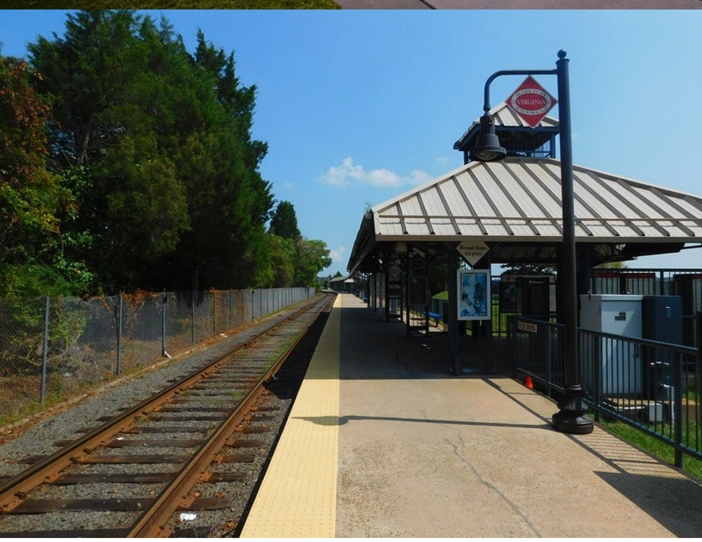


Innovation Park Town Center Shuttle Service Feasibility Study

DRAFT Final Report

Prepared by:

FOURSQUARE ITP

In association with:

THE SEAL OF PRINCE WILLIAM COUNTY VA.

Metropolitan Washington **Council of Governments**

CONTENTS

FIGURES

TABLES

CONTENTS

EXECUTIVE SUMMARY

In December 2020, the Prince William Board of County Supervisors adopted a small-area plan for the Innovation Park area of Prince William County. The Innovation Park Small Area Plan divided the 1,760 acre area surrounding George Mason University's Science and Technology Campus into three distinct districts: Employment Center, University Center, and Technology Center.

Although Innovation Park currently has approximately 700 residents, the Small Area Plan projected that future development could include up to 4,000 homes and 38,000 jobs through a mixed-use, pedestrian-oriented town center offering student housing, office space, and recreational and commercial areas anchored around GMU.

This feasibility study presents a phased approach to transit implementation that introduces new service, and new service types, to support the planning initiatives presented in the Small Area Plan and to complement the anticipated growth and development of the Innovation Park area. Key recommendations include the following:

- App-based microtransit pilot program offering on-demand point-to-point service within the Innovation Park area, and limited service to Manassas Mall and Broad Run station, to support local circulation and regional connections while the area develops but overall densities remain too low to support traditional fixed-route service.
- Autonomous vehicle shuttle service to link the GMU Science and Technology Campus with the Innovation Park Town Center, allowing microtransit service to continue to serve more diverse and defused origin/destination pairs.
- Fixed-route transit service, replacing microtransit service, from Broad Run VRE to Innovation Park Town Center/GMU, followed by additional routes, as strong ridership corridors emerge.

The following document lays out not only the details of these recommendations, but also the findings and analyses that led up to their development. Following this executive summary, the document consists of four chapters, corresponding to the major phases of the study:

- **Existing and Future Conditions –** An overview of the current and planned land-uses and mobility landscape in the study area, including development plans, roadway infrastructure, transit services, and bicycle/pedestrian amenities.
- **Market Analysis –** An assessment of the market for transit services in the vicinity of the Innovation Park study area, based on population and employment density, socio-economic and demographic characteristics, and regional travel patterns.
- **Overview of Service Scenarios** – A presentation of three preliminary transit service scenarios, encompassing fixed-route, microtransit, and autonomous shuttle approaches, as well as a summary of stakeholder feedback received in response to each scenario.
- **Preferred Scenario Implementation Plan** – A three-phase, 25-year transit service plan for the Innovation Park area presented in detail, by phase, together with supporting elements including bus stop design standards and transit service standards.

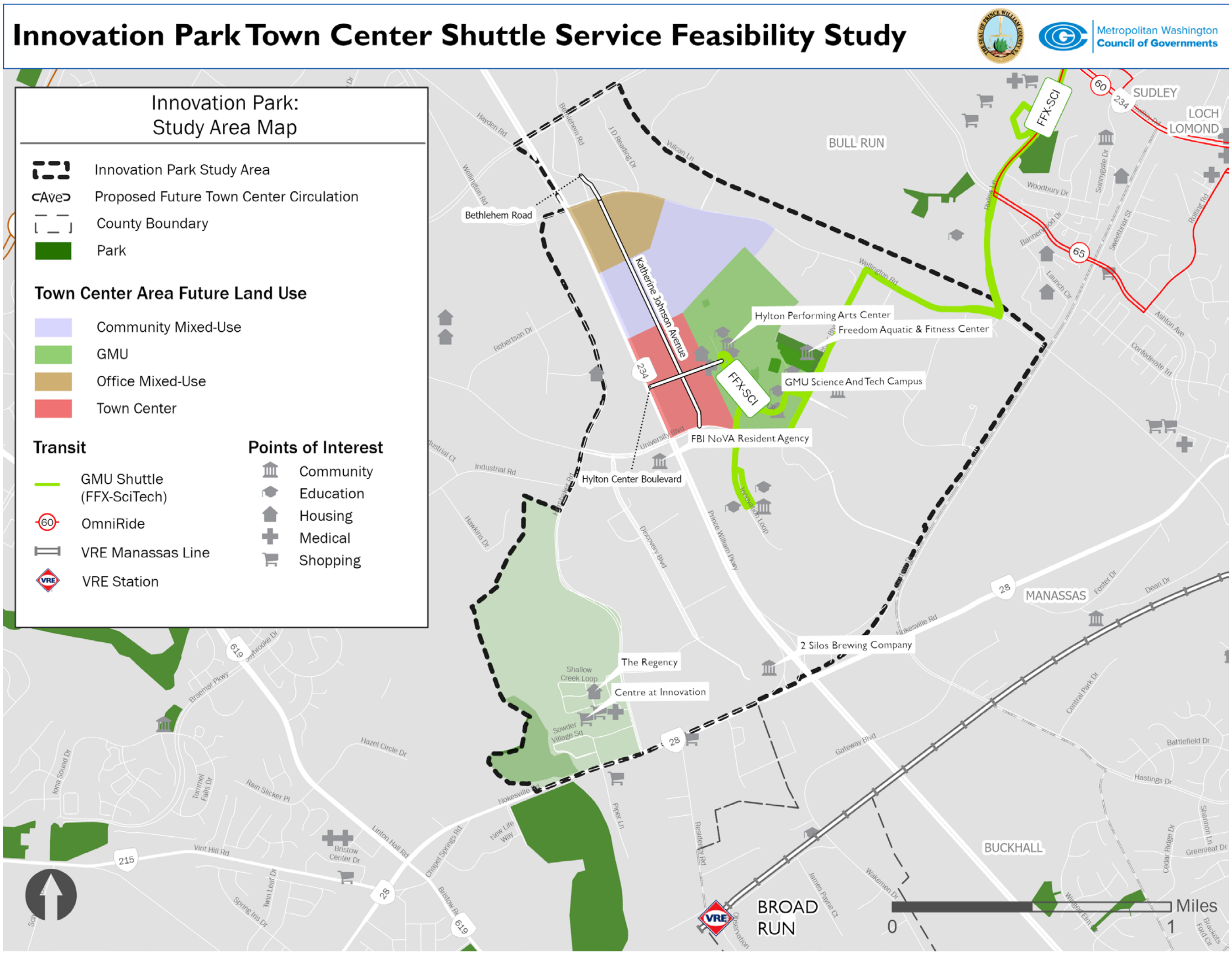
EXISTING AND FUTURE CONDITIONS

Innovation Park Area Overview

Figure 1 provides an overview of the Innovation Park study area, which is bounded by Nokesville Road (VA-28) and Godwin Drive to the south, Norfolk Southern Railway tracks and Sudley Manor Drive to the northeast, and Hornbaker Road and Broad Run to the west. Innovation Park is located near the center of Prince William County, adjacent to the City of Manassas and Manassas Regional Airport, and about 35 miles southwest of Washington, DC via VA-28 and I-66. Major roads bisecting the area include Prince William Parkway (VA-234), Wellington Road, University Boulevard, Discovery Boulevard, and Freedom Center Boulevard.

Figure 1 highlights future land use in proximity of the proposed town center, including the office mixed-use (north of the town center), community mixed-use (north of the town center), and GMU (east of the town center) designations. Future main roads in the corridor will include Katherine Johnson Avenue (north-south), Hylton Center Boulevard (east-west), and a realignment of Bethlehem Road at its intersection with Wellington Road.

FIGURE 1: INNOVATION PARK SMALL AREA



Innovation Park Small Area Plan

The future of the Innovation Park area is guided in large part by the Innovation Park Small Area Plan, which includes the following vision: "to create a sustainable advanced science & technology academic and business community anchored around George Mason University (GMU) – Science and Technology (SciTech) Campus while also preserving existing natural resources." The Small Area Plan envisions a walkable, mixed-use, higher-density region anchored by a new town center. Proposals put forth in the Small Area Plan are referenced throughout this document when comparing existing to future conditions.

The Innovation Park Town Center area will provide shopping, dining, and other amenities in a pedestrian-friendly urban setting. It will be surrounded by office and community mixed-use areas that combine residential with commercial, office, and community spaces to develop desirable and unique neighborhoods. Adjacent to the Innovation Park Town Center, University Village provides student housing, as well as a recreational and entertainment community hub, to attract students to the SciTech campus.

Land Use and Development

EXISTING

Currently, approximately 43 percent of land in Innovation Park is classified as Undeveloped. The next largest land uses are Industrial (14 percent), Institutional (eight percent), Agricultural (eight percent), and Commercial (six percent). A large portion of Innovation Park is currently zoned under the Planned Business District designation. In addition, in accordance with its significance as a future hub for the development of the technology sector in the County, Innovation Park is included in a Prince William Technology Overlay District as well as a Data Center Opportunity Zone overlay.

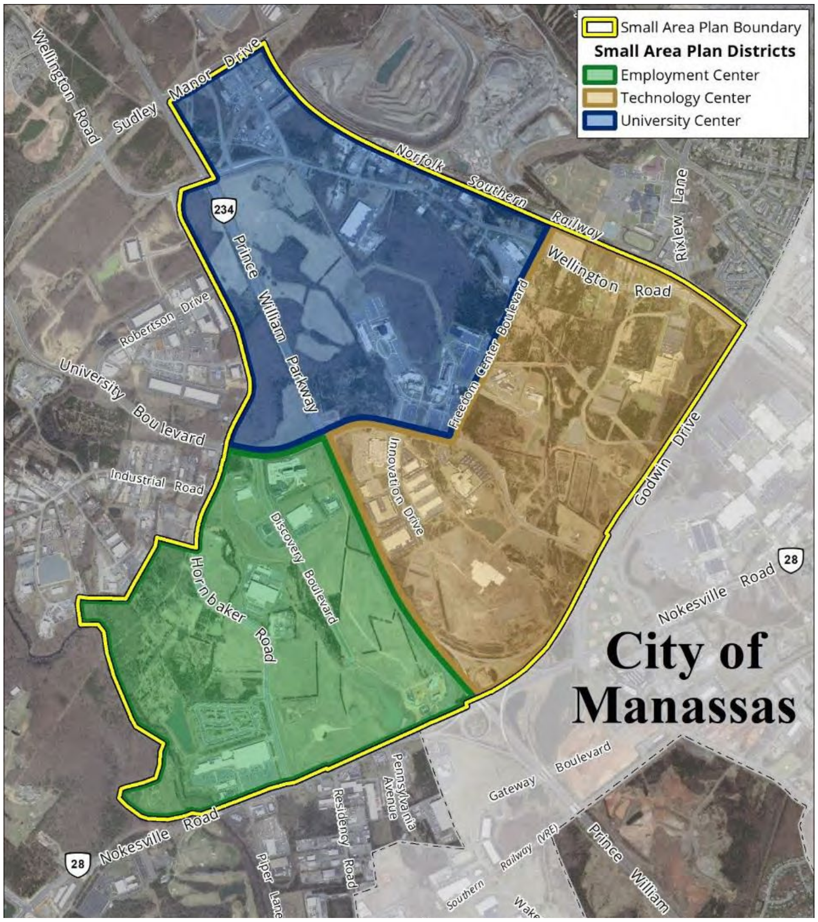
Innovation Park's main attractor is the GMU Science and Technology Campus, a destination which includes the Hylton Performing Arts Center and the Freedom Aquatics and Fitness Center. Additional destinations include:

- NVCC's Innovation Park campus.
- 2 Silos Brewing Company, a brewery and restaurant located adjacent to Farm Brew LIVE, an eight-acre campus featuring live music.
- Federal Bureau of Investigation (FBI) Northern Virginia Resident Agency.
- Centre at Innovation Shopping Center, featuring stores such as Target, TJ Maxx, and PetSmart.
- Virginia Department of Forensic Science.
- Limited residential apartments (the Regency apartment complex located off Hornbaker Road) and single-family residences.

PROPOSED

As shown in **Figure 2**, the Small Area Plan aims to significantly replan the region, designating the northern portion of Innovation Park as a University Center (encompassing the Innovation Park Town Center and GMU planning efforts), with the remaining areas split into Technology (designed to provide opportunities for light industrial, office, and warehouse space), and Employment Center districts.

FIGURE 2: INNOVATION PARK SMALL AREA PLAN DISTRICTS



The Small Area Plan further categorizes the area into 11 future land use classifications, . Showcasing the diversity of uses planned for the burgeoning Innovation Park area, **Table 1** summarizes primary uses anticipated for each classification type; **Figure 3** maps these classifications. Future land use highlights include:

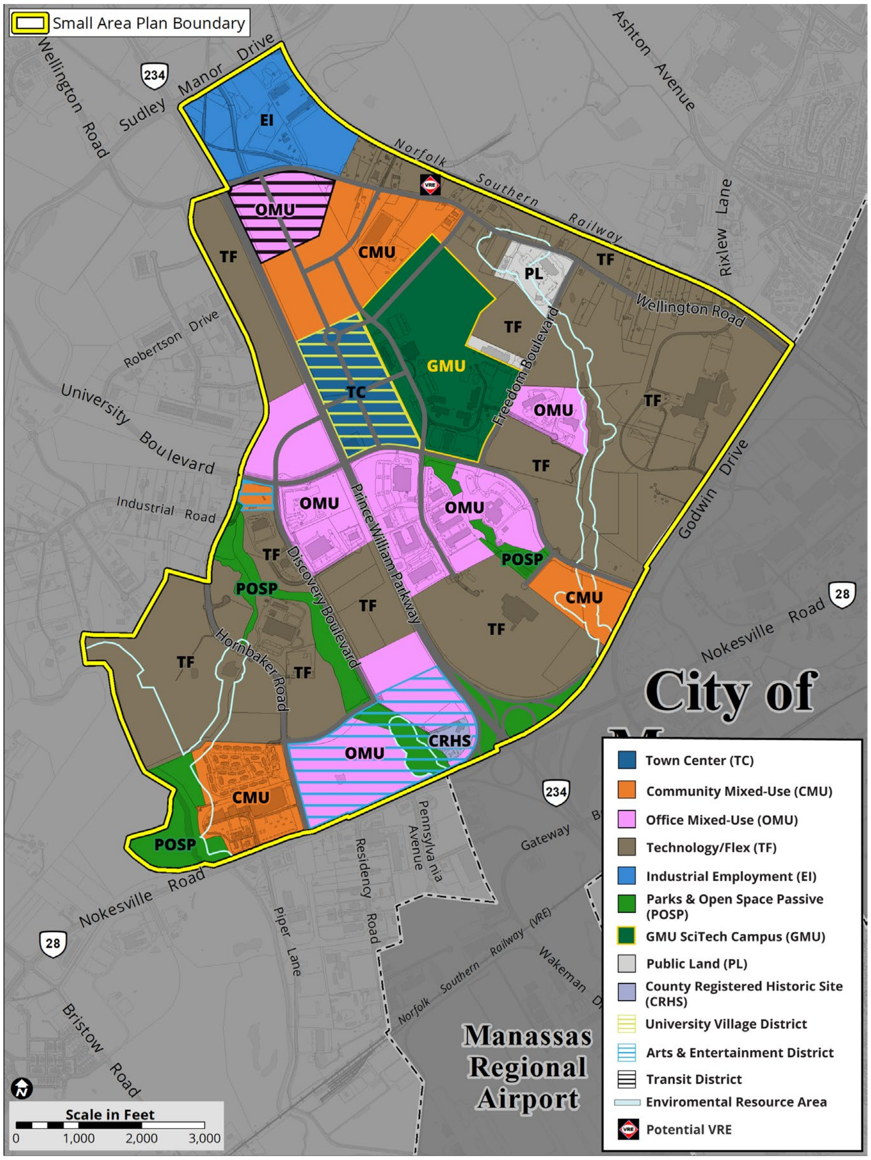
- The majority of land is planned to be Technology/Flex (TF), Office Mixed-Use (OMU), and Community Mixed-Use (CMU). TF zones will include light production, warehouse, and office uses that cause minimal disturbance to the surrounding area. OMU areas provide for low-to-high-rise office and retail space, while CMU integrates residential, commercial, and business uses in pedestrian-friendly urban form.

TABLE 1: INNOVATION PARK SMALL AREA PLAN LONG-RANGE LAND USE CLASSIFICATIONS

Classification	Primary Uses	
Town Center	■ Retail & Service Commercial ■ Office ■ Multi-Family Residential	■ Government Contracting ■ Hotel ■ Conference Center
Community Mixed-Use	■ High-Density Townhouses ■ Multi-Family Residential ■ Retail & Service Commercial	■ Healthcare ■ Life Science ■ Government Contracting
Office Mixed-Use	■ Offices ■ Business Schools, Colleges ■ Computer and Network Services	■ Medical or Dental Office ■ Package or Courier Services ■ Research & Development

Classification	Primary Uses	
	■ Hotel	■ Government Contracting
Technology/Flex	■ Data Centers ■ Healthcare ■ Life Sciences ■ Federal Government Contracting ■ Research & Development	■ Flex Space ■ Light Industrial ■ Warehousing & Logistics ■ Advanced Manufacturing
Industrial Employment	■ Manufacturing ■ Industrial Park ■ Wholesale/Distribution Facilities, Warehouses	■ Certain Public Facilities and Utilities ■ Other Industrial Uses
Public Land	■ Public Facilities ■ Institutions ■ Government Center	■ Judicial Centers ■ Transit Centers ■ Commuter lots
Parks and Open Space Passive	■ Passive Recreation ■ Trails, Hiking, Bicycles	■ Fishing ■ Canoeing, Kayaking
County Registered Historic Site	■ Development that would potentially impact these resources shall occur in accordance with the standards and criteria set forth in the Cultural Resources Plan.	
University Village Overlay	In addition to the underlying district uses: ■ Healthcare ■ Science and Technology	■ Residential/Dorms ■ Academic Support Facilities
Arts and Entertainment Overlay	In addition to the underlying district uses: ■ Cultural Arts Center ■ Theaters ■ Music Store and Education Venue ■ Academy for Performing Arts	■ Art Galleries ■ Dance/Yoga Studio ■ Museum ■ Art studio (lessons, painting, pottery, etc.)
Transit District Overlay	In addition to the underlying district primary uses: ■ Multifamily Residential	■ Attached Residential

FIGURE 3: INNOVATION PARK SMALL AREA PLAN FUTURE LAND USE CLASSIFICATIONS



Design Guidelines

To complement land use designations, the Innovation Park Small Area Plan also includes design guidelines to ensure a well-designed pedestrian-scaled community incorporating "elements of access, architecture, visibility, security, sustainability, and innovation to develop a distinctive yet cohesive community." The plan's design guidelines specify elements such as the preferred character, form, and façade of buildings, as well as items including vehicular access, parking, street furniture and plaza design.

Current Development Proposals

Following adoption of the Small Area Plan, the Innovation Park Town Center and University Village developments, each approved by Prince William County in September 2021, are governed by design guidelines regarding architecture, streets and roadways, and parks to develop a dynamic, mixed-use, pedestrian-oriented area where people will want to live, work, and play.

Within the Innovation Park Town Center, a central parcel bounded by the new Hylton Center Boulevard, Prince William Parkway, Wellington Road, and GMU, mid-rise multifamily apartments will be integrated with office, retail, commercial, and public space using design and placemaking best practices. The town center will be high-density, and pedestrian-friendly, and in addition to a commercial and residential attraction, will also serve as a recreational and entertainment destination.

University Village, a development within the Town Center designation adjacent to the GMU campus, will include a mix of student and market-rate housing in multifamily buildings combined with office and retail space. University Village will be bounded by University Boulevard, Prince William Parkway, the new Hylton Center Boulevard, and GMU.

Education[1]

GEORGE MASON UNIVERSITY

Existing

Established in 1997, the George Mason University Science and Technology Campus serves a small, primarily commuter portion of GMU's student body. While the primary academic focus is teaching and research in the STEM fields, the campus offers coursework in the College of Humanities and Social Sciences, College of Science, Schar School of Policy and Government, School of Kinesiology, and Volgenau School of Engineering. The campus also includes the Hylton Performing Arts Center, a major theater and musical space, and the Freedom Aquatics and Fitness Center.

Proposed

Released in April 2021, GMU's Master Plan indicates a commitment to transforming the relatively small SciTech campus into a full-blown campus and destination that would complement the anticipated University Village development. GMU has suggested a partnership with developers of the Innovation Town Center and University Village rezonings to encourage integration between development and the campus as well as to establish a mixed use "Main Street" with academic, residential, and retail uses along the western arm of George Mason Circle. In addition, the potential move of some core undergraduate and graduate departments to the campus could render SciTech a more desirable place for students for housing and recreation.

