Comprehensive Transportation Study

King Buick Redevelopment

City of Rockville, MD

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Executive Summary

The following report is a Comprehensive Transportation Review (CTR) for the King Buick site redevelopment. This report reviews the transportation aspects of the project's Preliminary Plan application in compliance with City of Rockville's Comprehensive Transportation Review (CTR) guidelines.

The purpose of this study is to evaluate whether the project will generate a detrimental impact to the surrounding transportation network. This evaluation is based on a technical comparison of the existing conditions, background conditions, and total future conditions. The following conclusions were reached based on this technical analysis:

- All of the study intersections identified by City for evaluation will operate within acceptable levels after considering existing volumes, background developments, background growth and site-generated traffic (total future conditions) without the need for mitigation measures; and,
- A signal warrant analysis at the full-access site driveway at Fredrick Road determined that future conditions at this intersection meet the four-hour signal warrant and the peak-hour signal warrant with the projected traffic volumes from the proposed project.

This report concludes that **the project will not have a detrimental impact** to the surrounding transportation network assuming that all proposed site design elements are implemented.

Proposed Project

The site, located at 16200 Frederick Road, is currently occupied by the King Buick/GMC/Mitsubishi car dealership. The site is generally bounded by Frederick Road (MD 355) to the east, commercial uses to the north, and the King Farm residential community to the south and west. The property currently straddles the City of Rockville and Montgomery County while the property is in the process of being annexed into the City of Rockville from Montgomery County.

The project will replace the car dealership site and the existing vacant grass area with a residential subdivision, consisting of 368 townhomes and an approximately 5,000 square feet community center.

Pedestrian facilities along the perimeter of the site on Frederick Road will be improved and designed so that they meet or exceed County, Maryland Department of Transportation State Highway Administration (SHA), and Americans with Disabilities Act (ADA) standards for sidewalks, crosswalks, and curb ramps. This includes sidewalks that meet or exceed the width requirements, crosswalks at all necessary locations, and curb ramps with detectable warnings. Existing pedestrian facilities connect the site to Frederick Road and will connect the project to the Shady Grove Metrorail station to the northeast, encouraging non-auto travel.

Access to the existing car dealership is provided along Frederick Road through two (2) curb cuts. Two (2) additional curb cuts along the frontage of the site are not active and are currently used as space to showcase cars. The existing full-access driveway at the median break will be improved to serve as the primary access to the project. The three (3) other existing curb cuts along Frederick Road will be removed. A second access to the development is proposed to the southwest of the site to provide a connection to Pleasant Drive.

Multi-Modal Overview

Transit

The site is adequately served by regional and local transit services such as Metrorail, MARC, and Ride On-Montgomery County. The site is approximately 0.7 miles from the Shady Grove Metrorail station. The nearest Ride On stop is located approximately 0.1 miles south of the site on Frederick Road. Three (3) Ride On-Montgomery County routes directly service the site, providing a good connection to Metrorail and other destinations. Additional Ride On stops are located along Shady Grove Road approximately 0.2 miles from the site.

Pedestrian

The site is surrounded by a pedestrian network providing good connectivity to nearby points of interests. Most roadways within a quarter-mile radius provide sidewalks and acceptable crosswalks and curb ramps, particularly along primary walking routes.

As a result of the development, pedestrian facilities along the perimeter of the site will be improved. The development will install a shared-use path along the site frontage on the southbound side of Frederick Road. The site will be served by a new internal sidewalk network. These sidewalks will provide extensive pedestrian connections within the development. The proposed internal sidewalk network will also connect the site with

Pleasant Drive, providing inter-community connections for pedestrians. The proposed sidewalks will meet or exceed SHA and ADA requirements and provide an improved pedestrian environment.

Bicycle

The site has access to existing bicycle facilities. There are existing shared use paths along Gaither Road and Piccard Drive to the south and west of the site, and existing shared roadway routes along King Farm Boulevard and Grand Champion Drive to the south and east of the site. According to the Montgomery County Bicycle Master plan, separated bikeway routes are recommended along the site frontage on Frederick Road and along Shady Grove Road to the north of the site. The separated bikeways allow shared use between bicyclists and pedestrians, providing connectivity to the cores of City of Rockville and City of Gaithersburg.

Vehicular

The site is directly served by Frederick Road (MD 355) and is in close proximity to Shady Grove Road, both principal arterials providing a robust network of local and regional connectivity. These roadways connect the site to the nearby I-370 and I-270, which provide access to the Intercounty Connector (MD 200) and the Capital Beltway (I-495).

Site Impact and Mitigation Measures

In order to determine if the proposed development will have a negative impact on this transportation network, this report projects future conditions with and without the development of the site and performs intersection capacity analyses using the Critical Lane Volume (CLV) technique. The intersection volume/capacity (v/c) ratios and the corresponding Level of Service (LOS) are compared to the intersection impact thresholds for transit-oriented areas (TOAs) and non-transit-oriented areas (non-TOAs) set by City of Rockville CTR standards to determine if the site will negatively impact the study area. Signalized intersections that operate at or near capacity under existing conditions were further analyzed using the Highway Capacity Manual (HCM) methodology.

A signal warrant analysis was conducted for the intersection of Frederick Road (MD 355) and the full-access site driveway. The analyses conclude that this intersection meets Warrant 2: Four-Hour Vehicular Volume and Warrant 3: Peak Hour signal warrants in future conditions with the development.

Summary and Recommendations

This report concludes that the proposed development will not have a detrimental impact to the surrounding transportation network assuming that all planned site design elements are implemented. The full-access site driveway and Fredrick Road intersection meets the four-hour signal warrant and the peak-hour signal warrant with the projected traffic volumes from the proposed project. Signalizing the site driveway and Frederick Road (MD 355) intersection will reduce the delay for inbound and outbound site trips and provide an additional connection for pedestrians to the Shady Grove Metro station.

The development has several positive elements contained within its design that minimize potential transportation impacts, including:

- The site’s proximity to the Metrorail Red Line, MARC Train Brunswick Line, and several local and regional bus lines;
- The site’s location within a well-connected pedestrian network; and
- The pedestrian and bicycle facilities adjacent to and within the site being that will be improved as part of the project.

Introduction

This report reviews the transportation elements of the King Buick site redevelopment. The site, shown in Figure 1, currently straddles the City of Rockville and Montgomery County while in the process of being annexed into the City of Rockville from Montgomery County. Figure 2 provides an aerial of the site.

Purpose of Study

The purpose of this report is to:

1. Review the transportation elements of the development site plan and demonstrate that the site conforms to the City of Rockville's CTR policies.
2. Provide information to the City of Rockville, MCDOT, MDOT SHA, and other agencies on how the development of the site will influence the local transportation network. This report accomplishes this by identifying the potential trips generated by the site on all major modes of travel and where these trips will be distributed on the network.
3. Determine whether the proposed project will lead to an adverse impact on the local transportation network. This report accomplishes this by projecting future conditions with and without development of the site and performing analyses of study area intersections using the CLV methodology as required by the CTR guidelines. Intersection v/c ratios and the corresponding LOS are compared to the impact thresholds set by City of Rockville CTR standards to determine if the site will negatively impact the study area. The report discusses what improvements to the transportation network are needed to mitigate adverse impacts as needed.

Contents of Study

This report contains 11 components as follows:

- Project Overview
  This component reviews the area near and adjacent to the proposed project and includes an overview of the project, including existing and proposed land uses, site plan and access, transit-oriented area (TOA) designation, and a summary of the site trip generation before reductions and/or credits.
- Study Area and Multimodal Overview
  This component includes the transportation study area and study intersections of the project and provides an overview of the multimodal facilities around the transportation study area.
- Existing Conditions
  This component reviews the existing conditions within the transportation study area, including the roadway network, existing peak-hour traffic volumes, and existing capacity analyses. This component also summarizes the existing pedestrian, bicycle, and transit access and facilities around the site.
- Background Conditions
  This component outlines the background traffic components, including approved pipeline developments and annual traffic growth, and performs capacity analyses for background conditions. This component also reviews planned roadway, pedestrian, bicycle, and transit improvements by other agencies around the site.
- Trip Generation and Trip Reduction
  This component outlines the travel demand of the proposed project. It summarizes the proposed trip generation of the project and outlines the applicable trip reduction factors for the site trip generation.
- Trip Distribution and Trip Assignment
  This component provides the assumptions of the trip distribution and route assignment for the site-generated trips.
- Intersection Capacity Analysis
  This component summarizes the intersection capacity analysis results of the total future conditions.
- Other Studies
  This component includes other requested traffic studies, including a traffic signal warrant study, a queueing analysis, a cut-through traffic evaluation, and a pedestrian study.
- Proposed On-Site Transportation
  This component reviews the transportation aspects of the project, including site access, vehicle parking, bicycle parking, pedestrian facilities, and bicycle facilities proposed by the project.
- Mitigation Requirements
  This component reviews the mitigation requirements that

apply to the development and discusses any proposed mitigation measures, as necessary.

- Summary and Conclusions
  This component presents overall findings and conclusions and presents a summary of the recommended mitigation measures by mode, as necessary.

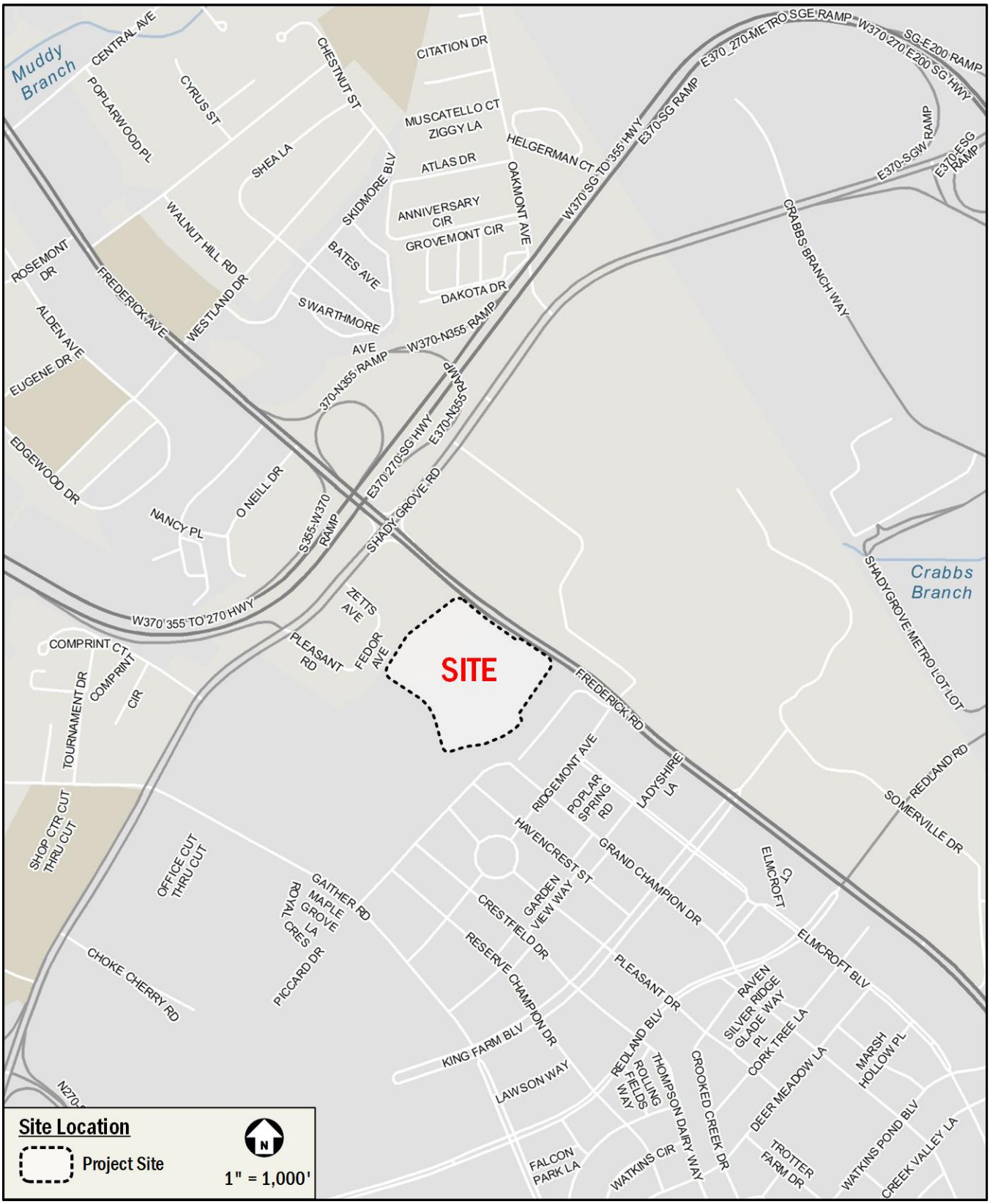

Figure 1: Site Location

Figure 2: Site Aerial

Project Overview

This section provides an overview of the development project, including the existing and proposed land uses of the site, transit-oriented area (TOA) designation of the project site, and a summary of the trip generation before any reductions or credits.

Site Land Use

Existing Land Use

The site, located at 16200 Frederick Road, is generally bounded by Frederick Road (MD 355) to the northeast, commercial uses to the northwest, and the King Farm residential community to the south and west. The property currently straddles the City of Rockville and Montgomery County and is in the process of being annexed to the City of Rockville from Montgomery County.

The existing land use is retail consisting of approximately 56,540 square feet dedicated to new-car dealership use, and approximately 3,600 square feet dedicated to used-car dealership use. The site also includes a paved parking lot utilized by the car dealership. There is also a significant portion of unutilized grass area within the southeast and southwest portions of the site.

Proposed Land Use

The project will replace the existing buildings, parking lot, and grass area with a residential subdivision, consisting of 368 townhomes and an approximately 5,000 square feet community center.

Figure 3 shows an overview of the development program and site plan elements.

Site Access

Access to the existing car dealership uses two (2) curb cuts on Frederick Road. Two (2) additional curb cuts along the frontage of the site are not active and are currently used as space to showcase cars. The existing full-access driveway at the median break will be improved to serve as the primary access to the residential subdivision. The three (3) other existing curb cuts along Frederick Road will be removed. A second driveway is proposed to the southwest of the site to provide a connection to Pleasant Drive. The layout of the site access is shown in Figure 3.

Transit-Oriented Area (TOA) Designation

Figure 4 shows the site location with an overlay of the transit-oriented area (TOA) defined in Appendix C of the City of Rockville CTR guidelines. Although only a portion of the site is located within the defined TOA, TOA-specific considerations are applicable to the project due to its proximity and accessibility to the Shady Grove Metrorail station, as approved by City Staff during the scoping process.

Trip Generation Summary

Trip generation for the proposed redevelopment was based on the methodology outlined in the Institute of Transportation Engineers (ITE) *Trip Generation Manual*, 10th Edition and the City of Rockville Comprehensive Transportation Review (CTR) guidelines (2018).

Trip generation rates for “Automobile Sales (New)”, ITE Land Use 840, were used in trip generation calculations for all the existing dealership uses, following the ITE Land Use 840 description that automobile sales (new) may include the sale or leasing of new cars, used car sales, automobile service, and parts sales.

Trip generation rates for “Residential (Low-Rise)” (Land Use 220) were used in trip generation calculations for the residential subdivision. The proposed community center is for residents’ use only and is not expected to generate external trips to the site. Because of the TOA designation of the site, a trip reduction of 15 percent was applied to account for non-auto mode splits.

The total site-generated vehicular trip results with credits and reductions are summarized in Table 1.

As shown in Table 1, the trip generation for the development program will generate 27 net new trips in the morning peak hour (50 fewer inbound trips, 77 new outbound trips), 14 net new trips in the afternoon peak hour (42 new inbound trips, 28 fewer outbound trips), and 67 net new trips in the Saturday peak hour (46 new inbound trips, 21 new outbound trips).

The City of Rockville CTR guidelines require vehicular analysis if a development generates 30 or more trips. As seen in Table 1, the development will generate more than 30 peak-hour vehicle trips. As such, a vehicular capacity analysis will be required for the proposed development.

Table 1: King Buick Site Trip Generation Summary

Land Use	Size			AM Peak Hour			PM Peak Hour			ADT	Sat Peak Hour		
				In	Out	Total	In	Out	Total		In	Out	Total
Existing Trip Generation													
Auto Sales New (840)	60,140	sf	ITE	82	30	112	58	88	146	1,694	121	121	242
Total Existing Trips				82	30	112	58	88	146	1,694	121	121	242
Proposed Trip Generation													
Residential (220)	368	units	ITE	38	126	164	118	70	188	2,741	197	167	364
Subtotal Proposed Trips				38	126	164	118	70	188	2,741	197	167	364
Multimodal trip reduction (15% for TOA)				**-6**	**-19**	**-25**	**-18**	**-10**	**-28**	**-411**	**-30**	**-25**	**-55**
Total Site trips with Reduction				32	107	139	100	60	160	2,330	167	142	309
Net New Trips without 15% TOA Reduction*				**-44**	**96**	**52**	**60**	**-18**	**42**	**1,047**	**76**	**46**	**122**
Net New Trips with 15% TOA Reduction**				**-50**	**77**	**27**	**42**	**-28**	**14**	**636**	**46**	**21**	**67**

* Used to determine study area and mitigation requirements.

