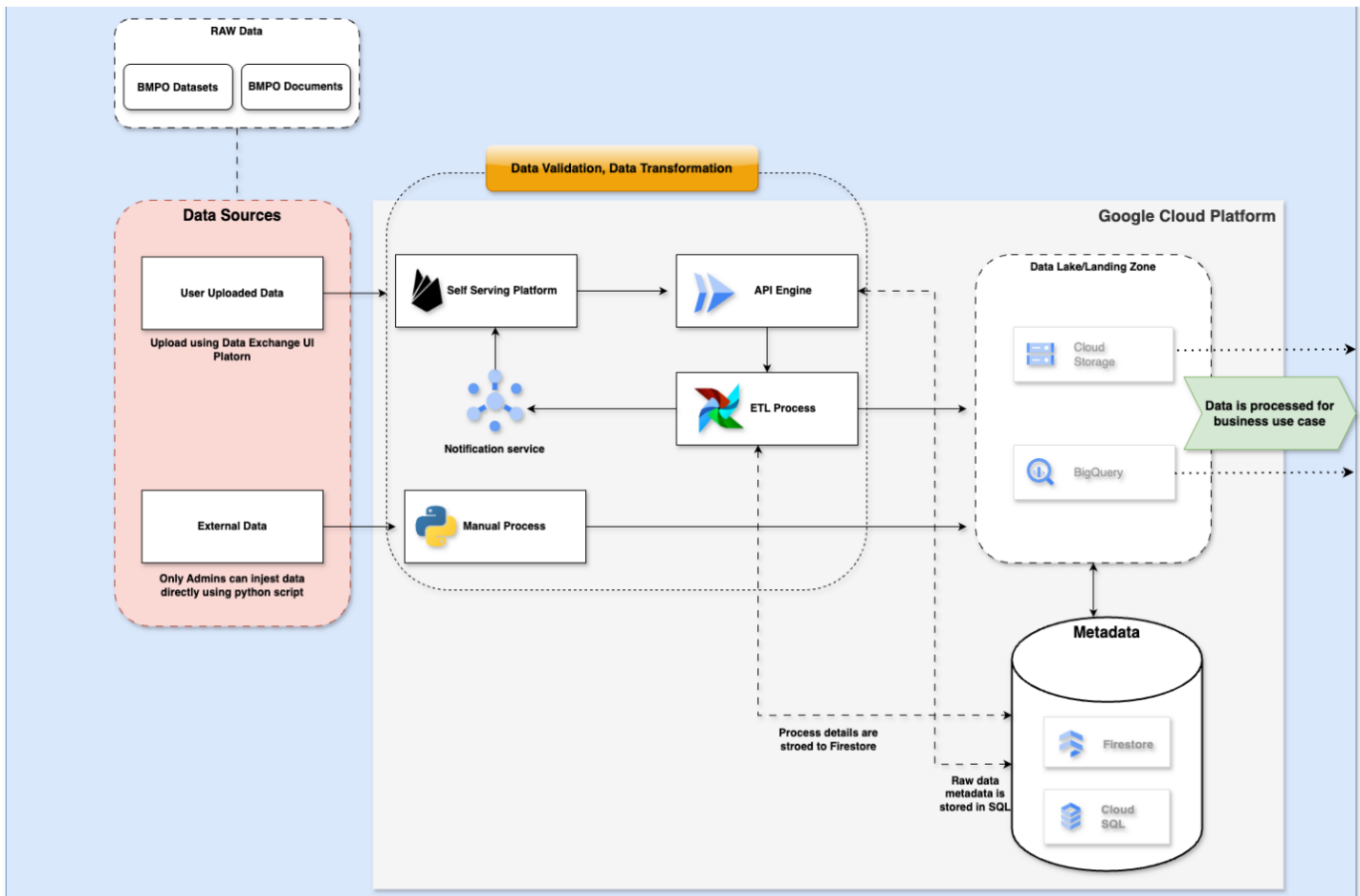


Figure 3: SMART METRO data ingestion pipeline.

Systems integration also supports user-driven data uploads for cross-agency coordination and sharing, with compatibility for multiple formats (Shapefiles, GeoJSON, Geopackage, Geodatabase, PDF, TXT, XLSX, etc.). Users can access, upload, and filter both tabular and document data. SMART METRO’s Gemini large language model (LLM) facilitates natural language querying and insight generation, while APiGEE and Cloud Run orchestrate requests and operations to the data repository.

## Data Processing

Integrated data pipelines enable SMART METRO to transform and manipulate ingested data for analysis. This includes cleaning, normalization, and transformation, supported by Extract, Transform, and Load (ETL) processes and custom business logic. Systems integration supports seamless data indexing for both RAG document and Text-to-SQL tabular workflows.

Orchestration via Cloud Composer manages ETL workflows, extracting data from Cloud Storage and processing it with Cloud Functions before loading into BigQuery. This integrated approach enables efficient, scalable, and repeatable data processing.

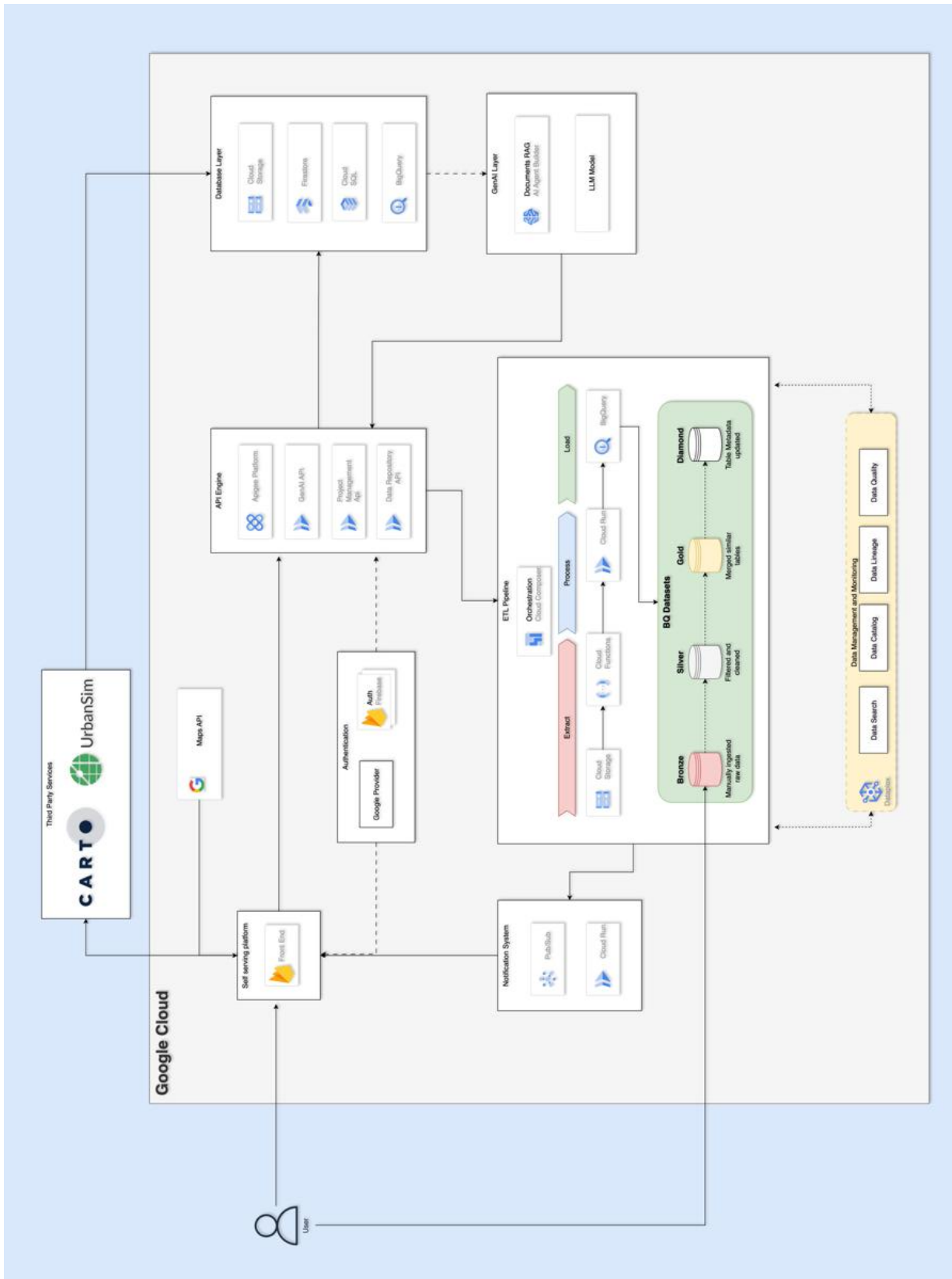


Figure 4: SMART METRO data architecture.

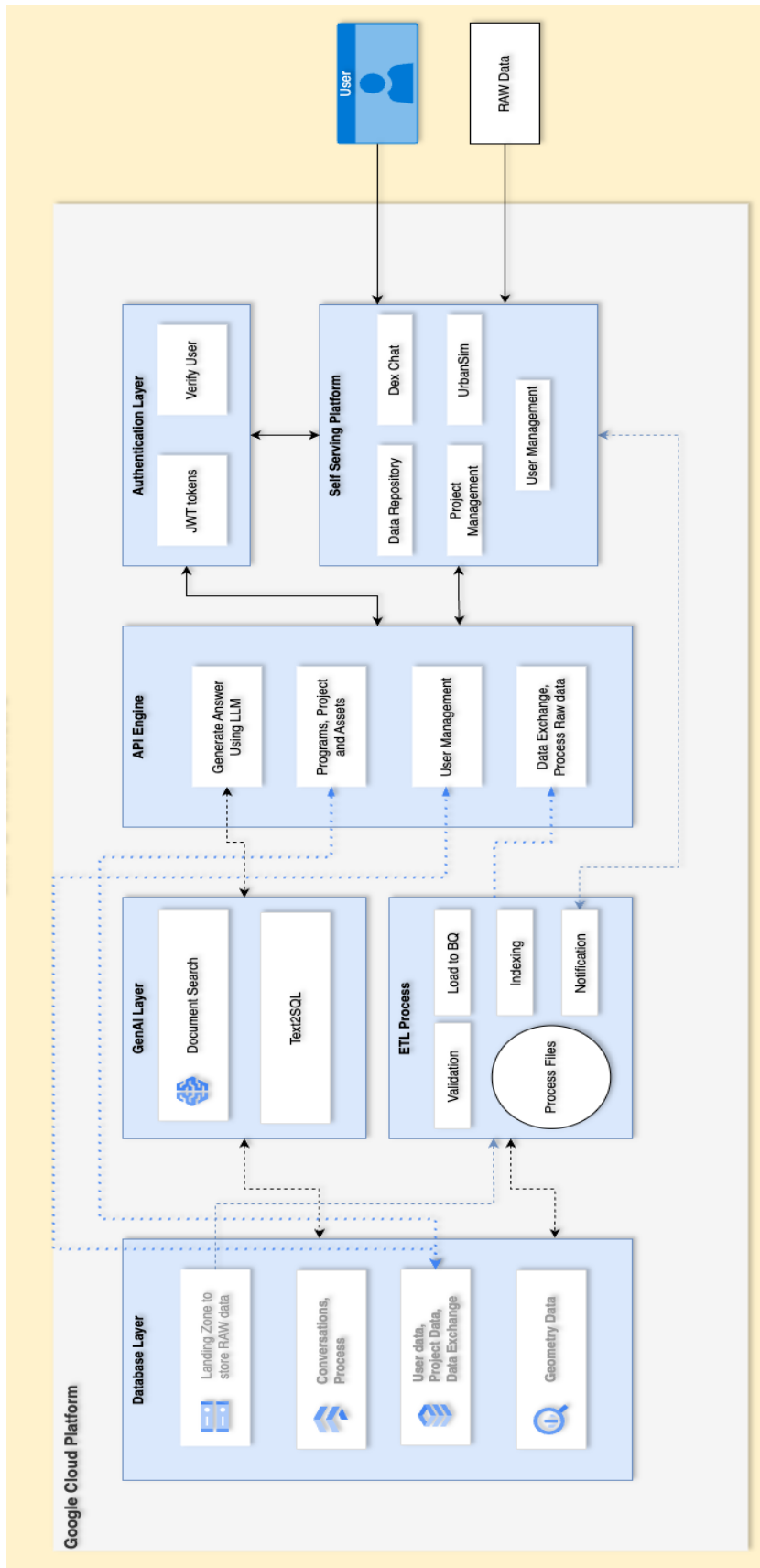


Figure 5: SMART METRO data flow diagram.

Systems integration underpins SMART METRO’s data storage architecture. Data is initially placed in Google Cloud Storage landing buckets, triggered by user uploads or upstream providers, ensuring encryption in transit and at rest, as well as backup procedures. Unstructured data (PDF, TXT, DOCX, etc.) is pushed to a GCP AI Applications Data Store for chunking, embedding, and indexing.

For tabular and geospatial data, Dataplex and Cloud Functions manage governance and ETL logic before landing in BigQuery. CloudSQL maintains metadata for incoming files, including table and column descriptions. Firestore, a NoSQL document database, logs user prompts, process times, data sources, feedback, and metadata for Generative AI (GenAI) responses, demonstrating comprehensive systems integration across storage modalities.

## Data Analysis

Systems integration enables SMART METRO to utilize RAG and Text-to-SQL processes for complex data analysis based on natural language queries. Google’s Gemini LLM interprets baseline and predictive datasets, generates geospatial visualizations, and creates analytic widgets for rapid insights. In Stage 2, SMART METRO will further integrate predictive and prescriptive machine learning environments, including demand forecasting, neural networks for transportation pattern recognition, and safety, congestion management analytics, 3D visualizations, and streamline workflows.

## Visualization

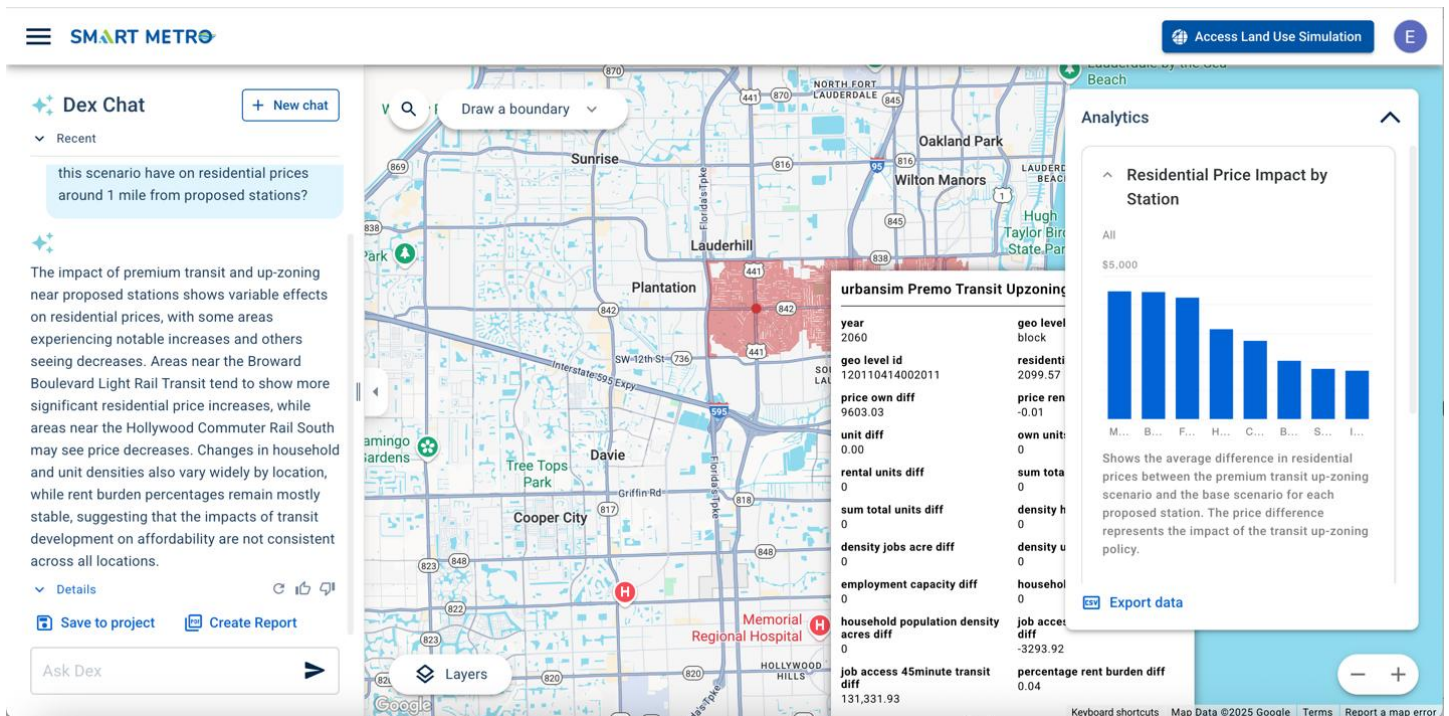


Figure 6: SMART METRO’s interface showing the response to: “Considering the scenario of Premium Transit and up-zoning, what impact would this scenario have on residential prices around 1 mile from proposed stations?”.

Integrated visualization tools and libraries, including Google Maps, CARTO, and UrbanSim, enable SMART METRO to graphically represent data while optimizing customization and analytic capabilities. CARTO is a cloud-native location intelligence tool that analyzes, visualizes, and optimizes spatial data. UrbanSim is an open-source simulation tool used to model the long-term impacts of land use, transportation, and public policy

decisions. Systems integration supports seamless interoperability between these tools, enhancing the overall user experience. By leveraging familiar interfaces, SMART METRO supports new users while also delivering the advanced functionality needed for data analytics and modeling.

**Digital Environment Management**

SMART METRO’s deployment strategy is built on systems integration principles, employing Branching Strategy and Environment Promotion for a robust continuous integration / continuous delivery (CI/CD) pipeline. Distinct branches for development (dev), stage (quality assurance (QA)), and production (prod) enable controlled, isolated deployments. Code is developed and tested in dev, promoted to QA for further validation, and merged into prod for production deployment, ensuring only thoroughly tested and approved code reaches production.

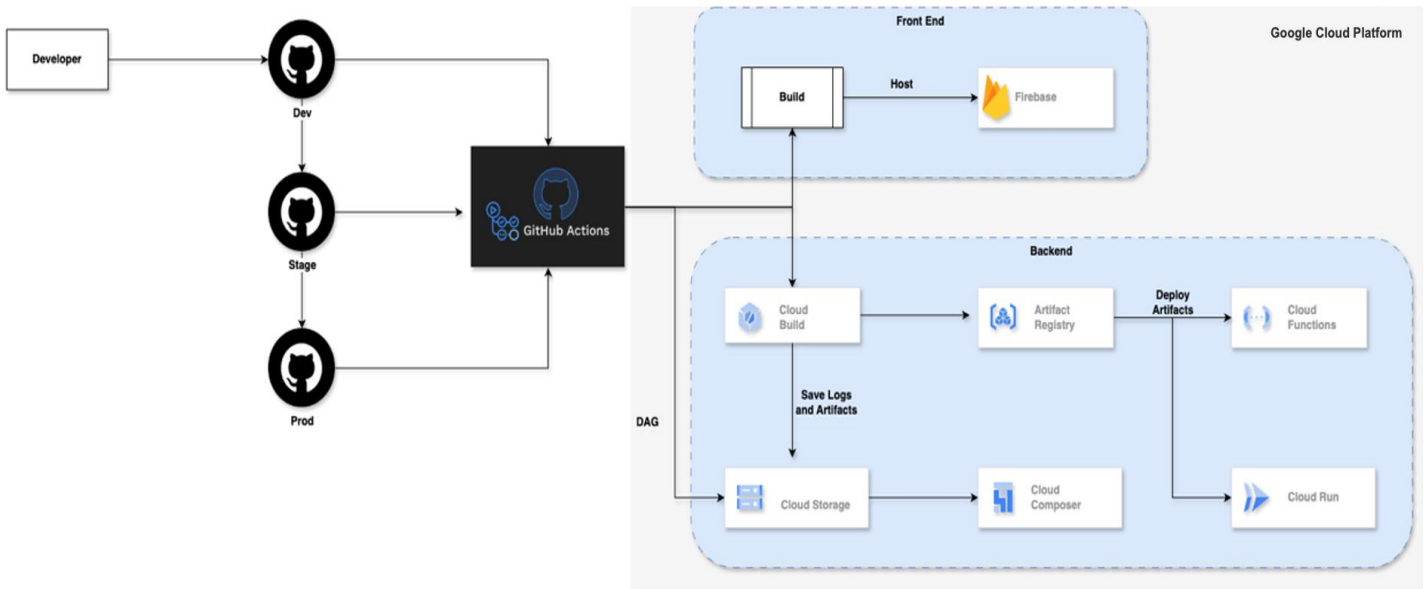


Figure 7: CI/CD diagram.