GMU lists the following goals for the SciTech campus in its Master Plan:

- Establish a research park where GMU can relocate large research centers.
- Provide infrastructure to support upskilling, reskilling and, retraining in data center operations, cloud computing, and cybersecurity via continuing education.
- Deliver entrepreneurship services related to Small and Medium-Sized Enterprises (SMEs) that support data centers, cloud, and cyber activities.

Additionally, GMU has explored the possibility of opening a medical school on the SciTech campus.

Transportation Network

ROADWAY

Existing

Innovation Park's principal arterial is Prince William Parkway, a Virginia Corridor of Statewide Significance. Within the study area, Prince William Parkway runs north-south, intersecting with minor arterials Wellington Road and University Boulevard, the latter of which serves as the southern edge of the GMU campus. Freedom Center Boulevard, Hornbaker Road, Innovation Drive, and Discovery Boulevard are major collectors. Remaining local roads connect individual parcels and facilities in the Innovation region.

Proposed

Future main roads spanning the corridor will include Katherine Johnson Avenue (north-south) and Hylton Center Boulevard (east-west). In total, the Small Area Plan also calls for six new pedestrian-friendly, multimodal thoroughfares that will create a grid network in the Town Center. These roadways are designed to promote a walkable, bikeable, livable, mixed-use community.

[1] Northern Virginia Community College's Innovation Park Center campus is located on Innovation Drive. As of now, the campus is quite small and has not factored predominantly into the discussion of future plans in the region. For this reason, NVCC is not profiled in this section.

EXISTING AND FUTURE CONDITIONS

Additional active and planned roadway projects to improve connectivity include:

- Prince William County recently widened VA-28 on the southern edge of the Innovation Park area from a four-lane undivided roadway to a six-lane divided highway with a shared use path on the south side.
- Just south of the Innovation Park area, a shared use path is being constructed along Residency Road to link to the Broad Run VRE station.
- The intersection of Prince William Parkway and University Boulevard will be improved to include a quadrant loop ramp to improve the safety, capacity, and efficiency of the intersection. This project is scheduled to begin construction in 2022.
- University Boulevard will be extended from its current terminus at Sudley Manor Drive to Devlin Road, enhancing connectivity through the immediate vicinity of Innovation Park. This project is scheduled to begin construction in 2022.
- At the intersection and area surrounding of Sudley Manor Drive and Prince William Parkway (at the northern end of the Innovation Park area), Prince William County has proposed the following:
  - Grade separation of the intersection of Sudley Manor Drive and Prince William Parkway.
  - Conversion of the intersection of Wellington Road and Prince William Parkway to right-in/right out only for Wellington Road and right-turn/thru only for Prince William Parkway.
  - Conversion of the “T” intersection of Hornbaker Road and Wellington Road into a roundabout.
  - Safety improvements at the intersections of Sudley Manor Drive and Wellington Road and with Bethlehem Road.
  - Relocating Bethlehem Road at its intersection with Wellington Road.
  - Construction of new shared use paths along Sudley Manor Drive and Bethlehem Road.

PUBLIC TRANSIT

Innovation Park is not currently served by any regional transit providers. However, the GMU Fairfax/SciTech route serves the GMU SciTech campus, and OmniRide and VRE service are located within relatively close proximity. This section profiles existing and future transit conditions in the vicinity of Innovation Park.

OmniRide (PRTC)

EXISTING

OmniRide is the operating name of mobility services provided by the Potomac and Rappahannock Transportation Commission (PRTC). OmniRide operates both local and express service. **Table 2** summarizes operating characteristics and recent monthly ridership on OmniRide services located within a few miles of Innovation Park, the closest of which is Route 65.

TABLE 2: OMNIRIDE SERVICE IN VICINITY OF INNOVATION PARK

Route	Name	Description	Weekday Span	Frequency	Monthly Ridership	
					Aug. 2021	*Sept. 2021*
60	Manassas Metro Express	Manassas to Tysons Corner Metrorail	4:15 a.m. – 9:51 a.m. 3:10 p.m. – 8:11 p.m.	30-90 min.	717	974
65	Manassas OmniRide Local	Downtown Manassas to NOVA Community College	5:24 a.m. – 8:17 p.m.	90 min.	2,462	2,262
67	Manassas OmniRide Local	Downtown Manassas to Manassas Park VRE	7:30 a.m. – 8:15 p.m.	90 min.	1,249	953
68	Manassas Park OmniRide Local	Downtown Manassas to Manassas Park VRE	7:30 a.m. – 7:30 p.m.	90 min.	592	805

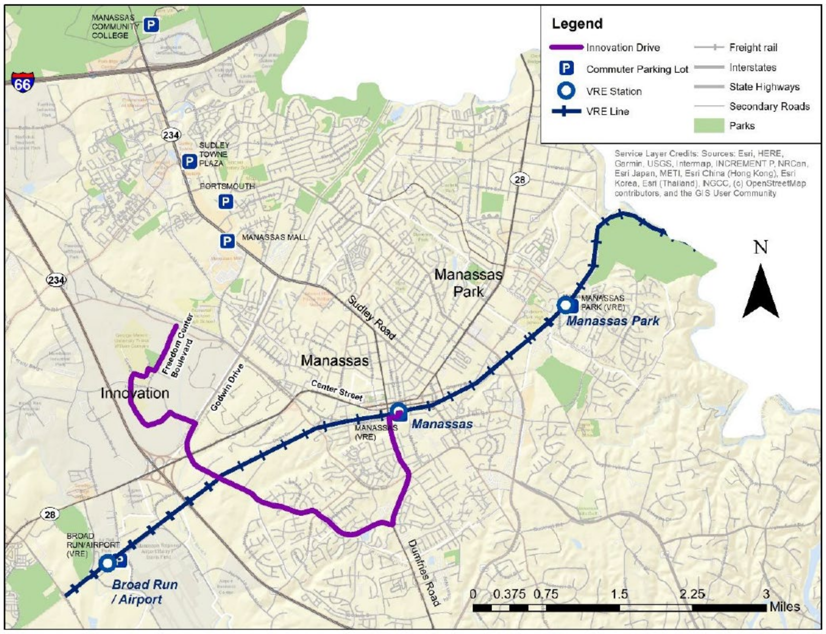
Route	Name	Description	Weekday Span	Frequency	Monthly Ridership	
					Aug. 2021	Sept. 2021
96	East-West Express	Manassas to Eastern Prince William	6:00 a.m. – 8:15 p.m.	60-90 min.	3,287	2,686

PROPOSED

New Innovation Route

Although OmniRide does not currently operate in Innovation Park, the agency's November 2020 Transit Strategic Plan (TSP) proposed a local route operating from downtown Manassas to the Innovation Park area that would terminate on Freedom Center Boulevard (**Figure 4**). Billed as a connection between Manassas and the growing Innovation region as well as GMU, the route is proposed for operation by FY2028

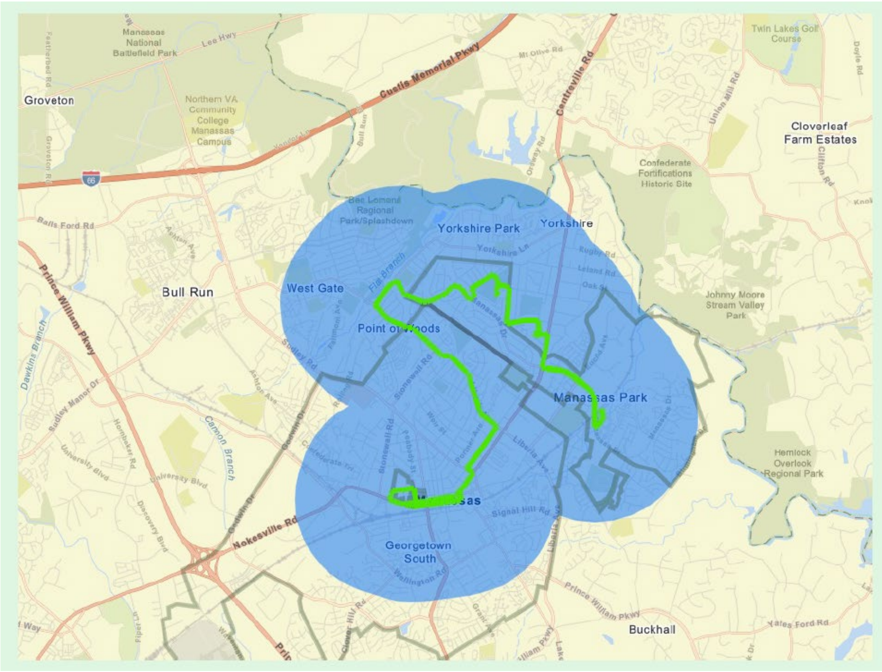
FIGURE 4: OMNIRIDE TRANSIT STRATEGIC PLAN PROPOSED MANASSAS-INNOVATION SERVICE



Microtransit

OmniRide has also considered converting Route 68 to a microtransit operation due to low ridership, lack of trip generators, and poor public perception. Microtransit would allow for on-demand service, with technology enabling flexible routes and pickup or drop-off points. Although Route 68 is not currently easily accessible from Innovation Park, as shown in **Figure 5**, the proposed microtransit zone would reach the edge of the study area, allowing for a potential connection to other services in the future.

FIGURE 5: PROPOSED OMNIRIDE 68 MICROTRANSIT COVERAGE ZONE



George Mason University

EXISTING

Table 3 summarizes operating characteristics and recent ridership patterns for the GMU Fairfax/Science & Technology Campus Route, which runs from the University's Fairfax campus to the SciTech campus via Manassas Mall. The service makes stops at destinations on campus such as Colgan Hall and the Hylton Performing Arts Center. This shuttle is one of several operated by GMU, and the only fixed-route transit currently operating in the Innovation Park area. As outlined in **Table 3**, average daily ridership (mainly on weekdays) declined greatly from 2019 to 2021, likely an effect of the COVID-19 pandemic.

TABLE 3: GMU FAIRFAX-SCITECH SHUTTLE OPERATING CHARACTERISTICS AND RIDERSHIP

Description	Weekday Span	Weekday Frequency	Weekend Span	Weekend Frequency	Average Daily Ridership	
					October 2019	*October 2021*
Sandy Creek Transit Center (GMU Fairfax Campus) to SciTech Campus	6:00 a.m. – 12:45 a.m.	40 min.	8:00 a.m. – 7:55 p.m.	2 Hours	**Weekday:** 849	**Weekday:** 413
					Weekend: 40	**Weekend:** 24

PROPOSED

The GMU Fairfax/SciTech shuttle is not currently proposed for any service changes. However, it should be considered thoroughly in the context of planning potential future shuttle connections.

Virginia Railway Express (VRE)

EXISTING

Virginia Railway Express (VRE) is a two-line commuter rail service providing service to and from points in Virginia and Washington, DC. Broad Run Station, served by VRE's Manassas Line, is located approximately 0.65 miles south of the study area. From Broad Run, passengers may access a variety of destinations, including Alexandria and Crystal City in Virginia and L'Enfant Plaza and Union Station in Washington, DC.

Table 4 provides the weekday schedule and the average daily ridership patterns, at Broad Run. Prior to the COVID-19 pandemic, Broad Run Station averaged over 900 daily boardings.

TABLE 4: VRE WEEKDAY MANASSAS LINE SERVICE AT BROAD RUN STATION

Service Period and Direction	Weekday Trip Start Times								Average Daily Ridership[2]	
									FY2019	FY2020
Northbound Service; Broad Run to Union Station (DC)	5:01 a.m.	5:21 a.m.	5:56 a.m.	6:16 a.m.	7:21 a.m.	8:01 a.m.	3:38 p.m.	5:10 p.m.	962 (Boardings)	687
Southbound Service; Union Station to Broad Run	6:35 a.m.	1:15 p.m.	3:20 p.m.	4:10 p.m.	5:10 p.m.	5:30 p.m.	6:00 p.m.	7:00 p.m.	922 (Alightings)	658

PROPOSED

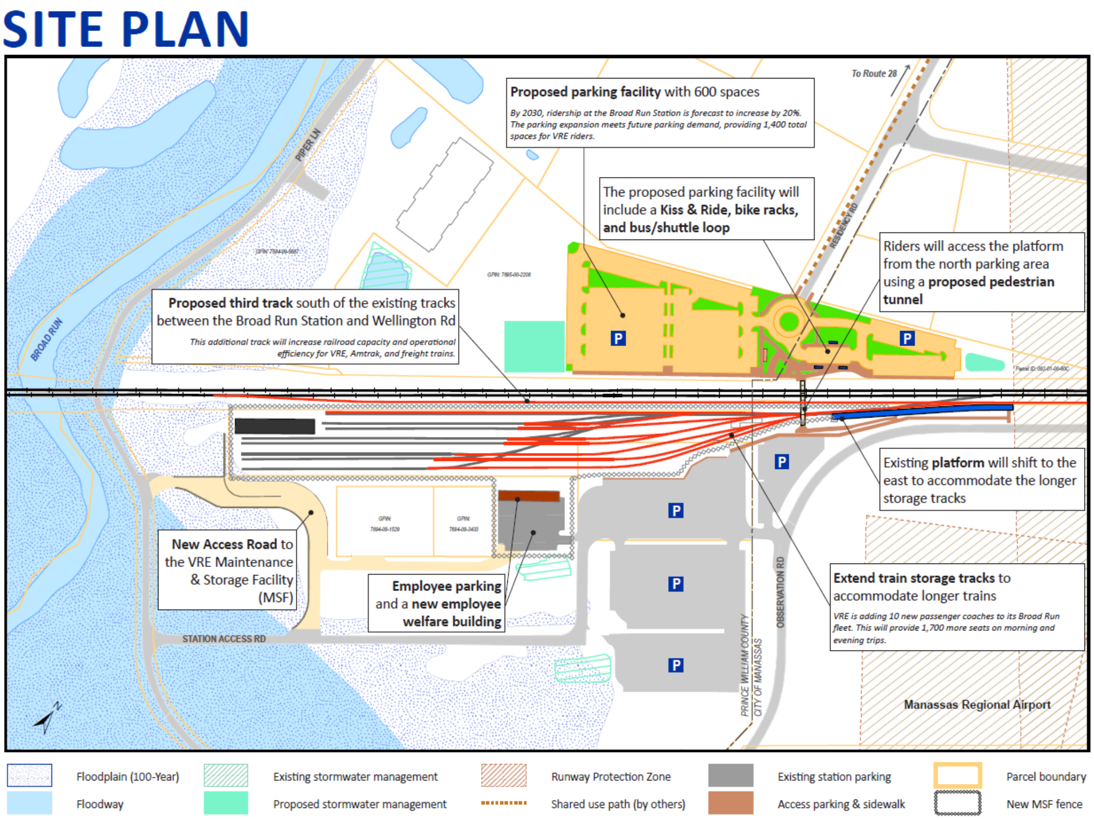
Broad Run Station Expansion

As shown in the site plan in **Figure 6**, VRE plans to expand Broad Run Station to include the following:

- A 600-space parking facility north of the station (total expansion of the facility would include 1,400 spaces).
- The expansion of a Maintenance and Storage facility.
- A third main track to increase railroad capacity and operational efficiency, and to minimize potential for conflicts between VRE, Amtrak, and freight trains.
- As aforementioned, a shared use path on Residency Road that would link to VA-28 and offer a new access point to the station.

[2] FY2020 ridership numbers dropped, on average, due to the impact of the COVID-19 pandemic. During a post-COVID-19 reduced schedule operating from March 17, 2020 through June 30, 2020, Broad Run Station averaged approximately 30 daily boardings and alightings. Prior to the pandemic, the service had been averaging approximately 900 daily boardings during FY2019.

FIGURE 6: PROPOSED VRE BROAD RUN STATION EXPANSION PLAN



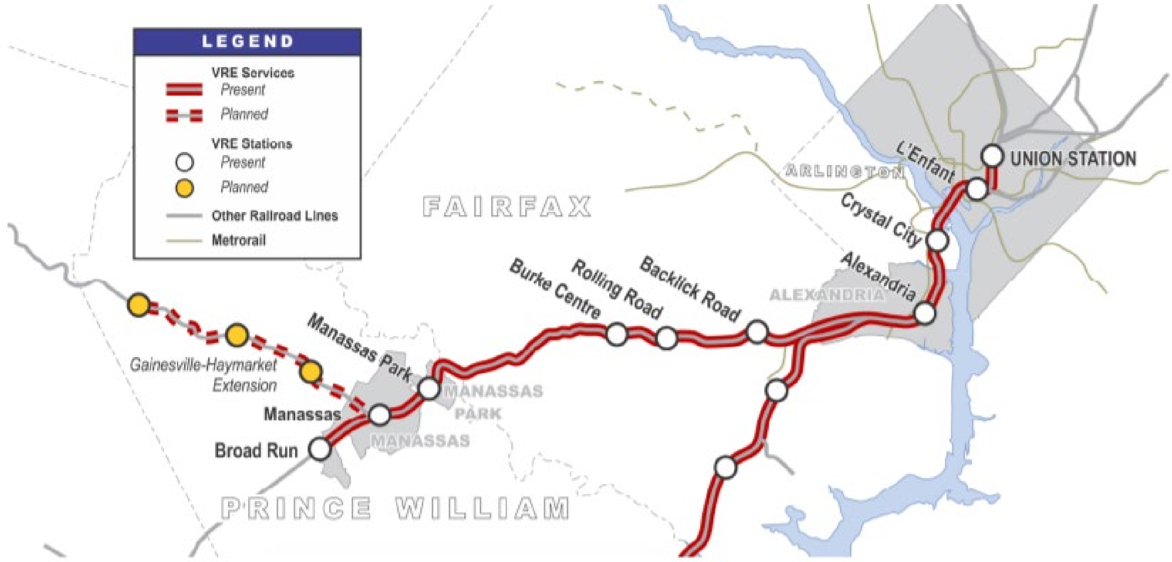
Service Expansion

In its VRE System Plan 2040, VRE explored expanding service to a broader market, including Gainesville and Haymarket (**Figure 7**). The proposed route would extend westward from Manassas for nearly 11 miles along the Norfolk-Southern B Line to the Gainesville-Haymarket region, including the Innovation business district and GMU. The plan considers up to three stations: Wellington (adjacent to Innovation Technology Park), Gainesville, and the US-15/I-66 Interchange (Haymarket).

A 2017 analysis revealed that ridership numbers on the proposed VRE spur would not justify anticipated costs and the decision was made to focus investment into expanding capacity at Broad Run Station. As such, this service plan is not currently planned for implementation, but is instead considered a potential option in the future.

EXISTING AND FUTURE CONDITIONS

FIGURE 7: PROPOSED VRE GAINESVILLE-HAYMARKET EXPANSION



New Service Levels

In its long-range planning, VRE has also explored implementation of reverse peak service as well as all-day service. Manassas Line trains currently operate limited reverse peak service primarily for cycling trainsets for peak trips. Implementation of all-day, bidirectional service would be designed to serve passengers traveling in either direction. Such a service model would revolutionize VRE in the region and attract more ridership than just commuters. A higher level of service would also enhance Innovation Park's potential. Mid-day service on the Manassas Line is expected to be introduced sometime between 2026 and 2030.

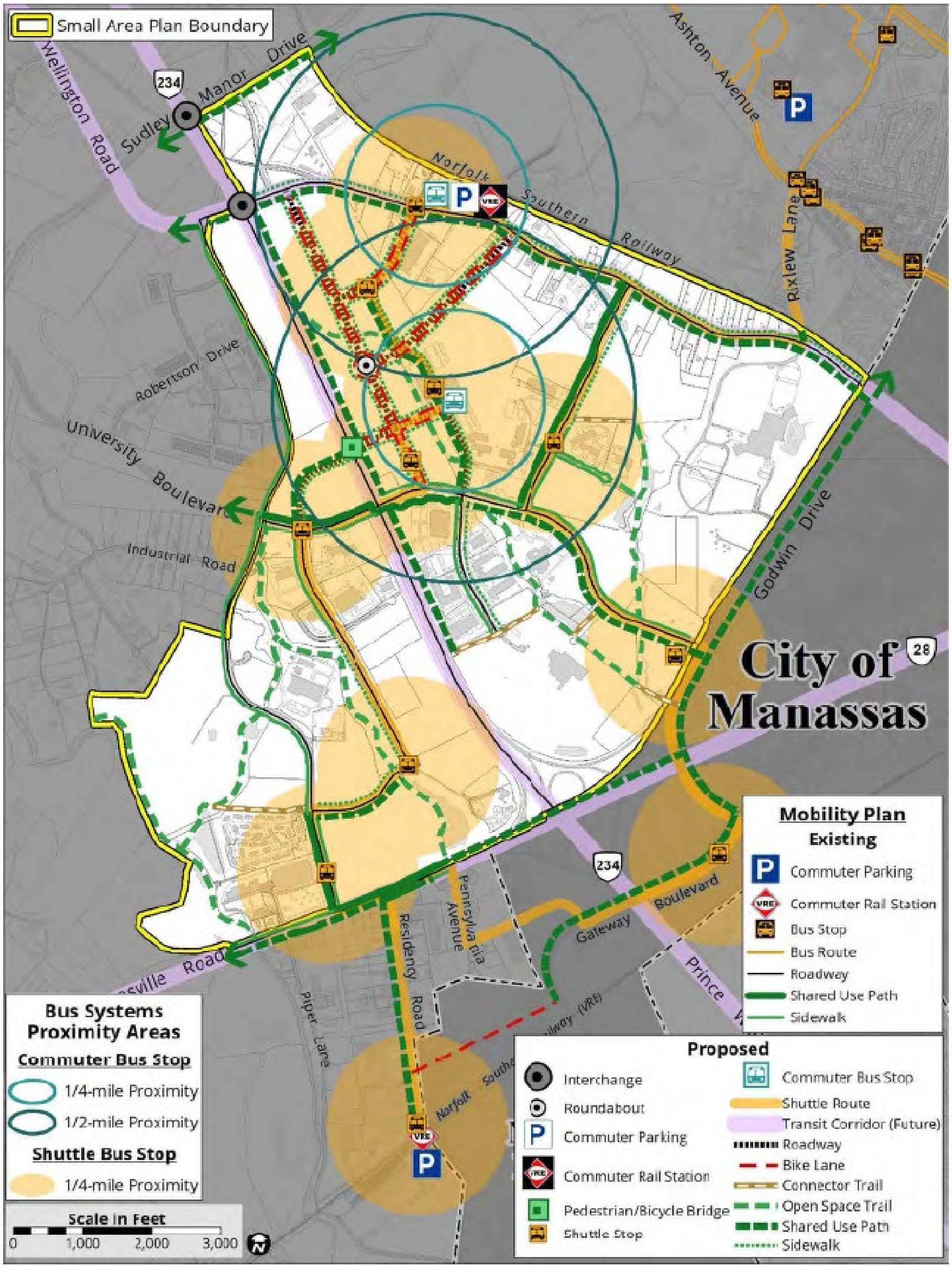
Proposed Shuttle and/or Bus Service

Given that regional fixed-route service does not currently operate in Innovation Park, to accommodate the vast development planned for the region, the Innovation Park Small Area Plan's mobility plan proposes a series of traffic-related improvements, bicycle/pedestrian infrastructure and trails, as well as new bus service in the region (**Figure 8**). Future transit would include:

- A potential new bus service that forms a loop with planned and existing VRE service, the Town Center, and the GMU campus. Future transit corridors are identified as Prince William Parkway, Wellington Road, and Nokesville Road. OmniRide, the main bus transit operator in Prince William County, may ultimately be identified as a provider for such a service.
- A new shuttle service for "lunch, dinner, and recreation throughout the plan area to enhance the vibrancy and connectivity of Innovation Park." As shown in **Figure 8**, this proposed shuttle would operate on Residency Road (along with a new shared use path to Broad Run VRE), Hornbaker Road, Thomasson Barn Road, Discovery Boulevard, University Boulevard, Wellington Road, and new thoroughfares proposed for the Town Center region. Shuttle stops are proposed for a variety of locations, including across the Town Center, the GMU campus, and the Centre at Innovation Shopping Center.