** Used in the capacity analysis.

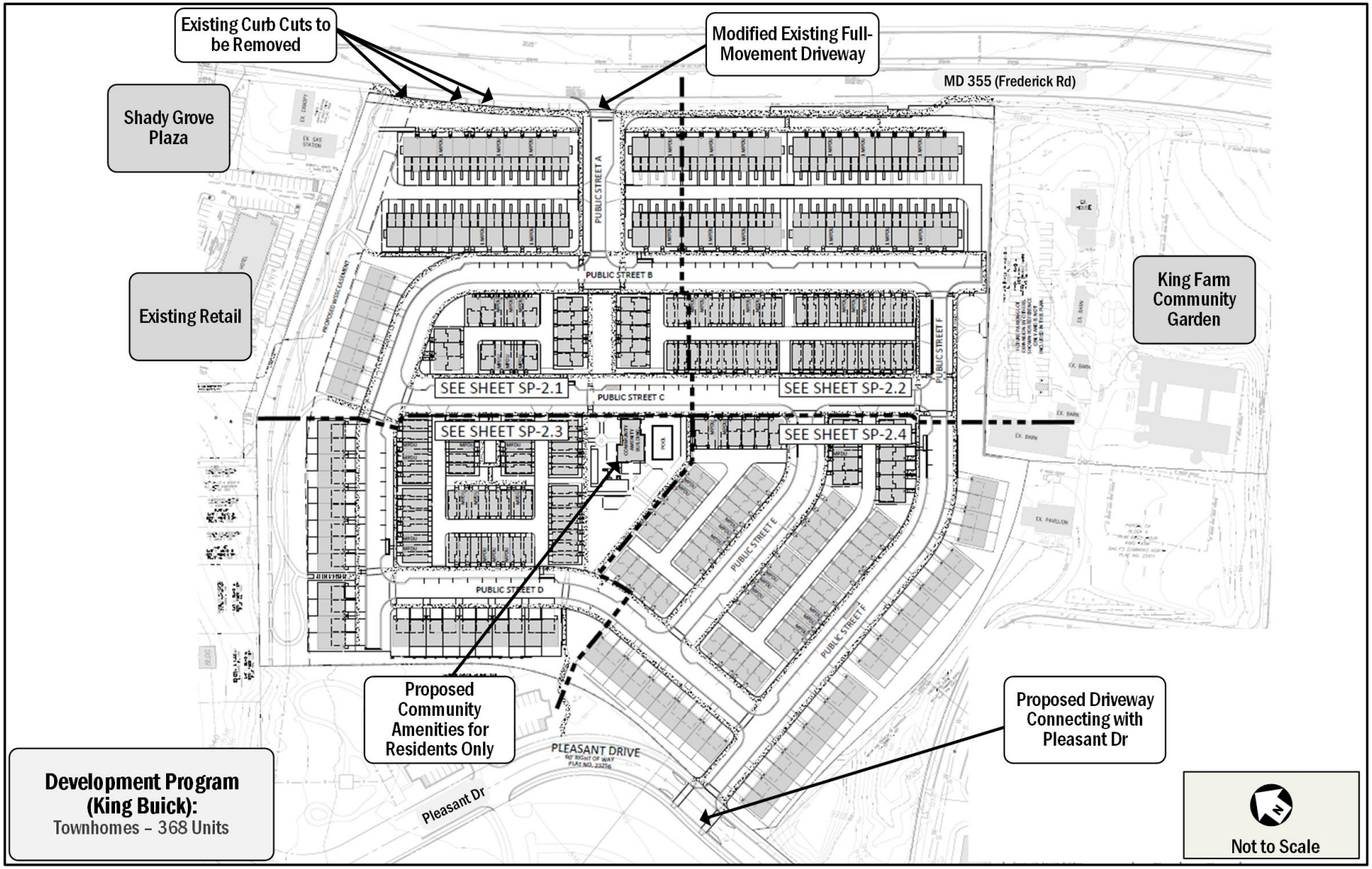

Figure 3: Site Plan

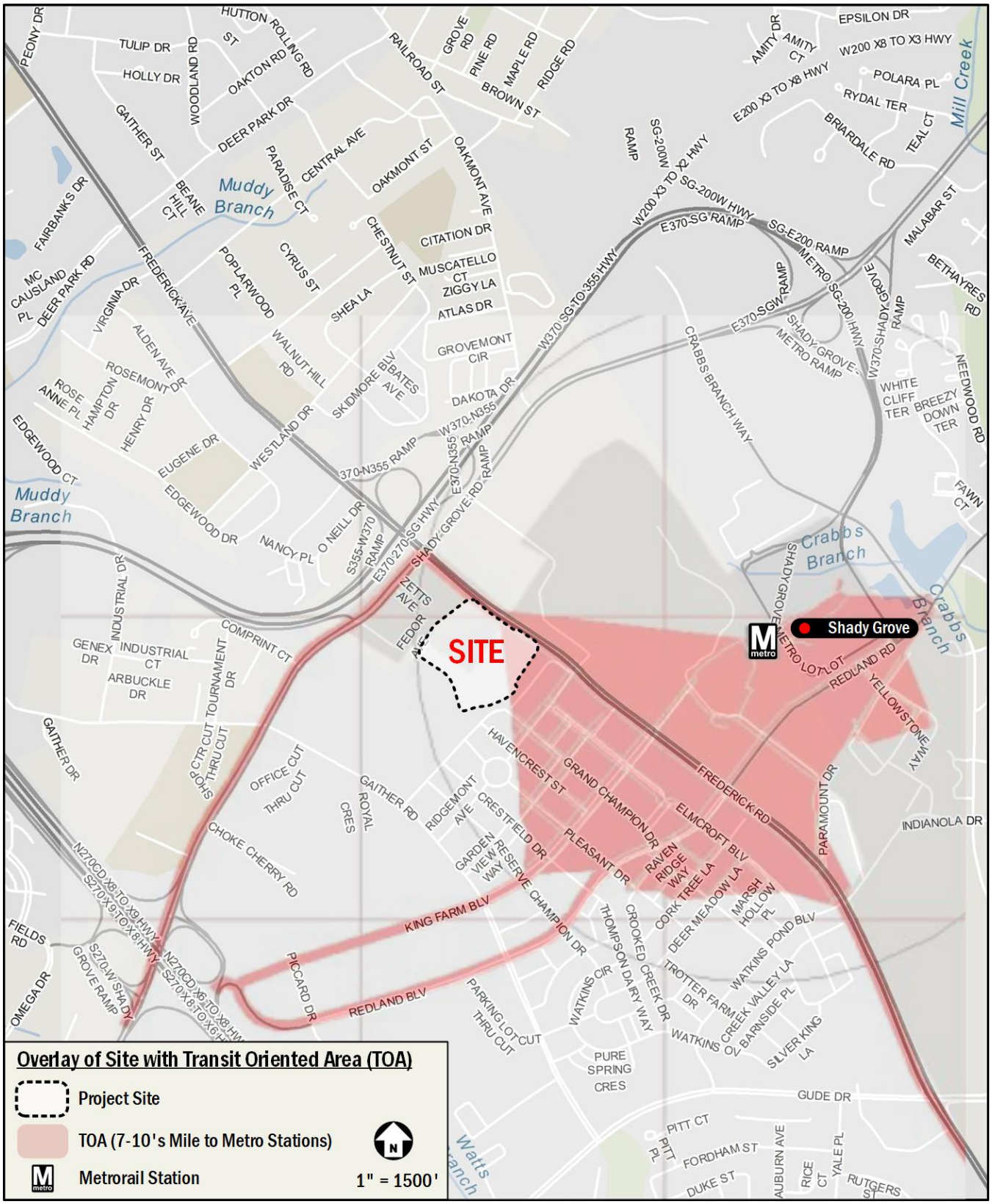

Figure 4: Transit-Oriented Area (TOA) Designation

Study Area and Multimodal Overview

This section specifies the transportation study area of this project and includes a summary of the major multimodal transportation characteristics of the study area.

This section concludes:

- Six (6) significant intersections within 0.25 miles of the site are included in the study area for analysis.
- The site is surrounded by an extensive regional and local transportation system that will connect the proposed project's residents and employees to the rest of the surrounding areas.
- The site is well-served by public transportation, being in proximity to the Shady Grove Metrorail station and several local and regional bus lines.
- There is existing bicycle infrastructure surrounding the site including shared use paths to the south and west of the site, which provide north-south connectivity to the site.
- Pedestrian conditions are generally good, particularly along anticipated major walking routes.

Study Intersections

The City of Rockville CTR guidelines specify the minimum number of intersections to be analyzed and the minimum radius of the transportation study area based on the new peak hour site trips before reductions are applied.

As shown in Table 1, the net new morning and afternoon peak hour trips with credit given for the existing land use are greater than 30 and fewer than 124. Per the CTR guidelines, at least four (4) significant intersections within 0.25 miles of the site are required to be analyzed. Per the scoping agreement letter approved by the City and included in the Technical Attachments, the following intersections, shown in Figure 5, were chosen for analysis:

1. Frederick Road (MD 355) & Shady Grove Road
2. Frederick Road (MD 355) & Full-Access Site Driveway
3. Frederick Road (MD 355) & Right-In / Right-Out Site Driveway (Existing and Background Conditions only)
4. Frederick Road (MD 355) & Ridgemont Avenue
5. Piccard Drive & Pleasant Drive
6. Park Road (northern extension of Pleasant Drive) & Rear Site Driveway

Major Transportation Features

Overview of Regional Access

The site has ample access to regional, vehicular, and transit-based transportation options, shown in Figure 6, that connect the site to destinations within Maryland, Virginia, and the District.

The site has direct frontage on Frederick Road (MD 355) and is in close proximity to Shady Grove Road. Both principal arterials that connect the site to I-270, I-370, the Intercounty Connector (MD 200), and the Capital Beltway (I-495), providing ample connectivity to the Washington DC Metropolitan area and its inner suburbs, as well as regional destinations in Maryland and Virginia.

The site is located approximately 0.7 miles, approximately a 15-minute walk, from the Shady Grove Metrorail station, which is served by the Red Line. The Red Line runs from the Shady Grove station in Rockville, through DC, to Glenmont in Silver Spring, making the rest of the Metrorail lines and most of the DC Metropolitan area accessible via public transportation. The site also has access to the Brunswick Line of the MARC rail system at the Washington Grove station, which provides connections to areas in the District, Maryland, and West Virginia.

Overall, the site has excellent access to regional roadways and transit options, making it convenient to travel between the site and destinations in Maryland, Virginia, and the District.

Overview of Local Access

There are local transportation options near the site that serve vehicular, transit, walking, and bicycling trips.

The site is served by a local vehicular network that includes principal arterials such as Frederick Road (MD 355) and Shady Grove Road. In addition, there is an existing network of collector and local roadways that provide direct access to the site. Table 2 provides a list of the local roadways in the project study area.

The Ride On-Montgomery County bus system provides local transit service in the vicinity of the site. There are three (3) bus routes that service the site directly, traveling along Frederick Road. There is one (1) additional bus route traveling along Shady Grove Road. Four (4) other Ride On-Montgomery County bus routes and four (4) WMATA Metrobus routes serve the west side of Shady Grove Metrorail station.

There are existing shared use paths along Gaither Road and Piccard Drive to the south and west of the site, and existing shared roadway routes along King Farm Boulevard and Grand Champion Drive to the south and east of the site. As part of the 2018 Montgomery County Bicycle Master plan, separated bikeway routes are recommended along the site frontage on Frederick Road and along Shady Grove Road to the north of the site, filling in missing gaps and improving connectivity for bicycles to and from the site.

In the vicinity of the site, most roadways provide sidewalks with crosswalks present at most intersections. Anticipated pedestrian routes, such as those to public transportation stops, retail zones, and community amenities, provide good pedestrian facilities. A detailed review of existing pedestrian access and infrastructure is provided in the Existing Conditions section of this report.

Overall, the site is surrounded by a local transportation network that allows for convenient transportation options via transit, bicycle, walking, or vehicular modes.

Table 2: Summary of Study Area Roadways

Roadway	Jurisdiction	Functional Classification	Rural vs Urban	# of Lanes	Speed Limit
Frederick Road (MD 355)	Maryland SHA	Principal Arterial	Urban	6	40 MPH
Shady Grove Road	Montgomery County	Principal Arterial	Urban	6	40 MPH
Ridgemont Avenue	City of Rockville	Local	Urban	2	25 MPH
King Farm Boulevard	City of Rockville	Local	Urban	2	25 MPH
Pleasant Drive	City of Rockville	Local	Urban	2	25 MPH

