Micro Mobility Transit Study

Transit Authority of River City (TARC)

Final Report - August 2022

Via Mobility, LLC.

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1. Introduction and executive summary.

1.1. Introduction.

This study evaluates how the Transit Authority of River City (TARC) can use Mobility on Demand (MOD) — safe, affordable, technology-enabled services integrated into the public transit network, such as microtransit, bike share, ride-hailing, mobility hubs, and others — to offer customers improved quality of service and extend the reach of its network to suburban areas where fixed-route service is currently limited or absent.

The Micro Mobility Transit Study aims to explore and evaluate innovative transportation options to improve connections between TARC's fixed-route bus network and the suburban and exurban destinations in Louisville Metro and surrounding counties. The ongoing disruption to typical travel behavior patterns due to the COVID-19 pandemic, particularly with respect to commuting, represents a rare opportunity to encourage people who have not ridden transit in the past to become loyal TARC customers. However, the existing network of fixed-route bus lines provides insufficient frequency to some riders and inadequate coverage to many others; alone, this current transit service structure is unlikely to be sufficient to recover the levels of ridership pre-pandemic that TARC needs to operate sustainably.

Fixed-route transit also faces significant barriers to success in the Louisville Metro region, such as the region's prevailing low-density development patterns, the car-oriented street designs of many corridors, relatively cheap and plentiful parking, and large "last-mile" gaps between bus stops and major activity centers. However, a range of emerging, innovative transportation options – microtransit (pre-booked or dynamic), dynamic carpooling, car share, and bike/scooter-share, among others – can help to overcome these barriers by extending the reach of the TARC network farther into suburban areas and filling spatial and temporal service coverage gaps. These innovative mobility options can help TARC to redirect its scarce transit operations funding back into key trunk corridors, where they are more cost-effective, while still providing passengers in suburban and exurban areas with a high quality of service. Therefore, the Micro Mobility Transit Study begins by identifying regional mobility needs and evaluating gaps between those needs and existing transit service levels.

One of the key findings from TARC's 2021 Comprehensive Operations Analysis (COA) is that 77% of the system's ridership activity occurred in more urbanized areas within the Watterson Expressway, compared to just 20% of ridership in the much larger and more suburban/exurban areas beyond it. The relative lack of frequent service corridors in the more suburban areas of the region is at least partly responsible for this pattern. Riders require high service frequencies (ideally 15 minutes or better) throughout the day to keep the average waiting times low, obviate the need to consult bus schedules, and make transit a viable option for a wider range of trip purposes, including

spontaneous or discretionary trips. Outside of three corridors – the 4-Fourth Street, 10-Dixie Rapid, and 23-Broadway – there is no frequent service beyond the Watterson Expressway, and likewise none is available outside of Jefferson County. While there is no frequent transit service in these "outer" areas, this report details that in many instances in them, there nonetheless remains both significant need and activity-based demand for additional transit service. This finding is representative of significant unmet mobility needs in the suburban and exurban parts of the region, where people are unlikely to have viable alternatives to private car ownership to access jobs, education, healthcare, services, and other essential activities in their everyday lives. Unfortunately, the capital and operating costs required to extend high-frequency, fixed-route service to every residential community and major activity center in the region are insurmountably high in the near-term.

This study focuses particularly on improving mobility in suburban and exurban areas of Louisville Metro, including in Jefferson, Oldham, and Bullitt counties in Kentucky as well as in Clark and Floyd counties in Indiana. This focus is due in part to the suspension of numerous local, circulator, and regional express routes in these areas due to the post-COVID decline in ridership TARC has experienced. Some of the suspended Circulator routes include the 20-Riverport Circulator, 77-Main-Market Circulator, 96-UL Health Campus Circulator, each of which provide local mobility to workers in major regional employment centers. Likewise, several Express services have also been suspended, including the 45X-Okolona Hillview Express, 49X-Westport Road Express, 53X-Breckenridge Lane Express, 54X-Manslick Express, 65X-Sellersburg Express, 66X-Bullitt County Express, 67X-Oldham County Express, and 68X-Prospect Express. While these express services primarily connected residential neighborhoods with Downtown Louisville, rather than suburban job centers, their suspension means that many of these communities now lack fixed-route service of any kind. Other local route suspensions, such as the 62-Breckenridge-Shepherdsville and the 82-New Albany-Jeffersonville, reduce suburb-to-suburb transportations options for workers in high-growth job centers in Clark, Floyd, and Bullitt counties.

1.2. Study goals and objectives.

The Micro Mobility Transit Study evaluates how TARC can leverage technology-enabled Mobility on Demand (MOD) strategies to improve local and regional mobility in Greater Louisville while expanding the reach of the transit network by bridging first-mile/last-mile connections to suburban destinations. The study aims to develop a vision for the implementation of a pilot project in the Greater Louisville region by synthesizing best practices and lessons learned from other MOD programs at peer transit agencies with similar characteristics to TARC. The study's components include an existing conditions assessment of both the TARC transit network as well as regional travel demand patterns, a problem evaluation which identifies key gaps between mobility needs and existing service levels, a series of case studies from promising American MOD programs drawn from extensive interviews with peer transit agencies, the evaluation of several of potential

new mobility services in carefully selected MOD opportunity zones, prioritization of these MOD opportunity zones against a series of key performance indicators, and an implementation plan with detailed recommendations to prepare for the launch and operations of a Mobility on Demand service. The study was informed by stakeholder discussions through a Steering Committee, which met twice during the study period. Based on input from TARC and these discussions, broad goals and objectives of the study include the following:

- Explore and implement transportation opportunities that enhance the social, economic, and environmental well-being of the service area.
- Connect riders with job opportunities by addressing mobility gaps between fixed-route network and suburban job centers (i.e. “first-mile/last-mile connections”)
- Removing barriers to equity and inclusion
- Provide realistic options to serve customer needs in the current built environment, recognizing it is not fiscally or operationally sustainable to connect all passengers to far-flung destinations with conventional fixed-route bus service.
- Explore opportunities for commingling TARC3 paratransit and Mobility on Demand alternatives to provide flexible, same-day service for these customers at lower cost to TARC.
- Analyze the costs and benefits of Mobility on Demand solutions (e.g. ride-hailing, bike share, car share, autonomous shuttles, microtransit, etc.) as well as technology required, operational and regulatory considerations, and potential barriers to implementation.

1.3. Report structure.

This report is divided into five sections:

Existing conditions analysis: This section lays the groundwork for subsequent tasks of this study. The existing conditions section was undertaken to gain an understanding of the factors that influence the mobility needs of the Louisville area, such as land use, transit market, existing travel patterns, and existing transit and transportation services.

Problem evaluation: This section uses the knowledge gained from the existing conditions analysis to identify locations in the area with unmet mobility needs using an advanced spatial analysis methodology. These efforts provide the context for the study to help determine the feasibility of innovative mobility solutions.

Promising MOD programs from peer transit agencies: Many transit agencies have broadened their service portfolios to include more flexible, on-demand solutions that are better suited to areas with either no or underperforming fixed-route transit. Other transit agencies have implemented new mobility services to expand their reach and connect new riders into the transit network. This section includes eight case studies of innovative mobility services relevant to TARC based on the identified needs in the existing conditions analysis and problem evaluation sections.

Each agency was interviewed to uncover details on purpose and use case, funding and governance, implementation and operations, outcomes, and key lessons learned.

Untested opportunity identification: This chapter summarizes the evaluation of a series of Mobility on Demand alternatives intended to improve the effectiveness of the TARC network in serving existing riders and attracting new customers. These MOD alternatives evaluated include on-demand microtransit, ride-hailing, and micromobility (bike share) alternatives. Evaluations consisted of extensive modeling and simulations to estimate ridership, determine fleet requirements, and perform cost-benefit analysis of each alternative. The section also includes discussion of mobility hubs, multimodal connection points that can facilitate transfers between TARC fixed-route and on-demand services at high-demand locations.

Implementation and launch plan: This section begins by evaluating and prioritizing the 12 different MOD alternatives evaluated in the Untested Opportunity Identification section according to a series of quantitative and qualitative metrics, such as ridership, cost per passenger trip, utilization, potential cost-sharing partnerships, and more. Following is a detailed set of recommendations to prepare for launch and operation of a TARC Mobility on Demand pilot project, including potential funding sources, partnership models, pre- and post-launch activities, marketing and rider education, and accessibility accommodations.

Following is a summary of the study's key recommendations, which are categorized by transportation mode.

1.4. Key recommendations by mode.

1.4.1. Microtransit.

The project team identified eight potential zones in the study area where microtransit service may be viable. Several of these microtransit alternatives are designed to improve first/last-mile connections between suburban job centers beyond the Watterson Freeway and key stops or stations along TARC's most frequent bus lines, including the Dixie BRT corridor Routes 4 (4th Street), 23 (Broadway), and 28 (Preston). Other options are designed to replace low-ridership circulator services (e.g. 75-Bluegrass) or route variants — low-traffic conjugations of a primary route that offer only intermittent service — in suburban areas that operate at high cost per passenger trip.

Of the eight potential microtransit zones evaluated, the four zones with greater promise include Watterson Park, South West End, Preston Highway, and 4th Street/Manslick Road. These zones feature relatively high estimated ridership, the highest forecasted utilization (passenger boardings per vehicle-hour), higher rates of passenger aggregation or shared-rides, and lower operating costs per passenger trip. The Watterson Park and Preston Highway zones, located adjacent to one another in southern Louisville, are particularly promising due to its relatively low vehicle

requirement (just 3-5 vehicles required for each zone, depending on ridership) and connections to frequent TARC service along Route 28-Preston. Additionally, these two zones features a wide range of major employers (e.g. Amazon, UPS Worldport, GE Appliance Park), which may be willing to sponsor the service, as either zone would at least partially resolve workforce transportation issues.

Costs for microtransit implementation depend heavily on the partnership model used to operate the service. If an agency-operated model is used, assuming TARC's hourly operating cost for demand-response service, annual costs would range between $1.30 million (medium-demand) and $2.14 million (high-demand) for both the Watterson Park and Preston Highway zones, combined. Alternatively, if a turnkey purchased transportation model is used, costs for the combined zones would range between $2.18 million (medium-demand) and $3.58 million (high-demand).

To achieve maximum efficiency of service and meet TARC's objectives for Mobility on Demand, microtransit service must offer a range of generalized features including but not limited to:

- Integration with fixed-route service (e.g. GTFS for trip planning and fare payment apps such as MyTARC)
- Effective shared-ride aggregation
- Accommodations for cash-preferred or unbanked riders, riders without smartphones, and riders with limited English proficiency
- Customer service center for customers who prefer to book rides by phone
- Wheelchair-accessible vehicles must be available, such that average wait times are comparable to non-accessible vehicles
- Curb-to-curb service must be available for passengers with disabilities

1.4.2. Ride-hailing.

The project team evaluated four MOD zones that were determined to be unsuitable for other modes (microtransit, micromobility, etc.) for one of several reasons: limited number of destinations to generate ridership, low estimated ridership, and/or lack of a connection with other TARC services. These zones include Clarksville, New Albany North, River Ridge, and Worthington.

Ride-hailing services (e.g. Uber, Lyft) have shown some degree of success in providing flexible transportation service to low-density and hard-to-serve areas in formal pilot programs in which transit agencies contribute a share of rider's costs on the platforms. However, there are a number of challenges inherent to ride-hailing companies' non-dedicated service model that must be overcome in order to serve important TARC customer groups and remain equitable and accessible to riders who need them. Transit agencies typically contract with an additional third party, such as a taxi company, human service transportation provider or non-emergency medical transportation (NEMT) service, to provide equivalent on-demand service with wheelchair-accessible vehicles (WAVs), as well as booking and fare payment options for cash-preferred or non-smartphone-using riders. We recommend that TARC contract with its current demand-response provider, MV

Transportation, to provide on-demand service compliant with FTA regulations to customers in addition to any ride-hailing company.

The cost of ride-hailing service partnerships depends highly on the share of passengers who require traditional demand-response service operated by TARC's existing provider (e.g. because they need to pay cash fares or require a wheelchair-accessible vehicle), which features higher costs per passenger trip. If ridership is evenly split between trips on ride-hailing services and trips fulfilled by the existing demand-response provider, average costs per passenger trip in the four MOD zones evaluated for this mode — Clarksville, New Albany North, River Ridge, and Worthington — will range from $27 to $33 per trip. Unlike microtransit or other shared-ride services, ride-hail services' total operating costs increase in direct proportion to ridership growth, as no aggregation of passengers occurs. Annual cost ranges for the potential ride-hailing zones evaluated in this study include:

- **Clarksville:** $160,000 (medium-demand) to $250,000 (high-demand)
- **New Albany North:** $110,000 (medium-demand) to $170,000 (high-demand)
- **River Ridge:** $60,000 (medium-demand) to $100,000 (high-demand)
- **Worthington:** $310,000 (medium-demand) to $490,000 (high-demand)

1.4.3. Micromobility.

The most promising area of Greater Louisville for micromobility (bike / scooter share), in Downtown New Albany, features a relatively high density of destinations (e.g. shopping, medical, recreation, and employment) and a supportive network of bike and pedestrian infrastructure. This zone is bounded roughly by Charlestown Road and New Albany Plaza to the north, Silver Creek to the east, the Ohio River waterfront to the south, and I-265 to the west. The Downtown New Albany zone features a mix of destinations likely to drive ridership, including New Albany Plaza; the walkable commercial core of Downtown New Albany along State, Spring, and Main Streets; the neighborhood retail corridor along Vincennes Street; and Baptist Health Floyd Hospital. The zone is also accessible to central Louisville via the Ohio River Greenway, which connects to Downtown via the Big Four Bridge in Jeffersonville.

We recommend operating micromobility in New Albany by expanding the existing LouVelo system and installing new docking stations within the zone. LouVelo's only docking stations on the Indiana side of the Ohio River are located in Jeffersonville, near the entrance to the Big Four Bridge. However, the connection between the Big Four Bridge and New Albany via the Ohio River Greenway makes the New Albany zone a suitable expansion area. The zone would advance stakeholder goals of operating LouVelo as a truly regional bike share system, rather than one mostly confined to the most urbanized area of central Louisville. Additionally, there are economies of scale with expanding the existing LouVelo program by using current staff, service contracts, and maintenance facilities.

The project team used best practices in bike share system planning to establish that a minimum of 13 docking stations needed to effectively operate the service in the New Albany zone. Ridership is expected to range from 33 daily rides to 99 daily rides in the zone, assuming a utilization of 0.25 - 0.75 rides per device per day, which is somewhat higher than LouVelo's current utilization but lower than most other American bike share systems. Capital costs for a system with 13 docking stations include about $330,000 in bike acquisition costs and $660,000 for station installation costs. Operating costs range from about $40,000 to about $90,000, depending on the level of ridership in the zone.

1.4.4. Mobility hubs.

Mobility hubs are premium multimodal connection points that include convenient and integrated access for multiple transportation services situated together at high-ridership locations. Mobility hubs improve the rider experience by making the experience of waiting for transit more comfortable and making intermodal transfers more convenient. A variety of different infrastructure should be included at mobility hub locations to facilitate multimodal transfers and encourage ridership, such as:

- Real-time information signage for fixed-route and microtransit services
- Loading zones for ride-hailing vehicles
- Shelters and seating
- Transit pass sales (e.g. MyTARC vending machine)
- EV charging stations (DC Fast chargers) to support bus fleet electrification
- Bike share docking stations (e.g. LouVelo)

One of the most significant benefits of mobility hubs is their ability to encourage transfers between fixed-route and microtransit services. In several cities, some physical infrastructure has been built to support microtransit, including booking/payment kiosks, designated pickup/dropoff curb space, and wayfinding and signage to direct people to designated pickup/dropoff zones or informational kiosks. Mobility hubs provide safe places for people to book and wait for rides, thereby encouraging microtransit use. Seating, shelters, wifi, and other amenities can further improve this experience. Kiosks and ticket machines can make on-demand services accessible to those without smartphones or credit/debit cards by offering additional ways to book and pay for rides with cash. Finally, from an operations perspective, a microtransit mobility hub can lead to further aggregation of rides by creating a logical and easy point for people to choose as their pickup/dropoff destination.

Mobility hubs should be prioritized along fixed-route corridors with frequent service to ensure high-ridership locations are served and wait times for passengers are relatively short, to enable seamless multimodal connections. For the suburban areas of Greater Louisville that are the focus of this Study, these corridors include Route 4-Fourth Street, Route 10-Dixie Rapid, Route 23-Broadway, and Route 28-Preston. Some of the most promising locations for mobility hubs include the South Central Library (Central & McCauley) and Jefferson Mall, both along Route

28-Preston. Both locations have activity throughout the day, supporting riders making multiple types of trips. In addition, both locations have safe waiting areas at bus stops and free public restrooms.

2. Existing Conditions Analysis.

Understanding where transit riders live, work, and travel is critical to designing an effective mobility network that meets the needs of the community. The existing conditions section serves to review land-use, sociodemographic, and transit service datasets to identify gaps in the existing transit network, with a particular focus on access to employment centers located in suburban and exurban areas of the Louisville region. The data collected and presented in this section will be used as the inputs in conducting the problem evaluation in the following section. Although the methods utilized here present a data-driven approach in creating transit service recommendations, it is important to note that qualitative factors outside of strictly quantitative data and analysis also contribute to service implementation. These factors will be addressed through subsequent tasks.

2.1. Methodology.

This study's methodology for evaluating existing conditions in the TARC service area is described in the following section.

2.1.1. Land Use and Activity Center Review.

An important reason for the study's focus on suburban and exurban areas is that these areas of the region are responsible for a substantial share of recent housing and employment growth. Many high-growth areas and key activity centers such as the shopping centers, hospitals, large employers, and college campuses described in the study's **Land Use and Activity Center Review**, have either infrequent TARC service or lack fixed-route transit coverage entirely. These locations are likely to generate and attract significant shares of regional travel demand, and they could produce significant TARC ridership if they were effectively connected to the agency's fixed-route network. The UPS logistics hub at Heritage Creek, Ford's Kentucky Truck Plant, warehousing areas in Shepherdsville, the Southwest campus of Jefferson Community & Technical College, and Preston Crossing development are but some of the more significant activity centers that currently lack fixed-route service within walking distance. [DB1]

2.1.2. Market Assessment.

In this study's **Market Assessment**, the project team makes clear connections between the distribution of population and employment centers, residents' relative level of transit need, and

existing transit service levels. These steps are essential to determining where gaps or inefficiencies in the TARC service network exist and where investment in additional fixed-route service, or more cost-effective service models, may be warranted. We begin by evaluating population and employment densities and matching these with their corresponding recommended transit service models (e.g., fixed-route, dynamic on-demand transit, or pre-scheduled on-demand transit). We then evaluate socioeconomic data to assess each community's relative level of transit need, also known as transit propensity or transit dependence. Together, these two respective approaches yield an "Activity Index" and a "Need Index," two indices that are evaluated against the existing fixed-route network to identify gaps in transit coverage.

2.1.3. Travel Patterns Assessment.

To evaluate the full range of regional travel behavior, we supplement this approach with an analysis of **Travel Patterns** using location-based services (LBS) datasets. LBS data provide a more complete picture of real, recorded travel patterns, as opposed to inferences made from Census data based on residents' home or work locations. The Market Assessment evaluates current performance metrics for TARC's fixed-route service and its ADA paratransit service, TARC3. We also analyze outstanding requests for additional service, such as extended hours of operation or more frequent service, throughout TARC's service area. These requests are straightforward indicators of unmet mobility needs, and they are more highly concentrated in areas where existing service is sparser (e.g., New Albany, Clarksville, Riverport, Jeffersontown, and St. Matthews) as well as the high-need West End neighborhood.

This section also catalogs alternative mobility options available in Louisville Metro, including a vanpool service operated by KIPDA the region's Metropolitan Planning Organization (MPO), the LouVelo dock-based bike share program, dockless scooter-share services, and taxis/TNCs. These programs appear to have both limited coverage and limited market penetration relative to other TARC services.

2.1.4. Transit Service Assessment.

We evaluate the service classification of each TARC bus route (e.g., local, frequent, circulator, or express service patterns) as well as their productivity of service (boardings per revenue-hour and per revenue-mile), and cost per passenger trip. These metrics illustrate which corridors or zones of the network underperform, or perform well, according to established benchmarks of fixed-route bus service performance.

The next step is to evaluate the intensity of current transit service, based on the number of scheduled bus trips at each stop within an area. We call this approach the "Transit Supply Index," as it accounts for not only service coverage, but also service frequency and accessibility via the local street network. In the **Gap Analysis** section, we compare transit demand, expressed by either the Activity Index or Need Index above, with the Transit Supply Index to evaluate service gaps or

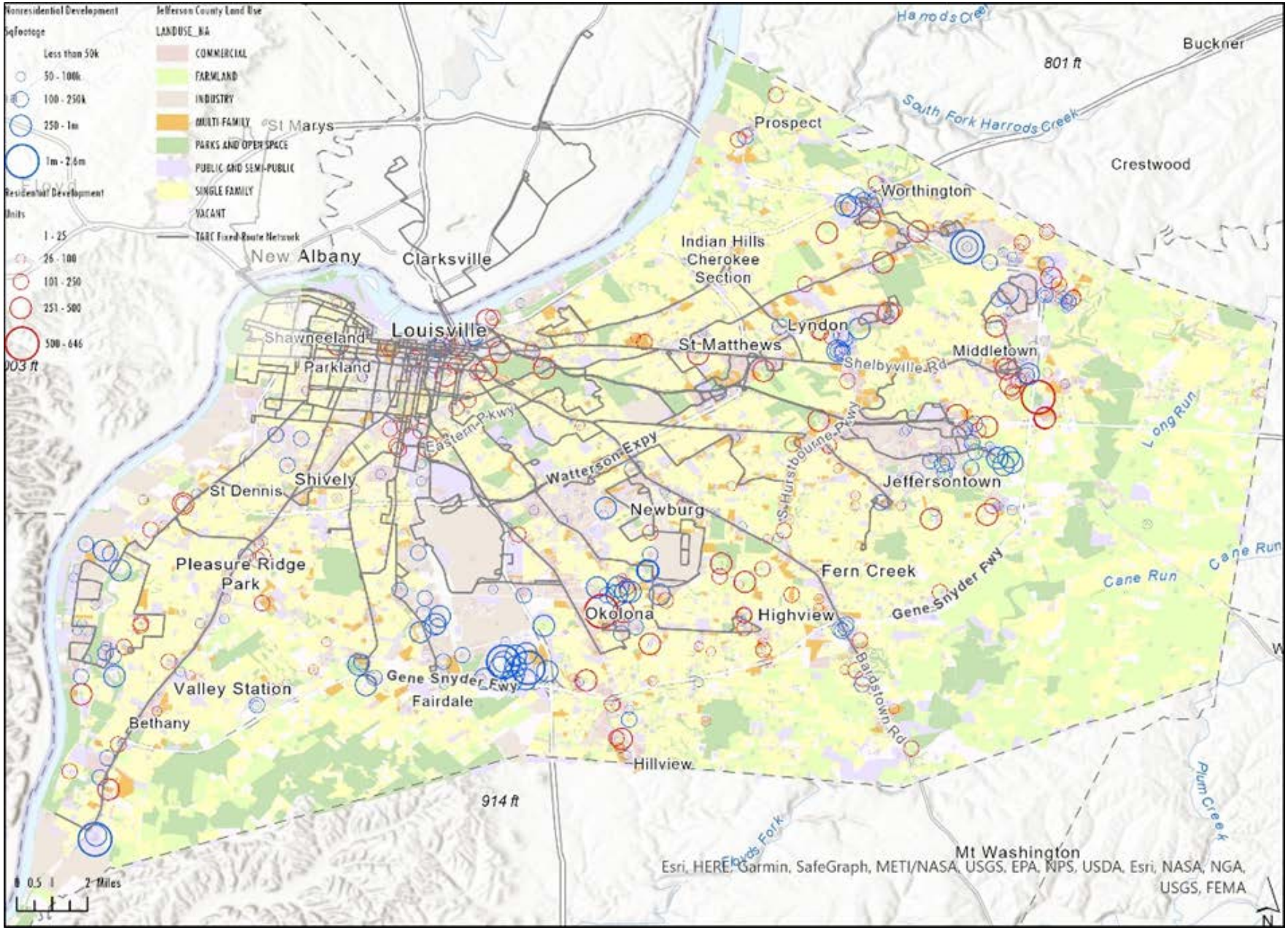
inefficiencies in the region. Service gaps are shown in areas with high Activity or Need scores and low Transit Supply scores. On the other hand, inefficiencies in the network are indicated in areas with low Activity or Need scores and high Transit Supply scores.

Imbalances between transit supply and demand suggest that innovative mobility options may help fill gaps in service and complement the existing fixed-route system. Service gaps point to the need for increased service investment, whether in more frequent, longer-lasting fixed-route service or the introduction of innovative mobility options to support connections with more frequent existing fixed-route corridors. Inefficiencies indicate that fixed-route service is underperforming in a zone or corridor despite strong levels of relative transit demand, and it may be more cost-effective to reduce service, or replace this service with an alternative service model.

2.2. Land Use and Activity Center Review.

An initial element of this study's analysis of existing conditions consists of a review of regional land use and activity centers, which serve as indicators of potential mobility needs in Louisville Metro. Land use, and the intensity of new urban development, is an important determinant in future travel behavior and mobility. Areas with a high intensity of new development may contribute to TARC ridership growth provided they are located within walking distance of frequent transit service corridors that facilitate a variety of journey types. Alternatively, if these high-growth areas are not easily accessible from the TARC network, they may contribute to vehicular traffic congestion as well as mobility challenges for those with limited or no access to private vehicles.

The following map displays Jefferson County's pipeline of completed and/or approved multi-family residential, commercial, and industrial development from 2010 to 2019, as cataloged by Louisville Metro (no equivalent data were available for surrounding counties). These land uses are of particular importance to this analysis because they tend to generate higher rates of person-trips compared with other less intensive uses, such as single-family homes. The distribution of these recent developments is shown in graduated rings (commercial and industrial in blue, multi-family residential in red) corresponding to various classes of development magnitude, shown in total square footage or dwelling units, respectively. The parcel-based, generalized land use patterns of the region are shown in the background.



Data Sources: ESRI, LOJIC, Louisville Metro

This analysis highlights a series of suburban high-growth centers in Jefferson County where recent development is likely to result in greater mobility needs of residents, employees, and visitors. These high-growth areas are distributed far beyond the traditional hubs of higher-intensity development, such as Downtown Louisville, Phoenix Hill, and the University of Louisville campus. Some of the more prominent high-growth areas with significant recent development are in the broad zone between the Watterson Expressway and the Snyder Freeway, including:

- **Worthington**, **near the Snyder Freeway interchange of Brownsboro Road / Ballardsville Road.** Recent developments in this area include the Norton Brownsboro Hospital (600,000 square feet of medical space), Olympia Park Plaza (800,000 square feet of office space), and multi-family housing at Simcoe Lane and The Madison (600 units).
- **Eastpoint**, **along the Snyder Freeway between Old Henry Road and La Grange Road.** Recent developments in this area include Eastpoint Office Park (300,000 square feet of industrial space), LINAK distribution center (300,000 square feet of warehouse space), Old Henry Crossing (200,000 square feet of office space), and multi-family housing at Avoca Ridge Drive, Claibourne Crossing, and Factory Lane (700 units).
- **University of Louisville's Shelbyhurst Campus.** This area's recent developments include multi-family housing on Morat Avenue (500 units), office developments along Hurstbourne Parkway (1 million square feet), and mixed-use development along Whitington Parkway (1 million square feet).
- **Middletown, along the Old Shelbyville Road corridor between the Snyder Freeway and Juneau Drive,** where the Middletown Commons shopping center (500,000 square feet of retail) was recently completed.
- **Signature Point / English Station, on the east side of the Snyder Freeway between Old Shelbyville Road and I-64.** This area recently developed 700 multi-family housing units at English Station / Cool Springs, along English Station Road, and 600 units at "The Villages at English Point," along English Station Way.
- **Blankenbaker Station, at the southwest side of the Snyder Freeway / I-64 interchange.** This area contains more than 3 million square feet of recently developed warehousing and manufacturing space, including a FedEx Ground distribution center. The area also contains more than 500 new multi-family and senior assisted living units along Tucker Station Road.
- **Ashville, along the Bardstown Road corridor between roughly Seatonville Road and Long Home Road.** This area contains more than 400 multi-family and senior assisted living units. An additional 500,000 square feet of retail/commercial space recently opened at the new Southpointe Commons shopping center.
- **Highview, particularly near the intersection of Beulah Church Road and Fegenbush Lane.** This area recently developed nearly 900 multi-family units in the Frontgate and Ashton Park, along Outer Loop and Beulah Church Road, respectively.
- **Jefferson Boulevard area, between Fern Valley Road and Outer Loop, and between Preston Highway and Shepherdsville Road.** Nearly 5 million square feet of primarily warehousing/logistics space were recently built in this area, including major developments

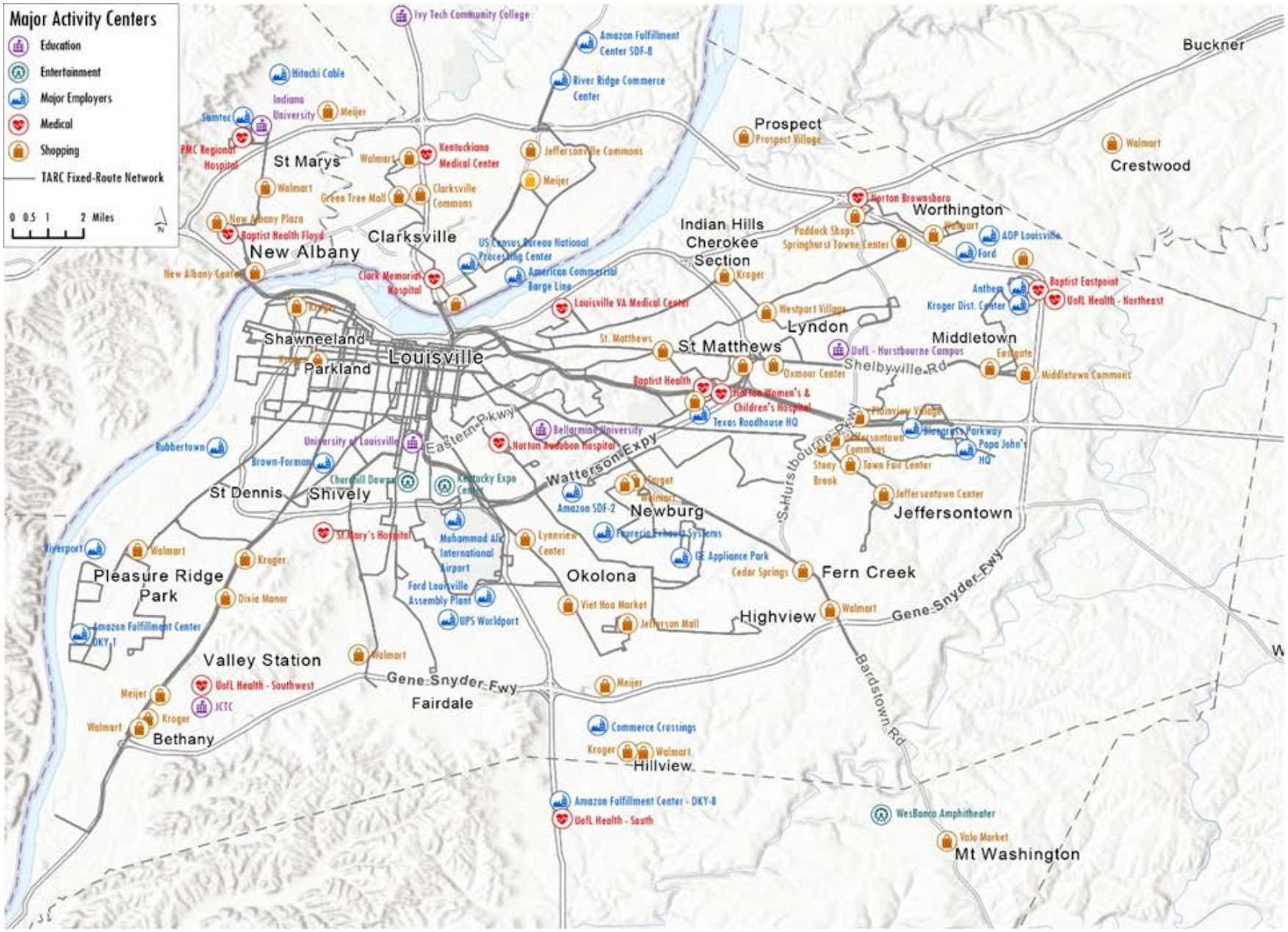
at the Poplar Logistics Center on Rangeland Road, the Jefferson Commerce Center on Jefferson Boulevard, and the Fern Valley Distribution Center along Fern Valley Road. The area has also developed about 1,300 multi-family apartment units, with the largest developments at 1253 McCawley Road, 5100 Gemma Way, and 7321 Jefferson Boulevard.

- **Preston Highway corridor, from roughly the Snyder Freeway south to Antle Drive.** This area is home to the newly built, 200,000 square foot Menards home improvement store as well as over 700 new multi-family units, primarily along Interchange Drive and at the Creekside Crossings development on Cooper Church Drive.
- **Louisville Industrial Center / Heritage Creek, between the Snyder Freeway and Outer Loop, west of I-65 and east of National Turnpike.** This major logistics hub has recently developed nearly 8 million square feet of industrial, warehousing, and distribution center space. Its most significant developments include Renaissance South Business Park, along Minor Lane, and expanded UPS facilities along Air Commerce Drive.
- **New Cut, the area along the Snyder Freeway's New Cut Road exit.** This area recently developed about 1.4 million square feet of industrial and warehousing space, much of it located in a cluster of UPS facilities at New Cut Center (6112 New Cut Road).
- **Valley Village, along the Dixie Highway corridor between Orell Road and Lewis Road.** This area recently developed about 3.2 million square feet of industrial and warehousing space. Its most prominent development is the Southport Warehouses, a distribution center at 6501 Lewis Road.
- **Trade Port Drive / Greenbelt Highway area.** This area contains about 1.4 million square feet of recently built warehousing, manufacturing, and distribution center space. Its largest developments include Algood Manufacturing and a Guess Distribution Center.
- **Greenbelt Highway near Riverport Drive.** This area recently developed about 1.4 million square feet of warehousing space, including a Michelin warehouse.
- **Shepherdsville on the east side of the Kentucky Turnpike (I-65), near the Cedar Grove Road exit**, where several large distribution centers (e.g., Amazon SDF-9, LUK-7, Best Buy) have been recently completed.

This study also examined local and regional activity centers that are likely to generate and attract significant travel demand in Louisville Metro, such as large employers, business parks, shopping centers, hospitals, universities, and entertainment venues. Consideration of these activity centers is important because large shares of TARC's ridership are likely to frequently need transportation to these destinations. As shown in the map below, some significant activity centers currently lack direct fixed-route bus service within ¼ mile, including but not limited to the following (with locations outside the city of Louisville indicated in parenthesis):

- University of Louisville Health – Medical Center South (Shepherdsville)
- University of Louisville Health – Medical Center Southwest
- University of Louisville Health – Medical Center Northeast
- Ford Kentucky Truck Plant
- Heritage Creek (UPS logistics hub), described on the previous page

- Riverport
- Rubbertown
- Amazon Fulfillment Center DKY-8 (Shepherdsville)
- Jefferson Community & Technical College – Southwest Campus
- Ivy Tech Community College (Sellersburg)
- Preston Crossing
- Walmart (Crestwood)
- Walmart (LaGrange)
- WesBanco Amphitheater (Mt. Washington)



Data Sources: Via, Greater Louisville Inc., ESRI

2.3. Market Assessment.

A market assessment is conducted here to: (1) evaluate the specific sociodemographic variables of the community that influence the potential demand for transit, and (2) to understand the need and feasibility of public transportation services in the Louisville metro region. The market assessment is divided into two subsections: (1) an Activity Index and (2) a Needs Index. The Activity Index section addresses the population and jobs in the region and locates areas that satisfy appropriate thresholds supportive of various levels of transit service. The second section, the Needs Index, addresses the sociodemographic variables that are related to increased reliance on transit service.

Two data sources were utilized in the process of conducting the market assessment: the 2019 American Community Survey (ACS) and the 2018 Longitudinal Employer-Household Dynamics (LEHD) data. The ACS was utilized to obtain variables regarding population and households, while LEHD was utilized for employment data. All datasets were downloaded at the Census Block Group (CBG) level so that all variables shared a common geographical unit and could therefore be aggregated to create multivariate indices, discussed further in the next two sections.

2.3.1. Activity Index.

Population and employment density are primary drivers of transit demand. In addition, typical transit market capture is limited to areas within walking distance of stops because most riders walk to access transit and nearly all riders walk after alighting. As a result, population and employment densities along a route determine how many people will have access to transit and ultimately influence the level of service that can be supported in an area. Locations with higher densities typically support greater frequencies of service, while lower density areas are typically better suited to lower-frequency fixed route service or alternative modes such as flexible routes or on-demand service.

Research conducted by the Transit Cooperative Research Program (TCRP) and Institute of Transportation Engineers (ITE) has identified density thresholds for population and jobs that correspond to various levels of transit service. The density thresholds are used to locate areas that are likely to support various types and intensities of transit service. If, for instance, an area has a density over the threshold appropriate for a minimum of 30-minute headway fixed route service but currently has 60-minute headway fixed-route service, then it may be a desirable location for service increases. For this application, the methodology has been adapted and modified here to include a greater level of detail on demand-response service.

An Activity Index is calculated here to measure the demand for transit service in the Louisville Metro region. Population and jobs at the Census Block Group (CBG) level are utilized as input variables. Because job density tends to have a greater effect on transit ridership than population,

the total jobs in each CBG is increased by a factor of two to create a jobs score.[1] [2] [3] The total population for each CBG is then added to the jobs score for an overall activity score. The activity score is then normalized by accessible area, in acres, to obtain an activity density for every CBG. Accessible area is defined here as any area within 0.25 miles from the street network exclusive of water area. Using the accessible area is preferred in this calculation because development is most likely concentrated along streets and not over bodies of water. The Activity Index Score is thereby calculated using the following formula:

Activity Index Score = (Population + (2 x jobs)) / accessible area

The Activity Index scores were then associated with minimum levels of transit service, as shown below in Table 2-1. Any score higher than 15 is likely supportive of fixed-route transit service. Many of the areas with scores in this range are likely to be job centers and major commercial areas. Activity Index scores ranging from 8 to 15 may support fixed-route transit service but may also be good candidates for dynamic on-demand service. Activity Index scores of 2 to 8 are most likely to support dynamic on-demand or pre-scheduled on-demand. The final category includes Activity Index scores less than 2, which is most likely suitable for pre-scheduled on-demand service only. Pre-scheduled on-demand service gives transit providers the advantage of geographically aggregating riders to a greater extent because they have greater control over the scheduling of trips, thus making it a more suitable transit mode in very low population and employment density environments.

Table 2-1. Density Thresholds to Support Transit Levels of Service

Transit Service	Activity Index Score[4]
Fixed Route	> 15
Fixed Route or Dynamic On-Demand	8 to 15
Dynamic On-Demand or Pre-scheduled On-Demand	2 to 8
Pre-Scheduled On-Demand	< 2

The Activity Index analysis results in many locations that appear as “activity islands,” or places that have high transit potential but are surrounded by less active CBGs. This pattern is expected,

[1] Arrington, G. B., and Cervero, Robert. 2008. “Effects of TOD on Housing, Parking, and Travel.” Transit Cooperative Research Program Report 128. Washington DC: Transportation Research Board.

[2] Transportation Research Board. 2009. “Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions.” Special Report 298. Washington DC: Transportation Research Board.

[3] Kolko, Jed. 2011. “Making the Most of Transit. Density, Employment Growth, and Ridership around New Stations.” Public Policy Institute of California.

[4] Activity Index Score is a calculation of population + 2 (jobs).

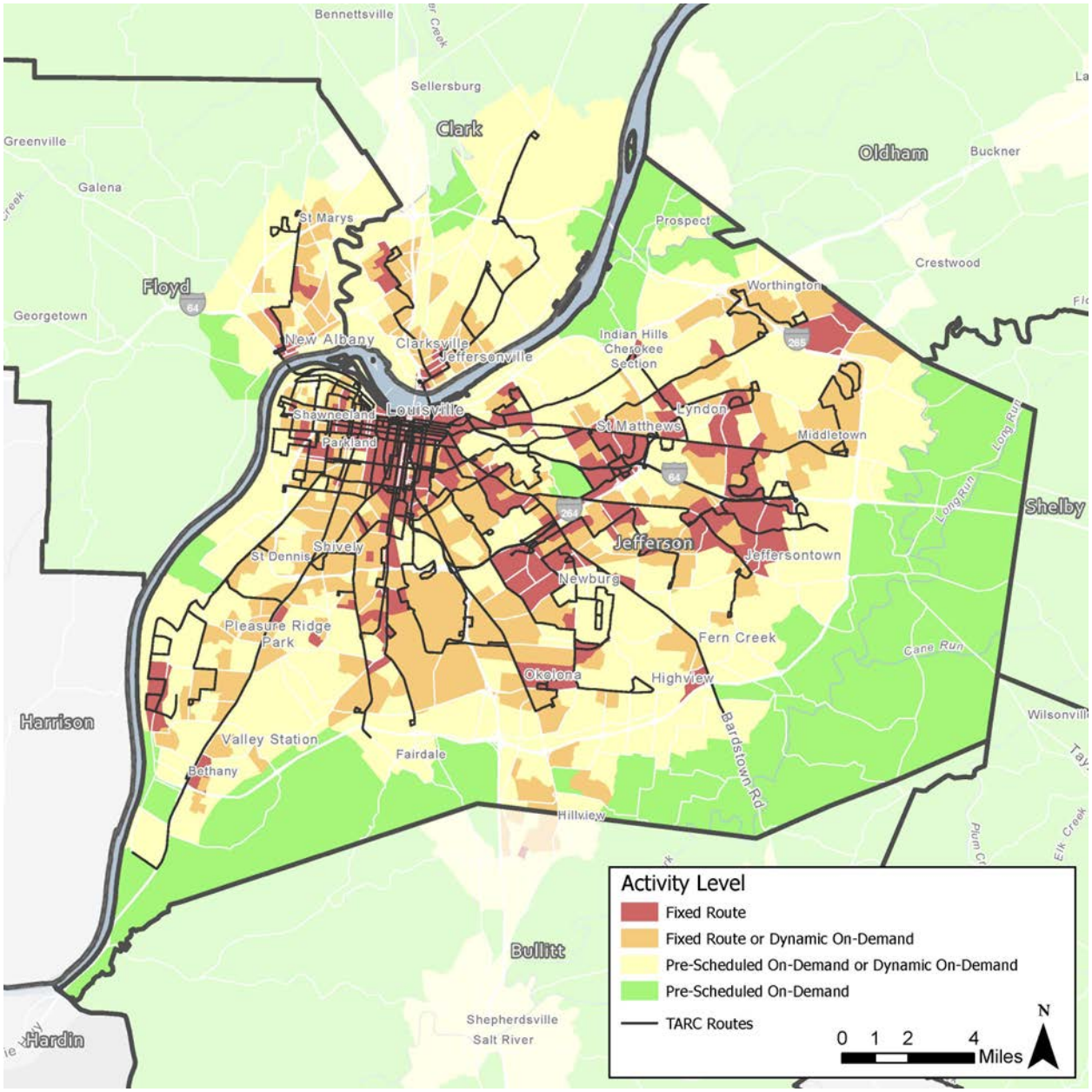
however, because land development does not take place in uniform patterns. The result of uneven development patterns is the need for transit service to operate through less active areas to reach areas with the greatest transit demand potential.

The results of the Activity Index with associated transit service levels are shown below in Figure 2-1. The highlights of this analysis are as follows:

- Nearly all areas in the highest activity level (fixed route) have at least some fixed-route service. The only two areas with little or no transit service in this category are:
    - The area in the far northeast bounded by Westport Road to the north, Gene Snyder Freeway to the west, and La Grange Road to the east has a high density of jobs. Ford, Eagle Steel Products, Deco Paper Products, and other businesses are in this area. Route 25 Oak – Westport serves along Westport Road but does not penetrate this CBG with high activity levels and operates approximately every 40 to 60 minutes.
    - A small CBG in Parkwood has low job density but high population density, with several apartment complexes. The CBG is located to the west of the intersection of Manslick Road, Palatka Road, and St Andrews Church Road. The nearest transit services operate frequent service but are beyond walking distance (Route 10 Dixie Rapid and Route 18 Dixie Highway to the west, and Route 6 Sixth Street – Taylor Boulevard to the east).
- The second highest activity level (fixed route or dynamic on-demand) is relatively well covered with fixed route service, with some exceptions:
    - Sections of New Albany have activity levels in the second highest level, but do not have fixed route service. These areas are primarily located in eastern Floyd County, generally between Spring Street and Charlestown Road. Population density is higher than job density in these areas. Route 82, which used to operate along Spring Street but has been eliminated, had a lackluster daily weekday average of approximately 59 boardings and alightings. The closest transit service is Route 71 Jefferson-Louisville-IUS, but much of this area is outside of a reasonable walking distance.
    - Several CBGs along Preston Highway at the edge of Jefferson County and near the Bullitt County line register as fixed-route or dynamic on-demand. Route 28 Preston operates as far south as St Rita Drive, but many of the CBGs are not within walking distance. This area has the highest activity levels outside but adjacent to the Jefferson County line.
- The third highest activity level (pre-scheduled on-demand or dynamic on-demand) exists largely beyond the reach of most fixed-route service.
    - The large area bound by New Cut Road to the east and Dixie Highway to the west and Gene Snyder Freeway to the south is made up of many CBGs with the third

highest activity level. This includes parts of Parkwood and Prairie Village, with medium to low density residential development.
    - The largely residential development along both sides of Gene Snyder Freeway from New Cut Road to Bardstown Road falls into this activity level. Most fixed routes stop short of Gene Snyder Freeway through this area.
    - Several CBGs in southern Clark County fall into this activity level but do not have transit service, including Oak Park and neighborhoods just beyond the reach of Route 71 Jefferson-Louisville-IUS and Route 72 Clarksville.
- The lowest activity level (pre-scheduled on-demand) occurs primarily along the Jefferson County boundary and outside of the TARC service area.

Figure 2-1. Activity Index by Associated Transit Level of Service



2.3.2. Needs Index.

Aside from concentration of population and employment, there are several sociodemographic characteristics that increase the likelihood of riding transit. The Needs Index aggregates and summarizes the relative need for transit service. A total of seven variables were utilized in the Needs Index, which are listed below:

1. low-income households
2. zero-vehicle households
3. minority population

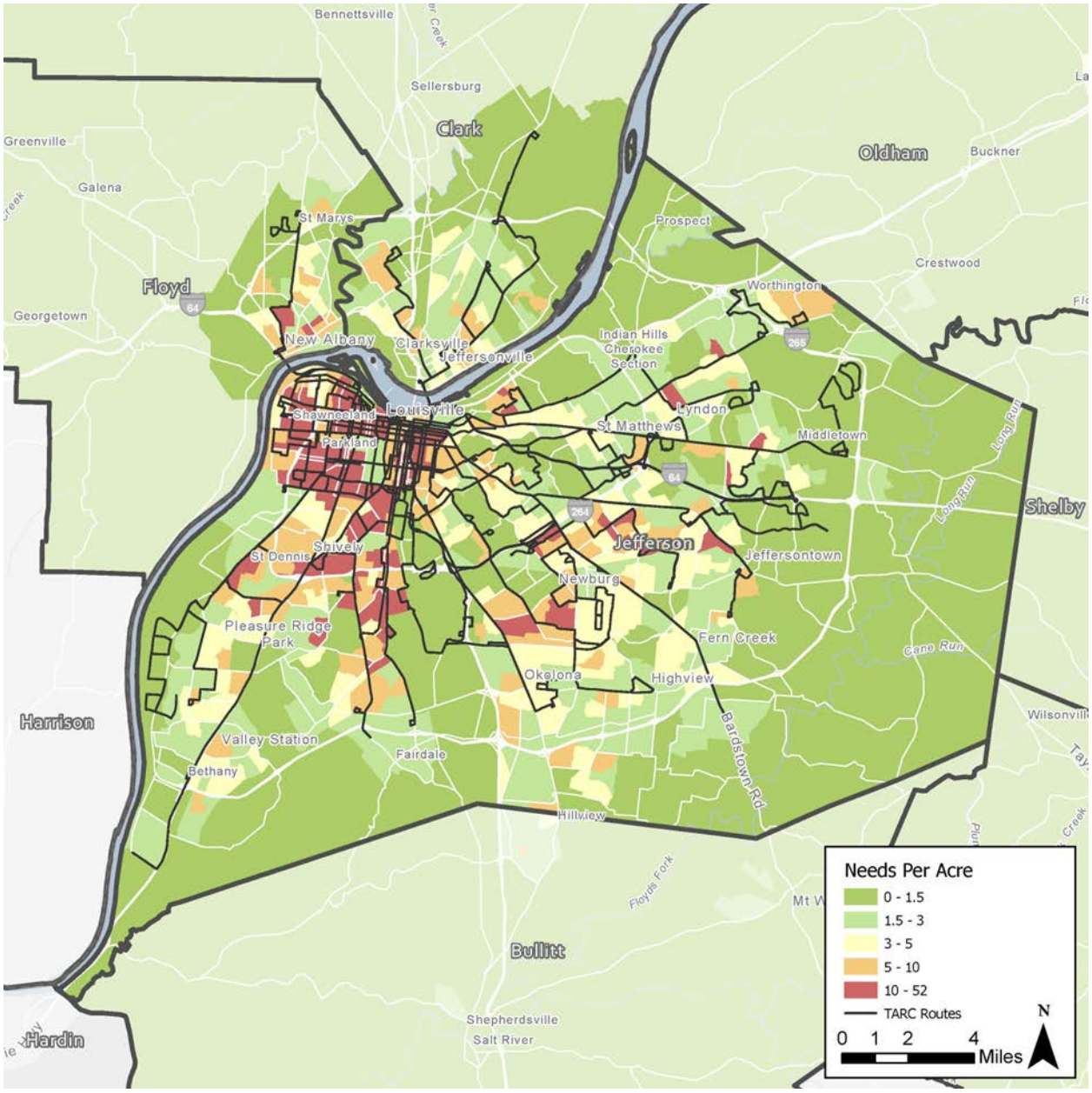
4. English-speaking ability
5. disability
6. elderly population
7. student population

Each variable in the Needs Index was given equal weight so that an individual counted as elderly has equal weight as a student, minority individual, etc. Because two of the seven variables are only available at the household level (instead of at the population level), these variables were multiplied by the average household size for that specific CBG. Using this methodology creates seven variables that are all at the population level for every CBG in the study area. Therefore, the Needs Index does not give variables at the population level more weight than the variables at the household level. Each of the seven variables were then added together and standardized using accessible areas so that a density of transit market variables was calculated for each CBG. Similar to the Activity Index, the Needs Index utilizes the accessible area, which is the measure of land within 0.25 miles of a street (as opposed to the total area). This is done so the demographic concentration is allocated along roadways instead of in the middle of large open fields or over bodies of water.

The results of the Needs Index analysis are shown in Figure 2-2. To show the greatest degree of differentiation in the map, Figure 2-2 uses the raw scores of the Needs Index (low, medium-low, medium-high, and high index scores are utilized in the gaps analysis). Key findings of the TMI analysis are shown below:

- Nearly all of the CBGs with the highest needs are served with transit along the nearest major road.
    - The only exception to this in Jefferson County is in Parkwood, to the west of Iroquois Park. The neighborhoods to the west of Manslick Road register as some of the highest-need CBGs, but do not have transit service within walking distance. The nearest routes are Route 6 Sixth Street to the east and Route 10 Dixie Rapid and Route 18 Dixie Highway.
    - The only exception to this in Indiana is in New Albany, in the neighborhoods along Spring Street and Vincennes Street. Route 71 Jeffersonville-Louisville-IUS serves to the west of these neighborhoods but does not penetrate several high needs CBGs. Route 71 Jeffersonville-Louisville-IUS is approximately 1 mile west of Vincennes Street.
- Several CBGs just beyond the reach of Route 28 Preston have relatively high scores on the Needs Index but are not directly served by fixed route transit.
    - This includes the CBG in the northeast quadrant of Gene Snyder Freeway and I-65, as well as multiple CBGs in the southeast quadrant of Preston Highway and Gene Snyder Freeway.
- Oak Park, in Clark Indiana has a CBG between Route 71 Jeffersonville-Louisville-IUS and the Ohio River with relatively high needs but is a long walk to transit service (about 0.5 to 1 mile) for most residents.

Figure 2-2. Needs Index



2.4. Travel Pattern Assessment.

The previous sections on transit markets identified the places where transit riders are most likely to live and work. While this approach captures the greatest trip generators (home) and attractors (work), it does not capture trips made for other purposes such as shopping, medical appointments, education, etc. The travel pattern assessment makes use of data derived from actual recorded travel movements, and therefore captures a large percentage of trips that the sociodemographic data cannot necessarily predict.

The travel pattern assessment begins with a description of the travel movement datasets utilized. This is followed by discussions of the average weekday total trips, home trips, and work trips observed over the Louisville metro area. Finally, the number of trips over the course of a 24-hour period is compared to the number of TARC bus trips operated over the same time.

2.4.1. LBS Data.

Location-based services (LBS) is a term that can be applied to any software services that utilize geographic data. Within the transportation industry, LBS has been utilized with increasing frequency to understand how people travel within various locations and timeframes. Some of the most common applications of LBS are found in cell phones and other mobile devices that track location for a variety of end-user functions. In this section, data from one of the leading providers of LBS data (AirSage) is used to reveal travel patterns in Louisville, which aids in evaluating current and future transit networks.

The LBS data utilized in this study is in a trip matrix format using CBG as the geographical unit of analysis for Bullitt, Jefferson, Oldham, Shelby, and Spencer counties in Kentucky, and Clark and Floyd counties in Indiana. The study period for this analysis is April of 2021. Each record includes an origin zone, a destination zone, and the number of trips occurring between the two. The data also include information on hour of day (0-24), day of week (Monday-Thursday, Friday, Saturday, and Sunday), and trip purpose. For the purposes of this study, all analysis referring to “weekday” utilizes the Monday through Thursday trip dataset.

The trip purposes are populated by AirSage based on algorithms that make assumptions of home and work locations, and therefore can assign trip type (e.g., home to work, work to home, home to other, etc.). Home locations are determined by where the mobile device spends the majority of the night hours over the period of a month. Work locations, conversely, are the locations where the mobile device spends the majority of traditional working hours. An important caveat is that while many trips are assigned some combination of home, work, and other location, some trips are assigned a trip type that begins and ends at the same location (e.g., home to home). While initially counter-intuitive, this type of trip simply signifies a movement that starts and ends at the home location without stopping at an intermediate location long enough to trigger a trip end. An example of this situation could be where someone leaves their home only to stop at a gas station for four or five minutes and then returns home.

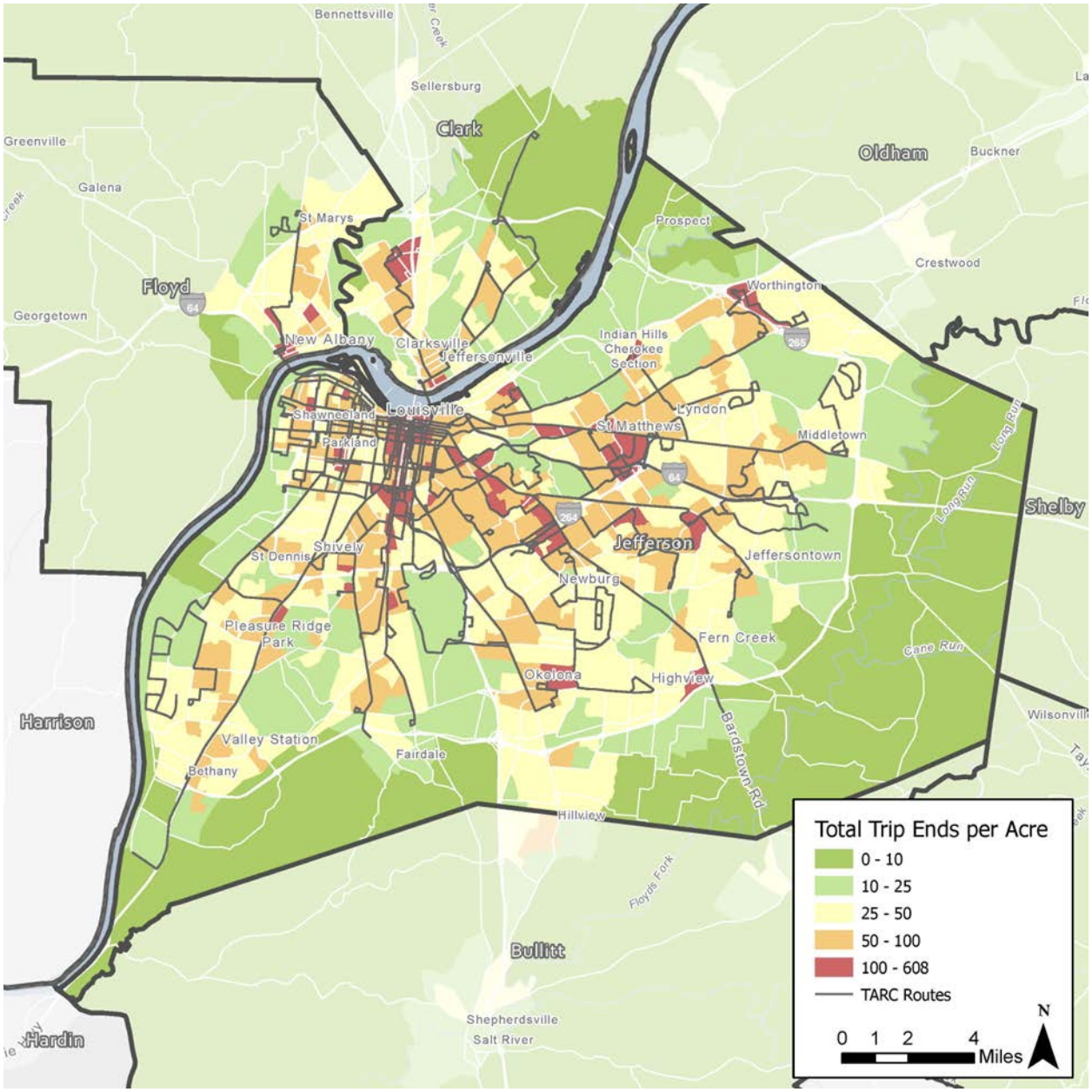
2.4.2. Total Trips.