**Reporting**

Dex Report- 09/09/2025 11:57:37 PM

**Prompt**

Considering the scenario of Premium Transit and up-zoning, what impact would this scenario have on residential prices around 1 mile from proposed stations?\*

The impact of premium transit and up-zoning near proposed stations shows variable effects on residential prices, with some areas experiencing notable increases and others seeing decreases. Areas near the Broward Boulevard Light Rail Transit tend to show more significant residential price increases, while areas near the Hollywood Commuter Rail South may see price decreases. Changes in household and unit densities also vary widely by location, while rent burden percentages remain mostly stable, suggesting that the impacts of transit development on affordability are not consistent across all locations.

**Analysis**

The impact of premium transit and up-zoning within a one-mile radius of proposed stations on residential prices varies significantly depending on location and a combination of factors beyond mere proximity to transit. Projecting to the year 2060, some areas near proposed Commuter Rail South and Light Rail Transit stations may experience price decreases while others see substantial increases. For example, blocks near the Hollywood Commuter Rail South station are projected to see residential price decreases (e.g., -\$222.25), whereas blocks near the Broward Boulevard Light Rail Transit could exhibit residential price increases (e.g., \$2075.87). Up-zoning, as indicated by differences in housing units ("unit diff"), shows only minor changes in unit counts for most blocks within the scenario projection data. However, some blocks, such as those near the Medical Center Commuter Rail South station, exhibit more significant increases in units (e.g., 37,586 units). Density, measured by changes in household, job, and unit densities per acre, also varies considerably. Blocks near the International Airport Commuter Rail South station show minimal change in density, while others, closer to the Fort Lauderdale Tri-Rail Light Rail Transit, show notable increases in household and unit densities. Changes in rent burden ("percentage rent burden diff") are

**Dex Layers**

- urbanism Premium Transit Upzoning base comparison
- PREMIO proposed stations

Systems integration facilitates cross-agency collaboration through project and report creation. The platform supports prompt and answer storage, as well as exporting reporting capabilities. Additional integrations and capabilities are planned for Stage 2 implementation.

**The goals and desired outcomes for at-scale implementation.**

As stated in BMPO’s Evaluation Plan, the goals and desired outcomes for at-scale implementation for SMART METRO are to:

Figure 8: Sample report created using SMART METRO’s AI.

- Plan smarter and holistically to support informed investment of resources across regional planning partnerships.
- Support reliable multi-modal mobility that is hardened to extreme weather.
- Enable the development of housing, foster workforce development, and promote concurrent economic growth in the region.

During at-scale implementation, these primary goals will address several areas of IJIA Public Law 117-58 Sec 25005 D(3)(ii) in the following ways:

## I. Reduce congestion and delays for commerce and the traveling public.

Broward's rapid regional growth has led to increased congestion. As BMPO and stakeholders evaluate new projects, it is essential for planners to understand the negative impacts of congestion and identify potential mitigation strategies. By integrating BMPO's travel demand model and real-time traffic operations data, among other models and data sets, SMART METRO will enable users to dynamically forecast congestion impacts and develop effective mitigation approaches. Currently, Broward-based planners lacked interactive tools for engaging with travel demand data; SMART METRO can provide a dynamic, data-driven platform for more informed planning decisions.

## II. Improve the safety and integration of transportation facilities and systems for pedestrians, bicyclists, and the broader traveling public.

At full implementation, SMART METRO can enhance safety by recommending targeted proven safety countermeasures, particularly in high-risk areas, proactively through predictive analytical capabilities. The platform will optimize resource and network management by efficiently prioritizing resource allocation and enabling traffic management, addressing risks and stress on the roadway networks, and vulnerable infrastructure. SMART METRO can also support traffic management through condition-specific strategies that improve traffic flow and facilitate adaptation. Additionally, the platform automates key processes to increase workforce productivity, such as generating reports for incident management and project screening, accelerating project delivery.

## III. Improve access to jobs, education, and essential services, including health care

Integrating demographic data with UrbanSim land use modeling significantly enhances planning capabilities by enabling a more comprehensive analysis of job accessibility across the region. By combining granular demographic information, such as population distribution, income levels, and commuting patterns, with predictive land use models, users will be able to accurately assess how changes in infrastructure, siting of economic and employment generators, zoning, or development projects impact access to employment opportunities. This integration supports data-driven decision-making, allowing users to evaluate job access alongside transportation plans, pipelines, and work programs. At full implementation, this type of evaluation can be performed for other essential services such as health care, insurance (cost burden), and other essential services.

#### IV. Connect or expand access for underserved or disadvantaged populations and reduce transportation costs.

SMART METRO will enable robust scenario analysis to help users and stakeholders understand the potential impacts of changes in transportation mode share. By modeling different pricing strategies and their effects on travel behavior, congestion, and access, SMART METRO allows users to evaluate a range of policy options. This data-driven approach supports informed decision-making, empowering stakeholders to compare outcomes and select the most effective strategies for managing transportation demand, optimizing network performance, and achieving broader planning goals.

#### V. Contribute to medium- and long-term economic competitiveness.

As SMART METRO's data inventory expands, the platform will provide more valuable insights into how investments in infrastructure and services, such as housing, can generate improved returns and drive economic development across the region. These tangible benefits represent the core value of SMART METRO.

#### VI. Improve the reliability of existing transportation facilities and systems.

SMART METRO's access to high-quality data, combined with custom-built models for pavement maintenance and construction cost estimation, empowers transportation agencies to make more informed, cost-effective decisions. By leveraging detailed datasets and tailored predictive analytics, planners can accurately forecast maintenance needs, optimize scheduling, and estimate project costs with greater precision. This approach not only enhances budget planning and resource allocation but also extends the lifespan of infrastructure and leads to more efficient use of public funds.

#### VII. Promote connectivity between and among connected vehicles, roadway infrastructure, pedestrians, bicyclists, the public, and transportation systems.

SMART METRO's systems integration and integrated data platforms enable rapid scenario analysis and evidence-based planning. Streamlined data access and analysis reduces the resources needed for project evaluation and planning. Comprehensive, accessible data supports more effective, transparent, and accountable decision-making. All of this contributes to a more connected transportation system that benefits all roadway users.

#### VIII. Incentivize private sector investments or partnerships, including by working with mobile and fixed telecommunication service providers, to the extent practicable.

Continued strategic collaborations between public agencies and private sector partners drive innovation, attract investment, and boost economic growth in Broward and beyond. These partnerships bring additional expertise and resources, enabling more ambitious projects. Clear roles and shared leadership foster organizational commitment so that projects are well-supported and positioned for long-term success. SMART METRO enhances these partnerships through the sharing of resources and data.

#### IX. Improve energy efficiency or reduce pollution.

SMART METRO will enable continuous monitoring of roadway conditions to support proactive planning. Advanced analytics will also allow for the prediction of future traffic patterns, providing valuable insights for

both immediate response and long-term planning. By integrating these capabilities, transportation agencies can proactively manage congestion, improve safety, and support efficiency goals.

#### X. Increase the strength of the transportation system.

Hardening transportation assets against extreme weather and cyber threats is essential for ensuring continuous and safe operations. Proactive risk management minimizes service interruptions, maintains public trust, and enhances system reliability. By implementing robust protocols and strengthening infrastructure, SMART METRO can help partners achieve faster recovery from disruptive events. This capability will support informed planning and empower stakeholders to make decisions that account for the increasing frequency and severity of extreme weather events.

#### XI. Improve emergency response.

Enhanced protocols and hardened infrastructure enable faster recovery from disruptive events and improve emergency response. These measures not only minimize downtime and service interruptions but also help transportation systems remain strong in the face of challenges. SMART METRO can strengthen both operational procedures and physical assets to better protect public safety, maintain system reliability, and restore normal operations more efficiently and quickly after incidents occur.

#### **Any other information that may be relevant:**

The above responses capture the relevant information about the goals and desired outcomes for at-scale implementation of SMART METRO in line with IJA Public Law 117-58 Sec 25005 D(3)(ii).

## 2. Describe the communities that would be impacted by at-scale implementation. How does the project connect or expand access for underserved or disadvantaged populations? How were community stakeholders meaningfully involved in determining program benefits?

At-scale implementation of this project will deliver measurable benefits to Broward residents and beyond by enabling data-driven, coordinated planning across domains. Traditionally, planning professionals have relied on siloed datasets, models, and fragmented processes, which impedes cross-departmental collaboration and slows progress on critical community issues. Housing, land use, stormwater management, emergency management, and transportation data are often managed independently, despite their strong interdependencies in real-world scenarios. This separation limits the ability to generate complete solutions addressing complex planning needs, including crash reduction, jobs-to-housing balance, travel-time optimization, and infrastructure hardening in the face of increasing extreme weather events.

By integrating systems and connecting datasets and workflows across departments, BMPO, other entities or metropolitan planning organizations (MPOs) across the nation can facilitate more robust collaboration among regional and local stakeholders. This approach supports advanced analytics, enabling more informed decision-making and targeted investments that align with community priorities, as well as state and federal mandates. Unified data environments empower planners to apply machine learning, predictive modeling, and geospatial analysis to deliver actionable insights for decision makers, that optimize outcomes, such as enhanced distribution of different transportation modes, more connected neighborhoods to jobs and essential services, and improved overall quality of life.

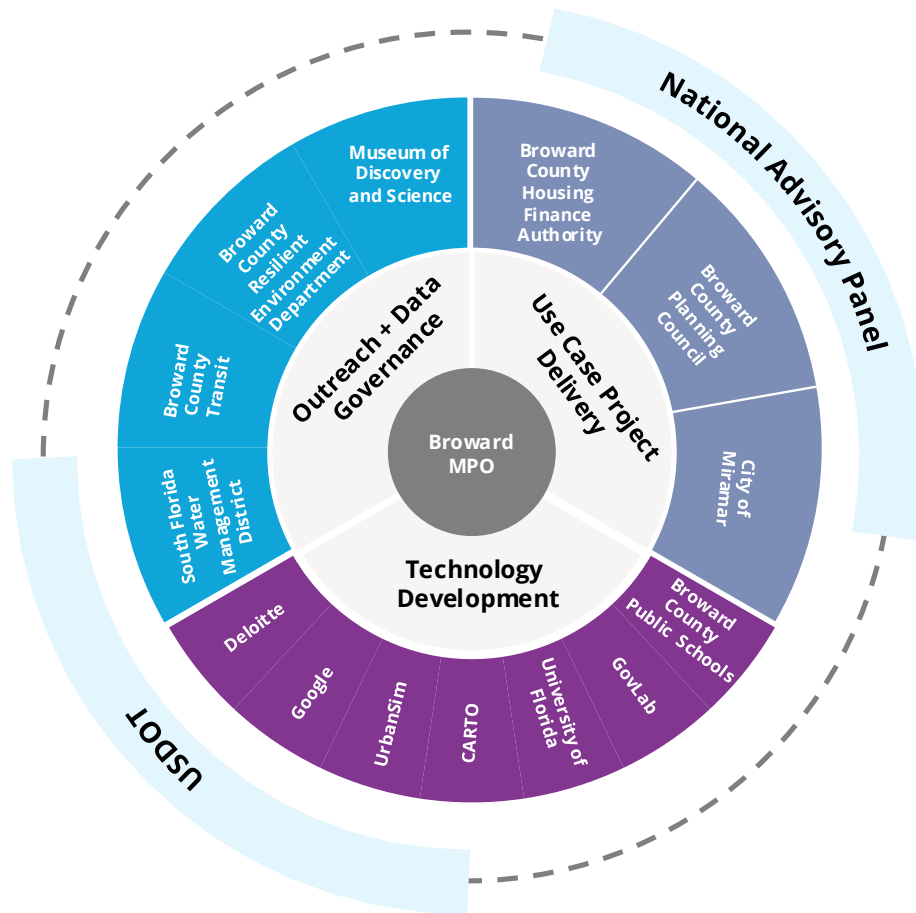


*Figure 9: Stakeholder kickoff event; December 4, 2024.*

At scale, current users, including the City of Miramar, Broward County, and BMPO, will continue leveraging SMART METRO to advance and manage their planning initiatives. As new use cases are identified, SMART METRO's extensibility will support onboarding additional users and datasets, further amplify its impact and fostering a data-centric culture across the nation.

MPOs are also strategically positioned to lead systems integration initiatives due to their role as critical connectors between local jurisdictions and state agencies. MPOs coordinate regional transportation planning, aggregating input from cities, counties, transportation partners (rail, freight, transit, etc.), and state departments of transportation to develop unified strategies for complex, cross-jurisdictional challenges.

Their established relationships and convening authority, combined with responsibility for managing federal and state transportation funding, enable MPOs to align diverse stakeholder priorities and facilitate robust data sharing. This integrative function allows MPOs to harmonize planning efforts across multiple governmental levels, creating a unified data environment that supports advanced analytics and evidence-based decision-making.



*Figure 10: Coalition of public, private, and academic stakeholders.*

To evaluate the programmatic benefits of SMART METRO at scale, BMPO leveraged its integrative role to assemble a multidisciplinary coalition of public, private, and academic partners. This collaborative approach enabled BMPO to gather expert input on implementation strategies, technology adoption, and data governance for SMART METRO, ensuring that the platform is robust, scalable, and adaptable to evolving needs.

### National MPO Collaboration

BMPO facilitated a collaborative process involving 15 MPOs from across the country, which together form BMPO’s broader community of practitioners. This community, hereby referred to as the National Advisory Panel, played a central role in shaping the design principles, technology implementation strategies, and data governance framework for SMART METRO. Importantly, the National Advisory Panel helped BMPO determine key factors for future performance, scalability, and program benefits, ensuring that SMART METRO can adapt to evolving needs and deliver sustained value. By actively participating in the process of determining program benefits, National Advisory Panel members validated that the platform would deliver meaningful outcomes for stakeholders and communities. National Advisory Panel members also shared best practices and lessons learned from their own technology deployments. Their input directly influenced SMART METRO’s approach to interoperability, scalability, and adaptability, ensuring the platform reflects the needs and priorities of diverse communities nationwide.

Participating MPOs included:



- Atlanta Regional Commission (ARC)
- Boston Region Metropolitan Planning Organization (CTPS)
- Capital Area Metropolitan Planning Organization (CAMPO)
- Chicago Metropolitan Agency for Planning (CMAP)
- Delaware Valley Regional Planning Commission (DVRPC)
- Denver Regional Council of Governments (DRCOG)
- Maricopa Association of Governments (AZMAG)
- Metropolitan Council
- Metropolitan Washington Council of Governments (MWCOG)
- Mid-Ohio Regional Planning Commission (MORPC)
- New Jersey Transportation Planning Authority (NJTPA)
- Rapides Area Planning Commission (RAPC)
- Sacramento Area Council of Governments (SACOG)
- Southern California Association of Governments (SCAG)
- Wasatch Front Regional Council (WFRC)

### Regional Stakeholder Engagement

Eight regional entities actively participated in developing and refining use cases for SMART METRO. These organizations validated datasets, ensuring that the data ingested into the platform was relevant and accurate for local needs. Their involvement helped shape the platform’s functionality to address real-world challenges in housing, transportation, education, stormwater management, and environmental management, and was instrumental in determining program benefits that reflect the priorities of Broward communities.

Regional stakeholders also advised on outreach and engagement strategies for broad community input. Through workshops, interviews, and working sessions, these entities helped prioritize features and capabilities that would deliver tangible benefits to Broward communities. Their feedback guided the development of tools for cross-agency data sharing, scenario analysis, and reporting, making SMART METRO a resource that is accessible and valuable to planners, decision-makers, and the public.

This multi-level engagement model confirms that SMART METRO’s program benefits are not only technically sound but also aligned with the priorities and needs of the communities it serves. The collaborative approach fosters transparency, inclusivity, and adaptability, positioning SMART METRO as a scalable solution for regional planning and decision-making.

Regional organizations included:

- Broward County Housing Finance Authority
- Broward County Planning Council
- Broward County Public Schools (BCPS)
- Broward County Resilient Environment Department
- Broward County Transit
- City of Miramar
- Museum of Discovery and Science (MODS)
- South Florida Water Management District

### Academic Partnership



Two academic institutions guided the data governance framework, tested SMART METRO capabilities, and provided feedback. Academic partners included:

- University of Florida
- New York University – The Governance Lab (GovLab)

#### Private Sector Contributions

Four private sector organizations provided technology development support, datasets, and AI infrastructure. These included:

- Google
- Deloitte
- UrbanSim
- CARTO

This coalition-driven approach helped SMART METRO's Stage 2 implementation be informed by a wide spectrum of expertise, facilitating scalable, data-centric planning and fostering innovation in urban analytics.

### 3. Describe the scale of the deployment in Stage 1 and the anticipated scale of an at-scale implementation. The measure of scale may vary by technology (e.g., the number of on-board units [OBUs], roadside units [RSUs], equipped intersections, partners with signed agreements, size/population of service area).

The SMART METRO vision was piloted through two Broward-based use cases: a redevelopment and land use planning use case in Historic Miramar (“Miramar”) and a use case aligning transportation and housing investments (“Development Coordination”). Demonstrating significant scale, these pilots engaged 26 regional and national partners and supported 14 active users on SMART METRO, highlighting broad collaboration and adoption.

Developed during the prototype Stage 1, these use cases integrate regional data and address complex challenges such as coordinating land use planning, transportation modeling, and development forecasting. By providing a unified platform for data integration and analysis, SMART METRO supports more informed, efficient, decision-making and collaborative regional planning.

This approach is fundamentally about scaling deployment and paving the way for Stage 2 full implementation. The scale of deployment will be represented not only by the growing number of use cases, but also by the expanding scope of SMART METRO’s capabilities. The Stage 1 use cases validate SMART METRO’s technical strengths and collaborative model, establishing a framework for increased participation and enhanced functionality.

BMPO will build on its Stage 1 use cases and introduce additional uses cases focusing on roadway safety, congestion management, and streamlining environmental documentation (e.g., NEPA) and other mandated MPO products. Stage 2 will enable SMART METRO to be implemented with a growing group of partners, including FDOT, and to further expand its capabilities. This progression from Stage 1 prototype to broader deployment demonstrates SMART METRO’s readiness for Stage 2 implementation at-scale, ensuring that the platform can meet the evolving needs of stakeholders and drive impactful outcomes across Broward and beyond.

## Use Cases

### Miramar

**Stage 1 Summary:** In Stage 1, the project concentrated on analyzing transportation infrastructure within the Historic Miramar Redevelopment area. Miramar, a city of more than 140,000 residents and 31 square miles, is the fourth largest city in Broward. The redevelopment program, covering over 3 square miles on the Miramar’s western edge, will include several hundred thousand square feet of new development. This public-private endeavor has already seen over \$20 million of investment from the City. In Stage 1, key analytic activities included evaluating congestion impacts and assessing flooding risks, with a particular focus on how these factors directly affect transportation access and level of service. These analyses provided a foundational understanding of the existing transportation network, its vulnerabilities, and the interplay between land use and infrastructure performance in the region.

**Stage 1 Key Questions:** What are the development’s impacts on adjacent roadways? How will the development be impacted by future flooding?

**Stage 2 Summary:** Stage 2 will expand the project’s scope by actively involving the Florida Department of Transportation (FDOT) as a strategic partner. Leveraging FDOT’s sensor data and technical expertise, the initiative will enhance its capacity to monitor and manage transportation infrastructure, especially around the

Historic Miramar Redevelopment. This phase will prioritize integration of FDOT’s I-75 roadway and managed lanes infrastructure, enabling real-time data collection and operational insights.

By connecting state-level transportation data with municipal planning efforts, the project will facilitate seamless, multi-jurisdictional collaboration. This vertical integration will support comprehensive, real-time analysis of traffic patterns, infrastructure reliability, and incident response, resulting in coordinated solutions that address both local, regional, and statewide transportation needs.

**Stage 2 Key Questions:** What are the development’s impacts on FDOT’s I-75? What modifications to the managed lane system could address these impacts? How could changes to land use help mitigate these impacts?