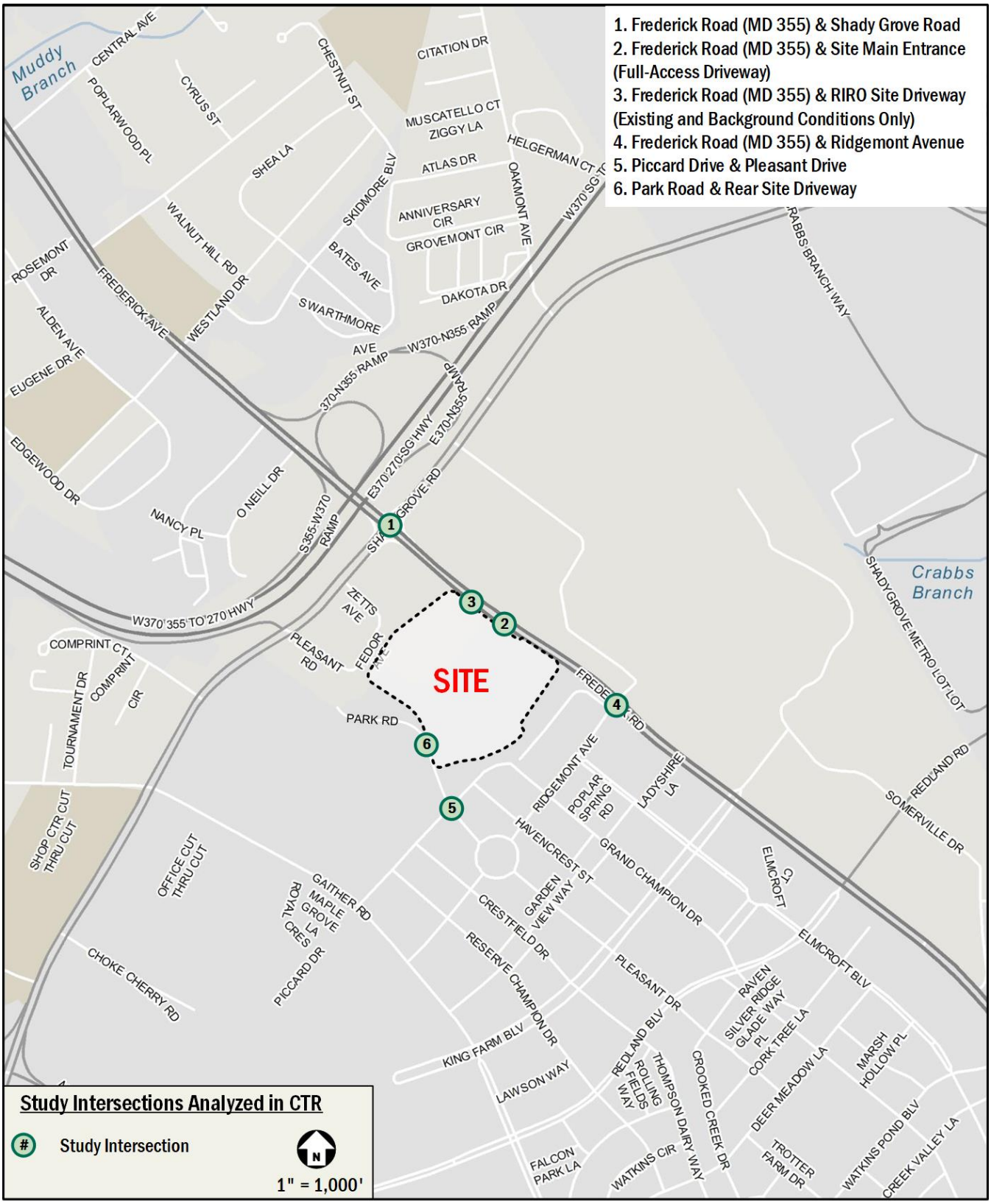

Figure 5: Study Intersections Analyzed in CTR

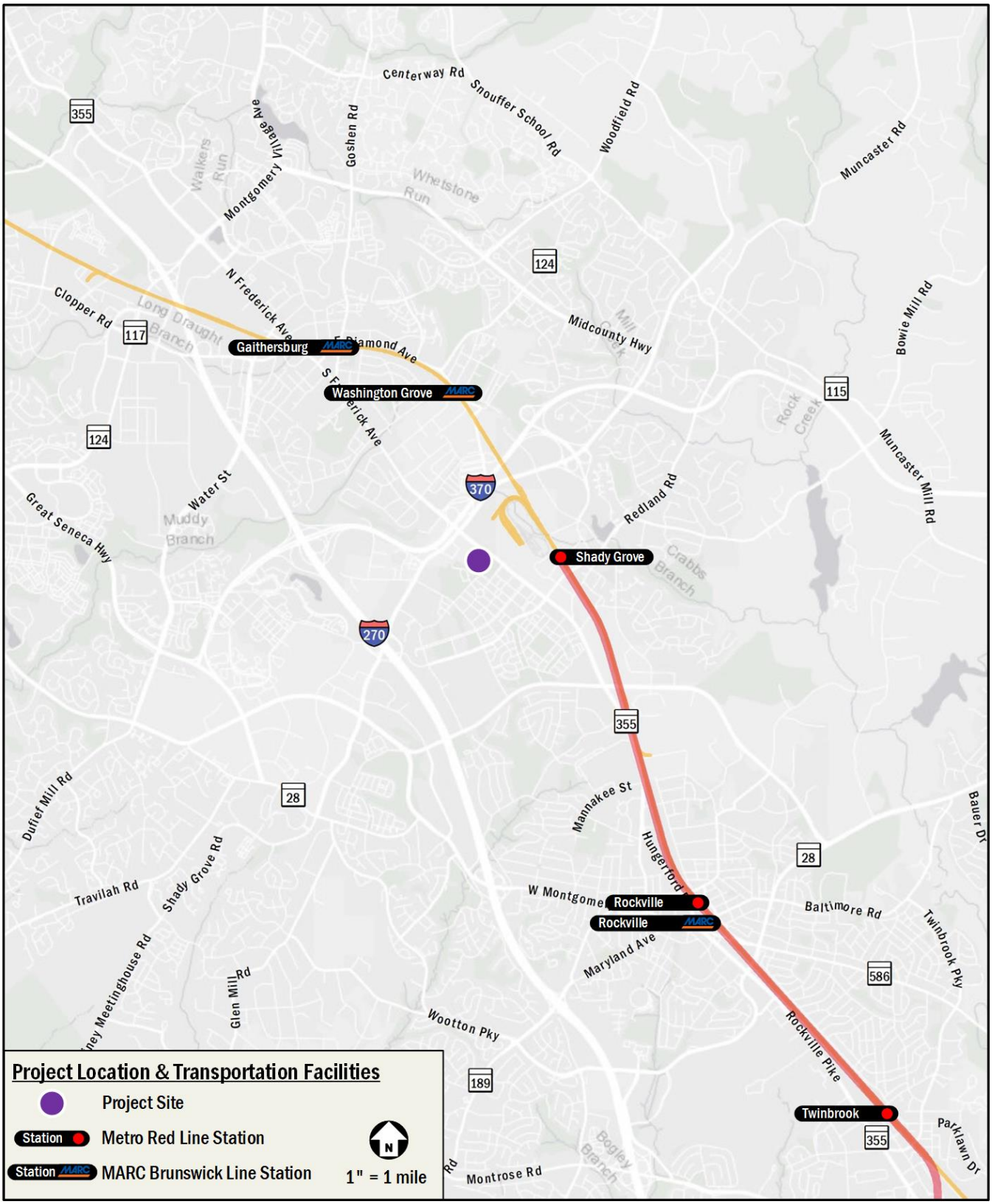

Figure 6: Project Location & Transportation Facilities

Existing Conditions

This section provides a summary of an analysis of the existing roadway capacity in the study area. The capacity analysis focuses on the morning and afternoon commuter peak hours as determined by the existing traffic volumes in the study area. This section also outlines the existing conditions of transit, pedestrian, and bicycle facilities in the vicinity of the site.

Land Parcel

The site, located at 16200 Frederick Road, is generally bounded by Frederick Road (MD 355) to the northeast, commercial uses to the northwest, and the King Farm residential community to the south and west.

The existing site is improved with retail uses consisting of approximately 56,540 square feet dedicated to a new-car dealership and approximately 3,600 square feet dedicated to used-car sales.

The site is directly served by a principal arterial, Frederick Road (MD 355). In addition, there is an existing network of other arterials and local roadways that provide access to the site, such as Shady Grove Road.

Figure 1 provides an overview of the site location and Table 2 provides a list of the local roadways in the project study area, as described in previous sections of this report.

Existing Traffic Volumes

Due to the COVID-19 pandemic, M-NCPPC issued guidance on alternative approaches to establish existing baseline traffic volumes. This analysis applies an adjustment factor to counts collected in 2020, consistent with the latest policy pertaining to traffic counts outlined in the Traffic Counts During COVID-19 Pandemic – Policy Update memorandum dated September 17, 2020, included in the Technical Attachments.

Turning movement count data was collected at three (3) out of the five (5) study intersections on Wednesday, December 2, 2020, including the following:

- Frederick Road (MD 355) & Existing Full-Access Site Driveway
- Frederick Road (MD 355) & Existing Right-In-Right-Out Site Driveway
- Piccard Drive and Pleasant Drive

Per M-NCPPC's policy on the new traffic counts, an adjustment factor of 1.07 was applied to the morning peak hour volumes and the afternoon peak hour volumes captured before 4:30 PM. For all intersections, the individual intersection peak hours were used. The results of the raw traffic counts are included in the Technical Attachments.

Historical traffic volumes from MCDOT's Intersection Analysis online application are available at the remaining two (2) study intersections:

- Frederick Road (MD 355) & Shady Grove Road, collected Wednesday, October 3, 2018
- Frederick Road (MD 355) & Ridgemont Avenue, collected Thursday, September 27, 2018

Per M-NCPPC's policy on historical counts, growth rates based on MDOT SHA AADT data, included in the Technical Attachments, were applied to the 2018 volumes. Table 3 outlines the applied growth rates.

Table 3: Growth Rate Data and Applied Total Growth Rates

Road	MDOT SHA AADT Average Annual Growth Between 2010-2019	Assumed Total Growth Between 2018 and 2020
Frederick Road (MD 355)	0.61%	1.20%
Shady Grove Road West of MD 355	-0.09%	0.20%
Shady Grove Road East of MD 355	-3.74%	0.20%
Ridgemont Avenue	N/A	0.20%

In addition, some volumes were added along the Frederick Road (MD 355) corridor to achieve a balance between the study intersections based on the 2018 count data, representing pre-COVID-19 traffic patterns.

Figure 7 shows the raw unadjusted peak hour volumes at the study intersections. Figure 8 shows the adjustment volumes based on the adjustment factor and growth. Figure 9 shows the addition of volumes to balance the study intersections after the application of adjustment factors and growth rates. Figure 10 shows the existing peak hour volumes after adjustments.

Existing Geometry and Operations

Field observations and MCDOT data confirmed the existing lane configurations and traffic controls at the study intersections. Existing signal timings and offsets were obtained from MCDOT.

The lane configurations and traffic controls for the existing conditions are shown in Figure 11. Signal timing data provided by MCDOT are included in the Technical Attachments.

Intersection Impact Thresholds and Capacity

The City's CTR guidelines outline the intersection impact thresholds based on different road classification for intersections located outside a TOA or along TOA access roadways, as shown in Table 4 and Table 5 respectively.

Table 4: Intersection Impact Thresholds for Non-TOAs

Road Classification*	Threshold for Volume /Capacity	Corresponding LOS
Primary Residential – Class II (Minor Collector), Secondary Residential	0.79	C
Major Arterials (Except where two Major Arterials connect), Minor Arterials, Primary Residential – Class I (Major Collector), Primary Industrial, Secondary Industrial	0.89	D
Business District roads, freeway ramps, and for locations where two Major Arterials intersect	0.99	E

*At intersections where two or more roads with different road classifications meet, the LOS threshold will be established based on the higher roadway classification (the classification where more congestion is acceptable).

Table 5: Intersection Impact Thresholds for TOAs

Road Classification*	Threshold for Volume /Capacity	Corresponding LOS
Primary Residential – Class II (Minor Collector), Secondary Residential	0.89	D
Major Arterials, Minor Arterials, Primary Residential – Class I (Major Collector), Primary Industrial, Business District and Secondary Industrial	0.99	E

*At intersections where two or more roads with different road classifications meet, the LOS threshold will be established based on the higher roadway classification (the classification where more congestion is acceptable).

Intersection capacity for each of the study intersections is calculated using Table 6 from the City's CTR guidelines. For unsignalized intersections, a 90-second cycle length and 2-phase operation was assumed, based on the City's CTR guidelines.

Table 6: Intersection Capacity

Cycle Length (seconds)	Number of Phases		
	2	3	4 or more
89 or less	1500	1400	1300
90 - 119	1600	1500	1400
120 - 149	1650	1600	1500
150 or more	1700	1650	1550

Table 7 summarizes the thresholds for volume to capacity ratio (v/c) and the corresponding LOS for each study intersection, based on their TOA designation, roadway classification, traffic control, signal phase, and cycle length.

Existing Conditions Capacity Analysis

Intersection capacity analyses were performed at the study intersections shown in Figure 5 for the morning and afternoon peak hours. The critical lane volume (CLV) method was used to analyze the study intersections based on methodology outlined in Appendix E of the City's CTR guidelines. Table 8 summarizes the capacity analysis results for existing conditions. Detailed CLV analyses are provided in the Technical Attachments.

It was found that under existing conditions, all study intersections operate within the acceptable capacity thresholds during both the morning and afternoon peak hours, with the exception of the Frederick Road (MD 355) and Shady Grove Road intersection which operates near the capacity threshold during the morning peak hour.

A supplemental analysis was requested by City of Rockville and MDOT SHA., Signalized intersections along the Frederick Road (MD 355) corridor were analyzed using the Highway Capacity Manual (HCM) methodology in addition to the required CLV analyses. Synchro Version 10 was used to analyze the signalized study intersections of Frederick Road (MD 355)/Shady Grove Road and Frederick Road (MD 355)/Ridgemont Avenue. Table 9 shows the results of the HCM capacity analysis, including LOS and average delay per vehicle (in seconds), at these intersections. The HCM analysis results were generally consistent with the CLV analysis results. Using the HCM methodology, the Frederick Road (MD 355) and Shady Grove intersection operates at an unacceptable level of service (LOS) during the afternoon peak hour.

SimTraffic microsimulation was performed for the queueing analysis along the Frederick Road (MD 355) corridor. Table 10 shows the queueing analysis results for the study intersections along the Frederick Road (MD 355) corridor.

Table 7: Summary of Capacity Thresholds for Study Intersections

Intersection	TOA	Classification	Traffic Control	Signal Phases	Cycle Length		Intersection Capacity		v/c Threshold	LOS Threshold
					AM	*PM*	*AM*	*PM*		
Frederick Road & Shady Grove Rd	No	Two Major Arterials Intersecting	Signalized	4	150	150	1550	1550	0.99	E
Frederick Road & Full-Access Site Driveway	Yes	Major Arterial	Unsignalized	2	90	90	1600	1600	0.99	E
Frederick Road & RIRO Site Driveway	Yes	Major Arterial	Unsignalized	2	90	90	1600	1600	0.99	E
Frederick Road & Ridgemont Avenue	Yes	Major Arterial	Signalized	3	150	150	1650	1650	0.99	E
Piccard Drive & Pleasant Drive	No	Primary Residential - Class I	Unsignalized	2	90	90	1600	1600	0.89	D
Park Road & Rear Site Driveway	No	Primary Residential - Class II	Unsignalized	2	90	90	1600	1600	0.79	C

Table 8: Summary of Existing Conditions Intersection Capacity Results

Intersection	Traffic Control	Intersection Capacity		v/c Threshold	LOS Threshold	MOE	2020 Existing Conditions	
		AM	*PM*				*AM*	*PM*
Frederick Road & Shady Grove Rd	Signalized	1550	1550	0.99	E	CLV v/c LOS	1481 0.96 E	1279 0.83 D
Frederick Road & Full-Access Site Driveway	Unsignalized	1600	1600	0.99	E	CLV v/c LOS	1092 0.68 B	999 0.62 B
Frederick Road & RIRO Site Driveway	Unsignalized	1600	1600	0.99	E	CLV v/c LOS	1099 0.69 B	706 0.44 A
Frederick Road & Ridgemont Avenue	Signalized	1650	1650	0.99	E	CLV v/c LOS	1146 0.69 B	984 0.60 A
Piccard Drive & Pleasant Drive	Unsignalized	1600	1600	0.89	D	CLV v/c LOS	77 0.05 A	155 0.10 A

Table 9: Summary of Existing Conditions Intersection Capacity Results (HCM)*

Intersection	Existing Conditions (2020)			
	AM Peak Hour		*PM Peak Hour*	
	Delay (s)	*LOS*	*Delay (s)*	*LOS*
Frederick Road & Shady Grove Road	69.1	E	94.8	F
Frederick Road & Ridgemont Avenue	11.9	B	7.5	A

* HCM analysis results presented as supplementary information only, as requested for signalized intersections along the Frederick Road (MD 355) corridor.

Table 10: Existing Conditions SimTraffic 50th and 95th Percentile Queueing Results for Study Intersections along Frederick Road (MD 355)

Intersection	Lane Group	Storage Length (ft)	Existing Conditions (2020)			
			AM Peak Hour		*PM Peak Hour*	
			50th	*95th*	*50th*	*95th*
Frederick Road & Shady Grove Road	Eastbound L	600	1	20	179	279
	Eastbound L	600	139	251	459	630
	Eastbound LT	920	218	294	543	724
	Eastbound T	920	171	251	471	636
	Eastbound R/TR	920	317	508	435	605
	Eastbound R	920	287	474	372	548
	Westbound L	550	159	252	27	98
	Westbound L	550	398	541	184	272
	Westbound LT	550	494	643	243	318
	Westbound T	620	411	540	179	259
	Westbound T	620	278	368	68	175
	Westbound T	620	177	268	6	65
	Westbound R	170	7	63	50	187
	Northbound L	500	169	296	180	297
	Northbound T	810	133	189	374	476
	Northbound T	810	132	192	382	488
	Northbound T	810	99	160	356	468
	Northbound T	810	36	94	284	404
	Northbound R	410	--	--	119	295
	Southbound L	525	247	546	183	303
	Southbound T	720	532	695	318	420
	Southbound T	720	480	634	269	366
	Southbound T	720	392	553	158	257
	Southbound R	700	218	456	--	--
Frederick Road & Full-Access Site Driveway	Eastbound LR	-	15	54	167	299
	Northbound L	250	8	0	0	5
	Northbound T	1020	30	0	0	3
	Southbound U	240	11	33	62	125
	Southbound T	800	3	67	0	5
	Southbound T	800	7	112	--	--
	Southbound TR	800	1	10	0	3
Frederick Road & Ridgemont Avenue	Eastbound L	360	15	44	18	48
	Eastbound TR	180	17	47	28	63
	Westbound L	100	24	57	18	47
	Westbound TR	100	15	42	17	46
	Northbound L	320	29	67	19	49
	Northbound T	930	43	114	99	226
	Northbound T	930	17	65	72	188
	Northbound TR	930	11	39	71	176
	Southbound L	250	9	29	22	56
	Southbound T	1020	145	333	18	65
	Southbound T	1020	167	361	47	108
	Southbound TR	1020	172	372	62	134