The total number of trip ends (origins + destinations) in the April 2021 AirSage dataset were aggregated to quantify and map the overall demand for travel in the study area. Figure 2-3 shows the average weekday trip density at the CBG level. Key findings are as follows:

- The vast majority of CBGs with high trip densities are served by TARC fixed routes. There are a few areas, however, with relatively high origins + destinations that are not directly served by fixed-route transit:

- New Albany has relatively high trip density in the northern sections of downtown, especially along Locust Street. The Spring Street corridor also has relatively high trip densities and lacks direct transit service. The nearest fixed route to these areas is Route 71 Jeffersonville-Louisville-IUS.
- The southeast quadrant of the Gene Snyder Freeway and Preston Highway interchange area has relatively high trip density. In general, the area along Gene Snyder Freeway from I-65 on the west to Bardstown Road on the east has elevated trip-densities compared to other locations along Gene Snyder Freeway.
- Prairie Village to the east of Valley Station has relatively high trip densities without direct fixed-route transit service. The nearest routes are Route 10 Dixie Rapid and Route 18 Dixie Highway, both to the west of this location.
- The neighborhood to the west of the intersection of St Andrews Church Road, Manslick Road, and Palatka Road has high trip-density without direct transit service. This neighborhood also scored high on the Activity Index and Needs Index in the previous sections.

Figure 2-3. Total Trips (Average Weekday)

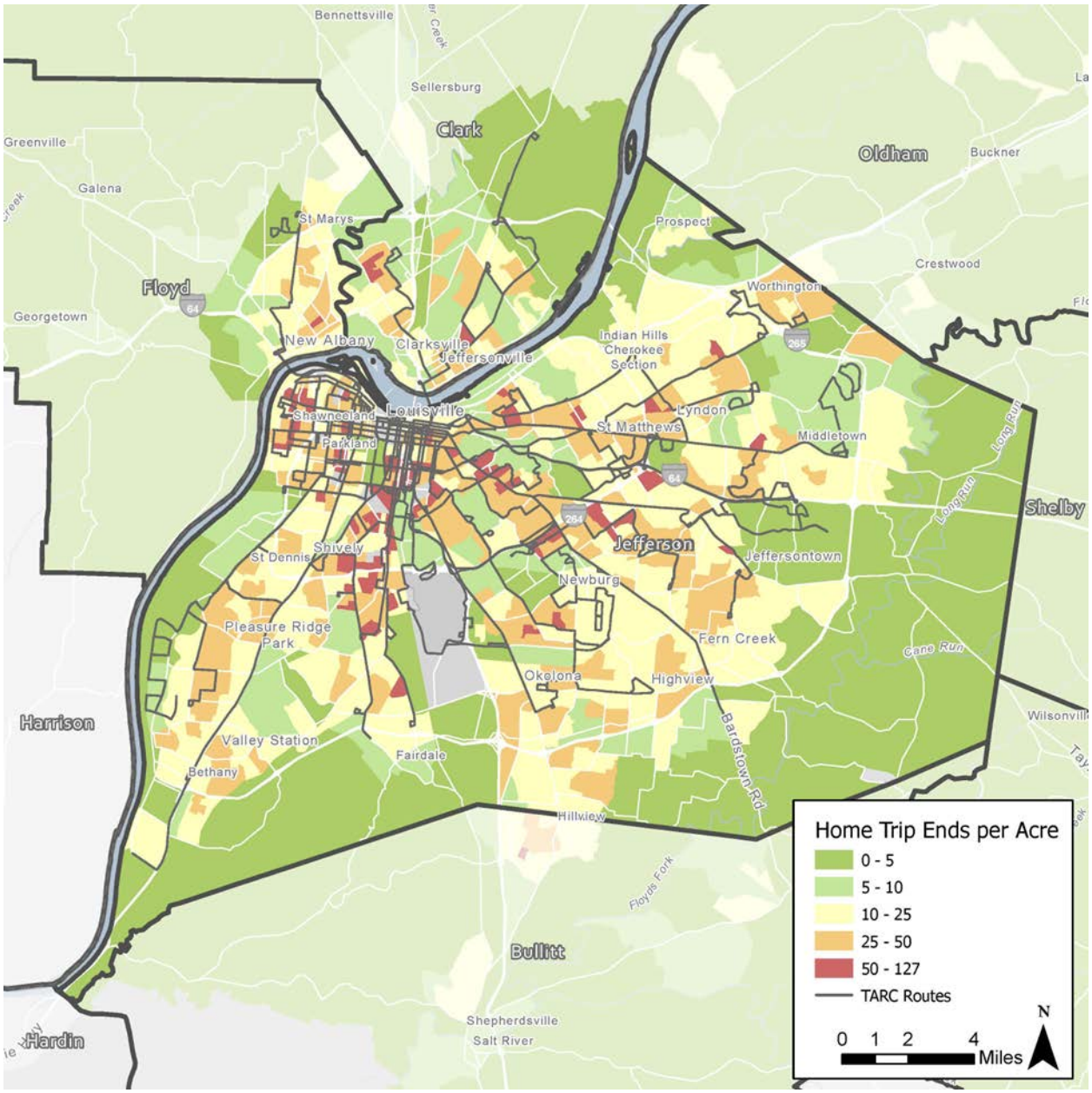


2.4.3. Home Trips.

The home location of average weekday trips that involved a home trip origin or destination were aggregated and summarized cartographically in Figure 2-4. This included the origin of “home to home”, “home to work”, and “home to other” trip types, as well as the destination of “home to home”, “work to home”, and “other to home” trip types. The aggregation of these trip types represents the home locations of travel movements weighted by how many trips start and end in each CBG. The results show the greatest number of trips occurring to and from homes. Key findings from this analysis are described below:

- Like the total trip count in the previous section, a large section of New Albany has higher trip density but is not directly served with fixed-route transit. The only route in New Albany is Route 71 Jeffersonville-Louisville-IUS.
- Also in Indiana, neighborhoods on the eastern side of Hamburg Pike have higher home trip density. These neighborhoods are between Route 71 Jeffersonville-Louisville-IUS on the east and Route 72 Clarksville on the west.
- Neighborhoods on the western side of Manslick Road have higher home trip density but no direct transit service. The nearest routes to this area are Route 6 Sixth Street to the east and Route 10 Dixie Rapid and Route 18 Dixie Highway to the west.
- Several sections in the Valley Station area have higher home trip density. Although Route 10 Dixie Rapid and Route 18 Dixie Highway service operate to the west, transit is likely too far for most residents to reach.
- The neighborhoods between I-65 and Preston Highway have higher home trip density than most other areas along the Gene Snyder Freeway. The neighborhoods just east of this area, including north and south of the Gene Snyder Freeway and to the east of Preston Highway also have higher home trip density.
- The neighborhoods on each side of Bardstown Road inside of the Gene Snyder Freeway have large areas that have higher home trip densities. Several of these neighborhoods are likely too far to reach Route 17 Bardstown Road or Route 43 Portland Poplar Level to the west, or Route 40 Taylorsville Road to the east.
- Just beyond the reach of Route 31 Shelbyville Road, the neighborhoods to the southeast of La Grange Road have high home trip densities. The neighborhoods are on the opposite side of the Gene Snyder Freeway from Route 31 Shelbyville Road, which makes utilizing the service very difficult.
- The neighborhoods to the north of Westport Road, on both sides of Murphy Lane, have higher home trip density than the surrounding area. Route 25 Oak-Westport serves a small section of these neighborhoods but does not penetrate most of the high trip areas.

Figure 2-4. Home Location of Home-Based Trips (Average Weekday)

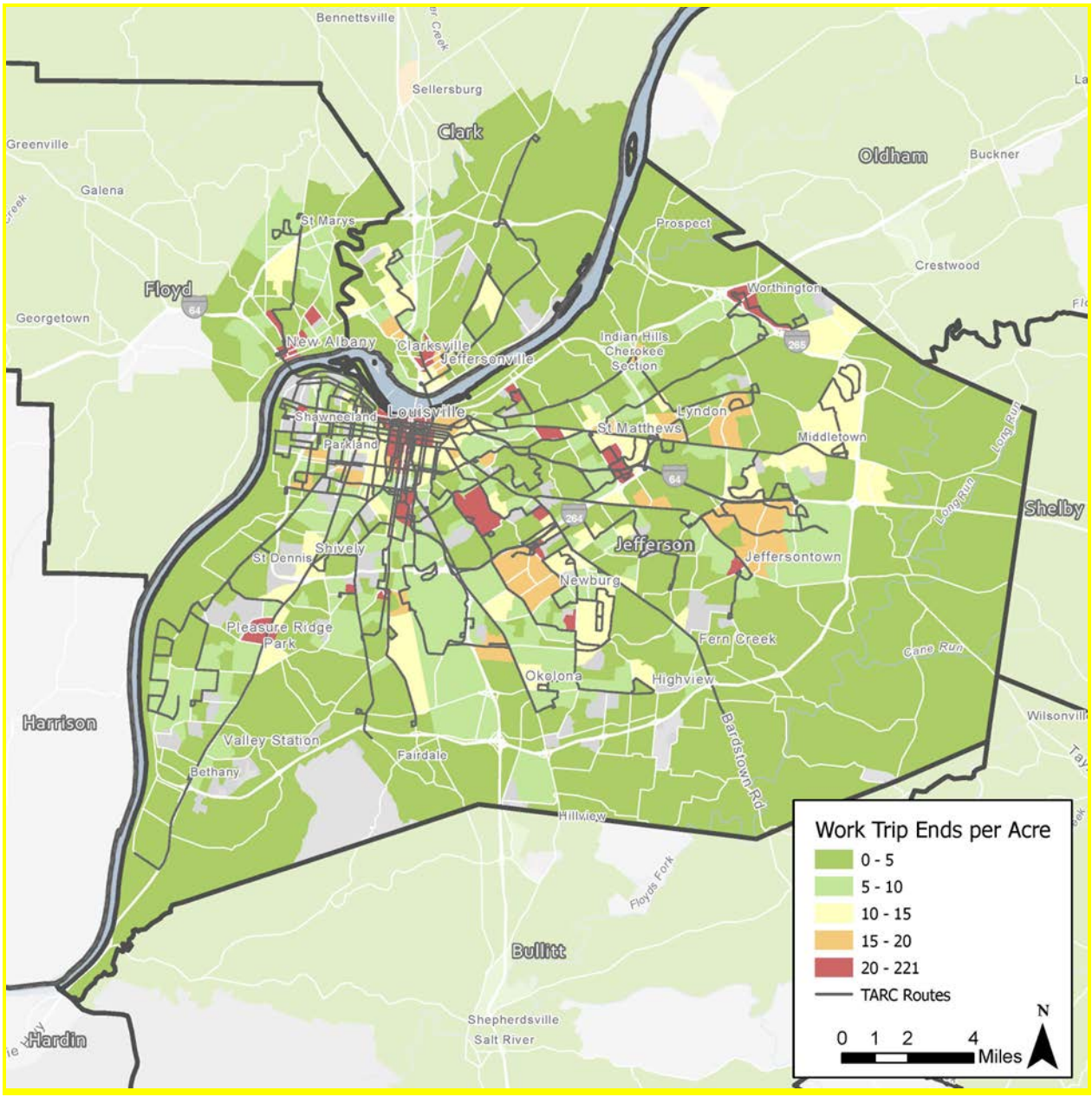


2.4.4. Work Trips.

The work location of average weekday trips that involved a work trip origin or destination were summarized and mapped in Figure 2 5. The LBS trip types included were the origin of “work to home”, “work to work”, and “work to other”, as well as the destination of “home to work”, “work to work”, and “other to work”. These trips were aggregated similarly to home trips in the previous section to show where work locations with the most trips occur in the region. Key findings from this analysis are as follows:

- Work trip ends are more concentrated than home trip ends, as is typical for many metro areas. This is because people tend to congregate in commercial or industrial areas, or at other job sites, in order to work. All of the highest work trip densities in the region are served by some fixed-route transit except for downtown New Albany. The high work trip locations in this area are likely too far to access the nearest route, Route 71 Jeffersonville-Louisville-IUS.
- Large areas along Gene Snyder Freeway, from I-64 to Westport Road, have relatively high work trip densities.
    - Route 31 Shelbyville Road circulates through some of the higher work trip density areas on the inside of the Gene Snyder Freeway. Most of this area, however, receives infrequent service (six trips a day on weekdays).
    - The CBG between La Grange Road and Westport Road, outside of the Gene Snyder Freeway, has adjacent service via Route 25 Oak-Westport but no direct service.
    - To the northwest of the previous example, a CBG along the Gene Snyder Freeway has high work trip end activity. Route 25 Oak-Westport operates directly through this area 22 times daily, with headways ranging from 30 to 50 minutes.

Figure 2-5. Work Location of Work-Based Trips (Average Weekday)

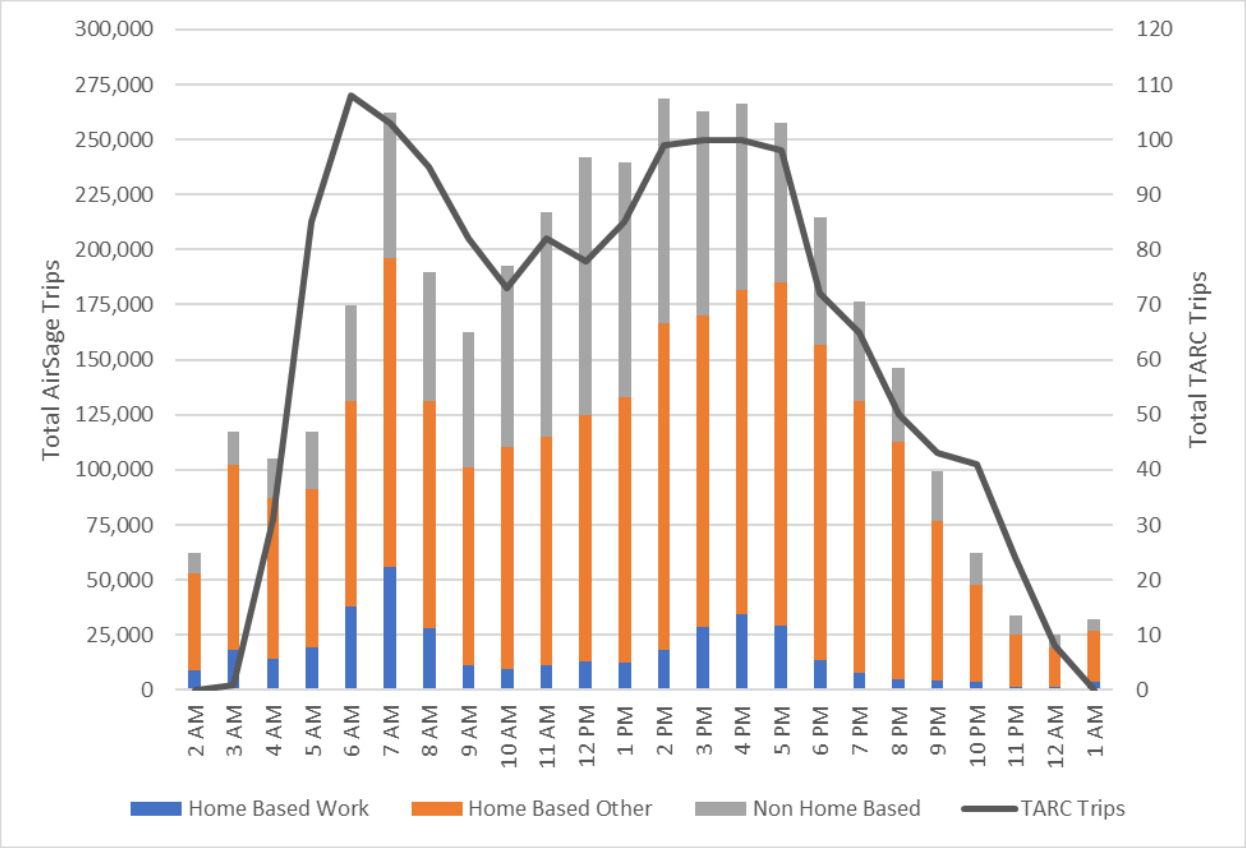


2.4.5. Temporal Patterns.

The LBS data was compared to the number of transit trips to gain insight into any disparities between total trips taken by all modes and transit service offered. Transit trips are defined here as the total number of trips taken by all routes in the system per hour. LBS data are segmented into home-based work, home-based other, and non-home-based trip types to see how each of the trip types vary in distribution over the course of a day. The results are shown in Figure 2-6. Key findings are as follows:

- Overall, LBS trips and transit trips track an expected diurnal pattern of 24-hour activity. The LBS dataset shows a steep increase in trips in the morning hours, leading up to an AM peak hour at 7am, followed by a steep decline.
- The afternoon peak increases gradually, creating a much wider distribution of trips in the afternoon hours compared to the morning. The transit trips follow a similar trend, with an am peak during the 6am hour and a wider pm peak from 2pm to 6pm.
- Slight differences in the distribution of LBS trips and transit trips exist in various parts of the day. For instance, there appear to be a slightly greater percentage of LBS trips from approximately 11am to 9pm. This suggests that it may be beneficial to consider offering additional transit trips during the midday and pm peak. It may be possible to increase the number of trips during these times by reducing the number of trips into the evening.
- Although there is also a difference in LBS trips and transit trips in the am peak, great care should be taken in considering eliminating early transit trips. Many transit trips in the TARC system are over an hour long and would only be counted in the first hour of operation in Figure 2-6 below.

Figure 2-6. LBS Trips and TARC Fixed-Route Service Trips



2.5. Transit Service Assessment.

TARC is the major transit service provider in the Louisville metro area. In addition to services provided by TARC, there is a vanpool service and there are private mobility services such TNCs and dockless bikes and scooters. This section details each of the mobility services in the TARC service area.

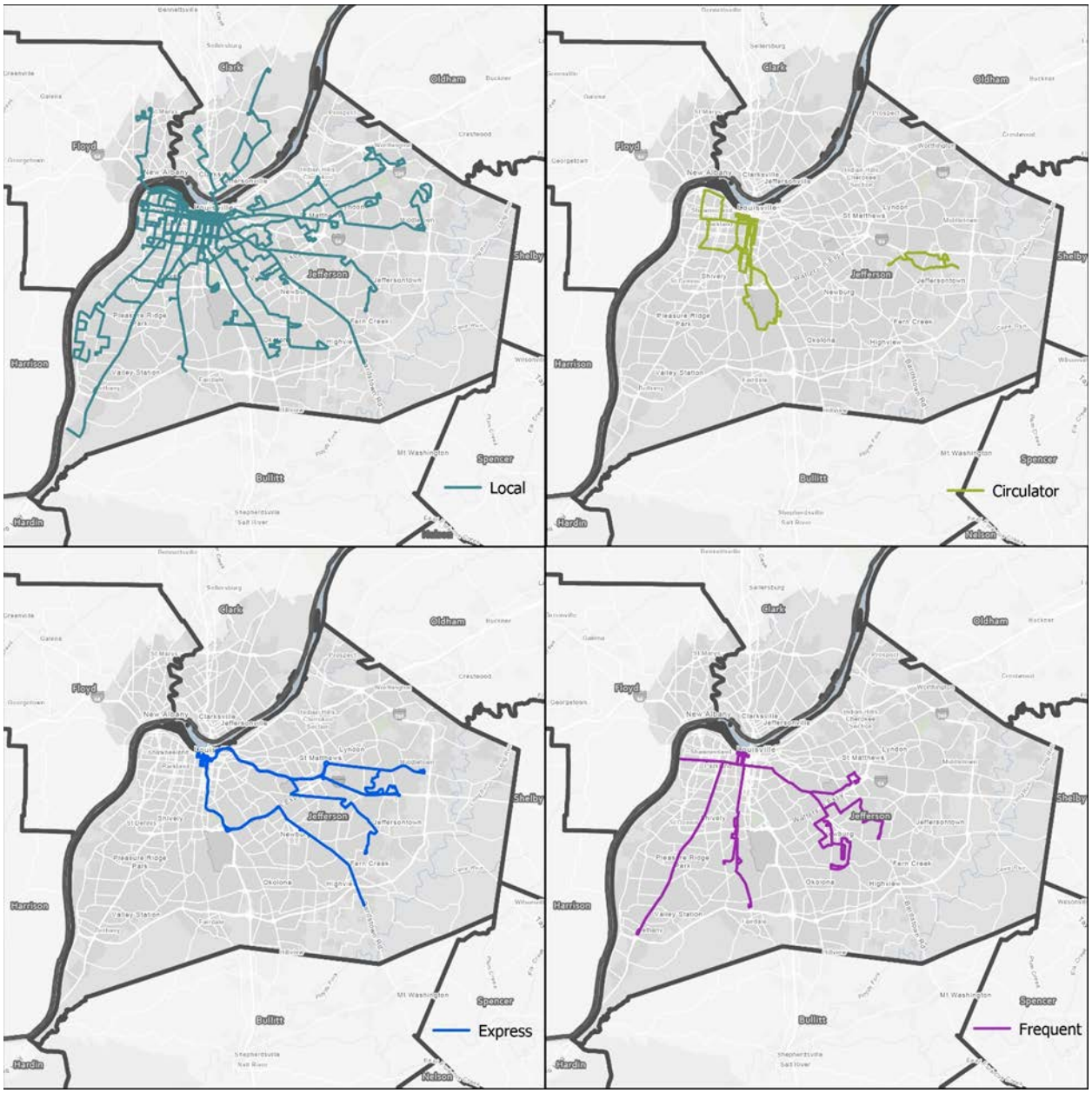
2.5.1. TARC Services.

TARC currently provides two types of transit service: bus and paratransit. The bus service is made up of 31 fixed routes, while the paratransit service is branded as TARC3 and operates as an ADA on-demand service. Bus service (fixed-route service) is discussed in section 2.4.1.1 and paratransit service (TARC3) is discussed in 2.4.1.3. Finally, outstanding service requests that have been submitted to TARC are discussed in section 2.4.1.4.

2.5.1.1. Bus Service.

TARC currently operates 31 fixed routes throughout the service area. All 31 routes operate on weekdays, 24 routes operate on Saturdays, and 21 routes operate on Sundays. Service is classified into service types, each tailored to meet the specific needs of the travel market. Currently there are four service types: Local (19 routes), Frequent (3 routes), Circulator (5 routes), and Express (4 routes). A map of the fixed route system can be seen in Figure 2-7 below. Immediately following the service map is a discussion of route performance using Key Performance Indicators (KPIs) that focus on the efficiency of service provided.

Figure 2-7. TARC Fixed-Route Service



2.5.1.2. Bus Performance Metrics.

KPIs were calculated from system service and ridership statistics to assess the performance of each TARC route by average weekday, Saturday, and Sunday for the last three bid periods (January 2021, June 2021, and August 2021). Although total ridership is oftentimes used as a measure of success, standardizing ridership using operating requirements provides a fairer comparison for evaluating efficiency. The following KPIs were utilized to rank how well routes perform relative to the fixed-route system:

- **Pax / trip** = Passengers per Trip. This measures total boardings, on average, for each one-way trip provided.

- **Pax / Rev Hr** = Passengers per Vehicle Revenue Hour. This measures how many passengers are using the service for each service hour provided.
- **Pax / Rev Mi** = Passengers per Vehicle Revenue Mile. This measures passenger boardings relative to revenue miles provided.
- **Cost / Pax** = Cost per Passenger Trip. This metric divides the cost to operate the route by the number of boardings.
- **Ave Rank** = Average of ranking for all four metrics. This summarizes how well each route compares to the rest of the system using all four metrics in a single value.

The KPI results are shown below in Table 2-2 (Weekday), Table 2-3 (Saturday), and Table 2-4 (Sunday). Immediately following the tables of KPIs in Figure 2-8 is a map of passengers per revenue mile by route, divided into the top third (above average), the middle third (average), and the bottom third (below average). Key findings from the bus performance metrics are described below:

- The Frequent service type outperforms the other three service types for all four metrics for all three day types. The best Frequent route is Route 23 Broadway, which outperforms all other routes by significant margins. Route 4 Fourth Street, another Frequent route, also performs very well across all metrics and day types.
- Express service performed the worst, which is at least in part due to the impact that the COVID-19 pandemic has had on work oriented commuter transit. The four express routes (17X, 31X, 40X, and 61X) make up the lowest performing routes on almost all four KPIs.
- The Circulator routes perform much better than the Express routes, but worse than the Local and Frequent routes. The Medical Center Circulator (operating downtown) tends to perform the best compared to the others, while the UPS U of L Shuttle generally performs the worst.
- The Local routes range from excellent to poor. The worst performing Local routes are:
    - Route 2 Second Street that operates to Louisville International Airport
    - Route 22 Twenty-Second Street, operating on the west end of downtown
    - Route 31 Shelbyville Road, operating from downtown west on Shelbyville Road before circulating through Berrytown and Baptist Eastpoint Hospital.
- Saturday service is the most cost-efficient day type, closely followed by Sunday. Weekday service is the least cost efficient, with the average cost per passenger for routes over twice that of Saturday service. This is largely due to Express service only operating during weekdays. However, the Local, Frequent, and Circulator routes average to be more cost efficient than weekdays. This suggests a need for additional Saturday service.
- Figure 2-8 shows the geographic distribution of route efficiency in terms of passengers per revenue mile. The UPS West Louisville and the UPS U of L Shuttle both are shown as poor performers, as are the routes operating in northeast Jefferson County, Route 31 Shelbyville Road, Route 31X Middletown Express, and Route 61X Planview Express.

Table 2-2. Weekday Route Performance (Average and Rank for 2021)

#	Route Name	Service Type	Pax / Trip		Pax / Rev Hr		Pax / Rev Mi		Cost / Pax		Ave Rank
			Ave	Rank	Ave	Rank	Ave	Rank	Ave	Rank	
2	Second Street	Local	2.5	24	4.3	24	0.37	23	$23.43	24	23.75
4	Fourth Street	Frequent	9.1	10	10.0	4	1.02	2	$9.62	2	4.5
6	Sixth Street-Taylor Boulevard	Local	9.5	7	10.1	3	0.88	3	$9.96	4	4.25
10	Dixie Rapid	Frequent	5.6	18	5.2	20	0.40	21	$20.31	21	20
12	Twelfth Street	Local	3.9	21	8.3	8	0.66	8	$12.48	7	11
15	Market Street	Local	9.4	8	7.7	11	0.63	11	$13.29	10	10
17	Bardstown Road	Local	8.1	15	6.7	16	0.55	16	$15.37	16	15.75
17X	Fern Creek Express	Express	1.3	26	1.1	29	0.07	27	$102.80	27	27.25
18	Dixie Highway	Local	9.8	6	8.0	9	0.65	10	$12.83	9	8.5
19	Muhammad Ali Boulevard	Local	13.6	2	9.6	5	0.80	5	$10.61	5	4.25
21	Chestnut Street	Local	8.4	11	6.8	15	0.59	14	$14.83	15	13.75
22	Twenty-Second Street	Local	1.2	27	2.0	26	0.18	26	$49.70	26	26.25
23	Broadway	Frequent	18.5	1	14.2	1	1.29	1	$7.02	1	1
25	Oak-Westport	Local	12.4	3	7.4	12	0.54	17	$14.38	13	11.25
27	Hill Street	Local	8.2	13	8.4	6	0.75	6	$11.90	6	7.75
28	Preston	Local	11.0	4	10.6	2	0.83	4	$9.84	3	3.25
29	Eastern Parkway	Local	9.1	9	8.3	7	0.65	9	$12.53	8	8.25
31	Shelbyville Road	Local	6.5	17	4.9	21	0.38	22	$21.18	23	20.75
31X	Middletown Express	Express	0.9	29	1.2	27	0.06	29	$108.30	29	28.5
40	Taylorsville Road	Local	7.1	16	5.9	18	0.47	19	$17.66	17	17.5
40X	Jeffersontown Express	Express	1.1	28	1.1	28	0.06	28	$103.52	28	28
43	Portland Poplar Level	Local	10.8	5	7.8	10	0.61	13	$13.33	11	9.75
52	Medical Center Circulator	Circulator	2.8	22	4.3	25	0.68	7	$20.06	20	18.5
61X	Plainview Express	Express	0.9	30	0.8	30	0.04	30	$160.71	30	30
63	Crums Lane	Local	8.2	14	7.4	13	0.52	18	$14.65	14	14.75
71	Jeffersonville-Louisville-IUS	Local	8.3	12	6.0	17	0.42	20	$18.09	18	16.75
72	Clarksville	Local	5.5	19	7.0	14	0.62	12	$14.33	12	14.25
93	UPS U of L Shuttle	Circulator	2.8	23	4.6	22	0.26	25	$25.78	25	23.75
94	UofL Cardinal Shuttle	Circulator	1.7	25	4.4	23	0.56	15	$20.64	22	21.25
99	UPS West Louisville	Circulator	4.9	20	5.8	19	0.35	24	$19.90	19	20.5
	System Average	Local	8.1		7.2		0.59		$16.34		
		Frequent	11.1		9.8		0.90		$12.31		
		Express	1.1		1.0		0.06		$118.83		
		Circulator	3.0		4.8		0.46		$21.59		
		All	6.8		6.3		0.53		$30.30		

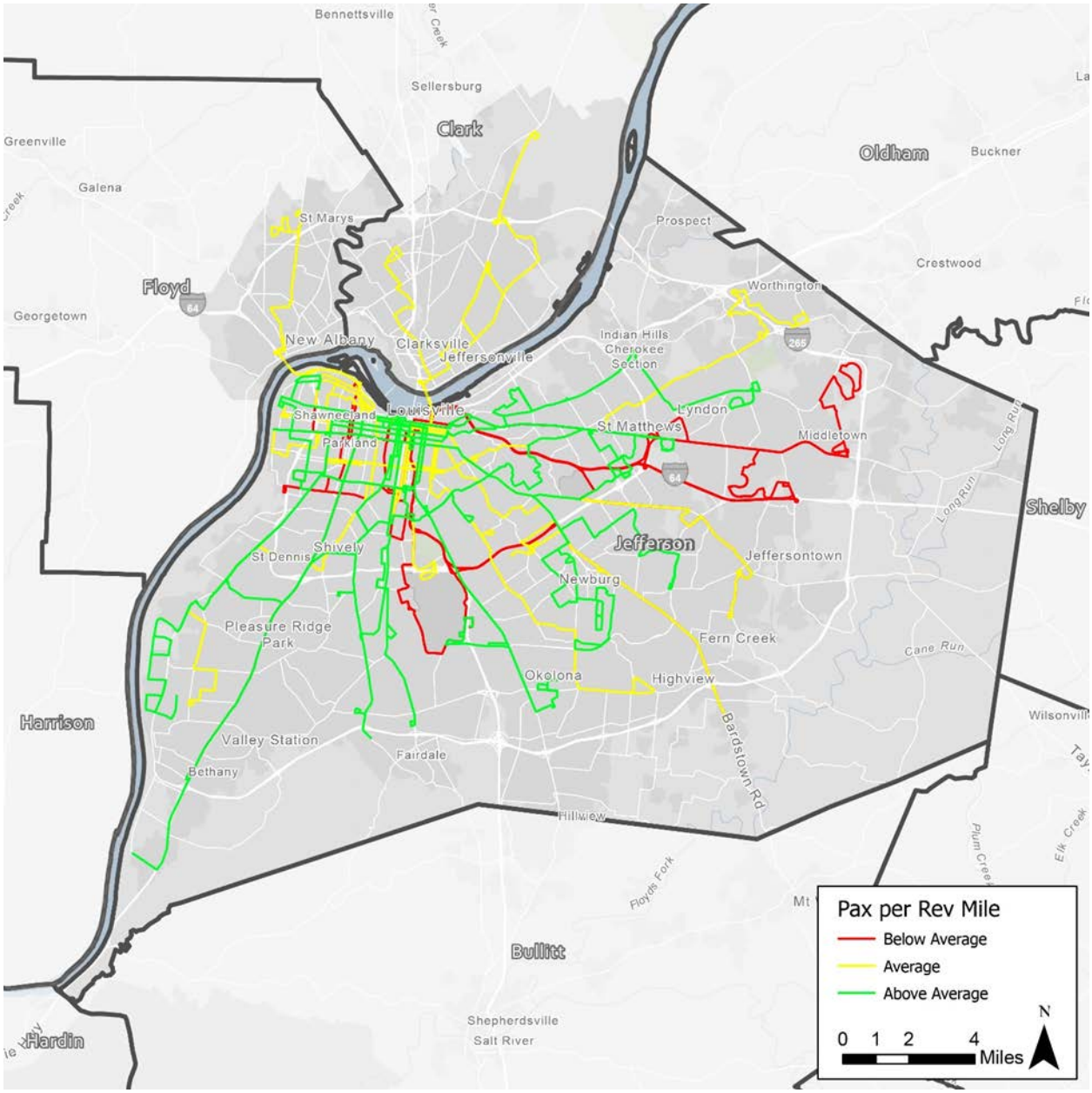
Table 2-3. Saturday Route Performance (Average and Rank for 2021)

#	Route Name	Service Type	Pax / Trip		Pax / Rev Hr		Pax / Rev Mi		Cost / Pax		Ave Rank
			Ave	Rank	Ave	Rank	Ave	Rank	Ave	Rank	
2	Second Street	Local	2.4	23	4.1	23	0.34	24	$24.92	23	23.25
4	Fourth Street	Frequent	9.1	8	11.6	2	1.08	2	$8.50	2	3.5
6	Sixth Street-Taylor Boulevard	Local	7.7	13	9.5	4	0.74	4	$11.04	4	6.25
10	Dixie Rapid	Frequent	6.5	17	6.0	21	0.46	18	$17.38	20	19
12	Twelfth Street	Local	3.5	21	7.5	14	0.61	9	$13.74	10	13.5
15	Market Street	Local	9.7	5	8.6	7	0.63	8	$12.40	7	6.75
17	Bardstown Road	Local	8.5	10	8.0	8	0.58	10	$13.41	8	9
18	Dixie Highway	Local	9.4	7	8.6	6	0.68	5	$12.03	6	6
19	Muhammad Ali Boulevard	Local	11.6	4	8.8	5	0.68	6	$11.89	5	5
21	Chestnut Street	Local	7.8	12	6.9	16	0.52	16	$15.42	16	15
23	Broadway	Frequent	16.7	1	13.1	1	1.09	1	$7.82	1	1
25	Oak-Westport	Local	12.4	2	7.9	9	0.53	13	$13.90	11	8.75
27	Hill Street	Local	6.3	18	6.9	15	0.58	11	$14.81	14	14.5
28	Preston	Local	11.7	3	10.3	3	0.85	3	$9.94	3	3
29	Eastern Parkway	Local	9.6	6	7.5	13	0.56	12	$14.11	13	11
31	Shelbyville Road	Local	7.1	15	6.1	20	0.46	20	$17.32	19	18.5
40	Taylorsville Road	Local	6.8	16	6.3	19	0.47	17	$16.75	18	17.5
43	Portland Poplar Level	Local	9.0	9	6.8	17	0.52	15	$15.42	17	14.5
52	Medical Center Circulator	Circulator	1.8	24	3.1	24	0.44	21	$28.65	24	23.25
63	Crums Lane	Local	8.3	11	7.8	10	0.52	14	$14.11	12	11.75
71	Jeffersonville-Louisville-IUS	Local	7.2	14	5.9	22	0.40	22	$18.67	22	20
72	Clarksville	Local	5.6	20	7.5	12	0.64	7	$13.48	9	12
93	UPS U of L Shuttle	Circulator	3.4	22	6.5	18	0.37	23	$18.06	21	21
99	UPS West Louisville	Circulator	5.7	19	7.7	11	0.46	19	$14.94	15	16
System Average		Local	8.0		7.5		0.57		$14.63		
		Frequent	10.8		10.3		0.88		$11.23		
		Express	-		-		-		-		
		Circulator	3.6		5.8		0.42		$20.55		
		All	7.8		7.6		0.59		$14.95		

Table 2-4. Sunday Route Performance (Average and Rank for 2021)

#	Route Name	Service Type	Pax / Trip		Pax / Rev Hr		Pax / Rev Mi		Cost / Pax		Ave Rank
			Ave	Rank	Ave	Rank	Ave	Rank	Ave	Rank	
2	Second Street	Local	1.9	21	3.3	21	0.27	21	$30.99	21	21
4	Fourth Street	Frequent	7.5	6	9.6	2	0.91	1	$10.22	2	2.75
6	Sixth Street-Taylor Boulevard	Local	6.4	10	8.1	4	0.60	5	$13.17	5	6
10	Dixie Rapid	Frequent	4.6	18	4.3	20	0.33	19	$24.32	20	19.25
12	Twelfth Street	Local	2.6	20	5.6	13	0.45	11	$18.45	12	14
15	Market Street	Local	7.2	7	6.5	7	0.47	10	$16.58	8	8
17	Bardstown Road	Local	5.8	15	5.5	14	0.39	15	$19.61	14	14.5
18	Dixie Highway	Local	6.5	9	6.0	11	0.47	9	$17.46	10	9.75
19	Muhammad Ali Boulevard	Local	8.3	4	6.3	8	0.49	7	$16.54	7	6.5
21	Chestnut Street	Local	6.2	11	5.3	15	0.41	13	$19.88	15	13.5
23	Broadway	Frequent	13.6	1	10.7	1	0.89	2	$9.57	1	1.25
25	Oak-Westport	Local	11.0	2	7.0	6	0.47	8	$15.66	6	5.5
27	Hill Street	Local	4.3	19	4.7	18	0.40	14	$21.50	18	17.25
28	Preston	Local	8.9	3	7.9	5	0.64	4	$13.13	4	4
29	Eastern Parkway	Local	7.6	5	5.9	12	0.44	12	$17.85	11	10
31	Shelbyville Road	Local	6.0	12	5.2	16	0.39	16	$20.50	16	15
40	Taylorsville Road	Local	5.5	17	5.1	17	0.38	17	$20.61	17	17
43	Portland Poplar Level	Local	7.2	8	6.0	10	0.52	6	$16.91	9	8.25
63	Crums Lane	Local	6.0	13	6.1	9	0.38	18	$18.70	13	13.25
71	Jeffersonville-Louisville-IUS	Local	5.7	16	4.7	19	0.32	20	$23.43	19	18.5
72	Clarksville	Local	5.8	14	8.1	3	0.66	3	$12.67	3	5.75
	System Average	Local	6.3		6.0		0.5		$18.54		
		Frequent	8.6		8.2		0.7		$14.70		
		Express	-		-		-		-		
		Circulator	-		-		-		-		
		All	6.6		6.3		0.5		$17.99		

Figure 2-8. Passengers per Revenue Mile by Route

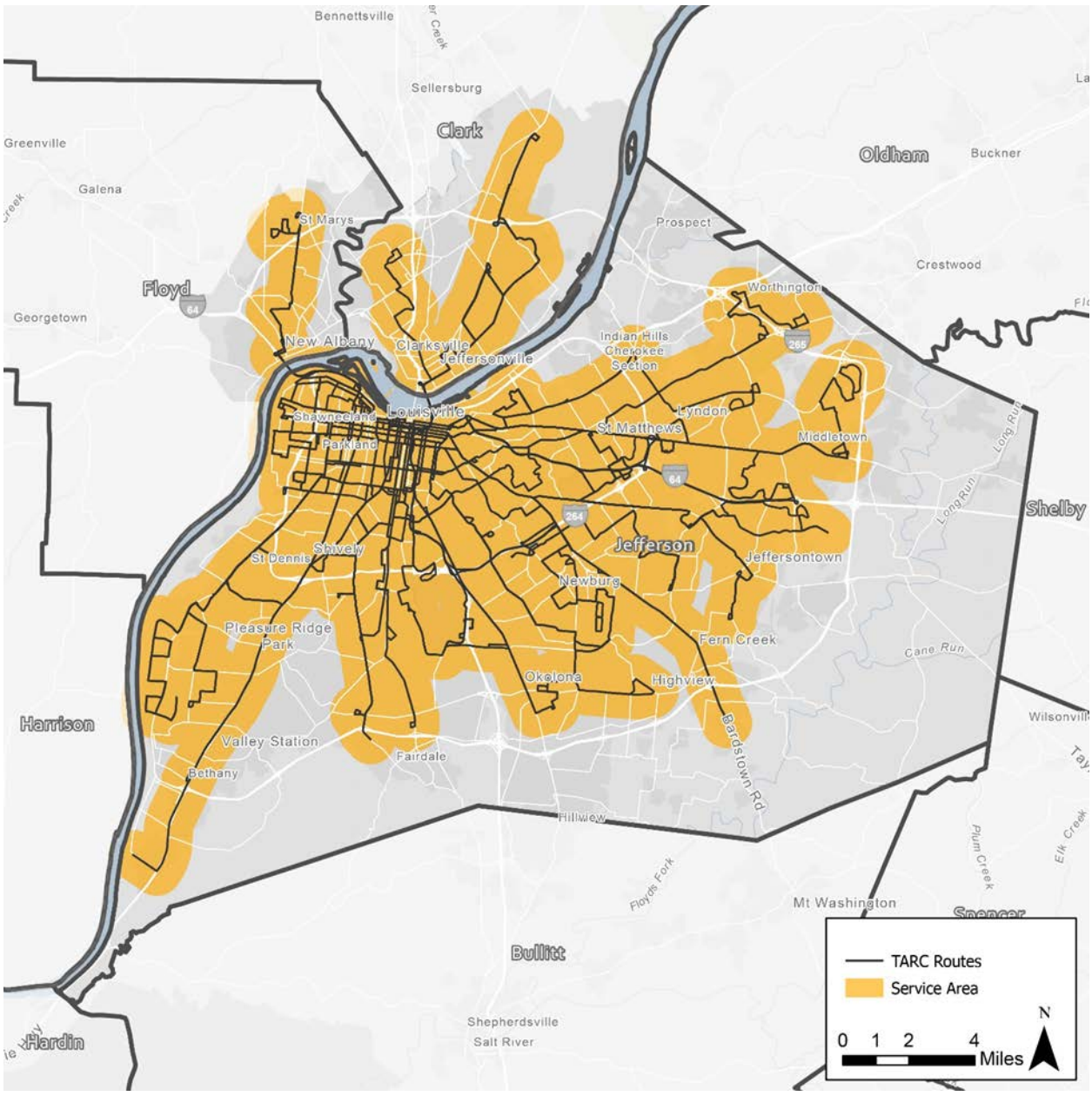


2.5.1.3. Paratransit Service.

TARC operates TARC3, a shared-ride, door-to-door paratransit service for anyone who cannot utilize fixed route service because of a disability. The service is available within ¾ of a mile from fixed-route service (excluding express routes), shown cartographically in Figure 2-9. TARC provides TARC3 eligibility determination, reservations, trip routing, and customer service. Private third-party companies provide the TARC3 service and the "Where's My Ride" service. TARC3 operates standard hours seven days a week from 6:00 am to 10:30 pm, with select trips available outside the standard hours timeframe. Trips are scheduled by calling the TARC3 reservation line.

Reservations can be made up to one week in advance and as late as 4:30 pm the day before the trip.

Figure 2-9. TARC3 Service Area



TARC3 provided about 500,000 trips in 2019, with a 20% decrease in annual ridership in 2020. 2021 year-to-date ridership is on track to reach a similarly reduced level as 2020 (see Figure 2-12). Significant clusters of paratransit trips occur in the Downtown and the West End neighborhoods, based on analysis of trip volumes per paratransit rider home location. There are other large cohorts of TARC3 riders living in the southern quadrant of Louisville Metro (e.g., Newburg, and Stony Brook) and to the east (St. Matthews). Similar patterns are shown in the subsequent map showing TARC3 pickups by zip code of the rider's registered home address. Further, it appears that

some paratransit trips originated in Bullitt and Oldham counties, which are areas outside of the prescribed ADA service area based on the ¾ mile threshold from fixed-route service corridors. It is likely these trips are from passengers who became eligible for TARC3 based on their residence before the COVID-related service reductions took place, when TARC still operated express services to these counties.

Figure 2-10 Trip Volume per Paratransit Rider Home Location

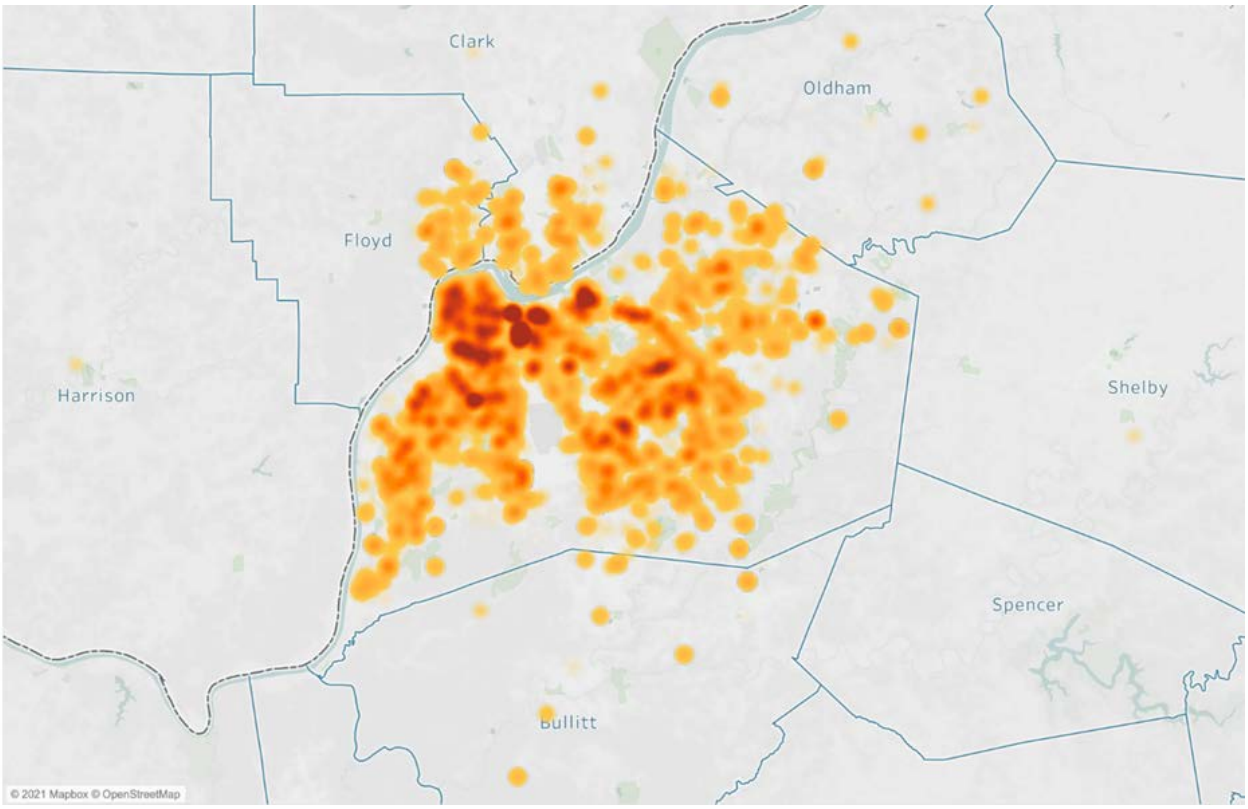


Figure 2-11 TARC3 Pickups by Zip code

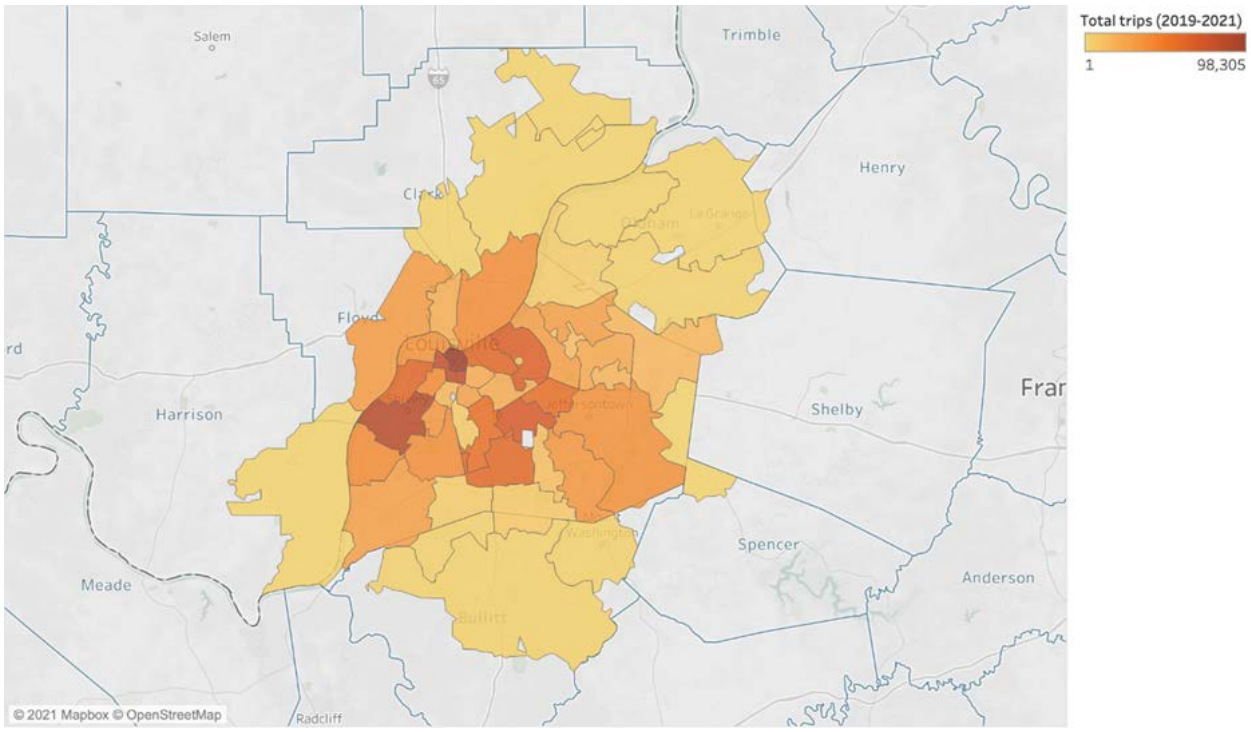
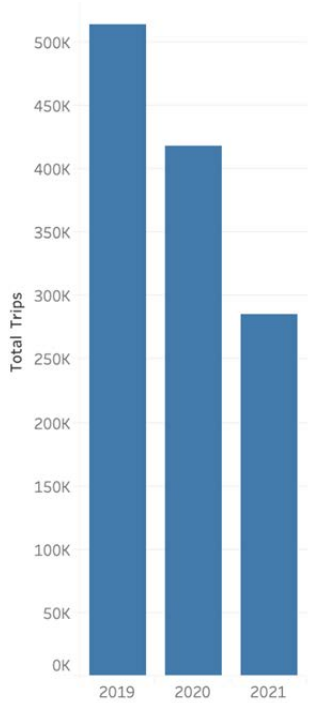


Figure 2-12 TARC3 Trips per Year

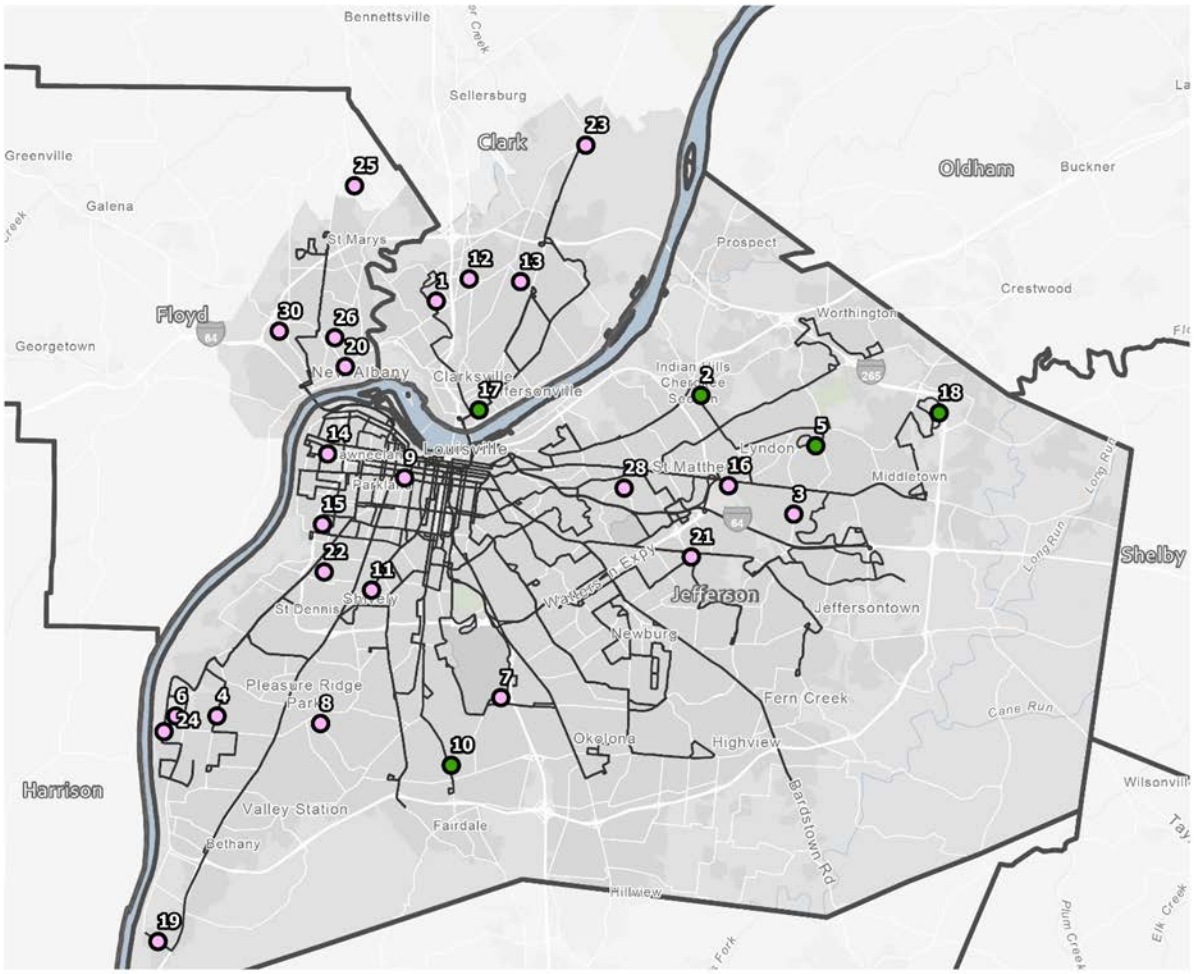


2.5.1.4. Outstanding Service Requests.

Service requests placed from mid-2017 to September 2021 were reviewed and summarized to understand the existing service gaps from the community's perspective. A total of 62 service requests were reviewed. Service requests that specified where the service gap existed were mapped and are shown below in Figure 2-13 with a total of 30 locations. The locations include cases where: (1) there was no fixed-route service and service was requested, or (2) there was fixed-route service and additional service was requested. Service requests that did not cite a specific geographic location but referenced a route were tabulated and shown below in Table 2-5. The service requests by route includes requests for increased service such as increased headways and/or span of service. Key findings from the service request review are described below.