Each of these concepts for future transportation will be considered when planning future shuttle service in the region.

FIGURE 8: INNOVATION PARK SMALL AREA PLAN MOBILITY PLAN



BICYCLE/PEDESTRIAN

Existing

Bicycle facilities are currently available as shared use paths on Freedom Center Boulevard, University Boulevard, and Hornbaker Road. Sidewalks are located on Hornbaker Road, University Boulevard, Freedom Center Boulevard, Discovery Boulevard, and Innovation Drive.

Proposed

As noted in **Figure 8** in the Small Area Plan, shared use paths are proposed to be collocated along many major roads in the study area (including along Residency Road, to connect to Broad Run VRE). Sidewalks are generally proposed on streets that are not slated for shared use paths. A series of local streets will be designed with bike lanes or similar bike-friendly infrastructure. Additionally, a bicycle and pedestrian bridge is proposed to cross Prince William Parkway to enhance connectivity throughout the area. Finally, three recreational trails are proposed through the area: along the Cannon Branch; along the Broad Run trail; and a trail to connect GMU and the Innovation Town Center.

MARKET ANALYSIS

Traditionally, when planning a fixed-route or on-demand transit service in a region, a Market Analysis can identify strong transit corridors and areas with relatively high transit need. This is based on existing demographic, density, and employment conditions. The Innovation Park area is unique in that suitability for transit shuttle service is contingent on future development and transportation initiatives profiled in this document. Therefore, where possible, the Market Analysis compares existing to future conditions. This approach further supports regional goals to direct future employment and population growth to designated activities centers.

The Market Analysis begins with an analysis of population and employment density, each key determinants of the efficiency and effectiveness of public transportation. Where there are higher concentrations of people and/or jobs, transit ridership tends to be higher. Following an examination of population and employment density individually, the two factors are combined in a transit potential index. Given that Innovation Park is currently home to relatively few residents or jobs per acre, this analysis relies heavily on future conditions. In addition, given that a shuttle service rather than regional transit operation is anticipated, scenario planning efforts will need to consider the locations of key points of interest.

Following the transit potential analysis, a transit need analysis focuses on current socio-economic characteristics such as income, automobile availability, age, and disability status that are indicative of a higher propensity to use transit. Due to data limitations, this analysis is only provided with current conditions. Nonetheless, it provides helpful context for the Innovation Park area.

The Market Analysis concludes with a look at 2040 regional travel demand patterns. While the Innovation Park shuttle service may ultimately strictly serve as an internal circulation service, this analysis offers additional background on how future services may best align or connect with current demand for enhanced regional connections.

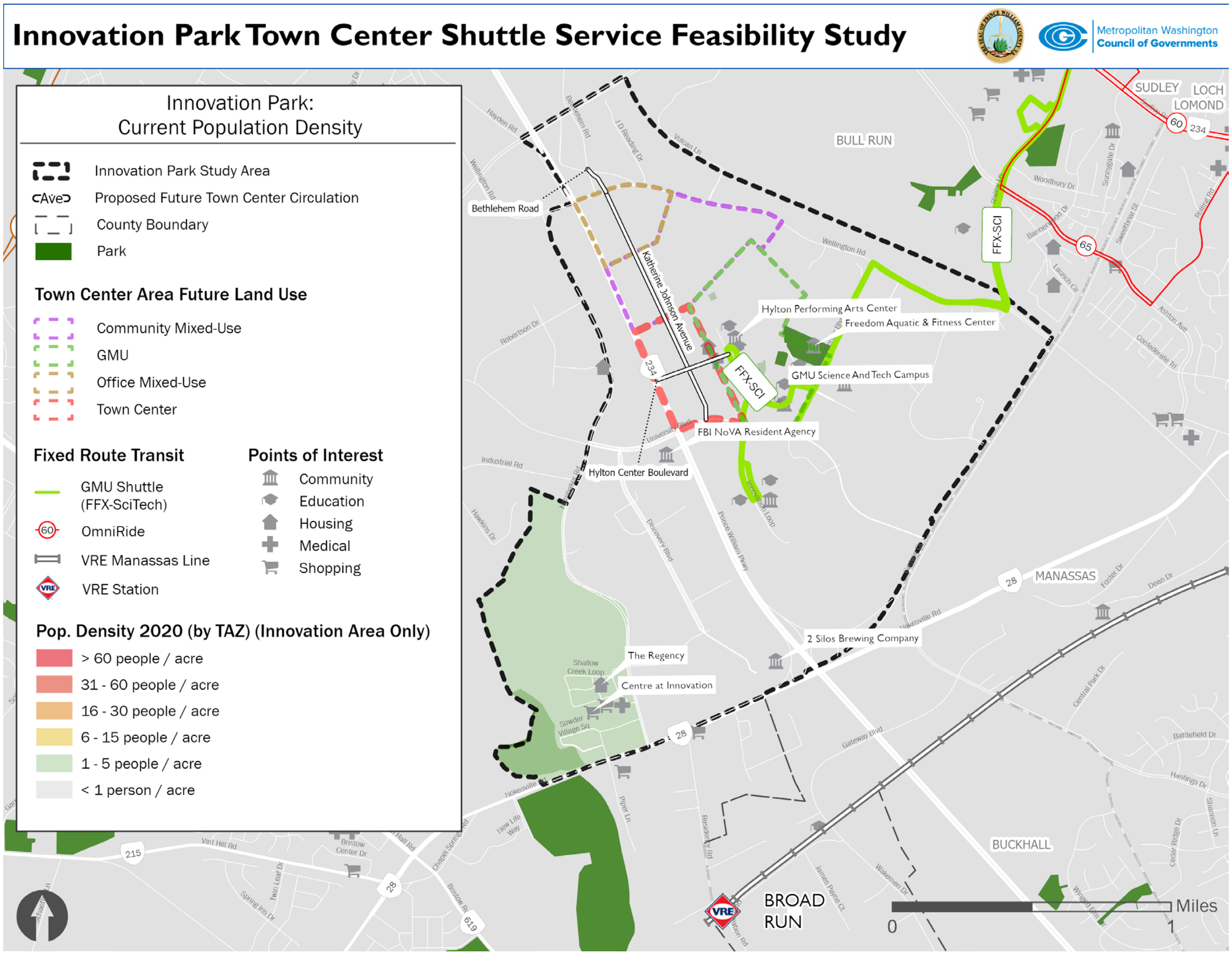
Population Density

In general, the reach of public transit is limited to within one-quarter mile to one-half mile of a transit line, or a 10-minute walk. For this reason, the size of a transit travel market is directly related to an area's population density. While circumstances may differ in the case of a regional shuttle, typically, a density greater than five people per acre is needed to support base-level (hourly) fixed-route transit service. This section summarizes current (2020) and projected population density within the Innovation Park area at the Transportation Analysis Zone (TAZ) level.

CURRENT

Figure 9 illustrates the current population density in the Innovation Park area by TAZ, alongside future main roads in the Town Center area as well as future land use. Currently, only a reported 696 people – mainly within the Regency apartment complex off Hornbaker Road – live within the boundary of the Innovation Park Small Area Plan. Perhaps as expected, all TAZ's other than the one including this apartment complex report a population density of fewer one person per acre.

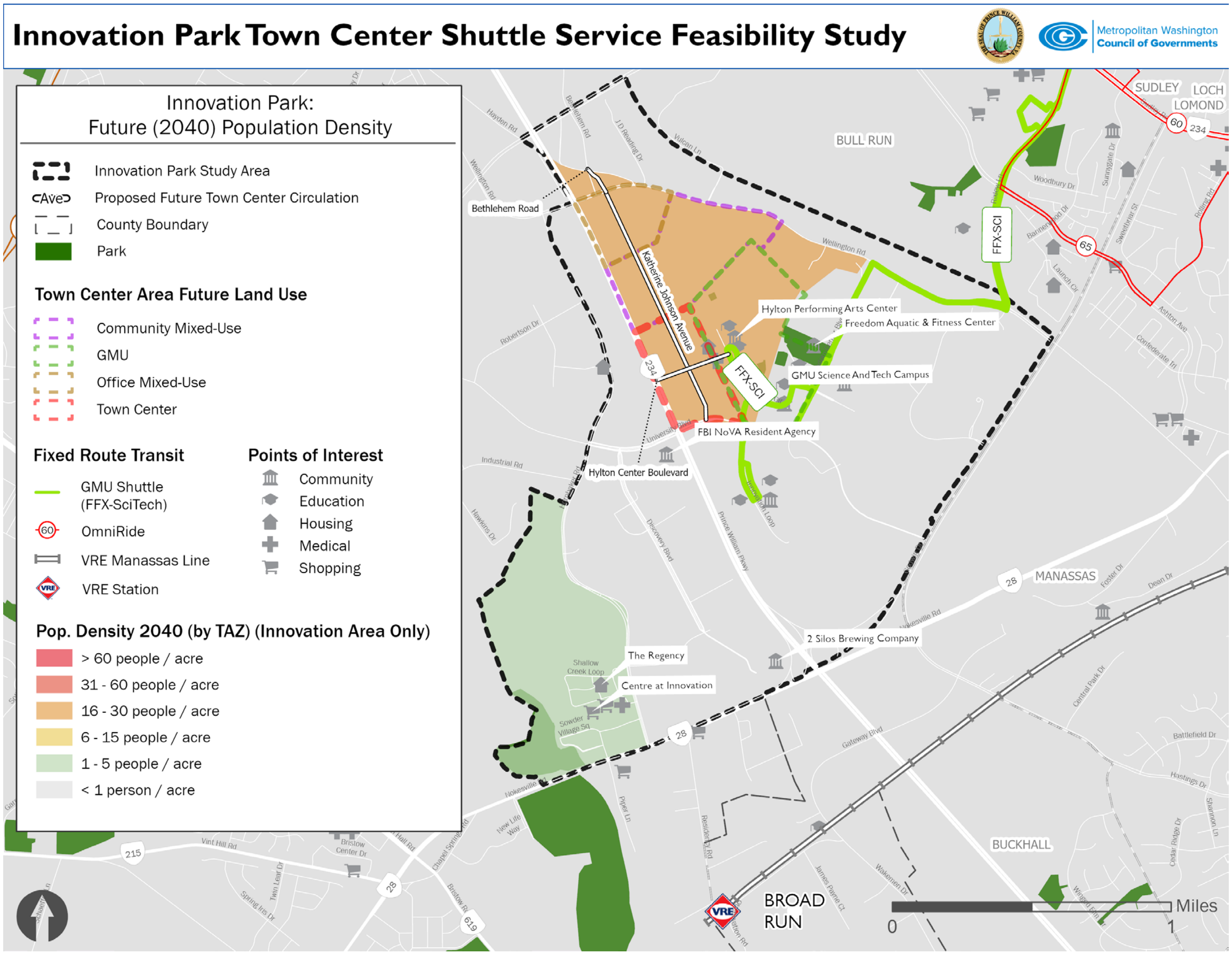
FIGURE 9: INNOVATION PARK AREA CURRENT POPULATION DENSITY BY TAZ



PROJECTED

Figure 10 illustrates the projected future (2040) population density for the Innovation Park area by TAZ. The construction of the Town Center and University Village will significantly increase population density in the region. The area bounded by Prince William Parkway, Wellington Road, Freedom Center Boulevard, and University Boulevard is projected to increase from less than one person per acre (2020) to between 16 and 30 people per acre in 2040. Remaining areas are projected to have unchanged average population density.

FIGURE 10: INNOVATION PARK AREA FUTURE POPULATION DENSITY BY TAZ



Employment Density

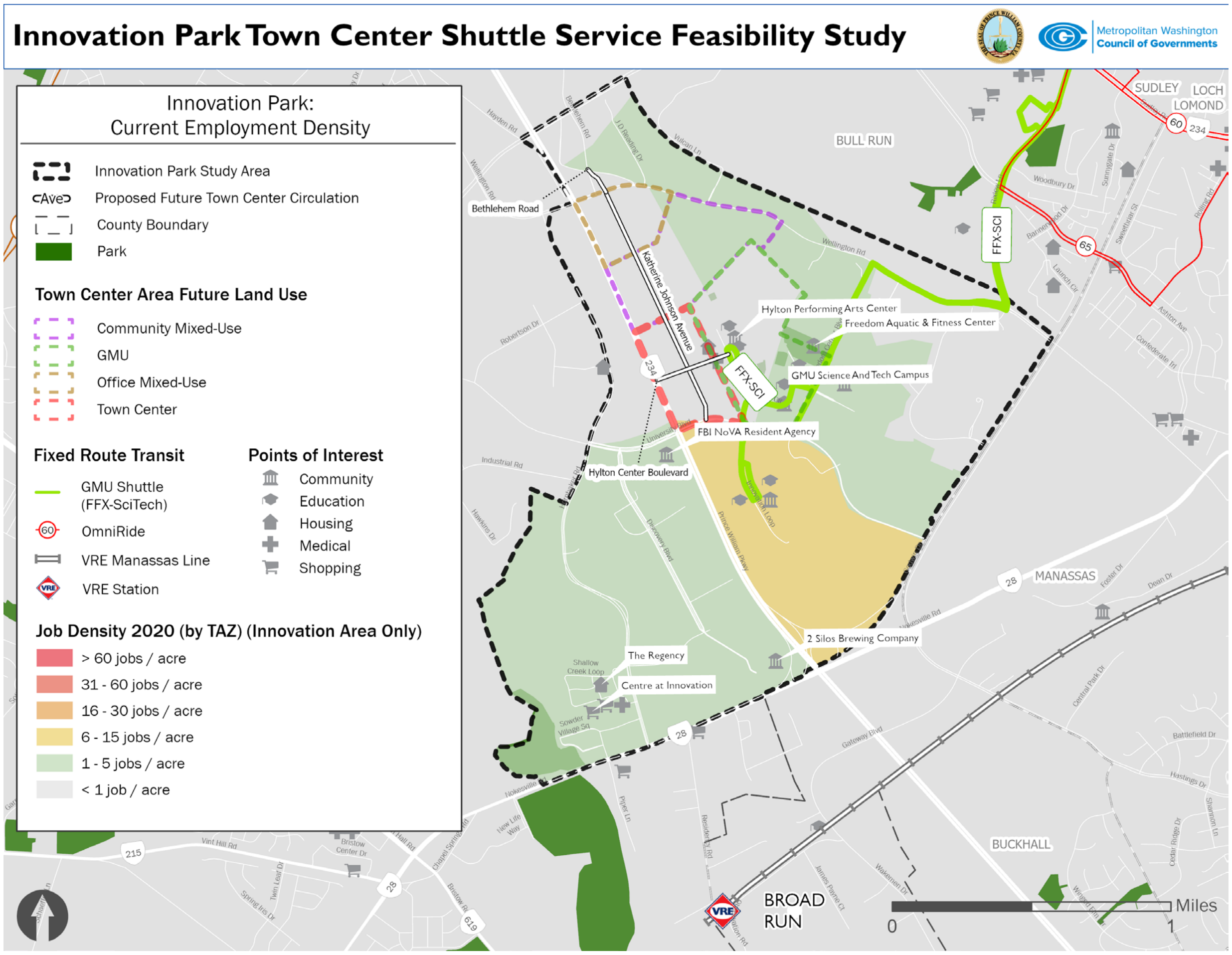
Given that traveling to and from work accounts for the largest single segment of transit trips in most markets, the location and number of jobs in a region are strong indicators of transit demand. Transit that serves areas of high employment density also provides key connections to job opportunities. Like population density, an employment density greater than five jobs per acre can typically support base-level fixed-route service. This section summarizes current and projected employment density within the Innovation Park area at the Transportation Analysis Zone (TAZ) level.

CURRENT

Figure 11 illustrates current employment density by TAZ for the Innovation Park area. Given that there are not many jobs currently located in Innovation Park, a good portion of the area falls into the one to five jobs per acre category. Areas with relatively higher employment density include:

- In the southwest quadrant (shaded in green), west of Prince William Parkway and south of University Boulevard, employers include a shopping center, brewery, restaurants, entertainment venue, data centers, technology manufacturing companies, and the FBI.
- In the areas shaded in green north of University Boulevard, major employers include the GMU SciTech campus, the Virginia Department of Forensic Science, PWC Western Police Station and various light industrial uses.
- The area shaded in yellow, bounded by Prince William Parkway and University Boulevard, currently has the highest employment density in the region, between six and 15 jobs per acre. Major employers in this zone include the NVCC campus, a Comcast service center, and various research and technology centers.

FIGURE 11: INNOVATION PARK AREA CURRENT EMPLOYMENT DENSITY BY TAZ

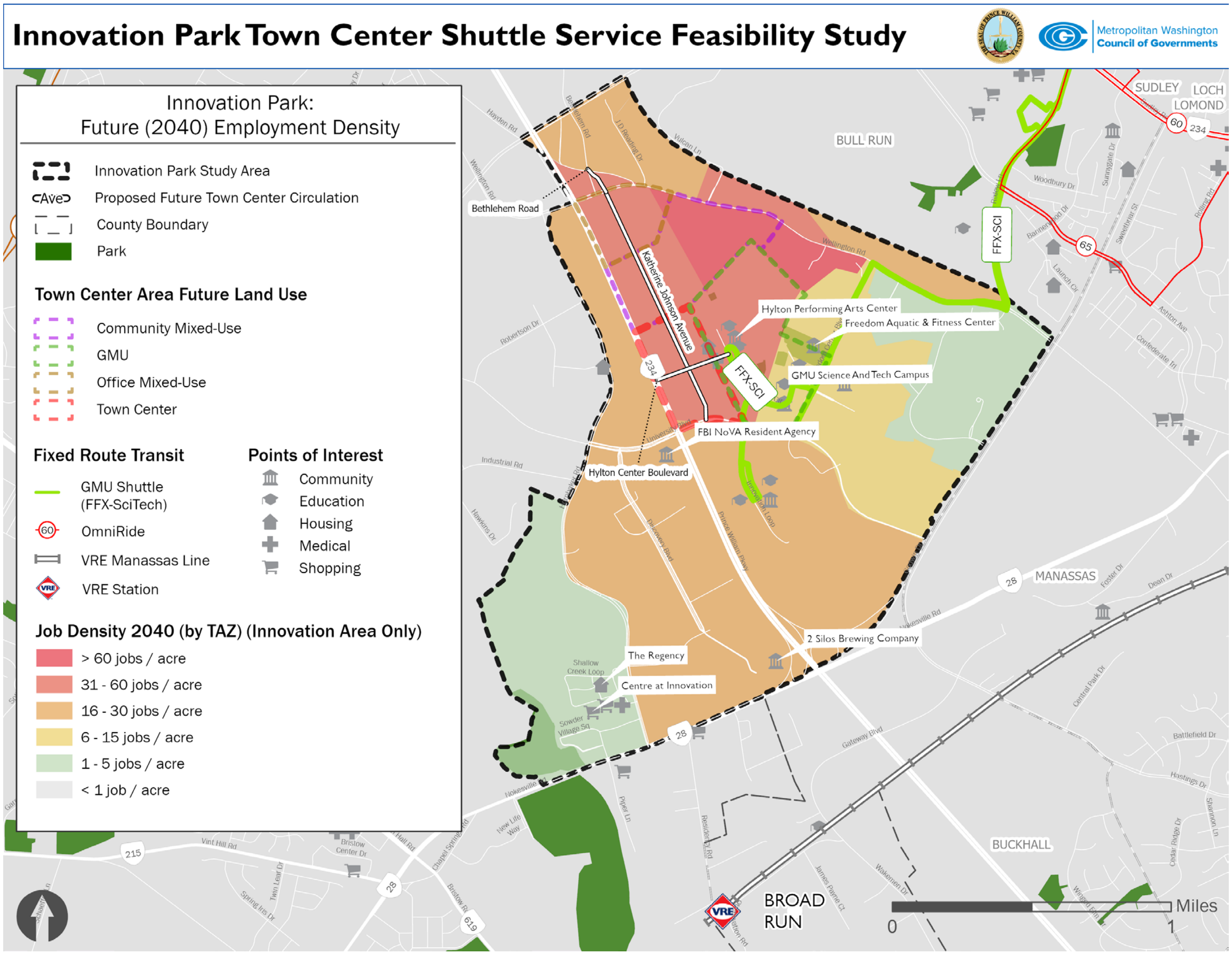


PROJECTED

Figure 12 illustrates the projected future (2040) employment density for the Innovation Park area by TAZ. This projection confirms the Innovation Park's transformation into a major employment center in the next 20 years. Only the areas in the far southwest and far northeast of the region (shown in green) are projected to remain below five jobs per acre.