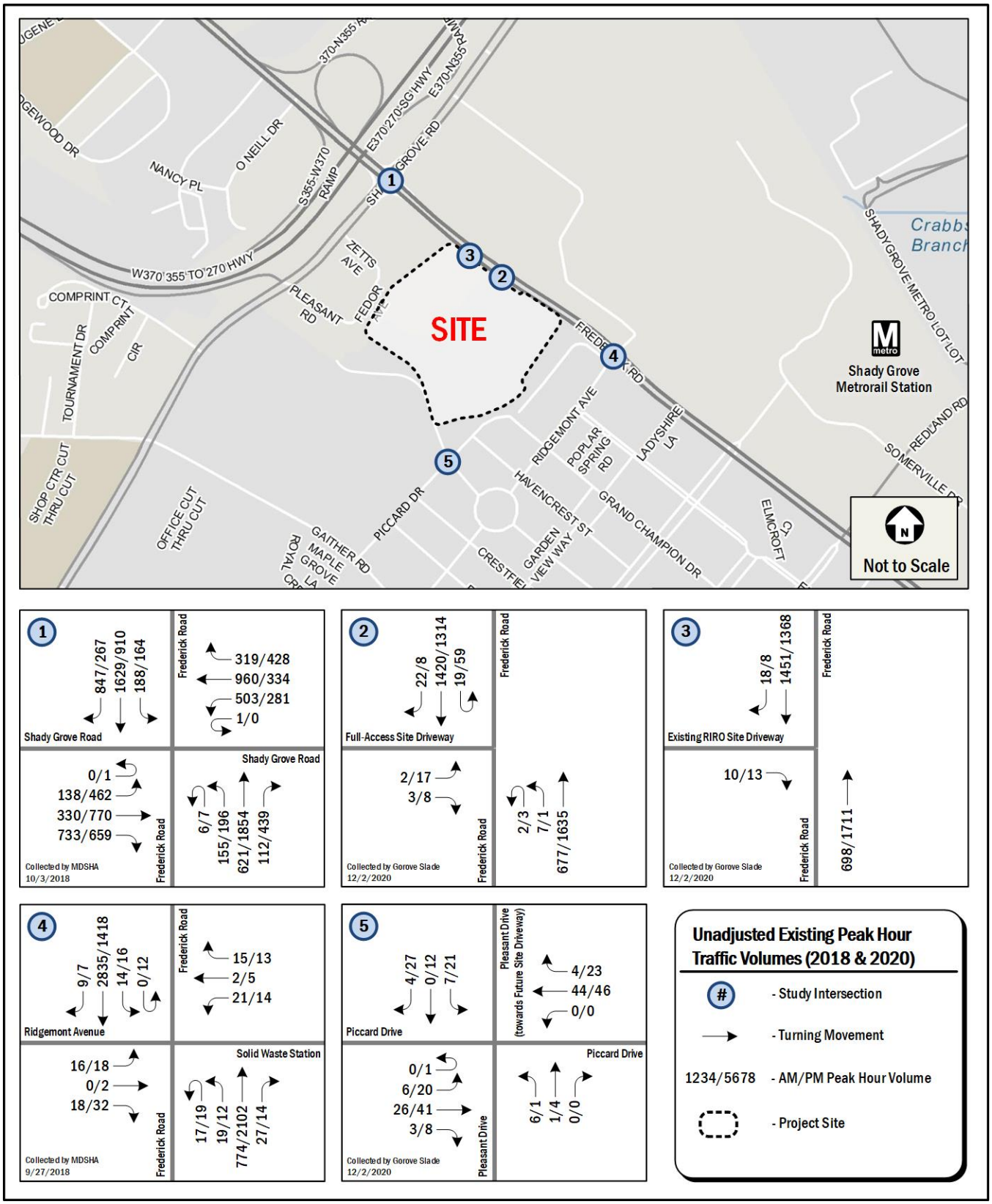

Figure 7: Unadjusted Existing Peak Hour Traffic Volumes

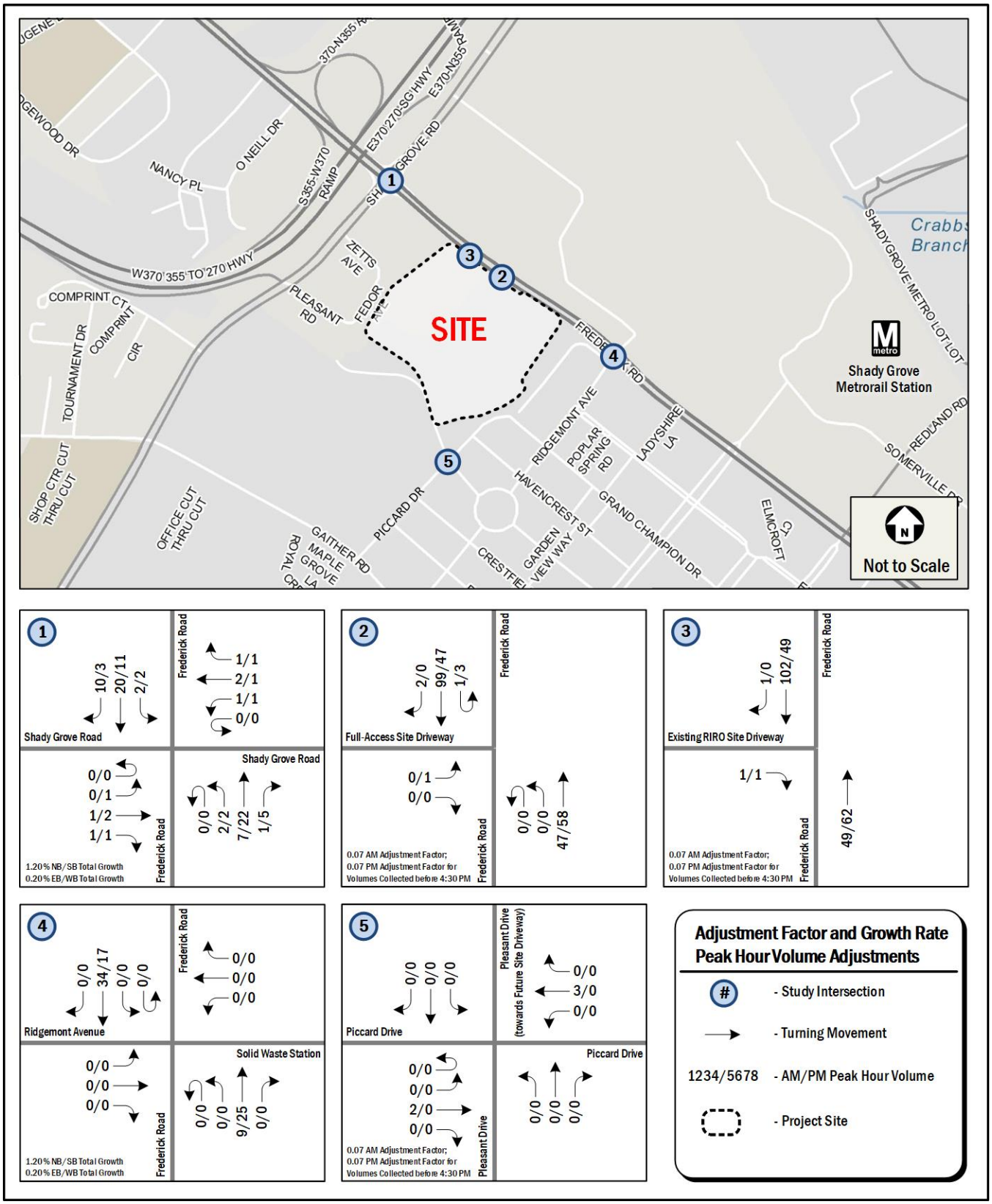

Figure 8: Adjustment Factor and Growth Rate Peak Hour Volume Adjustments

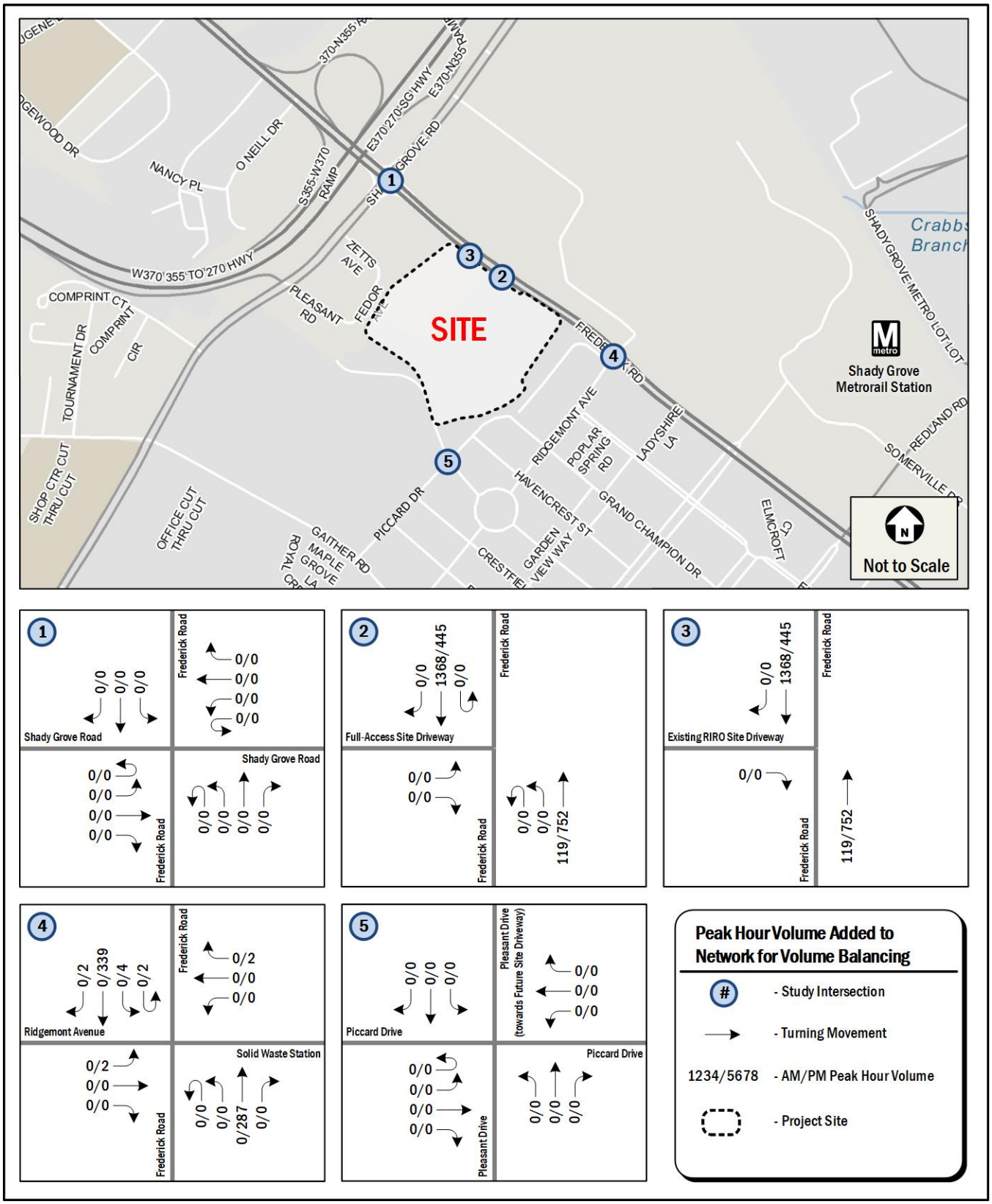

Figure 9: Addition of Peak Hour Traffic Volumes for Network Volume Balancing

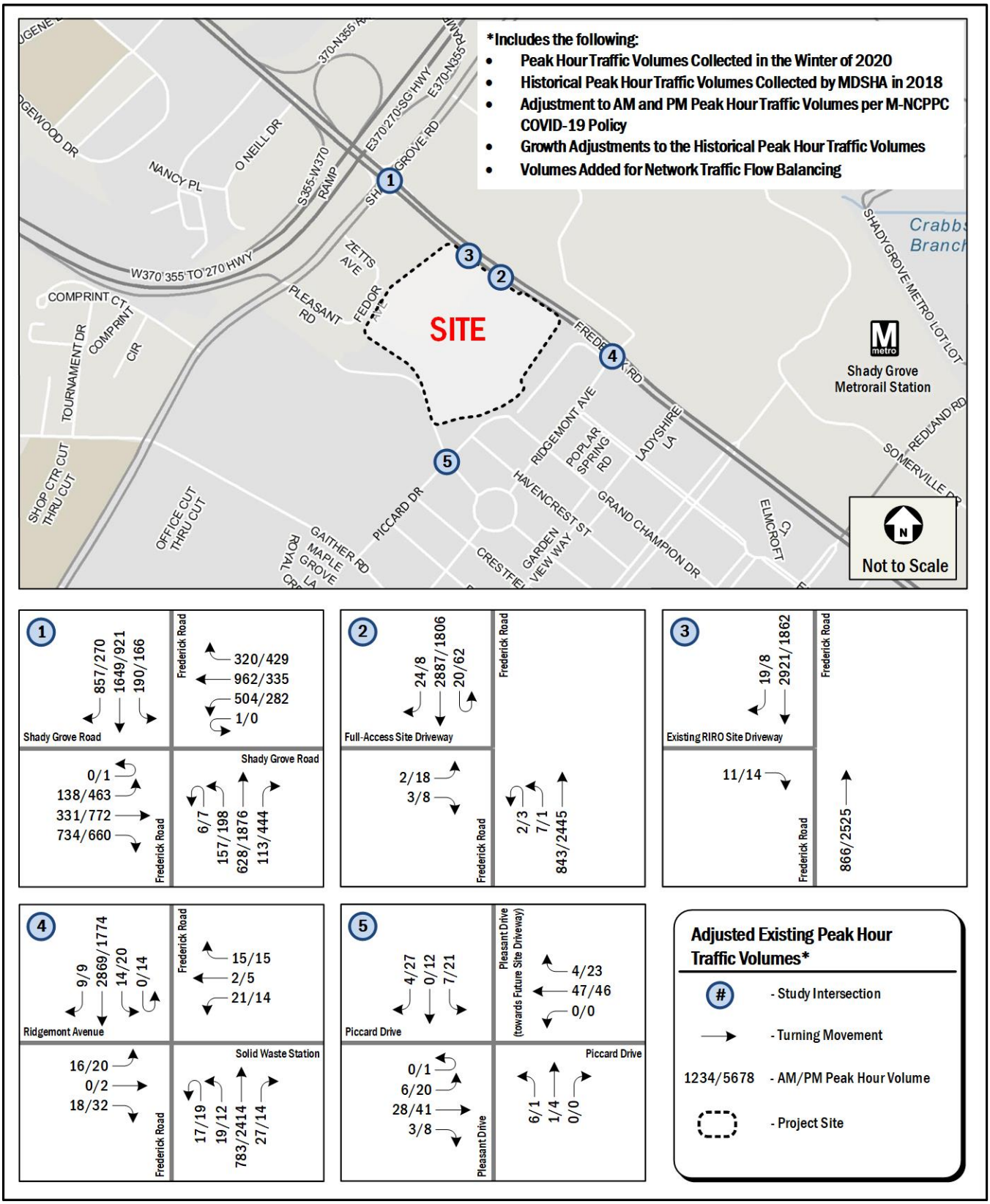

Figure 10: Adjusted Existing Peak Hour Traffic Volumes

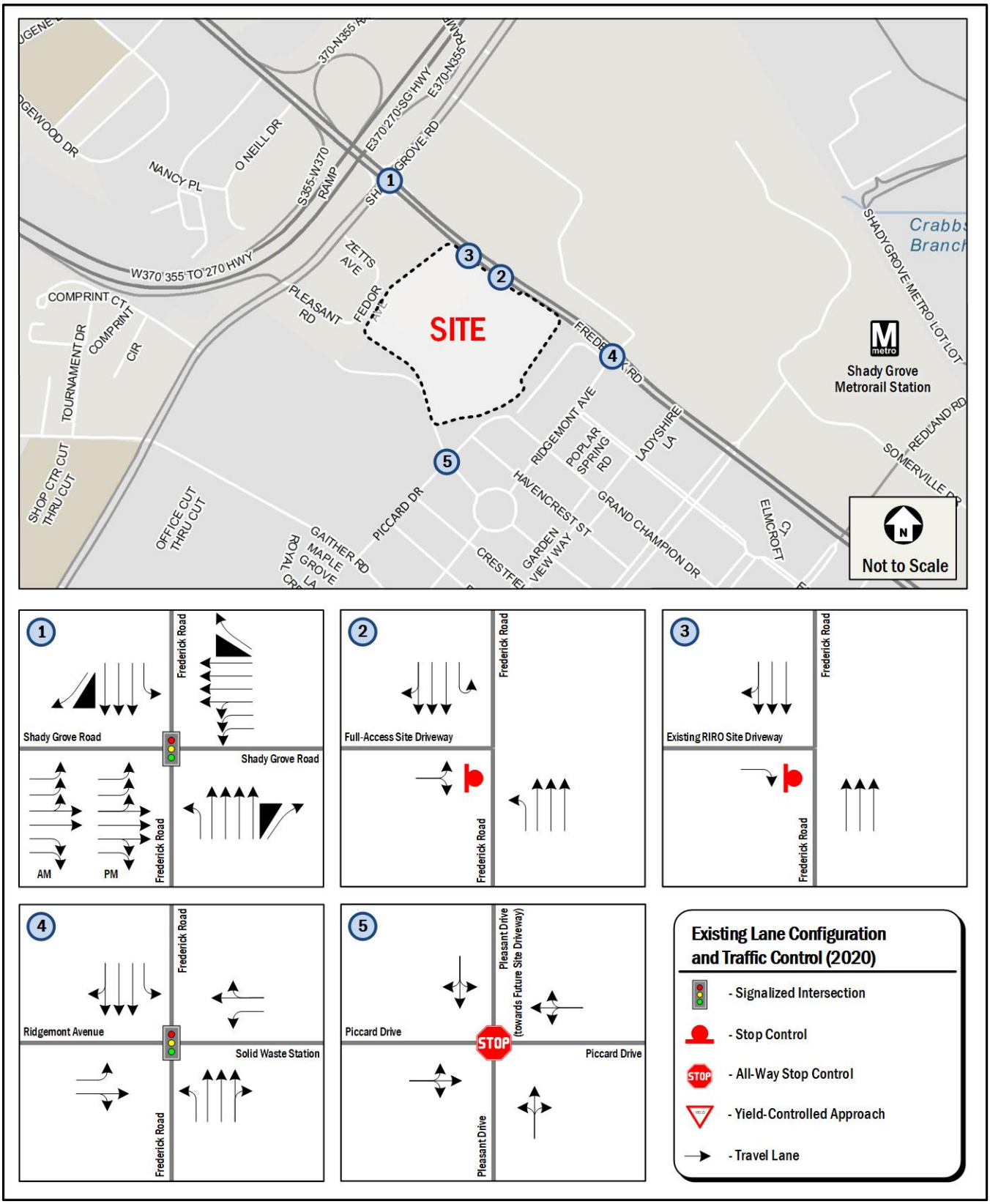

Figure 11: Existing Lane Configuration and Traffic Control

Existing Transit, Pedestrian, and Bicycle Facilities

Existing Transit Service

The site is well served by regional and local transit services such as Metrorail, MARC, and Ride On-Montgomery County. The site is approximately 0.7 miles from the Shady Grove Metrorail station. Ride On bus stops are available approximately 0.1 miles both north and south of the site on Frederick Road. The site is approximately 1.3 miles from the Washington Grove MARC train station located to the north. Combined, these transit services provide ample local, city wide, and regional transit connections and link the site with major cultural, residential, employment, and commercial destinations throughout the region. Figure 12 the major transit routes, stations, and stops in the study area.