**Stakeholders:** City of Miramar, FDOT District 4

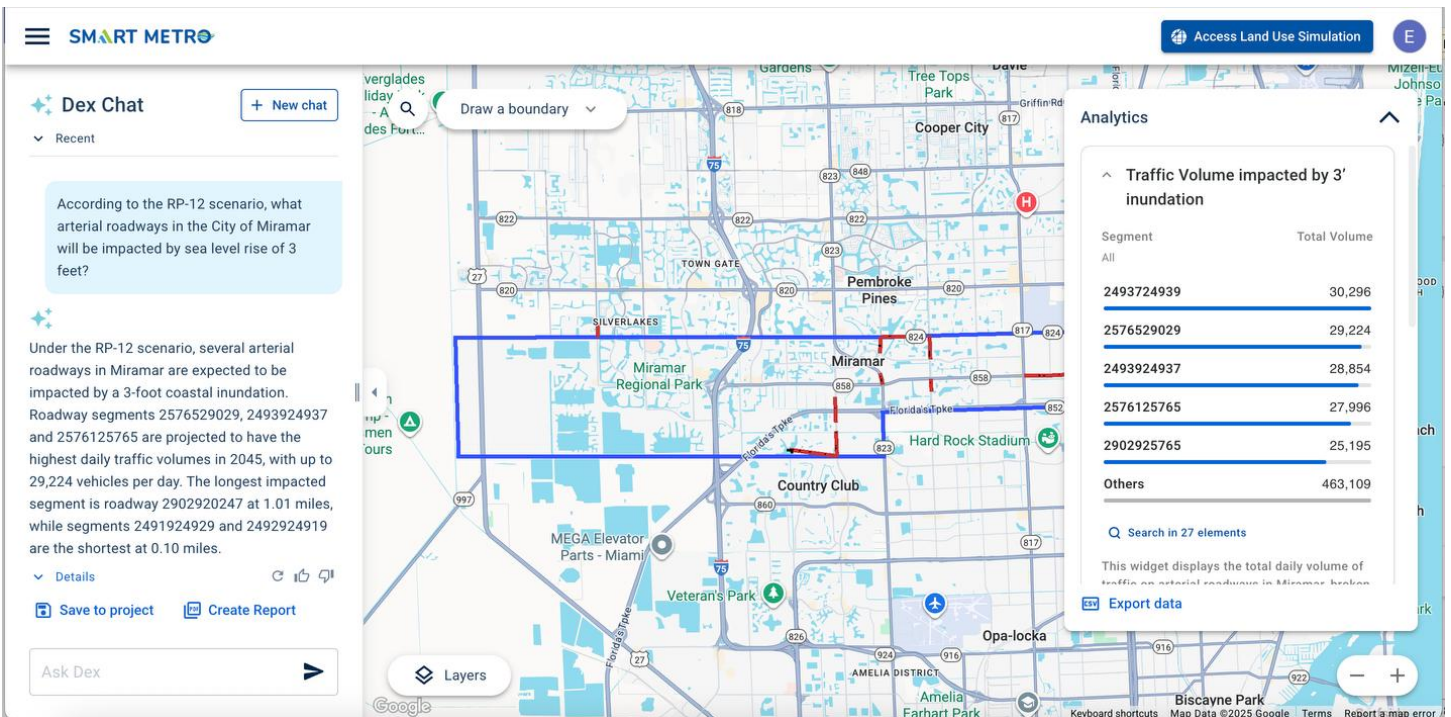


Figure 11: Screenshot from SMART METRO’s user interface showing the response to a question: “According to the RP-12 scenario, what arterial roadways in the City of Miramar will be impacted by sea level rise of 3 feet?”.

**Development Coordination**

**Stage 1 Summary:** In Stage 1, the use case centered on the relationship between rezoning, risk identification, and existing transportation infrastructure throughout Broward. Broward has a population of almost two million residents, making it the second most populous county in Florida after Miami-Dade. BMPO studied the entire 1,300-square-mile area to assess current and planned transit network (based on a recently adopted surtax-funded transit premium transit plan) and identified opportunities for improved connectivity. Data collection focused on mapping transportation assets and understanding baseline transportation accessibility by mode in Broward. Initial collaboration with agencies was established, laying the groundwork for integrating transportation modal considerations into early planning decisions.

**Stage 1 Key Questions:** What routes in the planned transit network and development areas are hardened to extreme weather risk? What are the impacts of rezonings around select planned infrastructure?

**Stage 2 Summary:** Stage 2 will expand and deepen the transportation-focused analyses begun in Stage 1. The project will enhance the quality of transportation and land use data and extend the geographic scope to capture a broader range of corridors and development opportunities. A major emphasis will be placed on involving Broward County Transit so that jobs-to-housing relationships and transit accessibility are fully integrated into site selection and planning. By leveraging improved datasets and fostering broader collaboration, Stage 2 will deliver more precise, actionable insights to guide and incentivize development that is strategically connected to public transportation infrastructure and essential services.

**Stage 2 Key Questions:** Where can Broward County site housing? What are the impacts of future transportation infrastructure on cost of living?

**Stakeholders:** Broward County Housing Finance Authority, Broward County Transit, Broward County Planning Council

#### Safety

**Stage 2 Summary:** By leveraging additional capabilities and data from FDOT, SMART METRO will also be able to analyze and address roadway safety concerns. This collaborative use case emphasizes data-driven planning, interagency coordination, and efficient decision-making. Integrating proven methodologies will help planning decisions remain forward-looking and tailored to the unique needs of the region.

**Stage 2 Key Questions:** Where are Broward County's hot spot areas? What proven safety countermeasure will increase roadway safety in Broward's hot spot areas? How can data and predictive analytics be leveraged to shift from a reactive focus on crash hotspots and locations to a proactive approach that prevents crashes through informed countermeasures and system improvements?

**Stakeholders:** FDOT District 4

#### Congestion Management

**Stage 2 Summary:** By leveraging additional capabilities and data from FDOT, SMART METRO will also be able to analyze and address roadway congestion. This collaborative use case emphasizes SMART METRO's AI that will allow agencies to actively manage roadway congestion through real-time traffic adjustments and event-based rerouting. This will also transform the BMPO's congestion management process by identifying problem areas and optimizing transportation modes and operational solutions.

**Stage 2 Key Questions:** Where are Broward County's most congested areas? How can FDOT increase roadway capacity, rerouting and better manage events in the transportation network?

**Stakeholders:** FDOT District 4

#### Transportation Planning Process

**Stage 2 Summary:** Stage 2 will explore additional capabilities for SMART METRO to streamline MPO processes and automate reporting, reducing time and resources required to update long range plans, Transportation Improvement Program, required reporting, and project analyses, such as NEPA.

**Stage 2 Key Questions:** What specific processes and requirements currently create the greatest inefficiencies in updating plans and project analyses? How can SMART METRO's AI and analytics be designed to automate these tasks while ensuring accuracy, compliance and usability for decision-makers?

## Technology Advancements

To implement these use cases, SMART METRO will require additional technological capabilities. BMPO is vendor agnostic and will seek to identify the tools best suited to meet the needs of the expanding use cases and growing user base. For example, when SMART METRO is at-scale, it will incorporate AI-driven evaluation of crash characteristics, weather conditions, roadway design, and surrounding land uses to proactively identify high-risk locations. By analyzing these factors, SMART METRO can predict where future crashes may occur and recommend data-informed interventions and FHWA's proven safety countermeasures, ranging from infrastructure improvements to operational or policy changes, to enhance safety and reduce risk.

Greater functionality will include:

- **Dynamic Virtual Environment:** SMART METRO will evolve beyond a simple 2D geographic information system (GIS) map and aim to adopt a robust 3D model. The value of a 3D model extends far beyond visualization or immersion, as it provides essential spatial context and reveals relationships between places. By layering information about people and infrastructure onto this model, it creates a comprehensive view of how entities interact. Ultimately, the user experience of engaging with a 3D model could lead to better-informed decision-making.
- **Advanced Simulation:** The next phase will prioritize the integration of simulation tools to further enhance the planning process and streamline workflows for all stakeholders. This expansion will include travel demand simulation, allowing users to model and forecast how changes in infrastructure, land use, or policy will influence travel patterns across the region. Regardless of the specific simulation tool used, enabling a more seamless and efficient approach to running and prompting scenarios will significantly improve overall effectiveness and provide a more integrated experience for planners, analysts, and decision-makers.
- **Integration with Standard Applications:** SMART METRO will have the capability to address standard needs, such as NEPA applications and other replicable processes.

With this implementation, SMART METRO can become a planner's assistant to support planners by applying domain-specific knowledge. SMART METRO integrates into the planning process by providing a planning assistant that provides a link between the database and the planning agent's natural language prompts queried in the chat feature. SMART METRO pulls data from the database and provides that data to the planning agent in real-time so that the planning agent can make better informed decisions.

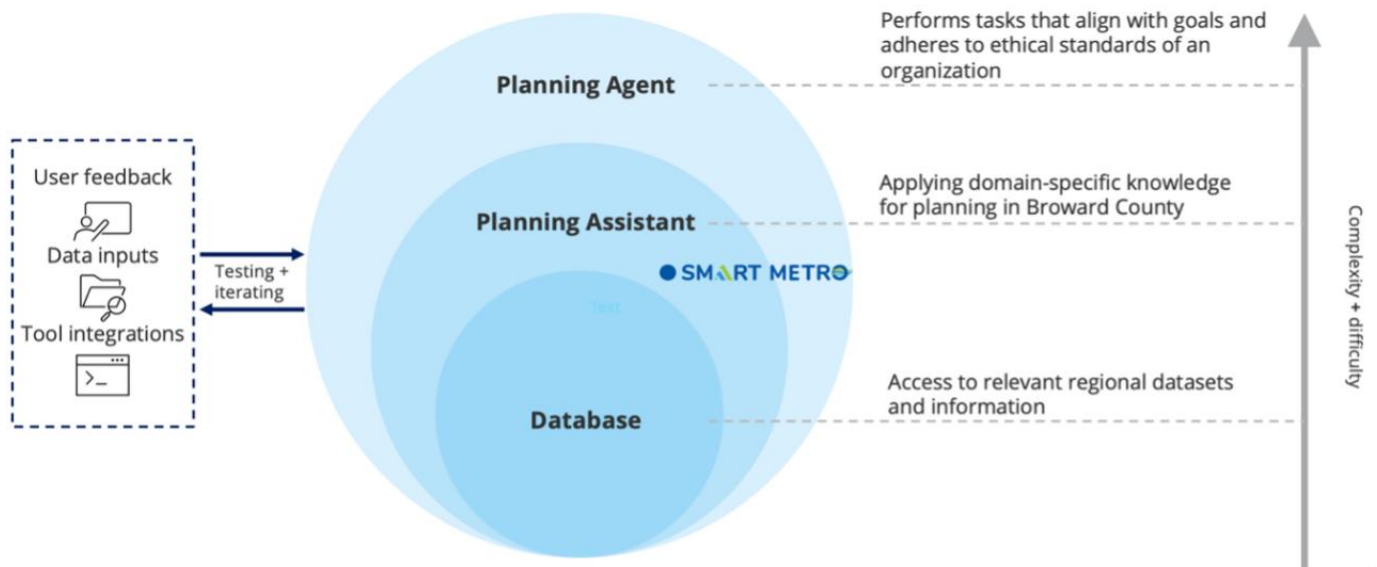


Figure 12: The evolution of AI in planning.

### Business Model

During Stage 2, BMPO will also focus on developing and standing up a business model that enables long-term operations and maintenance of SMART METRO. This will involve:

- **Governance:** Researching and benchmarking operating and governance models that have successfully maintained shared technology assets. BMPO will establish a governance structure that best aligns with SMART METRO’s mission, activities, and goals, while also identifying the roles, responsibilities, and training materials needed to support it in the long term. These operational structures will support SMART METRO beyond USDOT funding.
- **Financing:** Establishing a financing mechanism for SMART METRO users is essential for long-term success. By assessing market demand and available resources, the project can design a membership-based funding model that generates consistent revenue beyond initial grant support. This approach not only diversifies funding streams and encourages private commercialization, investment, and engagement. Over time, a well-structured membership model can serve as a reliable external funding source, supporting ongoing operations, maintenance, and future enhancements for SMART METRO. Additionally, this model can be tailored to accommodate different types of users and partners, ensuring flexibility and scalability as regional needs evolve.

### Geographic Expansion

BMPO is committed to exploring opportunities to expand SMART METRO beyond Broward County, demonstrating its replicability in diverse regions with varying conditions. During Stage 2, BMPO will focus on identifying and engaging potential partners for expansion, leveraging lessons learned and proven capabilities to support broader regional planning initiatives.

- **Neighboring Counties:** Neighboring counties such as Palm Beach and Miami-Dade present immediate opportunities for integration. These areas share similar transportation and housing challenges, and planners already collaborate on regional initiatives. Extending SMART METRO to these counties would foster a truly regional approach, enabling coordinated planning, data sharing, and unified scenario modeling across

county lines. This would enhance mobility, resource allocation, and infrastructure hardening for the entire South Florida region.

- **Distant Regions:** BMPO will also consider expansion into distant regions with different demographic, political, and physical contexts, such as Salt Lake City, Utah, and the Region 1 Planning Council in Illinois. These areas prioritize technological advancement and face unique planning challenges. Replicating SMART METRO in such locations would validate its adaptability and value, showcasing its ability to address a wide range of regional planning needs. By tailoring the platform to local requirements and integrating region-specific data sources, SMART METRO can support informed decision-making and strategic investment in diverse environments.

Through these expansion efforts, BMPO aims to position SMART METRO as a scalable, flexible solution for regional planning, capable of driving innovation and collaboration across geographic boundaries.

## 4. Summarize the project activities you have engaged in during Stage 1. The description should summarize the information provided in the quarterly reports, including key milestones accomplished, partners engaged, and outcomes described.

SMART METRO is designed to leverage data science, geospatial analytics, advanced AI, and simulation technologies to deliver actionable insights and address critical challenges. The expected outcomes include:

- **Establishing an Integrated Digital Twin Platform:** Develop a scalable proof-of-concept that integrates transportation, land use, demographic, and extreme weather data to support informed, outcome-based investment decisions.
- **Leveraging Advanced Analytics and AI Technologies:** Utilize data science, geospatial analytics, AI, and simulation tools to enable in-depth analysis and scenario modeling, addressing critical infrastructure, social, and environmental challenges.
- **Supporting Data-Driven Decision Making:** Provide a platform for stakeholders to assess and compare investment strategies, enabling the allocation of resources toward the most effective and sustainable outcomes.

Following USDOT’s outlines a systems engineering life cycle model known as the Vee Model, BMPO completed all necessary steps, from requirements gathering to system validation and maintenance, beginning with a clear definition of the system.

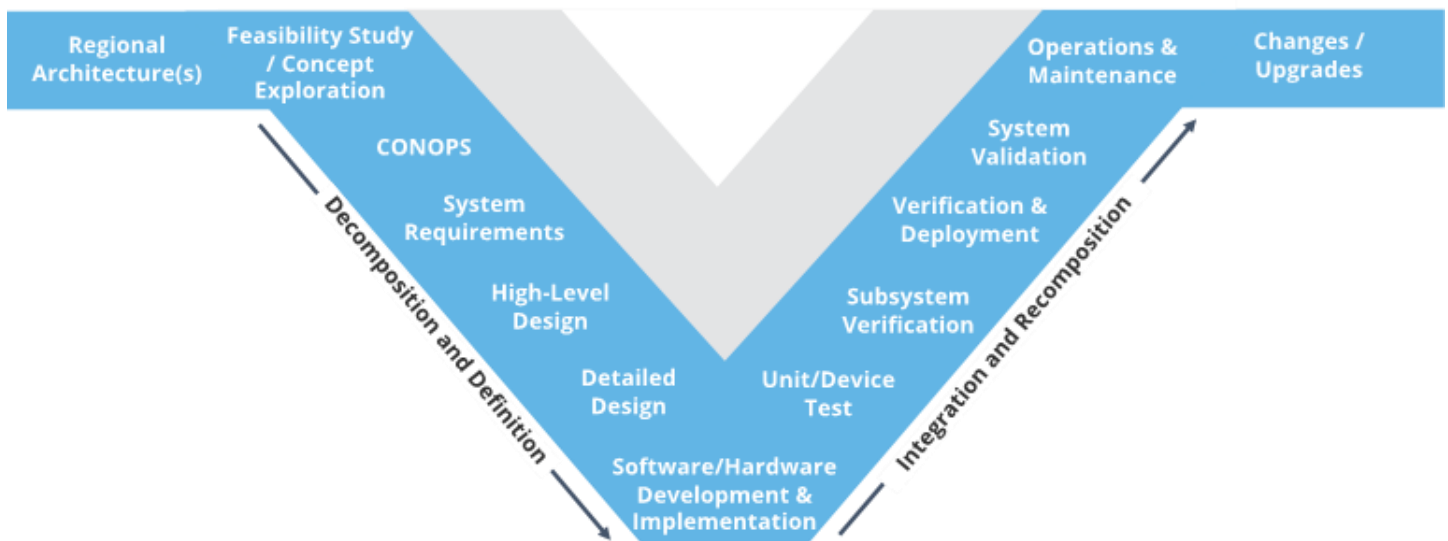


Figure 13: Vee Model.

Prior to Stage 1, BMPO began shaping SMART METRO’s design and governance strategy, initiating systems architecture, vendor evaluation, and stakeholder engagement to lay the groundwork for successful application. Key activities included developing the systems architecture, conducting vendor evaluations, and engaging stakeholders – critical steps for successful data collection and project implementation throughout the grant term. BMPO also planned two stakeholder working sessions, executed under Stage 1, and identified core technology partners. Additionally, BMPO sent invites for the regional and national working groups.

The project staff planned and executed the first stakeholder workshop, bringing together MPO leaders from across the country to provide feedback on new AI-enabled geospatial analysis features. Following the workshop, BMPO

distributed surveys to gather further insights, established two working groups, and conducted a thorough vendor evaluation to identify core technology partners.

BMPO then defined high-level capabilities focused on data management and analytics and scoped the platform's design. This included gathering both functional and non-functional requirements so that the platform would meet stakeholder needs and project objectives.

During Q2, BMPO deepened stakeholder engagement. The project staff held briefings with regional partners, confirming key questions and expectations for the use case projects. BMPO and the City of Miramar also participated in the BBC's Transforming Cities documentary, sharing insights on SMART METRO. The documentary played a pivotal role in sharing the story behind this important work, raising awareness of the challenges faced and the solutions proposed. By highlighting these experiences, it helped engage other organizations encountering similar issues, fostering collaboration and encouraging the exchange of ideas and best practices.

BMPO also initiated technology development. The SMART METRO prototype was then developed using Agile methodology for flexibility, rapid delivery, and continuous improvement. The Agile approach allowed for platform development to occur iteratively, prioritizing features based on their value to the project.

Key principles of Agile methodology include:

- **Iterative Development:** The process included breaking down the project into smaller, manageable parts and developing them in cycles. This approach allowed for change adaptation and continuous improvement.
- **Prioritization:** Features and capabilities were prioritized based on their value. It allowed the most critical functionalities to be developed first. These included a data management structure, analytics capabilities, and a simulation component.
- **Stakeholder Involvement:** Regular feedback from stakeholders was crucial. Frequent review sessions with regional and national stakeholders furthered alignment with future vision and requirements. Training was also conducted in a phased approach with an emphasis on Human-in-the-Loop (HIL) methodology.
- **Continuous Improvement:** The process included continuous improvement through regular user feedback loops, optimizing the flow of work and enhancing efficiency.

SMART METRO was built under a two-week sprint cycle, facilitating ongoing development, testing, and refinement. User testing incorporated feedback from BMPO, Broward County, and the City of Miramar, and will continue as the project advances to Stage 2. During this period, project staff set up the Google Cloud Platform (GCP) environment, began collecting and configuring data. Initial data acquisition incorporated land use datasets from Broward's 31 municipalities, flood prediction outputs from Broward County's MIKE hydrodynamic model, BMPO's travel demand model results, and other relevant sources. For each data need, BMPO prioritized the most current available datasets and enforced strict metadata standards, including comprehensive documentation of data provenance, schema, and update protocols, to facilitate ongoing data integration and future refreshes.

BMPO also finalized vendor scopes to enable integration of CARTO and UrbanSim capabilities. CARTO powers SMART METRO's mapping, data visualization, and spatial analytics functionalities. Through CARTO's integration, SMART METRO users can leverage advanced forecasting analytics and simulation capabilities. UrbanSim further enhances SMART METRO by enabling rapid simulation of planning scenarios. These scenarios can then be explored and analyzed in greater detail using the SMART METRO chat feature.

In Q3, BMPO made progress in both prototype development and stakeholder engagement. The project staff ingested more data into GCP, while initiating a GenAI LLM training to power prompt interpretation, document

querying, and visualization features. Additional data sources included documents hosted on the BMPO website, demographic data from the U.S. Census, and Broward County Transit’s PREMO plan.