- Figure 2-13 reveals several service request geographic trends:
    - Indiana has a disproportionate number of service requests. A total of 9 of the 30 locations referenced in the service request were in Indiana. Of these, there was roughly an equal split between Clark and Floyd counties, with five and four locations, respectively.
    - Only two of the 30 locations were outside of the existing service area, with one request in Elizabethtown and one from Spencer County.
- Table 2-5 reveals the distribution of service requests by route:
    - A total of 16 routes were requested for improved service (either in headway or span of service). Seven of the 16 have been eliminated and were either requested for improved service before elimination or requested for restarting service. Three of the 16 routes were express.
    - By far the most commonly requested route for improved service was Route 82, with a total of seven requests. Most of these requests were made after the removal of the route, requesting that Route 82 be restored.

Figure 2-13. Locations of Outstanding Service Requests



1. Serve Old Town Pottery
2. Ballard High School 7:30 am service
3. Service on Hurstbourne
4. Service down Terry Road
5. Later service
6. Bi-directional service request
7. More UPS service
8. More service on Fordhaven Road
9. More service on west Broadway
10. More Sunday/holiday service
11. More Service to address
12. More service on Veterans Pkwy
13. More service on Holmans Ln
14. More Service from west end to east end
15. More service on Bohne Ave
16. More service to Oxmoor
17. More service to Jeffersonville in evening
18. Early service on Eastpoint Pkwy
19. More service on Watson Ln
20. Service on Spring St and Vincennes St
21. More service at Breckenridge Ln at Hikes Ln
22. Service to Sacred Heart Village III
23. Bus stop and more service at Census Bureau
24. More service to Riverport/Tradeport
25. Service to VA Outpatient Center
26. Service on Charlestown Rd
27. Service in Elizabethtown
28. Service on Cannons Ln to Taylorsville Rd
29. Service from Spencer County to Louisville
30. Service farther on State St

Table 2-5. Requests for Service Improvement by Route

Route	Number of Requests	Percent of Total
6	1	4.2%
10	1	4.2%
12	2	8.3%
18	1	4.2%
19	1	4.2%
21	1	4.2%
28	2	8.3%
52	1	4.2%
58	1	4.2%
59	1	4.2%
62	1	4.2%
63	1	4.2%
65X	1	4.2%
67X	1	4.2%
68X	1	4.2%
82	7	29.2%
TOTAL	24	100%

Note: Highlighted routes are no longer in operation and were either requested before removal or requested for restoring service.

2.5.2. Transit Supply Index.

Transit supply is often quantified using ¼ mile buffers from bus routes or stops, effectively measuring the coverage (or reach) of a transit network. However, this method (hereafter called "coverage method") does not account for the frequency of transit service. Every bus stop is counted equally regardless of how many times a bus services the stop (e.g., a downtown stop on Muhammad Ali Blvd that has frequent bus service is counted the same as a stop on the edge of the service area with far less service). Another drawback in the coverage method is that it typically uses straight-line distance (colloquially known as "as the crow flies") to measure the ¼ mile distance from each bus stop, rather than a network distance that would more accurately account for how far pedestrians would need to walk to access the transit stop. Although the coverage method is effective at revealing a rough footprint of access to fixed-route transit service, it does not adequately convey how transit is distributed across a region because there is no frequency component.

Here, transit supply is measured using a Transit Supply Index (TSI), which utilizes a methodology that incorporates coverage, frequency, and accessibility. The process of creating the Transit Supply Index generally falls into three steps, summarized here:

8. A walk network was created using Open Street Map (OSM) street data for the region. OSM data were used here instead of US Census Topologically Integrated Geographic Encoding and Referencing (TIGER) data because OSM data typically have a more complete walkway

network. All streets are utilized in the study except for freeways (OSM classification of "motorway") and freeway ramps (OSM classification of "motorway link"). One caveat in this methodology is that aside from freeways and freeway ramps, all other roads are assumed to be walkable. Although it is acknowledged that not all streets are indeed walkable, this methodology has shown reasonable accuracy in the absence of a comprehensive sidewalk dataset in previous studies. Once the walk network dataset was created, a 0.25 mile walkshed was calculated for every bus stop in the TARC network to model the area accessible to transit service.

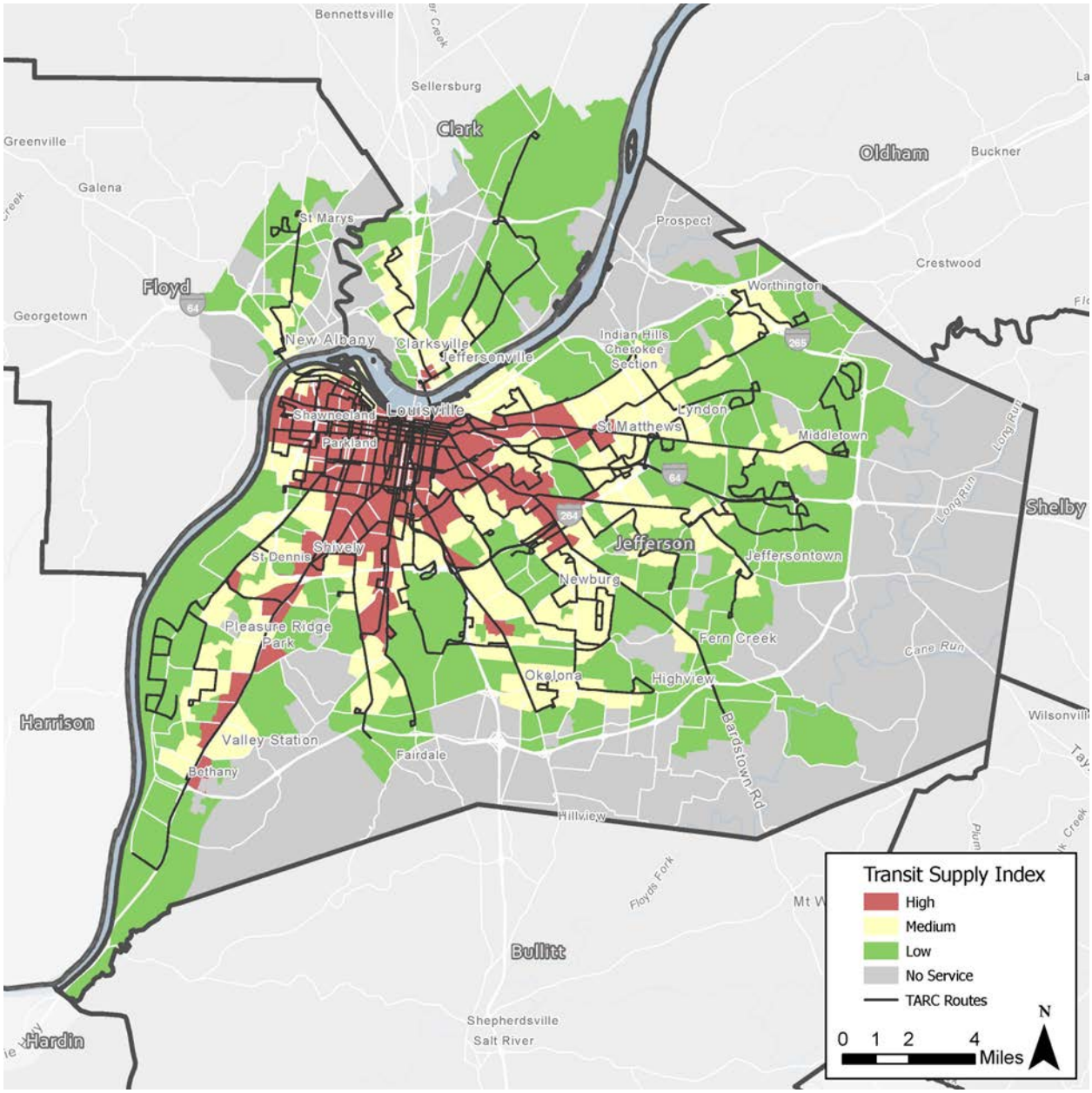
9. Using a Fall 2021 General Transit Feed Specification (GTFS) dataset, a trip dataset was created that included bus stops for every trip occurring on weekdays, Saturdays, and Sundays. The trips dataset was then joined to the walkshed dataset, and then dissolved by trip so that every TARC bus trip was represented by a shape of walksheds from all served bus stops. All the shapes of trip walksheds were then aggregated and summarized at the CBG level. The aggregate value was then normalized by the accessible area in the CBG, like the method for the Activity Index and Needs Index. Utilizing the accessible area that measures the land area within 0.25 miles of streets, instead of using the total area, ensures that a CBG is not penalized for not serving bodies of water. The results are a single score for every CBG in the region that accounts for both the transit coverage and frequency using ¼ mile network walk distance from bus stops.
10. The final step in the Transit Supply Index was to assign values into high, medium, low, or no service. There were a total of 828 CBGs in the dataset. Of the 828 CBGs, a total of 551 had access to transit service by measurement of ¼ mile walk distance to a bus stop. The 551 CBGs that had access to a bus stop were then evenly divided into three quantiles. The top one third CBGs were categorized as high, the middle one-third categorized as medium, and the bottom one-third categorized as low.

The results of the Transit Supply Index are shown in Figure 2-14. It is important to note that the size and shape of each CBG influences the TSI scores in some places, especially in areas where CBGs have large and/or irregular shapes. Despite this limitation, the results of the TSI scores still provide valuable insights into how service is distributed in the region. Key findings are bulleted below:

- The results of the Transit Supply Index show near-ubiquitous high scores throughout most of downtown Louisville south to Algonquin Parkway on the west and Eastern Parkway to the east.
- Several major corridors stretching from downtown Louisville that result in high TSI scores are:
    - Dixie Highway south to Gene Snyder Freeway
    - 3rd Street south to Kentwood Drive
    - Preston Highway south to I-264
    - Bardstown Road southeast to Bashford Manor Lane
    - Shelbyville Road to Hubbards Lane

- Most of the highest TSI scores are the result of overlapping routes, rather than a single high frequency route. An example of this is in downtown Jeffersonville, which results in high TSI scores from the short overlap of Route 71 Jeffersonville-Louisville-IUS and Route 72 Clarksville.
- Most of the TSI scores in the ring between the Watterson Expressway and the Gene Snyder Freeway are medium and low, although there are also some areas with no service.
- Most of the CBGs outside of the Gene Snyder Freeway resulted in no service. Several exceptions that extend a low TSI score outside of Gene Snyder Freeway are as follows:
    - Route 18 Dixie Highway along Dixie Highway
    - Route 6 Sixth Street along New Cut Road
    - Route 17 Bardstown Road and Route 17X Fern Creek Express along Bardstown Road
    - Route 31 Shelbyville Road along Aiken Road
    - Route 25 Oak-Westport along both Westport Road and I-71

Figure 2-14. Transit Supply Index



2.5.3. Ridership Analysis.

This section makes comparisons between predicted demand and observed demand in an effort to reveal locations that underperform with fixed-route transit service. The observed demand is measured using stop-level ridership data recorded with Automated Passenger Counters (APCs) in the Fall of 2018 (September 2018 - December 2018). The stop-level ridership data is presented in Figure 2-15, which shows the total average daily stop activity (boardings + alightings) for weekdays. For an in-depth analysis of stop-level ridership, refer to the 2019 Service Performance Assessment Report of the Comprehensive Operations Analysis (COA) and Long-Range Plan (LRP).

Predicted demand is measured using the results from the Activity Index. By layering stop-level ridership over the Activity Index (shown in Figure 2-16), differences in predicted demand and observed demand become apparent. Locations that have a combination of high predicted demand (as measured by high Activity Index), and low observed demand (as measured by stop-level ridership) become potential opportunities for innovative mobility solutions. Key findings from Figure 2-16 are described below.

- Many of the CBGs with the highest Activity Index levels are found in the downtown core of Louisville and have corresponding high levels of service and ridership.
- The CBGs along the segment of Watterson Trail between I-64 and Taylorsville Road have high activity but are only served eight times a day by Route 75 Bluegrass circulator. Route 78X also used to serve this area but has since been removed. Although the ridership for Route 75 Bluegrass Circulator was not available in the ridership data, the Route 78X average weekday ridership activity (boardings + alightings) was low, with about 50 per day.
- The large CBG bound by the Gene Snyder Freeway, La Grange Road, and Westport Road has high activity but low ridership. It should be noted that since the ridership data was collected in 2018, Route 64X Fincastle Forest Springs was discontinued.
- Watterson Park (bound by Henry Watterson Expressway, Produce Road, Newburg Road, and Poplar Level Road) has several CBGs with high activity but only one stop with more than 20 average weekday daily boardings + alightings. Route 43 Portland Poplar Level (approximately 30 to 70 minute headways) services the western side of this area and Route 21 Chestnut Street (30 to 90 minute headways) and Route 23 Broadway (50 minute headways) serve the eastern side of this area.
- Route 45X Okolona Hillview Express used to operate along Preston Highway, extending outside of Gene Snyder Freeway to the Bullitt County line. The average daily boardings + alightings was only 21 on weekdays on the segment outside of the Gene Snyder Freeway.

Figure 2-15. TARC 2018 Average Weekday Ridership by Stop

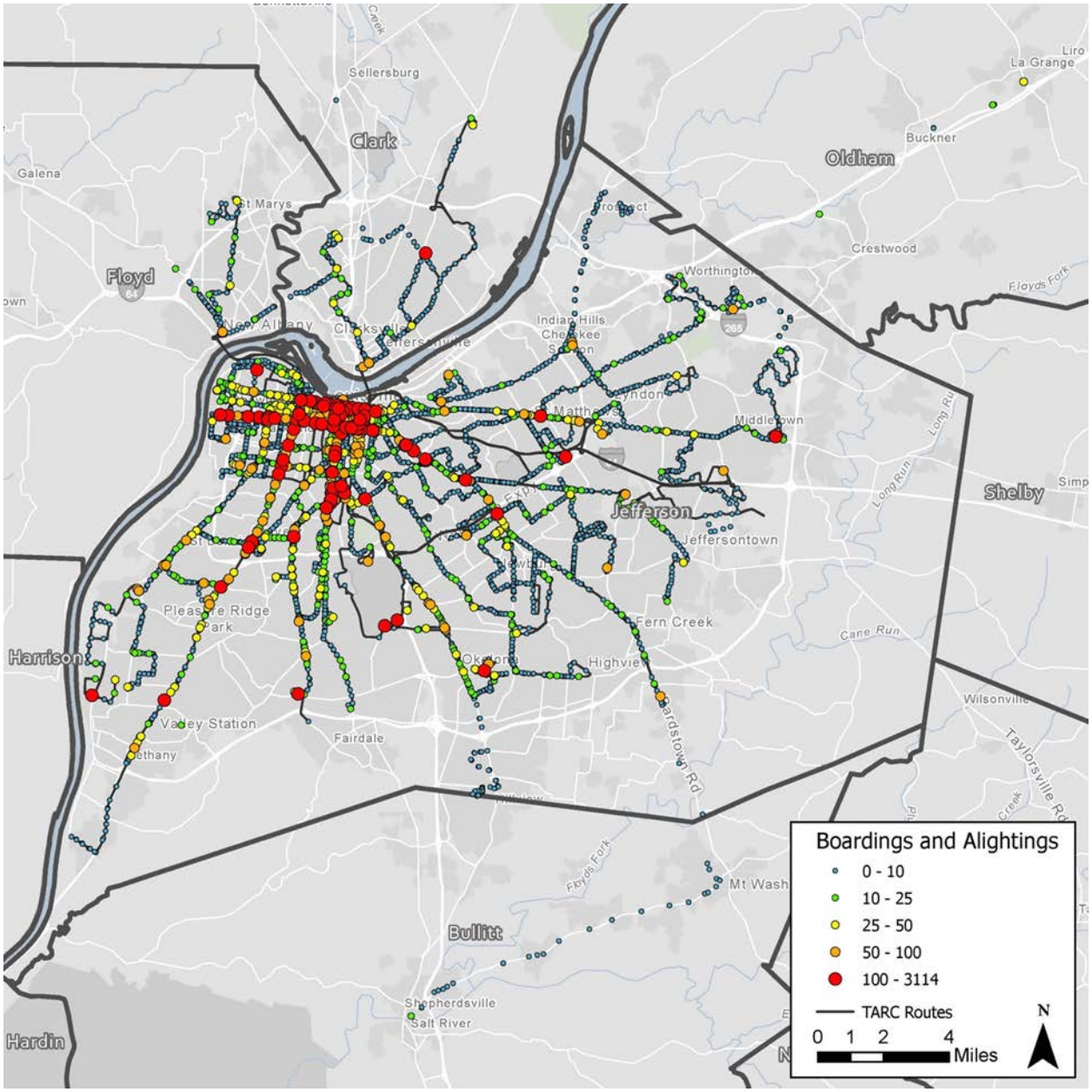
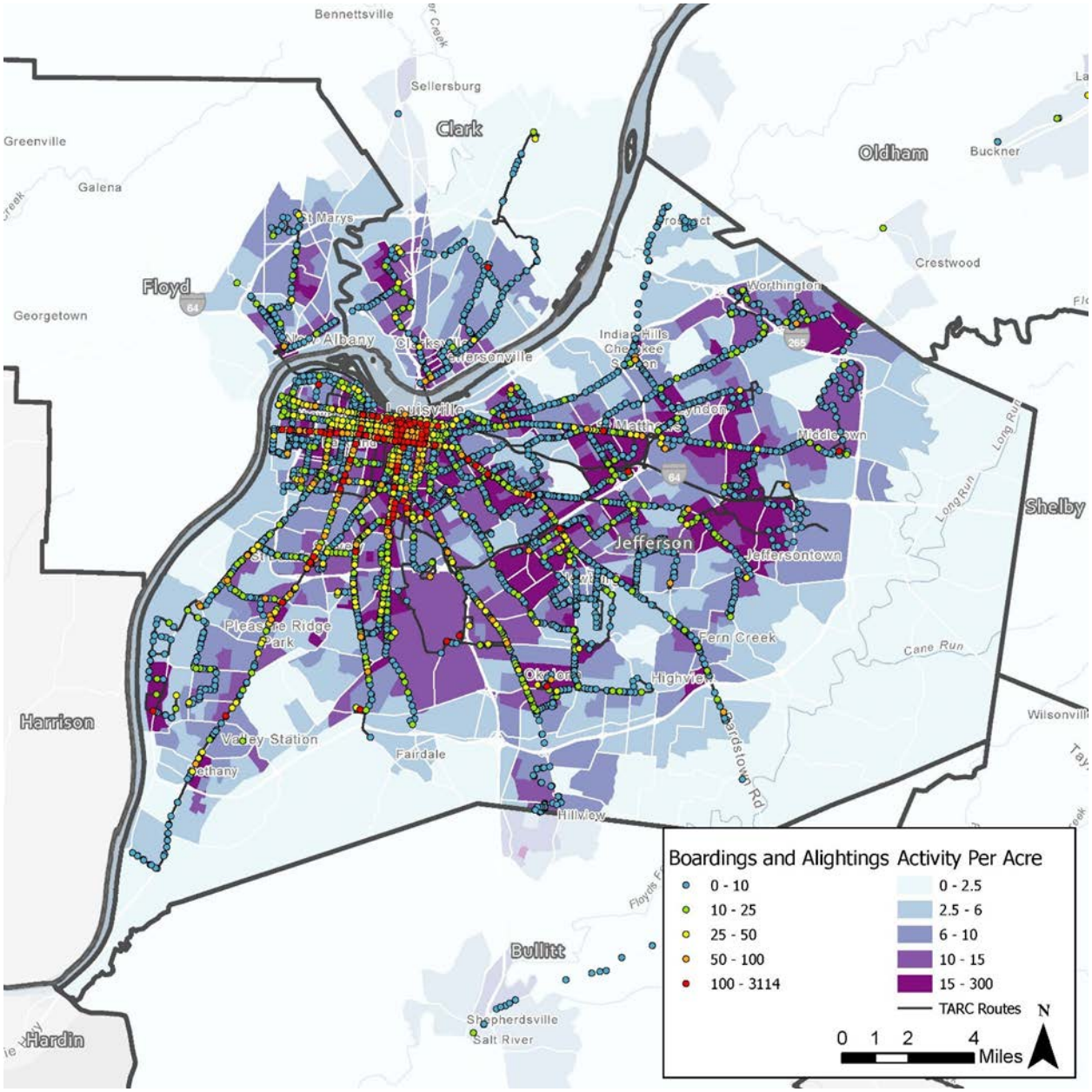


Figure 2-16. TARC 2018 Average Weekday Ridership and Activity Index



2.5.4. Other Mobility Services in the Region.

TARC is one part of a larger array of mobility services in the Louisville area. This includes a range of commuter services coordinated by KIPDA's Every Commute Counts program, bike share, dockless micromobility, taxis, and Transportation Network Companies (TNC's).

2.5.4.1. Every Commute Counts (Transportation Management Platform).

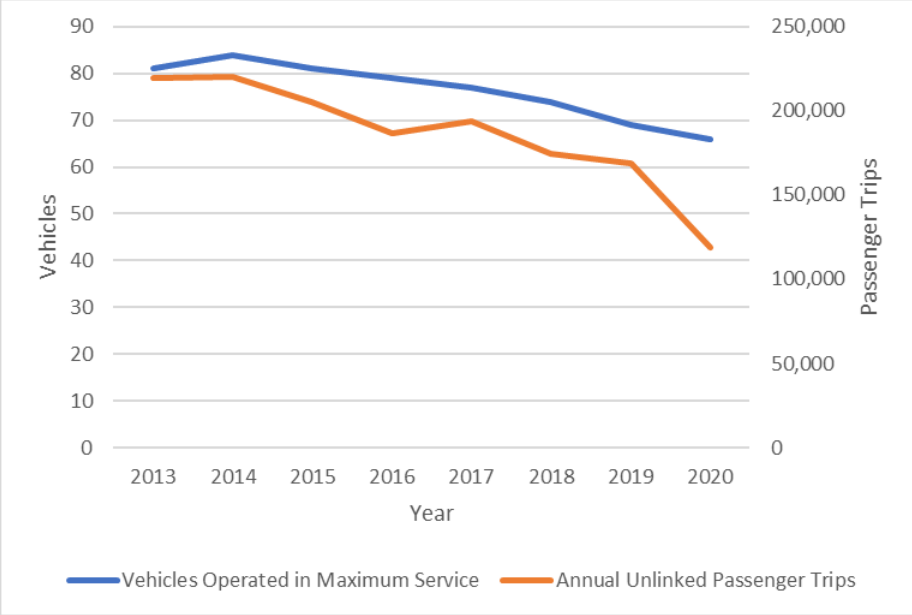
The Kentuckiana Regional Planning and Development Agency (KIPDA), the Metropolitan Planning Organization (MPO) for the region, operates a rideshare program called Every Commute Counts that focuses on encouraging transportation alternatives to single-occupancy motor vehicles. The

program works with both employers and commuters in the area to reduce congestion and single-occupancy vehicle travel by growing telework, bikepool, vanpool, carpool, and last mile options. Every Commute Counts is available to anyone who works or lives in one of the nine eligible counties in Indiana or Kentucky. Eligible counties in Kentucky include Bullitt, Henry, Jefferson, Oldham, Shelby, Spencer, and Trimble. Eligible counties in Indiana include Clark and Floyd.

2.5.4.2. Vanpool Service.

Vanpool data from Every Commuter Counts was obtained to better understand how this service supplements commuter travel patterns in the area. The vanpool service began in 2001 with three Vehicles Operated in Maximum Service (VOMS) and grew to its peak of 84 in 2014. From 2015 to 2019 the vanpool experienced relatively small decreases in both peak vehicles and ridership. In 2020 the VOMS decreased to 66, and ridership decreased approximately 30% in response to the COVID-19 pandemic. Figure 2-17 shows the VOMS and annual Unlinked Passenger Trips (UPT) counts from 2013 to 2020.

Figure 2-17.Every Commute Counts Vanpool VOMS and UPT



Currently, Every Commute Counts has a total of 70 vanpool routes that each have a specific origin location, destination location, and scheduled departure time. Nearly all of the routes are designed to transport commuters into Jefferson County from one of the neighboring counties. A total of 67 of the 70 vanpool routes either begin or end within the TARC service area. Seven vanpool routes both begin and end within the TARC service area, shown below in Figure 2-18 and listed in Table 2-6.

Figure 2-18. KIPDA Activity Index and Transit Supply Index Composite Map

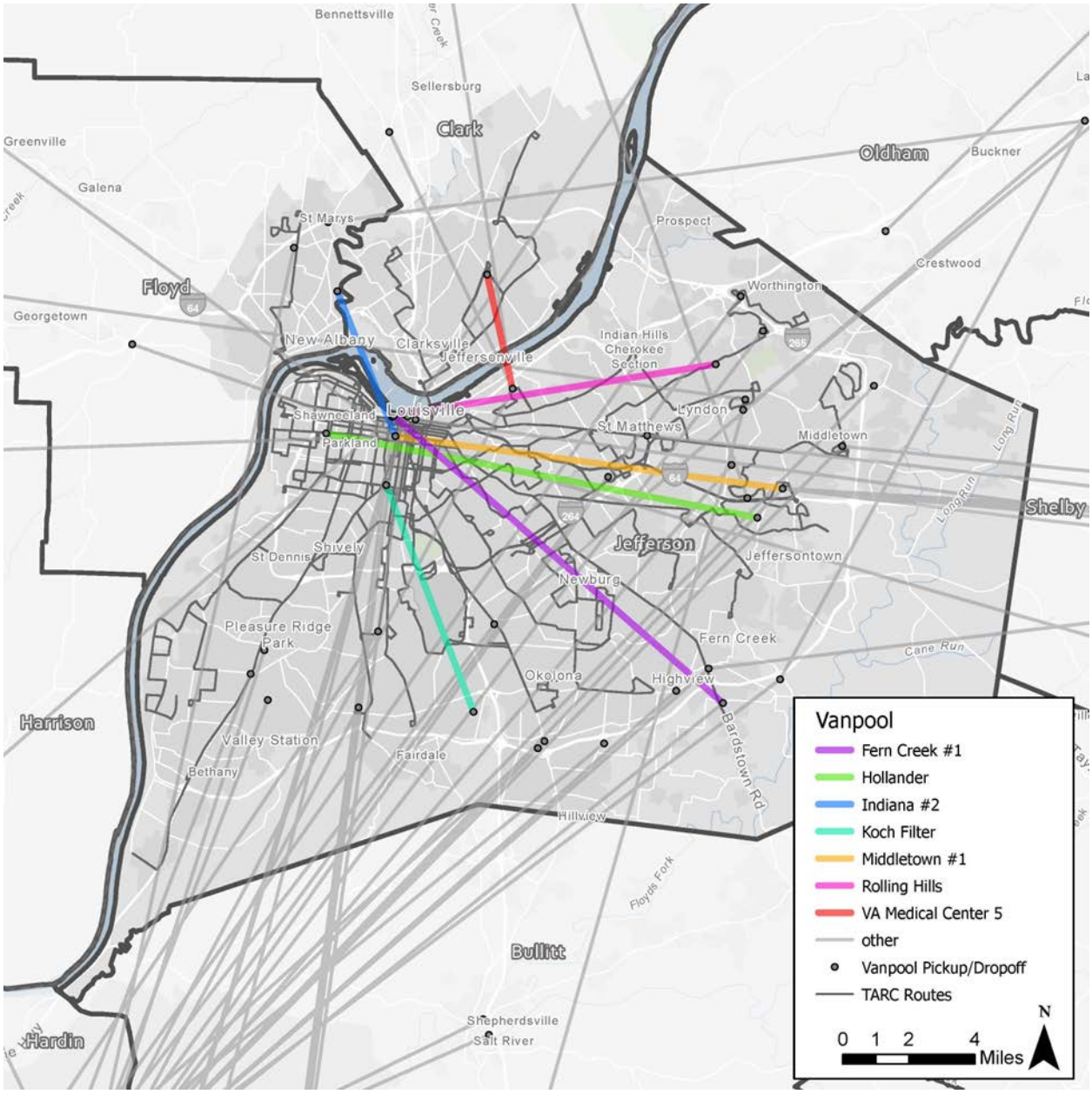


Table 2-6. Vanpools with Origin and Destination within TARC Service Area

Vanpool	Origin	Origin City	Destination	Destination City
Fern Creek #1	7915 Bardstown Road	Louisville	8th Street	Louisville
Hollander	Nia Travel and Jobs Center	Louisville	Hollander Sleep Products	Louisville
Indiana #2	1433 Bellemeade Drive	New Albany	US Army Corps of Engineers	Louisville
Koch Filter	625 W Hill Street	Louisville	Koch Filter Corporation	Louisville
Middletown #1	Southeast Christian Church	Louisville	Corps of Engineers	Louisville
Rolling Hills	9104 Westport Road	Louisville	8th Street	Louisville
VA Medical Center 5	2960 E 10th Street	Jeffersonville	VA Medical	Louisville

2.5.4.3. Dock-Based Bike Share (LouVelo).

Since 2017, Louisville Metro has managed a dock-based bike share program, LouVelo, with 38 active stations and more than 300 shared bikes located primarily in Downtown Louisville, Phoenix Hill, and Old Louisville neighborhoods. Several stations are also available in Jeffersonville and near the University of Louisville campus. LouVelo is operated by CycleHop, a national micromobility vendor, and is sponsored by major employers in the area such as Humana, UPS, and Norton Health, among others. LouVelo offers several pricing options, including the Bluegrass Pass ($7.50 day pass for 24-hour access), Pay-as-You-Go ($21 for 300 minutes), or Monthly/Annual memberships ($120/year or $16/month).

According to the most recent monthly report to Louisville Metro, the LouVelo program serves a related limited ridership of about 103 average daily trips or about 3,100 monthly trips. LouVelo has more than 1,000 Monthly or Annual members, who are responsible for 69% of trips on the system, compared to 31% of trips completed by Bluegrass Pass or Pay-as-you-Go users. About two-thirds (68%) of the Monthly/Annual memberships are purchased by Humana employees, who receive subsidized memberships as an employee benefit. Humana is the only local employer with this type of LouVelo benefit for employees. The utilization of its bikes is roughly 0.3 trips per bike per day, which is well below the micromobility industry standard of 2 trips per bike per day typically observed in more highly used systems in other large American cities.[5] The most popular LouVelo stations, measured by monthly origins and destinations, include the Big Four Bridge over the Ohio River, Preston & Witherspoon near Louisville Slugger Field, and 4th & Guthrie and 4th & Main in the Downtown area.

2.5.4.4. Dockless Micromobility.

Louisville Metro began permitting dockless scooter share vendors to operate in the city in August 2018. There are currently four operators in the city – Bird, Lime, Bolt, and Spin – offering dockless vehicles in a service zone roughly bounded by the Ohio River and the Watterson Expressway. Bird and Lime each operate up to 450 devices, while Bolt and Spin are each allowed up to 150 devices. These operators typically charge users a nominal fee (e.g., $1) to unlock the device, followed by a pay-as-you-go usage fee per minute of the ride duration. Some operators also offer pre-paid subscriptions for frequent users. Operators also typically offer discounted fare payment options for low-income riders, such as those who qualify for state or federal assistance programs.
Dockless micromobility operators served significantly higher ridership compared to LouVelo in 2019, though there is significant seasonal variation. In winter months, from November to March, ridership ranges from about 200 to about 600 trips per day, while between April and October ridership is often between 1,000 and 2,000 daily trips. As with LouVelo, dockless micromobility ridership is most heavily concentrated in the Downtown and Old Louisville neighborhoods. This is largely because these areas feature the highest population and job densities in the service zone, as well as a high intensity of entertainment venues and a relatively high concentration of streets

[5] Louisville Metro. 2019. "CycleHop LouVelo June 2019 Report." Retrieved from https://louisvilleky.gov/sites/default/files/migration/files-pt2/Bike%20Louisville/public_city_report_louvelo_june_2019.pdf

with bike facilities. As shown in the map below, Figure 2-19, significant numbers of trips also occur along the Bardstown Road corridor, near University of Louisville campus, and throughout the West end neighborhood. Ridership is notably sparse in Indian Hills, Audubon Park, St. Matthews, and Shively neighborhoods.

The map below, Figure 2-20, shows the most common dockless micromobility travel patterns by connecting trip origins and destinations in the service zone using line segments whose thickness is weighted by the number of trips. The most common trips on dockless scooters in Louisville are relatively short, often less than one mile in length. Likewise, most trips begin and end in the two districts where the dockless services are most popular, in Downtown, Phoenix Hill, and near the University of Louisville campus. The Bardstown Road corridor, Big Four Bridge, and Old Louisville district also see significant numbers of somewhat longer journeys. Continued growth of dockless micromobility in this area will likely depend on the expansion of bike facilities along major streets, particularly protected bike lanes which are notably absent in the region.

Figure 2-19 Dockless Micromobility Origins & Destinations

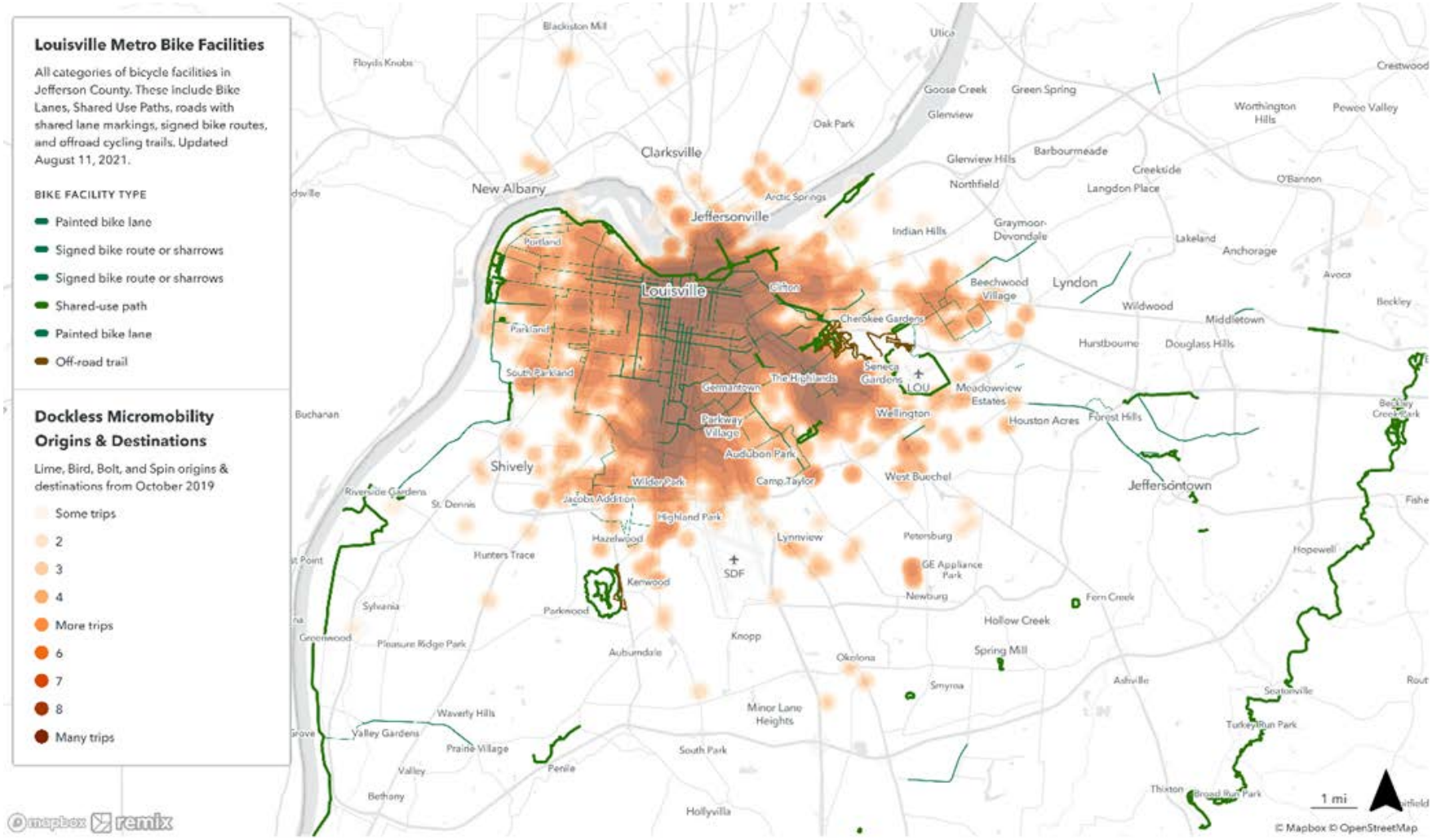
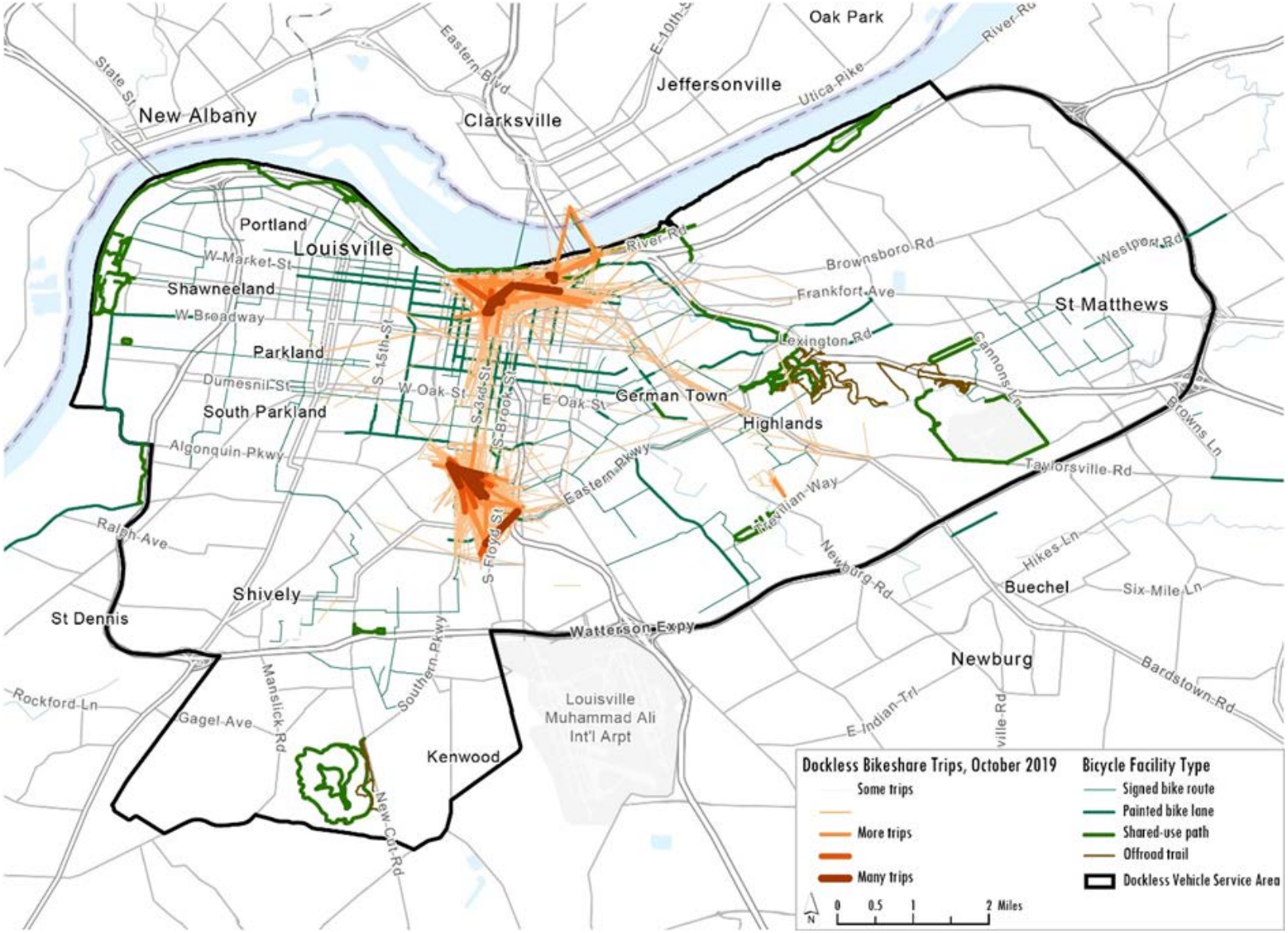


Figure 2-20 Dockless Micromobility Travel Patterns



2.5.4.5. Taxis and TNCs.

A Transportation Network Company (TNC) is a private company that matches passengers with vehicles via mobile apps and websites. Currently, ridesharing services Uber and Lyft serve the Louisville area. There are also several taxi companies serving the area, including Yellow Cab, Allen Transportation & Taxi, Green & Orange Cab of Louisville, and others.

3. Problem Evaluation.

In response to extensive suburban growth and requests for service to outlying areas, TARC's fixed route network has evolved over the years to include many routes with multiple branching patterns and suburban circulator routes to maximize service coverage throughout the region. While this approach allows TARC to maintain broad geographic service coverage, it in many cases comes at the expense of service quality in suburban areas, as large portions of TARC's service area receive minimal levels of service marked by long headways throughout the day.

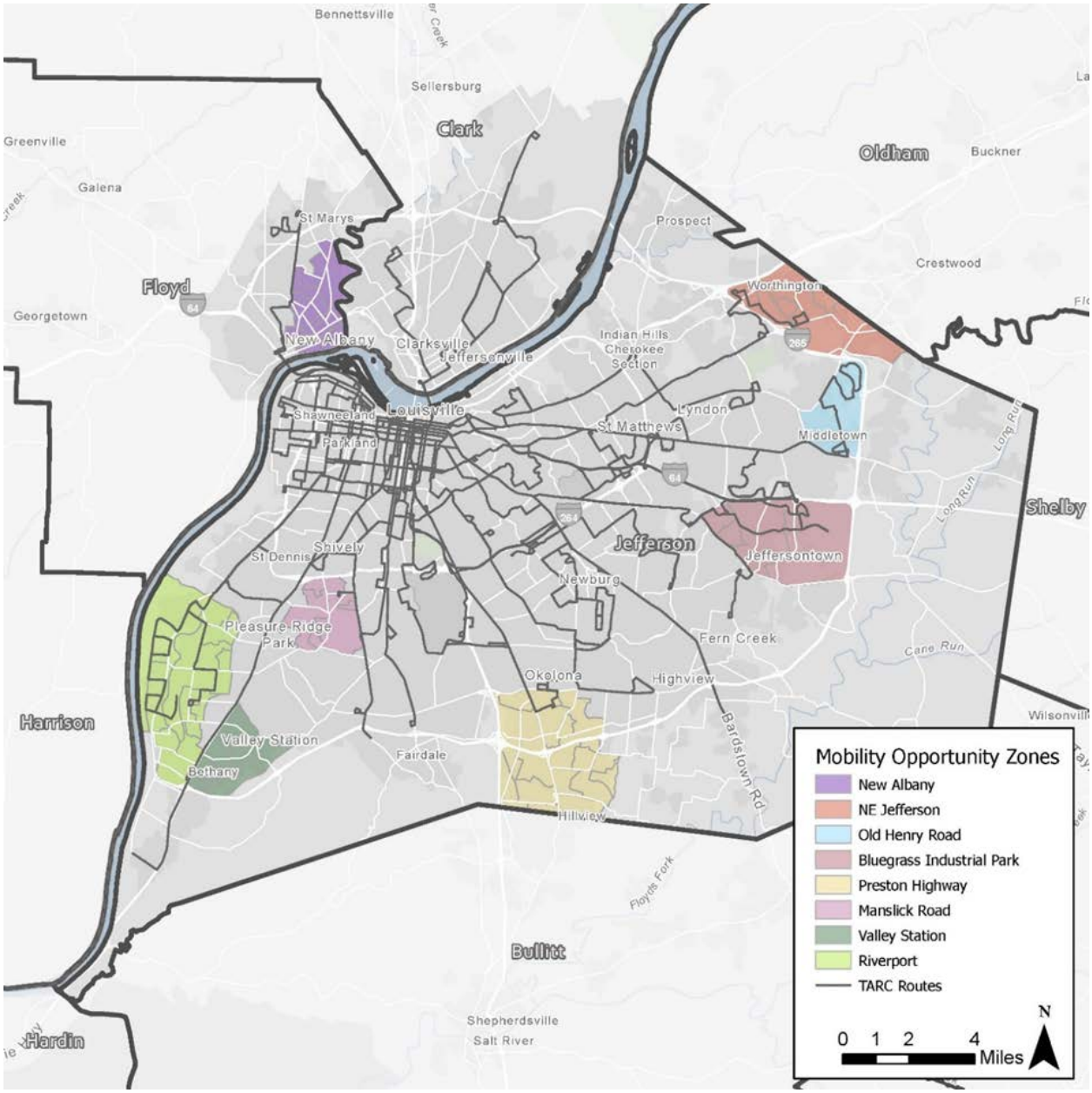
The far-reaching extent of TARC's service footprint in low-density suburban areas also creates barriers to efficient service delivery. In fact, as discovered in the most recent COA, 77% of TARC's weekday ridership activity in the Fall of 2018 occurred within the Watterson Freeway, while only 22% occurred across vast portions of the remainder of suburban Jefferson County. On a cost per passenger trip basis, routes serving areas within the Watterson tended to perform favorably, while some suburban routes showed average trip costs exceeding $20. At the same time, key employment centers and pockets of disadvantaged populations exist in these suburban communities that warrant mobility options to provide access to jobs and essential services. This section builds on the findings of the existing conditions assessment to take a data-driven approach to identify problem areas and frame mobility challenges that might be addressed through new innovative mobility services.

This section first presents a methodology for identifying locations where there are apparent imbalances in transit supply and demand in section 3.1. Section 3.2 discusses the results of the gaps analysis including specific locations where innovative and alternative service models may enhance local mobility.

3.1. Key Findings.

This report concludes with a discussion of several **Mobility Opportunity Zones**, which are recommended for further study with respect to the range of innovative mobility options explored in this study. Mobility Opportunity Zones are Census-based study areas within TARC's service geography where the team has identified significant service gaps or inefficiencies, as measured between levels of transit demand and supply. Subsequent phases of this study will identify best practices in innovative mobility programs and service design from peer cities, analyze and simulate

the performance of these mobility options in the most promising of the Mobility Opportunity Zones, and identify key action items and workflows necessary to advance these priorities to the implementation phase for future pilot projects. The following section summarizes these Mobility Opportunity Zones, their key service gaps and major activity centers underserved by transit. A map of the Mobility Opportunity Zones is shown below in Figure 1-1.



New Albany and the Spring Street/Charlestown Road corridors. Much of the downtown area of New Albany features high Activity and Need scores, but low Transit Supply scores. The area has access to just a single fixed-route corridor, 71 Jeffersonville-Louisville-IUS, and much of the eastern portion of the corridor is beyond walking distance to it. The area features a relatively grid-like street network with high intersection density, indicating the zone may be suitable for

fixed-route or micromobility options. This zone continues to be impacted by the suspension of Route 80, which operated along the Spring Street corridor before COVID. On the Charlestown Road corridor north of I-265, several major activity centers (Meijer, Jay C Food Store, and Ivy Tech Community College) lack access to fixed-route service, making it suitable for a potential future extension of the zone to this area.

Worthington, south of I-71 and between the Gene Snyder Freeway and the Jefferson County line. Portions of this area are served by Route 25 Oak-Westport, but areas north of Westport Road are beyond walking distance of fixed-route transit, resulting in low Transit Supply scores for the area. Many jobs are located south of Westport Road (e.g., at the Ford Kentucky Truck Plant), resulting in high Activity scores, while the neighborhoods north of Westport Road feature high Need scores. Some key activity centers in the zone include Norton Brownsboro Hospital, Paddock Shops, Springhurst Towne Center, and the Walmart on Westport Road. This zone also features very high volumes of person-trips along the Route 25 Oak-Westport corridor and high trip volumes in surrounding neighborhoods, with between 25 and 50 daily trips per acre in these areas. The portion of Route 25 Oak-Westport in this area features relatively low ridership (126 average weekday boardings) and a highly circuitous, coverage-oriented route geometry, indicating the need for more direct service with faster travel times to serve the area's residents and jobs. The zone has also seen significant recent development of multi-family housing and jobs since 2010, notably Olympia Park Plaza (800,000 square feet of office space), and multi-family housing at Simcoe Lane and The Madison (600 combined units).

Eastpoint, between Old Henry Road and LaGrange Road near the Gene Snyder Freeway. This zone is just south of the Worthington zone described above, though it features distinct activity centers and primary corridors, and separating these zones may be necessary to ensure a high quality of service, particularly if micromobility or on-demand transit modes are selected to serve local trips. Key activity centers in the zone include UofL Health Medical Center – Northeast, Baptist Eastpoint Hospital, Kroger Distribution Center, the Kroger on Old LaGrange Road, and Galen College of Nursing. Significant recent development has occurred in this area, including Eastpoint Office Park (300,000 square feet of industrial space), LINAK distribution center (300,000 square feet of warehouse space), Old Henry Crossing (200,000 square feet of office space), and multi-family housing at Avoca Ridge Drive, Claibourne Crossing, and Factory Lane (700 combined units). Route 31 Shelbyville Road currently serves this area with a meandering alignment only six times a day on weekdays. Transit Supply scores are low through this area, while its Activity scores are moderate and Need score is low throughout. LBS data shows a relatively high number of trips occur to and from this area (25 – 50 daily trips per acre). Ridership is very low on the segment of Route 31 Shelbyville Road that circulates through this area, with approximately 14 boardings per day on weekdays in 2018.

Bluegrass Industrial Park, a primarily industrial area bound by I-64 to the north, Taylorsville Road to the South, Gene Snyder Freeway to the east, and Hurstbourne Parkway to the west. The western section of this zone (west of Blankenbaker Parkway) has high Activity scores, while the

eastern section of the zone (east of Blankenbaker Parkway) has lower Activity scores. Much of the activity is derived from industrial development with significant employment centers. Apart from large employers like ADP and Papa John's corporate headquarters, major activity centers in the zone include shopping centers along Hurstbourne Parkway and Taylorsville Road such as Town Fair Center, Jeffersontown Commons, and Jeffersontown Center. East of Blankenbaker Parkway, the Blankenbaker Station development contains more than 3 million square feet of recently developed warehousing and manufacturing space, including a FedEx Ground distribution center. The Needs score of this zone is relatively low given that it is composed of primarily industrial land uses. Transit Supply scores of this area are low throughout, due to the low frequency of services, minimal coverage extent, and low street connectivity. Route 75-Bluegrass Circulator currently operates through this area in a large loop alignment on weekdays only, with four trips in the AM peak and four trips in the PM peak, serving about 22 average weekday boardings. Route 40 Taylorsville Road and Route 40X Jeffersontown Express operate on Taylorsville Road, with headways that range from approximately 40 to 80 minutes. Route 61X operates nearby as well, but on the northern side of I-64.

Preston Highway, near the Gene Snyder Freeway/Preston Highway Interchange between Outer Loop and the Jefferson County line and east of I-65. This zone contains both high and low Activity and Need scores, particularly near Outer Loop Road and the Jefferson County Line. Major activity centers in the zone include the Commerce Crossings logistics hub and shopping centers along Preston Highway (e.g., Meijer, Walmart, and Kroger). LBS data shows relatively high person-trip density of at least 25-50 daily trips per acre throughout and between 50 and 100 daily trips per acre in the southeastern quadrant of the interchange. Prior to the COVID-19 pandemic, Route 45X served the area but saw very low ridership of just 9 average weekday boardings, suggesting that fixed-route service may be unsuitable for the corridor. Route 28-Preston provides relatively frequent service, with 30 minute headways, though only at the northern edge of the zone, at its terminus at the Jefferson Mall. Alternative mobility options, such as on-demand transit, could facilitate transfers to Route 28-Preston at Jefferson Mall and serve passengers completing longer-distance regional trips.

Manslick Road corridor, between the Watterson Expressway, New Cut Road/Taylor Boulevard, St. Andrews Church Road/Palatka Road, and the Paducah & Louisville Railway corridor. The Parkwood neighborhood contains high Activity density generated largely by a collection of Section 8 apartment communities at Manslick Road and Palatka Road, though most surrounding areas in the zone have lower Activity scores. The most significant activity center in the zone unserved by fixed-route transit is St. Mary's Hospital, at Bluegrass Avenue and Churchman Avenue. Along the western boundary of the zone on the Dixie Highway corridor, Route 10-Dixie Rapid and Route 18-Dixie Highway provide frequent transit service to the west, with 15-minute and 30-minute frequencies, respectively. Route 6-Sixth Street – Taylor Boulevard provides relatively strong transit service to the east. However, most areas of these zones are beyond walking distance from these services, resulting in low Transit Supply scores. However, the strong transit corridors on either side

of the zone may provide opportunities for alternative mobility options to easily connect to fixed-route service. A potential extension of this zone south to Gene Snyder Freeway along New Cut Road would also enable the zone to serve the recently completed New Cut Center, a 1.4 million-square-feet UPS logistics center.

Valley Station, north of Gene Snyder Freeway and east of Dixie Highway, in Southwest Jefferson County. Activity scores are medium to high throughout this zone, with the highest activity found along Dixie Highway. Two major activity centers in the zone, the Jefferson Community & Technical College (JCTC) Southwest campus and UofL Health Medical Center – Southwest, currently lack fixed-route transit service. Route 20 previously served this area with one stop, with low ridership (average of 37 daily boardings), an indication that fixed-route transit may not be the most suitable mode for the area. The area sees relatively high travel demand based on LBS data, at least 25-50 daily trips per acre throughout and 50-100 daily trips per acre along the Dixie Highway corridor. With 15-minute and 30-minute respective service frequencies, Route 10 Dixie Rapid and Route 18 Dixie Highway create strong transit service along Dixie Highway to the west of this zone. However, most of the neighborhoods in Valley Station are beyond walking distance from these services. The strong service on Dixie Highway may, however, provide an opportunity for innovative mobility services to fulfill the first/last-mile gaps in the zone.

Riverport, a primarily industrial zone located between the Ohio River and Dixie Highway, from Greenbelt Highway/Roland Road to the Gene Snyder Freeway in southwestern Jefferson County. This area has high Activity scores, suggesting it could support fixed-route service. The zone has also seen significant recent development activity, such as the DKY-1 Amazon Fulfillment Center and more than 3 million additional square feet of industrial/warehouse space completed since 2010. LBS data shows this zone has high trip density, with typically 25 to 100 daily trips per acre. However, the area's low-density development patterns, large block size, and car-oriented street network makes serving Riverport with fixed-route transit challenging. Routes 19-Muhammad Ali Boulevard and 63-Crumm serve moderate ridership in the area (about 150 and 300 average weekday riders, respectively). The existing service results in low Transit Supply scores in the western portion of the zone and medium Transit Supply scores in the eastern portion. As with the Valley Station zone described above, alternative mobility options could help to bridge first/last-mile connections with the Dixie Highway corridor, where frequent service is available from the 10-Dixie Rapid and 18-Dixie Highway.

3.2. Gap Analysis Methodology.

The data utilized in the previous section on existing conditions was leveraged here to identify imbalances in transit service supply and demand. This section describes the methods utilized to quantify transit supply and demand, and how these measures are combined to identify the imbalances. It is important to understand however, that a measured imbalance between supply and demand does not necessarily indicate inadequate transit service or warrant changes to a transit

network. A myriad of variables are present in a population that influence and ultimately determine the appropriate level of transit service in each area. The gap analysis methods presented here are intended to reveal locations that have relatively disproportionate balance compared to the rest of the transit network, and therefore represent opportunities for alternative service delivery models.

3.2.1. Transit Supply

Transit supply is measured and quantified using the **Transit Supply Index** from section 2.4.2. The Transit Supply Index is created using the frequency, coverage, and access of fixed-route bus trips through the region using Fall 2021 GTFS data. The Transit Supply Index calculates a single score for every CBG in the region that represents how much transit is provided in each location.

3.2.2. Transit Demand

Transit demand is measured here using the **Activity Index and Needs Index**. The Activity Index (Section 2.2.1) measures the combination of population and employment, which are two of the most influential factors in determining the demand for transit service. The Needs Index (Section 2.2.2) measures the population most likely to rely on transit, using sociodemographic data (low-income households, zero-vehicle households, minority population, English-speaking ability, disability, elderly population, and student population).

3.2.3. Service Gaps and Inefficiencies

Service gaps (deficiencies) and inefficiencies are defined as locations where the measured transit supply and transit demand are incongruous. In cases where there is an excess of demand compared to supply, a service gap (deficiency) may exist. In cases where there is a lack of demand compared to supply, a service inefficiency may exist.

Service Gap (Deficiency) – relatively high transit service demand compared to transit service supply.
Service Inefficiency – relatively low transit service demand compared to transit service supply.

Table 3-1. Density Thresholds to Support Transit Levels of Service

Service Imbalance Type	Demand	Supply
Service Gap	High Activity Index	Low Supply Index
	High Needs Index	Low Supply Index
Service Inefficiency	Low Activity Index	High Supply Index
	Low Needs Index	High Supply Index

3.3. Results/Conclusions

This section details the results of the gaps analysis in the context of identifying locations for new on-demand service model opportunities. This includes pinpointing specific areas where innovative

transit service delivery models may prove to be a cost-effective method to improve access and service quality. The first section, TSI + Activity Index, focuses on the service gaps and inefficiencies apparent from combining the TSI and Activity Index. The second section, TSI + Needs Index, discusses the service gaps and inefficiencies from combining the Needs Index with the TSI (instead of the Activity Index). Finally, the last section, On-Demand Opportunities, summarizes the results from the various sections into a list of locations best suited for on-demand implementation.