The Shady Grove Metrorail station serves the Red Line which connects Rockville, MD with Glenmont, MD while providing access to the District core. Connections can be made at the Metro Center and Gallery Place-Chinatown stations to access the five other Metrorail lines, allowing access to destinations in Virginia and Prince George's County, Maryland. Under current operations during the COVID-19 pandemic, the Red line runs every six (6) minutes during the morning and afternoon peak periods and every 12 to 15 minutes during non-peak periods.

The Washington Grove MARC station is served by the Brunswick Line, which travels south from Martinsburg, West Virginia, through Washington County, Fredrick County, and Montgomery County and terminates at Union Station near the District core. Under current operations, Brunswick Line trains are running on a Limited-Service schedule servicing the Washington Grove MARC train station with four (4) trains in the morning and four (4) trains in the afternoon.

The site is also serviced by Ride On-Montgomery County routes along multiple primary corridors. Three (3) Ride On-Montgomery County routes directly service the site, providing a good connection to Metrorail and other destinations. Ride On stops are located approximately 0.1 miles from the site along Frederick Road and additional routes can be accessed close to the site along Shady Grove Road to the north. Table 11 shows a summary of the bus route information for the routes that serve the site, including service hours and headways under current operations, and distance to the nearest bus stop. Table 12 shows a detailed inventory of the amenities available at each of the existing bus stop within the transit study area.

Table 11: Local Bus Route Information

Route Number	Current Service Hours at Stop Closest to Site			Current Headway (minutes)	Walking Distance to Nearest Stop
	Weekdays	Saturdays	Sundays		
Ride On 43	5:00 AM – 12:05 AM	6:00 AM – 9: 51 PM	6:00 AM – 8:51 PM	25 - 55	0.2 mi (5 min)
Ride On 55	4:15 AM - 12:49 AM	5:00 AM - 12:38 AM	5:30 AM - 12:33 AM	12 - 35	0.15 mi (3 min)
Ride On 59	4:50 AM - 12:27 AM	5:20 AM – 12:36 PM	5:20 AM – 12:31 PM	20 - 45	0.15 mi (3 min)
Ride On 67	5:28 AM - 9:13 AM; 4:04 PM - 7:24 PM	-	-	30 - 41	0.15 mi (3 min)

Table 12: Bus Stop Inventory

Location	Stop ID	Routes Served	Amenities								
			Bus stop flag	Route map	Landing pad	Sidewalk	Bench	Shelter	Dynamic info sign	Lighting	Trash Recp.
Frederick Rd + Shady Grove Rd (SB)	22658	55,59,67	●		●	●	●	●		●	●
Frederick Rd + Ridgemont Ave (SB)	14530	55,59,67	●			●					
Frederick Rd + Ridgemont Ave (NB)	14535	55,59,67	●			●				●	●
Frederick Rd + Shady Grove Rd (NB)	22490	55,59,67	●		●	●	●	●		●	●
Shady Grove Rd + Frederick Rd (WB)	25988	43	●		●	●					●
Shady Grove Rd + Zetts Ave (EB)	25962	43,67	●			●					

Existing Pedestrian Facilities

Pedestrian Study Area

Facilities within a quarter mile of the site were evaluated as well as routes to nearby transit facilities. The site is easily accessible to transit options such as Shady Grove Metrorail station and bus stops along Frederick Road and Shady Grove Road. There is no barrier or area of concern within the study area that negatively impacts the quality of and attractiveness of the walking environment.

Pedestrian Infrastructure

A review of pedestrian facilities surrounding the planned development shows that most facilities meet City and SHA standards and provide an acceptable walking environment. Figure 13 shows a detailed inventory of the existing pedestrian infrastructure surrounding the site. Sidewalks, crosswalks, and curb ramps are evaluated based on the guidelines set forth by SHA's Bicycle and Pedestrian Design Guidelines in addition to ADA standards. Sidewalk widths and requirements for City of Rockville are shown below in Table 13. Figure 14 shows the existing conditions at each study intersection with respect to crosswalks, including the presence of pedestrian automated push buttons. A streetlight inventory around the site between study intersections is presented on Figure 15.

Table 13: Sidewalk Requirements

Street Type	Minimum Sidewalk Width	Minimum Buffer Width
Residential	4 ft - 5 ft	3 ft
Non-Residential	8 ft (Preferred)	3 ft

Within the area shown, most roadways outside of Frederick Road and Shady Grove Road are low volume residential streets. Some of the sidewalks surrounding the site do not comply with SHA standards, particularly due to the lack of buffer space. Sidewalks without adequate buffer space are also found along portions of Shady Grove Road.

ADA standards require that all curb ramps be provided wherever an accessible route crosses a curb and must have a detectable warning. Additionally, curb ramps shared between two crosswalks are not desired. As shown in Figure 13, under existing conditions there are some issues with crosswalks and curb ramps near the site, with most of these occurring on the low-volume residential streets to the south of the site.

Pedestrian Crossing Distance Analysis

A pedestrian crossing distance analysis was conducted at study intersections to determine the existing crossing conditions and signal timing necessary to meet the required pedestrian crossing needs. Crosswalk measurements were taken using Montgomery County GIS (MCATLAS) to determine the pedestrian crossing distances, measured curb to curb at each intersection. Using these measurements, the required pedestrian crossing time was calculated by dividing the distance by an average walking speed of 3.5 feet per second. Pedestrian crossing times were provided by Montgomery County via signal timing sheets. Table 14 shows the results of the pedestrian crossing distance analysis. Based on the results of the analysis, there are no intersections where pedestrians are not provided sufficient crossing time.

Table 14: Pedestrian Crossing Distance Analysis Results

Pedestrian Crossing Leg	Crossing Distance (ft)	Required Crossing Time (sec)	Maximum Provided Crossing Time AM (sec)	Maximum Provided Crossing Time PM (sec)
Frederick Road & Shady Grove Road				
North Leg	105	30	31	31
East Leg	115	33	43	43
West Leg	150	43	43	43
Frederick Road & Ridgemont Avenue				
South Leg	95	27	28	28
East Leg	80	23	23	23
West Leg	80	23	23	23

Existing Bicycle Facilities

The site has access to existing on- and off-street bicycle facilities. The site is located adjacent to the shared-use paths on Grand Champion Drive and Piccard Drive south of the site, which can be used to access the shared-use path on Gaither Road and on-street bicycle facilities on King Farm Boulevard.

In addition to personal bicycles, the Capital Bikeshare program provides additional cycle options for residents of the development. Two (2) Capital Bikeshare stations are located approximately 0.4 miles and 0.7 miles from the site, on King Farm Boulevard and at the Shady Grove Metrorail station, respectively.

According to the Montgomery County Bicycle Master plan, separated bikeway routes are proposed along the site frontage on Frederick Road and along Shady Grove Road to the north of the site in the future. Figure 16 illustrates the existing bicycle facilities and the future bicycle facilities planned in the area.