The Data Exchange (DeX) module, a fully integrated capability powered by Gemini, serves as the platform’s core. DeX provides users with text responses and data through a natural language panel that allows users to pull data through a chat communication function, enabling collaborative insights and reporting, and the user interface was designed to integrate text, map layers, and data visualization using CARTO. The DeX module allows users to provide direct feedback on response quality and clearly informs them if SMART METRO is unable to generate an answer. Integration with UrbanSim began for scenario analysis, and project staff held working sessions with

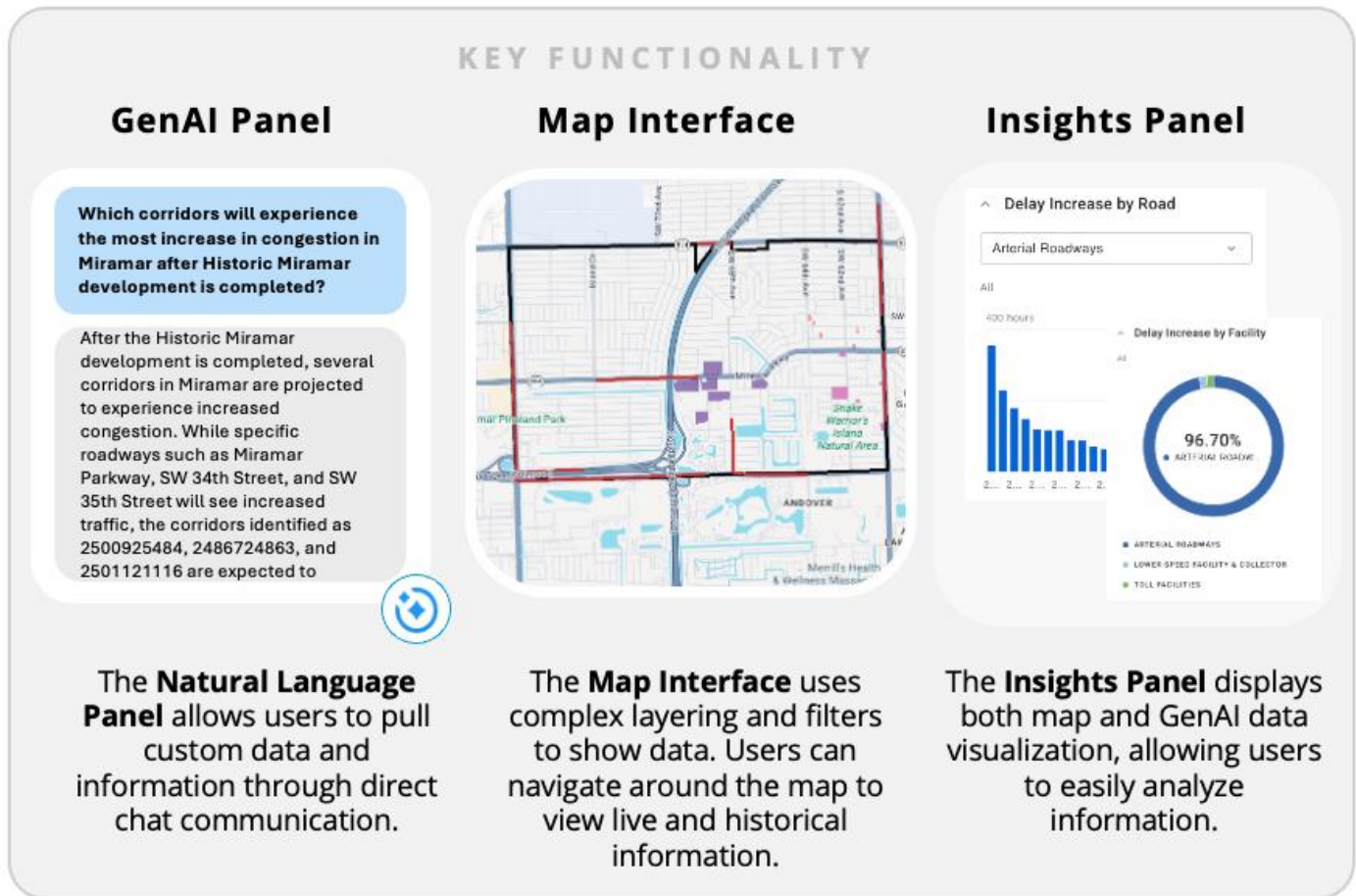


Figure 14: The SMART METRO user experience consists of three components: GenAI Panel, Map Interface, and Insights Panel.

national and regional partners to refine data governance and SMART METRO value.

Regional partners were trained on SMART METRO and provided Human-in-the-Loop (HIL) feedback, while the University of Florida conducted User Acceptance Testing (UAT) to validate improvements. This multi-factor validation from multiple rounds of testing provided valuable insights into the design and development of SMART METRO. This process was designed to determine whether the prototype was minimally viable. Before testing began, the project leaders and participating testers collaboratively outlined expectations for the natural language panel, map interface, and insights panel. These standards were set so that, at a minimum, the prototype would align with existing process outcomes and, ideally, provide additional insights.

**System Testing:** The System Testing phase tests the functionality of the individual system modules (i.e., Project Repository, Data Repository) for reliability prior to full platform integration. During the System Testing phase,

the project staff defines test cases and validation criteria to assess system performance, executes these test cases, and documents the results. This phase also involves identifying and preparing the test data and logging defects, which are tracked until closure. The development iteratively prioritized defects so that the platform is reliable and functioning as designed. The output of this phase is a comprehensive test case and execution report.

**Integration Testing:** In the Integration Testing phase, the integration points of the system modules are tested, validating that the platform is working as designed. These test cases were executed, analyzed the results, and validated the data flow between integrated components. Additionally, project staff performed UrbanSim connection testing for all connected modules, and any integration issues are logged and addressed. Project staff iteratively addressed and prioritized defects so that the platform is reliable and functioning as designed. The output of this phase is a comprehensive test case and execution report confirming that all integrated components function seamlessly together.

**End-to-End Testing:** The End-to-End Testing phase focused on developing and executing comprehensive test scenarios that mirrored BMPO's key business processes. This verified that the system performed as expected across all workflows, from initial data input to final analysis and reporting. Project staff validated end-user scenarios and workflows, conducted regression testing so new changes do not disrupt existing functionality, and documented any deviations from expected outcomes. The development staff iteratively addressed and prioritized defects so that the platform is reliable and functioning as designed. The output of this phase is a comprehensive test case and execution report, confirming end-to-end workflows are operating as designed.

Start your training journey by testing **master prompts**. Once comfortable, use the following standards to **generate unique prompts**:

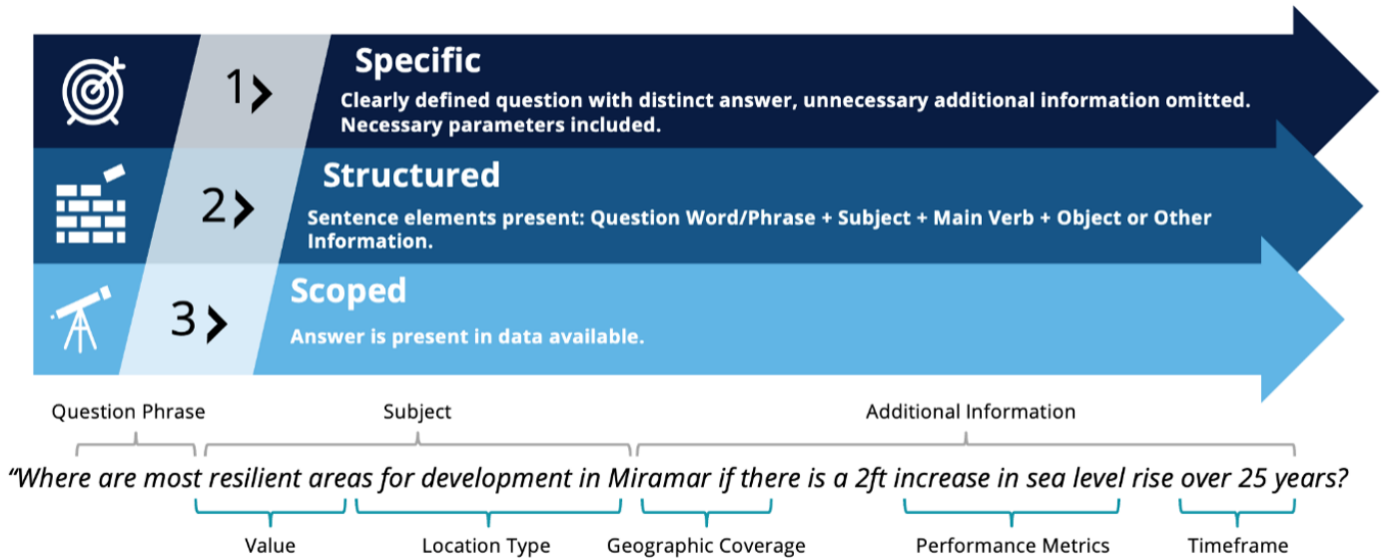


Figure 15: BMPO trained initial users to craft GenAI prompts that instruct the system to generate responses.

		Comments		
	Pass/Fail	Text	Map	Analytics
1	Pass	The text gets a little confusing when you read it. The prompt references "Miramar Redevelopment Plan." The response references MITAC, but that isn't really identified on the map. I assume it is the purple, but that needs to be shown in a legend. Additionally, from the response, I do not understand if the TOC is part of MITAC or something separate. Are the 83.5 acres (MITAC) separate from or included in the 439.7 acres (TOC)?	I assume the map outlines the TOC, but that is not reflected in the map legend. Only in reading the text do I get a hit at what the outline is. Additionally, the purple/pink/orange blocks are not identified.  What I expected to see was an outline of the Redevelopment Plan Area, with any sub-areas identified within the boundary.  It would be more useful to show the Flood Zones in the FEMA color code rather than randomly generated colors.  Blue Zones: These are the 1% annual-chance zones. Orange Zones: These are 0.2% annual-chance zones. ETC.	The analytics colors (orange/yellow/blue) do not reference anything you see on the map.
2	Pass	Odd phrasing of the prompt. Typically, the phrasing would be something more like "What flood zones are in Miramar?" "What type of flood zones are in Miramar?"		The colors for each flood zone change every time I ask the prompt. A consistent color coding would be beneficial. One of the responses had all the flood zones as the same color (or at least indistinguishable to my eye).
3	Fail	Reference data not matching the WordDoc. Odd phrasing of the prompt. I am not sure what we are asking to judge the response. The Data/Documents used are different from those listed in the WordDoc.	There is no legend to explain what the colors mean. Historic Miramar is in the prompt, but the City of Miramar is outlined on the map; the Historic area isn't identified at all. The prompt is specific to Miramar, but the map shows all of Broward County. The Dex Layers urbanism redevelopment base comparison doesn't make sense; it could be because the layer is only shown in red (see P3).	The analytics refer to the Miramar District. But, the map shows the county and Miramar. The "district" isn't identified at all.
4	Fail	Reference data not matching the WordDoc. The phrasing of the response is very technical and mentions 364 hours of delay.	Historic Miramar Boundary is inaccurate. The purple/pink/orange blocks are again shown by not identified.	Road segment numbers (such as 2486724863 with 364 delay hours) mean nothing. The arterial vs toll display doesn't tell anything as it relates to the prompt.
5	Pass	The text is a word salad. There is no explanation of what the RP-12 scenario is or where it comes from.	The majority of the impact is shown over existing bodies of water. There needs to be some cleanup so that the impacts on the land areas are identified.	The ranking vs depth area doesn't tell me anything. The depth column says count, but count of what?
6	Pass	The text references traffic volumes when the prompt didn't mention anything about traffic.	Not sure why the SERPM layer comes on. The layer comes on as red and looks like the roadways with the issues. When you look deeper, the roadways shown in black are the ones impacted. Very confusing.	Again, the Analysis shows a column for Total Volume but doesn't specify the volume of what, and the segments are just long numbers that are meaningless. The Total Arterial Roadway Miles analytics shows 35.3 miles of road impacted, and that isn't showing on the map.
7	Pass	No Comment	Not sure why transit and PREMO layers come up.	Did not develop any analysis. It would be nice to reference the text and show on the map.

Figure 16: Sample from feedback received from BMPO users.

User Acceptance Testing (UAT): During the UAT phase, BMPO evaluated test execution reports. After project staff addressed any issues, BMPO verified that each test case met validation criteria, reported any rejections, and confirmed acceptance. This phase concluded with BMPO approval and Stage 2 SMART grant application in parallel with national demonstrations. To aid BMPO in the UAT process, the University of Florida participates with UAT test cases. The University of Florida’s expertise confirms that functional and technical requirements are met.

The table below shows how UAT was documented and the feedback that was received. The researchers from the University of Florida validated whether SMART METRO met requirements and performed as expected. UAT is used so that models, user interfaces, and data pipelines deliver actionable results and integrate with anticipated workflows. Tests were developed based on how BMPO anticipates using SMART METRO.

Test Steps	Expected SQL	Acceptance Criteria	Actual Results	Pass or Fail?
<p>1. Select NEW CHAT and start a new Dex chat.</p> <p>2. Enter the prompt: "WITH SQL Where will greatest population density be in 2045?" into Dex chat.</p> <p>3. View generated response in the Dex chat panel, map panel, and analytics panel.</p>	<p>UrbanSim Results Sample (Table)</p> <p>Data Trust: High (100%), Reliability: High (86%)</p> <p>Broward County Cities Boundary (Table)</p> <p>Data Trust: High (100%), Reliability: Med (75%)</p> <p>Miramar Community Snapshot (PDF)</p> <p>Wastewater Master Plan (PDF)</p> <p>2020 Census Summary (PDF)</p> <p>Data Reliability: High (94%)</p> <p>BrowardWest Amendment PC 21-1 PH 7A (PDF)</p> <p>Community Change Snapshot (PDF)</p> <p>Data Reliability: High (93%)</p> <p>Florida Estimates of Population 2024 (PDF)</p> <p>Revisit &amp; Update Mobility Hubs Program (Website)</p> <p>CONTEXT (Website)</p> <p>Data Reliability: High (97%)</p> <p>Data Reliability: High (95%)</p> <p>Data Reliability: High (96%)</p> <p>Travel Demand Model Support (Website)</p> <p>Data Reliability: High (96%)</p> <p>Highway Vehicle Trips (Table)</p> <p>Miramar Development Projects 2024 Parcel (Table)</p> <p>BrowardWest Amendment PC 21-1 PH 7A (PDF)</p> <p>Data Reliability: High (94%)</p> <p>Wastewater Master Plan (PDF)</p> <p>Miramar Historic Drainage Phase IV (PDF)</p> <p>Miramar Community Snapshot (PDF)</p> <p>Data Reliability: High (97%)</p> <p>Community Change Snapshot (PDF)</p> <p>City of Miramar (Website)</p> <p>Complete Streets Master Plan (Website)</p> <p>Broward County Streets Advisory Committee (CSAC) Meeting (Website)</p> <p>CONTEXT (Website)</p> <p>Field Visit Findings (Website)</p> <p>Data Reliability: High (100%)</p> <p>Miramar Development Projects 2024 Parcel (Table)</p> <p>NOAA Sea Level Rise (Table)</p> <p>Historic Miramar Boundary (Table)</p> <p>Data Trust: High (92%), Reliability: High (77%)</p> <p>BrowardWest Amendment PC 21-1 PH 7A (PDF)</p> <p>Wastewater Master Plan (PDF)</p> <p>FOOT Resilience Action Plan - State Highway System (PDF)</p> <p>Miramar Historic Drainage Phase IV (PDF)</p> <p>Data Reliability: High (96%)</p> <p>Data Reliability: High (97%)</p> <p>Extreme Weather and Climate Change Risk to the Transportation System in</p>	<p>1. Response generated includes project population density in Miramar 2045.</p> <p>2. Response generated includes references to how information was derived (UrbanSim simulation projecting residential statistics)</p> <p>3. SQL query is generated. Expected SQL (exact match OR if SQL is different, a similar, close equivalent query is generated).</p> <p>4. References generated match Expected References, or include equivalent References.</p> <p>5. Data trust score is included for each data table in References. Data relevancy is included for each data source in References.</p> <p>6. SQL query is generated, GenAI layer(s) are generated and the layer is relevant to projected population density.</p> <p>7. If SQL query is generated, relevant widgets are generated in the GenAI Insights tab.</p>	<p>SELECT t1.geo_level_id, t1.household_population_density_acres, ST_ASTEXT(t1.geom) AS geom, t1.city_name, gsp_npr-0000424-011325-diamond-NOAA_Sea_Level_Rise AS t1 INNER JOIN us-con-gsp-npr-0000424-011325-diamond-Broward_County_Cities_Boundary AS t2 ON ST_INTERSECTS(t1.geom, t2.geom) WHERE t1.year = 2045 AND t1.geo_level = 'block_group' ORDER BY t1.household_population_density_acres DESC LIMIT 1</p> <p>OR</p> <p>SELECT t1.geo_level_id, t1.household_population_density_acres, ST_ASTEXT(t1.geom) AS geom, t1.city_name, ST_ASTEXT(t2.geom) AS geom, t2 FROM us-con-gsp-npr-0000424-011325-diamond-UrbanSim_Results_Sample AS t1 ON ST_INTERSECTS(t1.geom, t2.geom) WHERE t1.year = 2045 AND t1.geo_level = 'block_group' ORDER BY t1.household_population_density_acres DESC LIMIT 1</p>	<p>pass</p>
<p>1. Select NEW CHAT and start a new Dex chat.</p> <p>2. Enter the prompt: "WITH SQL Where will most congested corridors be in Miramar after historic Miramar development completes?" into Dex chat.</p> <p>3. View generated response in the Dex chat panel, map panel, and analytics panel.</p>	<p>Highway Vehicle Trips (Table)</p> <p>Miramar Development Projects 2024 Parcel (Table)</p> <p>BrowardWest Amendment PC 21-1 PH 7A (PDF)</p> <p>Data Reliability: High (94%)</p> <p>Wastewater Master Plan (PDF)</p> <p>Miramar Historic Drainage Phase IV (PDF)</p> <p>Miramar Community Snapshot (PDF)</p> <p>Data Reliability: High (97%)</p> <p>Community Change Snapshot (PDF)</p> <p>City of Miramar (Website)</p> <p>Complete Streets Master Plan (Website)</p> <p>Broward County Streets Advisory Committee (CSAC) Meeting (Website)</p> <p>CONTEXT (Website)</p> <p>Field Visit Findings (Website)</p> <p>Data Reliability: High (100%)</p> <p>Miramar Development Projects 2024 Parcel (Table)</p> <p>NOAA Sea Level Rise (Table)</p> <p>Historic Miramar Boundary (Table)</p> <p>Data Trust: High (92%), Reliability: High (77%)</p> <p>BrowardWest Amendment PC 21-1 PH 7A (PDF)</p> <p>Wastewater Master Plan (PDF)</p> <p>FOOT Resilience Action Plan - State Highway System (PDF)</p> <p>Miramar Historic Drainage Phase IV (PDF)</p> <p>Data Reliability: High (96%)</p> <p>Data Reliability: High (97%)</p> <p>Extreme Weather and Climate Change Risk to the Transportation System in</p>	<p>1. Response generated includes most congested corridors in Miramar after Historic Miramar development completes.</p> <p>2. Response generated includes references to how information was derived</p> <p>3. If SQL query is generated, it matches Expected SQL (exact match OR if SQL is different, a similar, close equivalent query is generated).</p> <p>4. References generated match Expected References, or include equivalent References.</p> <p>5. Data trust score is included for each data table in References. Data relevancy is included for each data source in References.</p> <p>6. If SQL query is generated, GenAI layer(s) are generated and the layer is relevant to projected development completes.</p> <p>7. If SQL query is generated, relevant widgets are generated in the GenAI Insights tab.</p>	<p>SELECT t1.Segment_Identifier, t1.AM_LOS_E_Capacity_Ratio, t1.OF_LOS_E_Capacity_Ratio, t1.PK_LOS_E_Capacity_Ratio, t1.Total_Vehicle_Hours_of_Delay, ST_Intersect(t1.geom, t2.geom) AS geom, t1.0000424-011325-diamond-Highway_Vehicle_Trips AS t1 INNER JOIN us-con-gsp-npr-0000424-011325-diamond-Historic_Miramar_Boundary AS t2 ON ST_INTERSECTS(t1.geom, t2.geom) WHERE t1.Year = 2045 ORDER BY t1.Total_Vehicle_Hours_of_Delay DESC LIMIT 10</p>	<p>pass</p>
<p>1. Select NEW CHAT and start a new Dex chat.</p> <p>2. Enter the prompt: "WITH SQL How could Historic Miramar developments be impacted by future sea level rise?" into Dex chat.</p> <p>3. View generated response in the Dex chat panel, map panel, and analytics panel.</p>	<p>Miramar Development Projects 2024 Parcel (Table)</p> <p>Data Trust: High (100%), Reliability: High (87%)</p> <p>NOAA Sea Level Rise (Table)</p> <p>Data Trust: High (90%), Reliability: High (87%)</p> <p>Historic Miramar Boundary (Table)</p> <p>Data Trust: High (92%), Reliability: High (77%)</p> <p>BrowardWest Amendment PC 21-1 PH 7A (PDF)</p> <p>Wastewater Master Plan (PDF)</p> <p>FOOT Resilience Action Plan - State Highway System (PDF)</p> <p>Miramar Historic Drainage Phase IV (PDF)</p> <p>Data Reliability: High (96%)</p> <p>Data Reliability: High (97%)</p> <p>Extreme Weather and Climate Change Risk to the Transportation System in</p>	<p>1. Response generated includes analysis for Miramar Development Projects impacted by a default sea level rise of 3.4</p> <p>2. Response generated includes references to how information was derived. Since no Miramar Development Projects are impacted by a future sea level rise of 3.4ft, the query should return no data. The level rise of 3.4ft is used to filter out irrelevant data.</p> <p>3. If SQL query is generated, it matches Expected SQL (exact match OR if SQL is different, a similar, close equivalent query is generated).</p> <p>4. References generated match Expected References, or include equivalent References.</p> <p>5. Data trust score is included for each data table in References. Data relevancy is included for each data source in References.</p> <p>6. If SQL query is generated, but GenAI layers are BLANK because no data was returned</p>	<p>SELECT ST_INTERSECTS(t1.geom, t2.geom) AS geom, t1.Acreage, t1.Area_Square_Feet, t1.Boundary_Length_Feet, t2.Relative_Sea_Level_Rise_Feet, t2.SLR_Zone_Acreage FROM us-con-gsp-npr-0000424-011325-diamond-Historic_Miramar_Boundary AS t1 INNER JOIN us-con-gsp-npr-0000424-011325-diamond-NOAA_Sea_Level_Rise AS t2 ON ST_INTERSECTS(t1.geom, t2.geom) WHERE t2.Relative_Sea_Level_Rise_Feet &gt; 3.4</p>	<p>pass</p>

Figure 17: Sample from feedback received from University of Florida.