3.3.1. TSI + Activity Index

The TSI was combined with the Activity Index to form a composite index that shows combinations of categories for each index. Figure 3-1 shows the number of CBGs that fall into each category of Activity Index and TSI score combination. The Activity Index is shown with associated transit service levels, represented in shades of pink. The TSI is shown as high, medium, low, or no service, represented in shades of blue. Each combination of Activity Index score and TSI score has a unique color, showing the relationship of the supply (TSI) and demand (Activity Index).
Potential service gaps can be found in Figure 3-1 in the upper left quadrant of the matrix. These cells represent higher activity categories of 3 (Fixed Route or Dynamix On-Demand) or 4 (Fixed Route) and lower TSI categories of 1 (No Service) or 2 (Low Service). Conversely, potential service inefficiencies can be found in Figure 3-1 in the lower right quadrant of the matrix. These cells represent lower Activity Index categories of 1 (Pre-Scheduled On-Demand) or 2 (Dynamic On-Demand or Pre-Scheduled On-Demand) and higher TSI categories of 3 (Medium) or 4 (High). The results of this approach are also shown as a bivariate choropleth map in Figure 3-2, with key points bulleted below:

- Overall, TSI scores aligned well with the Activity Index. Most of the CBGs with high Activity Index scores also had high TSI scores. Conversely, most of the CBGs with low Activity Index scores also had low TSI scores.
- Service gaps: Low TSI (category 1 or 2) and high Activity Index (category 3 or 4)
    - There were only two CBGs that had high activity but no fixed-route transit service:
        - A small CBG in Parkwood, west of Manslick Road
        - A small CBG in Hillview, outside of the service area, at the corner of Blossom Road and Summit Drive.
    - A total of 13 CBGs had high activity but fell into the lower 1/3rd of transit service.
        - The largest cluster of CBGs falling into these categories were in eastern Jefferson County, served by Route 75 Bluegrass Circulator. This area extends south to Taylorsville Road and north along Hurstbourne Parkway to La Grange Road. Route 61X Plainview Express and Route 15 Market Street serve these areas as well.
    - There were 33 CBGs that had the second highest activity levels but no fixed-route transit service:

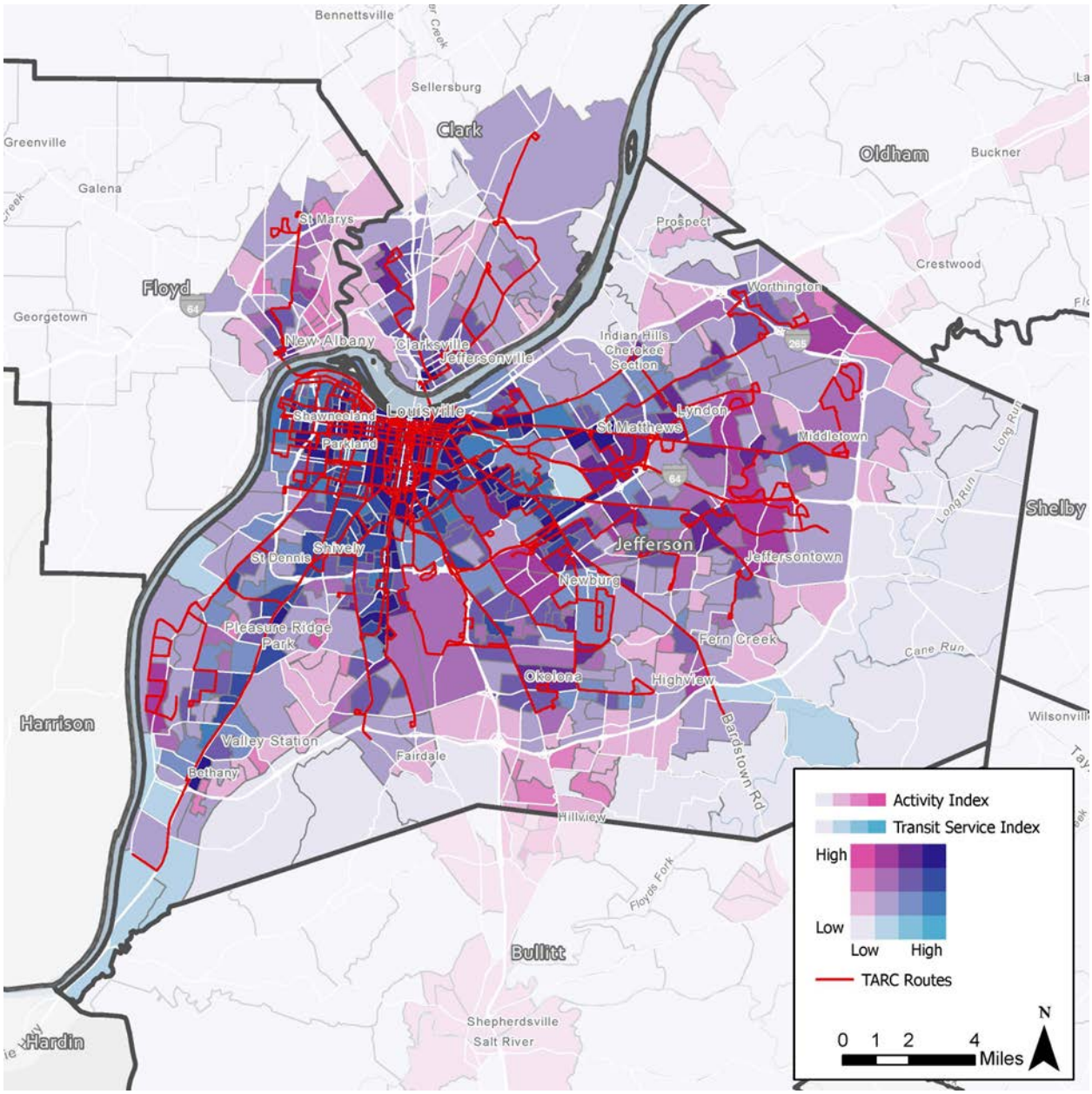
        - The largest cluster of CBGs that fits these criteria is along Preston Highway, to the south of the Gene Snyder Freeway. Several of these CBGs are just outside of Jefferson County, into Bullitt County.
        - New Albany also has a large cluster of CBGs with relatively high activity but no transit service. This includes a large section of northeastern downtown, along Spring Street and between Charleston Road and State Run Road.
        - There are two large CBGs with high activity and no service at the far edge of Northeast Jefferson County, adjacent to Oldham County. This includes the southern/eastern side of La Grange Road (just outside the reach of Route 31 Shelbyville Road), and Worthington Hills east of Lunenburg Drive.
- Service inefficiencies: High TSI (category 3 or 4) and low Activity Index (category 1 or 2)
    - No CBGs scored 3 (Medium) or 4 (High) on the TSI and 1 (Pre-Scheduled On-Demand) on the Activity Index.
    - There were 55 CBGs that scored 2 (Dynamic On-Demand or Pre-Scheduled On-Demand) on the Activity Index and 3 (Medium) on the TSI. Additionally, there were 17 CBGs that had Activity Index category 2 (Dynamic On-Demand or Pre-Scheduled On-Demand) on the Activity Index and 4 (High) on the TSI. Although these CBGs do not have the population and jobs densities that would appear to support fixed-route transit, most of them are along major corridors that lead to areas with higher densities.

Figure 3-1. Activity Index and Transit Supply Index Composite Categories

High Activity	4	Fixed Route	2	13	42	88
	3	Fixed Route or Dynamic On-Demand	33	50[GU1] [GM2]	87	79
	2	Dynamic On-Demand or Pre-scheduled On-Demand	103	114	55	17
Low Activity	1	Pre-Scheduled On-Demand	139	6	0	0
			No Service	Low (Bottom 33.3%)	Medium (33.3-66.6%)	High (Top 33.3%)
			1	2	3	4
			Low TSI			High TSI

1. Values in color matrix represent the number of block groups in each Activity Index and TSI score combination.
2. Colors in the color matrix correspond to colors shown in Figure 3-2.
3. Potential service gaps are found in the upper left quadrant of the matrix. These cells represent higher Activity Index categories 3 (Fixed Route or Dynamic On-Demand) or 4 (Fixed Route) and lower TSI categories 1 (No Service) or 2 (Low).
4. Potential service inefficiencies are found in the lower right quadrant of the matrix. These cells represent lower Activity Index categories 1 (Pre-Scheduled On-Demand) or 2 (Dynamic On-Demand or Pre-scheduled On-Demand) and higher TSI categories 3 (Medium) or 4 (High).

Figure 3-2. Activity Index and Transit Supply Index Composite Map



3.3.2. TSI + Needs Index

The TSI was also combined with the Needs Index to create a composite index to show the number and spatial distribution of index combinations. To calculate the combinations of index results, the Needs Index scores were divided into four quartiles: low (0-25%, medium low (25-50%), medium high (50-75%), and high (top 25%). Figure 3-3 shows how the Needs Index scores and TSI scores were combined to create a matrix of results with high and low transit needs and supply.

The results of the matrix are used to identify a second type of service gap with high needs and low supply. Potential service gaps can be found in Figure 3-3 in the upper left quadrant of the matrix.

These cells represent higher Needs Index categories of 3 (Medium High) or 4 (High) and lower TSI categories of 1 (No Service) or 2 (Low). Conversely, potential service inefficiencies can be found in Figure 3-3 in the lower right quadrant of the matrix. These cells represent lower Needs Index categories of 1 (Low) or 2 (Medium Low) and higher TSI categories of 3 (Medium) or 4 (High). Similar to the TSI + Activity Index section, the results of the combination of Needs Index and TSI are shown as a bivariate choropleth in Figure 3-4. The key takeaways from this analysis are as follows:

- Similar to the Activity Index and TSI composite, the Needs Index scores and TSI scores were well correlated. CBGs with high Needs Index scores also had high TSI scores, meaning that areas with the greatest need also had strong transit access.
- Service Gaps: Low TSI (category 1 or 2) and high Needs Index (category 3 or 4)
    - A total of 12 CBGs were identified as having both the highest need and no service.
        - Several of the locations with highest needs (category 4) and lowest service (TSI category 1) are in Floyd County. This includes downtown New Albany, as well as Green Valley Road inside of I-265.
        - The neighborhoods west of Manslick Road in Parkwood also had high need and no service.
        - The edge of Jefferson County along Preston Highway has high need and no service. This area has several CBGs that fall into the medium high category as well.
        - Several of the high need and no service areas occur outside of the TARC service area. This includes downtown Shepherdsville and an area just south of the Jefferson/Bullitt county line near I-65.
    - A total of 31 CBGs had medium high need and no service.
        - Several CBGs in the vicinity of the Preston Highway and the Gene Snyder Freeway interchange make up the largest areas of this combination of need and service.
- Service inefficiencies: High TSI (category 3 or 4) and low Needs Index (category 1 or 2)
    - Route 31 Shelbyville Road operates along Old Henry Road to Baptist Eastpoint Hospital inside of the Gene Snyder Freeway. Although this area is serviced infrequently, the 14 weekday daily boardings likely do not justify fixed route service.

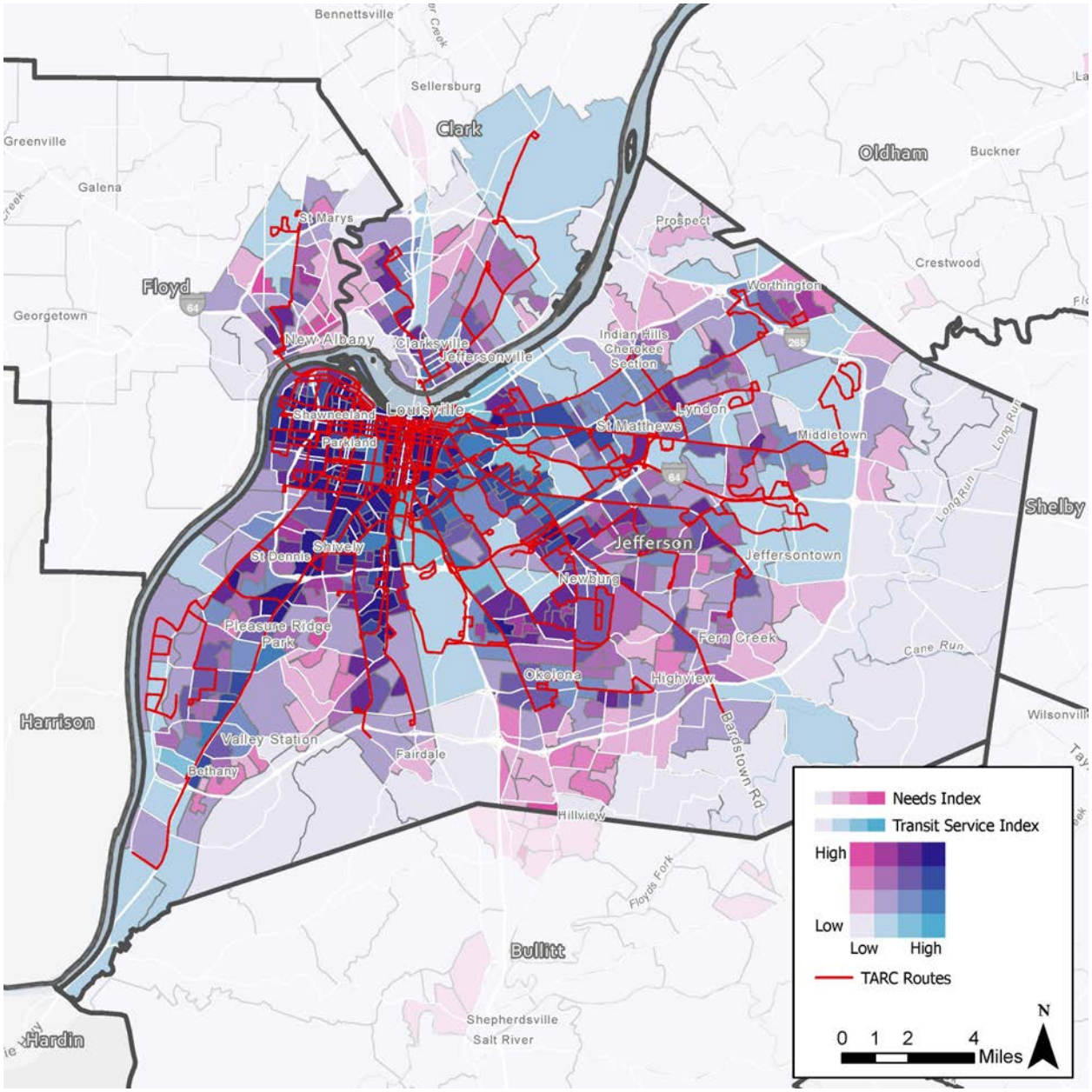
Figure 3-3. Needs Index and Transit Supply Index Composite Categories

High Need	4	High (Highest 25%)	12	19	61	115
	3	Medium High (50-75%)	31	57	70	49
	2	Medium Low (25-50%)	64	76	48	19

Low Need	1	Low (Lowest 25%)	**170**	31	5	1
			No Service	Low (Bottom 33%)	Medium (33-66%)	High (Top 33%)
			1	2	3	4
			Low TSI			High TSI

1. Values in color matrix represent the number of block groups in each Activity Index and TSI score combination.
2. Colors in the color matrix correspond to colors shown in Figure 3-4.
3. Potential service gaps are found in the upper left quadrant of the matrix. These cells represent higher Needs Index categories 3 (Fixed Route or Dynamic On-Demand) or 4 (Fixed Route) and lower TSI categories 1 (No Service) or 2 (Low).
4. Potential service inefficiencies are found in the lower right quadrant of the matrix. These cells represent lower Needs Index categories 1 (Pre-Scheduled On-Demand) or 2 (Dynamic On-Demand or Pre-scheduled On-Demand) and higher TSI categories 3 (Medium) or 4 (High).

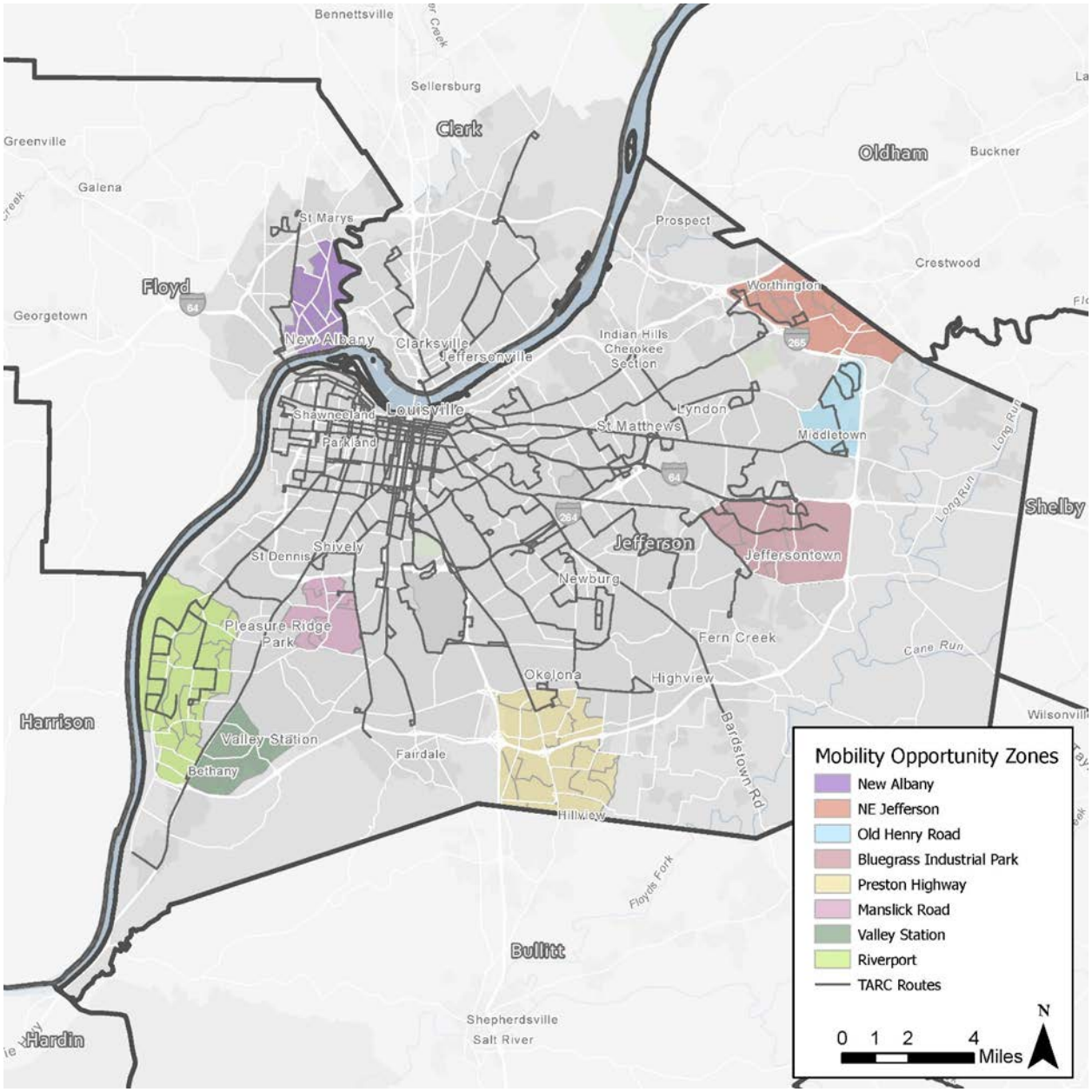
Figure 3-4. Needs Index and Transit Supply Index Composite



The imbalance between measured transit supply and demand suggest that innovative mobility options may help fill gaps in service and complement the existing fixed-route system. Figure 3-4 shows several locations that have surfaced as candidates for new or modified service throughout this analysis. Each zone has been created using the CBGs as the unit of geography, and therefore, some zones contain irregular shapes. It should be noted that further refinement of the zones will be required according to several factors, such as the specific mode of service delivery (e.g., on-demand, micromobility, ride-hail), key service parameters, use cases, activity centers served, and their specific connectors to the TARC fixed-route network. Therefore, the zones constructed

in this analysis should be used as general areas that warrant further discussion regarding mobility solutions. Each location is discussed further immediately following Figure 3-4 in no particular order.

Figure 3-5. Mobility Opportunity Zones



New Albany and the Charleston Road corridor

Location: This cluster of CBGs is in the downtown New Albany area, in Floyd County, Indiana. The zone is to the west of Silver Creek and to the east of Route 71 Jeffersonville-Louisville-IUS.

TSI: Route 71 Jeffersonville-Louisville-IUS operates through New Albany, but much of the eastern side of New Albany is too far to access the fixed-route service.
Activity Index: Several CBGs in downtown New Albany along Spring Street have high Activity Index scores.
Needs Index: Several CBGs in downtown New Albany have high Needs Index scores, like the Activity Index results.
LBS: Relatively high number of trips throughout most of the zone.
Ridership: When Route 80 served Spring Street there were approximately 30 daily boardings. Route 80 is no longer in service.
Other Mobility Services: Vanpool Indiana #2 operates in this area.

Northeast Jefferson County

Location: This cluster of CBGs is located just outside of the Gene Snyder Freeway up to the Jefferson County Line. The zone is generally south of I-71 and would likely extend south to La Grange Road or possibly Old Henry Road.
TSI: Route 25 Oak-Westport serves sections of this area relatively frequently (every 30 to 50 minutes on weekdays). Service only operates on the northern side of Westport Road, however, leaving much of the area with low TSI scores.
Activity Index: Several CBGs in this zone scored high on the Activity Index. A high number of jobs exist on the southern side of Westport Road.
Needs Index: The neighborhoods north of Westport Road indicate a relatively high need for transit services.
LBS: Very high trips occurring throughout the existing service of Route 25 Oak-Westport, but all other CBGs in the zone also have a relatively high number of trips (25 – 50 daily trips per acre).
Ridership: Ridership data show that approximately 126 daily boardings occurred on the segments that are still active.

Old Henry Road

Location: Although this area is in very close proximity to the previous zone of Northeast Jefferson County, it may be beneficial to operate separate on-demand zones for each side of the Gene Snyder Freeway. The zone would extend west of the Gene Snyder Freeway to La Grange Road, covering both sides of Old Henry Road. The zone would also extend south to the commercial development along Shelbyville Road.
TSI: Route 31 Shelbyville Road currently serves this area with a meandering alignment only six times a day on weekdays. TSI scores are low through this area.
Activity Index: A medium level of activity density occurs in this CBG.
Needs Index: The Needs Index is low in this area.
LBS: A relatively high number of trips occur to and from this area (25 – 50 daily trips per acre).

Ridership: Ridership is low on the segment of Route 31 Shelbyville Road that circulates through this area, with approximately 14 riders per day on weekdays in 2018.

Bluegrass Industrial Park

Location: The Bluegrass Industrial Park is made up of CBGs bounded by I-64 to the north, Taylorsville Road to the South, the Gene Snyder Freeway to the east, and Hurstbourne Parkway to the west.
TSI: Route 75 Bluegrass Circulator currently operates through this area in a large loop alignment on weekdays only, with four trips in the am peak and four trips in the pm peak. Route 40 Taylorsville Road and Route 40X Jeffersontown Express operate on Taylorsville Road, with headways that range from approximately 40 to 80 minutes. Route 61X operates nearby as well, but on the northern side of I-64. The resulting TSI scores are low.
Activity Index: The western section of this zone (west of Blankenbaker Parkway) has high activity levels, while the eastern section of the zone (east of Blankenbaker Parkway) has lower activity levels. Much of the activity is derived from industrial development with high job counts. Because these businesses are relatively spread out, the activity is likely higher than reflected in the Activity Index.
Needs Index: The Needs Index indicates a low number of residents living in the area need access to transit. However, most of this zone is job-focused.
LBS: Much of this zone has high trip densities considering the size of the CBGs. The highest density of work trips occurs west of Blankenbaker Parkway, with 15 – 20 daily trips per acre. The eastern side of Blankenbaker Parkway also has a high density of trips (5 – 10 daily trips per acre), especially considering how large the area is.
Ridership: Approximately 22 daily boardings were recorded on the Route 75 Bluegrass Circulator in the 2018 ridership dataset.
Other Mobility Services: Vanpool routes Middletown #1 and Hollander operate in this area.

Preston Highway

Location: The Preston Highway zone is made up of CBGs on all four quadrants of the Preston Highway and the Gene Snyder Freeway interchange. The zone would likely extend all the way to the Jefferson County Line on the southern end, and up to Outer Loop. Service would likely only operate on the eastern side of I-65.
TSI: Route 28 Preston currently services the northernmost edge of this zone, operating approximately every 30 minutes, yielding strong TSI scores but only for this small area. Introducing on-demand up to Outer Loop Road would provide the opportunity to streamline this section of Route 28 Preston Highway to operate directly to Jefferson Mall instead of deviating south of Outer Loop Road. The on-demand zone would likely connect to Route 28 Preston.

Activity Index: Several zones scored higher on the Activity Index, with the greatest scores occurring on the far northern end (along Outer Loop) and the far southern end (towards the Jefferson County and Bullitt County line)
Needs Index: CBGs in this area are mixed in terms of Needs Index scores, with several high needs CBGs adjacent to low needs CBGs.
LBS: Most of the area records 25 – 50 daily trips per acre, but an even higher trip density of 50 – 100 daily trips per acre occurs in the southeastern quadrant of the Gene Snyder Freeway and Preston Highway interchange.
Ridership: When Route 45X served this area of Preston Highway there was a low passenger count of about 9 daily boardings, suggesting that fixed-route transit was ineffective.

Manslick Road

Location: This cluster of CBGs is primarily composed of the neighborhoods between Taylor Boulevard and New Cut Road on the east, and the railroad tracks on the west. The Watterson Expressway would likely be the northern boundary, with St Andrews Church Road and Palatka Road operating as the southern boundary.
TSI: Route 10 Dixie Rapid and Route 18 Dixie Highway provide strong transit service to the west, and Route 6 Sixth Street – Taylor Boulevard provides strong transit service to the east. Much of the CBGs in this zone however are too far to walk to these services, creating low transit supply. The strong service on both sides of the zone may provide an opportunity for on-demand service to connect to fixed-route service.
Activity Index: Very high activity density generated by a single neighborhood at the intersection of Manslick Road, St Andrews Church Road, and Palatka Road. Most of the surrounding CBGs, however, have lower activity.
Needs Index: CBGs in this area indicate a range of scores on the Needs Index, ranging from the highest to the lowest.
LBS: Trip density is mixed throughout this cluster of zones, with a couple small zones recording as much as 50 – 100 daily trips per acre.
Ridership: Although Route 54X previously operated through this area, there is no ridership data available.

Valley Station

Location: This zone would likely contain the cluster of CBGs north of the Gene Snyder Freeway and east of Dixie Highway, in Southwest Jefferson County.
TSI: Route 10 Dixie Rapid and Route 18 Dixie Highway create strong transit service along Dixie Highway to the west of this zone, but most of the neighborhoods in Valley Station are too far to access the existing service. The strong service on Dixie Highway may, however, provide an opportunity for on-demand service to connect to.
Activity Index: Highest activity occurs along Dixie Highway, but most of the CBGs in this zone have at least medium activity.

Needs Index: The Needs Index indicates mixed levels of need, ranging from relatively high to low.
LBS: This entire area is made up of relatively large zones that produce 25 – 50 daily trips per acre and 50 – 100 daily trips per acre.
Ridership: Route 20 previously served this area with one stop, recording approximately 37 daily boardings.

Riverport

Location: The Riverport zone is in southwestern Jefferson, between the Ohio River and Dixie Highway. The northern edge of the zone would likely be around the Walmart on Greenbelt Highway, while the southern end would likely be Greenbelt Highway and the Gene Snyder Freeway.
TSI: The southwestern end of Route 19 Muhammad Ali Boulevard operates through this area, on Cane Run Road and Greenbelt Highway. Route 63 Crums Lane operates on Terry Road on the eastern side of the zone. The existing service results in low TSI scores in the west and medium TSI scores in the east. If an on-demand zone is implemented in this area, modifications to the fixed-route service in the area would likely be appropriate.
Activity Index: This area has high activity levels that would suggest it would be supportive of fixed route service. The development patterns through this area, however, makes serving Riverport with fixed-route transit relatively challenging.
Needs Index: Most of this zone is job based, and therefore results in unimpressive need densities. The eastern section of the zone does have neighborhoods however, which produces low and medium levels on the Needs Index.
LBS: Much of this area has relatively high total trip end density, made up of CBGs with 25 – 50 daily trips per acre and 50 – 100 daily trips per acre.
Ridership: The western side of this zone (served by Route 19 Muhammed Ali Boulevard) had 138 daily boardings, while the eastern side of the zone (served by Route 63 Crums Lane) had 118 total daily boardings. The total number of boardings was approximately 256 daily boardings in the 2018 dataset.

4. Promising Mobility on Demand Programs from Peer Transit Agencies.

4.1. Introduction.

There has been a proliferation of innovative mobility services established throughout the U.S. in recent years. Many transit agencies have broadened their service portfolios to include more flexible, on-demand solutions that are better suited to areas with either no or underperforming fixed-route transit. Other transit agencies have implemented new mobility services to expand their reach and connect new riders into the transit network. This section includes eight case studies of innovative mobility services relevant to TARC based on the identified needs from Task 2: Existing Conditions and Problem Evaluation.

The programs detailed in this report were identified through an industry scan that included 52 innovative mobility programs from 23 peer cities. From this initial list, the project team worked with TARC to select 13 relevant peers for further exploration. Eight of the 13 agencies contacted accepted an interview request, as identified in Table 1. Each agency was interviewed to uncover details on purpose and use case, funding and governance, implementation and operations, outcomes, and key lessons learned.

Table 1: Peer Cities

City	Agency	Program Name	Application
Pittsburgh, PA	PAAC	Move PGH	MaaS
Dallas, TX	DART	GoLink	Microtransit
Richmond, VA	GRTC	CARE On-Demand	Same Day ADA Paratransit
Orlando, FL	LYNX	NeighborLink	Microtransit
Memphis, TN	MATA	Ready! by MATA	Microtransit
St. Petersburg, FL	PSTA	Direct Connect	TNC/Taxi Partnership
Dayton, OH	RTA	RTA Connect	TNC/Taxi Partnership
Nashville, TN	WeGo	WeGo Public Transit	TNC/Taxi Partnership

4.2. Summary of Key Findings.

Key findings from the peer case studies are summarized below relevant to service design, implementation, technology, operations, and marketing considerations.

Service Design

The design of a new on-demand mobility service begins with having a clear understanding of the goals and objectives of the program. Agencies must ask themselves, "What are we trying to accomplish and who are we providing this service for?". The answers to these questions will help guide how the service is created and then evaluated. Although some aspects of a mobility on-demand program are flexible and oftentimes evolve to become more tailored to the specific market, other aspects such as choosing between service delivery models are more difficult to change. Understanding the purpose of the program and the market that it will serve will give clarity to the framework of the service design. Once operational, agencies should continually evaluate and refine the service to ensure it is meeting the needs of its customers.

Implementation

Implementation of a new service is a complex, multi-step process that requires significant coordination within the agency and with outside partners. Choosing partners that are committed and collaborate well with the agency is an important first step in ensuring smooth implementation. Internal buy-in across the entire organization is equally important to implement the new service successfully. Finally, implementing the new program while keeping the existing services in operation to provide a period of service overlap gives passengers time to adjust.

Technology

The technology component for on-demand service has undergone the most dramatic improvements in recent years, making service easier and simpler to implement. Still, decisions at the planning stages will have consequences downstream, making choice of technology a critical component. Agencies should consider technology that is scalable to meet both current and future needs, can serve the necessary reporting and operational requirements, and provides open data that the agency can use to track performance.

Operations

Many of the operational details of mobility on-demand will depend on who is operating the service. Some themes were universal however, such as the need to decide how comparable ADA paratransit service is provided alongside the on-demand service. The national driver shortage can become a challenge, either directly (agency operated) or indirectly (third-party operated). FTA requirements for drug and alcohol testing, ADA service, and Title VI are also key operational considerations that must be addressed. Finally, agencies should consider labor implications and union coordination and buy-in.

Marketing & Outreach

Many aspects of mobility on-demand service are new to the public, and thus require additional effort before adoption takes place. Identifying the target market, reaching and educating the market, and maintaining communication after the service is operational are all key components in a

successful service. Overall, peers suggested that satisfaction in service seems to be tied to the customer understanding of the service, underscoring the importance of marketing and outreach.

4.3. Peer Case Studies.

The following sections summarize case studies for each peer program. Each case study provides an overview of the program, key outcomes, and lessons learned.

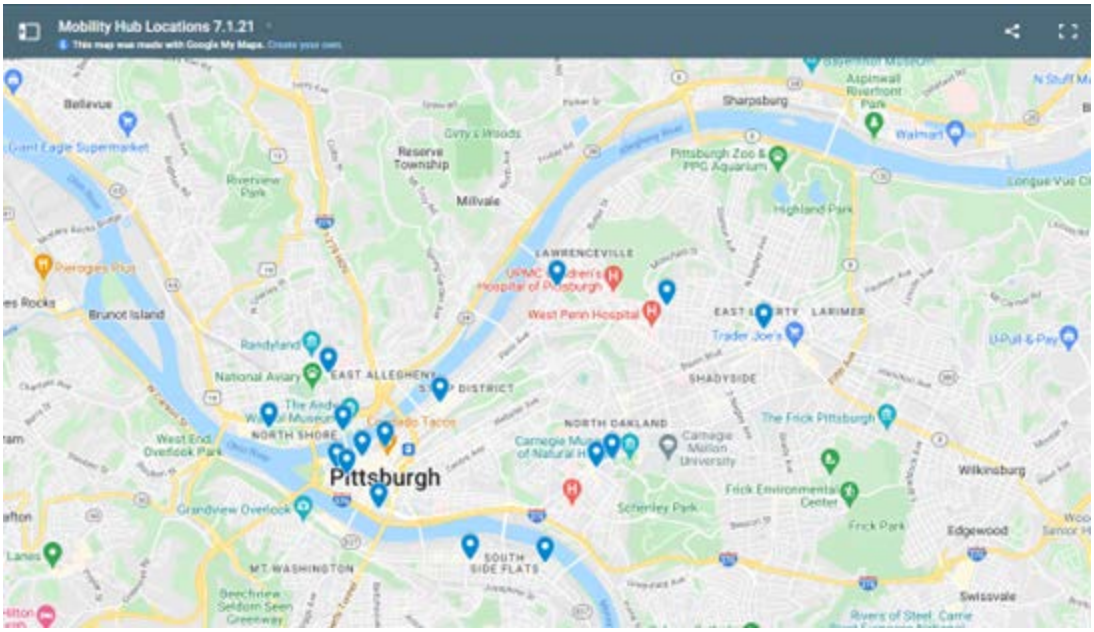
4.3.1. Pittsburgh (Port Authority).

Move PGH is a MaaS (Mobility as a Service) program that coordinates and provides access to transportation choices in Pittsburgh, PA. The program has been working to integrate transit, e-scooters, bikeshare, carshare, carpooling services, and mopeds into a more coordinated, efficient, and accessible mobility solution. The purpose of the program is to ensure that transportation technology and services are deployed strategically in Pittsburgh. Move PGH has been responsible for creating Mobility Hubs, which are places where people can connect between a variety of transportation options. Move PGH has also been working to incorporate the various transportation service providers into the Transit app to create a single platform for payment and trip planning information.

Move PGH is a program for all but is targeting those who have had previous difficulty in accessing mobility options. Move PGH works to ensure that transportation options are accessible and distributed equitably across Pittsburgh's neighborhoods with Mobility Hubs. In addition, Move PGH plans to launch a Guaranteed Basic Mobility pilot program in Spring of 2022 for low-income residents of Manchester neighborhood. Participants will be granted one year of shared mobility services at no cost.

Move PGH identified core goals to guide the program's development. First, the program hopes to expand the reach of transit and drive more usage of the existing transit network, recognizing that transit services are the backbone of shared mobility. In addition, Move PGH strives to decrease vehicle miles traveled, particularly single occupancy vehicles, by making it more attractive and accessible to use alternative modes of transport. Move PGH also seeks to close transportation gaps wherever they exist, such as in certain times of day or days of the week, or within certain neighborhoods or demographic groups that have less access to personal vehicles.

Figure 1. Move PGH Mobility Hub Locations



Source: https://move-pgh.com/mobility-hubs-maps

Funding & Governance.

Move PGH began as a collaboration between Pittsburgh's Department of Mobility and Infrastructure (DOMI) and New Urban Mobility Alliance (NUMO) to create a mobility collective that serves to connect transportation options in the area more effectively. An RFP was released detailing a vision of mobility partnership, preferred levels of service, and the necessary technology to link services together. Move PGH, sponsored by DOMI, was launched in July 2021 in coordination with the Pittsburgh Mobility Collective (PMC), with members that include Port Authority, Healthy Ride, Scoobi, Zipcar, and Waze Carpool.

Funding requirements for Move PGH are minimal, with one management position, funding for various pilot projects, and some technical assistance. Move PGH received early funding from NUMO but has since been funded largely by a grant through the Richard King Mellon Foundation.

Implementation & Operations.

Aside from the bike share program, which is a non-profit organization, and Port Authority, which is a governmental agency, each mobility service provider is privately owned and operated. Move PGH operates as the liaison to each of the mobility service providers and ensures that set policies and priorities are met by each provider. The program manager at Move PGH makes up the majority of ongoing program costs. Permitting fees are required of all mobility service providers, providing some revenue as well.

The program was marketed with direct outreach to community organizations, press releases, a website, social media, and through digital screens located at the Mobility Hubs. The Mobility Hubs continue to be the primary source of advertising to the community of all the various services that are linked through Move PGH.

Outcomes.

- Move PGH is tracking performance of many of the mobility providers through Key performance indicators (KPIs). Total ridership and utilization of services available are key metrics. Move PGH intends to track utilization trends to see if the addition of one service reduces the utilization of other services. The trends have yet to be analyzed however because the program has been in operation less than a year.
- Move PGH was careful and deliberate with the implementation of e-scooters to avoid obstructing pedestrian traffic and sidewalk clutter. Move PGH contracted with Landforce, a construction and maintenance organization to install over 100 scooter corrals for scooters to be parked at designated locations between usage.
- Move PGH is also focused on making mobility equitable in Pittsburgh by tracking how many modes are available in various parts of the city. Move PGH has intentionally distributed the Mobility Hubs throughout the city in an effort to close transportation gaps. Move PGH would like to make mobility more affordable through programs such as the Guaranteed Basic Mobility project.
- Move PGH plans to iterate and potentially expand should there be sufficient support. Vanpooling and/or microtransit could also be included in the program in the future.
- Move PGH is exploring ways to improve the user experience with single payment for multiple modes, as well as various types of fare bundling.

Key Lessons Learned.

- **Create partnerships carefully and deliberately.** Partnering with the right mobility services has been critical in creating a successful mobility collective. Overall, the partnerships created have been highly successful. However, the level of commitment and engagement between mobility service partners does vary. Some partnerships have been created through a memorandum of understanding (MOU) rather than binding legal contracts and therefore are less enforceable. A key point to understand when forming relationships with mobility service providers is that goals differ from commitments.
- **Understand state and local laws.** New types of mobility services can be challenging to implement. Move PGH experienced challenges in bringing e-scooters to Pittsburg because the vehicle type was not yet classified in the state vehicle code, and therefore could not legally be operated on public roads. State vehicle codes were updated to include e-scooters as a two-year pilot in the city of Pittsburgh, which had to be passed in the state

legislature. After two years the pilot will be assessed by a committee to inform a more permanent policy on e-scooters statewide.

4.3.2. Dallas (DART).

Dallas Area Rapid Transit (DART) provides multimodal transit services, including light rail, commuter rail, fixed-route bus, paratransit, and on-demand modes, to more than 220,000 passengers per day across a 700-square-mile service area in North Texas. DART was an early adopter of public on-demand service, launching its On-Call program in 1999 which eventually evolved into its current GoLink service. The purpose of GoLink is to improve travel options and increase first and last mile connections to the DART network for customers living and working in lower-density areas.

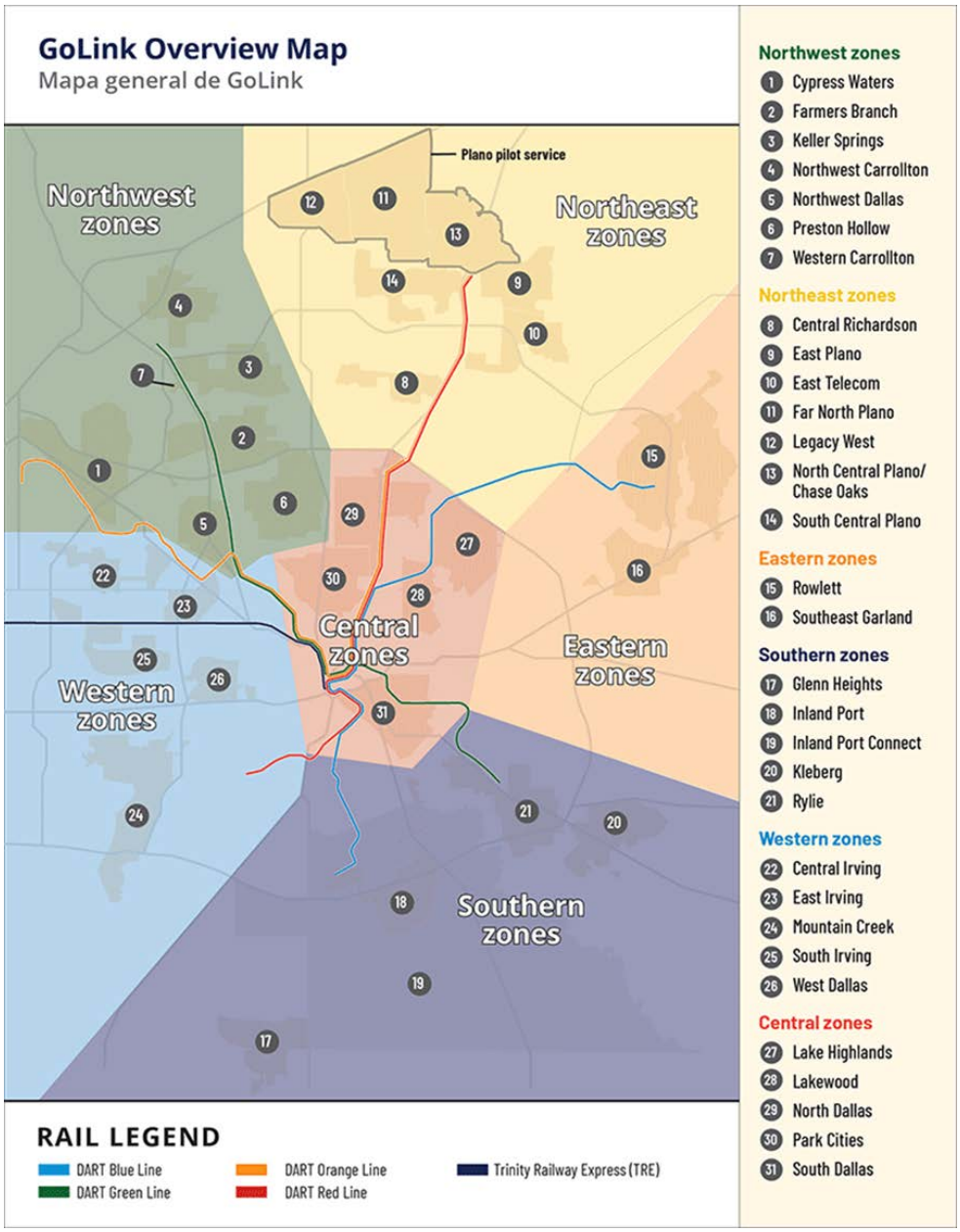
Prior to transitioning to GoLink in 2018, DART's On-Call program included eight zones, each operating with a single vehicle. Initially, peak period trips were required to begin or end at established anchor points and local travel was permitted only during off-peak periods. Dispatching was conducted manually, with bus drivers taking trip reservations using mobile phones. The restrictive nature of the service, along with inefficient scheduling and operational practices, contributed to relatively poor performance during the early years of the On-Call program.

The transition to the current GoLink program began in 2016 when DART was awarded a FTA Mobility On-Demand (MOD) Sandbox grant. The grant provided DART seed money to develop a platform within its existing GoPass fare payment app to facilitate multimodal trip planning, booking, and payment. This new technology platform provided the framework for DART to transform On-Call into a mobility management model that provides trips through a DART-branded microtransit service, TNCs, and taxis. DART used this opportunity to completely revamp its On-Call program, including a rebrand to GoLink and a removal of trip restrictions. After a successful pilot test in 2017, DART began rolling out GoLink to the rest of its On-Call zones in 2018 and completed its integration with UberPool in 2019.

Today, GoLink service is provided in 30 zones spanning 230 square miles. Local point-to-point travel is permitted in all zones in addition to first and last mile connections to DART's bus and rail services. Over 70% of trips are booked through the GoLink app, with the remaining trips booked via phone. Customers wishing to travel using UberPool are currently redirected to the Uber app, however DART intends to integrate Uber booking and payment into the GoLink app in the near future.

GoLink fares match DART's normal base bus fare. Fares are paid through the GoPass app using a credit or debit card or by linking a GoPass Tap card to the customer account. While cash is not an accepted form of payment, customers can load cash to their GoPass Tap card account at over 800 retail outlets throughout the DART service area.

Figure 3: DART GoLink Zones



Funding & Governance.

GoLink is governed by DART and funded through its general operating budget. DART leveraged an FTA MOD Sandbox grant as seed money for the development of GoLink. Total funding provided for the MOD Sandbox project was $1,204,000 in federal funds and $301,000 in local matching funds, for a total budget of $1,505,000.

Implementation & Operations.

GoLink is operated as a mobility management service (MMS). DART contracts with MV Transportation as the prime contractor responsible for brokering trip requests for both GoLink and its ADA paratransit service. The MMS prime contractor directly serves some trip requests using its own vehicles and assigns the remaining trips to multiple third-party service providers including local taxi operators and UberPool. To-date, about a quarter of GoLink trips are handled through UberPool.

Prior to rolling out GoLink in 2018, DART initiated an extensive marketing campaign that included web, print, TV, and digital advertising. To connect with a younger audience, DART incorporated the use of social media influencers into its digital marketing campaign.

In terms of service design, DART historically tried to limit zone size to about six square miles, which it could generally handle with a single vehicle without negatively impacting wait times. Now, with better dispatching and routing technology, many zones are between 10 and 20 square in size, with its largest zone covering 23 square miles with three vehicles. DART finds that wait times tend to increase in larger zones, even with additional vehicles. DART's goal for customer wait time is 15 minutes or less and currently averages about 13-14 minutes. DART continuously evaluates and makes changes to zonal boundaries based on customer requests and evolving development patterns.

When replacing existing fixed routes, GoLink typically launches service a month or two before the fixed-route is removed. This overlap in service provides DART the opportunity to conduct outreach on buses to inform customers of the planned service elimination and educate them on how to use the new on-demand service.

The primary challenge involved with the GoLink service model is the use of Uber as a trip provider, which to-date does not comply with FTA's drug and alcohol testing requirements. In order to satisfy FTA requirements, DART must offer customers a choice in service providers and customers must opt-in to using Uber as their trip provider.

Outcomes.

- GoLink costs about $8 million per year to operate all 30 zones and produces between 1,300 and 1,400 daily riders. DART uses subsidy per rider as a key metric to measure success. GoLink's subsidy per rider was about $26 prior to its recent expansion to 30 zones and is now down to about $16. DART's goal is to reduce the subsidy per passenger to $10 per rider. DART also evaluates riders per vehicle hour for trips provided using dedicated vehicles, with its top performing zone averaging about 4 passengers per hour. Finally, DART also looks at wait time as a measure of capacity and at operator rating as a measure of customer satisfaction.

- Having a proven on-demand service model in place was critical to the success of DART's recent bus network redesign. The long history of the GoLink and On-Call programs allowed DART to recommend replacing underperforming fixed-routes with a service that many riders were already accustomed to. Prior to the network redesign implementation in January 2022, DART operated 17 GoLink zones and had 45 bus routes with less than 300 riders per day. The redesign increased the number of zones to 30 and now operates fewer than 10 routes with less than 300 riders per day.
- DART is very pleased with the success of its GoLink program. DART does not expect to make significant geographic expansions to the program in the near-term, but is evaluating increasing service span to better match its fixed-route services. DART expects that service span improvements will cost as much as $2 million per year and will likely result in higher subsidies per rider.

Key Lessons Learned.

- **Think carefully about technology and back-office infrastructure.** Transit agencies should think carefully about the technology solutions and back-office infrastructure required to successfully operate on-demand service. Staff should invest time to define performance requirements, investigate what has worked elsewhere, and ensure that it is scalable.
- **Ensure the program is an agency-wide initiative.** The success of GoLink is in large part due to DART's agency-wide commitment to the program. Early in the planning process, DART leadership established a 25-person team with representatives from across every department in the organization. This approach helped reinforce the idea that on-demand was not a pet project of one person or department, but a critical component of DART's broader family of services.

4.3.3. Richmond (GRTC).

CARE On-Demand is part of GRTC's (Greater Richmond Transit Company) Specialized Transportation program that offers ADA paratransit service in the city of Richmond and parts of Henrico County, Virginia. The Specialized Transportation program also includes CARE (Community Assisted Ride Enterprise) and CARE Plus services. All three services offer curb to curb trips, but also can provide assistance to passengers beyond the curb.

CARE is the FTA required ADA paratransit service that operates within ¾ mile from fixed route service. CARE Plus differs from CARE in that it serves trips with an origin or destination outside of the ¾ mile from fixed route limit. Both CARE and CARE Plus are reservation-based (riders need to schedule a trip in advance) and shared ride (passengers often share trips with other passengers). CARE On-demand is also an ADA paratransit service, meaning that customers must first qualify to use the service. CARE On-Demand is distinguished from the other specialized transportation services in that it is same day on-demand service (no need to schedule a trip in advance) and

direct (passengers do not need to share rides with other passengers). Table 2 shows how CARE On-Demand differs from CARE and CARE Plus.

Table 2. GRTC Specialized Transportation Services

Service	Trip Request Type	Fare	Service Area	Operator
CARE	Reservation based (next day booking)	$3.00[1]	Up to ¾ mile from fixed route	First Transit and subcontractor UZURV
CARE Plus	Reservations based (next day booking)	$6.00[1]	From ¾ mile from fixed route service to city of Richmond and Henrico County limits	First Transit and subcontractor UZURV
CARE On-Demand	Same day on-demand (2 hours in advance booking)	Total cost of trip less $15.00 (minimum of $6)[2]	Up to ¾ mile from fixed route	UZURV and Roundtrip

1. CARE and CARE Plus are currently fare-free to reduce contact between drivers and passengers during the COVID-19 pandemic.
2. CARE On-Demand has a minimum fare of $6. GRTC covers up to $15 of the trip and the passenger must pay any additional cost. The total cost of the trip is determined during the trip reservation so the customer is aware of the total cost before submitting the trip request.

Trip booking is made by either scheduling online, through a smartphone app, or by contacting the call center. Passengers have a choice between two CARE On-Demand partners: Roundtrip and UZURV. When booking, the passengers request a pickup and drop-off location and receive a trip cost before booking the trip. Passengers are required to pay a minimum of $6.00 for a trip. The remaining trip costs up to $21.00 are covered by GRTC, effectively creating a maximum trip GRTC subsidy of $15.00. Any costs that exceed $21.00 are covered by the passenger.

The initial objective of CARE On-Demand was to reduce the operating costs of paratransit service while increasing the capacity. The management team set the goal of CARE On-Demand making up at least 10% of total paratransit trips. GRTC considers the CARE On-Demand pilot to be a success, and currently makes up approximately 12% of total paratransit trips.

Figure 4. Care On-Demand Partners

Funding & Governance.

GRTC initially developed an RFP for the pilot program in 2016 that would eventually become the CARE On-Demand service. In the RFP, GRTC requested that partners provide same day direct service that was accessible for people with disabilities. UZURV became the first available provider in August of 2017 and Roundtrip became the second in December of 2017. GRTC is non-exclusive with providers and has the ability to add more providers in the future. As of 2022, CARE On-Demand is still categorized as a pilot program, but GRTC plans to make the program permanent later in 2022. Funding for the pilot program comes from the GRTC operating/general fund, which has a total annual cost of approximately $400,000.

Implementation & Operations.

UZURV and Roundtrip are contracted for the day-to-day operations of the program, with the Chief of Transit Operations at GRTC serving as the contract administrator. UZURV and Roundtrip provide everything required to operate the service, including the drivers, vehicles, and call centers. Because passengers choose from multiple CARE On-Demand providers when booking a trip, the Taxicab Exception is in effect, meaning that drug and alcohol testing is not required for drivers. Both UZURV and Roundtrip use subcontractors for the wheelchair accessible rides, which make up approximately 12% of the CARE On-Demand trips.

Outcomes.

- As expected, CARE ridership decreased slightly when CARE On-Demand service launched, as some customers shifted their service usage. The objective to achieve cost savings has been met with the shift in ridership from CARE to CARE On-Demand service.
- The goal of the program was to have 10% of total paratransit trips on CARE On-Demand, which has been met and surpassed at approximately 12%. This is despite the fact that CARE and CARE Plus are currently operating fare free, while CARE On-Demand continues to charge fares.
- CARE On-Demand ridership is approximately 30,000 riders annually, with most months of the year providing over 2,000 trips. Ridership decreased from these numbers during the pandemic, but have rebounded to near pre-pandemic levels in Fall 2021.

Key Lessons Learned.

- **Ensure availability of accessible vehicles and drivers.** One challenge that GRTC has encountered has been ensuring enough vehicles are available for wheelchair accessible trips. Ideally, the agency should have clear expectations on how many vehicles are available to ensure the level of service is the same for ambulatory versus non-ambulatory trips. Another challenge has been the availability of drivers for all modes. UZURVE and Roundtrip have experienced the same difficulty in getting enough operators for the service.

- **Prioritize customer outreach and education.** Some passengers experienced difficulty in understanding variable pricing, especially at the start of the program. Education needs to be a key component when starting an on-demand program because some concepts, such as surge pricing, are new to the riders. GRTC staff indicated that dissatisfaction with the service is typically resolved after passengers understand variable pricing.
- **Begin with a "soft" rollout.** Beginning the program with a soft rollout helped start the service small and grow over time to avoid overwhelming demand.

4.3.4. Orlando (LYNX).

The Central Florida Regional Transportation Authority (LYNX) provides fixed-route, paratransit, vanpool, and on-demand services across Orange, Seminole, and Osceola counties in the Orlando, Florida region. LYNX' public on-demand service, branded as NeighborLink, provides mobility services in 13 zones throughout its service area. NeighborLink serves both local trips within each zone and first/last mile connections to LYNX's fixed-route network.

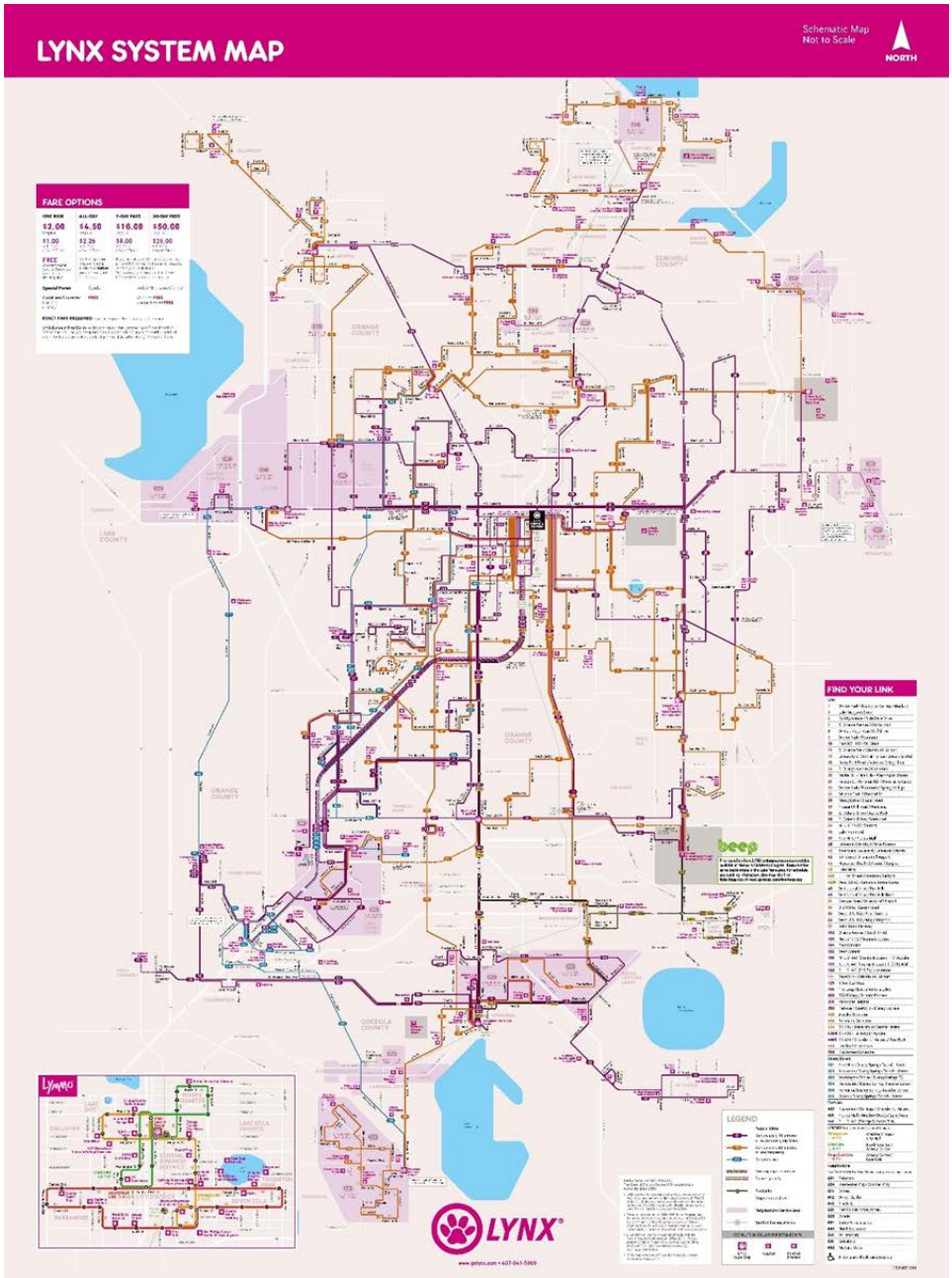
NeighborLink was initially conceived in 2007 to provide more cost-effective service in lower-density areas where fixed routes tended to perform poorly. In general, the zones help fill in the gaps in the fixed-route network, providing circulation in local residential neighborhoods that are more difficult to serve with traditional city buses. In some cases, NeighborLink zones replaced existing fixed-route services, while in others the zones were established based on requests from local jurisdictions to expand the service footprint.