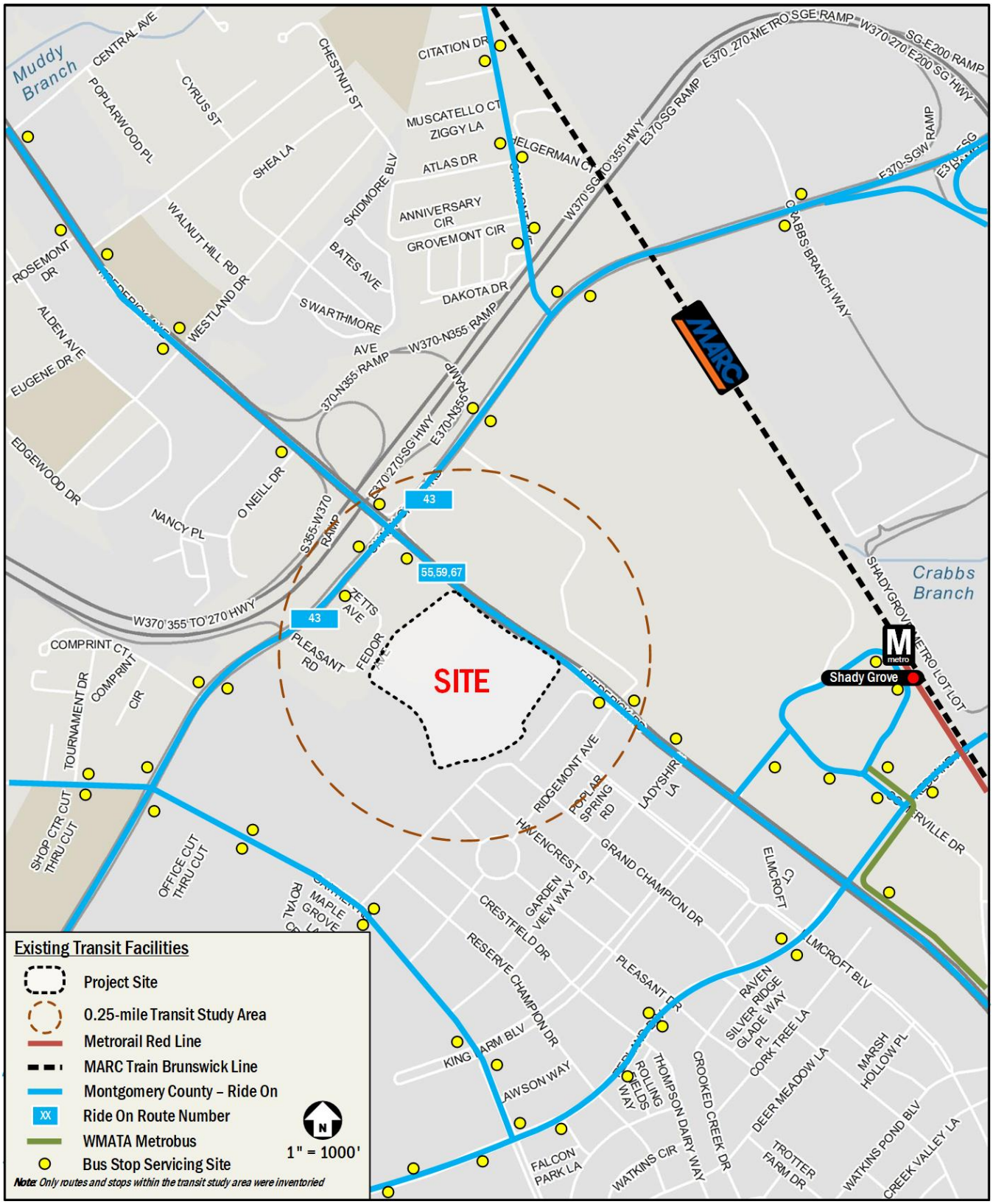

Figure 12: Existing Transit Facilities

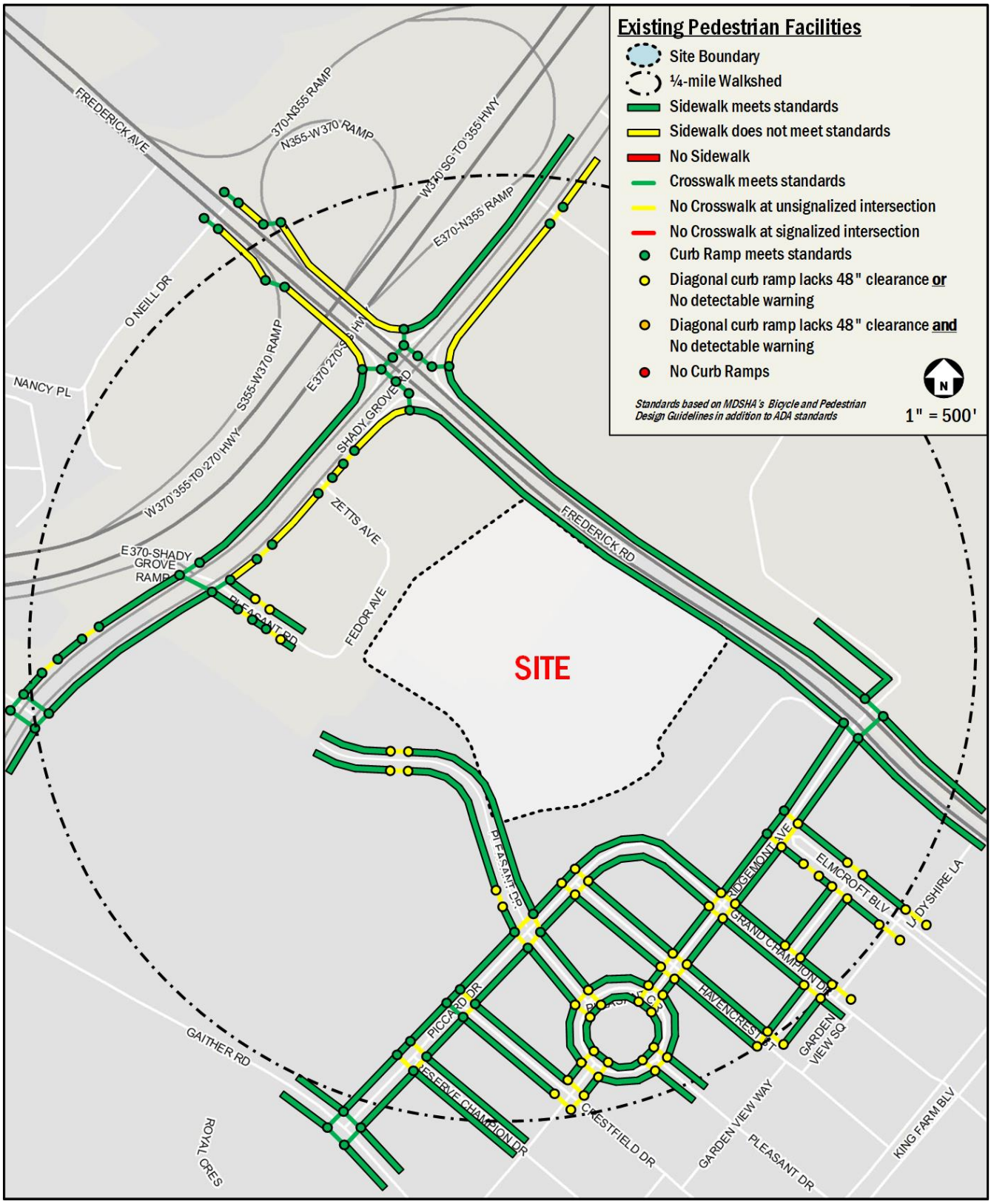

Figure 13: Existing Pedestrian Facilities

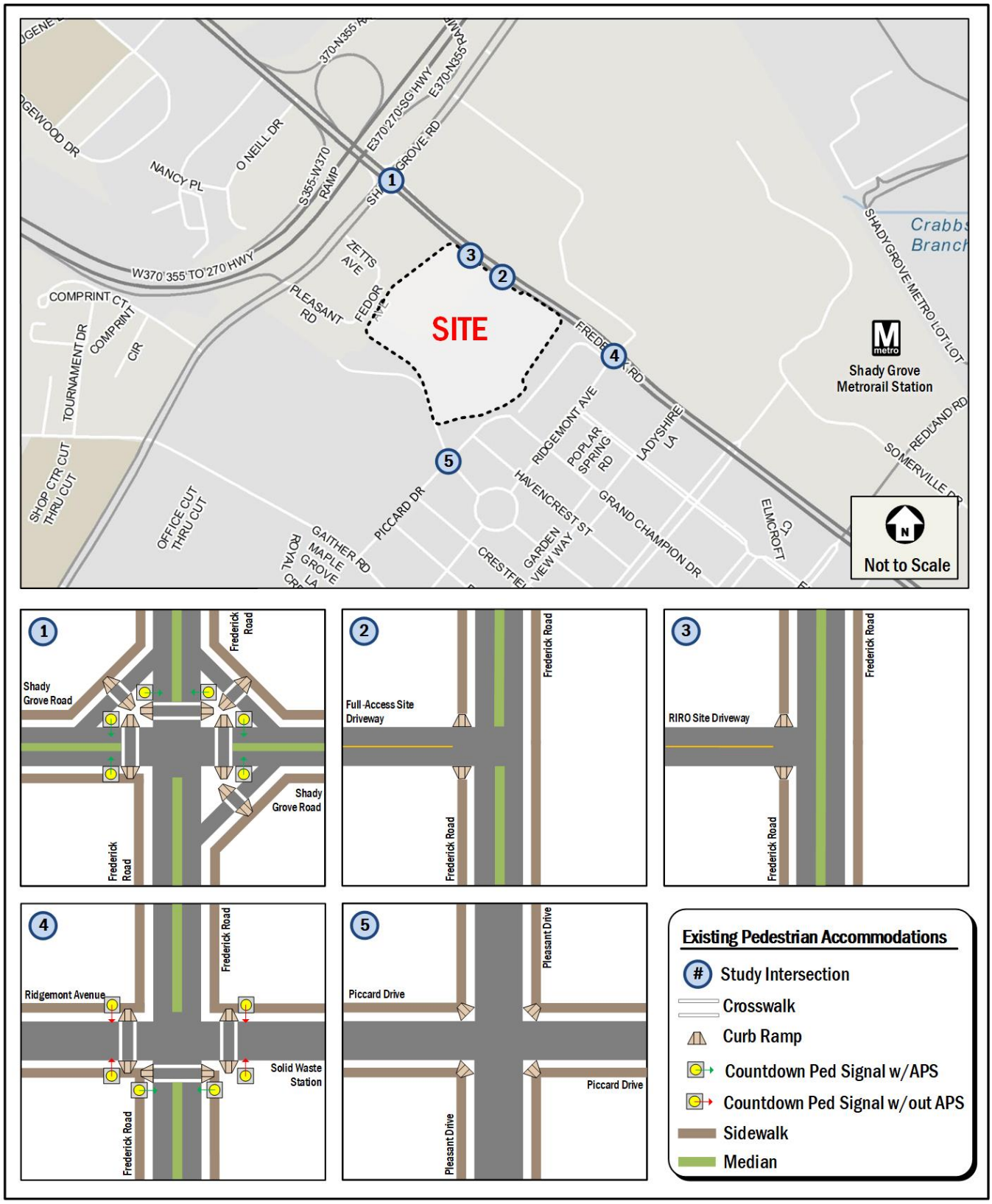

Figure 14: Existing Pedestrian Accommodations

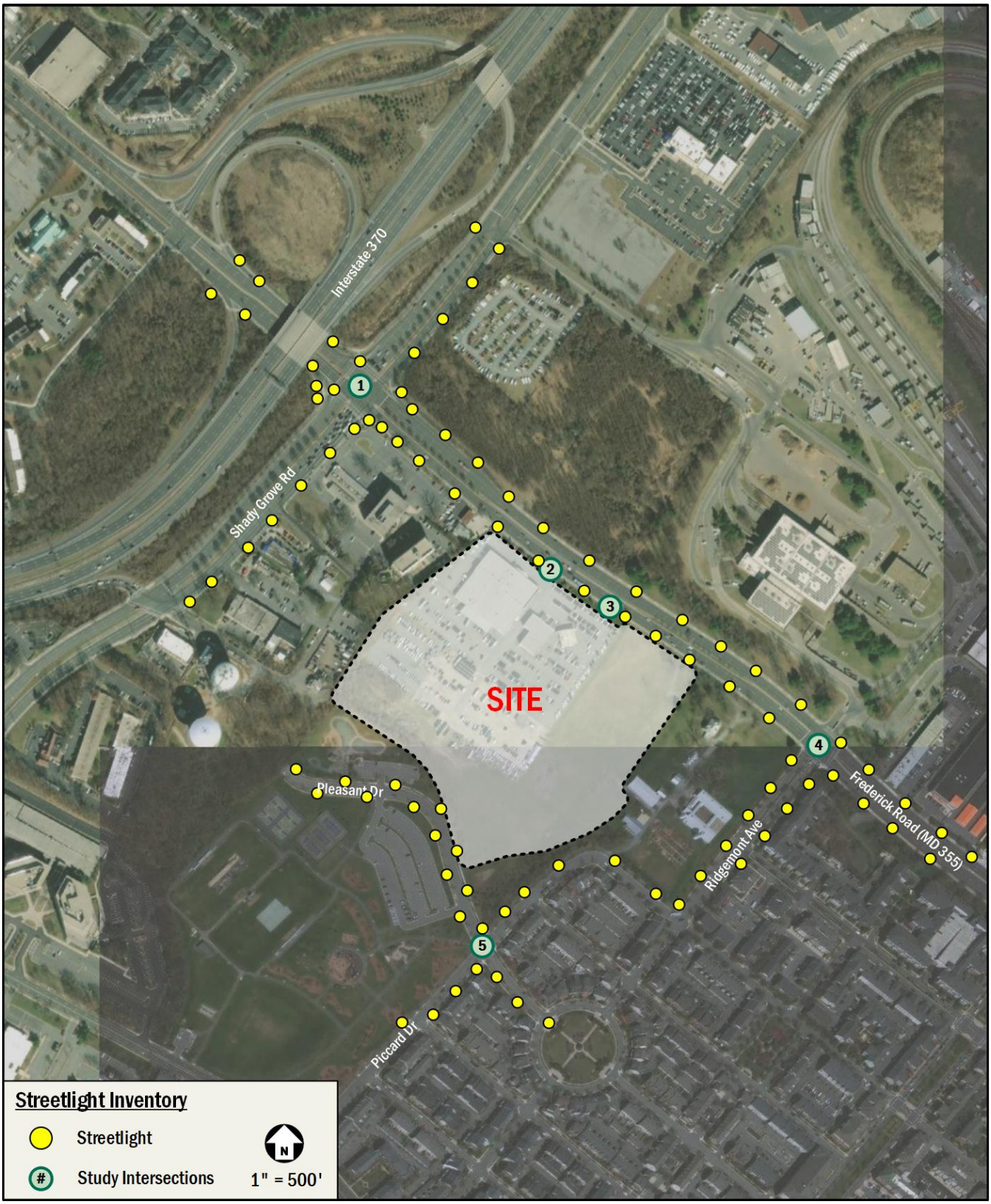

Figure 15: Streetlight Inventory

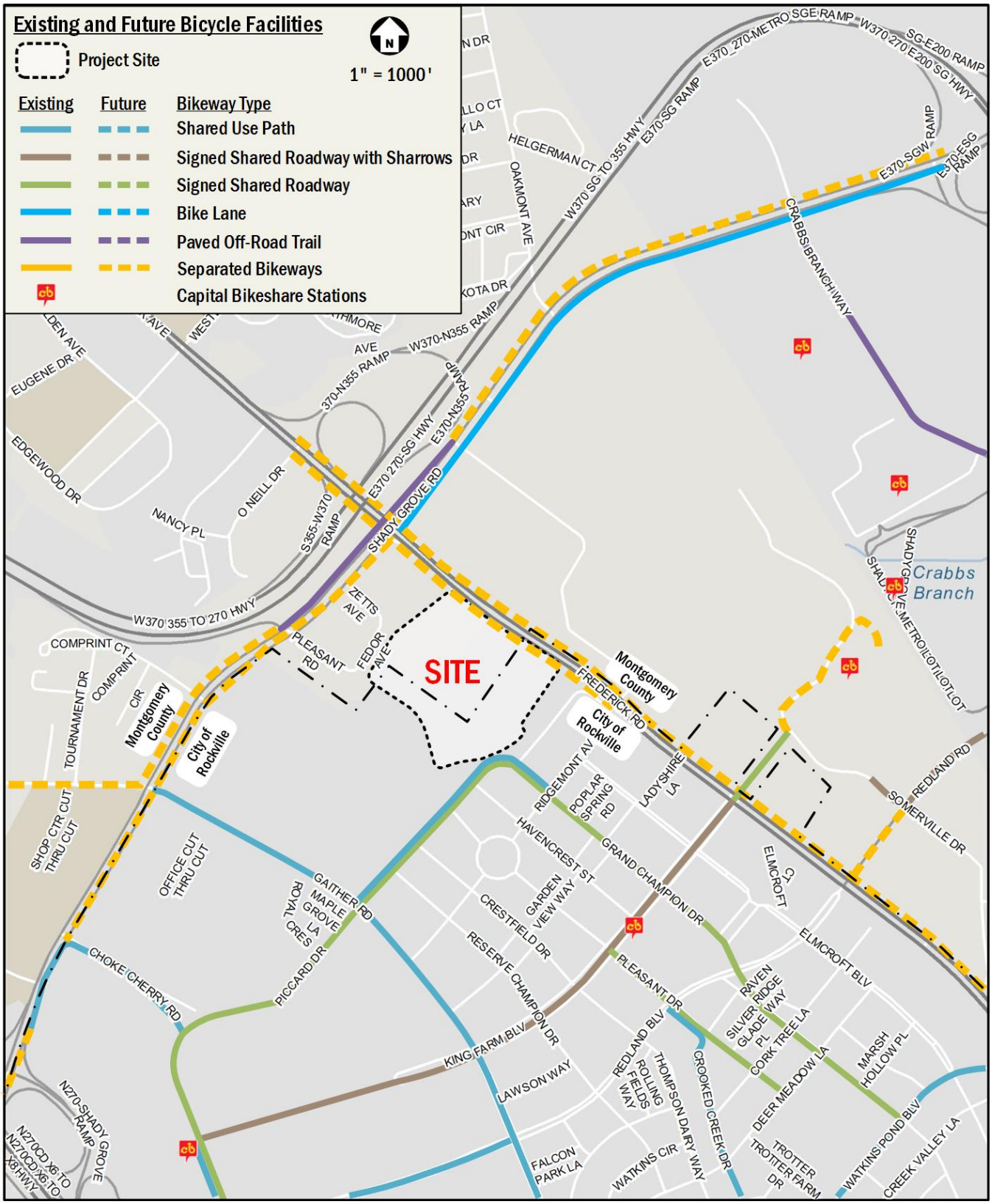

Figure 16: Existing and Future Bicycle Facilities

Background Conditions

This section evaluates the forecasted 2024 background traffic conditions in the study area, including planned multimodal improvements to the transportation network by other agencies around the project site. Traffic projections for the background conditions consist of:

- Existing peak hour traffic volumes at identified study intersections.
- Approved development projects without occupancy permit and/or building permit.
- Traffic growth from land uses outside the transportation study area.
- The removal of site-generated trips as captured under 2020 data collection and representing site trip generation during COVID-19 restrictions.
- The addition of approved site-generated trips based on the existing land use.

Background Developments

There are eight (8) potential development projects in the vicinity of the King Buick residential development. For the purpose of this analysis, only approved developments with an origin/destination within the study area were included. A list of all planned developments considered and relevant references to each development's traffic study or trip generation are included in the Technical Attachments. The eight (8) planned developments considered are described below. Figure 17 shows the location of these developments in relation to the proposed development.

North Westland Building

The North Westland Building development is located north of South Westland Drive and is approximately 0.6 miles from the project site. The development program features 12,700 SF office space.

Walnut Hill Shopping Center

The Walnut Hill Shopping Center development is located south of South Westland Drive and is approximately 0.5 miles from the project site. The development program includes 7,300 SF of unbuilt retail space.

Shady Grove Station

The Shady Grove Station residential development is located on Crabbs Branch Way, north of the Shady Grove Metrorail station, and is approximately 0.8 miles from the project site. The development program features 602 unbuilt townhome units and 1,126 unbuilt multifamily units.

Shady Grove Professional Building

The Shady Grove Professional Building development is located adjacent to the Site, at the southeast of corner of the intersection of Frederick Road and Shady Grove Road. The development program features 11,343 SF of office space and 15,107 SF of retail center.

Shady Grove Neighborhood Center

The Shady Grove Neighborhood Center development is located at the southwest corner of the intersection of Shady Grove Road and Gaither Road and is approximately 0.5 miles from the project site. The development program includes approximately 170,000 SF retail space, approximately 220,000 SF office space, a hotel with up to 240 rooms, 1,036 multifamily units, and 330 townhome units.

King Farm Townhouses

The King Farm Townhouses development is located west of Piccard Drive adjacent to the off-ramp of I-270 Exit 8 and is approximately 0.8 miles from the project site. The development program includes 76 unbuilt townhome units.

King Farm F-8 Site

The King Farm F-8 Site development is located east of Piccard Drive adjacent to the off-ramp of I-270 Exit 8 and is approximately 0.8 miles from the project site. The development program includes 29 townhome units.

Redland Tech Center

The Redland Tech Center development is located on Redland Boulevard and is approximately 0.8 miles from the project site. The development program features approximately 300,000 SF office space.

Background Developments Trip Generation

Existing transportation studies were available for most of the background developments. For those developments without available transportation studies, their trip generation was assumed based on the Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th Edition. Trip distribution assumptions for the background developments were based on previous studies if applicable and altered where necessary

based on anticipated travel patterns. Trip generation assumptions for the background developments are shown on Table 15. Trip distribution and assignment assumptions shown in maps for each of the background developments are included in the Technical Attachments. The traffic volumes generated by the background developments along the network are shown in Figure 18.

Background Regional Traffic Growth

While the background developments represent local traffic changes, regional traffic growth is typically accounted for using growth rates. The growth rates used in this analysis were derived using MDOT SHA historical AADT data for the past 10 years, shown in Table 16. Where negative growth was observed, a conservative 0.10 percent annual growth rate was applied to the roadway. The average annual growth between 2010 and 2019 and the applied growth rate assumptions for background conditions are shown in Table 17. The traffic volumes generated by the inherent growth along the network are shown in Figure 19.

Background Geometry and Operations Assumptions

Following national and City of Rockville CTR methodologies, a background improvement must meet the following criteria to be incorporated into the analysis:

- Be funded; and
- Have a construction completion date prior or close to the proposed development.

Based on these criteria, there are no funded projects or improvements programmed in the vicinity of the site area that affect the geometry of any of the study intersections.

Background Conditions Capacity Analysis

The existing site-generated traffic volumes as captured in the turning movement counts at the site driveways collected during the COVID-19 pandemic were removed from the background conditions as these do not reflect typical travel patterns because of the restrictions in place. The approved site trips based on ITE trip generation based on the existing site and shown in Table 1 were added to the background conditions. These volumes are shown in Figure 20 and Figure 21, respectively. The total peak hour traffic volumes for the 2024 background conditions are shown in Figure 22.

Intersection capacity analyses were performed for the background conditions at the study intersections shown in Figure 5 for the morning and afternoon peak hours. Critical lane volume (CLV) technique was used to analyze the study intersections based on the CLV methodology as outlined in the Appendix E of the CTR guidelines. Table 18 summarizes the capacity analysis results for background conditions. Detailed CLV analyses are provided in the Technical Attachments.

It was found that under background conditions, all study intersections, except the intersection of Frederick Road (MD 355) and Shady Grove Road, operate under the impact thresholds during both the morning and afternoon peak hours. The increase in peak hour volumes due to growth and background developments result in the Frederick Road (MD 355) and Shady Grove Road exceeding impact thresholds during the morning peak hour, while the intersection continues to operate near the capacity threshold during the afternoon peak hour.