The center of the region (shown in red), anchored by the Town Center, University Village, and surrounding community mixed-use/office mixed-use zones, shows employment density falling into the two highest categories (31-60 jobs per acre and more than 60 jobs per acre). This area is anticipated to include a high density of shops, restaurants, offices, and other commercial uses. The surrounding areas, shown in yellow and orange, will have between six and 30 jobs per acre, including office, research, and technology uses.

FIGURE 12: INNOVATION PARK AREA FUTURE EMPLOYMENT DENSITY BY TAZ



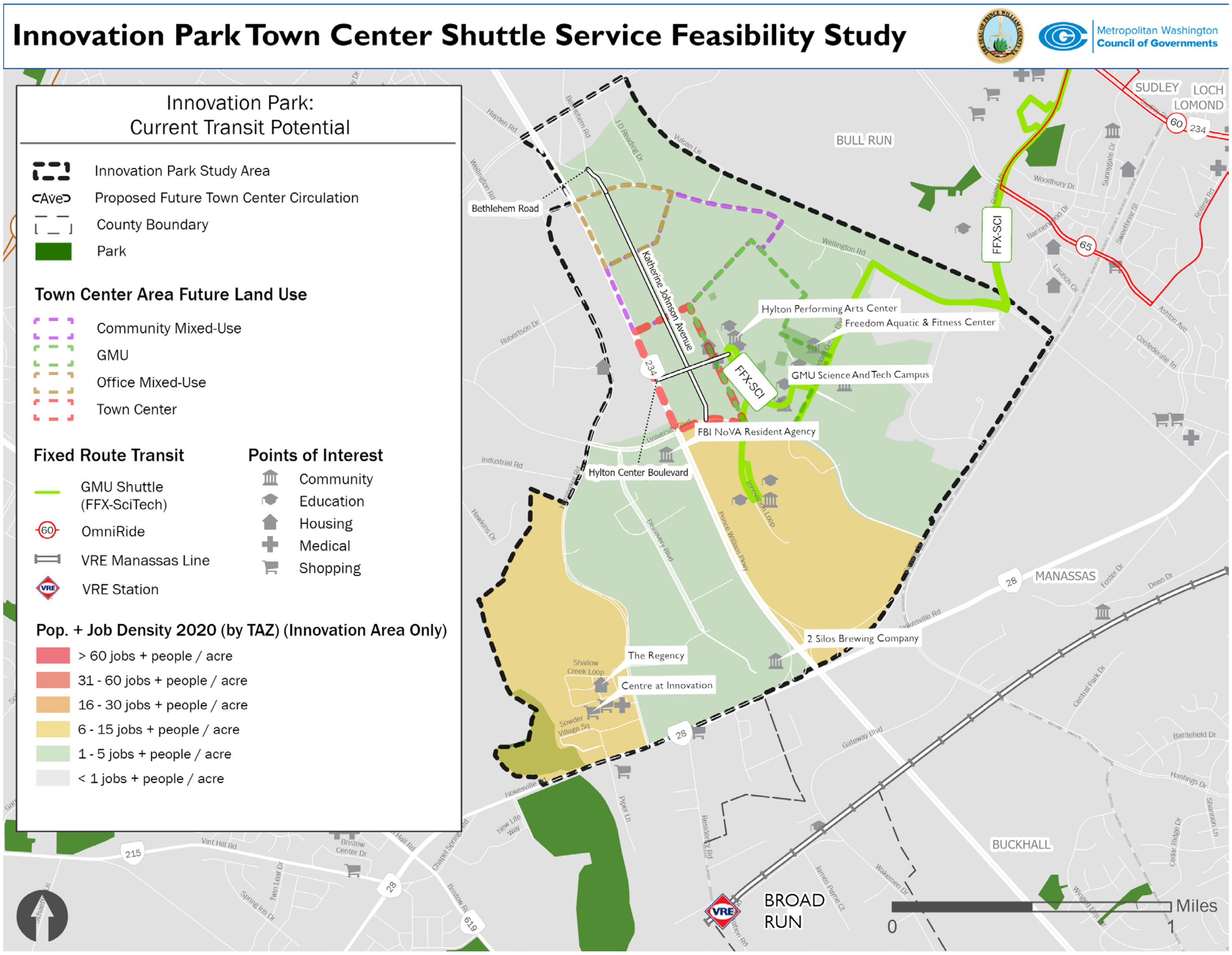
Transit Potential

The Transit Potential index combines the population and employment densities for each TAZ to indicate the viability of fixed-route service for an area.

CURRENT

Figure 13 illustrates the current transit potential (jobs plus people per acre) by TAZ for the Innovation Park area. As expected, current transit potential in the region is relatively low (green areas, showing between one and five jobs plus people per acre). Two areas – the southern part of the study area, between University Boulevard and Prince William Parkway; and the southwestern portion of the study area, west of Hornbaker Road – have between six and 15 jobs plus people per acre (shown in yellow). These areas respectively show higher current transit potential due to jobs from NVCC, Comcast, a shopping center, and various technology and research centers.

FIGURE 13: INNOVATION PARK AREA CURRENT TRANSIT POTENTIAL BY TAZ

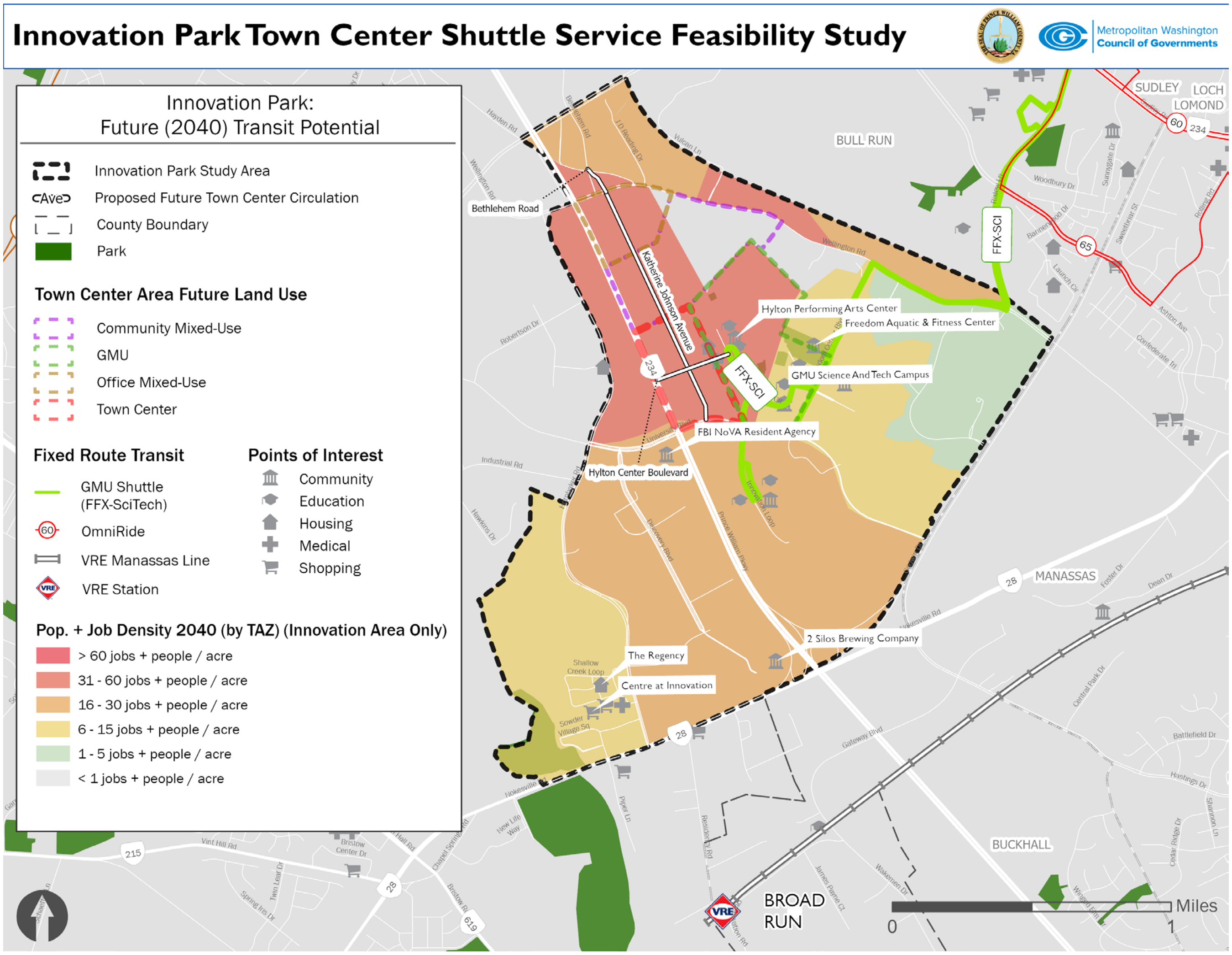


MARKET ANALYSIS

PROJECTED

Figure 14 illustrates the future projected transit potential in 2040 by TAZ for the Innovation Park area. Innovation Park is projected for transformation into a high transit potential region by 2040. The high-density, pedestrian-oriented, mixed-use Town Center and University Village developments will show the highest relatively transit potential (greater than 60 jobs plus people per acre). Surrounding research, technology, and office space combined with medium-density residential in the community/office mixed-use areas will have moderate to high transit potential (between 16 and 30 jobs plus people per acre). While outlying areas in the east and southwest of Innovation Park will have relatively lower transit potential due to lower density, transit potential is still projected to increase greatly compared to current conditions.

FIGURE 14: INNOVATION PARK AREA FUTURE TRANSIT POTENTIAL BY TAZ



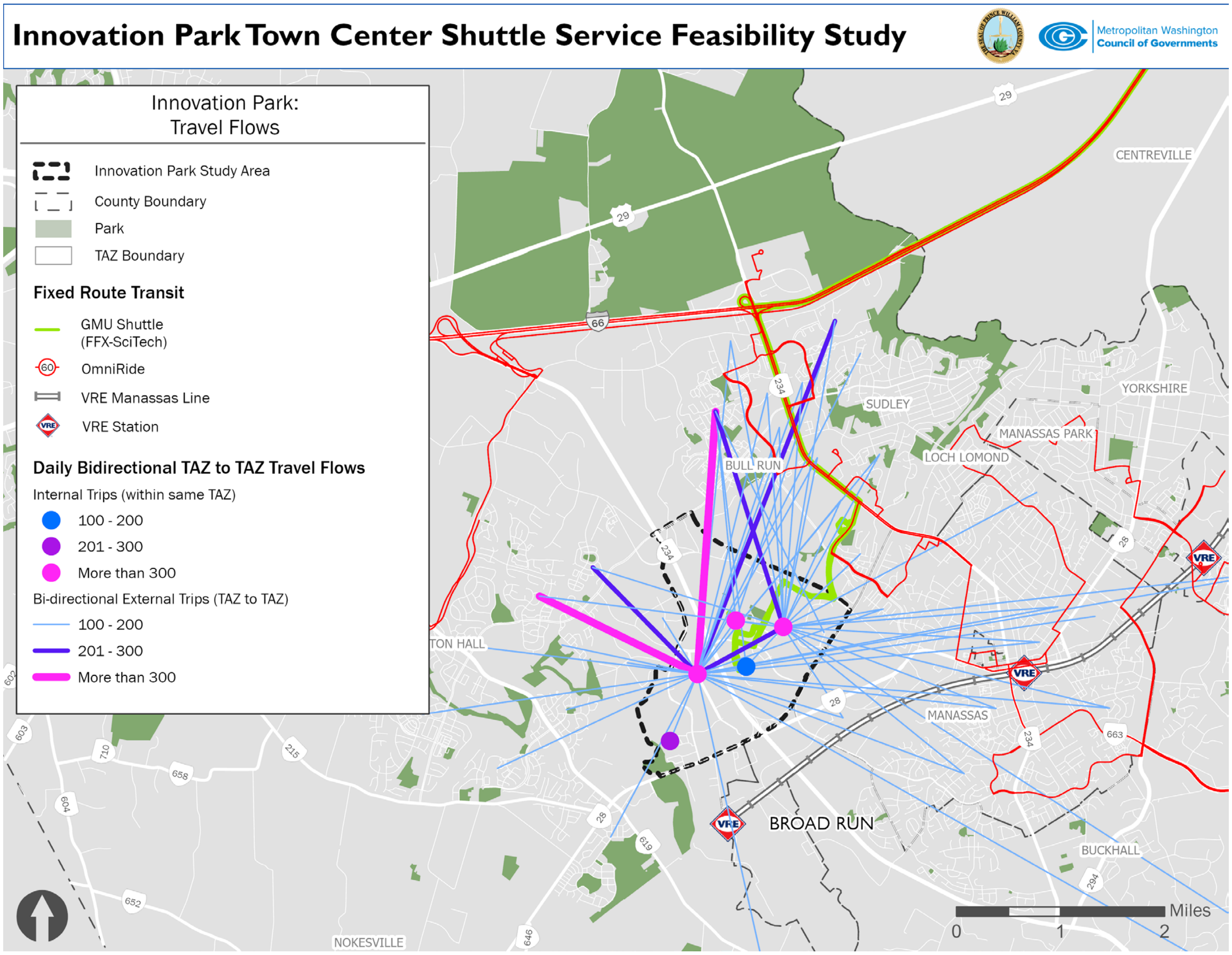
MARKET ANALYSIS

Regional Travel Demand

Regional travel demand models are used as a tool to highlight areas that may benefit from additional forms of transit and illustrate the most prevalent travel patterns in an area. **Figure 21** shows projected travel demand to and from TAZs in the Innovation Park area. The travel flows shown on the map are based on 2030 projected volumes, regardless of mode or trip type. Only those travel flows with volumes of at least 100 daily trips are shown.

External travel flows with greater than 300 trips connect destinations along Discovery Blvd with housing developments in Linton Hall (to the northwest), and north of Sudley Manor Drive and west of Ashton Ave (to the northeast). The model also indicates a significant number of internal travel flows within the Innovation region, shown as circles. In the Innovation Park Study area, internal flows are primarily made up of non-home-based trips, perhaps an expected result given the employment opportunities, retail, and university-related destinations currently located within the study area. Internal trips within the southern portion of the study area are also likely to and from 2 Silos, a local brewery, restaurant, and live performance center. As the area redevelops, Innovation Park travel flows are likely to change significantly over the next 20 years. This preliminary analysis provides context regarding current travel patterns. Although the future Innovation Park shuttle will likely not serve as a regional transit service, such an analysis could assist with future stop placement as well as proposed connections to regional transit.

FIGURE 15: INNOVATION PARK AREA REGIONAL TRAVEL FLOWS



MARKET ANALYSIS

OVERVIEW OF SERVICE SCENARIOS

Introduction

In transit service planning, scenario development involves the creation of discrete transit service concepts to serve the mobility needs of a community. Bearing in mind that fixed-route and demand response service each pose advantages and disadvantages, the Innovation Park Town Center Shuttle Service Feasibility Study considered three bus transit scenarios to serve the Innovation Park small area. This evaluation provides an overview of each scenario, including a narrative description and map, phasing and timeline considerations, potential operating partners, and outstanding questions related to implementation. It concludes with a high-level overview of the preferred scenario.

While each service scenario was presented as a standalone option, stakeholders were also given the opportunity to provide feedback on individual elements of each scenario. The aim of this process was to develop a preferred scenario consisting of either one of the preliminary scenarios, as designed; the most favorable elements of more than one preferred scenario; and/or a new concept entirely. The potential for phased implementation, or the implementation of various elements from one or more scenario over time, was also considered.

During the Feasibility Study, scenario development consisted of three phases:

- **Initial scenario development,** during which a fixed-route, microtransit, and combined microtransit/autonomous vehicle shuttle scenario were developed.
- **Stakeholder workshop,** during which scenarios were shared with stakeholders from Prince William County, George Mason University, Virginia Railway Express, OmniRide, and Northern Virginia Community College. Stakeholders provided feedback incorporated into preferred scenario development.
- **Prince William Planning Commission meeting and work session**, during which scenarios along with stakeholder workshop feedback were shared with the Commission for solicitation of additional comments.

Service Planning Considerations

BUS TRANSIT SERVICE TYPES COMPARISON

As a precursor to overviews of each scenario, Table 5 summarizes the characteristics, advantages, and disadvantages of both fixed-route and demand response bus transit service, including subcategories of each. These service models are addressed in greater detail in this document, as scenarios are reviewed.

The consideration of advantages and disadvantages is particularly important in transit service development, a process necessitating management of limited physical and financial resources. Based on the needs of riders as well as operational efficiency, service planners must make choices regarding when and how frequently to operate service, and which service type best fits a given area. For example, while fixed-route service has benefits including visibility and reliability in terms of stop locations, demand response service may better serve areas with limited street connectivity.

This table is followed by a more detailed analysis of feasibility considerations for fixed-route, microtransit, and autonomous shuttle service.

TABLE 5: BUS TRANSIT SERVICE TYPES SUMMARY

Service Type	Subcategory	Description	Advantages	Disadvantages
Fixed-Route	Traditional Bus	■ Fixed alignment with set stops on a schedule ■ Full-size vehicles (30-foot to 60-foot) ■ Different approaches to service models, such as serving a central hub ("hub and spoke") or crosstown service	■ Consistent, regular schedule ■ Predictability in terms of stop locations ■ If planned well, easy connections and transfers to other services	■ Fixed alignment can limit geographic reach of service (unless service efficiency suffers)
	Autonomous Shuttle or Bus	■ Fixed-route service with autonomous operation ■ Often smaller vehicles (10-15 passengers) ■ Currently, attendants are usually on-board for safety	■ Simple first mile/last mile connection with potential future expansion ■ Strong publicity for operating partners and region ■ Will ultimately be fully autonomous and not require attendants	■ Limited capacity ■ Current technology allows for relatively low speed only ■ Human attendants/operators currently required for safety reasons
Demand Response	Traditional Demand Response ("Dial-A-Ride")	■ Pooled shuttles or vans providing dynamic routing ■ Service operates within zones, but does not have set alignments or stops ■ Passengers reserve rides in advance (online or by calling)	■ Flexible routing and scheduling offers door-to-door service or similar level ■ No need to serve low-ridership locations all day ■ If necessary, responsive to trip change requests	■ High cancellation/no-show rate due trip reservation well in advance ■ Interface and process of reserving a trip can be cumbersome ■ Sometimes limited service hours (such as peak only or select weekdays)
	Microtransit	■ Pooled shuttles or vans providing dynamic routing ■ Service operates within zones, but does not have set alignments or stops ■ Passengers usually reserve rides through app-based system	■ Technology-enabled aspect allows for real-time vehicle booking and tracking ■ Flexible routing and scheduling offers door-to-door service or similar level ■ No need to serve low-ridership locations all day ■ Trip patterns can inform future fixed-route service development	■ Depending on trip requests, can be overwhelmed by areas of high demand

FIXED-ROUTE SERVICE FEASIBILITY CONSIDERATIONS

The Innovation Park Town Center Shuttle Service Feasibility Study scenario planning process faced the particular challenge of developing a transit service for a community anticipating a major development build-out over 20 years or longer. The proposed transit service should, as the Innovation Park Small Area Plan suggests, provide a shuttle service for “lunch, dinner, and recreation,” but should also serve the Virginia Railway Express (VRE) Broad Run Station as well as residents and workers gradually moving to the area.

While the Small Area Plan envisioned fixed-route service for Innovation Park, some communities are more suited for fixed-route service than others. For example, although the Innovation Park area anticipates major development leading to an influx of residents, workers, and visitors, the study area currently lacks a consistent, connected street grid. Moreover, certain stops—such as the VRE Broad Run Station—would currently only see peak rather than all-day demand.

For reference when considering the three scenarios, especially in the context of a phasing plan, **Table 6** lists and describes fixed-route service planning principles alongside each principle’s relevance to Innovation Park.

TABLE 6: FIXED-ROUTE SERVICE PLANNING PRINCIPLES

Fixed-Route Service Planning Principle	Principle Description	Relevance to Innovation Park Area
1. Service Should be Simple	For people to use transit, service should be designed so that it is easy to use and intuitive to understand.	A fixed-route service serving Innovation Park should include visible bus stops with clear signage, especially given that the area is up and coming.
2. Service Should Operate at Regular Intervals	In general, riders can easily remember repeating patterns, but have difficulty remembering irregular sequences. Where possible, fixed-route service should operate on a “clock-face” frequency, meaning that buses arrive at intervals which are factors of 60 (5, 10, 12, 15, etc.). If designed in such a way, passengers may arrive at a stop at the same time past the hour, each hour. This practice can attract and retain ridership.	The Feasibility Study’s implementation plan will make recommendations regarding frequency and span of service. Regardless of the mode chosen, this practice is ideal for any fixed-route service.
3. Routes Should Operate Along a Direct Path	The fewer directional changes a route makes, the easier it is to understand. Circuitous alignments are disorienting and difficult to remember.	While the Innovation Park area has major thoroughfares, some – such as Discovery Boulevard to 2 Silos Brewing Company and Innovation Drive – lack connectivity to other major corridors. This type of layout can cause fixed bus routes to retrace paths when returning to service.