**Human-in-the-Loop (HIL):** HIL Training is a machine learning and AI approach that integrates human expertise into the training and refinement process of models. This method combines the strengths of human judgment and machine efficiency to improve the accuracy, reliability, and performance of AI systems. Users provide feedback on DeX, and the project staff incorporated this feedback to train the model. Users also provided feedback on platform capabilities. The project staff incorporated this feedback beyond the prototype. The feedback group conducted training across three phases, in order for the GenAI model to continuously improve.

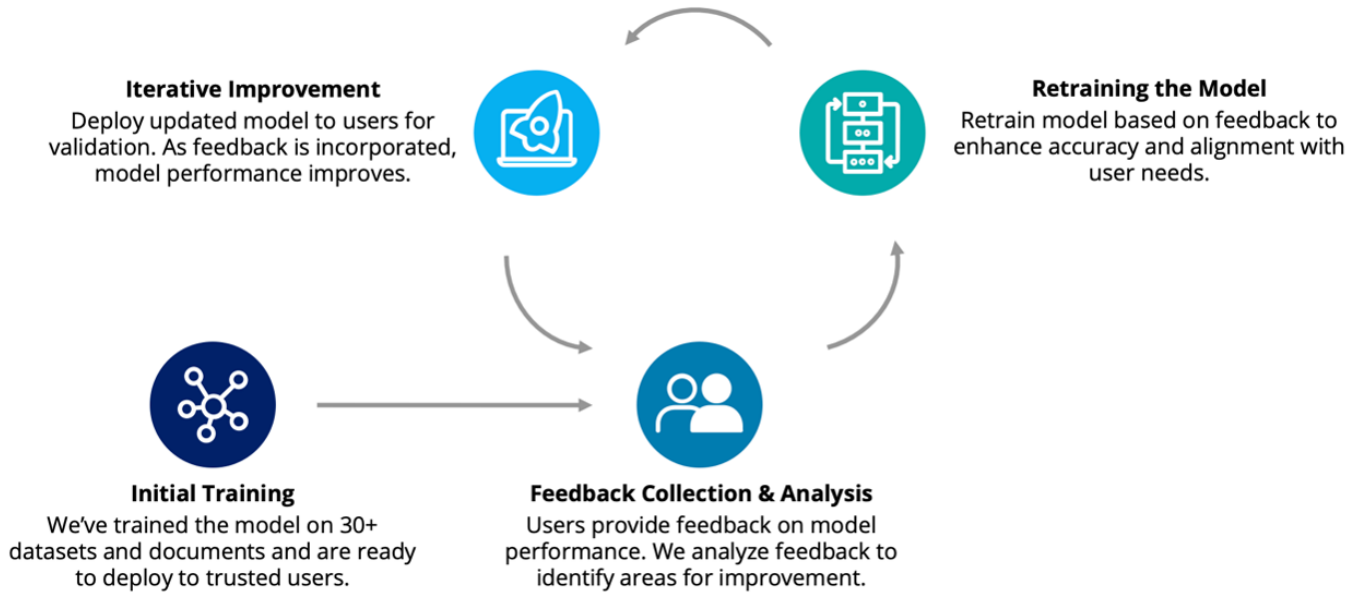


Figure 18: Users performed human-in-the-loop training so the GenAI model could continuously improve.

During Q4, BMPO focused on refining use case projects and advancing the prototype SMART METRO.

**Miramar:** The City of Miramar recently updated its land use code to accommodate higher density and incentivize investment in the Historic Miramar neighborhood. The site is prone to flooding and disconnected from Broward County Transit’s North-South bus routes, and the Miramar Innovation & Technology Village program does not include public transit upgrades to meet anticipated demand. The city wants to understand impacts of the proposed development on existing transportation infrastructure and whether the selected land uses meet their needs.

**Development Coordination:** To better coordinate transportation planning efforts, BMPO wanted to understand transportation and land use policies that best address housing and job opportunities for all residents. Effective planning integrated thinking and thoughtful actions by BMPO to decisions about which investments to prioritize.

Collaborating with stakeholders from the City of Miramar and Broward, the project staff identified and ingested additional data, validated prompts, and confirmed workflow components to better align with BMPO’s priorities. These validated prompts and their results indicate the delivery of an integrated digital twin platform that integrates transportation, land use, demographic, and extreme weather data to support informed, outcome-based investment decisions.

Use Case	Number	Prompt
Miramar	1	Provide details of the Historic Miramar redevelopment plan.
	2	What parts of Miramar are in different flood zones?
	3	What are the expected demographic consequences for population density in Miramar following the Historic Miramar redevelopment in the year 2050?
	4	Where will the most congested corridors in Miramar be after Historic Miramar development is completed?
	5	According to RP-12 scenario, how could future flooding of more than 3' impact the City of Miramar?
	6	According to the RP-12 scenario, what arterial roadways in the City of Miramar will be impacted by flooding of 3 feet?
Development Coordination	7	How does Broward define housing affordability?
	8	Where is there housing by municipality in Broward County?
	9	Where are the housing developments in Broward County that are currently in the flood zones?
	10	Where are the most hardened areas to site housing in Broward?
	11	What will be the most hardened areas for siting Premium Mobility transit (PREMO)?
	12	Considering the scenario of Premium Transit and up-zoning, what impact would this scenario have on residential prices around 1 mile from proposed stations?

Table 1: Table of validated master prompts.

Scenario modeling integration with UrbanSim was advanced, with baseline and projected models designed, tested, and uploaded to SMART METRO. Continuous prototype testing and UAT by regional partners and the University of Florida led to iterative enhancements and bug fixes. The quarter culminated in a comprehensive demonstration of the prototype SMART METRO to the USDOT’s Office of the Secretary Subject Matter Experts (SME) group, with ongoing refinement of the narrative and incorporation of feedback.

Results:

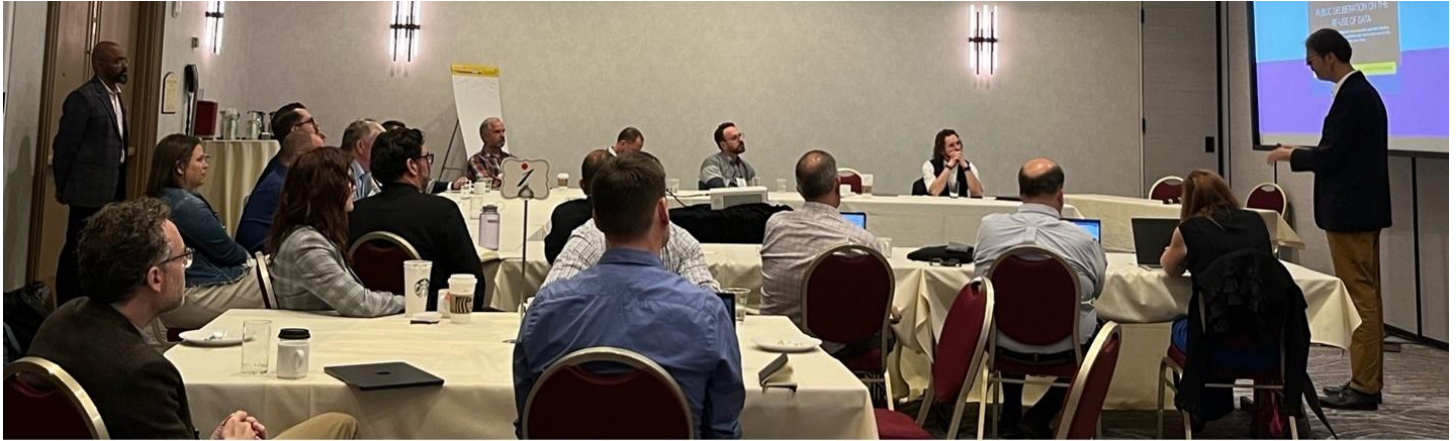
The SMART METRO prototype successfully delivered a regional digital twin through systems integration, enabling comprehensive planning and cost-effective evaluation of transportation challenges, resulting in the following accomplishments:

- Reduced planning process time by 50% through unified systems that directly expedite data collection, reviews and approvals, scenario modeling, statistical analysis, and report generation.
- Cost savings because of more efficient contracting and earlier project delivery.

## SMART METRO

- Improved planning with automated reporting, advanced analytics, and real-time scenario modeling.
- Piloted projects to demonstrate coordinated land use and development.

**5. What attention has this project gained, if any? Were any media stories published? Was the project discussed in any conference presentations or academic articles? Has information from the project been published such as data or best practices reports?**



*Figure 19: Working session with MPO representatives at the 2024 AMPO Conference.*

Prior to kicking off the grant, BMPO coordinated a working session with representatives from MPOs around the country at the 2024 Association of Metropolitan Planning Organizations (AMPO) Annual Conference in Salt Lake City, Utah. Participants learned about the possibilities of AI in planning and started to shape some of the use cases that would eventually become the focus of BMPO’s Stage 1 effort.

SMART METRO has generated significant interest among local stakeholders, including city officials and municipal departments, who recognize the platform’s potential to enhance planning, decision-making, and service delivery. City leaders are eager to leverage SMART METRO’s integrated data and analytics to address pressing challenges such as transportation efficiency and development approvals. FDOT District 4 has also expressed interest in becoming a partner in Stage 2 and ultimately implement SMART METRO.

Outside of the region. Other MPOs and Regional Planning Councils (RPCs) have expressed support for the platform’s collaborative approach and scalable architecture. These organizations see SMART METRO as a valuable AI-enabled tool for fostering cross-jurisdictional coordination, sharing best practices, and driving data-informed policies and decisions across regions. The growing enthusiasm among both current and prospective users underscores the platform’s relevance and positions SMART METRO as a catalyst for innovation and partnerships.

# SMART METRO

The project was the subject of an episode of the BBC Transforming Cities series. Transforming Cities is a collection of documentaries that explore how cities around the world are adapting to the challenges and opportunities of the 21st century. The series highlights innovative approaches to urban planning and technology, including how cities are reimagining themselves to improve quality of life for residents.

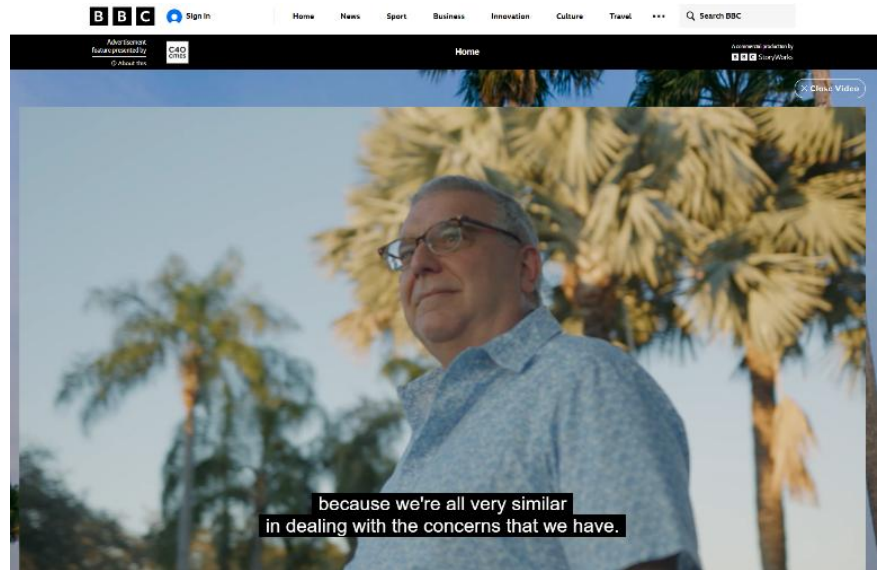


Figure 20 (Left): Behind-the-scenes shot of Greg Stuart, BMPO Executive Director, during filming; Figure 21 (Right): Screenshot of video posted on BBC's website.

SMART METRO was the primary subject on a panel at the Google Cloud Next 2025 Conference. The session focused on how urban planners have harnessed the power of geospatial systems and AI Scenario Planning to explore vast amounts of complex transportation data quickly, using simple natural language queries.



Figure 22: Melissa McConnell, Deloitte; Andrew Riddle, BMPO; and Reymund Dumlao, Google, at the Google Cloud Next Conference in April 2025.

Representatives from BMPO and the City of Miramar also presented at this year's National Association of Counties Conference. The panel shared a demonstration of SMART METRO and answered a series of questions about data governance, identifying technology partners, and funding mechanisms for this type of work.

The BMPO will lead a panel and working session at the upcoming 2025 AMPO Annual Conference in Providence, Rhode Island. Entitled “AI Agents in Action: Reshaping Transportation Planning with Digital Twins & Experts' Insights into AI Innovations in Transportation”, the session will provide participants with a comprehensive understanding of how SMART METRO leverages AI and Digital Twin technologies to transform transportation. The session will highlight practical applications, governance considerations, and collaborative opportunities to accelerate the development of efficient and future-ready transportation systems.



*Figure 23: Greg Stuart, BMPO Executive Director; Yvette Colbourne, Vice Mayor of the City of Miramar and BMPO Board Chair; Anant Dinamani, Deloitte Principal; and Margaret Moore-Jackson, CIO of Rockdale County, Georgia at NACo on July 12, 2025.*

**6. Note any major deviations or changes from the original proposal.**

There were no major deviations or changes from the original proposal for Stage 1 of SMART METRO.

## **7. Discuss your findings on the performance of your proof-of-concept or prototype. The description should include data on the performance metrics for the proof-of-concept or prototype discussed in your Evaluation Plan. Your summary should include data limitations.**

As specified in the Evaluation Plan, BMPO established a series of criteria to guide the development of the SMART METRO prototype. Data was collected in alignment with these criteria to assess system performance and integration capabilities.

### **How quickly could a dataset be integrated?**

**Main Result:** SMART METRO has demonstrated significant flexibility and speed in data integration, successfully onboarding 146 datasets, 37 manual documents, and 31,536 website documents. This showcases the platform's ability to handle diverse data sources efficiently.

**Approach:** The time required for dataset integration varies based on data format, quality, and complexity. In practice, the prototype phase revealed that new datasets could be ingested and made available for analysis almost instantly, particularly when data adheres to standardized formats. This rapid integration is facilitated by automated ingestion pipelines and standardized data formatting protocols, which streamline the onboarding process and minimize manual intervention.

SMART METRO's integration capabilities are measured not only by the speed of individual dataset onboarding but also by the overall volume and diversity of datasets successfully integrated. During targeted use case initiatives, data collection and cleansing remained resource-intensive, especially when dealing with disparate or unstructured sources. Quality assurance guardrails, a set of automated, pre-defined rules and validation checks that are built directly into the data integration pipeline to automatically protect the quality of the data in the system, were implemented to maintain data integrity throughout the process.

**Findings:** SMART METRO Stage 1 prototype has ingested 146 datasets, 37 manual documents, and 31,536 website documents, totaling approximately 11GB. The platform's data integration framework supports both structured (tabular) and unstructured data, enabling scalable and robust data management. These results underscore SMART METRO's ability to rapidly integrate diverse datasets while maintaining high standards for data quality and compatibility in accordance with the Data and Trust Alliance and internal BMPO data maintenance priorities.

### **How compatible are my results with the observed data?**

**Main Result:** SMART METRO's outputs demonstrate strong compatibility with observed data, with final accuracy metrics pending completion of ongoing validation efforts. This compatibility is essential for ensuring the reliability of analyses produced by the platform.

**Approach:** Output accuracy is assessed by systematically comparing SMART METRO's results to established validation datasets. This evaluation process helps the system's analyses align with real-world observations and supports confidence in the platform's predictive and analytical capabilities. The approach includes both quantitative accuracy checks and qualitative assessments of result consistency.

Validation efforts involve submitting a range of prompts and queries to SMART METRO, then benchmarking the generated outputs against reference datasets. The process is iterative, with continuous refinement based on feedback from domain experts and stakeholders.

**Findings:** To date, 12 master prompts have been tested and validated within SMART METRO, providing a foundation for accuracy assessment. The Regional Working Group has submitted 134 unique prompts, enabling a broad evaluation of the system’s analytical performance. SMART METRO generated responses in an average of 40.67 seconds per prompt, demonstrating reliable responsiveness and effective user engagement. Ongoing validation will further quantify the accuracy and compatibility of SMART METRO’s outputs with observed data, supporting robust decision-making and scenario analysis.

## How effective is my solution?

**Main Result:** SMART METRO delivers substantial value through reduced costs and increased speed in data collection, scenario preparation, and analysis compared to legacy systems.

**Approach:** Effectiveness is evaluated by comparing the time and resources required for scenario preparation and analysis using SMART METRO versus traditional modeling platforms. Metrics include total hours spent, direct costs, and the speed of generating actionable insights. The assessment focuses on quantifiable improvements in workflow efficiency and resource allocation.

The comparative analysis involves tracking scenario development cycles across multiple municipalities, measuring reductions in manual effort, and calculating associated cost savings. The approach also considers scalability, examining how SMART METRO’s efficiencies translate when adopted across larger networks or regions.

**Findings:** Preliminary analysis shows that full adoption of SMART METRO by all 31 municipalities could yield annual savings encompassing both time and cost reductions. These savings result from streamlined scenario preparation, faster analysis turnaround, and decreased reliance on manual processes. The findings highlight SMART METRO’s potential to deliver significant operational and financial efficiencies at scale, supporting broader adoption and sustained impact in urban planning and decision-making.

## How scalable is my solution?

**Main Result:** SMART METRO’s scalability is evidenced by its successful application to both micro-level and macro-level community challenges, demonstrating its ability to efficiently evaluate a wide range of alternatives.

**Approach:** Scalability and adaptability are assessed by tracking the number and diversity of studies and use cases supported by SMART METRO. This evaluation highlights the platform’s ability to inform planning decisions across different geographic scales and functional domains. Metrics include the range of community sizes, types of challenges addressed, and the complexity of scenarios managed.

The approach also considers SMART METRO’s technical architecture, which enables rapid onboarding of new use cases and seamless expansion to additional municipalities or regions. The platform’s modular design supports incremental growth without compromising performance or analytical rigor.

**Findings:** SMART METRO has contributed to two initial use cases:

- **Miramar:** Focused on local development impacts, demonstrating effectiveness in micro-level planning and scenario analysis.

- Development Coordination: Addressed countywide housing and transportation siting, illustrating capability in macro-level, multi-jurisdictional planning.

These applications showcase SMART METRO’s versatility and scalability, confirming its suitability for a broad spectrum of planning contexts and its potential for wider adoption across varied communities and regions.

## How engaged are people with the solution?

**Main Result:** Engagement with SMART METRO is measured by the number of stakeholders and users actively interacting with the platform, offering valuable insight into the scope and level of participation.

**Approach:** Engagement is quantified by tracking both individual users and organizations involved in the development, deployment, and ongoing use of SMART METRO. Metrics include the number of organizations represented, frequency of platform interactions, and diversity of stakeholder groups. This approach enables a comprehensive understanding of user adoption and collaborative involvement.

The evaluation considers participation in platform development, scenario analysis, feedback sessions, and training activities. Stakeholder engagement is also measured by the extent of contributions to use case development and the integration of user feedback into platform enhancements.

**Findings:** To date, 30 stakeholders have participated in the development of SMART METRO. This cohort includes 15 MPOs from across the United States and 8 regional or local entities, demonstrating broad-based interest and collaborative engagement. The diverse representation reflects strong buy-in from both regional and local planning bodies, supporting the platform’s continued evolution and relevance to a wide range of users.

## How well does the system engage workforce development?

**Main Result:** SMART METRO functions as an effective workforce development tool, fostering skills development, training, and knowledge enhancement among current and future professionals.

**Approach:** The impact of SMART METRO on workforce development is evaluated through direct input and collaboration with workforce development organizations. This includes gathering feedback on the platform’s utility for training, its ability to enhance relevant technical and analytical skills, and its integration into educational and professional development programs. The approach emphasizes ongoing dialogue so that SMART METRO’s capabilities align with evolving workforce and industry needs.