A supplemental analysis was requested by City of Rockville staff and MDOT SHA. Signalized intersections along the Frederick Road (MD 355) corridor were analyzed using the Highway Capacity Manual (HCM) methodology in addition to the required CLV analyses. Synchro Version 10 was used to analyze the signalized study intersections of Frederick Road (MD 355)/Shady Grove Road and Frederick Road (MD 355)/Ridgemont Avenue. Table 19 shows a comparison of the results of the HCM capacity analysis between background and existing conditions at this intersection. It was found that the delays increase, and the LOS exceeds acceptable levels during the peak hours at the Frederick Road (MD 355) and Shady Grove Road intersection due to trips generated by background developments as well as the regional traffic growth. Table 20 shows the SimTraffic microsimulation queueing analysis results for the study intersections. It was found that the Frederick Road (MD 355) and Shady Grove Road intersection exhibits that the 95th percentile queues of one or more lane group exceed the given storage length during the background conditions, including the following:

- Eastbound Left (PM)
- Eastbound Left/Through (PM)
- Eastbound Through (PM)
- Eastbound Through/Right (PM)
- Eastbound Right (PM)
- Westbound Left (AM)
- Westbound Left/Through (AM)
- Westbound Right (PM)
- Northbound Left (PM)
- Southbound Left (AM & PM)

Table 15: Background Developments Trip Generation

Background Development	Trip Generation Source	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
North Westland Building	W+A LATR	17	2	19	5	26	31
Walnut Hill Shopping Center	Lenhart TIS	11	9	20	26	24	50
Shady Grove Station	W+A LATR	244	441	685	469	368	837
Shady Grove Professional Building	ITE Trip Generation	35	9	44	17	25	42
Shady Grove Neighborhood Center	W+A CTR	-29	620	591	1,220	698	1,918
King Farm Townhouses (F-6 and F-7)	ITE Trip Generation	8	25	33	26	14	40
King Farm F-8 Site	ITE Trip Generation	3	10	13	11	7	8
Redland Tech Center	ITE Trip Generation	249	41	290	49	255	304
	Total	**538**	**1,157**	**1,695**	**1,823**	**1,417**	**3,230**

Table 16: MDOT SHA Historical AADT Data

Road	Location	Year										Average Annual Growth Between 2010-2019
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Frederick Rd	Shady Grove Rd to MD 586	43241	43412	47740	47841	42090	43181	44002	46710	46291	46292	0.61%
Shady Grove Rd	West of Frederick Rd	40571	40732	40750	40831	40712	39540	40291	41262	40450	40451	-0.09%
Shady Grove Rd	East of Frederick Rd	34871	35012	35030	35101	35002	32940	33571	34382	28370	28371	-3.74%

Table 17: Growth Rate Data and Applied Annual and Total Growth Rates

Road	MDOT SHA AADT Growth 2010-2019	Annual Growth Rate Assumption	Proposed Total Growth Between 2020 and 2024
Frederick Road	0.61%	0.60%	2.42%
Shady Grove Road	-0.09% / -3.74%	0.10%	0.40%
Ridgemont Avenue	N/A	0.10%	0.40%

Table 18: Summary of Background Conditions Intersection Capacity Results

Intersection	Traffic Control	Intersection Capacity		v/c Threshold	LOS Threshold	MOE	2020 Existing Conditions		2024 Background Conditions	
		AM	*PM*				*AM*	*PM*	*AM*	*PM*
Frederick Road & Shady Grove Rd	Signalized	1550	1550	0.99	E	CLV v/c LOS	1481 0.96 E	1279 0.83 D	1582 1.02 F	1494 0.96 E
Frederick Road & Full-Access Site Driveway	Unsignalized	1600	1600	0.99	E	CLV v/c LOS	1092 0.68 B	999 0.62 B	1174 0.73 C	1100 0.69 B
Frederick Road & RIRO Site Driveway	Unsignalized	1600	1600	0.99	E	CLV v/c LOS	1099 0.69 B	706 0.44 A	1140 0.71 C	756 0.47 A
Frederick Road & Ridgemont Avenue	Signalized	1650	1650	0.99	E	CLV v/c LOS	1146 0.69 B	984 0.60 A	1185 0.72 C	1039 0.63 B
Piccard Drive & Pleasant Drive	Unsignalized	1600	1600	0.89	D	CLV v/c LOS	77 0.05 A	155 0.10 A	77 0.05 A	155 0.10 A

Table 19: Summary of Background Conditions Intersection Capacity Results (HCM)*

Intersection	Existing Conditions (2020)				Background Conditions (2024)			
	AM Peak Hour		*PM Peak Hour*		*AM Peak Hour*		*PM Peak Hour*	
	Delay (s)	*LOS*	*Delay (s)*	*LOS*	*Delay (s)*	*LOS*	*Delay (s)*	*LOS*
Frederick Road & Shady Grove Road	69.1	E	94.8	F	88.2	F	127.1	F
Frederick Road & Ridgemont Avenue	11.9	B	7.5	A	12.4	B	7.6	A

* HCM analysis results presented as supplementary information only, as requested for signalized intersections along the Frederick Road (MD 355) corridor.

Table 20: B Background Conditions SimTraffic 50th and 95th Percentile Queueing Results for Study Intersections along Frederick Road (MD 355)

Intersection	Lane Group	Storage Length (ft)	Existing Conditions (2020)				Background Conditions (2024)			
			AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
			50th	95th	50th	95th	50th	95th	50th	95th
Frederick Road & Shady Grove Road	Eastbound L	600	1	20	179	279	23	100	265	407
	Eastbound L	600	139	251	459	630	235	389	674	727
	Eastbound LT	920	218	294	543	724	315	445	936	1050
	Eastbound T	920	171	251	471	636	268	398	926	1053
	Eastbound R/TR	920	317	508	435	605	465	695	921	1071
	Eastbound R	920	287	474	372	548	429	662	893	1083
	Westbound L	550	159	252	27	98	186	289	39	133
	Westbound L	550	398	541	184	272	441	584	200	305
	Westbound LT	550	494	643	243	318	545	693	279	353
	Westbound T	620	411	540	179	259	452	594	214	298
	Westbound T	620	278	368	68	175	326	423	114	219
	Westbound T	620	177	268	6	65	234	342	22	134
	Westbound R	170	7	63	50	187	29	157	66	215
	Northbound L	500	169	296	180	297	272	458	391	652
	Northbound T	810	133	189	374	476	139	193	497	793
	Northbound T	810	132	192	382	488	136	196	485	762
	Northbound T	810	99	160	356	468	106	161	382	548
	Northbound T	810	36	94	284	404	42	106	303	417
	Northbound R	410	--	--	119	295	1	15	164	350
	Southbound L	525	247	546	183	303	410	665	409	639
	Southbound T	720	532	695	318	420	513	545	436	599
	Southbound T	720	480	634	269	366	498	562	329	511
	Southbound T	720	392	553	158	257	481	582	246	426
	Southbound R	700	218	456	--	--	424	649	21	153
Frederick Road & Full-Access Site Driveway	Eastbound LR	-	15	54	167	299	227	258	236	253
	Northbound L	250	8	0	0	5	53	191	0	4
	Northbound T	1020	30	0	0	3	4	60	3	38
	Southbound U	240	11	33	62	125	11	34	71	162
	Southbound T	800	3	67	0	5	1	9	0	0
	Southbound T	800	7	112	--	--	--	--	--	--
	Southbound TR	800	1	10	0	3	1	9	0	0
Frederick Road & Ridgemont Avenue	Eastbound L	360	15	44	18	48	15	44	25	57
	Eastbound TR	180	17	47	28	63	17	49	30	64
	Westbound L	100	24	57	18	47	20	53	21	55
	Westbound TR	100	15	42	17	46	13	40	14	44
	Northbound L	320	29	67	19	49	27	63	20	46
	Northbound T	930	43	114	99	226	36	99	124	279
	Northbound T	930	17	65	72	188	10	43	89	227
	Northbound TR	930	11	39	71	176	9	33	78	196
	Southbound L	250	9	29	22	56	8	28	19	49
	Southbound T	1020	145	333	18	65	125	289	22	71
	Southbound T	1020	167	361	47	108	143	322	54	118
	Southbound TR	1020	172	372	62	134	146	327	65	137