Fixed-Route Service Planning Principle	Principle Description	Relevance to Innovation Park Area
4. Routes Should be Symmetrical	To the extent possible, routes should operate along the same alignment in both directions to make it easy for riders to know how to get back to where they came from.	Road patterns described above can hamper efficient bidirectional service. However, street grids such as the region surrounding the intersection of the future Hylton Center Boulevard and Katherine Johnson Avenue can allow for efficient, bidirectional service.
5. Routes Should Serve Well-Defined Markets	The purpose of a route should be clear, and each should include strong anchors and a mix of origins and destinations.	Strong anchors such as the VRE Broad Run Station, the GMU campus, and the future Town Center each have the potential to serve as well-defined markets and support this principle.
6. Service Should be Well-Coordinated	At major transfer locations, schedules should be coordinated to the greatest extent possible to minimize connection times for the predominant transfer flows.	Regardless of selected mode, any shuttle service should include well-timed connections to the existing GMU shuttle as well as any future OmniRide local service.

MICROTRANSIT SERVICE FEASIBILITY CONSIDERATIONS

Microtransit service involves the use of a mobile app, through which passengers have the ability to reserve trips to and from anywhere within a confined service zone during designated service hours. Microtransit offers the benefit of increased service flexibility and is useful in low to medium density transit demand areas. This service type can often convey moderate amounts of passengers with greater efficiency than fixed-route service. Riders are enticed by door-to-door service or similar and a more flexible schedule, while agencies benefit from potentially lower costs, higher ridership, not needing to serve low-ridership locations all day, and a rich amount of data generated for studying ridership patterns and improving service. Additionally, if microtransit achieves high ridership demand, it can be converted to fixed-route service when warranted.

The main drawbacks of microtransit are that it can be overwhelmed in areas of high demand, resulting in long wait and/or trip times for riders, and that the service may not be intuitive to users who are not familiar with the technology or have limited smartphone access. The first drawback can be mitigated by only deploying microtransit in lower demand areas where it can be successful, and with sufficient vehicles to meet demand. The latter can be addressed by providing alternate means of reserving trips, such as calling an operator to schedule, but will result in additional administrative costs.

AUTONOMOUS SHUTTLE SERVICE FEASIBILITY CONSIDERATIONS

Prince William County has expressed particular interest in providing an autonomous shuttle operate within the study area, given that the area serves as a hub for innovative technology research and application. Currently, nearly all autonomous shuttle pilot projects in the United States consist of small (6-12 passenger) low-speed (10-15 mph) vehicles that can operate without human intervention in most conditions; however, the vehicles generally have an on-board operator present if needed. These vehicles are often electric, have operating times of approximately six to eight hours from full charge, and a charging time of three to six hours.

Autonomous shuttles generally serve route distances of around one mile with few stops and free fares. While the vehicles can operate in mixed traffic, low-traffic and low-speed (posted speed limit under 25 mph) conditions are ideal. Thus, autonomous shuttles can have the greatest utility when serving as first mile-last mile connectors or as circulators serving local destinations, such as university campuses, stadiums, office parks, transit stations, and downtowns/entertainment areas.

Notable projects currently implemented include the following:

- **Fairfax, Virginia:** connecting the Mosaic District entertainment area to the Dunn Loring Metro station (just under one mile each way).
- **Ann Arbor, Michigan:** shuttle service around the University of Michigan's north campus for students and faculty (one-mile loop).
- **Arlington, Texas:** three routes serving an entertainment district and stadiums (each under a half-mile).
- **St. Petersburg, Florida:** shuttle service in entertainment district (under one mile each way)

In addition, in 2023, as part of the CTfastrak program, the Connecticut Department of Transportation is set to pilot a 40-foot transit bus in partnership with New Flyer industries. This project will operate as bus rapid transit on CTfastrak's nine-mile limited-access busway in Hartford, Connecticut, marking the first program of this type in the United States.

At this stage of development, several studies have concluded that automated shuttles have operational costs similar to current bus systems and therefore yield little cost benefit compared to a traditional electric shuttle bus. However, these costs will likely decrease as newer technology reaches full automation and eliminates the need for on-board staff. Additionally, multiple studies have determined that autonomous vehicles could yield substantial cost savings when implemented in lower-capacity, demand-response transit situations (such as paratransit).

Finally, autonomous vehicles, and partially autonomous shuttles, also have safety and operational benefits that will likely only improve over time:

- Autonomous steering control has been proven to allow buses to operate more safely in narrow lanes such as freeway shoulders, increasing roadway capacity.
- Adaptive cruise control allows buses to 'platoon' by reducing the minimum required braking distance between vehicles, dramatically increasing busway capacity.
- Precision docking technology allows buses to have level boarding similar to rail vehicles that are difficult with manual driving, offering boarding benefits to individuals with disabilities.

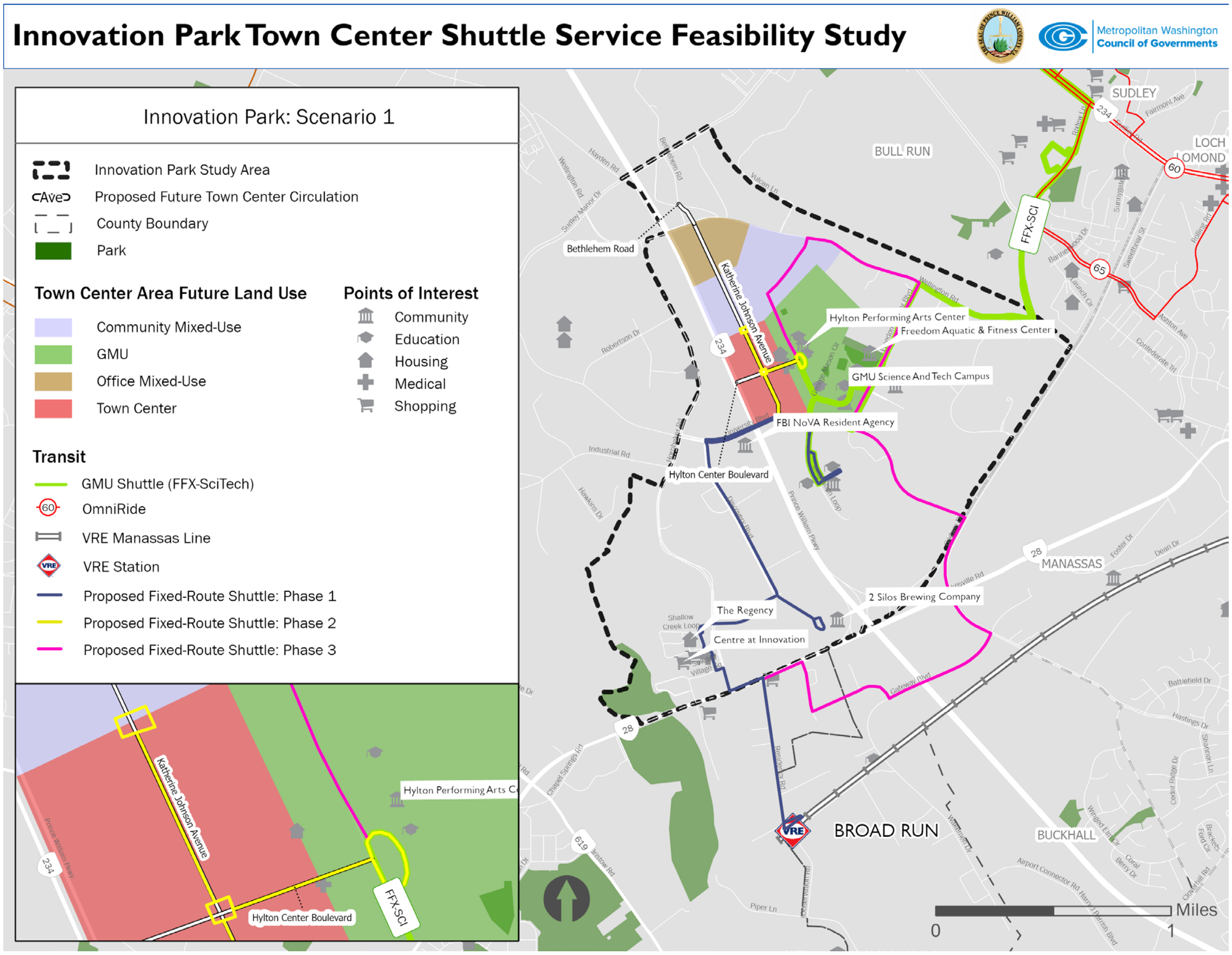
Scenario 1: Fixed-Route

OVERVIEW

Scenario 1 (**Figure 16**) consists of a bidirectional fixed-route shuttle with an alignment that most closely resembles the design featured in the Innovation Park Small Area Plan. Ideally, service would operate using clean technology such as battery electric buses, consistent with climate change mitigation goals adopted by Prince William County and the Metropolitan Washington Council of Governments. As shown in the map below, to allow travel demand to increase as the area densifies and planned developments are completed, Scenario 1 would be implemented in three phases:

- **Phase 1:** Via the proposed Residency Road connection, Phase I connects the VRE Broad Run Station with the Innovation Drive commercial area via the Centre at Innovation shopping center, Regency Apartments, 2 Silos, and the FBI facility. This alignment serves portions of the study area with existing development, prior to initial build-out.
- **Phase 2:** Building on Phase 1, Phase 2 expands coverage to provide service to the Innovation Park Town Center area. Phase 2 service would operate along Hylton Center Boulevard to the edge of the GMU campus and Katherine Johnson Avenue to the edge of the proposed Town Center land use zone. This service would connect to the proposed OmniRide fixed-route service outlined in the Existing and Future Conditions Assessment.
- **Phase 3:** Building on the Phase 2 alignment, Phase 3 provides additional coverage throughout the study area and slightly beyond. Key points of interest served would include the Freedom Center and apartments south of Nokesville Road. Phase 3 is heavily contingent on regional development greatly expanding outward from the Town Center area; it is thus slated for later implementation.

FIGURE 16: SCENARIO 1



FUTURE CONSIDERATIONS

Table 7 summarizes future considerations regarding Phases 1, 2, and 3 of Scenario 1. Fixed-route service in Innovation Park would most likely be operated by OmniRide, the primary fixed-route bus service provider in Prince William County. However, depending on funding arrangements, less likely arrangements involving GMU or developer-funded service could come into play. Given that Phase 1 would serve mainly existing development, implementation could occur in within five years. Phases 2 and 3 are respectively slated for the 5 to 10 and 10 to 20-year range to coincide with ongoing future development.

Outstanding questions associated with Scenario 1 span a wide range, including whether fixed-route service would be the most efficient option for the study area, short- or long-term. Moreover, while VRE has ultimately planned for all-day, bidirectional service to the VRE Broad Run Station, shuttle service operating to and from the station all day could prove to be inefficient. Future planning efforts must also consider potential duplication with the GMU shuttle as well as how quickly or slowly development in the region occurs.

TABLE 7: SCENARIO 1 FUTURE CONSIDERATIONS

Potential Operator(s)	Phasing and Timeline	Outstanding Questions
■ OmniRide ■ George Mason University ■ New Provider	■ Phase 1: 5 Years ■ Phase 2: 5-10 Years ■ Phase 3: 10-20 Years	■ Is fixed-route the best transit service solution for the area, given efficiency and connectivity constraints? ■ If peak-only service continues, how can the VRE Broad Run Station be served efficiently all day? ■ Will potential duplication of the GMU shuttle service cause issues, warranting further coordination between the shuttle operator and GMU? ■ How will phasing timelines warrant modification over time, as development in the area takes shape?

Scenario 2: Microtransit

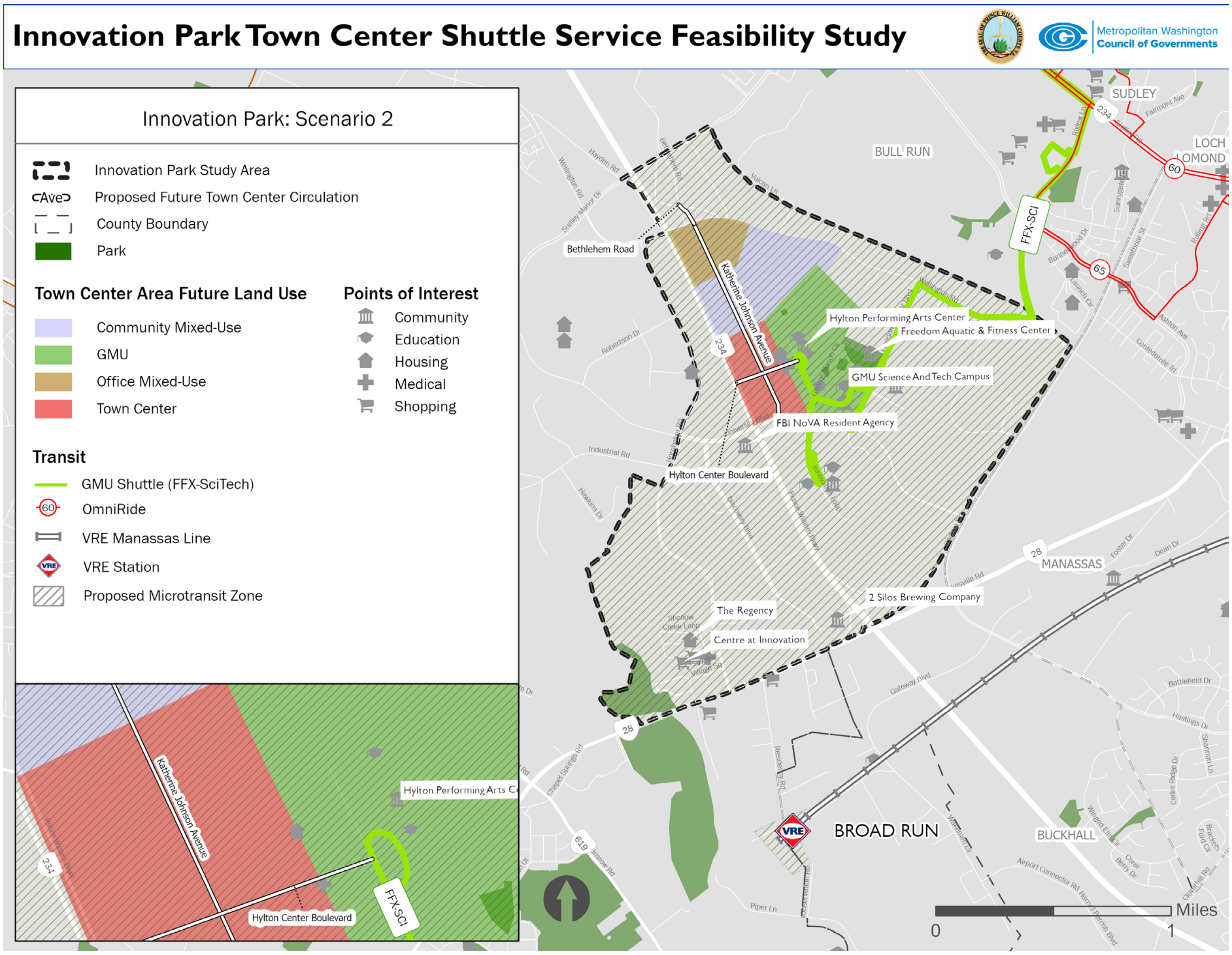
OVERVIEW

Scenario 2 (**Figure 17**) consists of a microtransit zone encompassing the entire Innovation Park study area as well as Broad Run VRE Station. Under this scenario, using a mobile app, passengers would have the ability to reserve trips to and from anywhere within this confined area during designated service hours.

In an area such as Innovation Park, where ridership patterns have not yet been established due to low existing residency and employment, microtransit is an ideal first service model. While microtransit can in some situations be overwhelmed by areas of high demand, the Innovation Park area would only require two to three vehicles for initial service, and would thus likely not result in high wait times or trip times (at least initially).

In addition, while microtransit can sometimes create challenges for users who are not familiar with the technology or have limited smartphone access, this drawback is less applicable to the study area, given that microtransit would be a brand new service without legacy transit users. Innovation Park microtransit would also likely serve a relatively younger (university students) and more tech-savvy population. Furthermore, for those unable to use a mobile app, the service could offer a telephone reservation system as an alternative. Microtransit can initially be implemented as a pilot program.

FIGURE 17: SCENARIO 2



FUTURE CONSIDERATIONS

Table 8 summarizes future considerations regarding Scenario 2. OmniRide is preparing to launch the first public microtransit service in the region and is currently listed as the only potential operating partner. Given the relative ease of implementing a service, depending on funding levels and other logistical challenges, microtransit could likely be operational within five years.

Outstanding questions mainly stem from potential operating models, of which microtransit typically has three that each offer different benefits and drawbacks. Agencies may select a microtransit operating model that best suits their needs:

- **Option 1: Turnkey services.** All elements, including vehicles, operators, and required software are provided by a private operator.
- **Option 2: Purchasing software as a service.** A transit agency provides vehicles and operators but uses purchased, private software to connect riders with vehicles.
- **Option 3: Some combination of Options 1 and 2.** Options 1 and 2 can be combined to different degrees, such as agencies providing vehicles while a private company provides operators and software. While this model is relatively easy for agencies (as they simply have to fund service), it can suffer from lower levels of oversight, and available ridership data can be limited.

An additional outstanding question regards service phasing. As ridership increases over time, a microtransit service may require implementation of additional vehicles and/or flexible routing patterns. In addition, if microtransit is successful, future planning efforts will need to determine whether to continue and/or expand implementation of this service model, or to pivot to fixed-route service.

TABLE 8: SCENARIO 2 FUTURE CONSIDERATIONS

Potential Operator(s)	Phasing and Timeline	Outstanding Questions
▪ OmniRide	▪ Initial Implementation: Within 5 Years	▪ Will the operating model be a turnkey service, or will the agency provide the vehicles and operators and purchase software as a service? ▪ How will service be phased as the area develops?

Scenario 3: Autonomous Shuttle

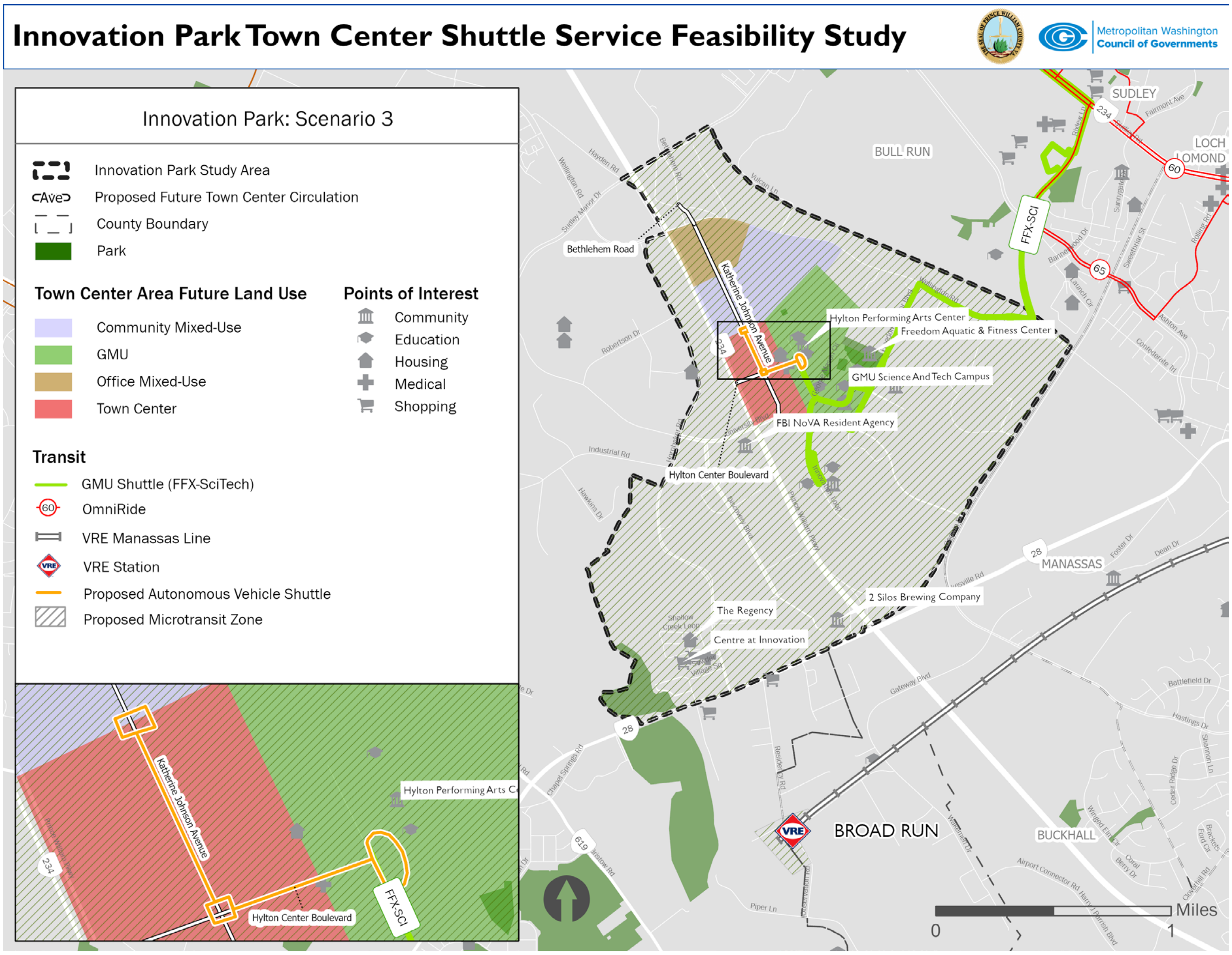
OVERVIEW

Scenario 3 (**Figure 18**) includes the same microtransit zone shown in Scenario 2, with the addition of an autonomous shuttle looping around the GMU campus and the Innovation Park Town Center. The autonomous shuttle would connect the GMU Campus to the Town Center along the future Hylton Center Boulevard and Katherine Johnson Avenue, in a loop spanning approximately one mile (both directions).