Key aspects assessed include:

- Relevance of platform features to workforce skill requirements
- Opportunities for hands-on training and scenario-based learning
- Integration of SMART METRO into curricula and professional development initiatives

**Findings:** Four regional workforce organizations have been actively consulted during SMART METRO’s development:

- Broward County Planning Council
- Broward County Public Schools
- Museum of Discovery and Science
- University of Florida

These collaborations have provided valuable insights into workforce needs and have helped shape platform features to support skills development. Ongoing engagement with these organizations will continue to inform curriculum development, ensuring that training programs remain aligned with industry trends and future workforce requirements. This proactive approach positions SMART METRO as a catalyst for preparing the next generation of planners, analysts, and decision-makers.

## 8. How has the proof-of-concept or prototype met the original expectations stated in the project proposal?

As outlined in BMPO’s SMART grant Stage 1 proposal, SMART METRO original expectations were:

- **Establish Common Standards and Data Protocols:** The platform will establish a shared set of standards, data protocols, and tools that can be applied across multiple planning and operational applications.
- **Immediate Use and Future Adaptability:** The digital twin will support present transportation modeling requirements and be able to adapt to the evolution of future use cases, emerging technologies, and AI simulation.
- **Workforce Development Tool:** SMART METRO will become a workforce development tool, enabling regional education partners to expose students to real-world scenarios in transportation systems and prepare them to use data analytics and tools to assess the complex interaction among transportation, public health, and the environment. We are also asking partners for feedback and ideas for expanding SMART METRO functionality to serve their workforce development needs. SMART METRO will also make it possible to analyze and improve access to jobs.

The prototype SMART METRO has met these original expectations in the following ways:

ID	Table Name	Table Description	Modified	Creation Date	Upload Date	Uploader	Columns	Rows	Source
10	BSAP_Collision_Data	The table 'BSAP_Collision_Data' ...	7/30/2025 by Ra...	5/8/2025	5/8/2025		59	316688	new Sr
1004	Broward_County_Data_2019	The boundary line for the count...	4/15/2025 by Ad...	2/16/2025	4/15/2025	Admin	16	1	US Cer
1012	Flood_Risk_Major_Transit_Hubs	Flood risk areas for major transi...	4/15/2025 by Ad...	2/24/2025	4/15/2025	Admin	3	2	FDEP
1017	Highway_Vehicle_Trips	Modelled vehicle trips for 2015 ...	4/15/2025 by Ad...	3/5/2025	4/15/2025	Admin	64	69753	Browar
1020	Land_Surface_Temperature	This table provides the land surf...	4/15/2025 by Ad...	3/4/2025	4/15/2025	Admin	6	105346	Browar
1021	Miramar_Development_Projects...	Historic Miramar Redevelopmen...	7/16/2025 by Ma...	2/11/2025	4/15/2025	Admin	9	8	City of
1026	Miramar_Storm_Drainage_Lines	The locations and types of drain...	4/15/2025 by Ad...	2/26/2025	4/15/2025	Admin	6	1124	Miram:
1054	Broward_MTP_Resilience_Road...	Resilience Score geodatabase t...	6/6/2025 by Avin...	5/8/2025	5/8/2025	Dilip Hiremath	6	21	Browar
15	Inland_Flooding_Scenario_RP12...	Table represents the RP-12 sce...	6/12/2025 by Bro...	4/30/2025	5/27/2025	Naveen Juvva	3	60468	Browar
1014	Flood_Risk_Sewage_Facilities	Flood risk areas for sewage faci...	4/15/2025 by Ad...	2/24/2025	4/15/2025	Admin	3	94	FDEP
1027	Miramar_Streets	Geographic locations for all stre...	4/15/2025 by Ad...	2/12/2025	4/15/2025	Admin	18	4882	City of

Figure 24: Screenshot from SMART METRO’s data repository.

(On a scale of 0 -100, 0 being untrustworthy)

Criteria	Description	Score 0	Score 100
<b>Source</b>	Reliability of data origin	Data comes from unreliable or unknown origin	Data sourced from highly reputable and trustworthy origin
<b>Metadata</b>	Information about data itself	Data lacks metadata or has incomplete and unclear metadata	Data has comprehensive, clear, and detailed metadata
<b>Accuracy</b>	Correctness of data	Data is highly inaccurate and contains many errors	Data is highly accurate and free from errors
<b>Completeness</b>	All columns filled in	Data is significantly incomplete, missing many necessary elements	Data is fully complete with all necessary elements present
<b>Timeliness</b>	Relevance of data in terms of time it was collected	Data is outdated and no longer relevant	Data is up-to-date and highly relevant

Table 2: SMART METRO’s Data Trust Score helps to establish transparent data trust reporting.

BMPO accomplished this by establishing a source that allows planning entities to share widely accepted data seamlessly. This approach hinges on data trust and security. As part of SMART METRO’s GenAI Quality Assurance, Data Trust Scores (DTS) are generated using methodologies from the Data and Trust Alliance. DTS is a metric that quantifies confidence in the quality and reliability of a dataset. This score is displayed in the 'References' section following each response to a user's prompt, helping users assess the trustworthiness of the data sources used. This scoring system offers a standardized method to assess and convey the quality of data utilized in AI systems. It aids in making informed decisions, supports regulatory compliance, promotes ethical AI practices, and fosters trust among users and stakeholders. By investing in mechanisms to evaluate and enhance the DTS, organizations can greatly improve the efficiency and dependability of their AI applications.

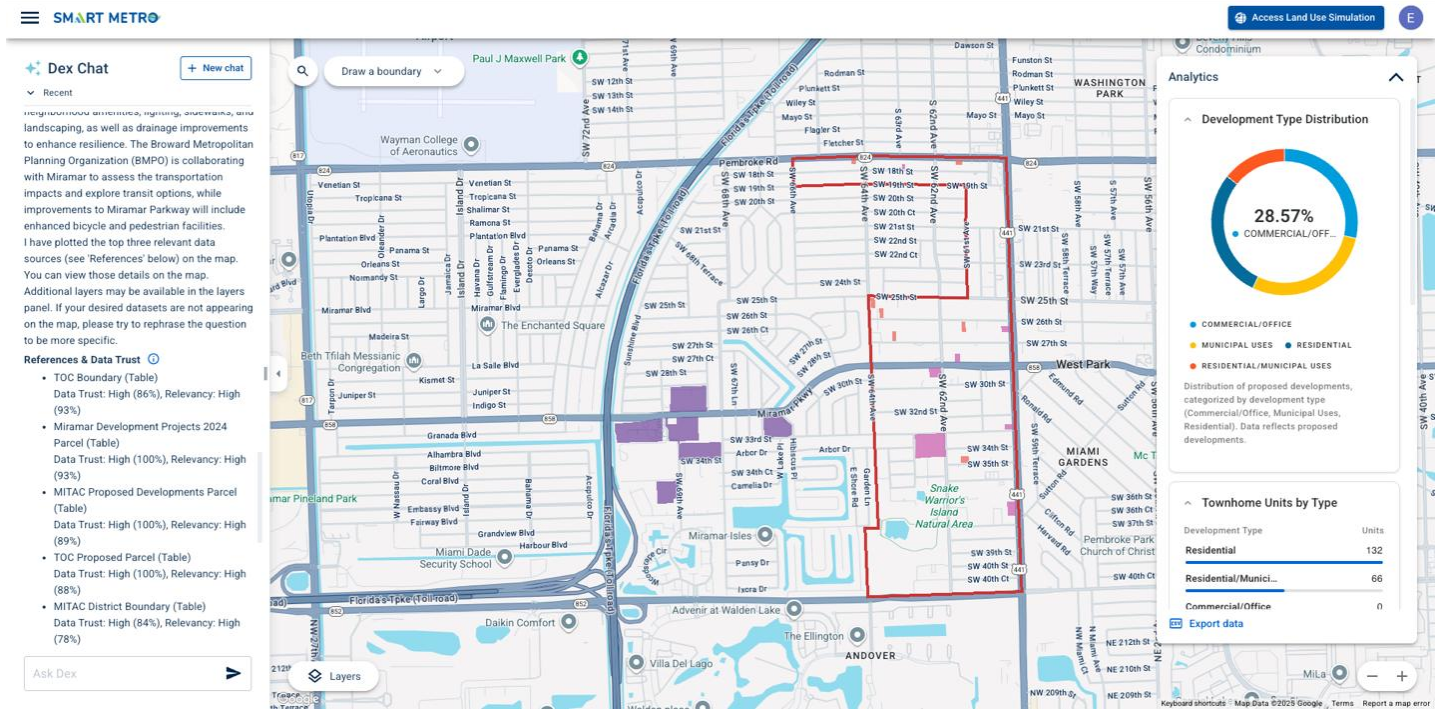


Figure 25: SMART METRO’s Data Trust Score reveals below the DeX Chat prompt response.

The DTS is calculated using a comprehensive evaluation of several key criteria, each rated on a scale from 1 to 10. These criteria create a robust assessment of the data's quality and trustworthiness. By systematically scoring each criterion, the DTS provides a standardized approach to evaluate and communicate the quality of data used in AI systems, supporting informed decision-making, and enhancing trust among users and stakeholders. SMART METRO is one step closer to providing the public with access to real-time integrated traffic, transit, and multimodal transportation information to make informed travel decisions.

### Immediate Use and Future Adaptability

True to its mission, SMART METRO integrates multiple data sources and modeling systems to enable comprehensive analysis and actionable insights. The platform is designed to efficiently handle large-scale data and seamlessly exchange inputs and outputs across diverse software environments. By combining advanced AI techniques, including simulation and forecasting, BMPO has enhanced SMART METRO’s planning capabilities. While forecasting uses historical data and statistical models to predict future trends, simulation creates a virtual model to explore potential, realistic scenarios and outcomes. GenAI democratizes access to reliable insights, empowering all stakeholders to make data-driven decisions.

SMART METRO’s “plug-and-play” modules facilitate scalability and adaptability as requirements and technology evolve. They are self-contained components that can be easily added, removed, or updated without breaking the entire platform. Advanced models serve as the system’s core intelligence, dynamically modeling variable interactions over time to support informed decision-making. They are the complex engines that perform simulations and forecasts. The platform is also software agnostic, emphasizing the importance of integrating disparate systems. Users do not have to abandon existing tools. Instead, SMART METRO acts as a central hub capable of connecting to and pulling data from these systems, regardless of the vendor or technology. Unified data and processes foster collaboration, improve decision quality, and drive better outcomes. The cloud-based data ecosystem provides robust security, high performance, and compliance with stringent standards.

# SMART METRO

A very important feature of the platform on bringing together data into one place is that it allows users to upload new datasets and start interacting with them right away. This goes through the processes so that the data is checked and validated. As soon as the file is uploaded, the platform’s pipeline automatically performs a series of checks.

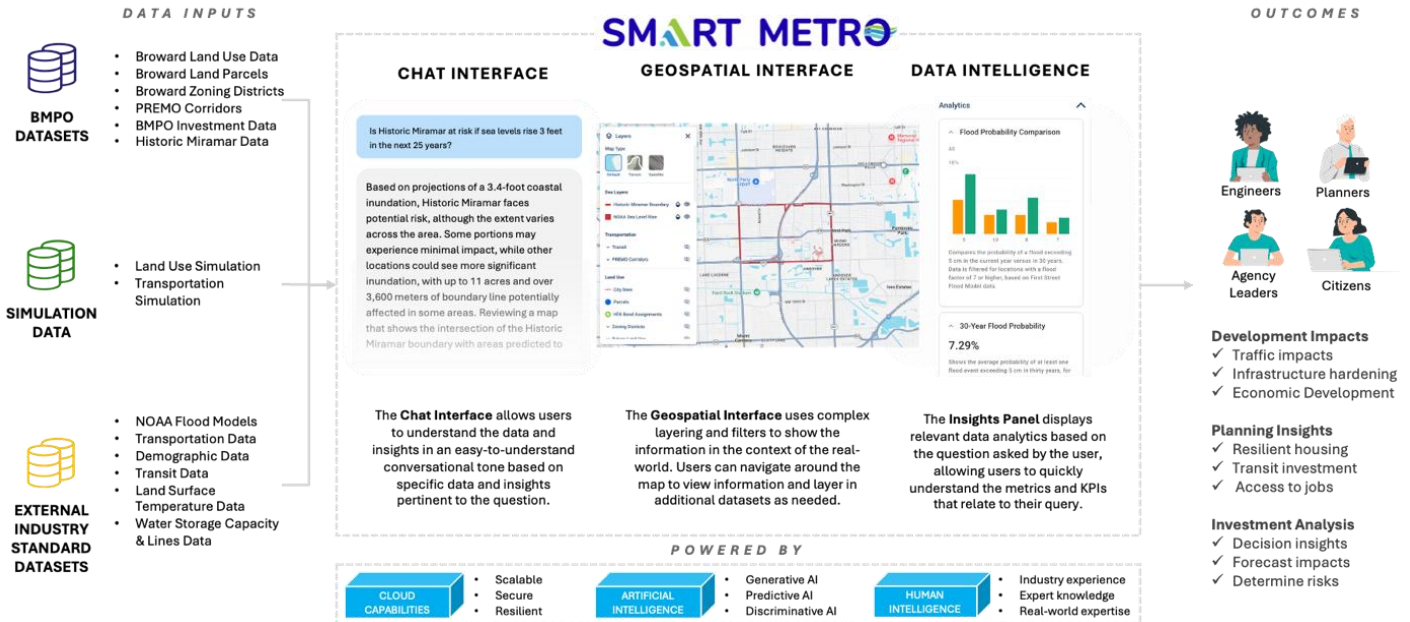


Figure 26: A systems integration approach brings it all together.

Ultimately, SMART METRO’s AI adoption is at its infancy, but it can evolve with AI advancements to better serve BMPO and partners. SMART METRO is capable of expansion and primed to become more deeply integrated into transportation planning processes with additional inputs.

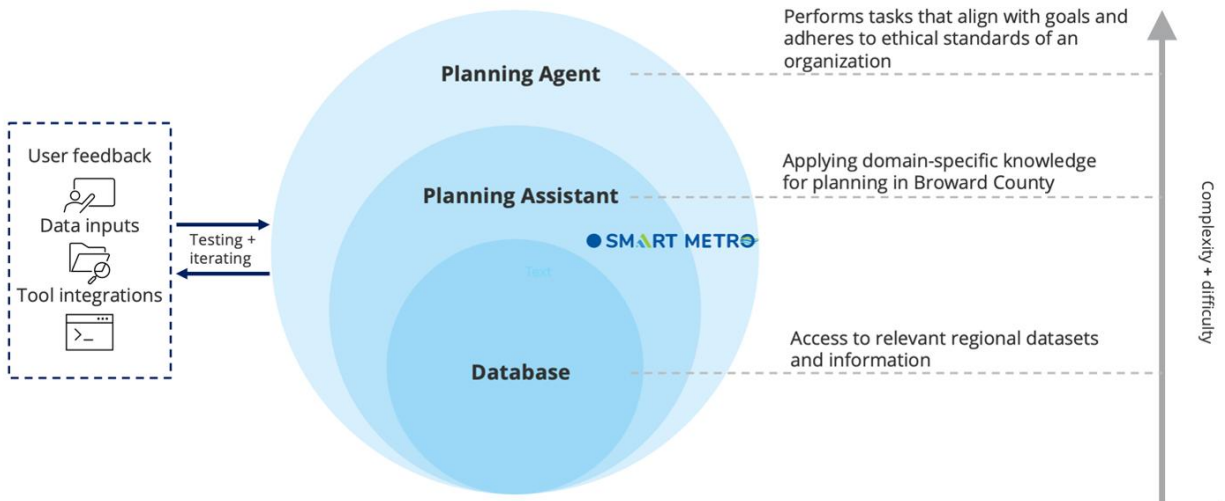


Figure 27: SMART METRO can evolve with Stage 2 resources and advanced AI technology.

During Stage 1, BMPO prioritized engagement with regional and local stakeholders who influenced workforce development in Broward. These partners were consistently involved and consulted, driving the development of SMART METRO. A Regional Working Group included representatives from agencies across the county, including members from BCPS and MODS. Both BCPS and MODS are actively seeking ways to reduce barriers and improve access to jobs and education.

Feedback from Dr. Lisa Milenkovic, a Regional Working Group member and BCPS's STEM and Computer Science Supervisor, reinforced the platform's value for students. She provided valuable student perspectives and insights into successful STEM and Computer Science curriculum integrations. A draft workforce development curriculum was developed and bi-weekly working sessions with BCPS throughout March and April were helping to determine the most effective ways to integrate such programming across BCPS schools. MODS recently received a private grant to expand museum offerings, helping children and the public explore new ideas for building a better future. BMPO and MODS are discussing ways to integrate SMART METRO into these programs, with plans for interactive exhibits that will expand participants' understanding of cutting-edge technology and transportation.

For all users and testers of the SMART METRO platform, the project staff implemented a multi-phased training approach, including PowerPoint materials, training calls, and interactive sessions. This enabled users to receive an introduction to AI technology and provided opportunities for BMPO to collect feedback on its applicability.

SMART METRO already generates insights on optimal locations for future projects to maximize job creation and access. These insights can be shared with local workforce development leaders to help prepare relevant workforce participants for potential new jobs before they are created.

Employers can use the platform to anticipate where new construction will occur, what types of jobs will be needed, and which skills to foster in their workforce to meet upcoming demand. This enables better forecasting of costs and that laborers have the necessary credentials and are paid competitively when projects launch.

Overall, the prototype successfully met the original expectations and goals described in the project proposal, as demonstrated by these targeted initiatives and capabilities. The prototype established a shared set of standards, data protocols, and tools that were applied across multiple planning and operational applications. The digital twin supported present transportation modeling requirements and is adaptable to the evolution of future use cases, emerging technologies, and AI simulation. SMART METRO became a workforce development tool, enabling regional education partners to expose students to real-world scenarios in transportation systems and prepare them to use data analytics and tools to assess the complex interaction among transportation, public health, and natural systems. We are also asking partners for feedback and ideas for expanding SMART METRO functionality to serve their workforce development needs. SMART METRO will also make it possible to analyze and improve access to jobs.

## 9. How has your Stage 1 project demonstrated improvement in the statutory areas relevant to your project?

Stage 1 of SMART METRO directly demonstrated improvement in the following statutory areas relevant to the project:

### I. Reduce congestion and delays for commerce and the traveling public.

As part of the Miramar use case initiative, BMPO integrated outputs from the Southeast Florida Regional Planning Model (SERPM) to assess the impact of development on surrounding roadways. Leveraging the dynamic capabilities of this activity-based model enabled the City of Miramar to identify areas of congestion and plan effective mitigation strategies. SMART METRO's user interface streamlines this process, combining a chat interface, analytics panel, and geospatial map for an intuitive experience. By synthesizing multiple previously unconnected datasets, SMART METRO empowers users to quickly interpret insights and take informed action, advancing informed, accurate analysis around reducing congestion and delays for commerce and the traveling public.

### II. Improve the safety and integration of transportation facilities and systems for pedestrians, bicyclists, and the broader traveling public.

SMART METRO integrates a range of transportation systems, creating a unified platform that enables stakeholders across the region to collaborate more effectively. This enhanced integration facilitates the sharing of data, resources, and insights among agencies, helping to break down silos and promote coordinated decision-making. As part of the countywide development analysis, BMPO conducted an evaluation in SMART METRO of planned transit infrastructure to determine its risk to flooding. By assessing the extent to which transit projects are hardened against flooding, BMPO guides investments to support the region long term. Additionally, this analysis examines how transit improvements contribute to advancing the region's broader development objectives, such as economic growth.

By leveraging SMART METRO's integrated capabilities, BMPO and its partners can more effectively and efficiently identify opportunities to enhance connectivity, prioritize projects that deliver the greatest benefits, and respond proactively to emerging challenges. Ultimately, this approach supports the creation of a safer and more forward-looking transportation network for Broward.