NeighborLink service is available Monday through Saturday except in Buena Ventura Lakes, Intercession City/Campbell City, Maitland and North Kissimmee where rides are available Monday through Friday. Service hours vary by route, with most routes operating between 6:00 am and 7:00 pm on weekdays and Saturdays. Customers can book trips by phone, through the NeighborLink mobile application, or website. Subscription service is also available to customers wishing to make recurring trips.

NeighborLink fares are consistent with LYNX's fixed-route fare policy, which offers single-ride trips for $2.00 and all-day passes for $4.50. Free transfers are provided to fixed-route services. All payment types are accepted on-board, including cash.

Figure 5: NeighborLink Vehicle

Figure 6: LYNX System Map with NeighborLink Zones



Funding & Governance.

LYNX established NeighborLink in 2007. The program is directly governed by LYNX and is funded through LYNX's general operating fund which includes a mix of federal, state, and local sources. To

the extent possible, LYNX leverages FTA Section 5310/5311 formula funds to support zones outside of the Orlando and Kissimmee urbanized areas.

Implementation & Operations.

NeighborLink is designed as a hybrid between a dynamic point-to-point and anchored flex-route model. Each NeighborLink zone is operated with a single vehicle and has an established anchor point from which the bus departs every hour, usually at a key shopping center with transfer access to LYNX' fixed-route network or a SunRail commuter rail station. Customers can access the service by simply boarding a bus at the designated anchor point or by scheduling a trip through the app, website, or call center. Current policy requires that customers book a trip at least two hours in advance, but staff indicate that this window could be reduced in the future. Once on-board, curb-to-curb transportation is provided anywhere within the defined zone.

NeighborLink is operated through a service contract that is currently held by MV Transportation. The service contract covers both LYNX's ADA paratransit service and NeighborLink, but to-date there is no commingling of trips between the two services. The annual cost of the program is about $2.5 million, or about $180,000 per zone.

Outcomes.

- According to a National Transit Database (NTD) report, NeighborLink served about 500 weekday trips and 325 Saturday trips on average in 2019, for a total of approximately 140,000 annual trips. In 2020, ridership dropped to about 325 weekday trips and 200 Saturday trips due to the COVID-19 pandemic. In 2019, NeighborLink averaged about 2.9 passengers per vehicle revenue hour. In areas where NeighborLink replaced existing fixed-routes, LYNX typically observed negligible impacts on fixed-route ridership.
- LYNX uses several key metrics to measure NeighborLink's performance, including passengers per trip, passengers per vehicle hour, and passenger no-shows. These metrics, along with origin-destination data, is used to refine zonal boundaries on a regular basis.
- LYNX generally views the NeighborLink program as a success and intends to expand the program going forward. LYNX's latest Transit Development Plan major update anticipates a $1 million expansion to NeighborLink's annual operating budget through 2027.

Key Lessons Learned.

- **Prioritize marketing and advertising.** LYNX staff emphasized the need to prioritize advertising and marketing when launching a new on-demand service. Once the service is established, ongoing marketing and outreach is crucial to build awareness and educate riders on how to use the service.
- **Understand your target market and design service accordingly.** LYNX finds that its NeighborLink customers are loyal and frequent users of the service. As such, it is important

to understand your target market and cater the service to their needs. After the initial service is launched, agencies should evaluate and update boundaries on an annual basis, at a minimum, to adapt to changing land uses and customer needs. Additionally, agencies should consider larger zones to provide better connectivity and ensure that anchor points to connecting fixed-route services are clearly marked as such.

- **Invest for success but manage expectations.** When starting a new on-demand program, agencies should ensure that sufficient resources are allocated up front to maximize the usefulness of the service (e.g. minimizing wait times). At the same time, agencies should set realistic performance targets and be mindful that the success of on-demand service should be measured differently from fixed-route service.

4.3.5. Memphis (MATA).

MATA (Memphis Area Transit Authority) is the transit provider operating fixed-route buses, streetcar, paratransit, and on-demand services in Shelby County and the city of Memphis, TN. MATA's on-demand service, advertised as "Ready! by MATA", operates in three distinct zones at the periphery of the transit service area: 1) Southwest Memphis (Boxtown, Westwood, and Whitehaven), 2) Northhaven and Frayser, and 3) Cordova. Groove On-Demand is another on-demand option formed through a partnership with the Downtown Memphis Commission, and operates in Downtown, the Medical District, South City, and New Chicago.

Ready service offers curb to curb shared-ride transportation within each zone without the need for a reservation in advance. The Ready program began to improve transit service in areas that have been difficult to serve with fixed-route service because of circuitous street networks, lack of sidewalks, and low-density development. The target market for Ready is the general public within the designed zones. The service does not require a certificate of eligibility, unlike the paratransit service, MATAplus. All Ready vehicles are 8 passenger vans and can accommodate passengers with disabilities.

Requesting a trip can be made through a reservation line or through the mobile app and desktop booking systems. The goal is for pickups to occur within 20 minutes of request but may be shorter or longer depending on demand and vehicles available. Riders have the option of requesting trips when they have an immediate need or one to three days in advance. Recurring trips can also be scheduled but are subject to availability. Trips are grouped geographically to make the routing efficient, and therefore trips are oftentimes shared between passengers in the vehicles. Some out of direction travel should be expected in the case of shared rides. Rides can be paid with cash onboard the Ready vehicles. MATA plans to accept payments through a website and mobile app in the near future.

Figure 7. MATA Ready Vehicle.

Source: localmemphis.com

Funding & Governance.

The project was originally conceived as part of a short-range plan in 2010, when it was recognized that sections of southwest Memphis were difficult to serve with fixed route transit but still needed to retain service. In 2017 and 2018, the Shared Use Mobility Center and Federal Transit Administration provided technical assistance to further refine the on-demand plans through the MOD On-Ramp program. Transloc was also instrumental in refining the project, providing simulations of how the on-demand service would work and what level of supply would be necessary. Transloc also helped MATA determine appropriate boundaries of the zone and helped balance the number of vehicles and the anticipated demand. The technical assistance was bolstered with community engagement to gain input and further refine the service.

The first zone launched in August of 2021 in southwest Memphis in the neighborhoods of Boxtown, Westwood, and a portion of Whitehaven. The service is a one-year pilot program, but it's also part of the Transit Vision which included in the Memphis 3.0 plan, formally adopted by the Land Use Control Board and signed by executive order by Mayor Jim Strickland.

MATA has been successful in applying for various Federal and State funding for the program. In June 2018, MATA announced that they were one of six agencies being awarded $394,000 in Integrated Mobility Innovation assistance, an FTA demonstration program. MATA was also awarded an FTA AIM (Accelerating Innovative Mobility) grant of $483,000 for the service. MATA applied for and received a total of $240,0000 in CMAQ (Congestion Mitigation and Air Quality) funding through a TDOT (Tennessee Department of Transportation) IMPROVE (Improving Manufacturing, Public Roads, and Opportunities for a Vibrant Economy) Act for Ready. The funding required a $60,000 local match (20% of total funding) but will help operate the southwest on-demand zone for an additional year.

The Downtown Memphis Commission submitted a grant proposal to TDOT and was awarded $350,000 in CMAQ funding to continue the Groove On-Demand service. The funding requires a 50% local match, which is being provided by the Downtown Memphis Commission. MATA is currently aiming to add $700,000 in funding for the Groove On-Demand service budget but will need the support from the MATA board for final approval. This would bring the total annual budget to approximately $1.4 million and enable an expansion of service hours and service zone boundaries.

Implementation & Operations.

The first zone in southwest Memphis (Boxtown, Westwood, and Whitehaven) was implemented in coordination with a reduction of fixed route service in August 2021. Route 38, the primary route serving the neighborhoods, consistently underperformed and was therefore removed and replaced with the new on-demand service. MATA later introduced two additional on-demand zones in a response to fixed-route service reductions forced by driver shortages, bringing the total on-demand zones to three.

An initial marketing effort was done for the first zone through social media. MATA has not been marketing the expansion of Ready service, however, because they're already at capacity in terms of ridership with the manpower they currently have to operate the vehicles.

Fares for the on-demand service are planned to be priced at the same cost as fixed route service of $1 per trip. Currently, however, fares are free for a limited time due to the COVID-19 pandemic. Fixed route service was previously priced at $1.75 a trip, but has been reduced to $1 per trip because of the pandemic. MATA is currently working to introduce a new fare system that will feature a fare cap which would enable passengers to pay once to board any of the MATA transit services and then transfer for free within an allotted time period (e.g. pay a $1 fare and receive unlimited transfers for up to 2 hours).

Ready is operated in-house by MATAplus, the ADA paratransit division of MATA. Reservationists at MATA take calls and requests for service and use Transloc technology for dispatching. The Ready service uses Ford Transit Vans that are all ADA accessible.

The Groove On-Demand service is a turnkey service, operated by Via, an independent, third party contractor. Via supplies the vehicles, drivers, and the technology. Via also executed the initial marketing campaign for the start of the service.

Outcomes.

- MATA has experienced challenges keeping the service operating at planned service levels because of the driver shortage. One advantage that Ready has over fixed-route service however, is that drivers are not required to obtain a CDL (Commercial Drivers License) and is therefore easier to fill positions. Despite this advantage, MATA still has had difficulty finding enough operators for vehicles. This has been especially challenging during times of high COVID-19 cases, such as the recent wave of Omicron cases. The Groove On-Demand service has experienced difficulty filling open positions for drivers. The service typically

operates with three vehicles, and planned to expand to four, but has had difficulty operating four vehicles because of the driver shortage.

- Ridership on Ready is currently at capacity with approximately 300 riders a day so increasing ridership is not currently a goal. Much of this ridership is from the first zone in southwest Memphis. Increasing ridership in the other two zones will not be a priority until more drivers are available. Groove On-Demand has also been successful in terms of ridership. The goal was to have 500 riders per week, which has recently been achieved.
- MATA is still considering and evaluating what KPIs should be used in evaluating the service. MATA is interested in exploring how access has improved with the addition of the new services, especially access to jobs, medical services, food, and other essential services. MATA is interested in improving mobility to low-income neighborhoods that are too difficult to serve effectively with fixed-route transit.
- MATA is also looking to expand the Ready service by creating one or two additional zones in the more industrial, logistics-based development near Memphis International Airport. The greatest challenge in maintaining and eventually expanding the Ready service has been funding.
- The service overall has been very well received and customers have been very happy with the service.
- The only major unexpected result has been the large number of school-trips taken to grade schools. MATA formed a policy that requires passengers to be at least the age of 13 to make a reservation and at least age 6 to ride without an adult.

Key Lessons Learned.

- **Outreach and community engagement is critical.** Community input is a critical component of service changes, including the creation of on-demand zones. Ensure strategic communications with both elected officials and the members of the community.
- **Understand your market.** Take time to understand the market by doing research and using the right tools. MATA has access to Remix and has used the tool to get a better understanding of the potential markets.
- **Make the right partnerships.** Partnering with the right service providers from the beginning is key because it will be difficult to change mid-stream to another platform. Understanding what partnerships your partners have is also important, particularly with fare payment systems.
- **Emphasize open data.** Make sure that the data collected by the service providers are open and accessible. Both partners, Transloc and Via, have been open and helpful in sharing the data collected so MATA can continue to build and improve the service.

4.3.6. St. Petersburg (PSTA).

Pinellas Suncoast Transit Authority (PSTA) provides transit service in Pinellas County, FL, which includes fixed route, ADA paratransit, and on-demand. The on-demand service, called Direct

Connect, is a partnership with several mobility operators that offers a discount on rides to/from designated Direct Connect transfer points where passengers can connect to the fixed route network. The service providers currently partnered with PSTA are Uber, Lyft, United Taxi, and Wheelchair Transport.

There are currently 26 Direct Connect locations. Anyone in Pinellas County can request a trip to any of the Direct Connection transfer locations within 10 miles of the pickup point. Additionally, the pickup/drop off must occur within 800 feet of a Direct Connect point. Direct Connect points are strategically located with a connection to frequent service and are dispersed throughout the county to provide coverage in all areas of the county. Customers simply use a voucher code when booking a trip in the Uber or Lyft app to receive $5 off of their ride as long as the pickup/drop off locations fit the aforementioned restrictions of the program.

The purpose of the program is to provide riders with a better experience when connecting to the PSTA core transit network. Instead of using an infrequent fixed route service or taking a long walk to get to PSTA's frequent fixed route network, riders can utilize Direct Connect to get picked up at their residence and taken to the Direct Connect point. With Direct Connect, PSTA is targeting current and potential riders who have difficulty reaching the fixed route service by walking and would need to (or simply prefer to) have a direct ride to the frequent network.

PSTA operates in a relatively unique service area serving the entire county of Pinellas, a peninsula on the west coast of Florida. The development is therefore geographically restricted to a limited land area and is actually the most densely populated county in Florida. However, much of the development is suburban residential that is difficult to serve with fixed-route transit effectively.

Funding & Governance.

Direct Connect was initially developed after PSTA recognized the need to overhaul the service in Pinellas Park due to underperforming transit service in the area. PSTA began the service as a pilot project in February 2016 but did not have partners procured until the program became a regular service in Spring 2020. The partners for Direct Connect include Uber, Lyft, United Taxi, and Wheelchair Transport. PSTA provides $5 off vouchers for Uber, Lyft, and United Taxi, and $25 off Wheelchair Transport trips. The program is funded through local operating dollars. No state funding is channeled to Direct Connect because of state restrictions on funding TNCs. Legal concerns are minimal because PSTA provides a voucher for a third-party service rather than operating the service themselves.

Figure 8. Direct Connect Point Locations

Source: https://www.psta.net/riding-psta/direct-connect/

Implementation & Operations.

Direct Connect began in 2016 as one zone in Pinellas Park, with the option of connecting with either the transit station or the local Walmart. The service was implemented to provide an alternative to Route 444, a local fixed route that was underperforming. After on-demand was introduced, the ridership on Route 444 decreased even more and was then eliminated entirely. PSTA saw the Direct Connect as moderately successful, but recognized the high potential in the new service.

When PSTA increased the program to cover the entire county in January 2017, Direct Connect had a total of eight separate zones, each with one corresponding connection point. The service forced many passengers to travel out of direction to connect to the fixed route network though. Ultimately in April 2018, PSTA modified the service so that passengers could connect to any of the zones within 10 miles of the pickup/drop off point to reduce the out of direction travel.

Minor changes to the fixed route network have been implemented as the program has expanded. Generally, operating Direct Connect enables PSTA to reduce the number of deviations off major corridors to operate faster and more efficient fixed-route service.

PSTA conducted marketing and outreach to the community for the Direct Connect program, including social media messaging and site visits to senior living, community centers, and affected apartment complexes. PSTA also worked with Uber to reach out to existing Uber users via email. Originally, the voucher for Direct Connect was worth 50% of the value of the trip up to a maximum of $3. PSTA decided to increase the value of the voucher to $5, regardless of the cost of the trip in January 2017. This was done to simplify the program and keep up with increasing trip costs. PSTA budgets $125,000 annually for the program.

Outcomes.

- PSTA monitors the program in an effort to keep track of performance with metrics such as passenger trips, response time, unique riders, and trips per unique rider. Generally, the data received by Uber and Lyft are not as detailed as data for other programs that are operated in-house.
- Annual ridership for FY21 was approximately 15,000 trips. This is relatively small compared to the annual ridership for the agency, and the overall impact of the program on system-wide ridership is very low. Increasing system ridership through Direct Connect is generally not a goal for PSTA. It has been difficult to detect any measurable change in ridership at the Direct Connect transfer points. Ridership increases at transfer locations is hard to detect because the ridership at those transit centers is already high due to transfer activity.
- Response time, or passenger wait time, is typically less than 15 minutes. TNCs are ubiquitous in the county giving most riders very short wait times. COVID-19 has had an impact at certain times however, giving unusually high wait times when TNCs are less available.

Key Lessons Learned.

- Consider the level of integration desired. Some on-demand services are more integrated with the transit agency with branding on vehicles and smartphone apps. These programs often own and operate the vehicles themselves, which comes with additional cost, but there are some benefits of doing so.

- Educate your customer base. Customers typically end up liking the benefits provided with on-demand service. However, some passengers need time and assistance to get familiar with using the software. There have been instances where customers become displeased with the service because they are not using the software properly or do not understand the restrictions of the program. Some passengers try to use the voucher code outside of transit service hours or even outside of the county. Once passengers are familiar with how the service works, they come to appreciate it.
- Consider the openness of data from service providers. Data coming from Uber and Lyft are not as detailed as they could be. With more specific data it might be able to fine-tune the program to improve it, but there are limitations on the data reported.

4.3.7. Dayton (RTA).

The Greater Dayton Regional Transit Authority, known as RTA, is the transit agency serving the Dayton area in Montgomery and Greene counties with streetcar, fixed route transit, paratransit, and on-demand service. The on-demand service, known as RTA Connect, is operated through partnerships with transportation network companies (TNCs) Uber and Lyft and a local tax service (Anton's Transportation). RTA paratransit operates trips that require wheelchair accessible vehicles and trips for passengers less than 18 years of age. The program is currently available in six discrete zones with point-to-point transportation service to anywhere in the zone as long as both origin and destination are in the same zone. Although passengers have the option of going anywhere within the zone, the service is primarily designed for and operates as a first mile last mile solution to connect to fixed-route service.

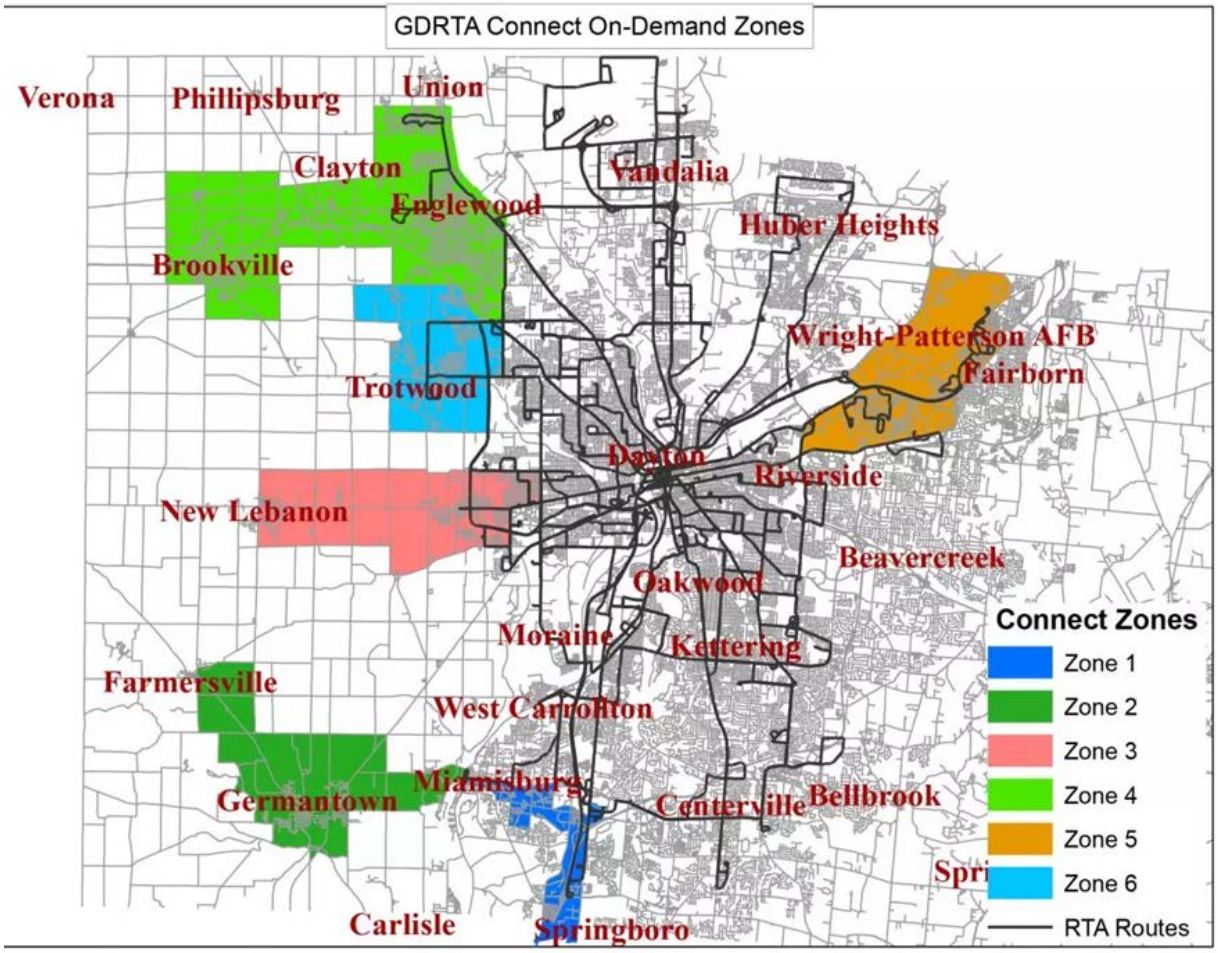
The program was initially developed to provide cost effective service in areas with low demand for transit. The program was also implemented to maintain a balanced budget. RTA needed to respond to decreases in operating revenues caused by changes in sales tax by reducing operating expenses. RTA replaced fixed-route service with the on-demand service, creating enough savings to introduce a new downtown circulator route and balance the operating budget.

The development patterns in the on-demand zones are primarily low-density suburban and rural. The fixed route service that was being replaced with on-demand service performed poorly in terms of cost efficiency and ridership. The fixed-route service was therefore removed in coordination with the implementation of the on-demand service. RTA targeted passengers that were going to be affected to communicate the changes to make the switch for passengers easier. RTA communicated with the community and jurisdictions that were being impacted to emphasize that service was being modified (as opposed to removed), with positive feedback. Although some riders have voiced a preference for the fixed-route service that was removed, the overall response to the changes have been overwhelmingly positive.

To use the service, passengers must use the Uber or Lyft app, or call the RTA call center to request a trip. The Uber app requires a one-time code to use in the app, while the Lyft app requires a

zone-specific code. Passengers can also call RTA to schedule a ride, where RTA representatives book a trip on behalf of the passenger using Uber Central. Trip requests are roughly even between booking trips via the smartphone app and calling in.

Figure 9. RTA Connect On-Demand Zone Locations



Source: https://www.iriderta.org/ride/alternative-transportation-options/demand

Funding & Governance.

RTA Connect launched in June 2017 as a pilot program with one zone. At the time, there were two service providers: the RTA paratransit service and Lyft. RTA decided to launch the program after researching and conducting a peer review. RTA went through a formal procurement process to go out to bid for service providers. The procurement is continual however, so even after the board approved the selection of the initial providers, other providers can still be added as long as they meet minimum requirements outlined in the RFP. RTA later added Uber and a local taxi service to the program. Uber is now the predominant provider because RTA shifted to their scheduling platform for trip request call-ins. The current service contract charges RTA the public rates of

Uber, Lyft, and the taxi service. The program was approved as a regular RTA service in February 2021 by its Board of Trustees. Although the program would be eligible to apply for Federal funding, RTA only uses restricted local operating dollars to fund the program to avoid any possible future risk of evolving Federal funding requirements.

Implementation & Operations.

RTA Connect is managed by the RTA Special Services Supervisor, who coordinates with regional managers from Uber, Lyft, and the taxi service when necessary. Uber, Lyft, and the taxi service are all independent companies responsible for vehicles, drivers, and operations.

The annual operating cost of the RTA Connect is $600,000. The implementation of the six on-demand zones enabled RTA to modify the fixed route network to reduce fixed route revenue hours by approximately 30,000 annually. The service change was effective in reducing the operating cost to respond to operating budget reductions. The addition of a downtown circulator was made possible with the cost savings from switching to on-demand service as well.

RTA Connect is currently free. However, RTA is considering charging fares with RTA fare cards in the future as the program expands. Coordination with Uber and Lyft will be necessary to enable RTA fare cards to be used as payment. Ultimately, it might be possible to enable free transfers from RTA Connect to the fixed route service. Current ridership levels do not warrant pursuit of fare system modification.

RTA did not conduct extensive marketing for the program. Instead, RTA focused on capturing and maintaining the riders that were impacted by the service changes. RTA sent staff with informational packets on the routes that were being modified to talk to the customers.

Outcomes.

- RTA tracks ridership to monitor the program. At its peak, RTA Connect served 6,000 riders per month just before the pandemic in December 2019. The COVID-19 pandemic has reduced ridership, which has hovered around 3,000 over the past two years.
- The service is intended to provide first and last mile connectivity to the fixed route network and has been successful at doing so. In 2019, there were approximately 500 riders per day. Approximately 70% (350 riders) used the service to connect to the fixed route service, and 30% (150 riders) used it as a point-to-point service within the zone.
- Origin destination data are provided by Lyft and Uber so RTA can track trip patterns. The average trip length is between three and four miles long. There have been cases where RTA has needed to change the zones based on trip patterns, which has been a relatively easy process. The planning department at RTA sends GIS files to Uber and Lyft and they update the zone in their system.
- RTA expects RTA Connect to grow in the future, with more riders shifting from fixed route service to on-demand service. Ridership in some areas hasn't recovered since COVID and

could get replaced with RTA Connect. There could be the possibility of short turning on more buses and using more on-demand zones to connect to higher frequency fixed route service. There is also an opportunity to operate the service at times when the fixed route service either isn't as frequent or doesn't operate, such as overnight.

- Many agencies focus on various performance metrics to measure success of on-demand programs. RTA focuses instead on what their customers think of the program. Once a year RTA reaches out to customers to evaluate the service. Aside from some minor issues at the beginning of the program, there has been very high customer satisfaction.
- The annual budget for RTA Connect is $600,000. The average cost per trip is $11 to $13 and has proven to be very cost effective. Implementing this service enabled RTA to save approximately 300,000 in fixed route revenue hours. RTA was able to balance the operating budget as well as create a new downtown circulator, The Flyer, which is one of the highest ridership routes in the transit network.

Key Lessons Learned.

- **Provide an overlap in services during transitions.** It is best to implement the on-demand service before removing the fixed route service. Providing overlap for a short time creates a smoother transition than removing one service and replacing it with another on the same day.
- **Clearly identify the project purpose.** RTA Connect was a risk but has resulted in a very successful program. Part of the reason for this success was having very clear reasons for implementing it.
- **Consider app integration.** One improvement could be providing better integration of the on-demand service in the Transit app. Currently, the Transit app will show the on-demand zone for connections and show the zone is zero fare, but requesting a trip still requires the user to exit the Transit app and use the Uber or Lyft app.
- **Engage with customers.** Reaching out to affected customers and jurisdictions in advance of changes is key. Some may misunderstand and resist the changes if there is no discussion beforehand. RTA was successful in reaching out to the customers and getting buy-in before the changes took place. After the changes take place, it is important to continue to reach out to monitor the service.
- **Understand and apply FTA requirements.** Although RTA Connect does not receive federal funding for the program, it is a possible funding source when working with TNCs. Key points to consider when working with TNCs are number of providers, ADA accessibility, and fare payments. The number of providers is important because if there are two or more providers and passengers are given a choice, then there is a drug and alcohol testing exemption given by the FTA (Taxi Cab Exemption). Accessibility for ADA trips is important because TNCs typically do not make accommodations for wheelchair accessible vehicle trips. Fare payments are an important issue because TNCs typically use cashless systems which may become a Title VI issue.

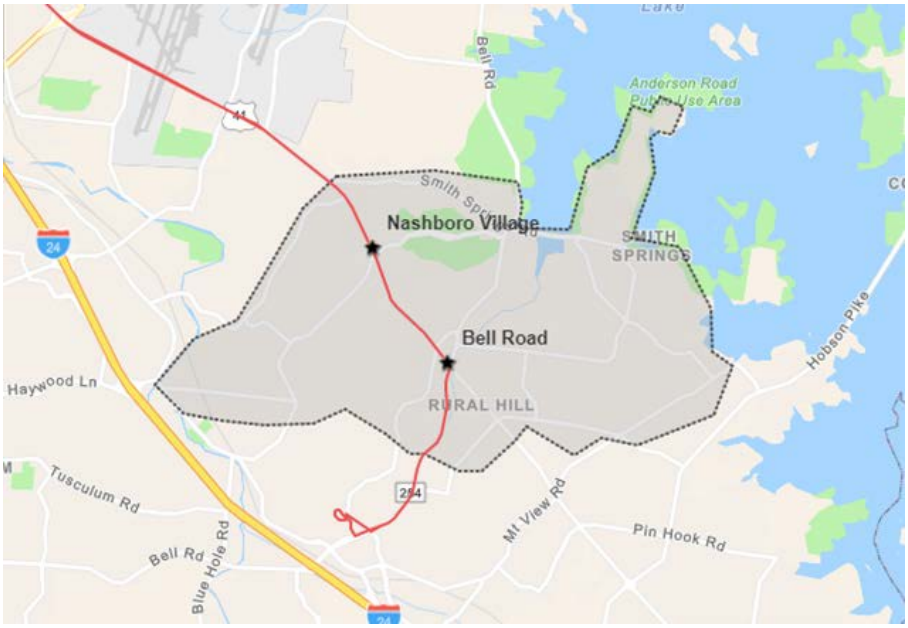
4.3.8. Nashville (WeGo).

The Nashville Metropolitan Transit Authority, also known as WeGo Public Transit (or simply WeGo), serves Nashville and Davidson County, TN with primarily fixed route buses and paratransit service. WeGo recently launched a new service called WeGo Link, introducing a new method to connect to WeGo transit service. WeGo Link is essentially a partnership between WeGo Public Transit and two on-demand service providers (Uber and Mobility Solutions) that serves to connect riders to WeGo fixed routes.

The service is intended to make connecting to the fixed route service easier and more available to neighborhoods that are difficult to serve effectively with fixed-route transit service because of low density development. There has been a growing need for transit service in areas beyond the current fixed route service area, but many of these neighborhoods are difficult to serve effectively with fixed route service. Affordable housing has recently become a greater concern in Nashville with low-income residents having greater difficulty remaining in areas with transit service. The service is intended to serve the population that needs access to transit service but will not or cannot walk to the service for reasons such as safety or disability.

WeGo Link provides first and last mile connectivity as opposed to general local circulation. Uber and Mobility Solutions trips are discounted by WeGo provided that the trip consists of an origin or destination in the designated WeGo Link zone and connects to a connection point in the fixed route network. Currently, WeGo Link has a single zone south Nashville International Airport, with two connection points with the high frequency Route 55 Murfreesboro Pike that operates 10-minute headways during peak periods. Passengers can access a voucher code online to either insert into the Uber app or Mobility Solutions call center to receive a discounted ride to/from one of the connection points.

Figure 10. WeGo Link On-Demand Zone Location



Source: https://www.wegotransit.com/ride/transit-services/wego-link/

Funding & Governance.

WeGo Link is a pilot project that was developed internally when WeGo recognized a need to expand services into neighborhoods that were too difficult to operate with traditional fixed-route service in. WeGo conducted community outreach, coordinated with councilmembers, and held stakeholder engagement to understand the needs of the community. The neighborhoods adjacent to Route 55 Murfreesboro Pike were identified as areas in need of better connections to the fixed route service. WeGo conducted research including a peer review and worked with several potential service providers to better understand what type of service model would be most appropriate for this use case.

After determining that potential demand in this area was likely going to be very low, WeGo decided against using a Software as a Service (SaaS) because the anticipated ridership didn't justify the investment. A decision was made to operate on-demand as a Transportation as a Service (TaaS) service delivery model. WeGo subsequently contracted with Uber and Mobility Solutions to operate the service.

WeGo Link is funded entirely by WeGo with local operating funds. WeGo partners with Uber and Mobility Solutions with a TaaS service delivery model. An existing partnership with Mobility Solutions had already been in place, with Mobility Solutions providing the paratransit service in the county already. Contracting with Uber required additional effort to get both parties comfortable with contractual language around indemnification, and to a lesser extent, insurance requirements. Ultimately, it was important for it to be clear that WeGo is providing a discount on an existing

service already provided by Uber rather than providing and operating a new transportation service.

Implementation & Operations.

WeGo Link is operated entirely by the two operating partners Uber and Mobility Solutions, with limited oversight required by WeGo. Uber serves general trip requests in the zone, while Mobility Solutions serves trips requiring a wheelchair accessible vehicle, any trips requiring cash payment, or any passenger 17 years of age or younger. Both Uber and Mobility Solutions provide drivers, vehicles, technology, and all other components required to operate the service.

Although there has not been a large marketing effort to-date, WeGo is considering increasing its marketing in the future as additional zones are added. Instead, the project began intentionally small to avoid growing too quickly. Signage at bus stops and information on the WeGo website was added, as well as a press release. Targeted outreach to the specific neighborhoods where the service is available is a future possibility.

The current base fare for the service is $2. WeGo covers the next $8 in trip costs and the passenger pays any remaining costs. The resulting fares paid by passengers however rarely exceeds the $2 base fare, which would only occur for trips from the most extreme ends of the zones. Surge pricing is not typically seen in the zone but can affect trip costs as well.
The current annual budget was $100,000 for the first year. With current ridership of approximately two passengers per day and an average trip cost to the agency of just over $6, WeGo Link is projected to cost much less than budgeted.

Although the implementation of the on-demand zone coincided with the removal of Route 38, this was not originally planned. The Route 38 Express route was performing poorly, and there were plans to introduce the WeGo Link service as an additional service before making the decision to remove the Route 38 Express. However, the ridership on Route 38 dropped so significantly during the pandemic that it became clear that it should be removed just as the new WeGo Link service opened.

Outcomes.

- Ideally, on-demand service could reduce operating costs by shifting some paratransit users to the on-demand service. This has not been the case with the implementation of WeGo Link though because there is not a strong incentive for existing paratransit users to switch. WeGo Access, the ADA paratransit service, costs $3.70 a trip, which gives riders a one seat ride from anywhere in the county to anywhere else in the county. For WeGo Link, the service is limited to rides to/from the on-demand zone to/from the fixed route network connection points. The on-demand portion costs $2, and the fixed route service costs $1. Although WeGo Link has the advantage of not requiring a reservation like WeGo Access, it results in only a $0.70 savings per trip.

- Ridership is one metric that WeGo has been tracking throughout the program. WeGo wishes to strike a balance between the overall volume of ridership with the ridership costs. Currently, WeGo has averaged approximately two riders per day, which is very low even for this type of service. WeGo would like to see ridership increase but understands that should ridership increase dramatically that program costs would increase correspondingly. Eventually increasing the ridership to a target of approximately 20 to 30 trips a day is desirable. Ridership, however, is not the main goal of the program.
- WeGo Link has proven successful in providing the ability to increase transit service coverage to low-density neighborhoods that need it. Implementing this service avoids expanding relatively expensive and inefficient fixed-route service into the low-density neighborhoods. This program gives WeGo the ability to focus resources on increasing service along higher density corridors, such as Murfreesboro Pike.
- The program has proven to be simple and easy to use for most customers. One issue that was discovered and worked out through the beta testing process was that passengers and drivers were not clear on where to pick up and drop off passengers in order to connect to the fixed route service. WeGo then designated safe areas for drivers to stage using Uber's geofencing technology for passenger boarding and alighting. Long term solutions to this issue would include pedestrian infrastructure improvements around the passenger pick up and drop off locations.
- The program has been considered a success. WeGo is currently analyzing additional areas for potential expansion by mapping high areas of minority, low-income, and zero-care households in locations not currently served by fixed route transit.

Key Lessons Learned.

1. **Make an informed decision when choosing a service delivery model.** A critical step in implementing on-demand service is deciding the service delivery model of SaaS or TaaS. WeGo initially contemplated owning and operating the service and using SaaS for the technology and dispatching. After understanding the projected ridership and investment needed in the potential service area, WeGo decided that TaaS was the better option for them. The most successful examples of SaaS service delivery are connections to rail that serve 6 or 7 passengers per revenue hour.
2. **Consider the implications with the operators' union.** The relationship with the drivers union can be critical if there are plans to downsize the union labor force in concert with implementation of a new service such as a TNC partnership.
3. **Maintain consistent span of service between modes.** Make sure there is an agreement with operators that there is guaranteed service whenever the fixed route service is operating.
4. **Plan for ADA-compliant service.** Providing ADA accessible vehicles is also an important operational consideration. WeGo has a contract with Mobility Solutions specifically for operating the ADA accessible trips. WeGo pays a higher discount on these trips because

they are more expensive to operate, thereby keeping the cost to paratransit riders equivalent to other trips served by Uber.

5. Untested Opportunity Identification.

5.1. Introduction.

This chapter summarizes the evaluation of a series of Mobility on Demand alternatives intended to improve the effectiveness of the TARC network in serving existing riders and attracting new customers. Here, Mobility on Demand (MOD) refers to an integrated and multimodal network of safe, affordable, and reliable transportation options that are available and accessible to all travelers via technology platforms. The intent of this analysis is to evaluate the feasibility of a range of MOD solutions in Greater Louisville, including but not limited to the Mobility Opportunity Zones described in the Existing Conditions Report. These mobility alternatives are particularly focused on improving first-mile/last-mile connections to TARC service as well as broader access to suburban destinations such as employment hubs, medical centers, colleges and universities, and shopping centers. In this context, MOD alternatives are aimed at improving mobility within particular geographic areas or zones, making them distinct from some other, more regionally-focused mobility options.

Recent transportation and land use plans — such as TARC's 2021 Comprehensive Operations Analysis (COA), Move Louisville, and Plan 2040 — have highlighted several strategies for which TARC could play a leading role, including the establishment of transit centers at key TARC stop locations, expanding universal transit pass programs among large employers, or the electrification of the TARC bus fleet. This study builds upon these initiatives by evaluating which of the growing range of technology-enabled, shared mobility options can best achieve TARC's strategic priorities: growing ridership, improving access to key suburban destinations, expanding the geographic reach of its network, improving customer satisfaction, and serving high-need communities.

On-demand transit, also known as microtransit, is one of the more promising recent innovations in transit technology and is being quickly adopted by many leading transit agencies, as shown in the Peer Agencies Report. In this memorandum, we identify a range of opportunities where on-demand transit can expand TARC's network coverage and provide first- and last-mile connections to high-frequency fixed-route service. Several of these on-demand transit alternatives are designed to improve first/last-mile connections between suburban job centers beyond the Watterson Freeway and key stops or stations along TARC's most frequent bus lines, including the Dixie BRT corridor Routes 4 (4th Street), 23 (Broadway), and 28 (Preston). Frequent bus services, with 15 minute headways or better, offer the best potential first/last-mile use case because they minimize passenger wait times to encourage transfers and offer a generally higher quality of service. Other options are designed to replace low-ridership circulator services (e.g.

75-Bluegrass) or route variants — low-traffic conjugations of a primary route that offer only intermittent service — in suburban areas that operate at high cost per passenger trip.

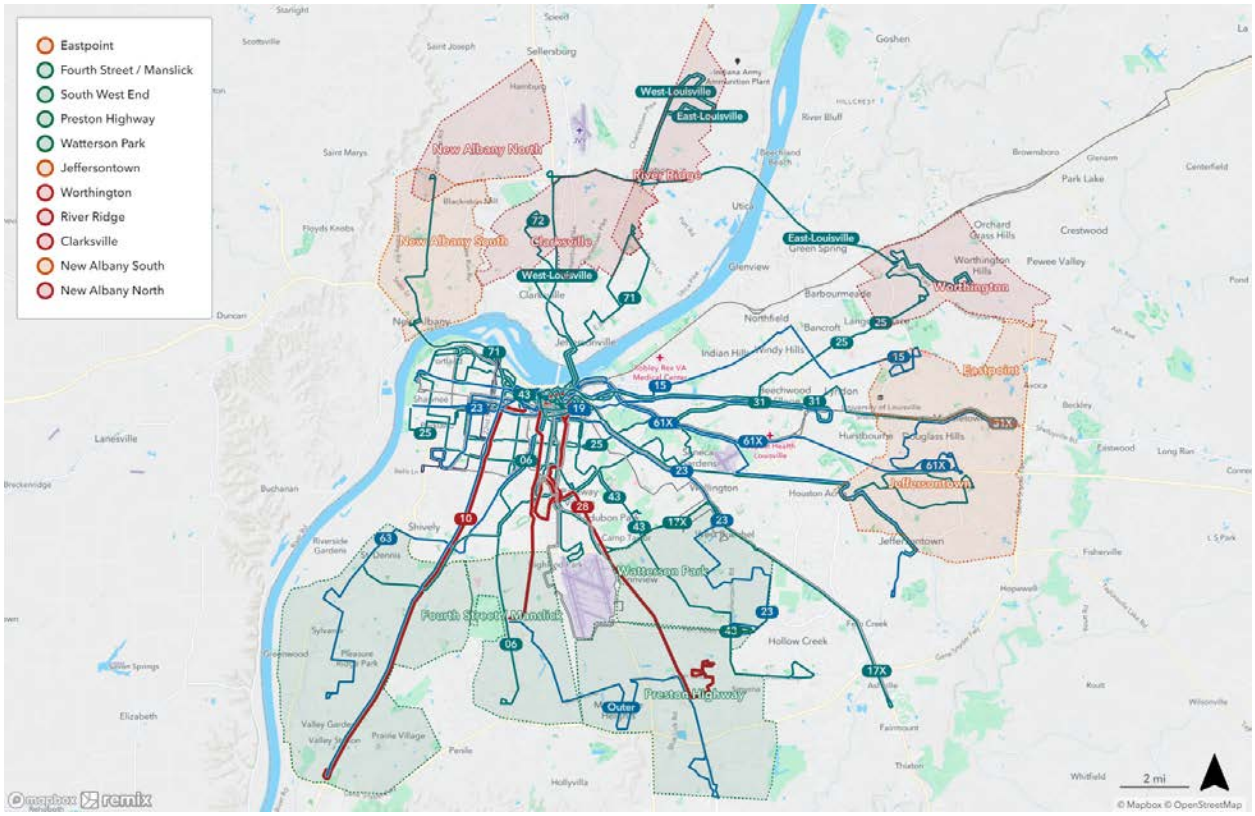
In some parts of the region, where ridership is forecast to be very low or no direct connection to a frequent TARC service is available, on-demand transit would be challenging to operate efficiently. Some of the fastest-growing job centers in Louisville Metro, such as the warehousing and logistics parks in the River Ridge area of Jeffersonville or along the I-65 corridor in Shepherdsville, fall into this category. For these outer suburban job centers, this study evaluates other innovative Mobility on Demand options that offer potentially greater cost-effectiveness, including ride-hailing services and commuter bus options.[6] We also detail a micromobility (bike or scooter share) option that can improve local mobility in the New Albany area as well as provide safe bike/scooter connections to Louisville via the Big Four Bridge. The memorandum concludes with an evaluation of mobility hubs, a series of multimodal connection points where TARC bus stops are functionally integrated with other mobility services to improve access to nearby destinations. A table summarizing the potential MOD alternatives evaluated for the Micro Mobility Transit Study is provided below, along with the key regional destinations served by each.

Geographic Zone	**Mobility on Demand Alternative**	**Key Destinations Served**
Watterson Park	Microtransit	GE Appliance Park, Bashford Manor, Lynnview Shopping Center, Amazon SDF2
South West End	Microtransit	Dixie Manor Shopping Center, Riverport, JCTC-Southwest, UofL Health Southwest
Preston Highway	Microtransit	UPS Worldport, Commerce Crossing, Heritage Creek, Jefferson Mall
Fourth Street-Manslick	Microtransit	National Turnpike corridor, Iroquois Park, St. Mary's Hospital
New Albany South	Microtransit	IU-Southeast, Downtown New Albany, New Albany Plaza, Baptist Health Floyd, PMC Regional Hospital
New Albany Downtown / Uptown	Bike / scooter share	Downtown New Albany, New Albany Plaza, Baptist Health Floyd
Jeffersontown	Microtransit	Bluegrass Industrial Park, Stony Brook shopping center, Oxmoor Mall, Jeffersontown Commons, Middletown Road corridor, Jeffersontown Main Street
Eastpoint	Microtransit	UofL Shelbyhurst campus, Middletown Road corridor, Oxmoor Mall
River Ridge	Ride-hail	Jeffersonville Commons, Meijer
Shepherdsville	Express bus	Settlers Point shopping center, I-65 corridor

[6] In the TARC system, these routes are branded "express" and operate with limited-stop segments during peak-only hours.

Geographic Zone	Mobility on Demand Alternative	Key Destinations Served
Clarksville	Ride-hail	Jeffersonville Commons, Meijer, Kentuckiana Medical Center
Shepherdsville	Microtransit	Settlers Point shopping center, I-65 corridor
New Albany North	Ride-hail	Ivy Tech Community College, IU-Southeast, Meijer
Worthington	Ride-hail	Norton Brownsboro Hospital, Ormsby Station, Springhurst Towne Center

A map of these zones evaluated for various MOD alternatives is shown below. Zones shown in green indicate a mobility option where higher productivity of service (passengers per vehicle-hour of service) is expected, while zones shown in orange indicate lower-productivity services. Zones shown in red are areas designated for ride-hailing services. The proposed bike / scooter share zone in New Albany and express bus option to Shepherdsville are not shown on this map.



5.2. Mobility On Demand Options

Transit agencies like TARC can make leverage of Mobility on Demand programs and services more quickly and adaptively, because of their low infrastructure requirements, compared to other transit capital projects. However, coordinating planning and implementation of MOD technologies and

tools with infrastructure projects and service increases could potentially enhance the longer-term impacts of a pilot program. This study focuses on near-term, low-cost approaches that would require minimal or no investment in infrastructure and which supplement other, ongoing TARC operations. A summary of each MOD solution explored in this study is provided in the following section.

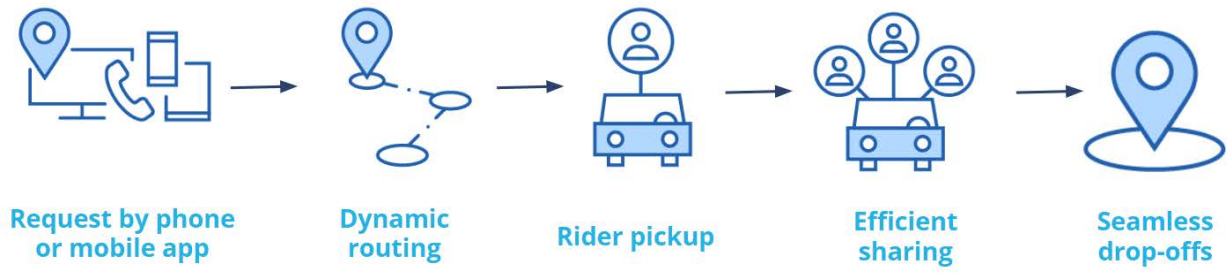
5.2.1. Microtransit

Microtransit, also known as "on-demand transit," features flexible routing and flexible scheduling of vehicles, typically booked through a smartphone application. Microtransit operators design services to match passenger demand (trips) with supply (vehicles) to improve the efficiency and reach of the transit system in lower-density areas. Possible pickup/dropoff locations are restricted to maximize the efficiency of service, usually within a geofenced area, known as the "service zone." Vehicle type can vary, but microtransit is often operated by a van or minibus, typically with capacity for 6 - 12 passengers.

Conceptually, microtransit blends the flexibility and convenience of private vehicles (e.g. private cars or taxis) and the reliability and affordable fares of transit buses operating along fixed routes. Fares are typically kept low (often equivalent to other public buses), and operations are typically subsidized by a transit agency, municipality, or nonprofit organization. This is because many microtransit services are offered in lower-density, hard-to-serve areas and therefore do not serve a ridership high enough to operate commercially without additional subsidy. Microtransit often supports passengers making intermodal connections to other public transit services, such as local or regional bus service.

Passengers who live or work beyond walking distance from fixed-route bus stops along a corridor can use microtransit to bridge the "first-and-last-mile" gap to reach the longer-distance service. In the suburban areas that are the focus of the Micro Mobility Transit Study, microtransit's primary application is to improve mobility in hard-to-serve, lower-density settings by offering high-quality service where fixed-route buses cannot operate efficiently. In other settings with more frequent fixed-route services, microtransit can also be used to provide supplemental service during hours when fixed-route buses are no longer operating, such as weekends, late-night, or off-peak periods.

Diagram of Microtransit Process Flow



Typically, customers request a ride using a smartphone app or by calling a dispatcher, and a vehicle is dynamically routed to pick them up near their location and take them to their destination, while picking up and dropping off other riders along the way and balancing rider convenience and overall service efficiency.[7]

To book a ride, a rider starts by indicating the number of passengers in their party and their desired pickup and dropoff locations. When booking using the app, riders will clearly see the geofenced service zone in which service is offered. Requesting a trip beyond this zone is not possible, so passengers always know where the microtransit service is available. Once the rider submits a ride request, they are given a proposal that tells them when the vehicle will arrive and where to meet it. Typically, riders will wait between 10 and 20 minutes for a trip, although this may vary depending on service design, as well as the level of demand and the number of vehicles available. Riders can track the vehicle in real-time using the app. The passenger is provided with vehicle information—for example: license plate, driver name, driver photo, and vehicle ID number. Riders can usually cancel a ride at any time

[7] Alternatively, many transit agencies operate microtransit as a pre-scheduled service, in which passengers must book and pay for their journeys ahead of time, from 24 hours to several weeks in advance. This approach is particularly suited to rural areas with very low demand, as it enables transit agencies to increase the efficiency of the service by sequencing passenger pickups and dropoffs in advance and potentially reducing the fleet required to serve the ridership; however, this approach sacrifices some degree of flexibility in operations due to potential service disruptions (e.g. from a late driver or vehicle malfunction) as well as the spontaneity of an on-demand service that allows passengers to book rides at the time they need to travel.

before pickup, but as cancellations may negatively affect other passengers, a small fee is often charged to discourage cancellations.

Once the vehicle arrives, the driver confirms the passenger's details using the driver app. Riders can pay using credit and debit cards (linked to the mobile app), tickets or passes issued by the transit agency (e.g. MyTARC passes), cash, vouchers, and more. Most public microtransit services take care to include payment options for people without credit cards or bank accounts to ensure that the service is accessible to all. The rider is then taken to their destination. Along the way, the vehicle will pick up and drop off other riders heading in the same direction, but care is taken to avoid lengthy detours for riders already on board. The rider can track their progress using the app. After each trip, riders may be automatically emailed a receipt. Passengers may also be able to provide real-time and post-trip feedback through the app.

5.2.2. Ride-hailing

Ride-hailing services, also known as Transportation Network Companies (TNCs), match riders with drivers in real-time through mobile apps that process rider payments through credit/debit cards. Base fares are typically similar to taxis, though they often feature dynamic pricing that fluctuates according to passenger demand throughout the day. These platforms typically operate through a network of third-party contractor drivers using non-commercial vehicles. Ride-hailing drivers are not themselves travelers, distinguishing the services from other forms of dynamic carpooling, in which rides are shared between fellow commuters. Ride-hailing companies are distinguished from taxi services by the inability to street hail (can only pick up prearranged rides). The companies typically offer several ride types, such as private ride and pooled-ride/fare splitting in some markets, in which multiple passengers with origins and destinations along a similar route can hail the same driver in real time.

5.2.3. Micromobility

Micromobility services consist of shared bikes, scooters, or other small mobility devices not classified as motor vehicles made available to riders for short-term rentals. Riders may access the devices on demand via modular docking stations/kiosks or distributed freely ("dockless") throughout a defined service area. These modes may be directly operated by municipal transportation or public transit agencies, operated through public/private partnerships, or operated by the private sector and publicly regulated. Docked systems typically require riders to pick up and return their vehicle from dedicated facilities. Dockless systems generally allow vehicles to be picked up or left almost anywhere within the

service zone, while hybrid systems combine a mixture of docking stations and areas where dockless parking is allowed.

5.2.4. Mobility hubs

Mobility hubs are high-quality, multimodal facilities that include integrated access points for multiple transportation services, often on transit agency- or city-owned property at high-demand locations. Mobility hubs improve the rider experience by making the experience of waiting for transit more comfortable and making intermodal transfers more convenient. Mobility hubs typically include connections or points of entry to several different modes of transportation, as well as amenities and infrastructure to support these modes. Common transportation options that are available at mobility hubs include:

- Frequent local bus service (e.g. TARC Routes 4 Fourth Street, 10 Dixie Rapid, 28 Preston, or 23 Broadway)
- Microtransit
- Parking for car share services (e.g. Zipcar)
- Loading zone for ride-hail services
- Bike or scooter share (e.g. LouVelo or dockless operators)

Typically mobility hubs are located at key transit stations served by at least one high frequency route. This focal point could be a local train station or a bus stop with fifteen-minute headways. A successful mobility hub will connect people between multiple high frequency routes in addition to first-and-last-mile transportation options. Mobility hubs often are located within walking distance of employment, recreation, retail, and housing. Infrastructure surrounding the hub should be walkable and bikeable, and the hub should have ample seating and other features that make for a comfortable and safe public realm.

In addition to providing more mobility options for residents and visitors, mobility hubs can enhance transit-oriented development, encourage people to use fewer single-occupancy vehicles, and further a city's sustainability goals by increasing the utility of transit and shared mobility options by creating functional and convenient links between them. They are also intended to improve the overall customer experience for transit users.

Mobility hubs range in size depending on their location and expected passenger numbers. Some smaller hubs look like a high frequency bus stop with ample covered seating, bike racks, and a few electric charging stations for private vehicles. On the larger end, a mobility hub can take up an entire city block near a high frequency train station, and provide connections to multiple local buses, be adjacent to a large housing complex, have restaurants, outdoor seating, car sharing, lockers, and public restrooms.

Mobility hubs are typically located at major transportation connection points that individuals are likely to pass through or near when making trips. These locations may include:

- Transit centers

- Park-and-rides
- Route terminals
- Major institutions: employment centers, stadiums, airports, university campuses, or shopping centers
- Bus stops with high transfer activity

5.2.5. Commuter / express bus options

Commuter or express bus options are not typically described as a Mobility on Demand strategy, as they typically utilize transit agencies' existing drivers and vehicles, and they generally do not themselves introduce new technology features apart from its GTFS information to be processed by trip planning software. However, the Micro Mobility Transit Study is squarely focused on addressing the mobility challenges of suburban areas of the TARC network. A review of other MOD strategies identified commuter buses as the only suitable approach to provide reliable and affordable public transit between disconnected, typically low-income urban neighborhoods and exurban job centers located far beyond TARC's fixed-route network. Commuter or express bus options are particularly suitable for these types of trips because they can provide more comfortable journeys over longer distances compared to local fixed-route bus or microtransit approaches.

The Shepherdsville job center, a series of warehousing and distribution centers clustered along the I-65 corridor near Cedar Grove Road, exemplifies this type of emerging job center whose isolated location makes serving it via other forms of public transit challenging and costly. Several members of the study's Steering Committee described the area as being particularly challenging with respect to providing workforce transportation. Because of the relatively low wages offered by many employers in the area, transportation represents a significant household expense for its workers given the absence of affordable public transportation options, and a personal vehicle is required to access and maintain employment.