The addition of an autonomous shuttle would supplement microtransit service in the future highest density area of Innovation Park, thereby alleviating future demand on microtransit, and avoiding long wait and trip times. This assumption is of course contingent on the success of microtransit in the Innovation Park study area.

The proposed route is ideal for a low-speed autonomous shuttle operation moving six to 12 passengers per vehicle. Moreover, the shuttle would serve two distinct anchors—GMU and the Innovation Park Town Center—and provide excellent publicity for the burgeoning area.

FIGURE 18: SCENARIO 3



FUTURE CONSIDERATIONS

Table 9 summarizes future considerations regarding Scenario 3. While OmniRide would likely operate microtransit service, GMU has expressed interest in coordinating on implementation of an autonomous shuttle, potentially through a partnership with the College of Engineering. Such a partnership would offer the opportunity for some costs to be funded through research grant opportunities. Additionally, the presence of an autonomous shuttle would showcase the Innovation Park area and GMU as a tech-savvy and innovative area, possibly attracting other companies and/or residents to the area.

Consistent with Scenario 2, microtransit is slated for implementation within five years. The initial autonomous shown in Scenario 3 would be implemented within five to ten years. In addition, contingent on developing technology, additional autonomous shuttles or vehicles serving the Innovation Park area are listed for potential implementation within 10 to 15 years. Exact routing and service characteristics would be determined at a later date.

Outstanding questions ponder whether an microtransit demand would ultimately rise to the point of requiring a supplemental fixed-route service to alleviate long wait times. In addition, as the autonomous vehicle technology develops, the potential for advanced, faster, higher capacity service remains to be discovered.

TABLE 9: SCENARIO 3 FUTURE CONSIDERATIONS

Potential Operator(s)	Phasing and Timeline	Outstanding Questions
■ OmniRide (Microtransit) ■ George Mason University (Autonomous Shuttle)	■ Microtransit: Initial Implementation Within 5 Years ■ Autonomous Shuttle: 5-10 years ■ Autonomous Shuttle or Bus Expansion: 10-15 Years	■ Will microtransit demand rise to the level of requiring supplemental service? ■ Will an autonomous shuttle complement microtransit service or compete against it, making both less productive and efficient? ■ How far along will autonomous shuttle or bus technology be at the time of implementation?

Feedback on Service Scenarios

The three scenarios outlined in this document were presented in two venues: a stakeholder workshop and a Prince William County Planning Commission meeting. Feedback received was incorporated into refining the scenarios and developing a preferred alternative. The details of each meeting and a summary of feedback received are presented below.

STAKEHOLDER WORKSHOP

Participants

The stakeholder workshop was held on January 19, 2022, and included representatives from the following organizations:

- Prince William County.
- Virginia Railway Express (VRE).
- Potomac and Rappahannock Transportation Commission (OmniRide).
- George Mason University (GMU).
- Northern Virginia Community College.
- Metropolitan Washington Council of Governments (MWCOG).

Summary of Feedback

In general, key feedback fell into several categories:

- **Coordination with Current Service.** Participants expressed the viewpoint that any transit service should connect well with existing services and schedules (such as VRE at Broad Run and the GMU shuttle).
- **Service Evolution/Phasing.** Stakeholders noted that service should evolve as development occurs, considering microtransit in the near-term and fixed-route in the long term (to reap the benefits of consistency and visibility).
- **Autonomous Vehicles.** Participants were in favor of autonomous vehicles implementation to align with the innovative concept or theme of Innovation Park.
- **Regional Expansion and Multimodalism.** Participants encouraged future shuttle connections to areas outside the study area, such as Historic Manassas and commuter lots. Stakeholders highlighted the importance of appropriate bus stop amenities and bicycle/pedestrian connection.

Additional feedback is summarized by theme below.

VRE STATION CONNECTION

Workshop participants debated the merits of connecting a future shuttle to Manassas VRE Station instead of Broad Run VRE station. Key associated benefits included additional connections to Amtrak and OmniRide service as well as an option to connect Innovation Park residents with restaurants, shops, and entertainment in Old Town Manassas. This plan would also provide patrons of performances at the Hylton Performing Arts Center with a connection to businesses before or after shows.

In contrast, participants also noted that Innovation Park to Manassas would be a significantly longer shuttle route. After the Broad Run VRE Station expansion is completed, bus service will be able to access the north side of the station and avoid an at-grade crossing, providing fast and easy station access. Additionally, a planned OmniRide route would connect Innovation Park to Manassas.

MICROTRANSIT

Participants discussed potential benefits of microtransit in the study area, including: greater service flexibility and a good starting point to build on for future service; implementation of a new service with a more tech-savvy ridership base; and potential conversion to fixed-service route in the future if demand warrants this.

In the context of potential microtransit implementation models, stakeholders also considered not using a turnkey service due to lack of control and data; not overlapping fixed-route and microtransit due to operational redundancies and cost inefficiencies; and operating with at least two to three vehicles to maintain reliable wait and trip times. Additionally, a hybrid model could be implemented that has fixed-route running in the areas of highest demand and microtransit in the remainder of the area.

MISCELLANEOUS

Participants also briefly discussed other miscellaneous topics, including:

- GMU expressed an interest in partnering to develop the potential autonomous shuttle, as the College of Engineering has labs, facilities, and researchers with experience with the US Department of Transportation and autonomous vehicle technology.
- The name “Katherine Johnson Avenue” may be confusing as GMU has “Katherine Johnson Hall” on Freedom Center Boulevard and King Lane.
- The ellipse at the end of the future Hylton Center Boulevard will soon be changing due to construction on GMU’s campus. This construction will require coordination with Town Center developers.
- Participants expressed concern regarding phasing of pedestrian infrastructure with transit in the area. The Town Center will be pedestrian-oriented when constructed; however, the remainder of the study area is likely less high of a priority for pedestrian infrastructure.

PLANNING COMMISSION

Summary of Feedback

The three scenarios were presented to the Prince William County Planning Commission on February 23, 2022. After the presentation, Commissioners had several questions regarding the planned service. Questions and posited responses are shown below.

TABLE 10: PRINCE WILLIAM COUNTY PLANNING COMMISSION FEEDBACK

Question	Response
Is there a fee to the user for microtransit?	Yes, there is a fee, comparable to a regular transit trip. This would be significantly cheaper than a rideshare service such as Uber or Lyft.
Will the shuttle be supporting bicycles onboard?	Some cutaway bus or van models (as used for microtransit) have bicycle racks; this is a topic for future consideration.
Will the shuttle vehicles be electric vehicles?	It is preliminarily proposed that vehicles for service would be electric vehicles; autonomous shuttles would definitely be electric vehicles.
Innovation Park borders City of Manassas. Are there plans to work with the City of Manassas on this initiative?	Due to a limited scope, this plan focuses on Innovation Park and can be used as a springboard for future opportunities, to which the City of Manassas is receptive.
Are dedicated bus lanes needed and/or being considered?	The area is small and currently has little development. For this reason, dedicated lanes are not part of the current plan but will be studied in the future if traffic conditions necessitate.
Are bikeshare and/or scootershare being considered?	This study focuses on shuttle service, but bikeshare/scootershare could be the focus of another grant.
Are services presented exclusive or could multiple be implemented?	Multiple could be implemented, including fixed-route or microtransit simultaneously.
Is there any consideration of connecting with the NVCC campus in Manassas?	NVCC is no longer operating in Innovation Park, and there has not been discussion about expanding to NVCC Manassas. This is potentially a topic for future study.

PREFERRED SCENARIO IMPLEMENTATION PLAN

Preferred Scenario Overview

Based on analyses performed and feedback received during the scenario development process, **Table 11** outlines a three-phase, approximately 25-year transit service plan for the Innovation Park area:

- **Phase 1 (Years 3-5).** Transit service will commence with a pilot microtransit program to be implemented three to five years from the conclusion of this study. Within a set zone, microtransit will offer point-to-point connections as the regional development buildout continues, serving an area that is not yet sufficiently densely populated with jobs or residents to support traditional fixed-route service. Effective microtransit service will also serve as an attractor for the study area. Microtransit will address issues associated with serving Virginia Railway Express (VRE) trains at Broad Run Station, once mid-day service is introduced, and inefficient route deviations. Finally, microtransit service will allow for the analysis of emerging trip patterns that can be used in the future to determine when and where fixed-route transit service may be warranted.

  Given that OmniRide will likely serve as the microtransit operator to connect with the greater OmniRide local bus network, the Innovation Park microtransit service will offer limited daily service to Manassas Mall. These trips will be pre-scheduled, allowing riders to book a ride to the mall at a few designated times throughout the service day. If no seats are booked for a particular departure time, the microtransit vehicle assigned to the Manassas Mall trip will continue to provide on-demand service within the Innovation Park area instead.

  Finally, Phase 1 includes a research initiative – likely in partnership with George Mason University – to study autonomous shuttle implementation in Innovation Park.

- **Phase 2 (Years 5-10).** Implemented between five and 10 years from the completion of the study, Phase 2 will continue and potentially expand the microtransit zone initiated as a pilot program in Phase 1.

  An autonomous vehicle shuttle will be introduced by Year 10 to operate at low speed between the GMU campus and Innovation Park Town Center, as originally outlined in Scenario 3. If the technology on autonomous vehicles has progressed further by Year 10, this plan may be reevaluated accordingly.

- **Phase 3 (Years 10-25).** Phase 3 involves implementation of fixed-route service, split into two parts:

  - *Phase 3a (Years 10-20).* In Phase 3a, microtransit service will be phased out, and traditional (non-autonomous) fixed-route service will be introduced.[3] The first phase of Innovation Park fixed-route service will consist of fixed-route service from Broad Run VRE to Innovation Park Town Center/GMU via current Innovation Park destinations (such as 2 Silos Brewing Company, Regency Apartments, and the FBI office located on Discovery Boulevard). Depending on development conditions at the time of implementation as well as whether microtransit service reveals certain origin-destination patterns, this first phase alignment will likely mirror the first two phases of original Scenario 1. Autonomous vehicle shuttle service is slated to continue during this phase.

    Simultaneously, as microtransit is phased out in favor of fixed-route service, as referenced in the Existing and Future Conditions assessment, OmniRide may begin its planned fixed-route service from Innovation Park to Old Town Manassas during Phase 3a.

[3] This transition is contingent on the relative success of microtransit and/or the technology associated with autonomous vehicles at the time of transition. Depending on the technological capability of autonomous vehicles, autonomous vehicle technology could supplant traditional fixed-route by the time of Phase 3's implementation.

- *Phase 3b (Years 20-25)*. Phase 3b calls for implementation of additional fixed-route service in the Innovation Park region, after the region is fully built out. Depending on development and origin-destination patterns, the Phase 3b service alignment will likely be similar to what is shown as the third phase of original Scenario 1.

The Innovation Park preferred transit scenario implementation plan is contingent on development occurring in the Innovation Park area. While a variety of developments are planned, the Innovation Park Town Center and University Village developments are currently slated for completion by 2030 and 2026, respectively. Accounting for potential delays and additional developments, this transit service plan takes these timelines into account.

TABLE 11: INNOVATION PARK TRANSIT SERVICE SCENARIO PHASING PLAN TIMELINE

Service Overview	Description	Phase 1	Phase 2	Phase 3a	Phase 3b
		Years 3-5	*Years 5-10*	*Years 10-20*	*Years 20-25*
Microtransit with Select Trips	■ Microtransit Zone: Innovation Park + Broad Run VRE[4] — Select trips available by reservation to Manassas Mall to connect with OmniRide service — If trips are not reserved, vehicles operate as traditional microtransit			--	--
Autonomous Vehicle Shuttle	■ Small autonomous vehicle shuttle: GMU/Innovation Park Town Center loop	*Research Initiative*			
Innovation Park Fixed-Route: Phase I	■ Fixed-route service from Broad Run VRE to Innovation Park/GMU via FBI, 2 Silos (combination of original Scenario 1 Phases 1 and 2)	--	--		
Innovation Park Fixed-Route: Phase II	■ Fixed-route service to include future Innovation Park area destinations (original Scenario 1 Phase 3)	--	--	--	
OmniRide Innovation-Manassas Fixed Route	■ OmniRide planned fixed-route service from Innovation Park to Old Town Manassas/Manassas VRE	--	--		

4. Microtransit service to Broad Run Station will begin once mid-day VRE service becomes available (currently expected between 2026 and 2030).

Preferred Scenario Phase 1 (Years 3-5)

OVERVIEW

Table 12 summarizes Phase 1 of the preferred transit scenario, tentatively set for operation by three to five years after completion of the feasibility study. Under Phase 1, A pilot microtransit program will serve the Innovation Park study area as well as the Broad Run VRE Station (once mid-day VRE service begins). Through a mobile app (with an option for phone reservations for those who do not have access to a smart phone), passengers will be able to make same-day reservations for point-to-point trips, likely provided on cutaway buses or vans.

This service will begin with two battery electric vehicles operating concurrently during peak service. For efficiency purposes, the microtransit service will follow a combined public-private model. As OmniRide is the most likely operator of the proposed service[5], it is recommended that the agency employ its own vehicles and drivers while contracting with a microtransit platform provider to implement on-demand trip reservation technology, including a mobile app.

To connect with the greater OmniRide local bus network, the microtransit service will offer up to four pre-scheduled trips per weekday to and from Manassas Mall, tentatively set to originate at the GMU campus loop. Trip times will be coordinated for transfers with local OmniRide service. Passengers will have the opportunity to reserve seats on these trips through the mobile app. If no seats are reserved on a trip, the microtransit vehicle assigned to the trip will simply revert to providing on-demand service within the Innovation Park service zone.

In addition, while operation of an autonomous shuttle is slated to begin in Phase 2 of the preferred scenario, Phase 1 calls for a research initiative—likely in partnership with or led by George Mason University's Science and Technology campus—to study autonomous shuttle implementation in Innovation Park. Under the proposed plan, academic researchers and/or students across engineering and other disciplines would utilize this time to effectively investigate factors necessary for autonomous shuttle operation, such as:

- The optimal type of autonomous vehicle to operate within the Innovation Park Small Area Plans roadways.
- Optimal location and type of electric vehicle charging infrastructure (including at a depot or on-route).
- Emerging technological advances that might improve autonomous shuttle capacity and speed.
- Emerging technological advances to improve autonomous shuttle safety, including ability to operate independently without safety attendants.
- Pilot program structure, including proposed span and frequency, as well as total pilot duration.
- Future locations for autonomous vehicles in the Innovation Park area, outside of the primary alignment proposed in Phase 2.
- Proposed stop locations.
- The preferred operator for the service, ranging from GMU to a public or private entity.
- Methods to market autonomous shuttles as a hallmark of innovation within the Innovation Park area and the Science and Technology campus.

A proposed alignment for an autonomous shuttle, looping from the western edge of George Mason University to Innovation Park Town Center, is shown in Preferred Scenario Phase 2.

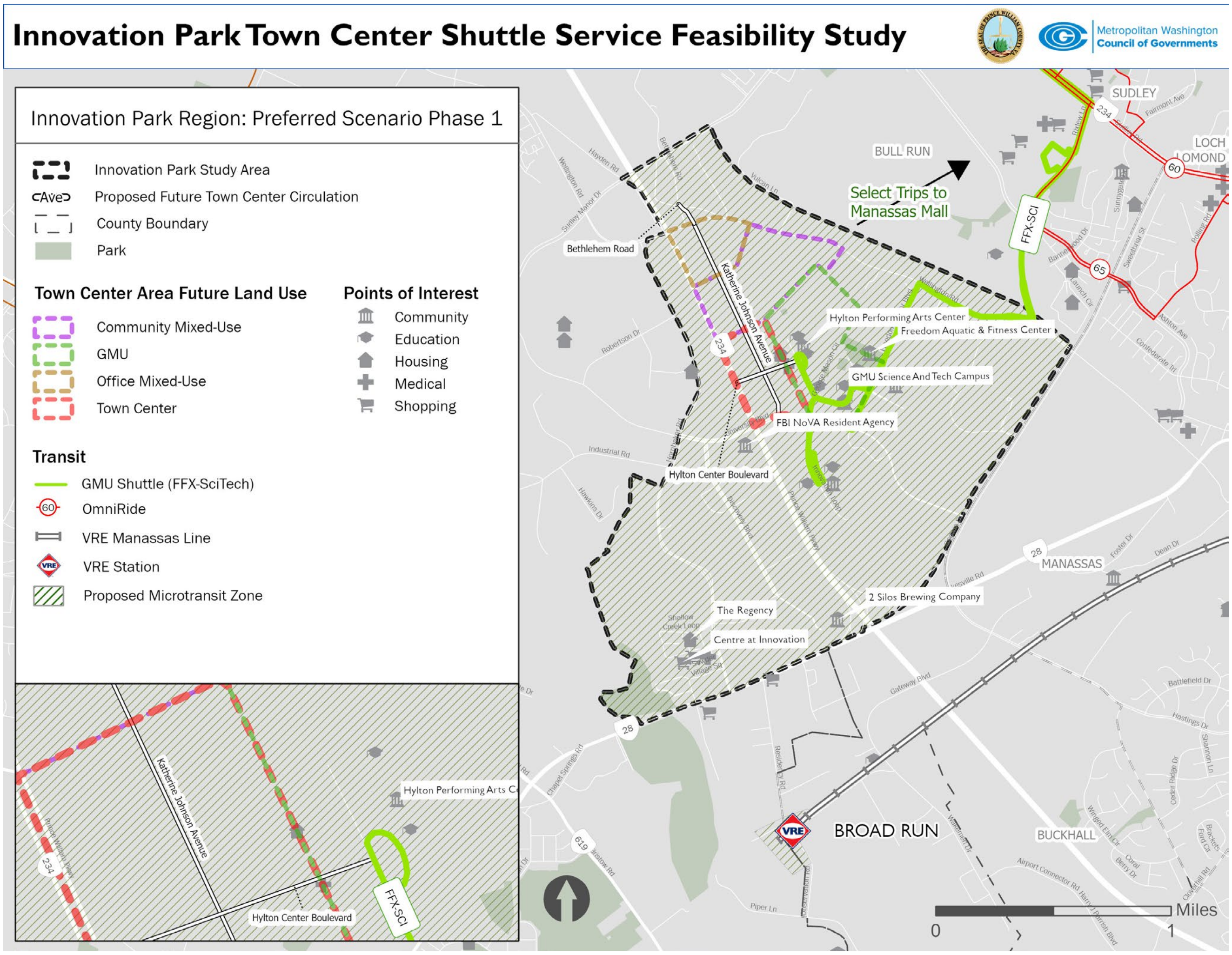
5 OmniRide's status and experience as the primary provider of local public transportation services in the region makes the agency a strong candidate to operate future microtransit service in the study area. However, other providers may also be considered.

TABLE 12: PREFERRED SCENARIO PHASE 1 OVERVIEW

Service Type	Likely Operator	Description
Microtransit (Public Operator and Vehicles; Private Technology)	OmniRide (PRTC)	▪ Microtransit Zone: Innovation Park + Broad Run VRE (once mid-day VRE service begins) ▪ Two electric vehicle cutaway buses or vans in peak service ▪ Select Innovation-Manassas Mall trips available by reservation to connect with OmniRide service — If trips are not reserved, vehicles operate as traditional microtransit

The microtransit zone covering Preferred Scenario Phase 1 is depicted in **Figure 19**.

FIGURE 19: PREFERRED SCENARIO PHASE 1



LEVEL OF SERVICE

Table 13 summarizes the proposed initial level of service for the Innovation Park microtransit service (Phase 1). Service is set to operate with two vehicles from 8:00 a.m. to 6:00 p.m. on weekdays, and 10:00 a.m. to 6:00 p.m. on Saturdays and Sundays. Service will be delivered on-demand, including four scheduled (reservable) trips to and from Manassas Mall on weekdays.

This level of service is meant to balance local mobility with financial viability. The operation of two vehicles will help keep wait times and travel times low in order to attract a wide range of riders, including choice riders who are most likely to be time-sensitive. The proposed span of service can accommodate internal commuters as housing options increase in the study area; daytime passengers seeking a lunch or recreation shuttle; and riders connecting to and from the VRE, once the commuter rail service is expanded beyond directional peak-period trips only.

Depending on factors such as the success of continued service and VRE's future service implementation plans, future phases may include expanded microtransit service hours.

TABLE 13: PHASE 1 PROPOSED LEVEL OF SERVICE

Service	Weekday		Saturday		Sunday	
	Span	Frequency	Span	Frequency	Span	Frequency
Innovation Park Microtransit	8:00 a.m. – 6:00 p.m.	On-Demand + Four Pre-Reserved Trips Each Way	10:00 a.m. – 6:00 p.m.	On-Demand	10:00 a.m. – 6:00 p.m.	On-Demand

ANTICIPATED COSTS

Operating Costs

Table 14 summarizes likely annual microtransit operating costs, assuming two vehicles operating during the service hours listed above. Service operating over 10 daily weekday and eight daily weekend hours will amount to 20 weekday daily vehicle hours and 16 weekend daily vehicle hours.

Based on OmniRide estimates, the hourly operating cost for microtransit service in coming years will be approximately $60 per vehicle hour. Assuming that service will operate over approximately 254 weekdays, 52 Saturdays, and 51 Sundays per year (and eight annual days in which service does not operate), total annual operating costs in Year One will come to just over $403,000[6], not including ongoing microtransit technology costs.