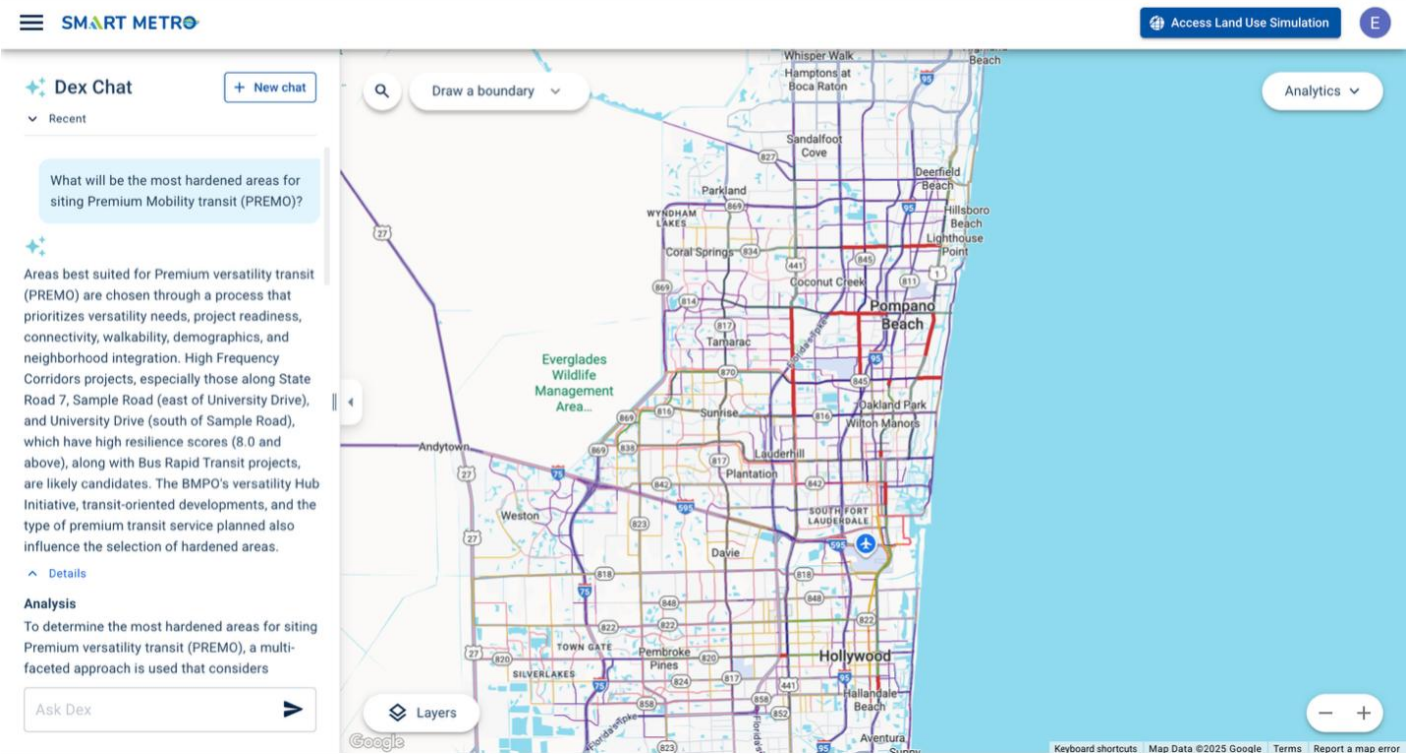


Figure 28: SMART METRO users can ask, “What will be the most hardened areas for siting Premium Mobility transit (PREMO)?” to understand impacts on future infrastructure.

### III. Improve access to jobs, education, and essential services.

As part of the Development Coordination initiative, BMPO created a scenario model to analyze the construction of Broward County Transit’s planned infrastructure through 2060. This model assessed the long-term impact of these improvements on job access across the country, revealing that the planned transit enhancements would significantly expand employment opportunities. SMART METRO offered a unified and intuitive interface for interacting with complex data. Its user-friendly design allows planners, policymakers, and elected officials to quickly access and interpret visualizations and analytics without extensive training on new software programs. This immediate access to actionable insights supports informed decision-making, helping leaders target investments to most effectively improve access to jobs, education, and essential services.

Beyond scenario modeling, BMPO launched workforce development programs to maximize SMART METRO’s impact. These programs focus on skills development, training, and knowledge enhancement, leveraging SMART METRO’s analytics to identify emerging workforce needs and tailor training initiatives. This holistic approach not only improves job access but also strengthens the region’s capacity for growth and prosperity.

SMART METRO serves as an effective workforce development tool, fostering skills and knowledge among current and future professionals. Its impact is evaluated through collaboration with workforce development organizations, gathering feedback on its utility for training, its ability to enhance technical and analytical skills, and its integration into educational and professional development programs. Ongoing dialogue helps SMART METRO’s capabilities remain aligned with evolving workforce and industry needs. It is a living tool that can be continuously updated based on direct, regular communication with the industry so that it includes the skills that are actually in demand in the market.

BMPO initiated new partnerships with organizations such as the Broward County Planning Council, Broward County Public Schools, Museum of Discovery and Science, and University of Florida that confirmed SMART METRO’s relevance to workforce skill requirements. These collaborations supported hands-on training, scenario-based learning, and integration into curricula and professional development initiatives. Insights from these partnerships helped shape platform features and inform curriculum development, ensuring training programs aligned with industry trends and future workforce needs.

This proactive approach positions SMART METRO as a catalyst for preparing the next generation of planners, analysts, and decision-makers. It also advances the President Trump’s policy priorities in [America’s AI Action Plan](#), aligning with [Improving Oversight of Federal Grantmaking](#), to support the creation of industry-driven training programs that address workforce needs tied to priority AI infrastructure occupations.

#### IV. Connect or expand access for underserved or disadvantaged populations and reduce transportation costs.

With the prototype, BMPO changed the way it performed a countywide analysis. By examining current conditions and projecting future trends, BMPO planners could better understand where new infrastructure can be most effectively placed and how it will shape the long-term development of these areas.

SMART METRO’s data integration allowed BMPO to rapidly identify strategic locations where housing development and transportation investment can be co-located. By aligning these two critical elements, the county can promote more efficient land use, reduce congestion, and support neighborhoods. This integrated approach to planning enables better coordination among stakeholders, encourages private investment, and lays the foundation for growth that meets the evolving needs of residents throughout the county.

#### IV. Connect or expand access for underserved or disadvantaged populations and reduce transportation costs.

During Stage 1 development, BMPO conducted extensive engagement and outreach with economic development stakeholders – including planners, agency leaders, elected officials, and non-profit administrators. These interactions provided valuable insights into how SMART METRO can support future economic growth and strengthen collaboration with private sector partners.

SMART METRO delivers forward-looking analytics, empowering leaders to take a proactive approach to development initiatives. For example, the Broward County Housing Finance Authority noted that SMART METRO’s ability to identify areas for housing will enable more effective coordination with private sector developers.

By facilitating the alignment of goals across agencies – both vertically and horizontally – SMART METRO enhances competitiveness. Through collaboration, it supports the growth of diverse industries and infrastructure that is appropriately scaled to meet current needs while enabling future economic growth and prosperity.

#### VI. Improve the reliability of existing transportation facilities and systems.

In collaboration with Miramar, BMPO conducted an analysis using SMART METRO to evaluate how anticipated growth and development could lead to increased congestion in the area. Previously, Miramar would have had to undergo a lengthy process to achieve the same results. This assessment considered a range of factors, including the square footage and type of new residential and commercial developments, projected trip generation based on a regional travel demand model, existing roadway capacity and levels of service, and planned transportation network improvements. By examining these elements, the analysis provided a clearer

understanding of how and where congestion is likely to intensify, as well as the potential impacts on daily commutes, local businesses, and overall quality of life, as measured by access to transit, access to jobs, roadway levels of service, and other factors. The results were clearer because SMART METRO provided an interactive, map-based visualization of the outputs. Instead of just tables of data, planners could directly see an integrated view, combining land use and transportation data on a single interface, which is much more intuitive and immediately understandable than a static report.

With these insights, Miramar is positioned to take a proactive approach to transportation planning. The city can explore and implement targeted mitigation strategies, such as optimizing traffic signal timing, expanding public transit options, investing in alternative transportation modes, and improving roadway infrastructure. Additionally, this forward-looking planning allows Miramar to engage with stakeholders, coordinate with regional partners, and prioritize investments that will help manage congestion and support growth.

## VII. Promote connectivity between and among connected vehicles, roadway infrastructure, pedestrians, bicyclists, the public, and transportation systems.

SMART METRO's systems integration plays a pivotal role in advancing the connectivity and efficiency of transportation networks. By enabling seamless integration between different transportation modes—including connected vehicles, roadway infrastructure, pedestrians, bicyclists, and public transit—these platforms foster communication and data sharing across the entire system. This interoperability allows for more coordinated traffic management, improved safety measures, and enhanced mobility options for all users.

By promoting collaboration among various stakeholders—including city agencies, transportation providers, and the public—SMART METRO's integrated approach supports proactive planning and rapid response to emerging challenges. This leads to a hardened, adaptable, and user-friendly transportation ecosystem that meets the evolving needs of urban communities.

## IX. Improve energy efficiency or reduce pollution.

By helping to proactively relieve congestion and addressing transportation challenges, SMART METRO significantly improves energy efficiency throughout the mobility network. When traffic flows more smoothly and bottlenecks are minimized, vehicles spend less time idling and traveling at inefficient speeds, which directly reduces fuel consumption. Integrated systems enable monitoring and management of traffic patterns, allowing for timely interventions that prevent congestion before it escalates.

## X. Increase the reliability of the transportation system, including cybersecurity and hardening to extreme weather.

### **Maintaining Cybersecurity**

The Data Management Plan established comprehensive standards and protocols for SMART METRO to maintain robust security and remain protected from external risks. By operating within a closed environment, SMART METRO minimizes exposure to unauthorized access and potential cyber threats. This approach includes strict access controls, regular security audits, and continuous monitoring to detect and respond to any suspicious activity.

SMART METRO's cloud-based ecosystem is designed to deliver both high performance and strong security. It adheres to rigorous industry requirements for reliability and data protection, including data encryption at rest and in transit, multi-factor authentication, and compliance with relevant regulatory frameworks. Regular updates and vulnerability assessments are conducted to address emerging threats and the integrity of the system.

Key cybersecurity features include role-based access capabilities (to be enhanced following the prototype phase), secure login protocols on a customized domain, and comprehensive logging and auditing of user activities and data access. Additionally, the Apigee platform manages API traffic, providing robust security, analytics, and monitoring for all data exchanges. These measures collectively safeguard sensitive transportation, demographic, and environmental data, ensuring that only authorized users can access and analyze information within SMART METRO. Access is controlled by assigned user roles.

## Preparing for Extreme Weather Events

SMART METRO is designed to identify both current and future extreme weather events and will support advanced risk and vulnerability assessments. Its future capabilities include pinpointing critical infrastructure, recommending countermeasures, and ensuring that funding is allocated to essential transportation networks to maintain system reliability and enable faster recovery after hazard events.

As part of the Miramar use case, BMPO used SMART METRO to evaluate how future extreme weather could affect roadway infrastructure. By leveraging authoritative county data, SMART METRO identified areas in the development area that may be at risk. This analysis will help guide planning decisions for the City of Miramar and private developers, supporting optimal return on investment.

SMART METRO's advanced modeling features, which span land use, extreme weather, and transportation, enable users to explore scenarios, analyze historical events, predict future outcomes, and assess potential impacts. In this way, SMART METRO, directly contributes to the Key Performance Indicators provided in the [U.S. Department of Transportation's FY 2022-2026 Strategic Plan](#), particularly efforts to support new data and technology for AI, cybersecurity, and infrastructure hardening and interoperable platforms with various tools.

## XI. improve emergency response.

Systems integration enables agencies to engage in proactive planning and response by providing seamless access to shared datasets. With data already crossing agency boundaries, collaboration is enhanced, allowing different departments to work together more effectively. This integrated approach is especially valuable during emergencies, when timely information sharing and coordinated action are critical for an effective response. By leveraging these interconnected datasets, agencies can anticipate challenges, make informed decisions, and deliver better outcomes for the communities they serve.

**10. Based on the findings discussed in Part 2 of this report, what are the anticipated/estimated impacts of at-scale implementation for each key goal area?**

In Stage 2, BMPO will implement SMART METRO with an expanding group of regional and national partners, analyzing additional use case projects that reflect the priorities and challenges of Broward region stakeholders. Potential partners for these use cases include Broward hospital networks, Broward County Public Schools, and the South Florida Water Management District. Simulation activities may also be conducted during this stage to further test and refine the platform.

BMPO will work to define the future ownership model for SMART METRO. While BMPO is currently developing the prototype, other MPOs and national partners have expressed interest in adopting a similar platform. During Stage 2, BMPO will determine how to support the long-term operations and maintenance of SMART METRO.

The anticipated impacts of at-scale implementation are expected to deliver a range of benefits for SMART METRO users across Broward. These benefits will be evaluated through the use case projects, which serve to bridge the gap between conceptual requirements and practical solutions. Use cases provide a blueprint for system design and development, guiding the creation of the prototype and enabling early feedback from users and stakeholders. This iterative process supports ongoing improvements and refinements prior to full-scale deployment.

By following this approach, BMPO aims for full-scale implementation to align with stakeholder expectations, address user needs, and mitigate risks, ultimately leading to a more successful and effective solution. At-scale implementation is expected to provide benefits across the following areas:

**I. Reduce congestion and delays for commerce and the traveling public.**

Data-driven planning and multimodal solutions ultimately help decrease congestion, improving travel times for all users. Less congestion leads to safer, less stressful commutes and healthier communities. Efficient transportation networks accommodate population growth without sacrificing mobility. Broward is projected to add 330,000 residents by 2050, significantly increasing demand on the transportation network. Accommodating this growth will require approximately 130,000 new homes, which is likely to result in more vehicles on already congested roadways. Currently, South Florida commuters spend an average of 79 hours per year in traffic. Without strategic planning, congestion could worsen considerably.

Population growth, along with the expansion of freight and passenger rail services, is expected to place additional strain on critical infrastructure such as railroad crossings and highway corridors. Addressing these challenges will require enhanced coordination among local, regional, and state governments to effectively manage traffic flow, reduce congestion, and align transportation investments with housing development plans.

Data-driven planning, congestions management, and multimodal solutions are essential for decreasing congestion and improving travel times for all users. Reduced congestion leads to safer, less stressful commutes and healthier communities. An efficient transportation network will allow Broward to accommodate population growth without sacrificing mobility.

## II. Improve the safety and integration of transportation facilities and systems for pedestrians, bicyclists, and the broader traveling public.

Ensuring the safety and well-being of all road users is the Broward MPO's highest priority. An analysis of crash records from 2017 to 2021 revealed over 300,000 crashes, with nearly 1,000 fatalities and more than 4,000 incidents involving incapacitating injuries. Angle and left-turn collisions were among the most dangerous, along with rear-end and lane departure crashes, which together accounted for a significant portion of severe incidents. Pedestrians, cyclists, motorcyclists, and aging road users faced disproportionately higher risks. For example, pedestrian crashes were nearly 15 times more likely to result in severe injury, and crashes involving cyclists were over six times as likely to be severe.

When fully implemented, SMART METRO will deliver a range of significant benefits for Broward's transportation system. The platform will integrate seamlessly into the Broward Safety Action Plan and proactively recommend targeted countermeasures in high-risk areas, helping to prevent accidents and improve overall security for all travelers. SMART METRO will prioritize resource allocation and enable effective traffic management, which is especially valuable for stressed networks and vulnerable infrastructure. Condition-specific strategies will support traffic management, facilitating adaptation to changing circumstances and providing commuters with smoother, more reliable journeys. The platform will also automate key tasks such as incident management and project screening, generating reports that boost workforce productivity and allow staff to focus on higher-value activities. Overall, SMART METRO is poised to make Broward's transportation network safer, more efficient, and better equipped to serve a growing population.

## III. Improve access to jobs, education, and essential services, including health care

The Broward MPO anticipates an absolute change in job growth of 117,942 by 2050. To accommodate this increase and enable access, transportation links are essential for connecting more people to jobs, education, and essential services. Targeted investments in transportation infrastructure promote development, while improved access to employment centers supports job growth and contributes to a more dynamic local economy. Enhanced connectivity not only facilitates workforce mobility but also strengthens the region's ability to attract and retain businesses, fostering long-term economic vitality.

## IV. Connect or expand access for underserved or disadvantaged populations and reduce transportation costs.

Broward's average household transportation cost is approximately \$900-\$1,100 per month, which is 10-30% higher than the national average. BMPO is committed to identifying ways to reduce these cost burdens. SMART METRO will offer significant benefits through its advanced scenario analysis capabilities. By allowing planners and stakeholders to model and assess the potential impacts of changes in mode share and associated costs, the platform helps users understand how different strategies affect travel behavior, congestion, and access. This empowers stakeholders to evaluate a range of policy options, potentially leading to lower transportation costs and improved access. The data-driven approach supports informed decision-making by enabling users to compare outcomes and select the most effective strategies for managing transportation demand and optimizing network performance.

## V. Contribute to medium- and long-term economic competitiveness.

Broward County's GDP is estimated at over \$100 billion annually. Transportation plays a critical role in maintaining the county's economic competitiveness. SMART METRO offers significant benefits through its robust scenario analysis capabilities. By enabling planners and stakeholders to model and assess the impacts of changes in roadway, freight, and other mode costs, the platform helps users understand how different strategies

affect travel behavior, congestion, and access. This empowers stakeholders to evaluate a range of policy options, potentially leading to reduced transportation costs and improving access. The data-driven approach supports informed decision-making, allowing users to compare outcomes and select the most effective strategies for managing transportation demand and optimizing network performance.

#### VI. Improve the reliability of existing transportation facilities and systems.

BMPO has committed to improving travel times by at least 5% by 2050, and SMART METRO can play a key role in achieving this goal. With access to high-quality data and custom-built models for planning and operations, SMART METRO will empower transportation agencies to make more informed and cost-effective decisions. By leveraging detailed datasets and predictive analytics, planners can accurately forecast maintenance needs, optimize scheduling, event rerouting, and estimate project costs with greater precision. This data-driven approach will enhance budget planning and resource allocation, extend the lifespan of infrastructure, and lead to more efficient use of public funds. As a result, agencies will be better positioned to maintain and improve transportation assets while maximizing the value delivered to the public.

#### VII. Promote connectivity between and among connected vehicles, roadway infrastructure, pedestrians, bicyclists, the public, and transportation systems.

SMART METRO's systems integration and integrated data platforms enable rapid scenario analysis and evidence-based planning. Streamlined data access and analysis reduces the resources needed for project evaluation and planning. Comprehensive, accessible data supports more effective, transparent, and accountable decision-making. All of this contributes to a more connected transportation system that benefits all roadway users.

#### VIII. Incentivize private sector investments or partnerships, including by working with mobile and fixed telecommunication service providers, to the extent practicable.

Continued strategic collaborations between public agencies and private sector partners drive innovation, attract investment, and boost economic growth in Broward and beyond. These partnerships bring additional expertise and resources, enabling more ambitious projects. Clear roles and shared leadership foster organizational commitment so that projects are well-supported and positioned for long-term success.

#### IX. Improve energy efficiency or reduce pollution.

SMART METRO will improve energy efficiency by enabling continuous monitoring of roadway conditions, which will support proactive planning and timely interventions. Advanced analytics will allow transportation agencies to predict future traffic patterns, offering valuable insights for both immediate response (rerouting) and long-term strategic planning. By integrating these capabilities, agencies will be able to proactively manage congestion, enhance safety, and advance their efficiency goals, ultimately leading to more effective transportation systems.

#### X. Increase the strength of the transportation system.

Hardening transportation assets against extreme weather and cyber threats is essential for ensuring continuous and safe operations. Proactive risk management minimizes service interruptions, maintains public trust, and enhances system reliability. By implementing robust protocols and strengthening infrastructure, SMART METRO can help partners achieve faster recovery from disruptive events. This capability will support informed planning and empower stakeholders to make decisions that account for the increasing frequency and severity of extreme weather events.

**XI. improve emergency response.**

At-scale implementation of SMART METRO will deliver enhanced protocols, enabling transportation systems to recover more quickly from disruptive events. These improvements will minimize downtime and service interruptions, ensuring greater reliability in the face of emergencies. SMART METRO will strengthen both operational procedures and physical assets, better protecting public safety and maintaining consistent service levels. As a result, agencies will be able to restore normal operations more efficiently after incidents, reducing costs associated with emergency response and safeguarding the community against future challenges.

## 11. What are anticipated costs of at-scale implementation? Include the overall estimated costs of the proof-of-concept or prototype.

The total cost of the prototype was \$2,000,000, funded by the SMART grant Stage 1. Stage 2 implementation will build on the foundation that was laid in the Stage 1 prototype to scale the use cases to a production-grade implementation and advancing SMART METRO’s technical capabilities. Estimated costs at scale consider various parameters across stakeholder engagement, implementation costs, advanced AI (predictive analytics and 3D capabilities), and technology costs. While SMART METRO is functional in the prototype phase, the number of use cases, limitations in analytics of scenarios, and user experience. Advanced AI, analytics, use cases, user benefits, and range of functionality, substantially increase with at-scale implementation.