Until August 2020, TARC operated Route 66/66X-Mt. Washington-Shepherdsville Express, a limited-stop, commuter bus service between Downtown Louisville and Shepherdsville, operating along I-65 over most of its length. The route was discontinued due to low ridership following the COVID-19 pandemic. Prior to its cancellation, Route 66/66X operated with four daily round-trips, on weekdays only during peak hours, with an average of 22 daily boardings and a very high cost per passenger trip, relative to other TARC services ($45/trip, according to TARC's 2021 COA). No TARC fixed-route service is currently available in Bullitt County, though some TARC3 paratransit customers reside in Bullitt County, after becoming eligible during the period when TARC operated Route 66/66X in Shepherdsville.

This study seeks to revisit commuter bus service on this corridor using a shorter, more direct alignment that will require fewer vehicles and drivers to operate. This commuter bus alternative

would be paired with a locally-oriented microtransit service in Shepherdsville to provide riders with a convenient, first-mile/last-mile connection between the terminus of the commuter bus route and employer destinations located in the city's periphery, such as along the Cedar Grove Road corridor. These commuter bus and microtransit alternatives should be considered as a coordinated package, though their costs and benefits are evaluated in this Study using different standards appropriate for each mode.

5.2.6. Other MOD strategies

This study does not explore car share, dynamic carpool, autonomous vehicles, or other MOD solutions that have been tested in other American cities. In a review of other MOD pilot programs, we find these strategies have struggled to achieve significant impacts even in supportive settings for alternative transportation programs. Dynamic carpool platforms (e.g. Waze Carpool, Scoop) have all but discontinued their public-private partnerships with transit agencies given the disruption following the COVID-19 pandemic and many passengers' hesitation to share rides with strangers in private cars over long journeys. Car share services offering one-way journeys, such as Maven and Car2Go, suffered from high operating costs due to the need to rebalance vehicle fleets across large, low-density areas.[8] [9] These operators ultimately folded when their parent companies, OEMs Ford and BMW, withdrew their investment.[10] Other car share platforms such as Zipcar, wary of these challenges, have limited vehicle availability in suburban areas and therefore little relevance for the aims of this study.[11] While the range of autonomous transit programs is growing across a number of cities, the capital cost and regulatory changes required to implement these programs do not make them suitable as a first step for MOD in the region. We therefore do not recommend these approaches for consideration in a potential MOD for Greater Louisville.

5.3. Evaluation Criteria for Mobility on Demand Zones

MOD services operate within a predefined coverage zone, and riders can only request trips that have both their origin and destination within this zone.[12] The project team identified potential MOD zones based on the following considerations:

- **Mix of use cases:** Potential use cases for MOD services include travel to access shopping, employment, schools, medical appointments and other critical services, and other local points of interest as well as connections to relatively frequent, fixed-route TARC services. Zones that serve a number of use cases are most likely to be well utilized and successful.

[8] Fingas, Jon. 2019. "Car2go Will Shut down in North America by February 29th, 2020 | Engadget." Engadget. December 18, 2019. https://www.engadget.com/2019-12-18-car2go-to-shut-down-in-north-america.html.

[9] Brown, Laura Sky. 2020. "GM's Car-Sharing Service, Maven, Shuts Down after Four Years." Car and Driver. April 22, 2020. https://www.caranddriver.com/news/a32235218/gm-maven-car-sharing-closes/.

[10] Berman, Bradley. 2019. "The Dream of Electric-Car Sharing Services Died in 2019." Electrek (blog). December 30, 2019. https://electrek.co/2019/12/30/the-dream-of-electric-car-sharing-services-died-in-2019/.

[11] As of Q2 of 2022, Zipcar's only Kentucky location was at the University of Louisville.

[12] Some micromobility services allow riders to temporarily operate vehicles outside of the designated service zone, though trips must begin and end within the zone to avoid a fine or, in some services, having the device remotely disabled by the vendor.

- **Alignment with TARC COA:** TARC completed a Comprehensive Operations Analysis (COA) in 2021 which laid out a long-term vision and strategy for the agency's transit network. Potential MOD zones were evaluated on the basis of how well they aligned with previous recommendations from the COA.
- **Fixed-route replacement opportunities:** In places where fixed-route bus routes, or segments of routes, have low productivity—move a small number of people per-vehicle per-hour—MOD solutions may be an efficient replacement for bus service. In some cases, a bus route may be efficient at peak times, but inefficient at off-peak times, and MOD may be a compelling evening or weekend alternative. Each potential MOD zone was evaluated to identify whether it offered opportunities to fully or partially replace underperforming fixed-route services.
- **First-mile/last-mile connections to TARC service:** MOD solutions can expand the reach of a transit network by enabling riders in lower-density areas to conveniently connect with fixed-route services. Each potential MOD zone was evaluated on the basis of the number and quality of useful connections to TARC's fixed-route network.
- **Network coverage expansion:** One of the key goals of this study is to identify strategies to expand TARC's coverage into traditionally hard-to-serve areas. Therefore each MOD zone was evaluated by the extent to which it expanded transit coverage into areas that are presently without TARC service.
- **Equity**: Each zone was evaluated on the basis of the extent to which it would provide service to vulnerable and high-need communities such as seniors, youth, people with disabilities, zero-vehicle households, and low-income residents.

The following sections describe best practices for each MOD approach explored as well as evaluations of the suitability of each MOD alternative. Each of these evaluations includes the results of simulations or modeling as well as cost/benefit analysis.

5.4. Microtransit

The following section describes best practices for microtransit service design and follows with the evaluation and simulation of a series of proposed microtransit zones. The proposed MOD zones evaluated for microtransit service include:

- Watterson Park
- South West End
- Preston Highway
- Fourth Street-Manslick Road corridor
- New Albany South
- Jeffersontown
- Eastpoint
- Shepherdsville (with commuter / express bus connection)

This section describes recommended service parameters for microtransit in these zones, the process for estimating ridership, results of agent-based simulations of microtransit performance, and cost-benefit analysis for each proposed zone.

5.4.1. Service model.

On-demand microtransit.

In an on-demand microtransit service model, riders book their trip requests at the time they need to travel and are quoted a short wait time, typically 10-20 minutes and no more than a maximum passenger wait time determined as part of the service design. The rider is quoted an estimated wait time and decides they would like to confirm the trip request. Riders then receive a trip booking confirmation via email or text and are able to track the vehicle on the mobile app until the vehicle has arrived. The primary advantage of this model is the provision of same-day, on-demand service with shorter typical passenger wait times and more flexibility in operations compared to pre-scheduled microtransit.

Pre-scheduled microtransit.

In pre-scheduled microtransit, riders must reserve their journeys in advance, often at least the night prior to travel. The microtransit software may negotiate their scheduled pickup by up to 60 minutes earlier or later than the rider's requested pickup time to maximize the efficiency of the service and accommodate other rider pickups. If the rider agrees to the negotiated pickup time, they receive a confirmation message (by mobile app or SMS) that their journey is booked, and they are then given an approximate pickup window of typically 30 minutes. The rider then tracks the vehicle on the mobile app and receives updated wait times and alerts indicating the vehicle is 2 minutes away or arriving. The primary advantage of this approach in the Louisville area is that it allows riders to book recurring journeys in advance, which may be useful for some types of journeys frequently taken by transit-dependent groups (e.g. recurring medical or social services appointments).

Key advantages and disadvantages of dynamic and pre-scheduled DRT options are shown in the table below.

Advantages and disadvantages of on-demand vs. pre-scheduled microtransit services

	Advantages	Disadvantages
On-demand microtransit	• Lower average wait times • Higher capacity for same-day bookings • Flexibility to book at time of need, adjusts easily to daily schedule • Simpler user experience • Automatic adjustments of supply without the need for dispatch intervention	• Rides cannot be booked in advance nor can recurring rides be booked • Selection of correct booking time is up to rider, no automatic link to other bus schedules • In low-density settings, greater variability in passenger wait times
Pre-scheduled microtransit	• Customers can book rides in advance and recurring rides - especially useful	• Higher average wait times • In a hybrid system, lower capacity for

	for some travelers (e.g. medical appointments) • Greater passenger familiarity with pre-booking from other demand-responsive transportation services (e.g. Rover) • Higher level of guarantee that a ride is indeed booked (barring unforeseen circumstances) • Greater potential for trip aggregation, especially in low-density areas	same day bookings because seats are filled "in advance" • Real-time incidents have a "domino effect" on subsequent pre-scheduled trips (e.g. late driver, vehicle malfunction) • Worse experience for rider if a pre-scheduled ride is missed compared to on-demand • More complex to operate, especially when needing to adjust supply

Pre-scheduled microtransit is not recommended for the proposed MOD zones because it results in higher average wait times for riders and lower flexibility of operations. However, we recognize that some riders will prefer to pre-schedule their rides for some types of recurring trips, such as commute trips or medical appointments. We therefore recommended adopting the hybrid service model of on-demand microtransit service, with optional pre-booking, described below.

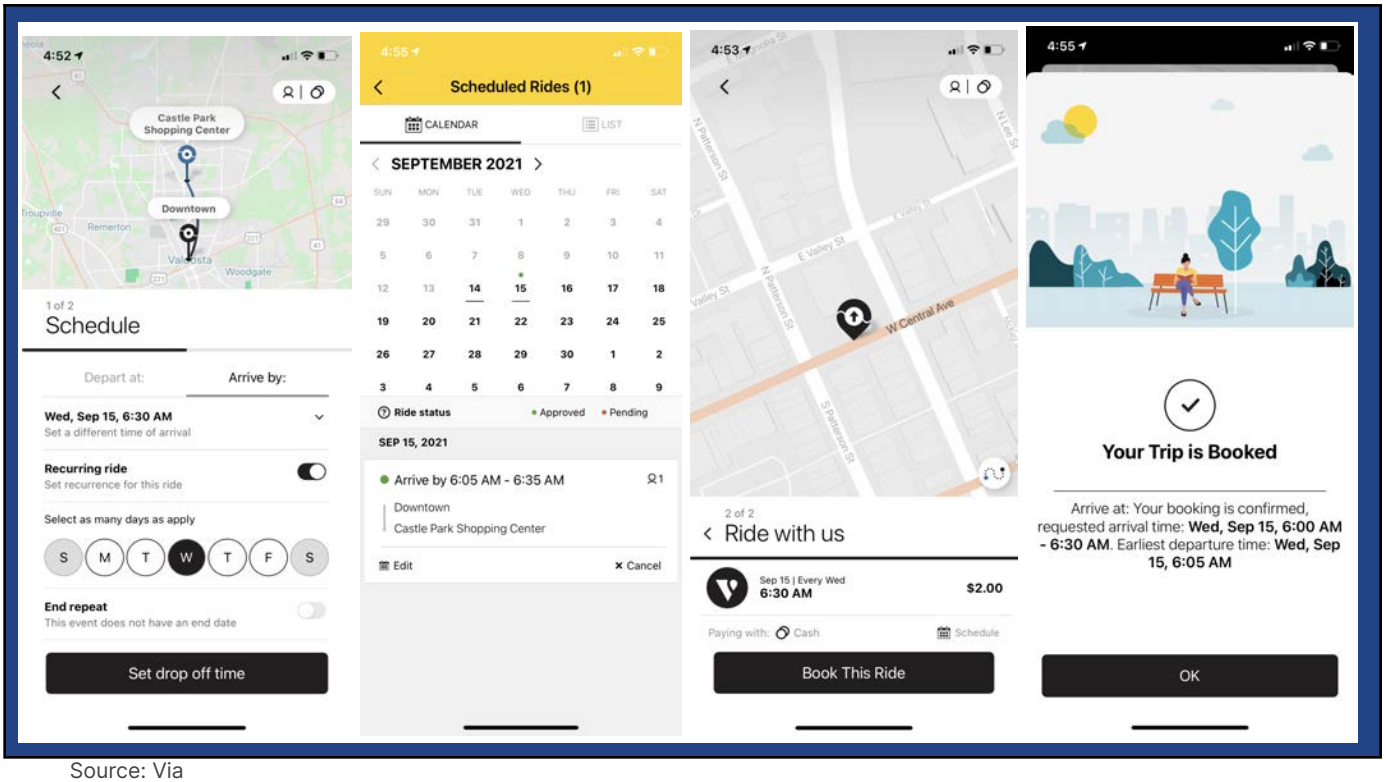
Hybrid approach: on-demand microtransit with optional pre-scheduling.

Some microtransit operators also offer a hybrid approach that blends on-demand and pre-scheduled microtransit. This approach is functionally a microtransit platform whose default setting is on-demand microtransit but which also offers passengers the option of pre-booking their trip. There are several reasons this approach may be attractive:

- Adding the pre-booking option increases the accessibility and uptake of the service, particularly among rider groups who may not be able to (or feel comfortable with) booking trips on-demand. This enables the service to broaden its appeal to a wider share of potential public transport customers.
- Pre-booking is essential for passengers with disabilities who need to book recurring and time-sensitive journeys for certain trip types, such as medical or dialysis appointments, where on-demand microtransit may not be appropriate. Even though the number of such passengers may be relatively small, these riders are often among the most reliant on public transportation of any group.

An example of the hybrid approach is shown in the case study below, from Valdosta, Georgia. If passengers prefer to book on-demand rides, they will input their origin and destination in the mobile application (or by calling a customer service center), and they will select from two ride proposals before confirming the booking, as shown in the screenshots below. Passengers can select between the real-time and pre-scheduling options by toggling the button shown in red before booking a ride. **In the Greater Louisville area, we recommend adopting the hybrid approach of on-demand microtransit with optional pre-booking to offer passengers shorter wait times and enable more flexible operations, while also accommodating the need for recurring trip requests for certain high-need populations.**

Mobile App Screenshot: On-Demand Microtransit with Optional Pre-Booking



Source: Via

5.4.2. Service design guide.

There are several important decisions related to the service design that must be made prior to the implementation of a microtransit service. These decisions relate specifically to:

- Quality of service
- On-demand vs. pre-scheduled service design
- Bus stop model

There are several service design tradeoffs that to be considered when planning a new microtransit service. Adjusting any one of the three factors of the trio will affect one or more of the other factors. The three factors include:

- **Supply.** This is the level of resources required to operate the microtransit service. Supply can be measured by vehicle hours, budget, or fleet size. With increased supply, the microtransit service can complete more trips at a comparable quality of service (that is, a quality of service that is kept constant), or complete the same number of trips with a higher quality of service. On the other hand, reduced supply will cause quality of service to diminish, if trip volumes are kept constant, and vice versa.
- **Demand.** This is the level of demand we can expect in a given microtransit service area and is typically equal to the ridership of the service. Demand can be increased by adjusting the size of the zone, reducing fares or offering other incentives to riders, or conducting

marketing campaigns to raise awareness of the service. If the demand rises significantly, either the quality of service will decrease (with the operating fleet size kept constant), or the service will need to add extra vehicles to ensure that the quality of service remains constant.

- **Quality of service**. This includes various metrics of how fast, frequent, comfortable, and direct the microtransit service is for passengers. Quality of service parameters are typically set using the technology provider's algorithm inputs, and the exact parameters may vary slightly between technology providers. Increasing quality of service will result in either higher operating costs, given additional vehicles needed to serve a fixed level of demand, or a lower passenger capacity if the service's budget is kept constant. The quality of service parameters described in the Quality of Service section are intended to balance the efficiency of service — which reduces the vehicle fleet required, and therefore the cost to operate microtransit —with the quality of service a rider experiences. Microtransit services with higher quality of service (i.e. shorter wait times or walk distances) require longer detours or more vehicles to operate, reducing their efficiency. Given a fixed level of demand and vehicle fleet, a lower quality of service is necessary to produce a more efficient microtransit service.

We recommend several quality of service parameters for on-demand microtransit in the Louisville area described below.

5.4.3. Quality of service parameters.

Each quality of service parameter is described below:

- **Service availability.** When a rider requests a trip, the microtransit service will provide them with a proposal that indicates how much time it will take for a vehicle to meet them at the pickup point. During especially busy times, there may not be sufficient vehicles to pick up a passenger in a reasonable amount of time due to prior trip commitments. If a passenger has to wait longer than a certain threshold (e.g., 30 minutes), the service is considered 'unavailable' for on-demand booking. **For each of the MOD zones explored in this study, we recommend setting a maximum wait time of 30 minutes**, beyond which the trip is considered 'not available' or 'denied'.[13] The percentage of trips that exceed this threshold should be measured; if it exceeds a few percentage points, adjustments to the service should be made to increase service availability. **A high-quality service should complete the vast majority of requested trips (90% or more).**
- **Wait times.** Wait time is the time a passenger waits after requesting a vehicle and applies mainly for on-demand services (as opposed to pre-scheduled services where a passenger is provided with a pickup window when they request their trip). By operating more vehicles,

[13] For a pre-scheduled service, when passengers cannot be provided with a time that falls within their desired pickup or dropoff time when attempting to book, that trip should be considered unavailable.

the microtransit service can reduce the average wait time a passenger experiences, but this will come at an additional cost. Shorter wait times generate higher ridership, and longer wait times will mean fewer riders use the service. Typically, average wait times for an on-demand service are between 5 and 20 minutes. **We recommend providing sufficient vehicle supply in each zone to offer riders average wait times of 15-20 minutes and maximum wait times set not to exceed 25 to 30 minutes, depending on the characteristics of the MOD zone.**

- **Bus stop model and walking distance.** Several different stop models for passengers are available, each of which affects the efficiency of the routing algorithm and the passenger experience. The different models are:[14]
    - **Curb-to-curb.** In this stop model, microtransit vehicles can pick up passengers directly outside their requested pick up address and drop them off directly outside their requested dropoff address. Some services also offer door-to-door service for riders with disabilities, which requires drivers to escort passengers to and from the entrances of their origins and destinations, upon request. While this is an essential service for some passengers with disabilities, this model does require additional driver training, which can raise the cost to operate the service.
    - **Corner-to-corner.** This model requires that passengers walk to a nearby corner to meet their vehicle at pickup as well as walk from their dropoff location to their final destination**.** Walking distances typically average between 400 and 800 feet, with maximum walking distances of ¼ mile. **This maximum walking distance threshold of ¼ mile is recommended for the zones explored in this study**; it is also traditionally known as the maximum distance that most riders will walk to access local bus service. Requiring passengers to walk to a nearby intersection, where feasible, improves the overall efficiency of service by limiting the number of vehicle detours that would be necessary to provide curb-to-curb service.
- **Detour allowance.** Detour allowance is the relative and absolute detour that a vehicle can take to complete other trips when a passenger is on-board. If the detour exceeds the maximum allowance, any additional trips will not be assigned to a vehicle. In practice, the average detour is typically much lower than the maximum detour. **In Greater Louisville we recommend allowing detours resulting in journeys up to 50% slower than the most direct route, with an absolute detour limit of 10 minutes.** In a trip that is 10 minutes long using the most direct route, this would enable a maximum detour of 5 minutes, while a trip that is 25 minutes via the most direct route would have its detour capped at 10 minutes.
- **Vehicle selection.** Vehicles must be large enough to accommodate multiple passengers comfortably. They must also be large enough to potentially be retrofitted to enable wheelchair ramp installation, to offer ADA-compliant service to passengers with disabilities.

[14] An additional bus-stop-to-bus-model is also used in some microtransit services that operate in areas with comprehensive fixed-route bus network coverage. In this model, passenger trips must begin and end at existing fixed-route bus stops. However, this model is not appropriate for the suburban areas of Greater Louisville explored in this study, because the coverage and density of TARC bus stops are not sufficient to offer riders short walking distances to access the service.

Most microtransit services use vehicles with a passenger capacity of between 6 and 12 passengers, beyond which higher operating costs are incurred due to increasing vehicle, insurance, and labor costs. **We recommend vehicles with 6+ passengers given the relatively low expected ridership and vehicle occupancy in most of the MOD zones explored in this study.**

5.4.4. Hours of operation.

Determining the appropriate hours of operation for a microtransit service involves an assessment of the use cases prevalent in Greater Louisville and types of trips riders are likely to make. Improving access to jobs was a key priority discussed among this Study's Steering Committee members, particularly for lower-wage employment in the warehousing and logistics, service, and healthcare industries. As a result, service must begin early enough in the day to accommodate commute trips. Additionally, mid-day service is needed to meet the needs of shopping, recreational, and non-emergency medical use cases needed by other high-need populations, such as low-income residents, older adults, and zero-vehicle households. Afternoon and evening service are necessary to facilitate commute trips returning from the workplace. **Broadly, we recommend the following hours of operation, except where noted otherwise:**

- **Monday through Friday from 5:30am to 8:30pm**
- **Saturdays from 7am to 9pm**
- **Sundays from 8am to 6pm**

These hours of operation are sufficient to meet most potential use cases of microtransit in Greater Louisville.

5.4.5. Key performance indicators.

To assess the performance of microtransit we recommend selecting several Key Performance Indicators (KPIs) to measure whether a service is meeting its goals and objectives. Below, we have suggested KPIs and recommended benchmarks that would be most applicable for Greater Louisville. These benchmarks are based on observed performance of microtransit services described in this Study's Peer Agencies Report.

Key Performance Indicators and Suggested Benchmarks

KPI	Description	Suggested Benchmarks
Ridership	The number of passengers using the on-demand service in a given time period.	Boardings per hour of weekday service. - Good: >15 - Average: 5-15 - Poor: <5
Cost per passenger trip	The total operating cost divided by the total ridership, which indicates the cost effectiveness of the service.	Cost per passenger trip - Good: <$10/ passenger trip - Average: $10-$25/ passenger trip - Poor: >$25/ passenger trip

KPI	Description	Suggested Benchmarks
Productivity (utilization)	The average number of passenger boardings per vehicle-hour, another measure of efficiency	Passenger boardings per vehicle hour - Good: >5 - Average: 2-5 - Poor: <2
Service availability	The percentage of trip requests where a vehicle was unavailable due to high demand.	% of trips denied - Good: <5% - Average: 5-10% - Poor: >10%
Wait time	The average time a passenger waits between requesting a trip and being picked up (for on-demand services)	Minutes - Good: 5-15 min - Average: 15-25 min - Poor: 25 min+
Requested vs. actual pickup time	The deviation between the pickup window provided to passengers when booking and the actual time they were picked up.	Minutes - Good: <5 min - Average: 5-10 min - Poor: 10 min+
Customer satisfaction	The average rating provided by passengers, ranked from one to five stars (one being very unsatisfied, five being very satisfied)	Stars (out of five): - Good: 4.8+ - Avg: 4.6+ - Poor: <4.5

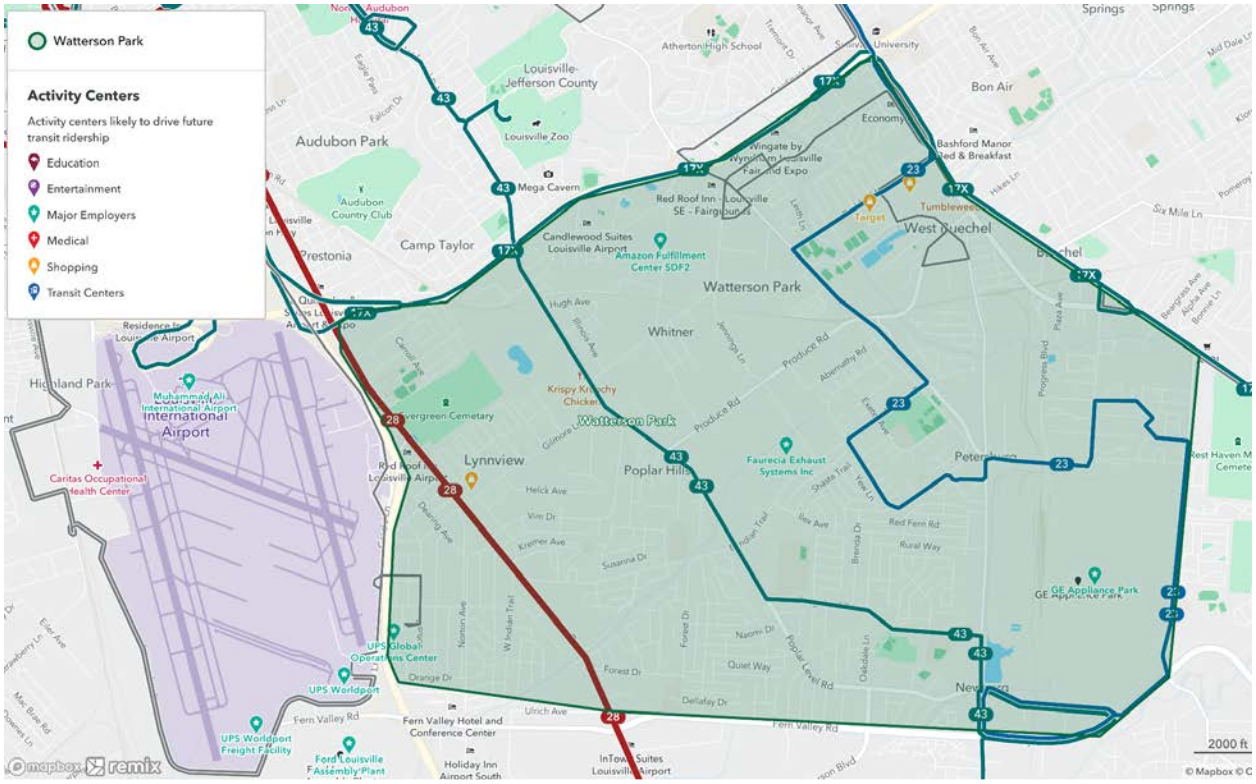
5.4.6. Microtransit Zone Alternatives.

Watterson Park.

The Watterson Park zone is bounded by the Watterson Expressway to the north, Bardstown Road to the east, Fern Valley Road to the south, and I-65 to the west. This zone has an area of 12.5 square miles, with a population and job density of 3,000 residents and 4,100 jobs per square mile, respectively. Within this zone, 8% of households are car-free, and half (50%) of households are within 200% of the poverty level.[15] Key activity centers in this zone include Walmart at Target locations at Bashford Manor, Lynnview Shopping Center, GE Appliance Park, and a major industrial park home to Amazon's SDF2 distribution center. This zone corresponds to the On Demand zone proposed for the area in Concepts 2 and 3 of TARC's 2021 Comprehensive Operations Analysis. Riders in this zone could make first-mile/last-mile connections with the rest of the TARC system by transferring to Route 28-Preston on Preston Highway, on the west side of the zone.

[15] Throughout the United States, zero-vehicle households typically use public transportation at higher rates than the general population, in areas where service is consistently available throughout the day. Likewise, low-income households also use public transportation more often than the general population where it is available. Here, we define "low-income" as 200% of the federal poverty level to include households that may still experience significant financial hardship due to transportation costs even though their income exceeds the federal poverty level. This threshold is common for many federal means-tested social programs.

If adopted, TARC could simplify Route 23-Broadway by truncating the existing variant that currently serves GE Appliance Park, instead terminating the fixed-route segment south of Bashford Manor and serving the area south of Watterson Expressway with microtransit. This change would enable TARC to reallocate fixed-route operating resources to higher-ridership segments of Route 23-Broadway, where the 2021 COA recommends additional frequency. The advantage of operating microtransit in this MOD zone is that it contains a range of widely dispersed activity centers and lower-density residential neighborhoods as well as a socially disadvantaged population, relative to other suburban areas explored in this Study. One potential challenge of the zone is that it would not meaningfully expand the reach of TARC's network into areas that currently lack fixed-route service.

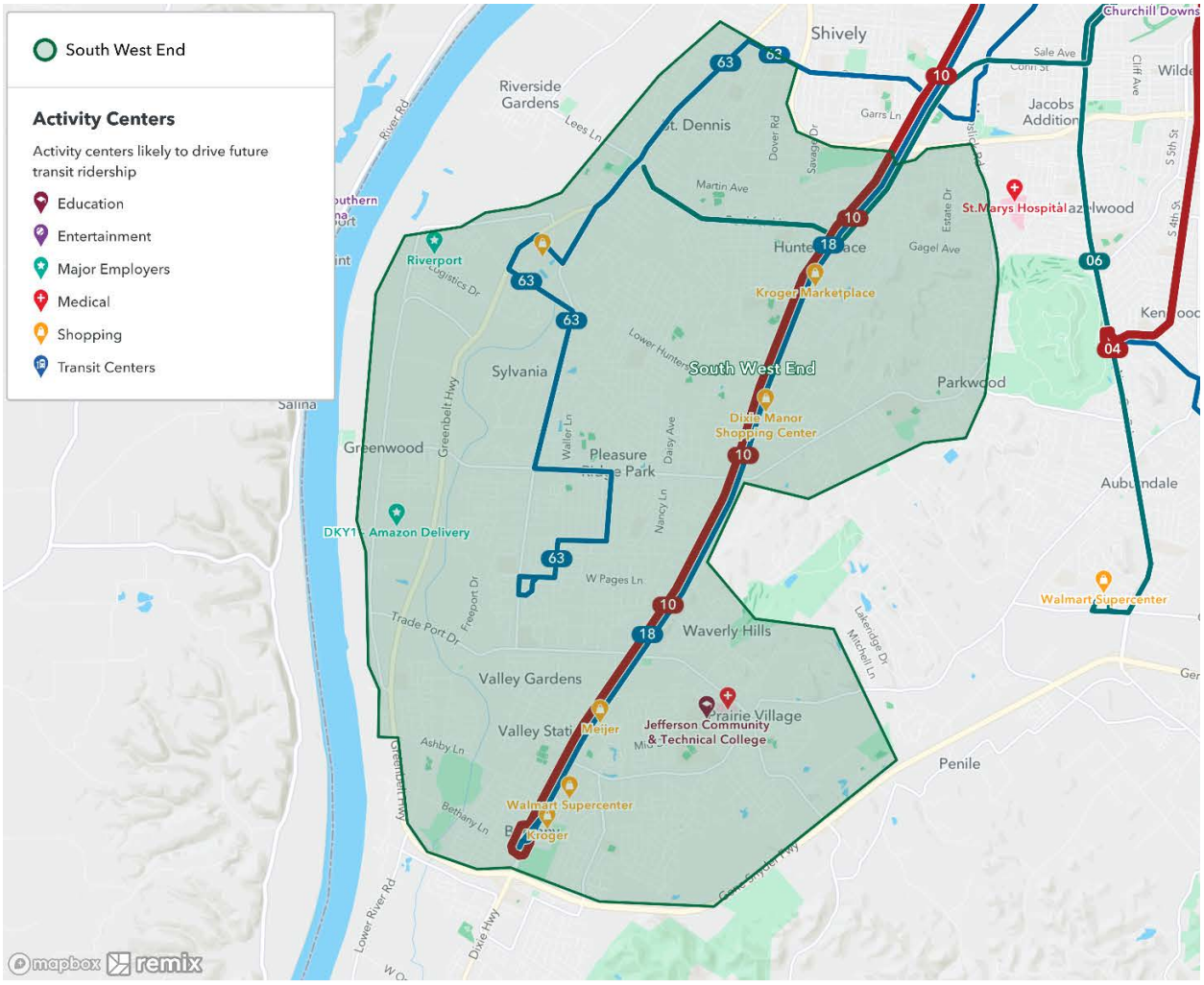


South West End.

The South West End zone is bounded by the Watterson Expressway to the north, Manslick Road to the east, Gene Snyder Freeway to the south, and Cane Run Road (along the Ohio River) to the west. This zone has an area of 28.8 square miles, with a population and job density of 3,000 residents and 800 jobs per square mile, respectively. Within this zone, 6% of households are car-free, and about one-third (32%) of households are within 200% of the poverty level. Key activity centers in this zone include Dixie Manor Shopping Center, Park Place shopping center, two Kroger grocery stores, a Walmart at Barrett Lane, Jefferson Community and Technical College's (JCTC) Southwest campus, UofL Health Southwest, and the regional job center at Riverport, home to many distribution centers for companies such as Amazon and Radial. This zone corresponds to the On Demand zone proposed for the area in Concepts 2 and 3 of TARC's 2021 Comprehensive

Operations Analysis. Riders in this zone would make first-mile/last-mile connections with the rest of the TARC system by transferring to Route 10-Dixie Rapid, which bisects the zone.

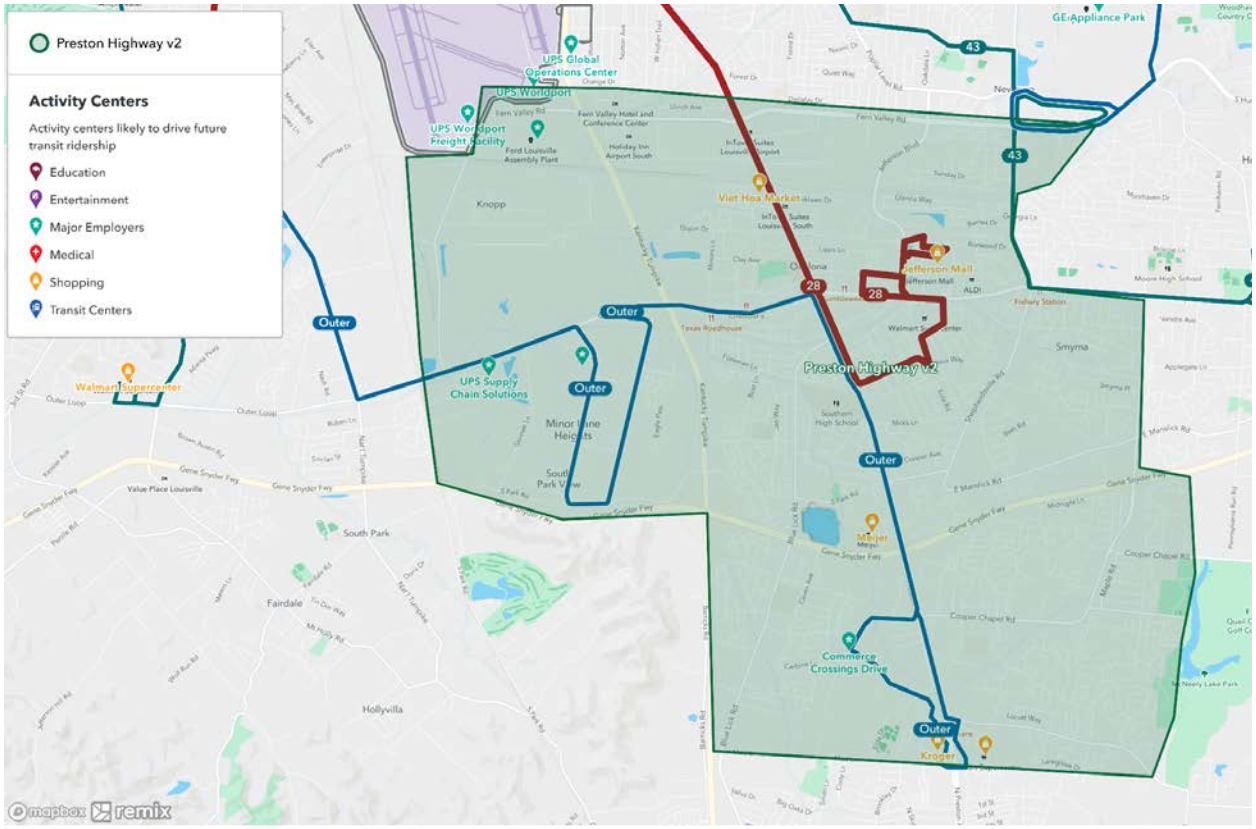
If adopted, TARC could simplify Route 63-Crumbs Lane by truncating the existing variant south of the Watterson Expressway and serving its corridor with microtransit. This change would enable TARC to reallocate fixed-route operating resources to Route 19-Muhammad Ali, which serves higher ridership and operates more daily trips within the zone. The advantage of operating microtransit in this MOD zone is that it contains the most attractive first-mile/last-mile connection of any alternative explored in this Study, to the Dixie Rapid, which features all-day frequent service and high quality stops/stations in the center of the zone. It would also provide additional service to the regional job center of Riverport, which currently has limited TARC fixed-route coverage. One potential challenge of the zone is that its large size would require the largest vehicle fleet to operate among all MOD alternatives explored in the Study. Its employment density is also relatively low compared to other zones, suggesting that other zones may be more effective at providing workforce transportation to other regional job centers.



Preston Highway.

The Preston Highway zone is bounded by Fern Valley Road and Louisville-Muhammad Ali International Airport to the north, Smyrna Parkway to the east, Gene Snyder Freeway and the Jefferson County line to the south, and Grade Lane to the west. This zone has an area of 21.6 square miles, with a population and job density of 2,300 residents and 1,600 jobs per square mile, respectively. Within this zone, 6% of households are car-free, and about one-third (30%) of households are within 200% of the poverty level. Key activity centers in this zone include UPS Worldport, large industrial parks at Commerce Crossing and Heritage Creek, Jefferson Mall, as well as several large grocery stores along Preston Highway (Walmart, Meijer, and Kroger). This zone corresponds to the On Demand zone proposed for the area in Concept 3 of TARC's 2021 Comprehensive Operations Analysis. Riders in this zone would make first-mile/last-mile connections with the rest of the TARC system by transferring to Route 28-Preston, which bisects the zone with its terminus at Jefferson Mall.

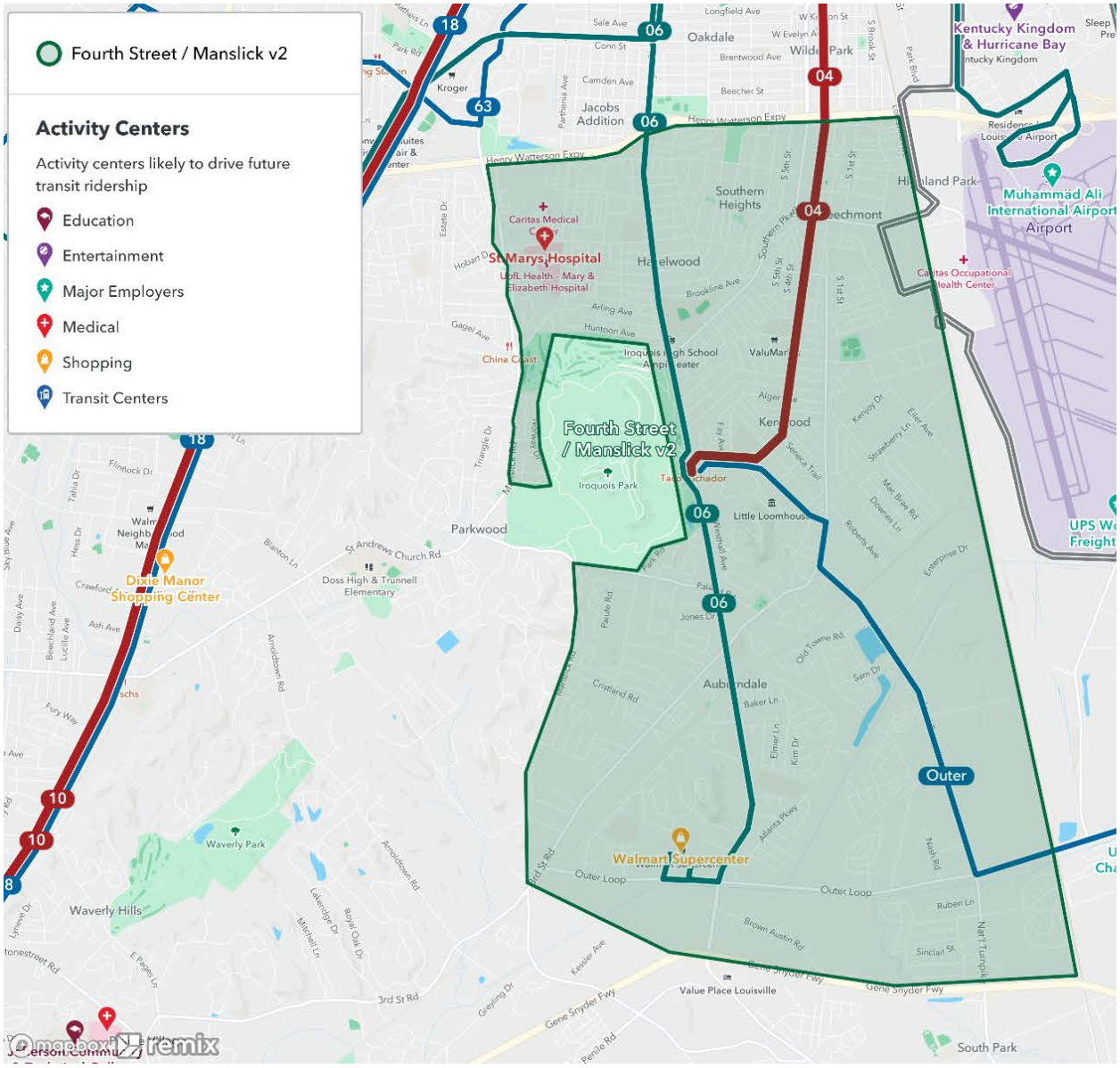
The advantage of operating microtransit in this MOD zone is that it contains multiple regional employment centers highlighted during Steering Committee discussions, and it would expand the reach of TARC services to areas between the Snyder Freeway and the Jefferson County line which have not been covered by fixed-route service in the past. One potential challenge of the zone is that unlike connections to the Dixie Rapid in the South West End zone described above, there are limited bus stop amenities at any of the stop locations likely to draw ridership on Route 28-Preston, particularly at Jefferson Mall or Central & McCauley (Southwest Regional Library). We therefore recommend prioritizing stop amenities to provide riders more convenient transfers between microtransit and TARC fixed-route service and encourage ridership at these locations. This approach is described in more detail in Mobility Hubs. Another potential challenge is this zone's exposure to traffic congestion at the interchange of the Snyder Freeway and Preston Highway, in the center of the zone, which could reduce the service's reliability and increase passenger wait times during peak periods.



Fourth Street-Manslick Road.

The Fourth Street-Manslick Road zone is bounded by the Watterson Expressway to the north, the CSX rail corridor to the east, Gene Snyder Freeway to the south, and Manslick Road to the west. This zone has an area of 11.6 square miles, with a population and job density of 3,700 residents and 1,400 jobs per square mile, respectively. Within this zone, 12% of households are car-free, and nearly half (44%) of households are within 200% of the poverty level. Key activity centers in this zone include St. Mary's Hospital, Iroquois Park, the industrial park along National Turnpike, and the Walmart at Outer Loop & New Cut Road. This zone corresponds to the On Demand zone proposed for the area in Concept 3 of TARC's 2021 Comprehensive Operations Analysis. Riders in this zone would make first-mile/last-mile connections with the rest of the TARC system by transferring to Route 4-Fourth Street at its terminus at Iroquois Park.

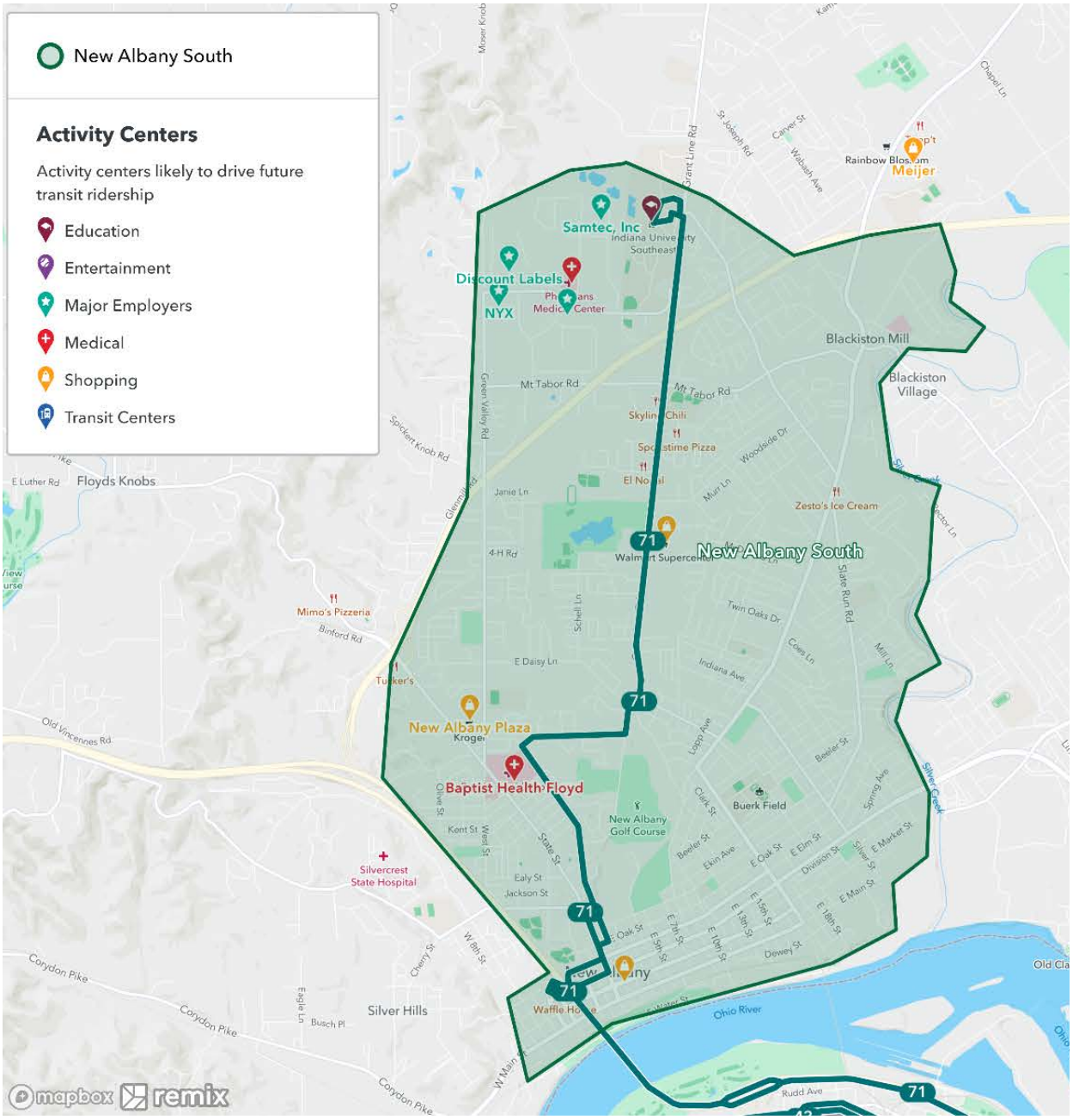
The advantage of operating microtransit in this MOD zone is that it would serve a socially disadvantaged community, with a higher share of residents living in or near poverty compared to other zones explored in this Study. There is also a fairly direct first-mile/last-mile connection to Route 4-Fourth Street at Iroquois Park. The primary challenge with this zone is that it would not meaningfully expand the reach of TARC's network to previously unserved areas.



New Albany South.

The New Albany South zone is bounded by the IU-Southeast campus to the north, Silver Creek to the east, the Ohio River waterfront to the south, and I-265 to the west. This zone has an area of 11 square miles, with a population and job density of 3,000 residents and 1,600 jobs per square mile, respectively. Within this zone, 9% of households are car-free, and more than a third (36%) of households are within 200% of the poverty level. Key activity centers in this zone include IU-Southeast campus, a large industrial park along Hausfeldt Lane, New Albany Plaza, medical centers at PMC Regional Hospital and Baptist Health Floyd, and the retail and entertainment district of Downtown New Albany. In TARC's 2021 Comprehensive Operations Analysis, the zone is slated for additional fixed-route service on Route 273 in Concept 2 and Routes 273/274 in Concept 3, via Green Valley Road/State Street and SR-111/Vincennes Street, respectively.

The advantage of operating microtransit in this MOD zone is that it would serve a major university campus and a wide range of shopping destinations and employment centers. Its primary challenge is its lack of a first-mile/last-mile connection to any frequent TARC fixed-route service; Route 71-Jeffersonville features average daily headways of 40-45 minutes on weekdays, limiting its utility for riders making regional connections to Louisville.

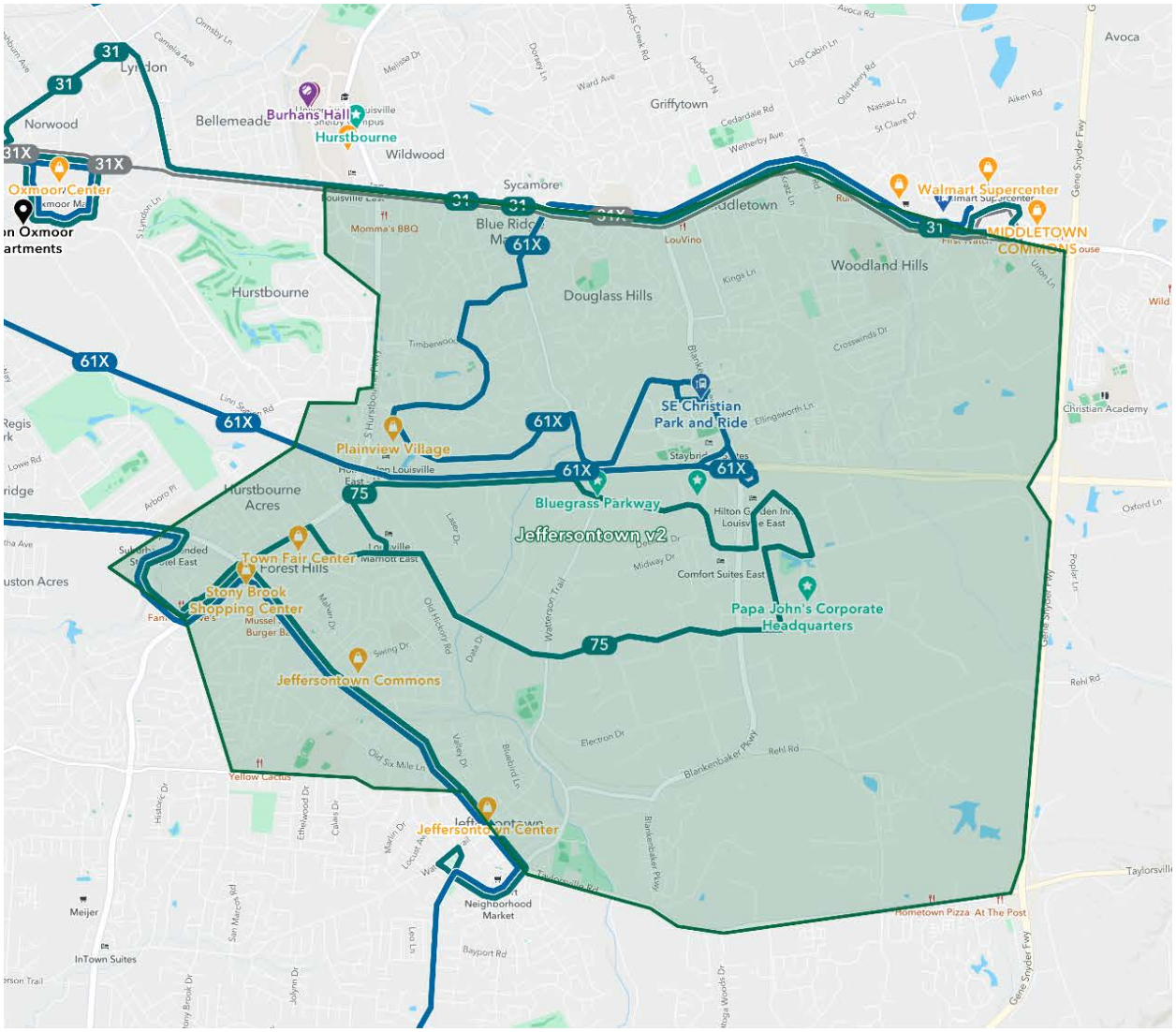


Jeffersontown.

The Jeffersontown zone is bounded by Middletown Road to the north, Snyder Freeway to the east, Taylorsville Road to the south, and Hurstbourne Parkway to the west. This zone has an area of 17

square miles, with a population and job density of 1,900 residents and 2,800 jobs per square mile, respectively. Within this zone, 4% of households are car-free, and about one fifth (18%) of households are within 200% of the poverty level. Key activity centers in this zone include Bluegrass Industrial Park — one of the region's largest employment centers — and a range of shopping centers such as Jeffersontown Commons, Town Fair Center, Stony Brook, and Plainview Village. In TARC's 2021 Comprehensive Operations Analysis, the zone corresponds with On Demand zones proposed for Concepts 2 and 3. If adopted, the zone could also facilitate the replacement of Route 75-Bluegrass Circulator, a fixed-route service that operates several peak-only trips and serves low ridership.

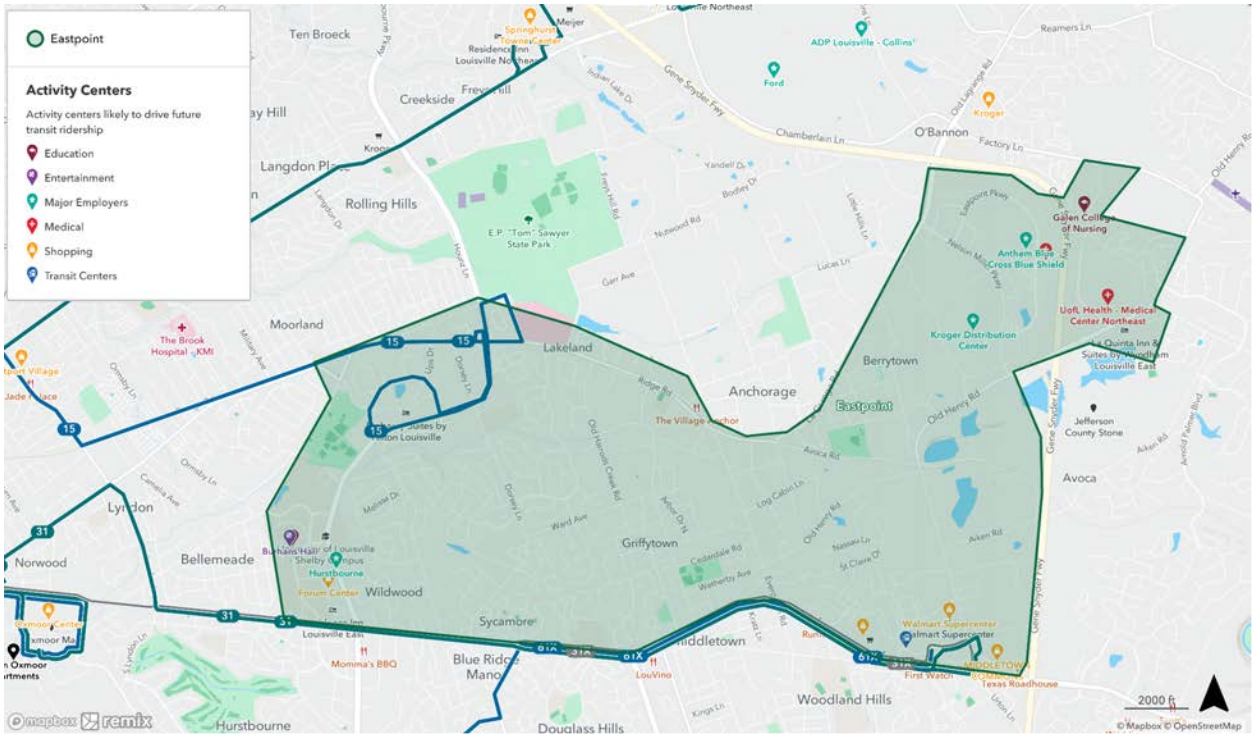
The advantage of operating microtransit in this MOD zone is that it would serve a significant regional employment center and an area with the highest employment density among all MOD zones considered in this Study. It would also significantly expand the TARC network's coverage to outer suburban areas along the Gene Snyder Freeway that currently do not have fixed-route bus service. Its primary challenge is its lack of a first-mile/last-mile connection to any frequent TARC fixed-route service; many riders may wish to transfer to Route 19-Muhammad Ali at Oxmoor Mall, about one mile east of the zone, but the variant serving this location offers only hourly service. Likewise, the zone features lower population density and a more affluent population less likely to ride public transit compared to other MOD zones explored in this Study.



Eastpoint.

The Eastpoint zone is bounded by LaGrange Road to the north, Snyder Freeway to the east, Middletown Road to the south, and Hurstbourne Parkway to the west. This zone has an area of 8.9 square miles, with a population and job density of 1,700 residents and 3,200 jobs per square mile, respectively. Within this zone, 6% of households are car-free, and less than one fifth (16%) of households are within 200% of the poverty level. Key activity centers in this zone include the University of Louisville's Hurstbourne campus, Galen College of Nursing, Baptist Eastpoint Hospital, and shopping centers at Eastgate and Middletown Commons. In TARC's 2021 Comprehensive Operations Analysis, the zone corresponds with On Demand zones proposed for Concepts 2 and 3. Additionally, Concepts 1 and 3 of the COA would improve the frequency of Route 15 to 20 minutes throughout the day, enabling a better first-mile/last-mile connection for riders to access the TARC network at Ormsby Station. If adopted, the zone could also facilitate the replacement of the variant of Route 31-Shelbyville between Eastpoint and Middletown Commons.