TABLE 14: PHASE 1 MICROTRANSIT OPERATING COSTS

	Weekday	Saturday	Sunday
Vehicle Operating Hours per Day (Assuming Two Vehicles)	20	16	16
Assumed Service Days per Year	254	52	51
Annual Vehicle Hours	5,080	832	816
Cost per Vehicle Hour	$60	$60	$60
Annual Operating Costs per Day Type	**$304,800**	**$49,920**	**$48,960**
Total Annual Operating Costs	**$403,680**		

6 All costs presented in 2022 Dollars.

Capital/One-Time Costs

Capital and one-time costs include the costs of purchasing microtransit vehicles, software installation fees, and annual software maintenance fees. While each of these costs can vary greatly, **Table 15** provides total capital cost estimates for Years One to Two of this service based on peer examples, and on the following assumptions:

- It is assumed that OmniRide, as the presumed operator of the proposed service, will purchase three battery electric buses or vans, including two peak vehicles and one spare. Selected vehicles should be ADA accessible and allow for wheelchair access.
- OmniRide has explored purchasing vehicles through the Federal Transit Administration's Low or No Emission Vehicle Program, and estimates that each vehicle could cost approximately $200,000, including each necessary charging station.[7] For reference, several small electric bus or van quotes and related information (dated 2021) are listed in **Table 16**, with prices ranging from $79,000 to over $228,000.
- Due to the relatively small size of the Innovation Park microtransit zone, vehicles are likely to be charged at the OmniRide Western Maintenance Facilityor at one location within the zone that allows ample parking space. The future electricity costs of charging these vehicles, while not forecasted in this document, should be taken into consideration with respect to microtransit, traditional fixed-route, and autonomous fixed-route vehicles. Depending on the scale of future operations, installing infrastructure may involve coordination with the local utility. OmniRide and/or Prince William County may wish to budget additional funds to allow a contingency for unanticipated infrastructure costs.
- OmniRide tentatively intends to supply microtransit vehicles and operators while contracting with a private firm to provide technology infrastructure on-board buses and through a mobile app. Based on estimates from several companies (provided in **Table 17**), the software installation fee is estimated to be a one-time cost of $50,000; ongoing annual software fees are anticipated to come to approximately $600 per vehicle, per month.

Based on these assumptions, capital costs are expected to total over $671,000 in Year One, and over $21,000 in subsequent years (depending on selected providers and existence of additional fees).

TABLE 15: PHASE 1 VEHICLE TECHNOLOGY COSTS

Item	Amount
Total Vehicles Needed (Two Peak Vehicles + One Spare; Vehicles Necessary to Provide a Median 15-Minute Wait Time)	Three Vehicles
Cost per Vehicle	$200,000
Total Vehicle Purchase Cost	$600,000
One-Time Software Installation Fee (Entire System)	$50,000
Annual Software Fee (Assuming 3 Vehicles at $600/Vehicle/Month)	$21,600
Year One Capital Cost (Vehicle Purchase Cost + One-Time Installation Fee + Annual Software Fee)	**$671,600**
Year Two Capital Cost (Annual Software Fee Only)	**$21,600**

[7] Depending on vehicle size, battery electric buses may be charged at a depot or at any available public charger (the locations of which are increasing in numbers throughout the country).

REFERENCE INFORMATION

TABLE 16: PHASE 1 ZERO EMISSIONS VEHICLE COST ESTIMATES (BASED ON 2021 PRICE QUOTES) AND SPECIFICATIONS

Vehicle	Base Price	Capacity	Range per Charge	Energy Storage Capacity
Lightning Systems LEV60/120	$79,900	15 Passengers	60-120 Miles	43-86 kWh
GreenPower EV Star Min-e Bus – 25'- Shuttle Bus	$172,900	14 Seated Passengers + 2 Wheelchair Positions	150 Miles	118 kWh
Phoenix Zeus 400 – 22' Shuttle Bus	$225,000	16 Passengers + 2 Wheelchair Positions	70-160 Miles	63-156 kWh
Motiv Power Systems F-59 Shuttle Bus	$228,095	Variable	105 Miles	127 kWh

TABLE 17: PHASE 1 MICROTRANSIT SOFTWARE PROVIDER QUOTES

Provider	Startup (Installation) Fee	Annual Software Fee
TransLoc	$20,000	$500/Vehicle/Month
Via	$40,000 - $60,000; may include additional charge depending on number of zones	$600/Vehicle/Month
Spare	$10,000 - $15,000 (Annual Platform Fee; Not One-Time)	$600/Vehicle/Month

PREFERRED SCENARIO IMPLEMENTATION PLAN

Preferred Scenario Phase 2 (Years 5-10)

OVERVIEW

Table 18 summarizes Phase 2 of the preferred scenario transit plan, tentatively set for operation within five to ten years after completion of the feasibility study. During Phase 2, microtransit proposed for Phase 1 will remain in operation, with an option to expand service hours and/or number of vehicles, as warranted by service performance and financial considerations.

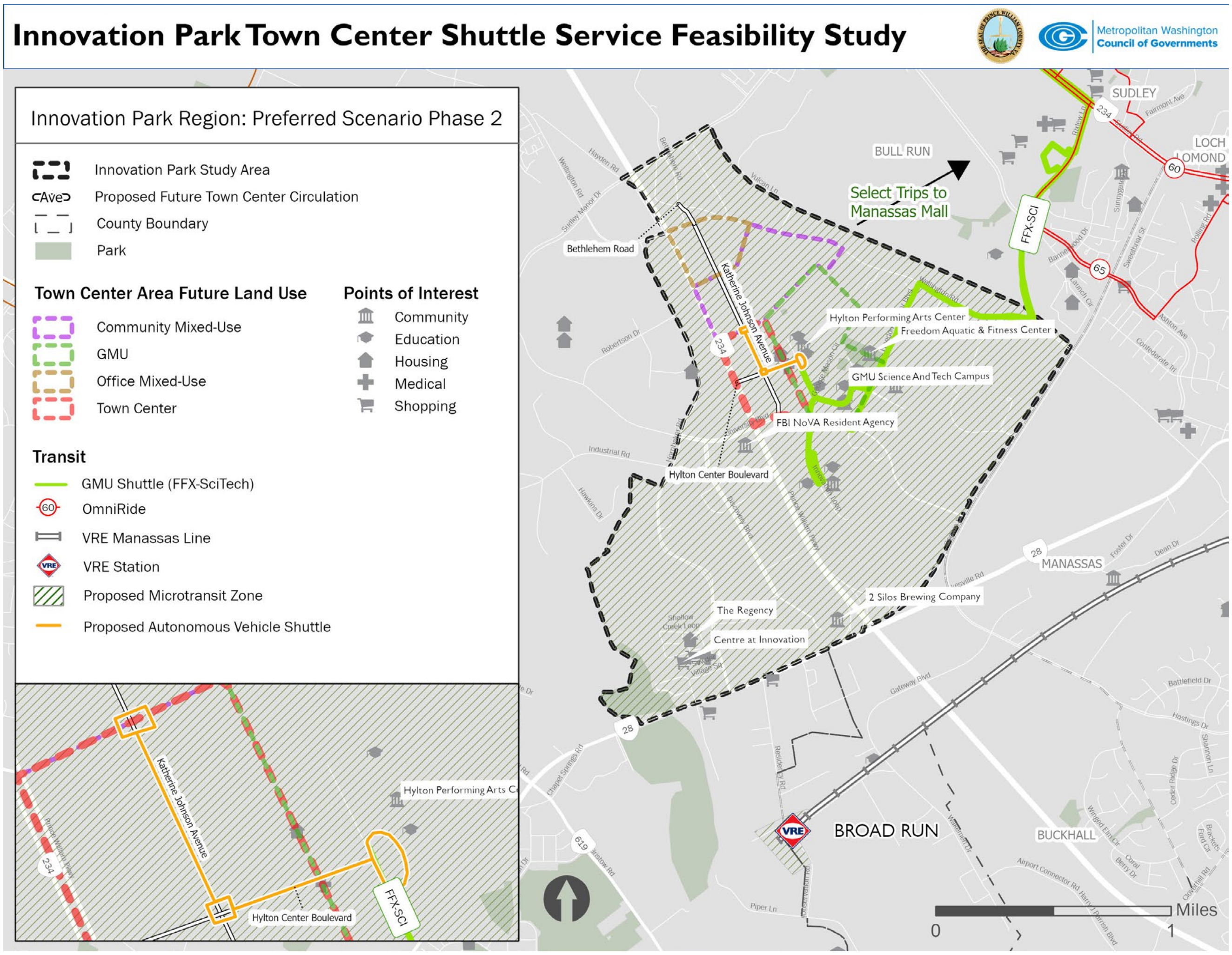
Phase 2 will include completion of the autonomous vehicle shuttle research initiative commenced in Phase 1, and implementation of an autonomous shuttle serving the edge of George Mason University to Innovation Park Town Center. Currently, the shuttle is anticipated to operate as a low-speed, autonomous electric vehicle. This fixed-route service will connect with George Mason University's Fairfax-SciTech shuttle at the campus loop location. It is preliminarily proposed in this study that George Mason University operate the autonomous vehicle shuttle, which would attract positive attention to the Science and Technology campus. The research initiative executed as part of Phase 1 would determine the optimal operator of the shuttle.

TABLE 18: PREFERRED SCENARIO PHASE 2 OVERVIEW

Service Type	Likely Operator	Description
Microtransit (Public Operator and Vehicles; Private Technology)	OmniRide (PRTC)	■ Microtransit Zone: Innovation Park + Broad Run VRE ■ Two electric vehicle cutaway buses or vans in peak service ■ Select Innovation-Manassas Mall trips available by reservation to connect with OmniRide service — If trips are not reserved, vehicles operate as traditional microtransit
Innovation-GMU Autonomous Vehicle Shuttle	George Mason University (and/or in partnership with a private entity)	■ Small autonomous vehicle shuttle: GMU/Innovation Park Town Center loop

Preferred Scenario Phase 2 is shown in **Figure 20**.

FIGURE 20:PREFERRED SCENARIO PHASE 2



LEVEL OF SERVICE

Table 19 summarizes levels of transit service proposed for Phase 2 operations. At this time, while the potential for expanded service hours should be explored during Phase 2, microtransit service is proposed to remain at the same level of service as operated in Phase 1.

The autonomous shuttle will operate as a pilot program for up to six hours on weekdays and four hours on weekends. Shuttles will arrive every 30 minutes.

TABLE 19: PHASE 2 PROPOSED LEVEL OF SERVICE

Service	Weekday		Saturday		Sunday	
	Span	Frequency	Span	Frequency	Span	Frequency
Innovation Park Microtransit	8:00 a.m. – 6:00 p.m.	On-Demand + Four Pre-Reserved Trips Each Way	10:00 a.m. – 6:00 p.m.	On-Demand	10:00 a.m. – 6:00 p.m.	On-Demand
Innovation-GMU Autonomous Shuttle	10:00 a.m. – 4:00 p.m.	30 Minutes	12:00 p.m. – 4:00 p.m.	30 Minutes	12:00 p.m. – 4:00 p.m.	30 Minutes

ANTICIPATED COSTS

Anticipated costs for all electric, ADA-compliant autonomous shuttles will likely change over the course of Phases 1 and 2 of the preferred transit service scenario. Cost estimates based on information currently available are provided below.[8]

Operating Costs

Table 20 summarizes operating cost estimates for the Innovation-GMU autonomous shuttle. Given that safety attendants currently staff all autonomous shuttle programs in the United States, operating costs are assumed to remain the same as those for microtransit - $60 per vehicle hour. Service would operate one vehicle during all service hours. Given these assumptions, total annual operating costs are estimated to be just above $116,000.

TABLE 20: AUTONOMOUS SHUTTLE OPERATING COSTS

	Weekday	Saturday	Sunday
Vehicle Operating Hours per Day (Assuming One Vehicle)	6	4	4
Assumed Service Days per Year	254	52	51
Annual Vehicle Hours	1,524	208	204
Cost per Vehicle Hour	$60	$60	$60
Annual Operating Costs per Day Type	**$91,440**	**$12,480**	**$12,240**
Total Annual Operating Costs	**$116,160**		

8 Microtransit costs are assumed to remain consistent with those shown in Phase 1 and are not summarized in this section.

Capital/One-Time Costs

Capital and one-time costs include the costs of leasing or purchasing autonomous shuttles, software installation fees (if applicable), and annual software maintenance fees. **Table 21** provides total capital cost estimates for Years One to Two of this service based on the following assumptions:

- It is assumed that the shuttle operator will purchase or lease up to two electric autonomous shuttles. Selected vehicles should be ADA accessible and allow for wheelchair access. Based on the results of the research initiative, one total vehicle may be deemed sufficient for this effort.
- Autonomous vehicle purchase or leasing costs can vary from approximately $200,000 to $400,000. Due to this variation, figures stated in **Table 21** pertain to a high estimate, the Perrone Robotics AV Star vehicle. The cost provided per vehicle ($400,000) includes software and setup costs. These costs are assumed to be one-time.
- The Perrone Robotics AV Star includes an annual support cost of $8,500. It is assumed that this fee is applied for the entire service rather than per vehicle.

Based on these assumptions, capital costs are expected to total up to $808,500 in Year One, and $8,500 in subsequent years (depending on selected providers and existence of additional fees).

TABLE 21: PHASE 2 AUTONOMOUS SHUTTLE CAPITAL COSTS

Item	Amount
Total Vehicles Needed (One In-Service Vehicle + One Spare)	Two Vehicles
Cost per Vehicle, Including Software and Setup (likely to lease rather than purchase)	$400,000
Total Vehicle One-Time Cost	$800,000
Annual Support Fee	$8,500
Year One Capital Cost **(Vehicle Purchase Cost + One-Time Installation Fee + Annual Software Fee)**	**$808,500**
Year Two Capital Cost (Annual Support Fee Only)	**$8,500**

Preferred Scenario Phase 3 (Years 10-25)

OVERVIEW

Table 22 summarizes Phase 3 of the preferred scenario transit plan, tentatively set for operation in two parts: Phase 3a will run from 10 to 20 years after the feasibility study's completion; Phase 3b will run from 20 to 25 years after completion of the feasibility study. Overall, Phase 3 signals the full transition from microtransit to autonomous and traditional fixed-route service:

- The Innovation-GMU autonomous shuttle is slated to continue in Phase 3; service hours are subject to reevaluation at the start of Phase 3. This program will be assessed within the context of whether to continue service, lease or purchase additional vehicles, expand autonomous shuttles across the Innovation Park area, and/or upgrade to improved autonomous technology. As aforementioned, depending on the technological capability of autonomous vehicles, autonomous vehicle technology could supplant traditional, operator-driven fixed-route by the time of Phase 3's implementation.
- Innovation Park Fixed-Route Phase I (Phase 3a) will consist of fixed-route service from Broad Run VRE to Innovation Park/GMU via current Innovation Park destinations, such as FBI, Regency Apartments, and 2 Silos Brewing Company.
- Innovation Park Fixed-Route Phase II (Phase 3b) provides additional coverage throughout the study area and slightly beyond. Key points of interest served would include the GMU Freedom Center and apartments south of Nokesville Road. Phase 3 is heavily contingent on regional development greatly expanding outward from the Town Center area; it is thus slated for later implementation.
- During Phase 3a, OmniRide may choose to implement its proposed Innovation-Old Town Manassas route. This route will provide an important connection between the Innovation Park small area and Old Town Manassas, as well as Manassas VRE. Given that the exact alignment of this route is yet to be determined, it is not shown on the Preferred Scenario Phase 3 map below (**Figure 21**).

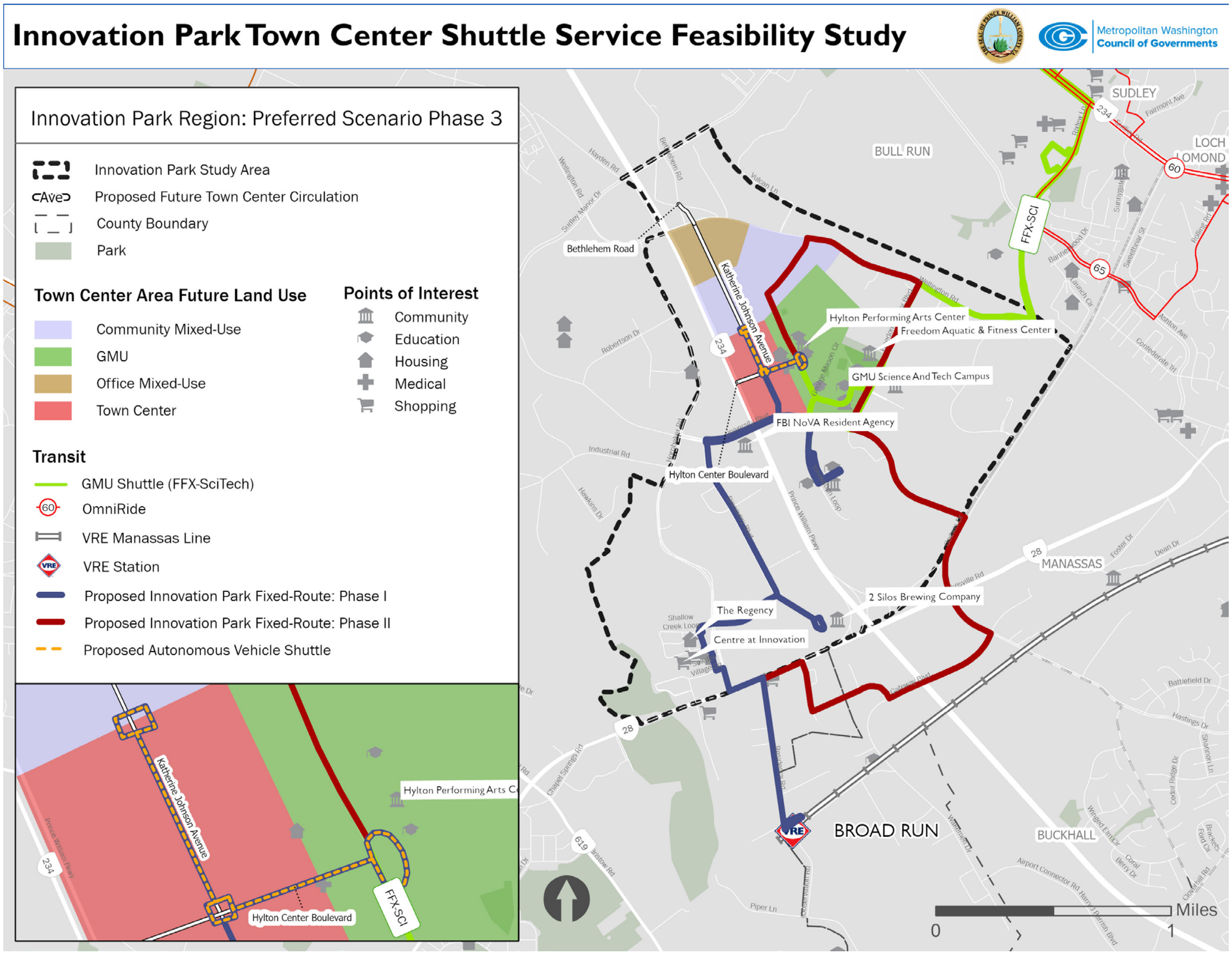
In the spirit of sustainable transit, bearing in mind future infrastructure and space limitations, service planners should aim for all fixed-route service to operate using battery electric vehicles.

While the transition to full fixed-route is estimated to begin occurring within ten years of completion of the feasibility study, planners should monitor hourly microtransit service passengers during Phases 1 and 2. After microtransit reaches a threshold of approximately eight passengers per hour, planners should consider transitioning to fixed-route service and/or adding additional microtransit vehicles to manage capacity. Planners should also monitor microtransit origin-destination patterns as well as whether the existing road network has been changed to evaluate whether to preserve or modify the fixed-route alignments listed in this study.

TABLE 22: PREFERRED SCENARIO PHASE 3 OVERVIEW

Service Type	Likely Operator	Description
Innovation-GMU Autonomous Vehicle Shuttle (Phases 3a-b)	George Mason University (and/or in partnership with a public or private entity)	■ Small autonomous vehicle shuttle: GMU/Innovation Park Town Center loop
Innovation Park Fixed-Route: Phase I (Phases 3a-b)	OmniRide (PRTC)	■ Fixed-route service from Broad Run VRE to Innovation Park/GMU (combination of original Scenario 1 Phases 1 and 2)
Innovation Park Fixed-Route: Phase II (Phase 3b)	OmniRide (PRTC)	■ Expanded fixed-route service to include future Innovation Park area destinations (original Scenario 1 Phase 3)
OmniRide Innovation-Manassas Fixed Route (Phases 3a-b)	OmniRide (PRTC)	■ OmniRide planned fixed-route service from Innovation Park to Old Town Manassas/Manassas VRE

FIGURE 21: PREFERRED SCENARIO PHASE 3



LEVEL OF SERVICE AND ANTICIPATED COSTS

Given that Phase 3 will not be implemented until the full buildout of the Innovation Park Small Area (likely 10 years or more from the completion of this study), the levels of service, operating costs, and capital costs for future traditional fixed-route services are not forecasted in this feasibility study.

Stop Design and Transit Service Standards

The following section provides service standards applicable to all service types profiled in the preferred scenario: microtransit, fixed-route autonomous shuttles, and traditional fixed-route service. Service standards are separated into shuttle stop design standards and transit service standards.

SHUTTLE STOP DESIGN STANDARDS

Designed to be in concert with the Innovation Park Town Center and University Village Design Guidelines, shuttle stop design standards are outlined such that all service types proposed in the preferred scenario may be accommodated safely and effectively. While space and related constraints will likely not permit inclusion of these standards at all future stops, standards should be particularly considered along the area's future main thoroughfares: Katherine Johnson Avenue and Hylton Center Boulevard.