Area	Illustrative Activities & Tasks	Estimated Costs
<b>Project Management, Administration &amp; Oversight</b>		
<b>Project Management &amp; Grant Administration</b>	<ul style="list-style-type: none"> <li>• Coordination, Convening, Reporting, Administration, and Oversight</li> <li>• Project Tracking, Risk Management, Task Reviews</li> <li>• Expert Inputs, Work Product Reviews, and Feedback</li> </ul>	\$1,500,000
<b>Stakeholder Management</b>	<ul style="list-style-type: none"> <li>• Stakeholder Workshops</li> <li>• Advisory Committee Coordination</li> <li>• Periodic Reviews and Status Reporting</li> </ul>	\$300,000
<b>Project Delivery Management</b>	<ul style="list-style-type: none"> <li>• Project Plan Management and Status Reporting</li> <li>• Implementation and Delivery Coordination</li> </ul>	\$450,000
<b>Implementation</b>		
<b>Technology Licenses &amp; Infrastructure Costs</b>	<ul style="list-style-type: none"> <li>• Infrastructure Cloud Provider</li> <li>• GIS Mapping Provider Licenses</li> <li>• Land Use &amp; Travel Demand Model Provider Licenses</li> </ul>	\$2,700,000
<b>Technology &amp; Infrastructure Setup</b>	<ul style="list-style-type: none"> <li>• Development, QA and Production Infrastructure Setup</li> <li>• Role-Based Access Control and User Access Setup</li> </ul>	\$500,000
<b>Architecture, Design and Functional Requirements</b>	<ul style="list-style-type: none"> <li>• Architecture Setup and Detailed Design Creation</li> <li>• Functional Subject Matter Expert Support</li> <li>• Requirements and User Stories Creation</li> </ul>	\$1,400,000
<b>Data Processing</b>	<ul style="list-style-type: none"> <li>• Data Collation, Cleansing &amp; Conflation (Large Data)</li> <li>• Data Processing, Source-To-Target Mapping</li> </ul>	\$1,550,000
<b>AI/ Modeling</b>	<ul style="list-style-type: none"> <li>• Retrieval Augmented Generation Setup &amp; Scale</li> <li>• Text-To-SQL Setup &amp; Scale</li> <li>• Generative AI Upgrades, 3D capabilities, and Model Enhancements</li> </ul>	\$2,300,000
<b>Software Engineering &amp; Systems Integration</b>	<ul style="list-style-type: none"> <li>• Front-End User Interface/ User Experience Engineering</li> <li>• Back-End Services, Infrastructure and Data Retrieval Engineering</li> </ul>	\$1,425,000
<b>Testing &amp; Validation</b>	<ul style="list-style-type: none"> <li>• System Testing, User Acceptance Testing</li> <li>• Security, Performance Testing</li> </ul>	\$800,000
<b>DevOps &amp; Security</b>	<ul style="list-style-type: none"> <li>• Continuous Integration and Continuous Delivery/Continuous Deployment setup</li> <li>• Security and Performance Testing Automation</li> </ul>	\$800,000
<b>Training &amp; Workforce Development</b>	<ul style="list-style-type: none"> <li>• User Training, Train-The-Trainer Model Implementation</li> <li>• Support Services, User Guides, How-To Guides Creation</li> </ul>	\$200,000
<b>Post-Implementation Optimization Phase</b>		
<b>Hypercare</b>	<ul style="list-style-type: none"> <li>• Stabilization, Refining Performance, and Usability</li> <li>• Platform Monitoring, Bug Fixes, SLA Management</li> </ul>	\$1,050,000
<b>Estimated Total Costs (Implementation 3-Years):</b>		<b>\$14,975,000</b>

Table 3: Anticipated costs of at-scale implementation of Stage 2 of SMART METRO.

**How do the expected deployment and operational costs of at-scale implementation compare with the benefits and savings the project would provide? Do you expect the benefits to exceed the costs?**

MPOs sit at the crucial intersection across federal, state and local entities as well as the private sector to drive effective planning and coordination across the entire region. BMPO plays a crucial role in the decisions that affect a large population as well as private sector investments. These decisions drive economic vitality for the region and dictate the quality of life for the population.

At scale, SMART METRO’s benefits to accrue not just for BMPO but also to the associated entities that intersect with the work that BMPO does. BMPO’s target use cases for the at-scale implementation will see the benefits accruing to Miramar, Broward, FDOT, as well as other industries such as real estate, health care, and insurers.

For BMPO, the value is derived from better decision-making as well as time and cost savings. Smarter insights, rapid analysis of possible scenarios and assessing projects from many dimensions will drive better decision-making and enable inter-agency collaboration. Based on initial estimates, we anticipate approximately 12,000 hours of annual time savings, and annual cost savings of approximately \$2.3 million. With further adoption across other regional agencies, we anticipate the savings to increase to approximately \$6 million.

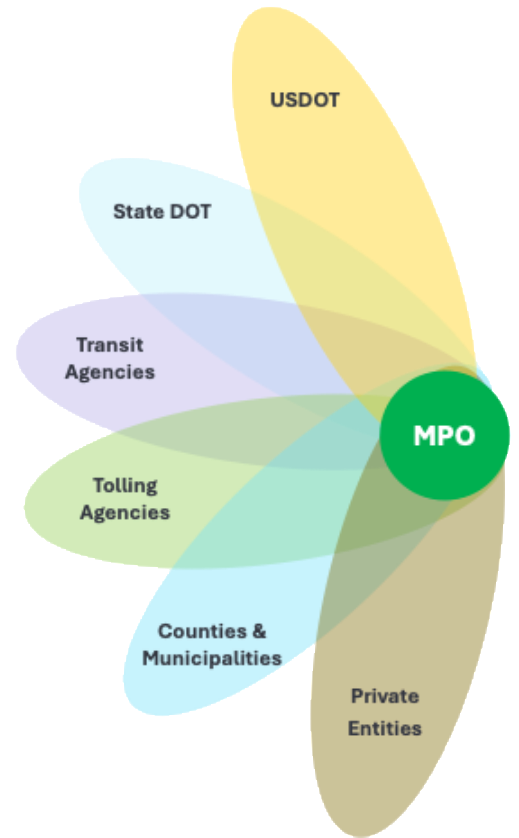


Figure 29: Depiction of MPO role.

ROI from Better Decision-Making

+

**How are better decisions made?**

- 1 Derive **better insights** to inform projects
- 2 **Rapidly analyze** possible scenarios
- 3 Make **insights accessible** to decision-makers
- 4 Assess projects from **many dimensions**
- 5 Enable inter-agency **collaboration**



**Primary sources of efficiencies for BMPO:**

BMPO Annual Savings	Time Savings (hr)	Cost Savings (\$)
Reviews + Approvals	6,280	\$1.5M
Sub-Area + Corridor Plans	1,154	\$145k
County-Wide Plans	4,047	\$516k
Infrastructure Hardening	741	\$92k
<b>BMPO Annual Savings</b>	<b>12,222</b>	<b>\$2.3M</b>

Figure 30: The SMART METRO prototype has demonstrated potential to deliver value to BMPO after full implementation.

## SMART METRO

In addition to the direct value that BMPO receives from the scaled implementation of SMART METRO, we anticipate each of the use cases will drive meaningful value to other entities. Miramar will benefit from improved land use planning capabilities, FDOT and potentially insurers will benefit from improved roadway safety, and developers will benefit from improved housing coordination.

SMART grant Stage 2 will help BMPO further refine these estimates by conducting detailed workshops with the stakeholders across all these areas. The initial high-level assessments suggest that these anticipated benefits can range anywhere from \$15 million to \$25 million annually.

**12. Describe any preliminary baseline data collected in Stage 1 for an evaluation of at-scale implementation. For the key goal areas of at-scale implementation, what are the current or historic levels of performance (e.g., crash rates for safety goals, travel times for mobility goals)?**

To evaluate the feasibility and benefits of implementing SMART METRO at scale, BMPO undertook a comprehensive data collection and analysis effort in collaboration with BMPO and its partner organizations. BMPO gathered detailed information on the average time required to complete tasks across five common project types, providing a clear baseline of current workflows and process durations, and allowing BMPO to identify where efficiencies could be gained. In parallel, the project staff documented the typical costs associated with these tasks, including both consultant fees and internal staff expenses, to establish a comprehensive view of current expenditures related to project delivery. Project consultants also solicited input from BMPO project managers and its partners to estimate the potential time savings that could be achieved by adopting SMART METRO, drawing on user experience, pilot project feedback, and benchmarking against similar technology implementations

BMPO also calculated the value to public and private stakeholders at full implementation, which would include the three use case initiatives, such as Miramar, Development Coordination, and Safety Planning. The project staff calculated value according to the following framework as well as the USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs as it pertains to safety programs. Private entities that receive value from SMART METRO could become a helpful component of its long-term success and funding source.

By combining BMPO operational and financial data, the project staff established benchmarks for the current state of delivery in terms of time and cost and then compared these benchmarks to the anticipated improvements with SMART METRO adoption, allowing BMPO to quantify potential efficiency gains, such as reduced task completion times, and calculate the corresponding financial benefits, including lowering BMPO's operational costs. This analysis provides a data-driven foundation for understanding the value proposition of SMART METRO at scale, enabling stakeholders to make informed decisions regarding broader SMART METRO implementation and resource allocation. The findings also offer strategic insights into which project types and workflow stages stand to benefit most from SMART METRO, guiding future rollout and optimization efforts.

The project staff then applied the framework to the anticipated implementation scope to assess the potential value available in Broward.

Use Case	Description	Value Recipient	Value	Calculations
Miramar	Consider alternative land use schemes based on potential impacts to jobs, commerce, and housing.	Developers	Streamline modeling and analysis; Analyze several scenarios; Consultant fees	<p><b>Savings</b> Land Use Consulting Fees: Developer Investment * Land Use Consulting Fees * SMART METRO Efficiencies</p> <p><b>Savings</b> Land Use Consulting Fees: City Investment * Land Use Consulting Fees * SMART METRO Efficiencies</p> <p>Internal Operations: Relevant Building, Planning &amp; Zoning Budget * SMART METRO Efficiencies</p> <p><b>Revenue</b> Tax: Anticipated Property Tax Revenue * Discount Rate to Reflect Time Savings from SMART METRO Efficiencies</p> <p>Permits: Permitting Fee * Developer Investment * Discount Rate to Reflect Increase in Collections from SMART METRO Efficiencies</p>
Miramar	Consider alternative land use schemes based on potential impacts to jobs, commerce, and housing.	Municipality	Streamline modeling and analysis; Analyze several scenarios; Consultant fees; Consolidate software; Tax revenue; Permit fees	<p><b>Savings</b> Land Use Consulting Fees: Developer Investment * Number Countywide * Land Use Consulting Fees * SMART METRO Efficiencies</p> <p>Pleasing &amp; Feasibility: Developer Investment * Planning &amp; Feasibility Analysis * Savings with Expedited Timeline from SMART METRO</p> <p>Securing Financing &amp; Approvals: Developer Investment * Securing Financing &amp; Approvals * Savings with Expedited Timeline from SMART METRO</p>
Housing Coordination	Drive impact by identifying and prioritizing development opportunities.	Developers	Accelerated reviews and approvals; Integrate disparate data to enhance site selection; Identify future land opportunities; Consultant fees	
Roadway Safety	Identify and address risks on roadways to using data-driven analysis.	Insurers	Predict future risks; Incident-related damages	<p><b>Savings</b> Cost to Insure: Cost to Insurers per Municipality for Auto Claims * Number of Municipalities in County * Anticipated Cost Reduction</p> <p><b>Revenues</b> Auto Revenue: Current Auto Revenue * Number of Municipalities County * Anticipated Growth</p>
Roadway Safety	Identify and address risks on roadways to using data-driven analysis.	DOT	Predict future risks; Incident-related damages	<p><b>Savings</b> Safety Planning: DOT Budget for Safety Planning * (County Roads / State Roads) * SMART METRO Efficiencies</p>

Figure 31: Framework for calculating value to stakeholders.

## Part 5 of 7: Challenges and Lessons Learned

### **13. Describe all project challenges encountered during the Stage 1 period of performance, lessons learned, and recommendations.**

Several key challenges were faced during Stage 1. Budget constraints necessitated a strategic approach to planning and resource allocation, resulting in limited overall capabilities. Partnerships also presented hurdles, particularly in stakeholder engagement. This required coordinating schedules across regional and national partners, which was difficult, and participants brought diverse priorities, expertise, and varying levels of engagement. Technology suitability and the complexity of systems integration with both new and legacy systems posed additional obstacles.

Data acquisition and preparation, while anticipated, proved especially demanding. Despite strong stakeholder relationships and regular communication, accessing accurate data and organizing it appropriately was time-consuming. This process often ran in parallel with stakeholders' daily planning activities, meaning that some critical data was still being developed or acquired throughout Stage 1.

These experiences highlighted the importance of establishing a robust data governance structure early to streamline future efforts and maintain data quality; however, data governance was further complicated by ongoing challenges in aligning stakeholder schedules, priorities, and participation, making it difficult to establish unified data practices.

BMPO also encountered challenges related to testing. Initial users frequently reported failed prompts and inaccuracies, which required BMPO to continually iterate on SMART METRO. As a result, the project staff had to perform testing simultaneously while still building the system.

While initial engagement with regional and national stakeholders was crucial for designing SMART METRO, it has been recognized that a more structured approach is needed to overcome long-standing collaboration hurdles. Going forward, the strategy will be more targeted. Establishment of a formal technical advisory group will be required to guide governance and create dedicated use case working groups focused on solving specific partner challenges. Furthermore, a formal data-sharing agreements will be required to break down information silos. This evolution from informal engagement to a structured, value-driven partnership will be critical for the platform's successful implementation and adoption.

#### **14. Describe the requirements for successful implementation. What are the key obstacles to scaling this project? Please also address project readiness for at-scale implementation including strategies or demonstrated progress. Please discuss uncertainties and risk mitigations.**

While successful implementation requires leadership, funding, and a robust technical infrastructure, BMPO's experience shows that a proactive risk management framework is the key to navigating challenges. For BMPO, "effective risk management" means moving beyond a reactive stance. BMPO use a formal risk register to anticipate and mitigate issues across key areas like stakeholder adoption and data integrity. For instance, to counter the risk of stakeholder disengagement, BMPO create problem-oriented working groups that provide immediate value. To manage data quality risks, BMPO use automated validation guardrails. This structured approach is fundamental to protecting the project and ensuring its long-term viability.

Deployment should incorporate enhanced functionality, including dynamic modeling of virtual and physical environments and advanced 3D and simulation capabilities. These features will enable more sophisticated analysis and planning, supporting a wider range of use cases. As BMPO deploy enhanced functionality, BMPO must also establish an appropriate organizational structure for long-term success. This means moving beyond the current project structure to create a permanent program with dedicated roles. This structure will be formally responsible for all support activities, including platform governance, technical maintenance, user training, and data stewardship, providing a sustainable framework for regional collaboration and growth.

In the long-term, BMPO proposes forming a consortium dedicated to SMART METRO data governance, operations and long-term sustainability. This consortium will provide a structure to support large-scale implementation and is designed to expand over time by inviting additional MPOs, DOTs, and other partners. It will serve as the foundation for a business model supporting ongoing operations and growth as technology evolves over time. By enabling technology sharing through a collaborative system, agencies across states can use a unified tool, share technology standards, and enable interoperability.

Successful implementation during Stage 2 and beyond involves navigating several key obstacles:

- **Data Governance:** Different agencies have varying policies on accessing, sharing, and integrating data. These requirements can complicate efforts to create a unified data platform.
- **Partnerships:** Aligning priorities, goals, and timelines is critical, but it can be difficult when multiple organizations are involved.
- **Technology Suitability:** Integrating data from a variety of sources poses technical challenges. Data standardization – consistent formats, definitions, and quality – can be resource-intensive. Additionally, many partners may rely on legacy systems that are outdated or incompatible, further complicating integration.
- **Procurement and Budget:** Beyond initial investment, developing a viable business model for ongoing operations, maintenance, and future expansion is essential but undefined.
- **Legal, Policy, and Regulatory Requirements:** Negotiating interagency agreements can be time-consuming and complex. Addressing liability and risk management, especially related to data, is also a critical concern.
- **Workforce Capacity:** Organizational resistance to change can slow the adoption of new processes and technologies. Making sure all partners have the necessary skills and resources to effectively use SMART METRO will require ongoing training and capacity building.
- **Public Acceptance:** Onboarding new partners while maintaining standards and governance can be complex. Additionally, adapting SMART METRO to different regulatory environments, data needs, and operational contexts will be an ongoing challenge.

Addressing these obstacles requires proactive planning, clear communication, and ongoing collaboration among all consortium members.

**15. What would you need to learn to better understand the maintenance and operating requirements that would be necessary to continuing this project (i.e., after at-scale implementation)? If technology needs to be updated in the future, do you have the capacity to make improvements and prevent technical debt?**

Transitioning from the SMART METRO prototype to a scalable solution requires that SMART METRO remain functional, maintainable, and adaptable. Items to consider include:

- Continued tracking of corrective, adaptive, perfective, and preventive maintenance items to maintain functionality. This includes planning for scalability and performance optimization. Implementation will bring increased load to SMART METRO and confirm that the code and infrastructure can handle more users and data.
- Enable change management and continuous improvement processes as more users adopt SMART METRO for their needs. To start, initiate a needs assessment. This includes channels for users to report issues, suggest improvements, and share knowledge with other users.

To do this, BMPO must continuously evolve operations for users. BMPO has successfully achieved this before with the Metro Transportation Engineering & Construction Cooperative (MTECC), which serves as a helpful example. With MTECC, engineering and construction services are provided through an independent self-funded cooperative. Member organizations pay proportional dues to cover operational costs. The legal entity operates independently from BMPO, though BMPO shares staff to support key functions.

Building on this foundation, long-term sustainability can be based on funding from user organizations that access SMART METRO insights and capabilities. Comprehensive training and support will be required for successful implementation. It is contemplated that participation will be open to both private and public users, including those outside of municipal membership; and all users will need to meet data sharing prerequisites to have effective collaboration and maximize the value of SMART METRO.

In Stage 2, BMPO will take on an integral position, serving as a connector between State and Local entities. Looking ahead, future expansion will bring on additional users and regions, further broadening the impact, both nearby and across the nation. Palm Beach TPA, WFRTC, and others have expressed interest and can have their own instances of SMART METRO. This initial implementation enables BMPO to develop the technology, which can then be commercialized and deployed to serve additional regions across the nation.

**16. Assess how at-scale implementation would harness beneficial impacts and mitigate negative impacts of new technologies on the availability of good-paying jobs with a free and fair choice to join a union.**

SMART METRO already generates insights into optimal locations for future projects to maximize job creation and access. These insights can be shared with local workforce development leaders to help prepare relevant workforce participants for potential new jobs before those jobs are created.

Employers can use SMART METRO to anticipate where new construction will occur, what types of jobs will be needed, and which skills to foster in their workforce to meet upcoming demand. This enables better forecasting of costs and helps laborers have the necessary credentials and are paid competitively when projects launch.

Educators can leverage SMART METRO to understand what types of jobs will be created by planned developments and adjust programs and curricula to prepare students for the evolving job market as shaped by these plans.

**17. Reflecting on the course of the project, did the proposed solution meet your expectations? Do you think you would make any notable changes to the proposed solution for at-scale implementation. What advice would you give to other communities embarking on the same path?**

Reflecting on Stage 1, the proposed solution largely met project staff expectations, particularly considering the rapid advancements in AI and resources available. BMPO has demonstrated a strong commitment to staying abreast of emerging technologies, ensuring that its strategies remain relevant and effective. However, as the initiative moves toward larger-scale implementation, it will be essential to maintain a mindset of ongoing adaptation and flexibility. This means not only responding to technological changes but also anticipating shifts in user needs, regulatory requirements, and industry best practices. For broader deployment, building in even greater agility will allow SMART METRO systems and processes to quickly integrate new capabilities and respond to evolving challenges, ensuring long-term success and impact.

The Stage 2 implementation phase will focus on expanding the range of use cases and enhancing system capabilities. A key priority will be to further integrate SMART METRO into BMPO's existing workflows, streamlining operations and driving greater efficiency across the organization. This integration will help maximize the value of the technology, reduce redundancies, and enable staff to focus on higher-value tasks. Additionally, Stage 2 will emphasize user training and change management for a smooth transition and widespread adoption.

BMPO has also importantly determined that SMART METRO is software agnostic; BMPO is open to considering and reevaluating its software choices as the project progresses into the next stage. This approach will help the selected tools and platforms remain the best fit for the organization's evolving needs and objectives.

For other communities to consider similar initiatives, it is important to proactively monitor priority regional use cases and remain open to iterative development. Solutions should be regularly evaluated and refined based on feedback and changing conditions. Early and active engagement with MPOs is highly recommended, as MPOs are uniquely positioned to convene diverse stakeholders, coordinate regional efforts, and navigate the complexities of technology adoption at scale. Their expertise and networks can help accelerate project timelines, foster collaboration, and support alignment with broader regional goals.

To realize the full benefits of these efforts, organizations should prioritize flexibility, cultivate strong partnerships, and commit to continuous learning. This approach will enable them to adapt to new opportunities and challenges, hardened systems, and drive sustained improvements in transportation planning and operations.

During Stage 1, the BMPO received significant interest from the emerging technologies and AI in transportation sectors to partner with in Stage 2 Implementation. In response, the BMPO is preparing an RFP for Stage 2 Implementation, beginning with an Industry Review and Request for Comments this fall. An in-person Industry Forum will take place at the BMPO's Safe Roads Summit in February 2026. The Industry Forum will review feedback, address the federal procurement process, and finalize outstanding questions prior to advertising. This approach enables the selection of the most qualified consultant resources for the successful Stage 2 implementation of SMART METRO.