The advantage of operating microtransit in this MOD zone is its compact size and low vehicle requirements, relative to other MOD zones explored in the Study, as well as the range of employment centers it would serve. It would also expand the TARC network's coverage to outer suburban areas along the Gene Snyder Freeway that currently do not have fixed-route bus service. Its primary challenge is its lack of a first-mile/last-mile connection to any frequent TARC fixed-route service; neither Route 15, at Ormsby Station, nor Route 19-Muhammad Ali, at Oxmoor Mall, operate frequently enough to provide attractive transfers to TARC service. The zone also features a significantly more affluent population less likely to ride public transit compared to other MOD zones explored in this Study.

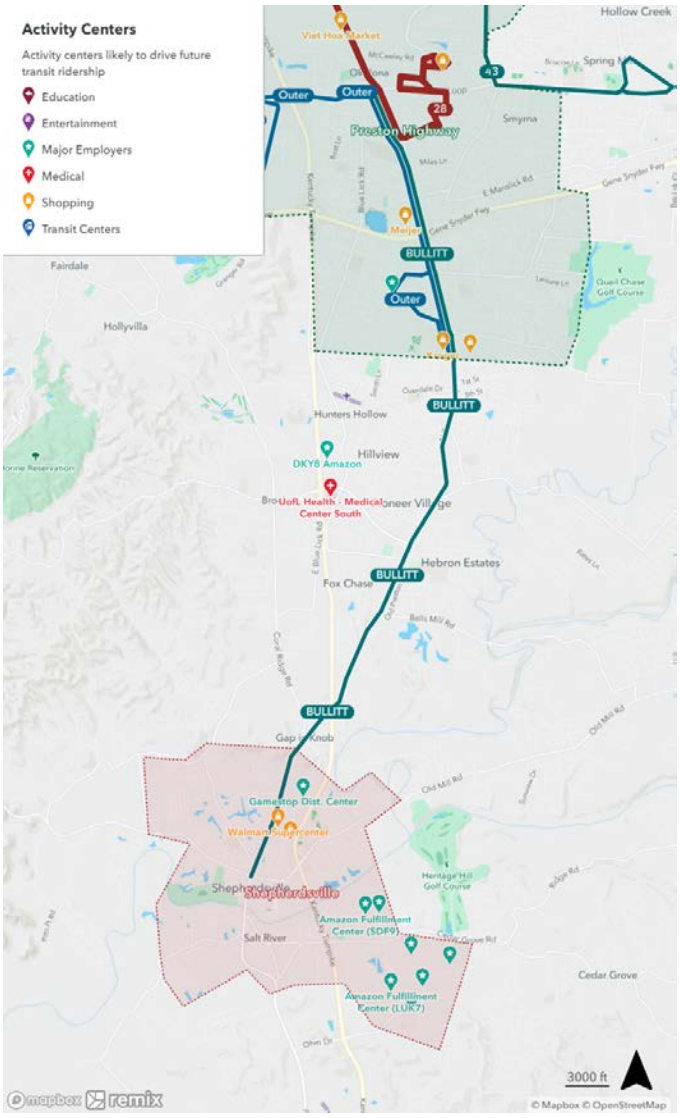


Shepherdsville.

The Shepherdsville zone is roughly coterminous with the city of Shepherdsville, in Bullitt County. This zone has an area of 10 square miles, with a population and job density of 1,300 residents and 900 jobs per square mile, respectively. Within this zone, 4% of households are car-free, and less than one third (29%) of households are within 200% of the poverty level. Key activity centers in this zone include the Settler's Point Shopping Center (Walmart), Shepherdsville town center at 4th Street & Buckman, and a variety of warehousing and distribution centers for companies such as McKesson, Amazon, Gamestop, and Best Buy.

The Shepherdsville microtransit zone has no connection to current TARC fixed-route service, with the cancellation of the former Route 66/66X in 2020. As a result, microtransit service in this zone is only considered viable if it is accompanied by a commuter bus option to connect the zone to other TARC services. In turn, microtransit is needed to supplement the commuter bus because most employment centers in the area are too far for most riders to access from 4th & Buckman by

walking. Here, we propose a “Bullitt County Express” route which would operate on weekdays only between Shepherdsville town center, at 4th & Buckman Streets, and Preston Highway & Bates Avenue. The purpose of the Bullitt County Express service is to connect riders to jobs in Shepherdsville from other areas of Louisville served by the TARC network. At its northern terminus along Preston Highway, riders can make connections to other TARC services such as Route 28-Preston or the CMAQ-funded route launching in August 2022 along the Outer Loop corridor. During peak-periods, from 6am to 9am and 4pm to 7pm on weekdays, the service would operate with two vehicles running every 45 minutes. Service frequency would be reduced to 90 minutes from 9am to 4pm and would require only one vehicle to operate.



The advantage of operating a paired microtransit and commuter bus service in this MOD zone is its ability to serve a rapidly growing employment center that is otherwise inaccessible by public transit. It would also expand the TARC network’s coverage to other exurban areas (e.g. Commerce Crossing, Pioneer Village, and Hebron Estates) that currently do not have fixed-route bus service. Its primary challenge is the relatively low population and employment density and relatively high car ownership in the area.

5.4.7. Ridership estimation.

The ridership estimates for a microtransit service zone impact important outcomes regarding the size of the vehicle fleet required to operate a particular quality of service, as well as the level of funding required for each zone. Ridership estimates were developed by applying a ratio of ride requests normalized to each service zone’s hours of operation, population, and employment. This ratio is based upon observed ridership patterns in other small North American cities and rural areas with similar characteristics to Louisville. For each zone, we developed a low, medium, and high ridership scenario to account for the uncertainty inherent in estimating travel demand. This

approach recognizes that ridership can be affected by many qualitative as well as quantitative factors, such as a transit agency's fare policy, marketing and customer outreach, and the extent of its service and technology integration with other transit services, to name just a few. These three scenarios are described below.

- **Low.** This scenario assumes the service does not perform as well as comparable peer microtransit services. Common reasons for lower ridership outcomes could include poor marketing, lack of community support, poor stakeholder relationships (e.g. with major employers), or unforeseen technological or operational challenges that affect the quality of service.
- **Medium.** The medium scenario represents the project team's best estimate of ridership within 6-12 months of operation, at a rate similar to the average of its peer services.
- **High**. This scenario assumes the service is more popular than most of its peers. Common reasons for an especially high-ridership microtransit service include strong community support, strong stakeholder and employer relationships (often employers are strong advocates of the service), fare-free service, or highly effective marketing campaigns.

Weekday ridership estimates assume hours of operation from 5:30am to 8:30pm, except where otherwise noted. Annual ridership estimates shown below are rounded to the nearest thousand, and they assume the following hours of operation: weekdays from 5:30am to 8:30pm, Saturday from 7am to 9pm, and Sundays from 8am to 6pm, except where otherwise noted. These estimates also include ridership from any fixed-route bus services or service variants replaced by microtransit. Low, medium, and high estimates of ridership are shown in the table below.

Ridership Estimates for Microtransit Zone Alternatives

Microtransit Zone	Estimated weekday ridership			Estimated annual ridership		
	Low	Medium	High	Low	Medium	High
Watterson Park	152	237	374	47,000	73,000	115,000
South West End[16]	249	398	637	76,000	122,000	196,000
Preston Highway	132	212	339	41,000	65,000	104,000
Fourth Street - Manslick Road	88	140	225	27,000	43,000	69,000
New Albany South	76	121	194	23,000	37,000	60,000
Jeffersontown	138	214	335	42,000	66,000	103,000
Eastpoint	94	135	200	29,000	41,000	62,000

[16] On Sundays, the South West End microtransit service would operate from 8am to 8pm. This longer service span on Sundays is intended to complement the service span of Route 10-Dixie Rapid.

Shepherdsville[17]	27	43	68	7,000	11,000	17,000

5.4.8. Simulation setup.

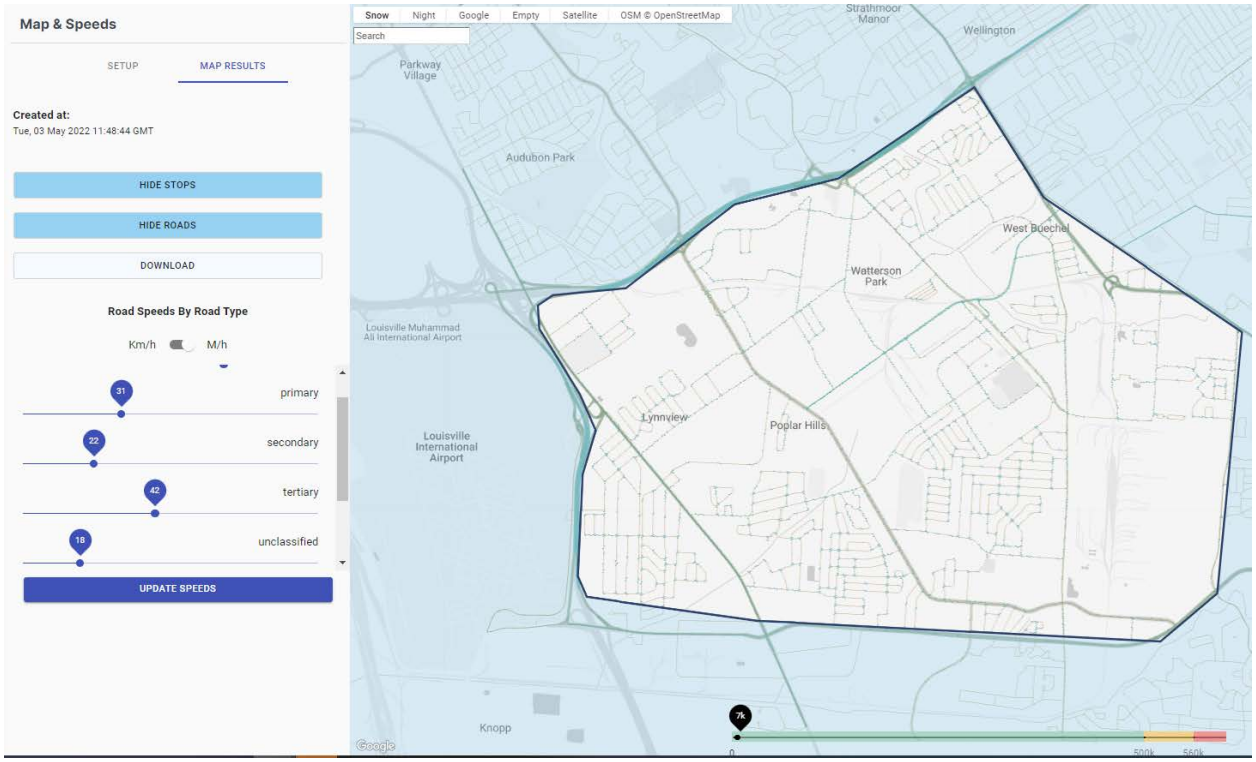
Using the information gathered during the previous steps, the project team conducted microtransit simulations to determine the quality of service based on different fleet sizes and levels of ridership. This technical exercise leveraged Via's proprietary agent-based simulation tool, which allows us to predict how different zones and fleet configurations will perform as real microtransit services. Below we outline the basic steps we used to simulate the proposed microtransit zones:

1. **Upload microtransit service zone polygons.** The origins and destinations of all trips are limited to these zones, described in Microtransit Zone Alternatives.
2. **Generate underlying road map** by pulling vector geometry data within the service zone boundaries from OpenStreetMap, including all roads categorized by functional classification, turn restrictions, directionality, and street walkability and drivability information.
3. **Determine traffic speeds** by querying Google's Maps APIs for traffic speeds specific to the time of day during which the service is being simulated. This ensures that wait times and trip times of the simulated service reflect real-world traffic conditions at the time of day for which service is being modeled. We simulated service during commuting peak hours (weekdays 7-9am) to show a relatively conservative estimate of the impact of traffic congestion.
4. **Set "terminals,"** to designate staging areas for vehicles that do not have active ride assignments. Terminals are safe parking areas that are distributed throughout the service zone, typically at large shopping centers or public parking facilities. When empty, vehicles will be routed to the terminal where the system has predicted demand. This ensures that each vehicle is used efficiently and that passengers will benefit from the shortest possible wait times.
5. **Generate "Virtual Bus Stops,"** to determine safe places for pickups and dropoffs. By default, Via's simulation tool generates Virtual Bus Stops throughout a zone, at points where vehicles can safely park. Via's simulation can be configured to assess curb-to-curb, corner-to-corner, or bus-stop-to-bus-stop service for riders. Typically, there are hundreds of Virtual Bus Stops in a smaller zone. When setting up the zone, Virtual Bus Stop generation considers unique features of the zone, such as the pedestrian walking map, no parking/standing areas, and existing TARC bus stops.
6. **Create demand scenario(s)** to simulate the number and types of trip requests we expect to see in a given zone. Using information gathered in the demand analysis phase, combined with Via's fixed route and microtransit operations experience, we can estimate travel patterns within the zone, and input them into the simulation tool.

[17] The Shepherdsville service would operate only on weekdays, from 6am to 7pm. This is because there is likely not sufficient demand to justify weekend service in this MOD zone.

7. **Set key service parameters** by determining the optimal configuration for achieving TARC's service quality and cost-effectiveness targets described in Key Performance Indicators. These inputs — like fleet size, vehicle capacity, optimal wait times, and walk distances to/from Virtual Bus Stops — are those we adjust most frequently when creating and iterating upon a new service. Some of these recommended key service parameters are described in Service Design Guide.

An example of the mapped road network and "Virtual Bus Stops" used by the simulation tool is shown below.



After these variables are set, the scenario is ready to run. We perform a number of different simulations for each zone, demonstrating how adjusting service parameters will impact the quality of service, capacity, and efficiency. We iterate simulations with different parameters to assess:

- Impact of total zone size and shape on quality of service
- Impact of overall service design on the performance of the transport network
- Impact of additional (or fewer) vehicles and quality of service
- Impact of shorter or longer permissible passenger wait times and vehicle detours on fleet requirements
- Impact of increasing or decreasing permissible walk distance and system efficiency

5.4.9. Simulation results.

A table showing the results of microtransit simulations in each of the proposed service zones is shown in the following section. These results include the following key metrics used to evaluate the performance of simulated service in each zone, related to quality of service, efficiency, and the fleet required to operate the service (using quality of service parameters specified in Service Design Guide:

- **Estimated weekday ridership.** This figure is based on the ridership estimates for each zone, prepared as part of Ridership Estimation. The three rows in the following tables represent the low, medium, and high-demand scenarios and their corresponding impacts upon all other metrics described here.
- **Number of vehicles required.** This is understood as the number of vehicles needed to serve all ride requests, assuming that each weekday ride request results in a completed passenger trip. In real microtransit services, a nominal percentage of ride requests result in no-shows or cancellations from riders who do not successfully complete a trip. Service is simulated during peak hours, when traffic is highest, and therefore the vehicle requirement represents the maximum number of vehicles needed to comfortably serve all ride requests when ridership is at its highest hourly volumes. This number of vehicles may not be needed to run at off-peak times, when demand is somewhat lower.
- **Average wait times.** This refers to the average time, in minutes, that passengers wait to be picked up by a vehicle, from the time they book their trip to the time the vehicle arrives at the curb.
- **Average trip duration.** Length of the trip, in minutes, from the pickup to dropoff.
- **Utilization:** This metric is defined as the number of passenger trips served per vehicle-hour and is roughly analogous to how public transit agencies typically define productivity of service, in passenger boardings per revenue-hour.[18]
- **Shared-ride duration percentage.** This is the percentage of time that vehicles are occupied by more than one passenger. A high shared-ride duration percentage is a key indicator of effective aggregation of passenger demand, and therefore relatively efficient microtransit service.

Simulation Results for Watterson Park Microtransit Zone

Demand Scenarios	Daily Ridership	Fleet Size	Average Passenger Wait Time	Utilization	Passenger Trips per Hour (Peak)	Average Ride Duration	Shared-Ride Duration Percentage
	Trips per day	*Number of Vehicles Required*	*Minutes from Request to Pickup*	*Passenger Boardings per Vehicle-Hour, Daily Average*	*Passenger Boardings per Hour, during Peak Period*	*Minutes*	*Percent of vehicle-time with multiple passengers*

[18] The difference in the two denominators is that in microtransit services, a small portion of vehicle-hours at the beginning and end of driver shifts are zero-passenger time spent traveling between terminals and the first rider pickup or dropoff. This time would be counted as dead-head in fixed-route bus service and excluded from the revenue-hours denominator, and as a result utilization figures are often 10-30% lower than their equivalent productivity of service figures as reported to the FTA National Transit Database.

Low	152	3	14	3.1 - 3.7	7 - 13	12	41%
Medium	237	3	16	5.0 - 5.6	13 - 19	12	66%
High	374	5	15	4.7 - 5.3	22 - 28	11	55%

Simulation Results for South West End Microtransit Zone

Demand Scenarios	Daily Ridership	Fleet Size	Average Passenger Wait Time	Utilization	Passenger Trips per Hour (Peak)	Average Ride Duration	Shared-Ride Duration Percentage
	Trips per day	*Number of Vehicles Required*	*Minutes from Request to Pickup*	*Passenger Boardings per Vehicle-Hour, Daily Average*	*Passenger Boardings per Hour, during Peak Period*	*Minutes*	*Percent of vehicle-time with multiple passengers*
Low	249	4	13	3.9 - 4.5	14 - 20	11	57%
Medium	398	5	12	5.0 - 5.6	23 - 30	13	72%
High	637	7	14	5.8 - 6.4	39 - 45	13	79%

Simulation Results for Preston Highway Microtransit Zone

Demand Scenarios	Daily Ridership	Fleet Size	Average Passenger Wait Time	Utilization	Passenger Trips per Hour (Peak)	Average Ride Duration	Shared-Ride Duration Percentage
	Trips per day	*Number of Vehicles Required*	*Minutes from Request to Pickup*	*Passenger Boardings per Vehicle-Hour, Daily Average*	*Passenger Boardings per Hour, during Peak Period*	*Minutes*	*Percent of vehicle-time with multiple passengers*
Low	132	3	10	2.6 - 3.2	7 - 11	11	22%
Medium	212	3	16	4.4 - 5.0	12 - 16	11	47%
High	339	5	15	4.2 - 4.8	20 - 26	10	35%

Simulation Results for Fourth Street-Manslick Road Microtransit Zone

Demand Scenarios	Daily Ridership	Fleet Size	Average Passenger Wait Time	Utilization	Passenger Trips per Hour (Peak)	Average Ride Duration	Shared-Ride Duration Percentage
	Trips per day	*Number of Vehicles Required*	*Minutes from Request to Pickup*	*Passenger Boardings per Vehicle-Hour, Daily Average*	*Passenger Boardings per Hour, during Peak Period*	*Minutes*	*Percent of vehicle-time with multiple passengers*
Low	88	2	9	2.6 - 3.2	5 - 7	8	17%
Medium	140	2	13	4.4 - 5.0	8 - 11	10	43%
High	225	3	12	4.7 - 5.3	12 - 18	10	55%

Simulation Results for New Albany South Microtransit Zone

Demand Scenarios	Daily Ridership	Fleet Size	Average Passenger Wait Time	Utilization	Passenger Trips per Hour (Peak)	Average Ride Duration	Shared-Ride Duration Percentage
	Trips per day	*Number of Vehicles Required*	*Minutes from Request to Pickup*	*Passenger Boardings per Vehicle-Hour, Daily Average*	*Passenger Boardings per Hour, during Peak Period*	*Minutes*	*Percent of vehicle-time with multiple passengers*

Low	76	2	13	2.2 - 2.8	4 - 6	9	22%
Medium	121	2	14	3.7 - 4.3	7 - 9	12	48%
High	194	4	12	2.9 - 3.5	10 - 14	10	37%

Simulation Results for Jeffersontown Microtransit Zone

Demand Scenarios	Daily Ridership	Fleet Size	Average Passenger Wait Time	Utilization	Passenger Trips per Hour (Peak)	Average Ride Duration	Shared-Ride Duration Percentage
	Trips per day	*Number of Vehicles Required*	*Minutes from Request to Pickup*	*Passenger Boardings per Vehicle-Hour, Daily Average*	*Passenger Boardings per Hour, during Peak Period*	*Minutes*	*Percent of vehicle-time with multiple passengers*
Low	138	3	19	2.8 - 3.4	7 - 11	12	35%
Medium	214	4	15	3.3 - 3.9	10 - 16	15	47%
High	335	6	18	3.4 - 4.0	16 - 24	16	57%

Simulation Results for Eastpoint Microtransit Zone

Demand Scenarios	Daily Ridership	Fleet Size	Average Passenger Wait Time	Utilization	Passenger Trips per Hour (Peak)	Average Ride Duration	Shared-Ride Duration Percentage
	Trips per day	*Number of Vehicles Required*	*Minutes from Request to Pickup*	*Passenger Boardings per Vehicle-Hour, Daily Average*	*Passenger Boardings per Hour, during Peak Period*	*Minutes*	*Percent of vehicle-time with multiple passengers*
Low	94	2	17	2.8 - 3.4	5 - 7	13	24%
Medium	135	3	16	2.7 - 3.3	7 - 11	13	43%
High	200	4	14	3.0 - 3.6	10 - 14	11	46%

Modeling Results for Shepherdsville Microtransit Zone[19]

Demand Scenarios	Daily Ridership	Fleet Size	Utilization	Passenger Trips per Hour (Peak)
	Trips per day	*Number of Vehicles Required*	*Passenger Boardings per Vehicle-Hour, Daily Average*	*Passenger Boardings per Hour, during Peak Period*
Low	27	2	1.1 - 1.7	2 - 3
Medium	43	2	1.8 - 2.4	4 - 6
High	69	2	3.2 - 3.7	5 - 8

[19] Note, this microtransit zone was not simulated due to its low ridership. Instead, given the zone's compact size and relatively small population and employment totals, we model the impacts of deploying a service with two vehicles here. Operating a service with one vehicle is not recommended due to potential reliability issues in the event of a no-show driver or vehicle malfunction, which would disable a one-vehicle service.

5.4.10. Partnership model.

TARC can select between several partnership models which best suit its budget, capabilities, and access to vehicles. Potential partnership models typically include:

Agency-operated service. In this model, TARC procures a software platform for the operation of microtransit service, and delivers service using its existing drivers, vehicles, and administrative and operations staff. Partnerships of this nature may be described as Software-as-a-Service, or "SaaS". Software contracts may include ongoing customer support and service optimization services. An agency-operated service has the advantages of allowing TARC to utilize its existing resources, potentially at lower cost per vehicle-hour, and assume a higher level of control over service delivery. The primary disadvantage of an agency-operated approach is that TARC would be required to develop administrative and operational capacity in a potentially unfamiliar service category, which has the potential to create inefficiencies and higher costs as the agency works to develop expertise in this area (vs. a contracted operator with developed expertise in operating microtransit service). When procuring software, we recommend TARC require the following capabilities at minimum:

- Dynamic vehicle routing and passenger aggregation (shared rides)
- Customer mobile application (available for iOS and Android) providing trip booking and providing real-time estimated time to arrivals (ETAs) and other trip updates
- Driver mobile application for real-time transmission of routing and trip information
- Ability for administrators/schedulers to book trips on behalf of customers (so customers can book trips over the phone)
- Ongoing technical, operational, and marketing support

Turnkey purchased transportation (vendor-operated). In this model, the vendor provides a solution which includes a microtransit software platform, along with the vehicles, drivers, and management services needed to operate service. This partnership model may be described as Transportation-as-a-Service, or "TaaS", and/or as a "turnkey" model. While historically less costly to provide compared to most agency-operated services, the relationship between costs for agency-operated and turnkey services is highly dependent upon local market conditions and may vary significantly between markets. Turnkey services are typically easier to scale quickly when compared to agency-operated alternatives, as third-party vendors can typically adjust vehicle supply or extend operating hours more easily than transit agencies. Turnkey models also ensure the operator and technology platform are designed to work interoperably and efficiently. Disadvantages of using a turnkey model include reliance on a vendor for all aspects of service delivery, and less direct control over operational decisions (potentially including vehicle make/model, driver recruitment and pay, and maintenance). However, a well-designed contract can address many of these concerns.

5.4.11. Cost-Benefit Analysis.

As a mid-sized public transit authority still recovering from the impacts of COVID-19, TARC's operating resources are highly constrained. As a result, the total annual cost to operate microtransit, as well as the operating cost-per-passenger-trip, are important metrics to evaluate each microtransit service alternative.

The partnership model described above has a direct impact on the overall cost to operate microtransit. Agency-operated microtransit service may be preferable to reduce overall costs because TARC incurs hourly operating costs for demand-response service that are somewhat below the national average. According to recent NTD reporting for FY 2022, the cost of TARC's agency-operated demand-response service (TARC3 paratransit) is $45.19 per revenue-hour. This figure is assumed to be the hourly operating cost, per vehicle-hour, in calculating the overall annual cost for microtransit operations below. This figure is slightly lower than the typical cost for paratransit operations of TARC's peer transit agencies, which are often in the $50-75 per revenue-hour range. It is important to note that the relative hourly operating costs between agency-operated and turnkey service models is highly dependent on the scale of these services, particularly the number of vehicles in the fleet. One reason that TARC's hourly operating costs for demand-response service are lower than for turnkey services, described below, is because TARC has a large vehicle fleet and a mature, multi-national operator (MV Transportation) providing its TARC3 paratransit service. The economies of scale of this approach are notable.

Alternatively, should TARC opt to pursue a turnkey purchased transportation service model for microtransit, the agency would face higher overall operating costs but lower reduced administrative and operational responsibilities. In this service model, the service's vehicle fleet, drivers, operations management, and customer support are provided by a third party. Using recent market assessments for similar operations, the project team estimates that a turnkey service model would cost between $75 to $85 per vehicle-hour to operate in Greater Louisville, with lower figures charged for services with larger fleets as an economy of scale. As with the agency-operated model described above, this range is used to calculate the overall annual cost for microtransit operations in a purchased transportation model.

It is worth noting that with significantly larger fleets than explored for any MOD zone in this Study (e.g. 30-40 vehicles), microtransit vendors can achieve much lower hourly operating costs in the $40-60 range for turnkey services, often below agency-operated hourly costs for demand-response. However, the relative parity between agency-operated and turnkey microtransit services is highly dependent on fleet sizes and a range of market conditions that should be evaluated carefully during a formal procurement process.

The following cost-benefit analysis tables show, for each microtransit service alternative:

- **Vehicles required.** The fleet size required to operate microtransit is determined by the simulations described in Simulation Results. This is considered the maximum fleet size needed to serve peak-period microtransit ride requests; the full fleet may not be required throughout the service day.
- **Annual vehicle-hours.** The number of vehicle-hours is rounded to the nearest hundred and assumes a service window of 6am to 8pm on weekdays, 7am to 8pm on Saturdays, and 8am to 6pm on Sundays (with the exceptions of South West End and Shepherdsville zones, as described earlier). The annualization factor assumes 255 weekdays, 52 Saturdays, and 52 Sundays per year in which the service is operating. The remaining 6 days per year are assumed to be holidays when the service is not running.
- **Annual operating cost (gross).** This figure is a multiple of the annual vehicle-hours required and the hourly operating costs described on the previous page. If an agency-operated service model is used, the cost is assumed to be $45.19 per vehicle-hour. If a purchased transportation service model is used, the cost is assumed to be in the range of $80-85 per vehicle-hour, depending on the number of vehicles required. This figure is rounded to the nearest $1,000.
- **Operating cost per passenger trip.** This total is rounded to the nearest dollar.
- **Annual fare revenues.** This calculation assumes an identical fare policy to the existing TARC network, in which a one-way fare costs $1.50, and qualifying passengers pay a discounted fare of $0.75 per trip. Here, we assume an average fare revenue per passenger trip of $1.00, given that a significant share of customers are eligible for discounted fares.[20] Totals are rounded to the nearest thousand dollars.
- **Net subsidy per passenger trip.** This calculation subtracts annual fare revenues from the annual operating cost, above. It is rounded to the nearest dollar.

The table below shows the cost-benefit analysis for each microtransit service alternative with an agency-operated service model followed by a purchased transportation service model.

[20] For the commuter bus / microtransit service alternative to Shepherdsville, we assume an average fare revenue per passenger trip of $3, with $2.75 charged for the commuter bus segment and $1.50 for the microtransit segment, while also accounting for a significant share of reduced-fare-eligible customers likely to use the service.

Cost-Benefit Analysis of Microtransit Alternatives with Agency-operated Service Model

	Demand Scenario	Watterson Park	South West End	Preston Highway	Fourth Street - Manslick Road	New Albany South	Jeffersontown	Eastpoint	Shepherdsville (with commuter bus)
Vehicles required	Low	3	4	3	2	2	3	2	2
	Medium	3	5	3	2	2	4	3	2
	High	5	7	5	3	4	6	4	2
Annual vehicle-hours	Low	13,000	19,000	13,000	10,000	10,000	13,000	10,000	7,000
	Medium	13,000	23,000	13,000	10,000	10,000	18,000	13,000	7,000
	High	22,000	33,000	22,000	13,000	18,000	26,000	18,000	7,000
Annual operating cost (gross)	Low	$648,000	$913,000	$648,000	$498,000	$498,000	$648,000	$498,000	$996,000
	Medium	$648,000	$1.13 million	$648,000	$498,000	$498,000	$897,000	$648,000	$996,000
	High	$1.07 million	$1.59 million	$1.07 million	$648,000	$897,000	$1.27 million	$897,000	$996,000
Cost per passenger trip (gross)	Low	$14	$12	$16	$19	$21	$15	$17	$73
	Medium	$9	$9	$10	$12	$13	$14	$16	$46
	High	$9	$8	$10	$9	$15	$12	$14	$29
Annual fare revenue	Low	$47,000	$76,000	$41,000	$27,000	$23,000	$42,000	$29,000	$21,000
	Medium	$73,000	$122,000	$65,000	$43,000	$37,000	$66,000	$41,000	$33,000
	High	$115,000	$196,000	$104,000	$69,000	$60,000	$103,000	$62,000	$52,000
Net subsidy per passenger trip	Low	$13	$11	$15	$18	$20	$14	$16	$72
	Medium	$8	$8	$9	$11	$12	$13	$15	$44
	High	$8	$7	$9	$8	$14	$11	$13	$27

Cost-Benefit Analysis of Microtransit Alternatives with Purchased Transportation Service Model

	Demand Scenario	Watterson Park	South West End	Preston Highway	Fourth Street - Manslick Road	New Albany South	Jeffersontown	Eastpoint	Shepherdsville (with commuter bus)
Vehicles required	Low	3	4	3	2	2	3	2	2
	Medium	3	5	3	2	2	4	3	2
	High	5	7	5	3	4	6	4	2
Annual vehicle-hours	Low	13,000	19,000	13,000	10,000	10,000	13,000	10,000	7,000
	Medium	13,000	23,000	13,000	10,000	10,000	18,000	13,000	7,000
	High	22,000	33,000	22,000	13,000	18,000	26,000	18,000	7,000
Annual operating cost (gross)	Low	$1.09 million	$1.55 million	$1.09 million	$849,000	$849,000	$1.09 million	$849,000	$1.24 million
	Medium	$1.09 million	$1.92 million	$1.09 million	$849,000	$849,000	$1.52 million	$1.09 million	$1.24 million
	High	$1.79 million	$2.68 million	$1.79 million	$1.07 million	$1.49 million	$2.15 million	$1.49 million	$1.24 million
Cost per passenger trip (gross)	Low	$23	$20	$27	$32	$36	$26	$29	$91
	Medium	$15	$16	$17	$20	$23	$23	$26	$57
	High	$16	$14	$17	$16	$25	$21	$24	$36
Annual fare revenue	Low	$47,000	$76,000	$41,000	$27,000	$23,000	$42,000	$29,000	$21,000
	Medium	$73,000	$122,000	$65,000	$43,000	$37,000	$66,000	$41,000	$33,000
	High	$115,000	$196,000	$104,000	$69,000	$60,000	$103,000	$62,000	$52,000
Net subsidy per passenger trip	Low	$22	$19	$26	$31	$35	$25	$28	$90
	Medium	$14	$15	$16	$19	$22	$22	$25	$55
	High	$15	$13	$16	$15	$24	$20	$23	$34

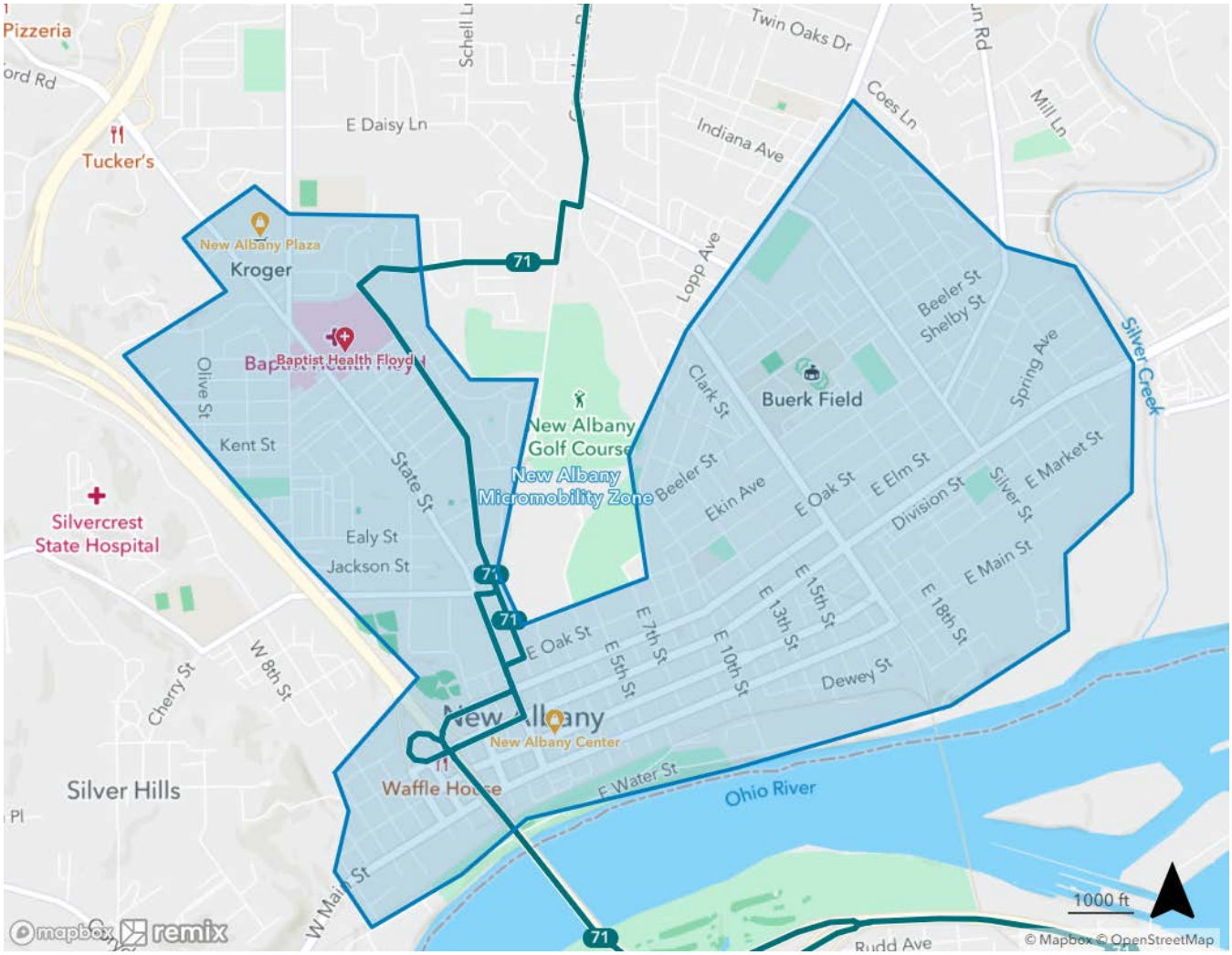
5.5. Micromobility (Bike / Scooter Share)

The following section describes best practices for micromobility service design and follows with the evaluation and modeling of a proposed expansion of the LouVelo system to a MOD zone in central New Albany. A cost-benefit analysis of LouVelo expansion to the New Albany zone is provided, using ridership modeling based upon current LouVelo travel patterns and capital and operating cost estimates based upon other North American bike share systems. This section also describes the bike infrastructure necessary to facilitate this MOD zone, including existing bike facilities and cost estimates for recommended additional facilities.

5.5.1. Rationale and zone selection.

Micromobility services require a network of safe, high-quality bicycle and pedestrian infrastructure as well as a high density of destinations to attract sufficient ridership to operate cost-effectively. In the suburban areas that are the focus of this Study, there are few areas that fulfill each of these criteria. Louisville Metro's existing, dock-based bike share program, LouVelo, currently operates in a roughly 3-square-mile area in Downtown Louisville, with 36 active docking stations and 250 bikes, as of April 2022.[21] Additionally, private scooter operators Bird and Lime make dockless e-scooters available to riders in a service zone roughly bounded by the Ohio River and the Watterson Expressway, with additional service in Downtown Jeffersonville. Outside of these existing service areas, in large part, population and employment densities are lower, activity centers are much more dispersed, and a lack of safe, connected bike and pedestrian facilities make micromobility services difficult and potentially unsafe to operate.

[21] Louisville Metro. 2022. "LouVelo Monthly Reports, April 2022." https://louisvilleky.gov/government/bike-louisville/louvelo-monthly-reports



The most promising area of Greater Louisville that features a relatively high density of destinations (e.g. shopping, medical, recreation, and employment) *and* a supportive network of bike and pedestrian infrastructure is located in central New Albany. This zone is shown in the map below and bounded roughly by Charlestown Road and New Albany Plaza to the north, Silver Creek to the east, the Ohio River waterfront to the south, and I-265 to the west. The Downtown New Albany MOD zone features a mix of destinations likely to drive ridership, including New Albany Plaza; the walkable commercial core of Downtown New Albany along State, Spring, and Main Streets; the neighborhood retail corridor along Vincennes Street; and Baptist Health Floyd Hospital. The zone is also accessible to central Louisville via the Ohio River Greenway, which connects to Downtown via the Big Four Bridge in Jeffersonville. In 2020, buffered bike lanes were installed along Spring Street, between Bank Street and Silver Street, improving access to safe bike infrastructure in the area.

5.5.2. Service design.

Micromobility in urban areas is generally deployed by one of two service models described below:

- **Dock-based bike share:** User picks up a bike at designated stations with docks. Users can reference an information kiosk co-located with the dock to get information on bike share payment and the network of stations. To date, e-scooters have yet to be deployed in a dock-based system.
- **Dockless micromobility:** User picks up a bike or e-scooter by using an app to geo-locate an available bike or e-scooter. Without specified docking locations, users can pick-up and return devices to any location within the service area; the provider provides proper parking/locking guidelines. Dockless services typically rely on digital locking and unlocking capabilities and require access to a smartphone.

We recommend operating micromobility in New Albany by expanding the existing LouVelo system and installing new docking stations within the zone. LouVelo's only docking stations on the Indiana side of the Ohio River are located in Jeffersonville, near the entrance to the Big Four Bridge. However, the connection between the Big Four Bridge and New Albany via the Ohio River Greenway makes the New Albany MOD zone a suitable expansion area. The zone would advance stakeholder goals of operating LouVelo as a truly regional bike share system, rather than one mostly confined to the most urbanized area of central Louisville. Additionally, there are economies of scale with expanding the existing LouVelo program by using current staff, service contracts, and maintenance facilities.

In dockless micromobility services, operators spend considerable time and expense rebalancing devices to ensure their consistent availability throughout the zone. As a result, dockless operators typically prefer densely populated zones with a large number of popular destinations to ensure a high degree of utilization (rides per vehicle per day) to minimize the cost of device rebalancing. This preference is borne out by previous studies of Louisville's dockless scooter operations, which found that e-scooter ridership is positively correlated with walkability and bikeability, as well as with commercial land uses, employment density, and proximity to the city center.[22] Because the New Albany zone is significantly less densely developed than most other urban markets where dockless micromobility operates, it is not clear that the current dockless operators, Bird and Lime, would find the New Albany zone to be commercially viable. This is an important consideration, as dockless services are not supported by any public subsidy, unlike Louisvile Metro-sponsored LouVelo. Finally, dockless micromobility operations may lead to public safety and nuisance concerns from stakeholders and residents due to the improper parking of devices on sidewalks and private property. To address these concerns, additional permitting would be required from the City of New Albany, which may prove to be politically challenging.

5.5.3. Modeling assumptions.

The project team used several key assumptions to model the estimated ridership and cost of the expansion of LouVelo to the New Albany MOD zone, including the following:

- **Station density:** NACTO recommends a station density between 20-30 stations per square mile in the most densely populated cities served by bike share systems, such as Paris, New

[22] Dibaj, S., Hosseinzadeh, A., Mladenovi, M., & Kluger, R. (2021). Where Have Shared E-Scooters Taken Us So Far? A Review of Mobility Patterns, Usage Frequency, and Personas. Sustainability , 13(21), [11792]. https://doi.org/10.3390/su132111792

York, and Mexico City. However, several successful American bike share systems in less densely populated cities (e.g. Austin, Denver, and Minneapolis) show that a density of between four and ten docking stations per square mile is suitable for lower-density cities like Louisville.[23] LouVelo's existing density of stations in central Louisville is roughly 12 stations per square mile. However, to minimize installation costs and reflect the lower-density nature of the New Albany MOD zone, **we assume the NACTO minimum of four stations per square mile, or 13 docking stations within the zone.**

- **Number of bikes and docks per station:** 10 bikes and 22 docks are considered typical capacities for docking stations in American bike share systems reviewed by the Institute for Transportation & Development Policy (ITDP).[24] This supply ratio would provide 290 docks and 132 bikes in a system consisting of 13 docking stations.
- **Ridership:** currently, LouVelo serves a small ridership relative to population of the service area, a ratio known as the **capture rate**. Based on April 2022 ridership patterns, LouVelo serves a capture rate of 0.23% of population in the central Louisville service area, while capture rates in other, more mature bike share systems typically range from 3-6%.[25] We use LouVelo's existing capture rate as the baseline for a "low-demand" scenario, in which the current low rate of ridership continues in the New Albany MOD zone. A "medium-demand" scenario doubles the existing capture rate, under the assumption that connections to more regional trails like the Ohio River Greenway and a wider range of destinations under a larger LouVelo system would spur greater ridership. A high-demand scenario, meanwhile, assumes three times the existing capture rate. These capture rates are applied to the New Albany MOD zone's population (14,200, according to the 2020 Census).
- **Utilization:** Utilization is expressed as the number of rides per bike per day. LouVelo currently averages 0.11 rides per bike per day based on April 2022 ridership patterns, which is likely a consequence of the limited size of its current service area. A utilization rate of at least one ride per device per day is considered typical for a smaller micromobility service, while services in larger cities typically serve more than 3 rides per device per day.[26] In this modeling exercise, we assume a modest improvement in utilization — 0.25 rides per device per day to 0.75 per device per day, in low-demand and high-demand scenarios, respectively — to reflect the increased utility of a larger, more comprehensive LouVelo system.
- **Capital and operating costs:** We assume similar capital and operating costs for bike share as reflected in industry guidance.[27] Each docking station is assumed to carry a capital cost of $50,000, while each bike is assumed to have an acquisition cost of $2,500. Operating costs are

[23] NACTO. 2015. "NACTO Bike Share: Equity Practitioners Paper #1." https://nacto.org/wp-content/uploads/2015/09/NACTO_Walkable-Station-Spacing-Is-Key-For-Bike-Share_Sc.pdf p. 4.
[24] Institute for Transportation & Development Policy (ITDP). 2018. "The Bike Share Planning Guide." https://www.itdp.org/who-we-are/for-the-press/the-bike-share-planning-guide/ p. 30.
[25] Ibid. p. 35
[26] NACTO. 2019. "Shared Micromobility in the US: 2019." https://nacto.org/shared-micromobility-2019/
[27] Institute for Transportation & Development Policy (ITDP). 2018. "The Bike Share Planning Guide." https://www.itdp.org/who-we-are/for-the-press/the-bike-share-planning-guide/ p. 82.

assumed to range from $2.55 to $3.24 per passenger trip, based on findings from other American bike share systems.

5.5.4. Cost-Benefit Analysis.

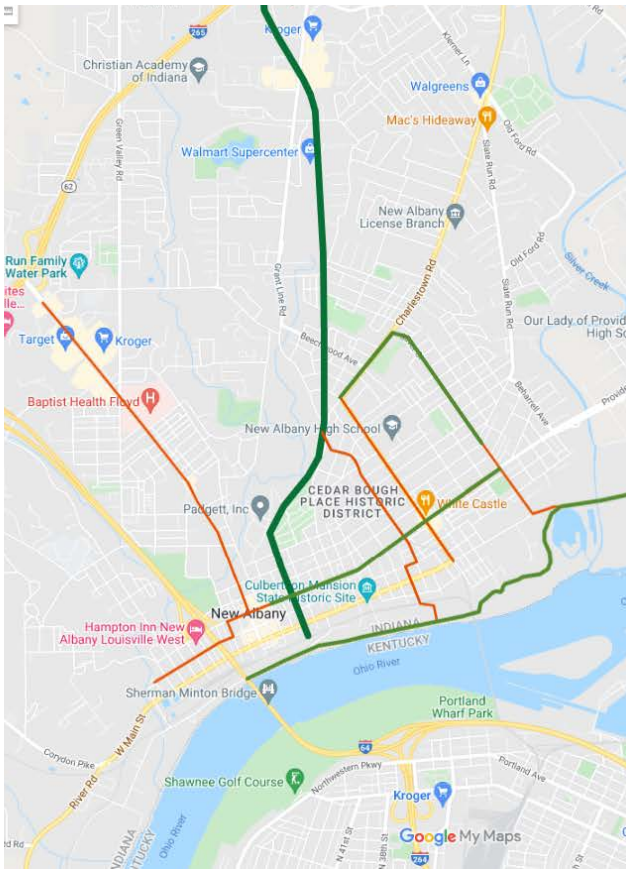
Findings from the cost-benefit analysis are shown in the table below. Ridership is expected to range from 33 daily rides to 99 daily rides in the zone, given a utilization of 0.25 - 0.75 rides per device per day. Capital costs for a system with 13 docking stations include $330,000 in bike acquisition costs and $660,000 for station installation costs, based on the assumptions described above. Operating costs range from about $39,000 to about $92,000, depending on the level of ridership.

	Low Demand	Medium Demand	High Demand
Estimated daily ridership	33	66	99
Total stations	13		
Total bikes	132		
Estimated utilization (rides per device per day)	0.25	0.50	0.75

Capital costs			
Total station costs	$660,000		
Total device acquisition costs	$330,000		
Total capital cost	**$990,000**		
Operating costs			
Estimated operating cost per rider trip	$3.24	$2.90	$2.55
Annual operating cost	**$38,834**	**$69,517**	**$91,691**

5.5.5. Current and future bike facilities.

Micromobility services depend on riders having access to a safe, high-quality, and connected network of bicycle and pedestrian facilities in order to grow and maintain ridership. While there are significant micromobility corridors in New Albany, such as the Spring Street bike lanes and Ohio River Greenway, connecting the zone with additional bike and pedestrian facilities can significantly influence performance outcomes. For example, the South Monon Freedom Trail is planned to connect the Ohio River Greenway to IU-Southeast campus in a multi-use path, separated from vehicle traffic, along a former rail corridor.[28] The City of New Albany recently applied for a $20 million grant to construct this 5.5-mile trail segment, though other shorter segments north of IU-Southeast have received funding. Additional on-street bicycle facilities would supplement the area's trail network to provide more locally oriented connections for micromobility users. On-street bicycle lanes typically range from $100,000 to $300,000 per mile, assuming more extensive road reconstruction is not necessary. A selection of corridors is recommended in the table below and shown in the map at right. In the map, the South Monon Freedom Trail is shown in dark green, existing bike facilities are shown in light green, and recommended additional bike facilities are shown in orange.



Segment	Estimated Cost
Vincennes Street — from Main Street to Charlestown Road	$103,000 - $309,000
State Street — from Daisy Lane to Spring Street	$204,000 - $612,000
Silver Street — from Oak Street to Ohio River Greenway	$60,400 - $181,200
Market Street — from W 8th Street to State Street	$59,600 - $178,800
Spring Street — from Scribner Drive to Silver Street	$165,000 - $420,000
Total capital cost	**$592,000 - $1.78 million**

[28] Hall, Michael. 2021, July 21. "New Albany Designates South Monon Freedom Trail as Most Impactful Regional Project to Drive Growth and Improve Quality of Life." New Albany City Hall. Accessed August 4, 2022. https://newalbanycityhall.com/home/2021/7/22/new-albany-designates-monon-south-freedom-trail-as-most-impactful-regional-project-to-drive-growth-and-improve-quality-of-life.

5.6. Ride-hailing

The project team has evaluated the potential for ride-hailing services to serve mobility in MOD zones that are determined to be less suitable for microtransit. Ride-hailing services (e.g. Uber, Lyft) have shown some degree of success in providing flexible transportation service to low-density and hard-to-serve areas in formal pilot programs in which transit agencies contribute a share of rider's costs on the platforms. However, as discussed in detail in the Peer Agencies Report, there are a number of challenges that must be mitigated in ride-hailing services to enable them to serve some use-cases and remain equitable and accessible to riders who need them.

Most ride-hailing companies do not reliably offer wheelchair-accessible vehicles, assistance with boarding/alighting, or other services required by riders with disabilities. Given ride-hailing companies' approach to partnering with drivers and leveraging their personally owned vehicles, it is challenging to use ride-hailing companies alone to provide ADA customers, in wheelchair-accessible vehicles (WAVs), with equivalent service compared with non-ADA customers. As private-sector, decentralized transportation "platforms" that connect riders with contracted drivers, they do not consider themselves legally to be transportation services subject to many federal regulations such as the ADA or Title VI.

Likewise, the ADA requires driver sensitivity training, criminal background checks, drug/alcohol testing, vehicle certification, and other elements that most ride-hailing companies have, thus far, been unwilling or unable to comply with. As such, fully ADA-compliant service directly through ride-hailing companies has been out of reach, which presents a significant barrier to widely adopting ride-hailing as a permanent MOD feature of TARC's network. To overcome these regulatory and operational challenges, transit agencies that have successfully partnered with ride-hailing companies have taken the following steps:

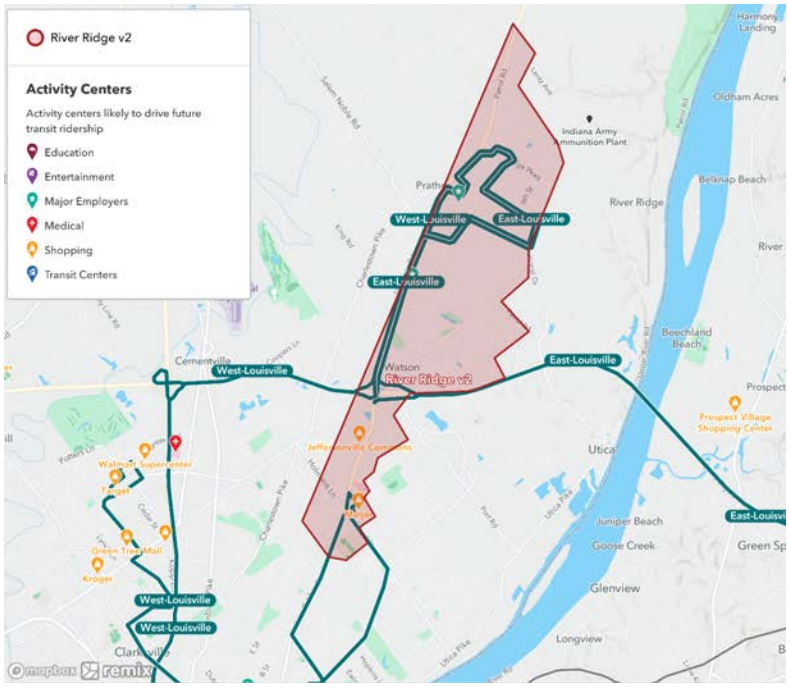
- Transit agencies typically contract with an additional third party, such as a taxi company, human service transportation provider or non-emergency medical transportation (NEMT) service, to provide equivalent on-demand service with WAVs. **Here, we recommend that TARC contract with its current demand-response provider, MV Transportation, to provide on-demand service compliant with FTA regulations to customers in addition to any ride-hailing company.** MV Transportation in Louisville has experience providing same-day service to TARC3 paratransit customers through partnerships with operators such as Silverride and UZURV.
- Transit agencies may fulfill the ADA's requirement for equivalent response times for WAV and non-WAV passengers by directly contracting with a third party operator apart from the ride-hailing service, by requiring the ride-hailing company to contract with a third party for WAV requests in its service level agreement, or by running agency-owned WAVs on-demand to fulfill wheelchair trip request.
- To comply with Title VI, transit agencies must also provide a service option for customers who do not have a cell phone, or do not have a credit or debit card. Accommodating these

passengers was a common motivation for transit agencies to partner with a conventional taxi company or broker service, as they are typically able to accept cash payment and dispatch vehicles from a customer service call center.

The project team has evaluated four MOD zones that were determined to be unsuitable for other modes (microtransit, micromobility, etc.) for one of several reasons: limited number of destinations to generate ridership, low population and employment density, and/or lack of a connection with other TARC services. The following section describes the characteristics of each of these four zones.

River Ridge.

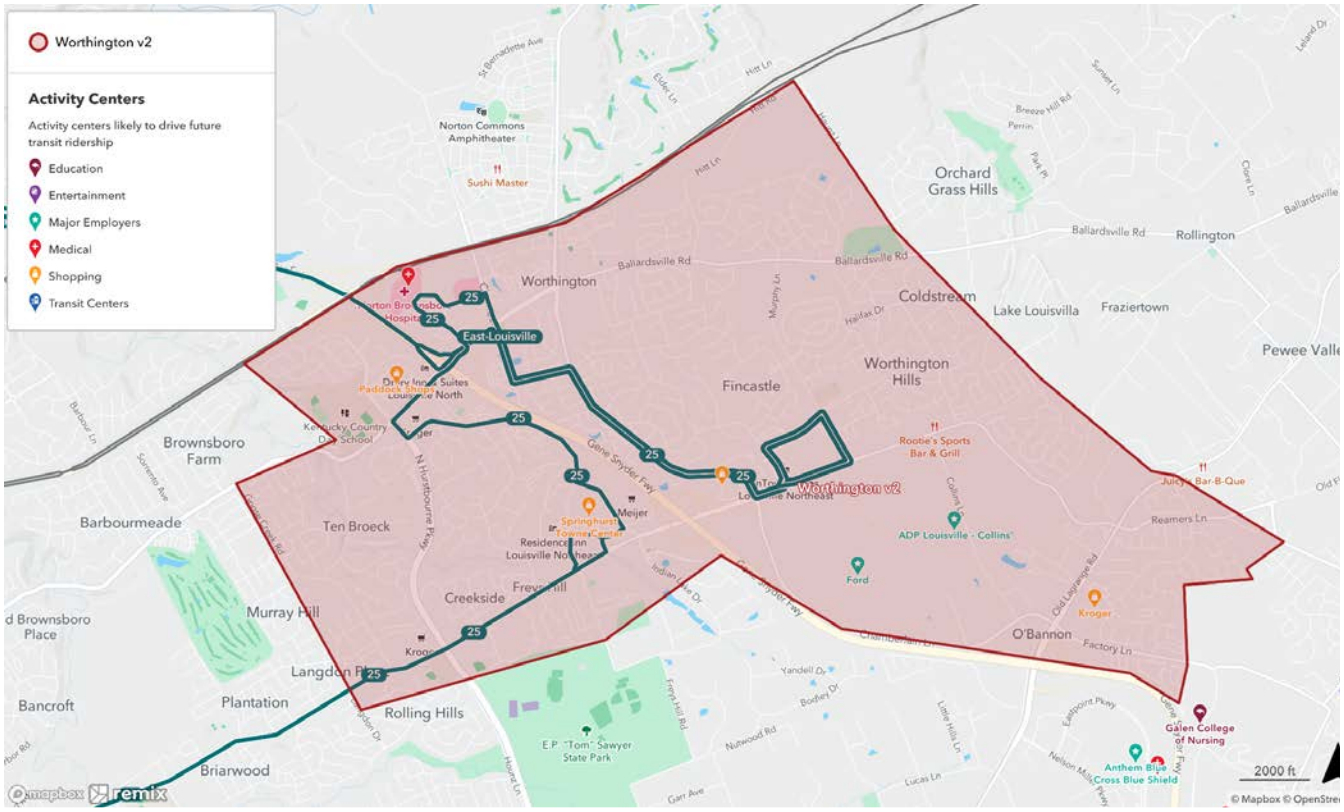
The River Ridge zone is bounded by Paul Garrett Avenue to the north, International Drive to the east, the planned Jefferson Ridge shopping center to the south, and SR-62 to the west. This zone has an area of 6.9 square miles, with a population and job density of 800 residents and 600 jobs per square mile, respectively. Within this zone, 4% of households are car-free, and about a quarter (27%) of households are within 200% of the poverty level. Key activity centers in this zone include River Ridge Commerce Center, Jeffersonville Commons (Kroger), and the Meijer on SR-62. This zone corresponds to the On Demand zone proposed for the area in Concepts 2 and 3 of TARC's 2021 Comprehensive Operations Analysis. Currently, the only connection between this zone and the TARC network is to Route 71-Jeffersonville, at Jeffersonville Meijer.