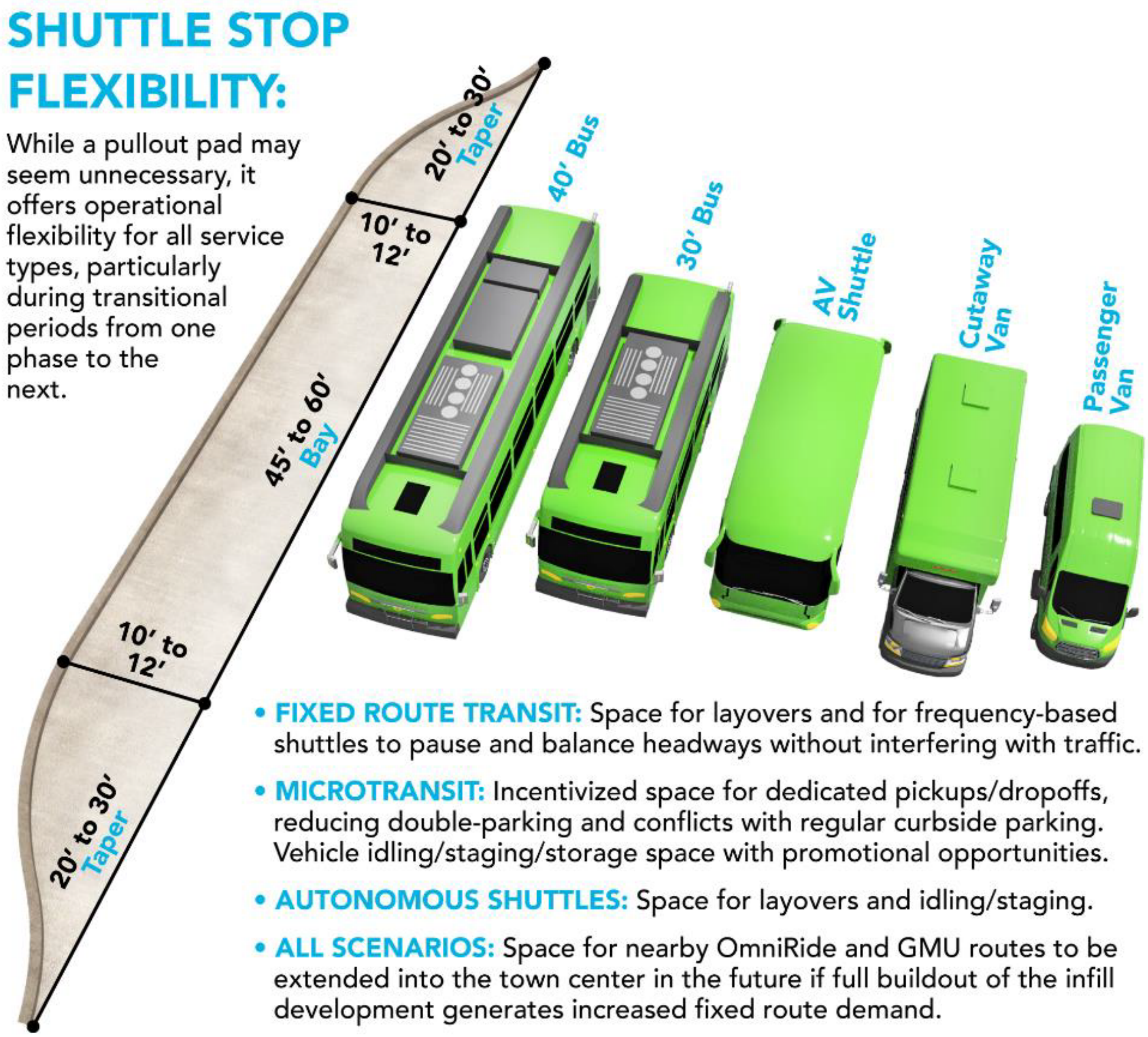
In addition, while on-demand microtransit service will likely not have fixed stops, flexible shuttle stops shown in the section that follows could potentially serve as layover or idling points for vehicles. These stops could serve as incentivized microtransit drop-off or pickup points operating under a service model in which passengers requesting trips congregate at an assigned, central location to maximize route efficiency.

Shuttle Stop Layout

As outlined in **Figure 22**, a flexible shuttle stop design can accommodate all types of vehicles necessary across all phases of the preferred scenario, from 40-foot buses to small passenger vans. This flexible stop design accounts for various vehicle movement scenarios as well as low or high ridership. By accommodating the full range of potential vehicle types and movements through a one-time design, the risk of future costly and disruptive stop retrofits along Katherine Johnson Avenue and Hylton Center Boulevard (to accommodate changes in phasing) is minimized.

For example, even if Phase 1 microtransit anticipates using smaller vehicles such as cutaway or passenger vans, if future ridership outstrips the capacity of those vehicles and larger 30-foot or 40-foot buses need to be introduced, any stops sized to the recommendations shown in **Figure 22** would still be able to accommodate larger buses. Additionally, should any OmniRide or GMU routes be extended into the study area in the future, any stops with the design shown would also be able to accommodate vehicles from those routes.

FIGURE 22: BENEFITS OF A FLEXIBLE SHUTTLE STOP LENGTH



While dedicated stops may ultimately remain unnecessary for microtransit service, there are potential advantages to including microtransit as part of shuttle stop design standards:

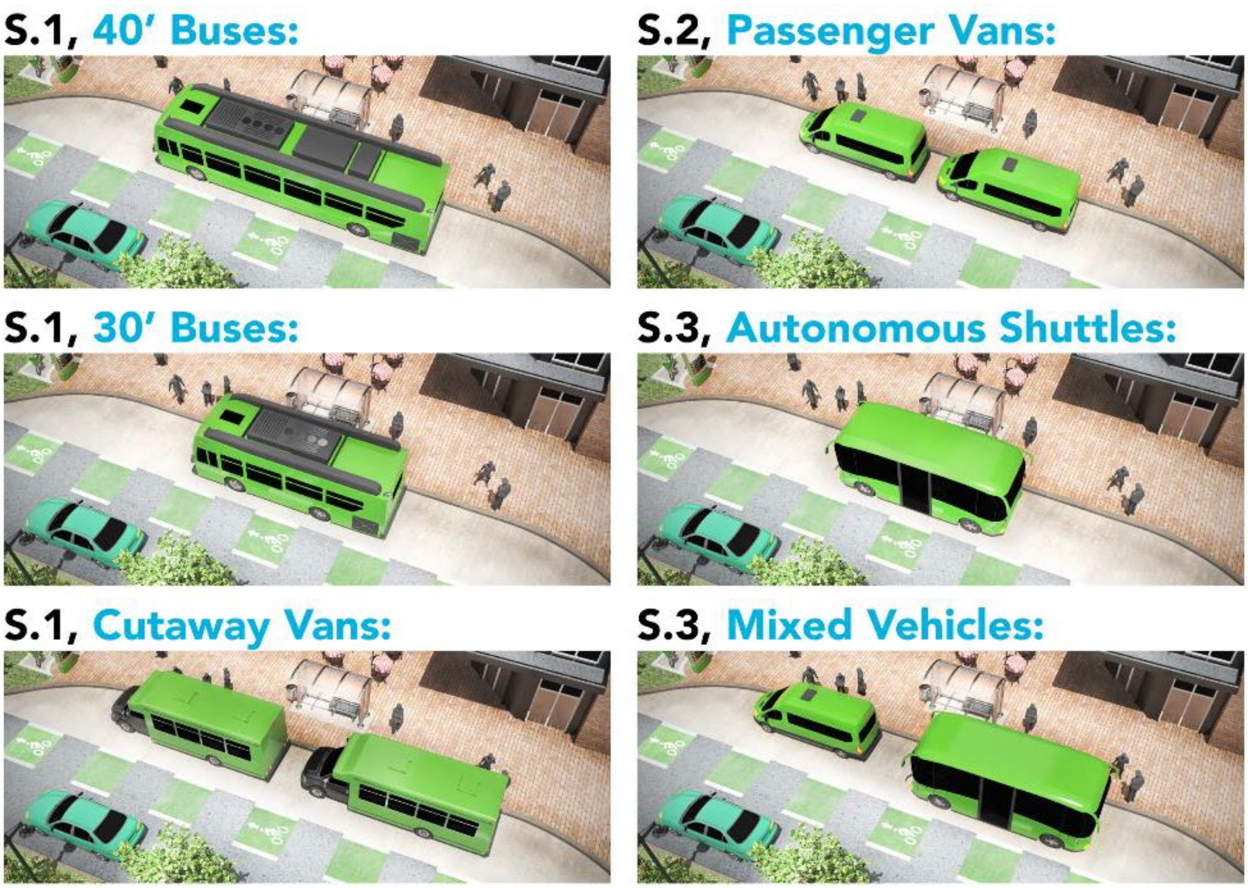
- In areas with high curbside parking demand, it may be difficult for microtransit vehicles to find curbside space to pick up and drop off riders, inducing microtransit drivers to double-park (double-parking is already extremely common among Uber and Lyft drivers in urban and suburban areas for this reason). A dedicated pullout pad remedies this issue and guarantees microtransit drivers a place to pull over and pick up/drop off riders.
- If desired, microtransit service could incentivize pickups/drop-offs at dedicated stops. Whether through fare incentives or other promotional campaigns, streamlining pickups and drop-offs at limited points can render microtransit service more efficient. This approach is becoming increasingly common at airports, college campuses, sports and concert venues, and other large activity centers to reduce the safety and accessibility challenges associated with multiple requested pickup and drop-off points.
- When not called into service, microtransit vehicles typically cruise between assignments or idle in available parking spaces. Dedicated pullout pads offer space for microtransit vehicles to wait between assignments or to park when they are not in service (i.e. overnight), reducing the need for reserved off-site vehicular storage.

- It can be challenging to improve public awareness of the availability of microtransit due to the service's lack of visible stop infrastructure, such as shelters, pylons, and signs. This can translate to a difficulty in attracting ridership if the service is not physically apparent. Dedicated pullout pads can increase the visibility of both microtransit and autonomous vehicles by allowing them to "stage" when not in service. If paired with promotional vehicle wraps/liveries, these dedicated pullout pads can improve the street presence and exposure of microtransit service, increasing its ridership.
- Finally, dedicated pullout pads can also prove be useful when microtransit and an autonomous shuttle are operating concurrently, as both types of vehicles may need to find shared curbside space to pick up and drop off riders transferring between modes.

Shuttle Stop Locations

Figure 23 demonstrates how a pullout pad described in the previous section can be accommodated along several of the study area's proposed roadways, including Katherine Johnson Avenue and Hylton Boulevard. As shown below, a pullout pad could fit into curbside parking lanes proposed. On busier arterials such as University Boulevard, where needed, the same style pullout pad could be retrofitted into the roadway's layout.

FIGURE 23: DIAGRAM SHOWING HOW A LARGE PULLOUT PAD COULD FLEXIBLY ACCOMMODATE TRANSIT VEHICLES OF VARYING SIZE



For all three service types, a pullout pad is recommended to minimize disruptions to traffic in the adjacent travel lane. For traditional fixed-route service, pullout pads allow vans or buses that are stopping to pick up or drop off passengers, laying over, or pausing to balance headways to do so without having to stop in the travel lane. For microtransit service or autonomous shuttle service, pullout pads allow vehicles to pick up or drop off passengers at dedicated points without having to double-park or find other curbside parking to do so.

Using this layout, under the preferred scenario, an important transfer stop will almost certainly be necessary at George Mason Circle (Hylton Performing Arts Center), where transit would connect to GMU's Fairfax-SciTech Shuttle. However, given the university's tentative plans to reconfigure George Mason Circle, illustrations depicting a potential transfer stop at this location have not been developed for this feasibility study.

Shuttle Stop Amenities

As shown in **Figure 24**, a minimum of four amenities are recommended for shuttle stops at major transfer or high boarding locations to ensure adequate rider comfort, accessibility, and safety.[9] While these amenities are not strictly necessary for microtransit or autonomous shuttle service, each of these modes would benefit from their provision for the same reasons described earlier.

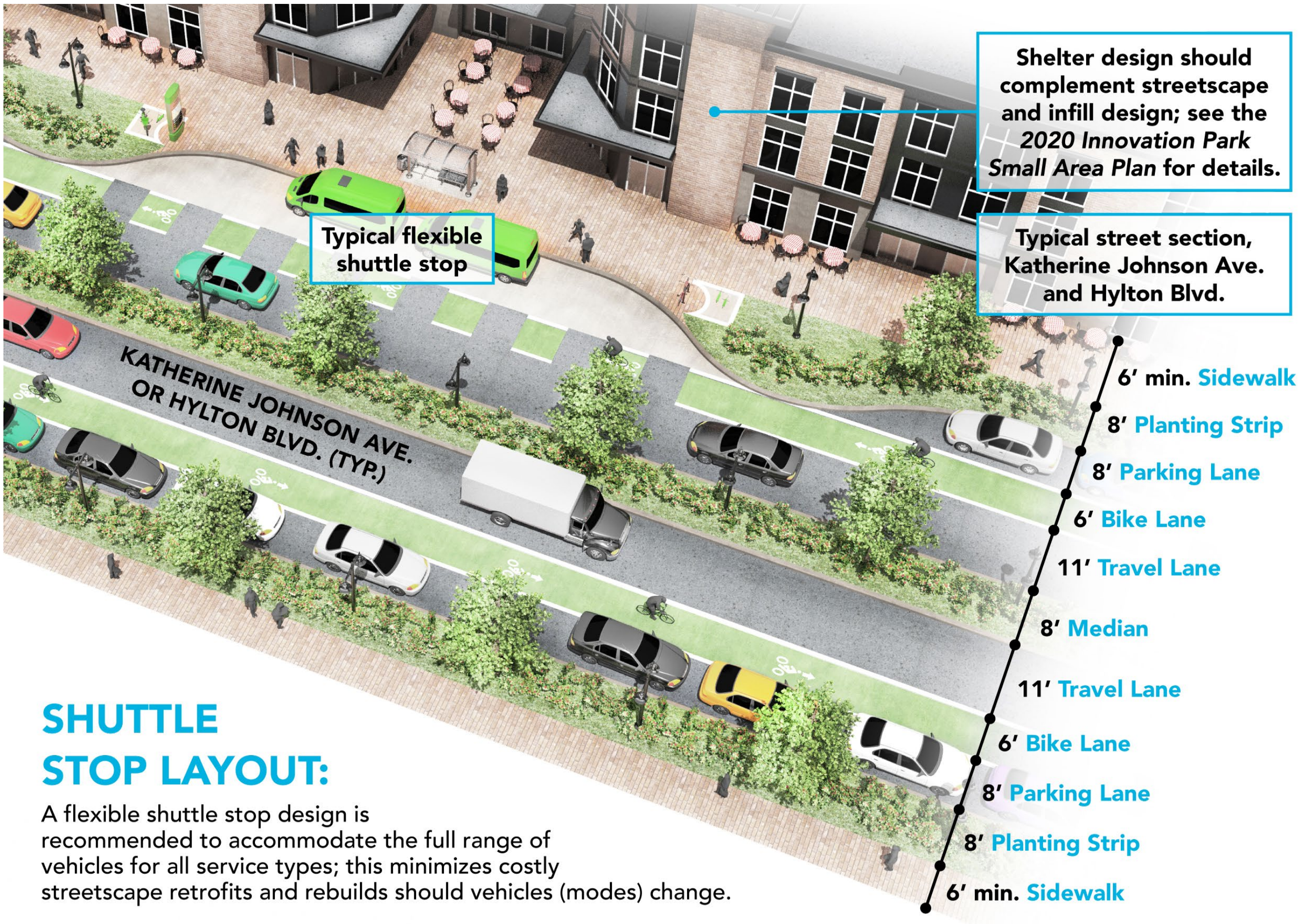
- **SHELTER:** Shelters provide waiting spaces protected from the elements for fixed-route riders and offer visibility and promotional opportunities for all modes. As indicated in **Figure 24**, shelters should provide ADA-compliant clearances on their perimeters. Each shelter should include a bench and trash can especially at high boarding locations.
- **PYLON:** A pylon with an LCD display can provide valuable information to riders, reducing barriers for riders interested in trying transit for the first time. For traditional and autonomous fixed-route service, a pylon could display real-time arrival information. For microtransit service, the pylon could alert passersby's to the availability of on-demand service at the stop location in addition to instructions for using the microtransit app and hailing the service. For all phases of the preferred scenario, the pylon could also contain wayfinding to local points of interest. In addition, pylons can be used to for marketing, branding, and place-making opportunities. In the Innovation Park area, pylon signage can reinforce the Innovation Park brand, inform of upcoming events in Prince William County, and/or help off-set operating costs with advertising revenue.
- **BIKE PARKING:** A bike rack and marked space for dropping e-scooters and e-bikes would reduce the obstacles these commonly pose to other users of the adjacent sidewalks, improving sidewalk accessibility and safety.
- **LIGHTING:** Where not already provided as part of the streetscape, adequate lighting is a must for rider safety.

FIGURE 24: MINIMUM PROPOSED AMENITIES FOR ALL SHUTTLE STOPS

9 As transit service grows in the Innovation Park area, planners may wish to establish average daily boarding thresholds at which case shelters or other transit amenities are installed. For example, while lower ridership stops may not require all the amenities listed in this section, higher ridership stops could most benefit from amenity installation.

Figure 25 provides a summary overview of the recommended layout for all shuttle stops.

FIGURE 25: SUMMARY OVERVIEW OF RECOMMENDED LAYOUT FOR ALL SHUTTLE STOPS



TRANSIT SERVICE STANDARDS

Transit service standards and key performance indicators have many benefits, including:

- **Objective Evaluation Tool for Performance Monitoring:** Service standards and targets allow agencies to objectively evaluate service and accordingly propose service changes.
- **Institutional Consistency and Transparency:** Using service guidelines and consistent performance monitoring processes ensures that evaluation of service is not only objective, but consistent over time. It also ensures public transparency and accountability in the service planning process.

Transit service standards proposed in this section will likely become more relevant as transit service takes shape in the Innovation Park area. Providers such as OmniRide may choose to consider these standards when operating and/or planning service, or may choose to implement existing agency standards within services they operate. Given that public transit service is not currently operational in the Innovation Park area, targets listed in the section below are largely based on transit industry standards rather than past performance.

On-Time Performance

On-time performance is an indicator of service reliability that measures how closely a route adheres to its published timetable. Consistently delivering on-time service makes trip planning easier for the customer and gives customers confidence in using transit service.

Table 23 summarizes proposed on-time performance service standards for microtransit and fixed-route (traditional and autonomous service). "On-time" is defined as any departure time from a designated stop (or pickup point, for microtransit) falling between the scheduled time and five minutes after the scheduled time. The standard for on-time performance across all modes is 80 percent of departure times (or arrival times, for a final stop) being on-time.

TABLE 23: ON-TIME PERFORMANCE SERVICE STANDARDS

Service Type	Standard
Microtransit	80%
Fixed-Route (Traditional and Autonomous)	80%

Passenger Load Factor

Passenger load factor refers to how many people are on the bus at any given moment compared to its seated and standing capacity. While high productivity is desirable for transit service, passenger loads must be monitored to ensure that the service remains attractive to travelers. If passenger loads exceed seating capacity, it may become difficult to attract or retain passengers due to overcrowded conditions. Conversely, excessively low passenger loads may be an indication that the supply of service exceeds demand. **Table 24** summarizes proposed passenger load factor service standards for microtransit and fixed-route (traditional and autonomous service). Given that large passenger loads are not expected initially, passenger load guidelines of up to 100 percent of vehicle seated capacity (no standees) are listed as a starting standard for each service type.

TABLE 24: PASSENGER LOAD FACTOR SERVICE STANDARDS

Service Type	Standard
Microtransit	100% of Seated Capacity
Fixed-Route (Traditional and Autonomous)	100% of Seated Capacity

Average Wait Time

Average wait time (**Table 25**) is a particularly useful service standard for microtransit. This metric measures the average wait time an individual waits for a scheduled trip. Factors such as number of trips scheduled can influence this metric's results, which can be particularly useful in assessing microtransit service span and number of vehicles necessary. Initially, Innovation Park microtransit should aim for an average wait time of no more than 20 minutes.

TABLE 25: AVERAGE WAIT TIME SERVICE STANDARDS

Service Type	Standard
Microtransit	20 minutes
Fixed-Route (Traditional and Autonomous)	N/A

Microtransit Ridership Projections

This section addresses preliminary ridership projections for microtransit service. For the reason that traditional fixed-route service will not operate in Innovation Park for at least ten years, ridership projections for this service type are not discussed in this study.

Given that Innovation Park is not currently served by public transit service and has limited housing and jobs, this study does not have the benefit of existing conditions with which to estimate ridership. Instead, one can turn to similar startup microtransit programs across the United States for initial ridership estimates.

As shown in **Table 26**, microtransit services typically average up to four passengers per vehicle service hour. For a new microtransit service in a relatively low-density area such as Innovation Park, it can be expected that for the first year of service or longer, ridership will be on the lower end of that scale: roughly one to two passengers per service hour. Given that ridership on microtransit service appears to largely be a function of the number of vehicles operating, it can also be anticipated that ridership could rise to the level of 20 to 30 passengers per day, initially.

TABLE 26: RIDERS PER SERVICE HOUR ON COMPARABLE MICROTRANSIT PILOT SERVICES

Microtransit Program Location	Service Hours	Service Area	Vehicles	Riders per Vehicle Service Hour
Rockville, Maryland	9:00 a.m. – 3:30 p.m.	0.7 Square Miles	1	1.52
Wheaton-Glenmont, Maryland	6:00 a.m. – 9:00 a.m. 3:30 p.m. – 7:00 p.m.	3.4 Square Miles	2	1.80
Santa Clara, California	5:30 a.m. to 8:30 p.m.	5.5 Square Miles	1	2.73
Raleigh, North Carolina	6:30 a.m. to 10:00 p.m.	—	2	3.45
Durham, North Carolina	10 Hours Daily	6.4 Square Miles	2	1.60
West Salem, Oregon	5:30 a.m. to 9:00 p.m.	2.38 Square Miles	1	3.23
Austin, Texas	7:00 a.m. to 7:00 p.m.	7.37 Square Miles	3	3.10

As the Innovation Park area grows denser and residents and workers become more familiar and comfortable with microtransit service, ridership is expected to grow significantly. Once Innovation Town Center and University Village and its surroundings become an all-day and night destination for residential, employment, and recreational purposes, microtransit service expansion could lead to more hours of operation and perhaps up to three or more peak vehicles. As noted, once microtransit ridership reaches the level of eight passengers per vehicle hour, it would become more economical and efficient to implement a fixed-route service in the area.