However, in August 2022 two additional CMAQ-funded, peak-only routes will provide additional commuter service to the River Ridge area. Route 73-West Louisville/River Ridge will connect the area to Worthington and the northern terminus of Route 25-Oak/Westport. Route 73-West Louisville will operate from 6-7:30am and 4-5:30pm on weekdays at 45-minute headways, and on Saturdays and Sundays every hour from 8-9am and 2-3pm. Route 74-Chamberlain Lane/River Ridge will operate along a similar service window and connect River Ridge to Downtown Louisville and West Louisville via Clarksville and I-65. While the River Ridge area is a fast-growing employment center, it is considered less suitable for microtransit due to its limited roadway connectivity, very low density, and lack of connection to a frequent TARC service.

Worthington.

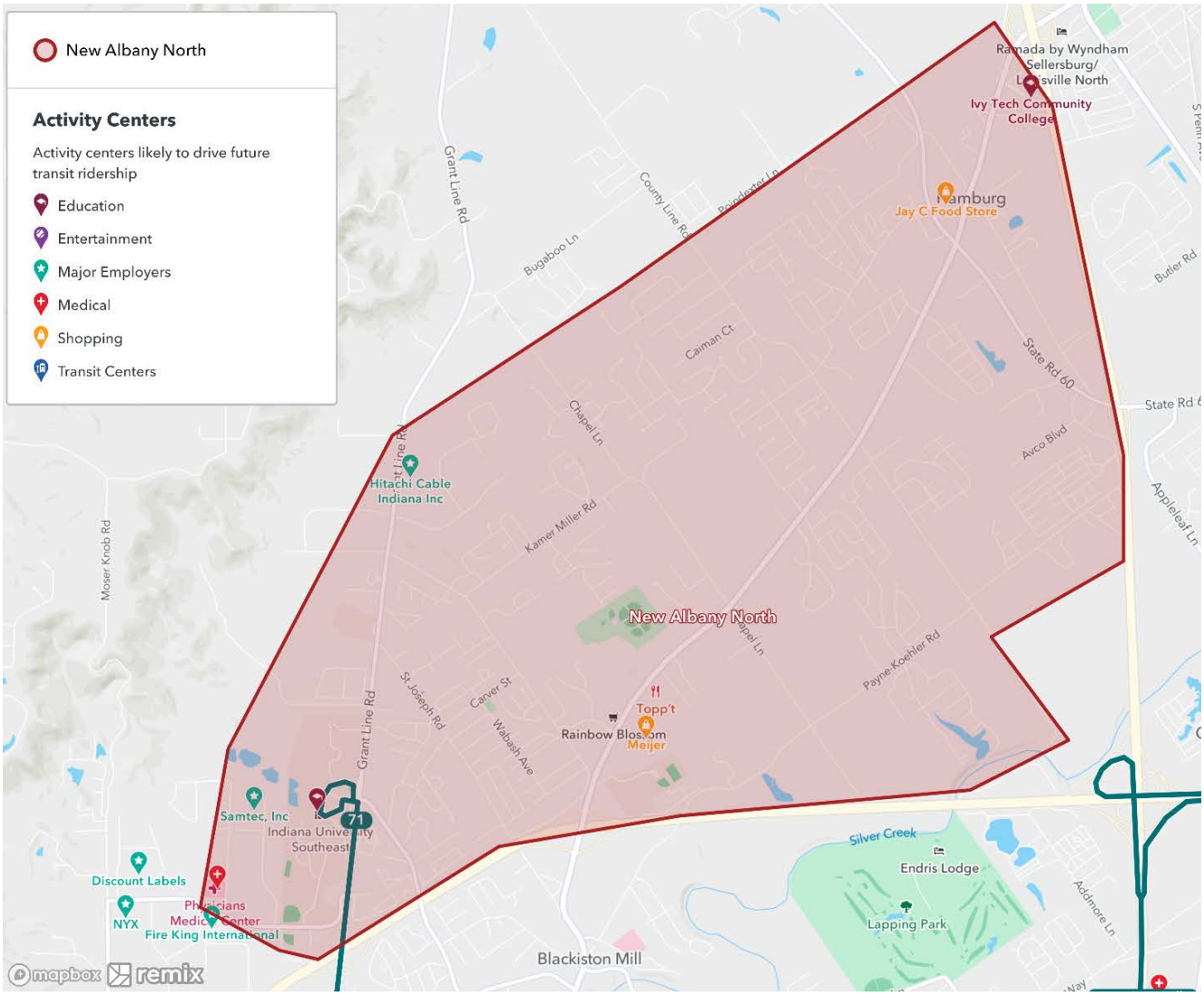
The Worthington zone is bounded by I-71 to the north, Haunz Lane to the east, the Gene Snyder Freeway and Tom Sawyer State Park to the south, and Goose Creek Road to the west. This zone has an area of 10.1 square miles, with a population and job density of 2,900 residents and 2,200 jobs per square mile, respectively. Within this zone, 3% of households are car-free, and less than a fifth (16%) of households are within 200% of the poverty level. Key activity centers in this zone include Norton Brownsboro Hospital, Ford Truck Assembly Plant, and shopping centers at Paddock Shops, Springhurst Town Center, Walmart, and Kroger. This zone is slated to receive 30-minute frequency throughout the day on Route 25-Oak/Westport under all alternatives recommended by the 2021 COA. The zone's strength is its strong mix of employment and shopping centers within a relatively compact area. Norton Brownsboro Hospital, in particular, has significant challenges with commuter transportation for employees who live in West Louisville. However, the zone is exceptionally affluent and possesses a high rate of car ownership compared to other MOD zones explored in this Study. Additionally, there are limited connections to TARC service in the zone. Route 25-Oak/Westport offers 40-minute frequency on weekdays and 70-minute frequency on weekends, making first-mile/last-mile connections in the zone challenging.



New Albany North.

The New Albany North zone is bounded by Poindexter Lane to the north, I-65 to the east, I-265 to the south, and PMC Regional Hospital to the west. This zone has an area of 8.9 square miles, with a population and job density of 1,800 residents and 600 jobs per square mile, respectively. Within this zone, 4% of households are car-free, and less than a fifth (18%) of households are within 200% of the

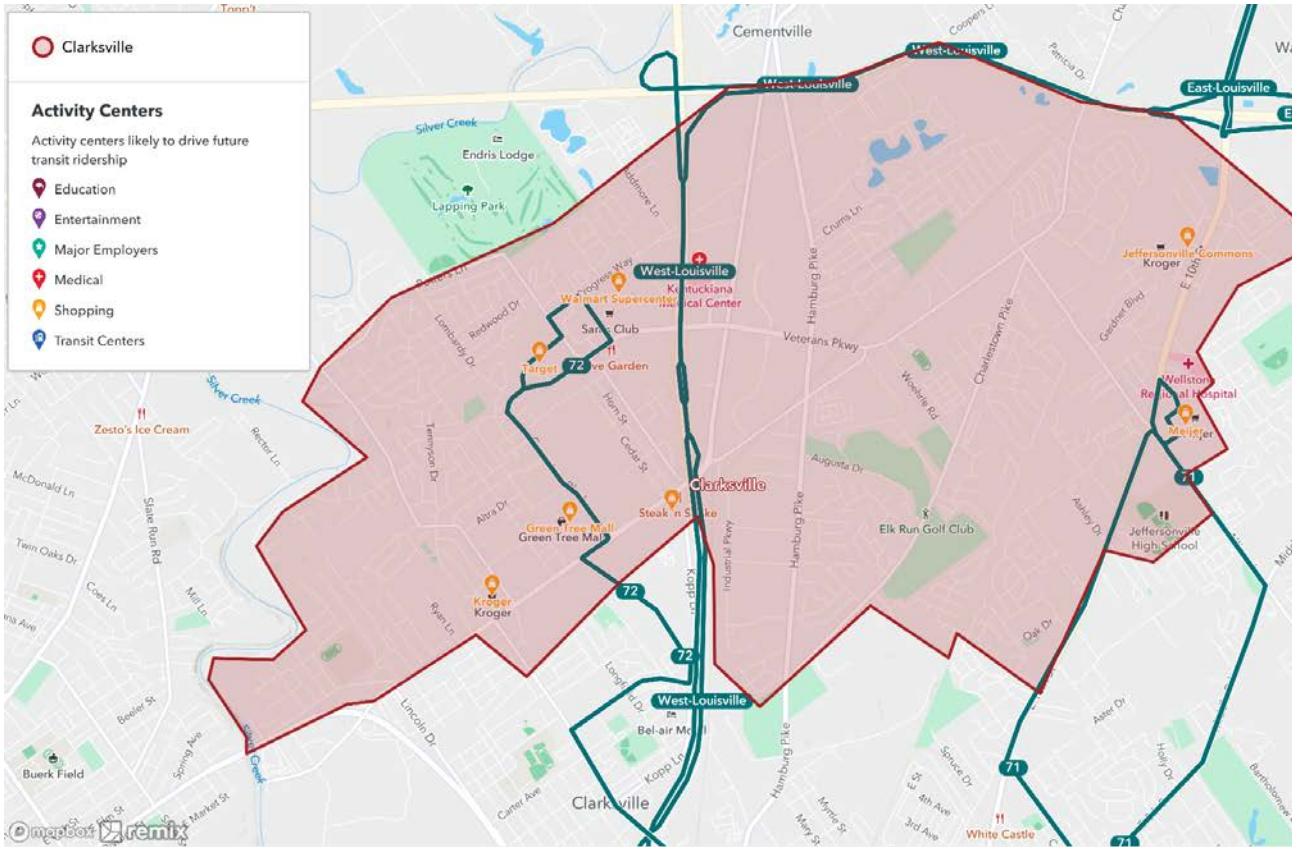
poverty level. Key activity centers in this zone include IU-Southeast campus, PMC Regional Hospital, Meijer on Charlestown Road, and Ivy Tech Community College. This zone does not correspond with any recommendations of the 2021 COA. The zone's strength is its two college campuses and the opportunity to meaningfully expand TARC's service footprint well into Floyd County. The zone has numerous challenges, including its low population and employment density compared to other MOD zones, limited number of activity centers, and lack of a frequent first-mile/last-mile connection to the TARC network. Route 71-Jeffersonville, which terminates at IU-Southeast campus, operates every 40-45 minutes on weekdays during the day and every 70 minutes during evenings, Saturdays, and Sundays.



Clarksville.

The Clarksville zone is bounded by Lapping Park and I-265 to the north, 10th Street/SR-62 to the east, Lewis and Clark Parkway to the south, and Silver Creek to the west. This zone has an area of 10.1 square miles, with a population and job density of 2,200 residents and 1,100 jobs per square mile, respectively. Within this zone, 6% of households are car-free, and less than one third (31%) of

households are within 200% of the poverty level. Key activity centers in this zone include Kentuckiana Medical Center, Green Tree Mall, Clarksville Commons, Jeffersonville Commons, and several large big-box stores (e.g. Walmart/Sam's Club and Target on Veterans Parkway, Jeffersonville Meijer on SR-62, and Kroger on Lewis and Clark Parkway). This zone is slated for additional fixed-route service with a proposed Route 273 in the 2021 COA, though it does not align with the COA's recommendations for On Demand service. The zone's strength is its large number of significant shopping centers and the opportunity to meaningfully expand TARC's service footprint well into Clark County. The zone's main challenge is its lack of a frequent first-mile/last-mile connection to the TARC network. Route 71-Jeffersonville, which terminates at IU-Southeast campus, operates every 40-45 minutes on weekdays during the day and every 70 minutes during evenings, Saturdays, and Sundays. Route 72-Clarksville, which connects the area to Downtown Louisville, features a similar service frequency. Neither route would offer convenient transfers to the rest of the TARC system.



Modeling assumptions

The project team used several key assumptions to model the estimated ridership and cost of the ride-hailing services in each of the four MOD zones described above, including the following:

- **Modal split between ride-hailing and TARC3 service provider:** We assume that half (50%) of rider trips will occur on ride-hailing services and 50% will occur with a TARC3 contracted service provider. This assumption is based on the ride-hailing partnerships profiled in the Peer Agencies Report, which highlighted that significant shares of riders in the service zones meet

one of three criteria: has a disability impairing their mobility; does not have a smartphone; does not have a bank account.

- **Trip restrictions:** To improve the efficiency of service and encourage passengers to make connections to locations where TARC service is available, we recommend requiring trips to begin or end at one of several hub locations within each zone. These hubs are specified for each zone below but can be amended in response to observed travel patterns:
    - **River Ridge:** River Ridge area and Jeffersonville Meijer on SR-62 (transfer to Route 71-Jeffersonville, Route 73-River Ridge/East Louisville, or Route 74-River Ridge/Chamberlain Lane)
    - **Worthington:** Ormsby Station (transfer to Route 15-Market Street), Springhurst Town Center, or Norton Brownsboro Hospital (transfer to Route 25-Oak/Westport)
    - **New Albany North:** IU-Southeast campus, Ivy Tech Community College, Meijer on Charlestown Road, or the Foundation Boulevard industrial park (Hitachi).
    - **Clarksville:** Jeffersonville Commons, Green Tree Mall, Kentuckiana Medical Center, Target/Walmart/Sam's Club on Veterans Parkway, or Meijer on Lewis and Clark Parkway.
- **Average total ride-hail fare:** Average total ride-hail fares are distance-based and queried from Uber's Fare Estimator.[29]
- **Minimum fare:** The minimum fare in Greater Louisville on the Uber platform is $7.10.
- **Ride-hailing company administrative fee:** In many ride-hailing partnerships, ride-hailing companies charge a small administrative fee for processing ride requests that are to be reimbursed by a transit agency. Here, **we assume a 10% administrative fee for each ride request.**
- **Fare per passenger:** Typically, ride-hailing partnerships with transit agencies require riders to pay a nominal fare, with the transit agency paying for the remainder of the fare. Here, **we assume each passenger pays $3.00 towards the total fare**, representing a "premium" fare comparable to TARC's express bus services.
- **Cost per passenger trip for TARC:** This figure is expressed as the difference between the total ride-hail fare minus the passenger fare above.
- **TARC3 brokered services, cost per passenger trip:** For riders who are referred to a TARC3 service provider (e.g. for riders with disabilities, cash-paying riders, or riders without smartphones) we assume an average cost per trip of $48.28, taken from TARC's cost per passenger trip on demand-response services reported to the FTA National Transit Database in FY2020.

[29] https://www.uber.com/global/en/price-estimate/

5.6.1. Cost-benefit analysis.

Cost-benefit analysis tables are shown for each of the MOD zones where ride-hailing partnerships are explored in this Study. In each table, costs are itemized for both ride-hailing companies and TARC3 brokered services (e.g. Silverride, UZURV, or other services from MV Transportation). The 50/50 split between ride-hailing and TARC3 brokered services and the relatively short journeys completed within each MOD zone — no typical trip would result in a ride-hail fare of more than $20 — results in average operating costs per passenger trip roughly in the middle of ride-hailing and TARC3 costs per passenger trip. In each zone, TARC would pay an average cost per passenger trip of $29-30 under these conditions. However, this represents a conservative scenario in which trips are evenly split between ride-hailing companies and TARC3. In a more optimistic scenario with ride-hailing companies serving 70-80% of trips, TARC's average cost per passenger trip would be closer to $20-25.

Cost-benefit analysis for ride-hailing partnership in the River Ridge MOD Zone

	Low Demand	Medium Demand	High Demand
Annual zone ridership	1355	2167	3468
Share of ridership for ride-hail	50%		
Adjusted ride-hail annual ridership	677	1,084	1,734
Average total ride-hail fare	$11.98		
Minimum fare	$7.10		
Fare per passenger	$3.00		
TARC cost per Uber passenger trip	$8.98		
10% admin fee	$811	$1,298	$2,076
Subtotal - ride-hail annual cost	$6,890	$11,025	$17,639
Share of ridership for TARC3 demand-response (e.g. SilverRide)	50%		
Cost/passenger trip for TARC3	$48.28		
TARC3 annual brokered ridership	677	1,084	1,734
Subtotal - annual brokered TARC3 cost	$32,699	$52,318	$83,709
Adjusted TARC annual cost	**$39,589**	**$63,343**	**$101,348**
Adjusted TARC annual cost/passenger-trip	**$29.23**		

Cost-benefit analysis for ride-hailing partnership in the Worthington MOD Zone

	Low Demand	Medium Demand	High Demand
Annual zone ridership	**6,310**	**10,096**	**16,153**
Share of ridership for ride-hail	50%		
Adjusted ride-hail annual ridership	3,155	5,048	8,077
Average total ride-hail fare	$14.06		
Minimum fare	$7.10		
Fare per passenger	$3.00		
TARC cost per ride-hail passenger trip	$11.06		
10% admin fee	$4,436	$7,097	$11,355
Subtotal - ride-hail annual cost	$39,327	$62,923	$100,676
Share of ridership for TARC3 demand-response (e.g. SilverRide)	50%		
Cost/passenger trip for TARC3	$48.28		
TARC3 annual brokered ridership	3,155	5,048	8,077
Subtotal - annual brokered TARC3 cost	$152,320	$243,712	$389,940
Adjusted TARC annual cost	**$191,647**	**$306,635**	**$490,616**
Adjusted TARC annual cost/passenger-trip	**$30.37**		

Cost-benefit analysis for ride-hailing partnership in the New Albany North MOD Zone

	Low Demand	Medium Demand	High Demand
Annual zone ridership	**2,243**	**3,588**	**5,742**
Share of ridership for ride-hail	50%		
Adjusted ride-hail annual ridership	1,121	1,794	2,871
Average total ride-hail fare [1]	$13.52		
Minimum fare [2]	$7.10		
Fare per passenger	$3.00		
TARC cost per Uber passenger trip	$10.52		
10% admin fee	$1,516	$2,426	$3,881
Subtotal - ride-hail annual cost	$13,314	$21,302	$34,083
Share of ridership for TARC3 demand-response (e.g. SilverRide)	50%		
Cost/passenger trip for TARC3	$48.28		
TARC3 annual brokered ridership	1,121	1,794	2,871
Subtotal - annual brokered TARC3 cost	$54,141	$86,626	$138,602
Adjusted TARC annual cost	$67,455	$107,928	$172,685

Adjusted TARC annual cost/passenger-trip	**$30.08**

Cost-benefit analysis for ride-hailing partnership in the Clarksville MOD Zone

	Low Demand	Medium Demand	High Demand
Annual zone ridership	**3,323**	**5,317**	**8,507**
Share of ridership for ride-hail	50%		
Adjusted ride-hail annual ridership	1,662	2,658	4,254
Average total ride-hail fare	$13.13		
Minimum fare	$7.10		
Fare per passenger	$3.00		
TARC cost per Uber passenger trip	$10.13		
10% admin fee	$2,181	$3,490	$5,585
Subtotal - ride-hail annual cost	$19,012	$30,419	$48,670
Share of ridership for TARC3 demand-response (e.g. SilverRide)	50%		
Cost/passenger trip for TARC3	$48.28		
TARC3 annual brokered ridership	1,662	2,658	4,254
Subtotal - annual brokered TARC3 cost	$80,220	$128,352	$205,363
Adjusted TARC annual cost	**$99,232**	**$158,771**	**$254,033**
Adjusted TARC annual cost/passenger-trip	**$29.86**		

5.7. Mobility hubs.

Mobility hubs are “premium” multimodal facilities that include integrated access points for multiple transportation services, often on transit agency- or city-owned property at high-demand locations. In addition, they may be connected to the regional transportation networks by being located near bike lanes, rail lines, and safe walking areas. Mobility hubs improve the rider experience by making the experience of waiting for transit more comfortable and making intermodal transfers more convenient. TARC’s 2021 COA recommended the installation of mobility hubs, in coordination with Louisville Metro, at several locations, including the University of Louisville, the Highlands neighborhood, Bardstown Road @ Goldsmith Lane, and Downtown Louisville.

A variety of different infrastructure is typically included at mobility hubs to support the use of multiple modes of transportation. This infrastructure includes:

- Real-time information signage for fixed-route and microtransit services
- Loading zones for ride-hailing vehicles
- Shelters and seating
- Transit pass sales (e.g. MyTARC vending machine)
- EV charging stations (DC Fast chargers) to support bus fleet electrification

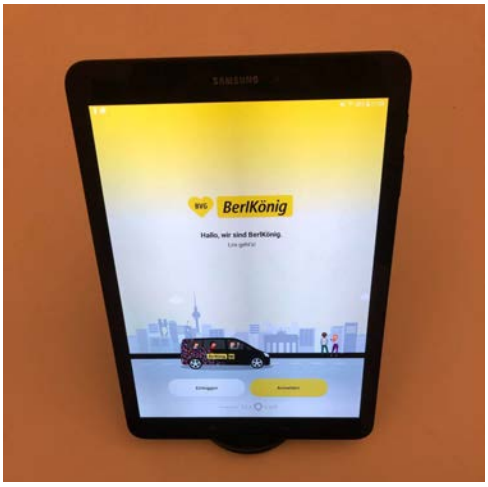
- Bike share docking stations (e.g. LouVelo)
- Secure bike parking (e.g. lockers)
- Bike repair stations
- WiFi and smartphone connectivity
- Restrooms
- Food and beverage sales

These additional amenities make mobility hubs more than just a place for transfering between modes but an actual destination. The co-location of businesses and transportation options is complementary, attracting people to the businesses and to the alternative mobility modes.

When selecting a location for a mobility hub, it is important to consider the current and future land-use patterns in the surrounding areas. Dense areas with a mix of residential, retail, and commercial destinations are likely to deliver the greatest benefits to the largest number of people. Additionally, it is important to prioritize mobility hub locations along fixed-route corridors with frequent service to ensure high-ridership locations are served and wait times for passengers are relatively short, to enable seamless multimodal connections. For the suburban areas of Greater Louisville that are the focus of this Study, these corridors include Route 4-Fourth Street, Route 10-Dixie Rapid, Route 23-Broadway, and Route 28-Preston.

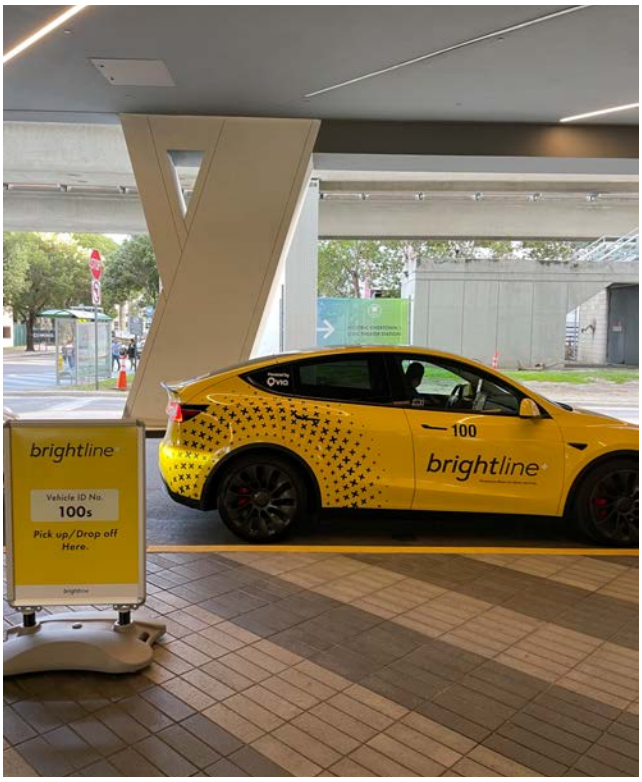
5.7.1. Mobility hubs and microtransit.

One of the most significant advantages of microtransit is its flexibility, little need for physical infrastructure, and adaptability to different environments and goals. Microtransit relies on digital infrastructure to connect people to vehicles and get them where they need to go in a dynamic way. This digital infrastructure includes a booking and payment portal (either in a rider app or dispatching portal) and a driver app that is regularly updated to direct drivers to best pickup and dropoff passengers efficiently. In practice, some physical infrastructure has been built to support microtransit, including booking/payment kiosks, designated pickup/dropoff curb space, and wayfinding and signage to direct people to designated pickup/dropoff zones or informational kiosks.



Above: Booking tablets located at shopping malls, hospitals, or transit stations can facilitate ride booking for those without access to a cell phone/smartphone.
Below: Signage and other wayfinding tools can help people find dedicated vehicle pickup/dropoff spaces at transit stations.

Microtransit mobility hubs can simplify and smoothen the transition between on-demand services and other modes of transportation by combining booking and payment processes across modes and conveniently co-locating services. They can also provide safe places for people to book and wait for rides, thereby encouraging microtransit use. Seating, shelters, wifi, and other amenities can further improve this experience. Kiosks and ticket machines can make on-demand services accessible to those without smartphones or credit/debit cards by offering other ways to book and pay for rides. Finally, from an operations perspective, a microtransit mobility hub can lead to further aggregation of rides by creating a logical and easy point for people to choose as their pickup/dropoff destination.



The following locations within three MOD zones have been identified as having the potential to serve as mobility hubs:

5.7.2. South West End MOD Zone.

Mobility hubs in this area would serve as enhancements to existing BRT stations along Route 10-Dixie Rapid, which already features several mobility hub attributes, including shelters, seating, and real-time transit information displays.

- Dixie Manor Shopping Center
- Dixie @ Ashby (Walmart)
- Dixie @ Citation (Meijer / SW Regional Library)

5.7.3. Preston Highway MOD Zone.

Mobility hubs in this area would connect riders primarily to Route 28-Preston . Of these locations, Jefferson Mall and Central & McCauley are the most suitable because they would offer riders access to destinations with public restrooms that do not require spending money at any retailer. The Jefferson Mall location offers additional advantages in potential cost-sharing opportunities with the shopping center's owner.

- Jefferson Mall
- Central @ McCauley (South Central Regional Library)
- Preston @ Fern Valley Road (Sam's Club)
- Noltemeyer Wynde @ Kroger (Timberwood Shopping Center)
- Judge Blvd @ Outer Loop (Walmart)

5.7.4. Watterson Park MOD Zone.

Hubs in this zone would enable riders to transfer between modes primarily along Route 28-Preston, on Preston Highway, or Route 23-Broadway, along Bardstown Road. The location at Bardstown Road & Heather corresponds with a recommendation from the 2021 COA.

- Preston @ Gilmore (Lynnview Shopping Plaza)
- Bashford Manor (Walmart/Target)
- Bardstown @ Heather (Costco

6. Implementation and launch plan.

6.1. Evaluation of MOD alternatives.

This section compares the various Mobility on Demand (MOD) service alternatives to prioritize implementation in an environment in which TARC must balance limited resources and competing funding priorities. Guided by TARC's goals and objectives for MOD, as described in Evaluation Criteria, which led to the formulation of each MOD alternative, the matrix below compares each MOD zone across nine different metrics, including:

- **Annual ridership:** The most suitable MOD alternatives will serve the largest number of estimated riders, which will help to build program loyalty among customers as well as potentially increase system-wide ridership as riders transfer between the MOD zone and other TARC services.
- **Annual operating cost:** The most suitable alternatives may be smaller programs that are easier for TARC to fund and operate in its first year, before long-term funding arrangements or cost-sharing agreements enable the pilot program to scale into a permanent feature of TARC's network. For reference, TARC's annual operating budget ranged from about $59 million in FY 2013[30] to about $71 million in FY 2020.[31]
- **Cost per passenger trip:** This is a common measure of efficiency for transit service. Fixed-route buses serve higher passenger volumes and therefore typically feature lower costs per passenger trip compared to demand-response, microtransit, or ride-hailing solutions. TARC's fixed-route operating costs per passenger trip range from $5.08 in FY 2017[32] to $8.61 in FY 2020.[33] On the other hand, demand-response options often feature higher costs per trip due to their curb-to-curb service model and limited rider cohorts, whether due to ADA eligibility requirements or limited service zones of microtransit or ride-hailing programs. For reference, operating costs for demand-response (TARC3) service averaged $33.21 per trip in FY 2020[34] and $48.28 per trip in FY 2022.[35] A suitable MOD alternative would ideally achieve a comparable or lower cost per passenger trip than existing TARC3 paratransit service.
- **Utilization:** This metric is defined as the number of passenger trips served per vehicle-hour and is roughly analogous to how public transit agencies typically define productivity of service, in passenger boardings per revenue-hour.[36]

[30] TARC. 2019, March. "Comprehensive Operations Analysis (COA). Appendix E, Market Analysis, Service Performance, Trend Analysis, and Peer Review. HDR. p. 3-6.
[31] FTA National Transit Database. 2020 Agency Profile.
[32] TARC. 2019, March. "Comprehensive Operations Analysis (COA). Appendix E, Market Analysis, Service Performance, Trend Analysis, and Peer Review. HDR. p. 3-12.
[33] FTA National Transit Database. 2020 Agency Profile.
[34] Ibid.
[35] Correspondence with TARC3 staff.
[36] The difference in the two denominators is that in microtransit services, a small portion of vehicle-hours at the beginning and end of driver shifts are zero-passenger time spent traveling between terminals and the first rider pickup or dropoff. This time would be counted as dead-head in fixed-route bus service and excluded from the revenue-hours denominator, and as a result

- **Aggregation / shared rides:** This metric is applicable only to microtransit alternatives and refers to the percentage of time that microtransit vehicles are occupied by more than one passenger. A high shared-ride duration percentage is a key indicator of effective aggregation of passenger demand, and therefore relatively efficient microtransit service. This metric is not applicable to the ride-hailing or bike share alternatives explored in this study.[37]
- **Potential employer sponsorships:** Some MOD zones may contain large employers with a strong interest in the longevity of a pilot program, and they therefore may consider cost-sharing agreements to support the service. Zones with larger numbers of these major employers are considered more promising due to these opportunities. This qualitative metric is based on findings from stakeholder discussions and the locations of employers identified in the Land Use and Activity Center Review section.
- **Scalability:** This qualitative criterion gauges whether a MOD zone can be easily expanded into neighboring communities, enabling the service to increase its ridership and the range of destinations served. Some MOD zones can easily expand into adjacent areas, while others are constrained by barriers such as highways, natural areas, or the Ohio River.
- **Complexity of staffing and training:** This qualitative metric evaluates the mode in question — microtransit, ride-hailing, bike share, and so on — rather than the individual zone's qualities. Ride-hailing solutions typically have a high degree of staffing complexity due to the multiple contractors required, while bike share and commuter bus solutions explored in this study have low complexity and would rely upon existing organizational staff capacity.
- **Complexity of technology development:** As with staffing complexity noted above, this qualitative metric evaluates the mode in question rather than the individual MOD zone. Ride-hailing solutions typically have the least complex technology development requirements because they leverage existing software platforms with minimal customization, while bike share tends to have greater complexity given the requirements of rebalancing micromobility fleets and bike/e-scooter maintenance.

In the table below, a darker blue signifies a zone that is ranked as more suitable and a higher priority for implementation based upon these evaluation criteria and TARC's broader goals and objectives. Both quantitative and qualitative evaluation criteria are amalgamated into an overall suitability index, shown in the last column at right and normalized into a 0-100 scale, where 100 is a perfect score across each metric. Each of the quantitative metrics in this evaluation — estimated ridership, total operating cost, cost per passenger trip, utilization, and shared-ride duration percentage — are derived from the "medium-demand scenario" developed in the Untested Opportunity Identification chapter for each MOD alternative. The Shepherdsville MOD alternatives, consisting of linked microtransit and commuter bus services, are evaluated in tandem as a single option except where otherwise noted.

utilization figures are often 10-30% lower than their equivalent productivity of service figures as reported to the FTA National Transit Database.

[37] Ride-hailing companies do not currently offer shared-ride service in Greater Louisville.

Based on this evaluation, MOD zones in the southern and western portions of suburban Louisville score highest. These zones including Watterson Park, South West End, Preston Highway, and Fourth Street-Manslick Road MOD zones, where microtransit is recommended as the service mode, scored particularly well across each of the evaluation metrics. These service zones are particularly scalable, with potential expansions into adjacent areas following a pilot program implementation. The South West End microtransit zone would serve the highest estimated ridership of all MOD alternatives evaluated as well as the highest degree of passenger aggregation into shared rides. Meanwhile, the Watterson Park zone would feature the lowest cost per passenger trip of the microtransit alternatives. The Watterson Park microtransit zone also features the highest utilization of any MOD alternative, followed closely by the South West End microtransit zone. Because the ride-hailing alternatives would serve significantly lower ridership and use a non-dedicated service model, they also feature the lowest total operating cost. While the bike share alternative in Downtown New Albany features the lowest cost per trip of any alternative in this study, it also features relatively low ridership and utilization and a high degree of complexity in technology development.

Zone	Mode	Est. Annual Ridership [38]	Est. Annual Operating Cost[37]	Est. Cost per Passenger Trip[37]	Utilization (Peak)[37]	Shared-Ride Duration Percentage [37]	Scalability to Adjacent Areas	Complexity of Staffing and Training	Complexity of Technology Development	Overall Suitability Score (0-100)
Watterson Park	Microtransit	73,000	$648,000	$8.89	5.8	66%	High	Medium	Medium	**67**
South West End	Microtransit	122,000	$1,125,000	$9.20	5.7	72%	High	Medium	Medium	**63**
Preston Highway	Microtransit	65,000	$648,000	$9.96	4.5	47%	High	Medium	Medium	**54**
Fourth Street-Manslick	Microtransit	43,000	$498,000	$11.57	4.8	43%	High	Medium	Medium	**53**
New Albany South	Microtransit	37,000	$498,000	$13.39	4.4	48%	Medium	Medium	Medium	**51**
New Albany Downtown	Bike share	24,000	$70,000	$2.90	0.5	N/A	Low	Low	High	**50**
Jeffersontown	Microtransit	66,000	$897,000	$13.66	3.1	47%	High	Medium	Medium	**43**
Eastpoint	Microtransit	41,000	$648,000	$15.65	3.4	43%	Medium	Medium	Medium	**40**
River Ridge	Ride-hail	2,000	$63,000	$29.23	N/A	N/A	Low	High	Low	**30**
Shepherdsville	Microtransit and Commuter bus	22,000	$996,000	$45.40	2.2	100%[39]	Low	Medium	Medium	**30**
Clarksville	Ride-hail	5,000	$159,000	$29.86	N/A	N/A	Low	High	Low	**27**
New Albany North	Ride-hail	4,000	$108,000	$30.08	N/A	N/A	Low	High	Low	**26**
Worthington	Ride-hail	10,000	$307,000	$30.37	N/A	N/A	Medium	High	Low	**24**

[38] This estimate refers to the medium-demand scenario developed in the Untested Opportunity Identification chapter.
[39] Refers to the commuter bus segment only.

6.2. Funding sources.

A common challenge when launching a Mobility on Demand (MOD) service is identifying and securing sustainable funding for capital and operating costs. In the MOD alternatives evaluated in this study, programs are intended to be implemented as a complement to TARC's existing transit network rather than a cost-neutral replacement for fixed-route service. This means that any MOD alternative advanced to implementation will require additional funding, as TARC typically does not have unallocated funds available. Transit agencies can use a variety of different funding sources to launch and operate MOD services. These include federal, state, regional and local sources. TARC's current and potential funding sources are outlined below.

6.2.1. Current TARC funding.

TARC has an annual operating budget of about $103 million. About $21 million (20%) of the operating budget is dedicated to TARC3 paratransit services, and $61 million (60%) is dedicated to fixed-route services, including wages, pensions, and benefits. The remaining $21 million (20%) covers materials and supplies as well as administrative and insurance costs. Sources for these funds include local operating revenue, local tax revenue, and federal and state funds. The majority (61%) of TARC's budget comes from local occupational taxes collected by Louisville Metro in Jefferson County ($67 million) into the Mass Transit Trust Fund (MTTF). TARC also receives ongoing operations support from the American Rescue Plan (ARP) (18% of its operating revenue), CARES Act and supplemental CRRSAA appropriations (12%), fare revenues (5%), state funds (1%), advertising (1%), and special services funded by CMAQ (less than 1%).[40]

6.2.2. Funding a Mobility on Demand (MOD) service.

TARC can pursue a variety of funding sources, above and beyond those described above, to fund MOD services. The section below describes these potential funding sources in detail.

6.2.2.1. Federal funding programs.

While federal sources account for only 17% of overall transit funding in the United States, it can be an important component of launching MOD services. Federal funding typically comes in two forms:

- Formula funds that are distributed throughout the states and then distributed to transit agencies based on area population, ridership, existing transit service, and other factors.
- Competitive grant programs that are open to any transit agency or eligible FTA recipient.

Section 5307 Urbanized Area Grants[41]

The 5307 program provides transit capital and operating assistance to urbanized areas, defined as incorporated areas with a population of 50,000 or more residents. Section 5307 funding is directed to

[40] TARC uses FTA formula funding (e.g. Section 5307 and 5310) only for capital expenses, not operating expenses.
[41] FTA. "Urbanized Area Formula Grants - 5307." Accessed June 6 2022.
https://www.transit.dot.gov/funding/grants/urbanized-area-formula-grants-5307

transit agencies and other local government agencies designated as direct recipients or sub-recipients of FTA funding. The FTA began recognizing microtransit as an eligible operating expense in 2016, allowing formula funds to be used towards these projects. Certain ride-hailing programs, provided they comply with FTA regulations such as driver drug/alcohol testing, ADA and Title VI, can also qualify for FTA formula funds as demand-responsive transportation. About 50% of 5307 formula funding is allocated based on the total revenue miles a transit agency operates each year. By launching an MOD service, TARC can quickly scale up the number of revenue miles provided and therefore increase the amount of 5307 formula funding the agency receives.

Transit agencies typically need to license the technology to power a microtransit service. Licensing software is considered a capital cost and is covered at up to an 80% match with federal formula funds. In addition, transit agencies may purchase new vehicles to operate the service, another capital expense. Alternatively, some transit agencies launch microtransit service by contracting with a third party operator. In this arrangement, agencies could apply the FTA's "capital cost of contracting" policy and receive up to 80% match for half of a contracted service's cost, or 40% of the overall contract.

Section 5310 Enhanced Mobility of Seniors and Individuals with Disabilities[42]

This program provides formula-based funding for the purpose of assisting transit agencies and nonprofit organizations in meeting the transportation needs of older adults and people with disabilities when existing transportation services are insufficient. As with Section 5307 above, Section 5310 funding is directed to transit agencies and other local government bodies designed as direct recipients or sub-recipients to FTA funding. Typically, metropolitan planning organizations (MPOs) like KIPDA establish Section 5310 allocations to projects identified in their Coordinated Human Services Transportation Plan, which is updated every 5 years and distributed to transit agencies like TARC and others.

6.2.2.2. Discretionary grants.

In addition to federal formula funding, many federal grants are also available to fund both capital and operating expenses. These grant opportunities are described below:

Accelerating Innovative Mobility (AIM)[43]

Funded by the Federal Transit Administration and formerly known as the Mobility on Demand Sandbox program, this competitive grant program funds forward-thinking approaches that improve transit financing, planning, system design and service. Eligible activities include all activities leading to the development and testing of innovative mobility, such as planning and developing business models, obtaining equipment and service, acquiring or developing software and hardware interfaces to implement the project, operating or implementing the new service model, and evaluating project

[42] FTA. "Enhanced Mobility of Seniors and Individuals with Disabilities - Section 5310." Accessed May 25, 2022. https://www.transit.dot.gov/funding/grants/enhanced-mobility-seniors-individuals-disabilities-section-5310.
[43] FTA. "Accelerating Innovative Mobility." Accessed May 25, 2022. https://www.transit.dot.gov/AIM.

results. In FY 2020, the AIM program allocated $14 million to 25 winning projects, including the PSTA Direct Connect project profiled in the St. Petersburg case study.

Congestion Mitigation and Air Quality Improvement Program (CMAQ)[44]

The CMAQ grant program is administered by the Federal Highway Administration to support projects and programs that work to improve air quality and maintain or attain the requirements set forth by the Clean Air Act. This competitive program is typically administered locally through metropolitan planning organizations such as KIPDA. Funds may be used for a transportation project or program that is likely to contribute to the attainment or maintenance of a national ambient air quality standard, with a high level of effectiveness in reducing air pollution, and that is included in the metropolitan planning organization's (MPO's) current transportation plan and transportation improvement program (TIP) or the current state transportation improvement program (STIP) in areas without an MPO. Typically, CMAQ funds are dedicated to areas that are outside of attainment of air quality standards set by the Clean Air Act. In early 2022, TARC was awarded CMAQ funding for three peak-period, fixed-route services connecting Louisville with the River Ridge and Outer Loop employment centers.

Integrated Mobility Innovation Program (IMI)[45]

The IMI demonstration program supports the transit industry's ability to leverage and integrate mobility innovations with existing services, while examining the impact of innovations on agency operations and the traveler experience. IMI leverages FTA's leadership of the Accessible Transportation Technologies Research Initiative (ATTRI) to ensure that all activities conducted as part of the IMI program advance the vision of a Complete Trip for All. The Complete Trip concept reflects the understanding that a person's travel consists of a chain of steps beginning with an often-spontaneous decision to make a trip, through to planning an itinerary, traversing the built environment and its transportation networks (with or without a vehicle); navigating streets, intersections, facilities, stations, and stops to their destination – safely, efficiently, and carefree. Eligible activities under the IMI program include all activities leading to the demonstration, such as planning and developing business models, obtaining equipment and service, acquiring or developing software and hardware interfaces to implement the project, operating the demonstration, and providing data to support performance measurement and evaluation. In FY 2019, the IMI program allocated $20.3 million to 25 winning projects, about half of which included the deployment of microtransit services, including the Ready! by MATA program profiled in the Memphis case study.

[44] FHWA | Federal Highway Administration. 2016. "Congestion Mitigation and Air Quality Improvement Program - FAST Act Fact Sheets - FHWA | Federal Highway Administration." March 10, 2016. https://www.fhwa.dot.gov/fastact/factsheets/cmaqfs.cfm.
[45] FTA. "Integrated Mobility Innovation." Accessed May 25, 2022. https://www.transit.dot.gov/IMI.

Advanced Transportation & Congestion Management Technologies Deployment (ATCMTD)[46]

Administered by the Federal Highway Administration, this program provides competitive grants for the development of model deployment sites for large scale installation and operation of advanced transportation technologies to improve safety, efficiency, system performance, and infrastructure return on investment. Grant recipients may use funds under this program to deploy advanced transportation and congestion management technologies. As of 2020, $60 million of ATCMTD funding is available annually.

In addition to the FTA, federal funding may also be available through the Department of Education, Department of Labor, Department of Veteran Affairs, Department of Housing and Urban Development (Office of Community Planning and Development and Federal Housing Administration), and the Department of Health and Human Services.

6.2.3. Local and regional funding programs.

Local and regional funding accounts for a majority of transportation funding in the United States. Local sources include transit fares, local government budgets, sales tax revenues, ballot measures, and local partnerships. Below are some potential sources and partnerships that an MOD service in Greater Louisville could leverage:

6.2.3.1. Fare revenues.

If the MOD service charges a fare, fares can offset a small portion of operating expenses, around 3 to 25% depending on ridership. Passenger fares are included as an expected offset in the cost-benefit analysis chapter (see Untested Opportunity Identification).

6.2.3.2. Local government budgets.

For MOD services that operate in zones beyond Jefferson County, TARC should seek cost-sharing partnerships with local municipalities, such as the cities of New Albany, Clarksville, Jeffersonville, or Shepherdsville as appropriate.

6.2.3.3. Sponsorship from local employers or nonprofit foundations.

TARC could form partnerships with local employers and key stakeholders in Greater Louisville to fund Mobility on Demand. Louisville's LouVelo bike share program receives sponsorships from major employers such as Humana and UPS to support operations. In other communities that have launched MOD services, employers that benefit the most from the service have tended to support the service financially. The Move PGH program in Pittsburgh, profiled in Peer Case Studies., is sponsored in part by the Richard King Mellon Foundation. Likewise, the City of Birmingham in Alabama partnered with the Community Foundation of Greater Birmingham to fund and launch a program providing microtransit

[46] FAST Act Fact Sheets - FHWA | Federal Highway Administration. 2016. "Advanced Transportation and Congestion Management Technologies Deployment." Accessed May 25, 2022. https://www.fhwa.dot.gov/fastact/factsheets/advtranscongmgmtfs.cfm.

service for low-income residents. They can also help to promote the service or educate their employees on the service during its launch, supporting ridership growth on microtransit.

6.2.3.4. Advertising.

Microtransit and micromobility programs can also generate nominal revenue through advertisements. Potential revenue streams include:

- **Rooftop screens** - These are screens on top of vehicles that provide dynamic content that can be updated in real time.
- **In-vehicle screens -** These are screens usually on the back of seats that can display a mix of ads, trip information and entertainment from key partners.
- **In-app -** These are display banners, targeted content or real-time promotions that are seamlessly integrated into the app.
- **Vehicle wraps -** These are display ads that would cover a portion of the vehicle exterior.
- **Docking station wraps** - Similar to vehicle wraps, but displayed at bike-share docking station payment kiosks.
- **Naming rights and sponsorship** - These would be longer term partnerships in which a local or national organization would sponsor the entire or parts of the service.

6.3. Pre-launch activities.

These steps must be completed prior to the MOD service completing its first passenger trip:

- **Finalize service design.** TARC will first need to finalize the service zone(s) it would like to implement, mode, fleet size, vehicle type, service hours, quality of service parameters, and fare structure.
- **Choose an operating model.** The three most common partnership models described in the next section of this report, Partnership model.
- **Procurement.** Depending on the partnership model selected, TARC will need to procure and license a software platform, or a bundled software/vehicles/drivers/operations package. If an agency-operated model is chosen, TARC may also need to work with its current demand-response operator, MV Transportation, to purchase or lease new vehicles if none are currently available for the service. We advise TARC to allow for between 6 and 9 months (from publishing the procurement to launching service) for implementing services where vehicle procurement is unnecessary, and between 9 months and one year for implementing services which require vehicle procurement.
- **Secure funding.** Once high-level service design and operating model have been selected, TARC can estimate the costs of launching a new microtransit service. Funding can be secured through federal grants, existing operating budgets, state or local sources, or partnerships with local employers, as described in the Funding sources chapter.
- **Marketing.** Marketing is an important step to inform the public about a new Mobility on Demand service. Furthermore, many potential passengers will be unfamiliar with this type of public transportation and need to learn how to use the service. TARC can coordinate Louisville Metro or other local municipalities on marketing in various ways, including creating a dedicated

website for the service, developing informational videos, sharing information on social media channels, and meeting with local community organizations to publicize the service. Nonprofit organizations (e.g. Kentuckiana Works, Greater Louisville Inc., River Ridge Commerce Center) can play a key role in marketing and outreach, particularly with respect to marketing the service to their clientele from high-need groups.

- **Driver training.** If an agency-operated model is selected, TARC will be responsible for hiring and training drivers. Drivers will need a strong understanding of the microtransit technology, as well as how to drive safely and engage with customers.

6.4. Partnership model.

Select an operating/contracting model. For MOD solutions involving microtransit or ride-hailing, TARC can select between several partnership models which best suit its budget, capabilities, and access to vehicles. Potential partnership models typically include:

Agency-operated service. In this model, TARC procures a software platform for the operation of microtransit service, and delivers service using drivers, vehicles, and an operations team from its existing demand-response operator, MV Transportation. Partnerships of this nature may be described as Software-as-a-Service, or "SaaS". Software contracts may include ongoing customer support and service optimization services. An agency-operated service has the advantages of allowing TMACC to utilize its existing resources (with MV Transportation) and assume a higher level of control over service delivery. The primary disadvantage of an agency-operated approach is that TARC would be required to develop administrative and operational capacity in a potentially unfamiliar service category, which has the potential to create inefficiencies and higher costs as the agency works to develop expertise in this area (vs. a contracted operator with developed expertise in operating microtransit service). When procuring software, we recommend TARC require the following capabilities at minimum:

- Dynamic vehicle routing and passenger aggregation (shared rides)
- Customer mobile application (available for iOS and Android) providing trip booking and providing real-time estimated time to arrivals (ETAs) and other trip updates
- Driver mobile application for real-time transmission of routing and trip information
- Ability for administrators/schedulers to book trips on behalf of customers (so customers can book trips over the phone)
- Ongoing technical, operational, and marketing support

Turnkey purchased transportation (vendor-operated). In this model, the vendor provides a solution which includes a microtransit software platform, along with the vehicles, drivers, and management services needed to operate service. This partnership model may be described as Transportation-as-a-Service, or "TaaS", and/or as a "turnkey" model. Turnkey services sometimes have lower operating costs and are typically easier to scale quickly when compared to agency-operated alternatives, as third-party vendors can typically adjust vehicle supply or extend operating hours more easily than transit agencies. Turnkey models also ensure the operator and technology platform are designed to work interoperably and efficiently. Disadvantages of using a turnkey model include

reliance on a vendor for all aspects of service delivery, and less direct control over operational decisions (potentially including vehicle make/model, driver recruitment and pay, and maintenance activities). However, a well-designed contract can address many of these concerns.

Non-dedicated transportation (ride-hailing or taxi). Rather than introducing a dedicated microtransit service, TARC can consider contracting with one or more local taxi or ride-hailing companies (e.g. Uber, Lyft) on a non-dedicated, or trip-by-trip basis as described in the Ride-hailing chapter. Under this model, ride-hailing companies would deliver agency-subsidized trips alongside trips for private consumers. This model may be appropriate for services with very low levels of estimated ridership (i.e. a service with projected demand that would not require a single dedicated vehicle resource), such as the MOD zones profiled in Clarksville, New Albany North, River Ridge, or Worthington. The disadvantages of the non-dedicated service model include limited oversight of operations, limited availability, higher costs per trip, and the requirement of contracting with multiple taxi operators to preserve eligibility for FTA funding (provided at least one of the taxi operators is able to meet drug and alcohol testing and ADA accessibility requirements). Further, trips are typically harder to aggregate in a non-dedicated model, meaning costs increase linearly as demand grows (as compared to a shared-ride model, where cost per trip decreases as more customers are aggregated).

6.5. Accessibility.

Any proposed Mobility on Demand system must support the needs of all passengers, providing a fully accessible form of public transportation. TARC should ensure the service is accessible to everyone, including passengers with disabilities and passengers without smartphones or credit cards. The following recommendations should be considered:

- **For customers with limited mobility:** The service should include at least one wheelchair-accessible vehicle (WAV) in each of the proposed zone alternatives. This will provide equivalent wait times for all passengers, including those requiring a WAV. To make the booking process simple for passengers with disabilities, the software platform should remember a passenger's need for a WAV, and ensure that a WAV request is the default for future bookings. When a new ride request is received, the system will only assign passengers to vehicles with an available wheelchair position.
- **For customers with hearing, vision, or cognitive impairments:** Either directly through the app or through notifying the customer service agent at the time of booking, passengers should be able to indicate their disability status. This information can be used to modify the service to better adapt for their needs, whether it's through enabling door-to-door pickup and drop-offs, discounted fares, or notification to the driver to provide additional assistance.
- **For customers without smartphones:** In addition to the smartphone app for booking trips, a phone-booking option should be provided for passengers without smartphones or for those who are unable or choose not to use an app. Some services also offer a web portal. Administrators should be able to easily book on-demand rides on behalf of customers who request by phone.

- **For customers without credit cards:** Unbanked or underbanked passengers should be able to pay for services with several different options: digital vouchers (purchased in cash at community centers, libraries, or the TARC Customer Service kiosk), prepaid debit cards at local retailers (e.g. Walmart, Meijer, or Kroger), and—to the extent feasible—cash onboard the vehicle.

6.6. Reporting.

When service is launched, the operator should track the service KPIs described in key performance indicators. Typically, transit agencies work with operators to prepare periodic reports on driver activity (e.g. driver-hours, vehicle mileage, etc.), ridership growth and common travel patterns, fare payment, and the ability to download data for analysis with other software tools.

These datasets can be used to prepare regular public reports on the TARC pilot program performance, which may include some of the following themes:

- Cost of operation per passenger-trip
- On-time performance at the time of pickup or dropoff
- Vehicle occupancy and shared-ride duration percentage
- Travel behavior patterns (e.g. average ride duration, origin/destination patterns)
- Utilization or productivity of service
- Quality of service metrics (e.g. average wait time, average walk distance, etc.)
- Mode replacement - i.e. survey passengers to find out how they would have completed their journeys in the absence of microtransit.

6.7. Marketing and rider education.

The ability to move easily and affordably between our homes, work, school, and essential services determines our ability to thrive. The transportation systems that enable this movement play such an important role in rider's everyday life that any potential changes to these systems — even beneficial ones — can be a source of apprehension.

Absent effective marketing and rider education, service changes can be potentially disruptive for high-need communities, for whom TARC service is a lifeline with no easy replacement. This risk is exacerbated when there is insufficient information (or misinformation) related to new forms of public transit would mean for these communities. Concerns about cost, access for those with accessibility needs, coverage areas, and more, routinely create opposition to pilot projects even before launch. Adopting a high-touch and proactive approach to marketing and rider education can not only help to mitigate potential concerns but also convert community members into advocates for the service. Support from the community is essential both to ensure a smooth launch process but also to set the foundation for the continued success, funding, and growth of the service.

Community engagement should begin several months before service launch to allow the maximum time to incorporate feedback from key stakeholders into the final service design and ensure the

community's needs are being met and their concerns addressed. To start this process, TARC should map out any high-need communities that may be highly sensitive to service changes or may require tailored communications to begin using the service. Examples of these communities may include:

Higher barriers to entry	Sensitive to service changes
Older adults	Labor unions (e.g. operators, dispatchers, schedulers, customer support)
Cash-paying or unbanked customers	Elected officials
Passengers with mobility impairments	Civic and business leaders
Passengers without smartphones	Major employers
Undocumented or homeless customers	Nonprofit and advocacy organizations
Limited-English proficiency communities	

Once key stakeholders have been identified, TARC can take proactive steps to preemptively address concerns. For example, if accessibility is an expected concern, educate customers or organizations about the wheelchair-accessible vehicles in the fleet and the ability to book door-to-door trips for passengers with disabilities. Alternatively, if the ability to pay cash fares is a primary concern, emphasize the service's accommodations for cash-paying customers, such as buying prepaid vouchers at local retailers or the TARC Customer Service center.

Effective marketing starts with a solid understanding of the likely use case(s) within the service zone. Some of the most likely use cases evaluated in this study include first-mile/last-mile connections to TARC service, access to jobs or healthcare, and locally oriented trips within high-need communities. Likewise, creating sustained awareness of the microtransit service prior to launch is essential, and some of the following strategies may be useful:

- **Create dedicated MOD webpage** on TARC and Louisville Metro websites
- **Develop a pre-launch press release** for distribution in local news media
- **Create a short informative video** for TARC website and social media channels
- **Targeted emails or print and social media advertisements for hard-to-reach customers,** e.g. for senior centers and libraries, registered paratransit customers, or University of Louisville students enrolled in TARC transit pass programs
- **Announce MOD service in TARC email communications**, newsletters to targeted communities such as TARC staff and contractors, operators and unions, local elected officials, and participating employers in the TARC Community Partners program
- **Distribute leaflets or branded materials to passerby** at grocery stores or other locations with high foot traffic

Encouraging awareness of microtransit through word of mouth is especially important. Fostering awareness via word of mouth can be achieved through some of the following approaches:

- **Direct engagement with the public** through virtual outreach, focus groups, or public meetings held via Zoom or other communication tools

- **Meetings with community organizations and stakeholders** (e.g. Kentuckiana Works, Greater Louisville Inc., Center for Accessible Living, etc.)
- **Discounted or promotional fares for new riders**
- **Referral programs** for existing passengers (e.g. refer a friend to the MOD service and get two free rides)

A rough, sequential outline of marketing focus areas and activities is shown in the table below.

Table 15. Timeline of *Marketing* Activities

	Pre-launch	Months 1-3	Months 4-6	Months 7+
Focus	**Marketing channels and materials**	**Service visibility and conversion funnel**	**Passenger understanding**	**Passenger engagement**
Activities	Design marketing materials Begin pre-launch awareness: social media, local press, and local government outlets	Digital (social media) and physical ads (flyers, direct mail, bus station signage). Press releases Events and direct public engagement	Continued awareness Rider surveys and focus groups Referral campaigns	Promotion of discounted tickets and referral campaigns Outreach to specific communities

6.8. Post-launch Activities.

Once the Mobility on Demand service has launched, the following steps should be completed.

- **Monitor and calibrate service:** After the service is launched, the managing organization can use the data from the live service to identify opportunities for improvement and adjust the service accordingly. This can include adjusting the quality of service parameters, zone boundaries, or virtual bus stops.
- **Continue to market:** In order to sustain growth in ridership, the service should be continually marketed. Fare promotions such as free first rides, referral discounts, and subscription models can also be implemented to attract new riders.
- **Service evaluation:** It is also recommended that the managing organization monitor the service over a more extended period of time against the established set of KPIs, such as the examples shown in the Key performance indicators section.
- **Expand service:** If the MOD service is proven successful, it is likely to gain the support of the community and local leaders. With additional support, it may be easier to raise new funds to expand Mobility on Demand in Greater Louisville. This can include service in new areas, expanded service hours, or improvements to the existing quality of service with additional vehicles.