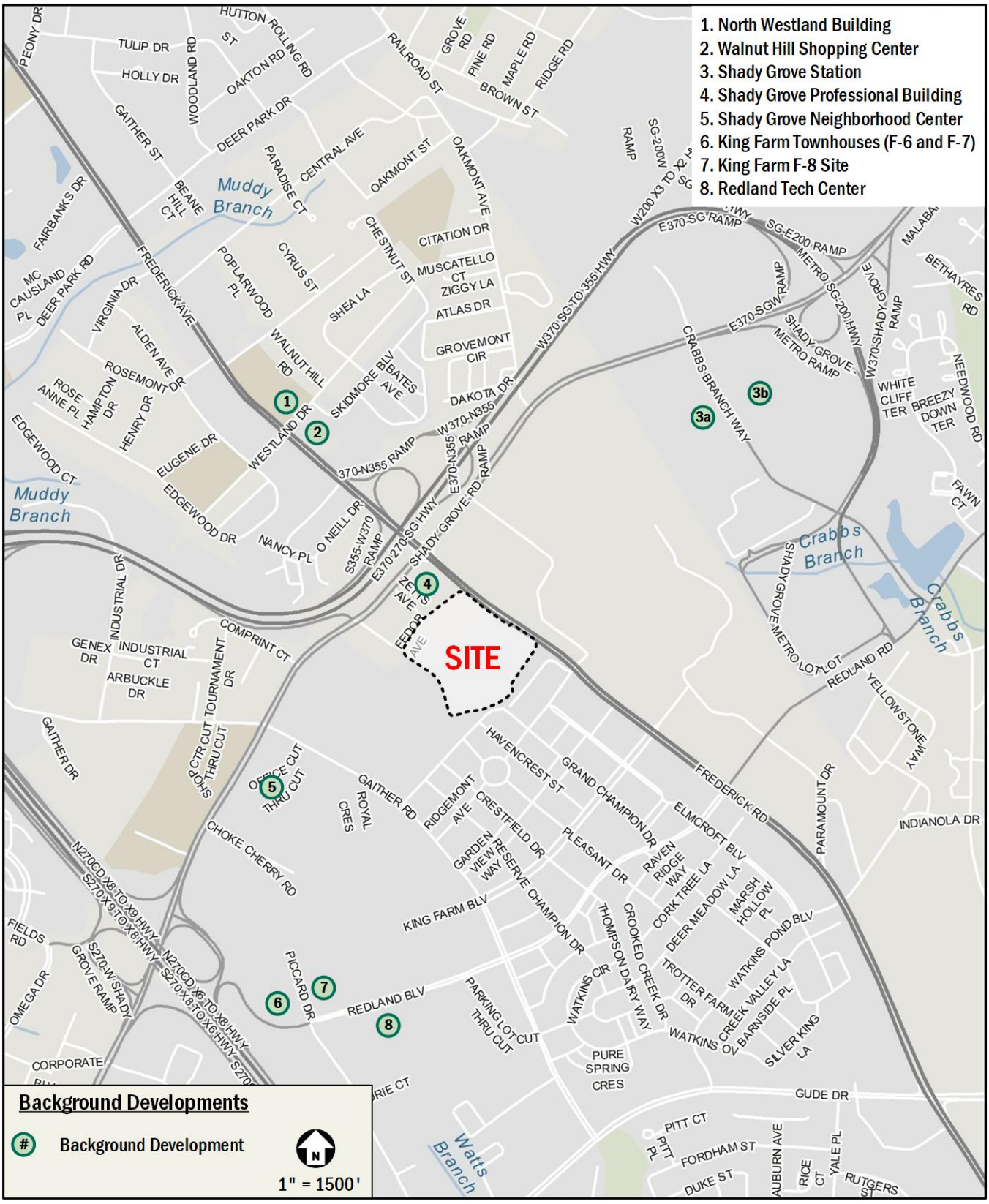

Figure 17: Background Developments

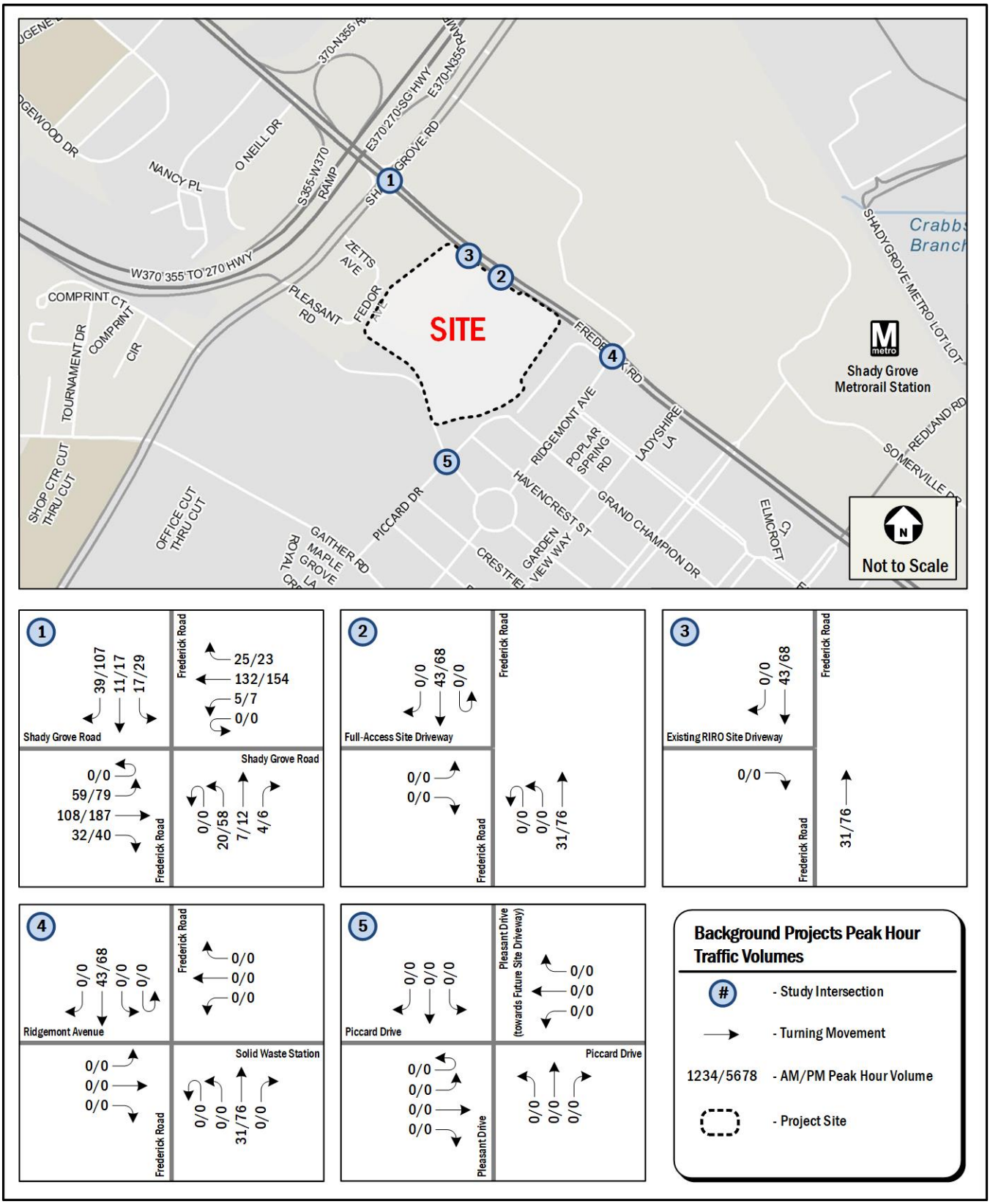

Figure 18: Background Projects Peak Hour Traffic Volumes

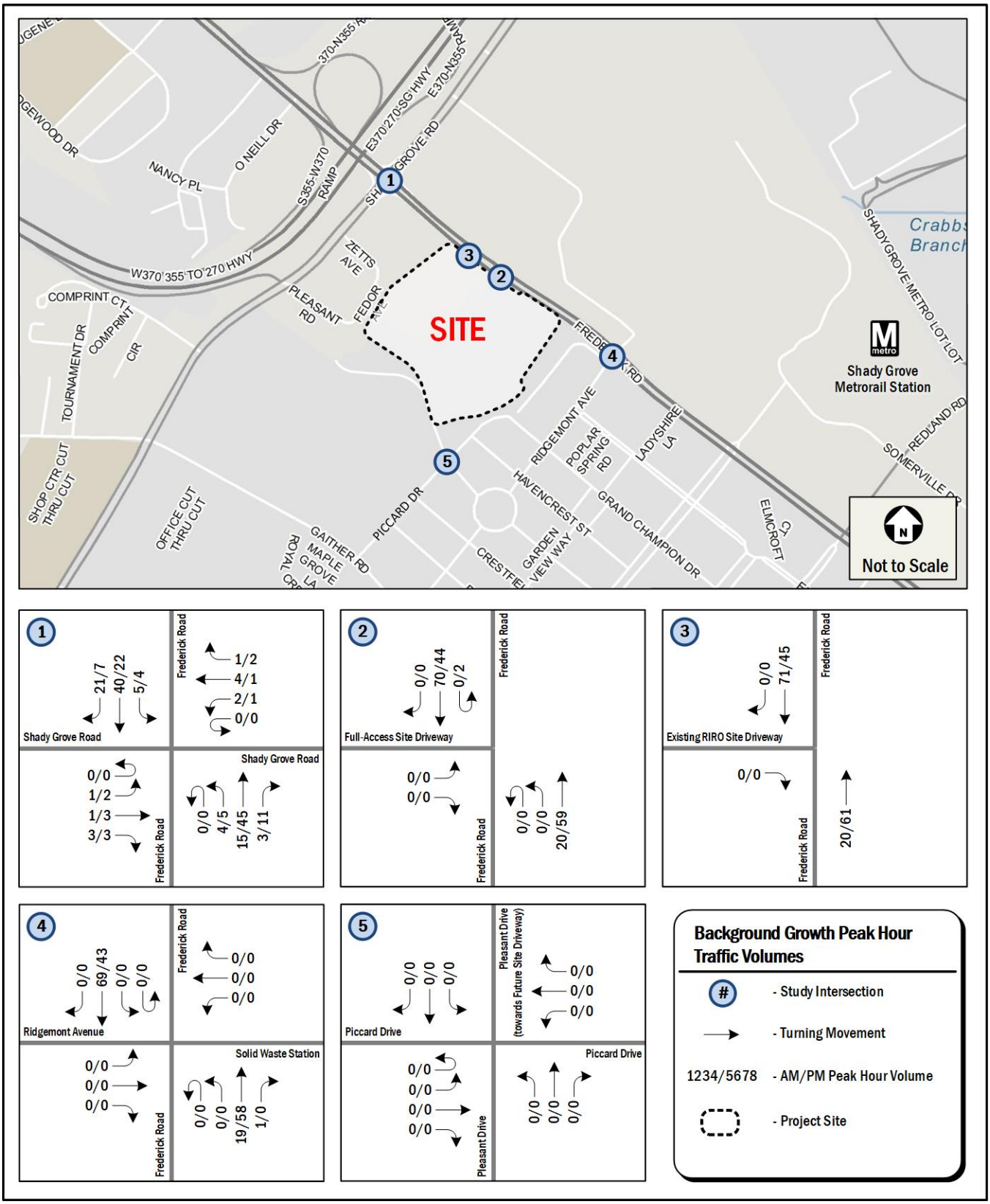

Figure 19: Background Growth Peak Hour Traffic Volumes

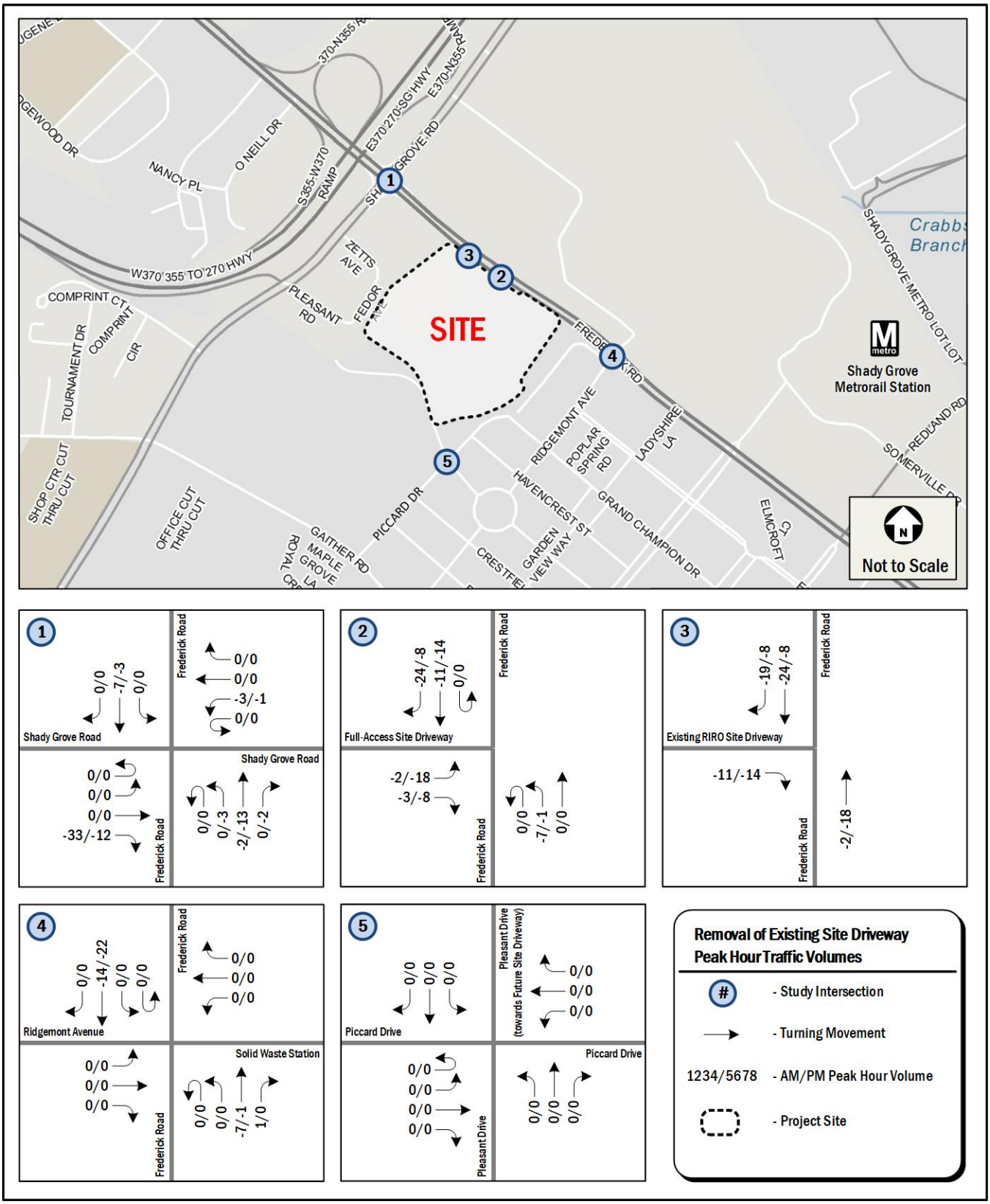

Figure 20: Removal of Existing Site Driveway Peak Hour Traffic Volumes

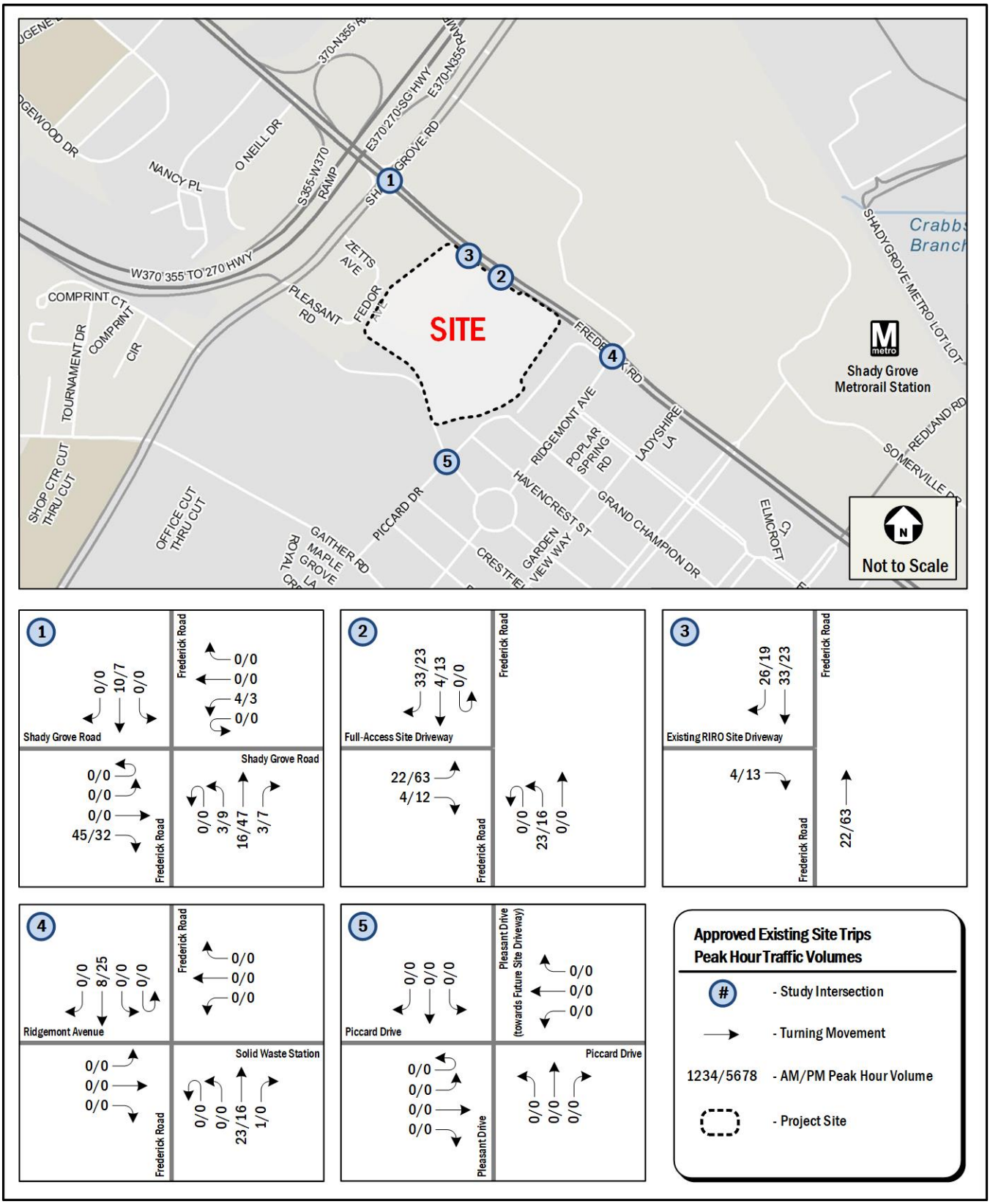

Figure 21: Approved Existing Site Trips Peak Hour Traffic Volumes

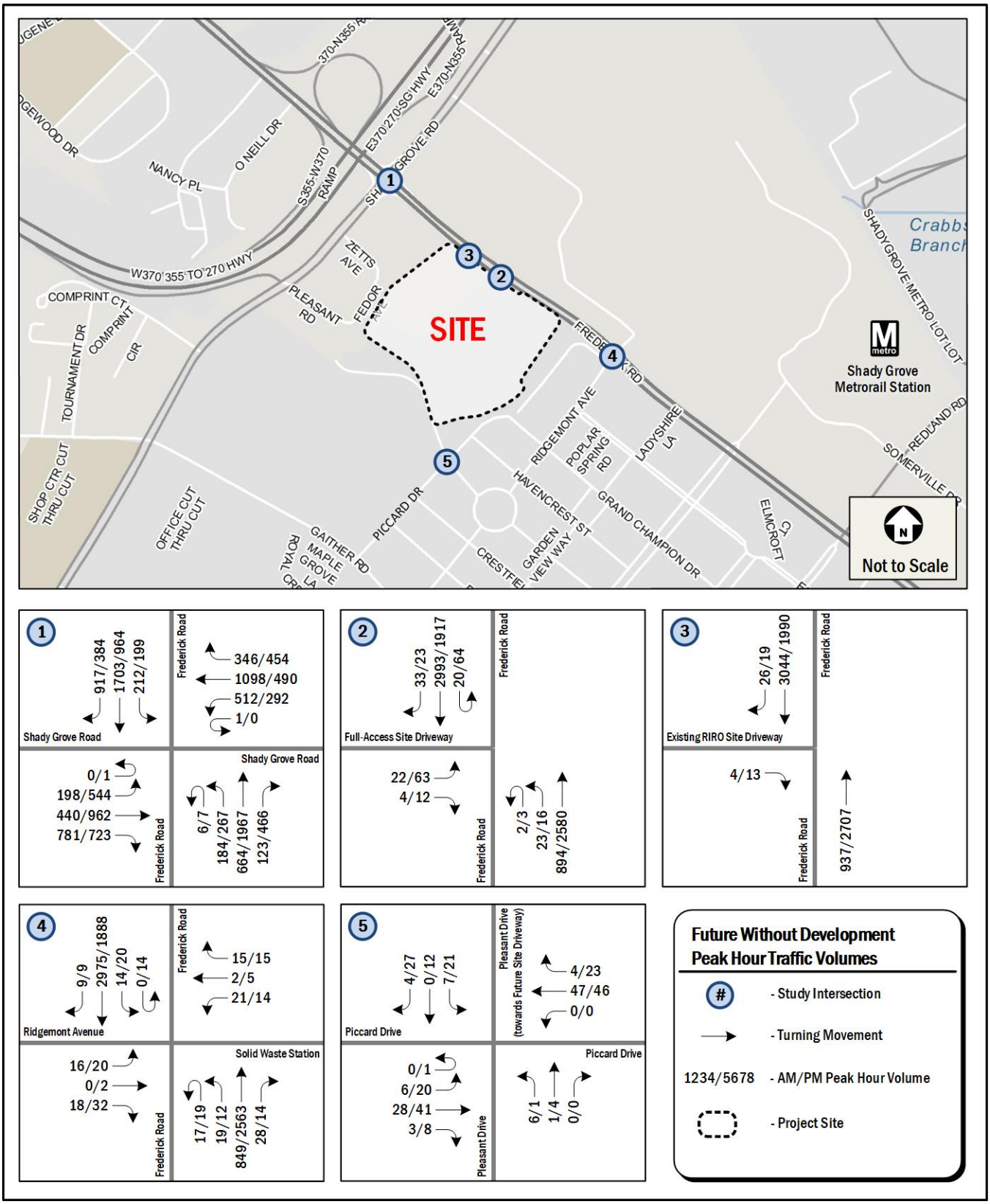

Figure 22: Future without Development Peak Hour Traffic Volumes

Planned Transit and Bicycle Facilities

Future Transit Service

As part of an initiative to bring Bus Rapid Transit (BRT) service to Montgomery County, the approved Countywide Transit Corridors Functional Master Plan prepared by M-NCPPC recommends implementing a 102-mile BRT system. One of the corridors selected is the MD 355 North corridor, which runs from the Rockville Metrorail Station and continues north to Redgrave Place in Clarksburg. The BRT route will travel along dedicated lanes on Frederick Road adjacent to the project site. Potential BRT stations include Shady Grove Metrorail station, Ridgemont Avenue, and Redland Boulevard.

From 2015 to 2017, MCDOT conducted a first phase study to select options for the MD 355 North BRT, identifying alternatives based on the placement of the BRT lanes. The second phase of the study is currently underway, and a preferred alternative has been selected. The future dedicated BRT lanes are expected to be located in the center of the roadway and separated from traffic by a raised curb or median, with potential gaps in median for left-turning vehicles.

The BRT improvements around the project site are not expected to be implemented before completion of the proposed project and were therefore not assumed to be in place in the background conditions scenario.

Future Bicycle Improvements

According to the proposed bicycle network from the 2017 Montgomery County Bicycle Master Plan, separated bikeways are recommended along Frederick Road and Shady Grove Road to provide north-south and east-west connectivity and to provide a direct link to the Shady Grove Metrorail station. The planned facilities are presented in Figure 16 in the previous section.

Trip Generation and Trip Reduction

This section outlines the transportation demand of the proposed King Buick site redevelopment. It summarizes the projected trip generation of the site, credit for existing trips generated by existing occupants of the site, and applicable trip reduction.

Proposed Trip Generation

The proposed development plan includes a residential subdivision, consisting of 368 townhomes and an approximately 5,000 square feet community center.

Trip generation for the proposed community center was included in the scoping intake form submitted to the City. However, the updated development program envisions the community amenities to be utilized by residents only. Therefore, the proposed community center is not expected to generate any external trips to the site. With the approval of the City staff, the trip generation for the community center is not included in the analyses for future conditions.

Weekday peak hour trip generation for the proposed use is calculated based on the methodology outlined in the Institute of Transportation Engineers' (ITE) *Trip Generation Manual*, 10th Edition. Residential trip generation for townhomes was calculated using ITE Land Use Code 220, *Multifamily (Low-rise)*.

Existing Trip Generation

The site is currently occupied by approximately 56,540 square feet new car dealership and approximately 3,600 square feet used car dealership.

Weekday peak hour trip generation for the existing use is calculated based on the methodology outlined in the Institute of Transportation Engineers' (ITE) *Trip Generation Manual*, 10th Edition. Trip generation for the entire dealership site was calculated using ITE Land Use Code 840, *Auto Sales New*, per the scoping agreement with City of Rockville.

Trip Reduction

The site is in proximity to the Shady Grove Metrorail station and is located partially within the Transit Oriented Area (TOA) shown in the map of CTR guidelines Appendix C. Per the scoping agreement with City of Rockville, a 15 percent of modal split trip reduction for TOA is allowed to be taken. Other trip reduction options, including pass-by reduction and mix-used reduction, are not applicable to the proposed residential development.

Trip Generation Summary

Following the removal of existing trips and the TOA modal split reduction, the proposed development will generate 27 net new trips during the morning peak hour and 14 net new trips during the afternoon peak hour, as detailed in Table 21. Detailed calculations are provided in the Technical Attachments.

Table 21: Trip Generation Summary

Land Use	Size			AM Peak Hour			PM Peak Hour			ADT	Sat Peak Hour		
				In	Out	Total	In	Out	Total		In	Out	Total
Existing Trip Generation													
Auto Sales New (840)	60,140	sf	ITE	82	30	112	58	88	146	1,694	121	121	242
Total Existing Trips				82	30	112	58	88	146	1,694	121	121	242
Proposed Trip Generation													
Residential (220)	368	units	ITE	38	126	164	118	70	188	2,741	197	167	364
Subtotal Proposed Trips				38	126	164	118	70	188	2,741	197	167	364
Multimodal trip reduction (15% for TOA)				**-6**	**-19**	**-25**	**-18**	**-10**	**-28**	**-411**	**-30**	**-25**	**-55**
Total Site trips with Reduction				32	107	139	100	60	160	2,330	167	142	309
Net New Trips without 15% TOA Reduction*				**-44**	**96**	**52**	**60**	**-18**	**42**	**1,047**	**76**	**46**	**122**
Net New Trips with 15% TOA Reduction**				**-50**	**77**	**27**	**42**	**-28**	**14**	**636**	**46**	**21**	**67**

Trip Distribution and Trip Assignment

Trip distribution for the site-generated trips was determined based on: (1) Table 2-6 of the M-NCPPC LATR Guidelines, included in the Technical Attachments, (2) existing travel patterns in the study area, (3) the site driveway layout of the development, and (4) consultation with City staff.

Based on traffic patterns and a comprehensive review of the site access locations, the site-generated trips were distributed through the study area intersections. A summary of trip distribution assumptions and routing for each element of the development is provided on Figure 23 for inbound trips and Figure 24 for outbound trips.

The assignment of the removal existing site driveway trips is shown on Figure 25. The assignment of site-generated traffic volumes through the study intersections is shown on Figure 26.

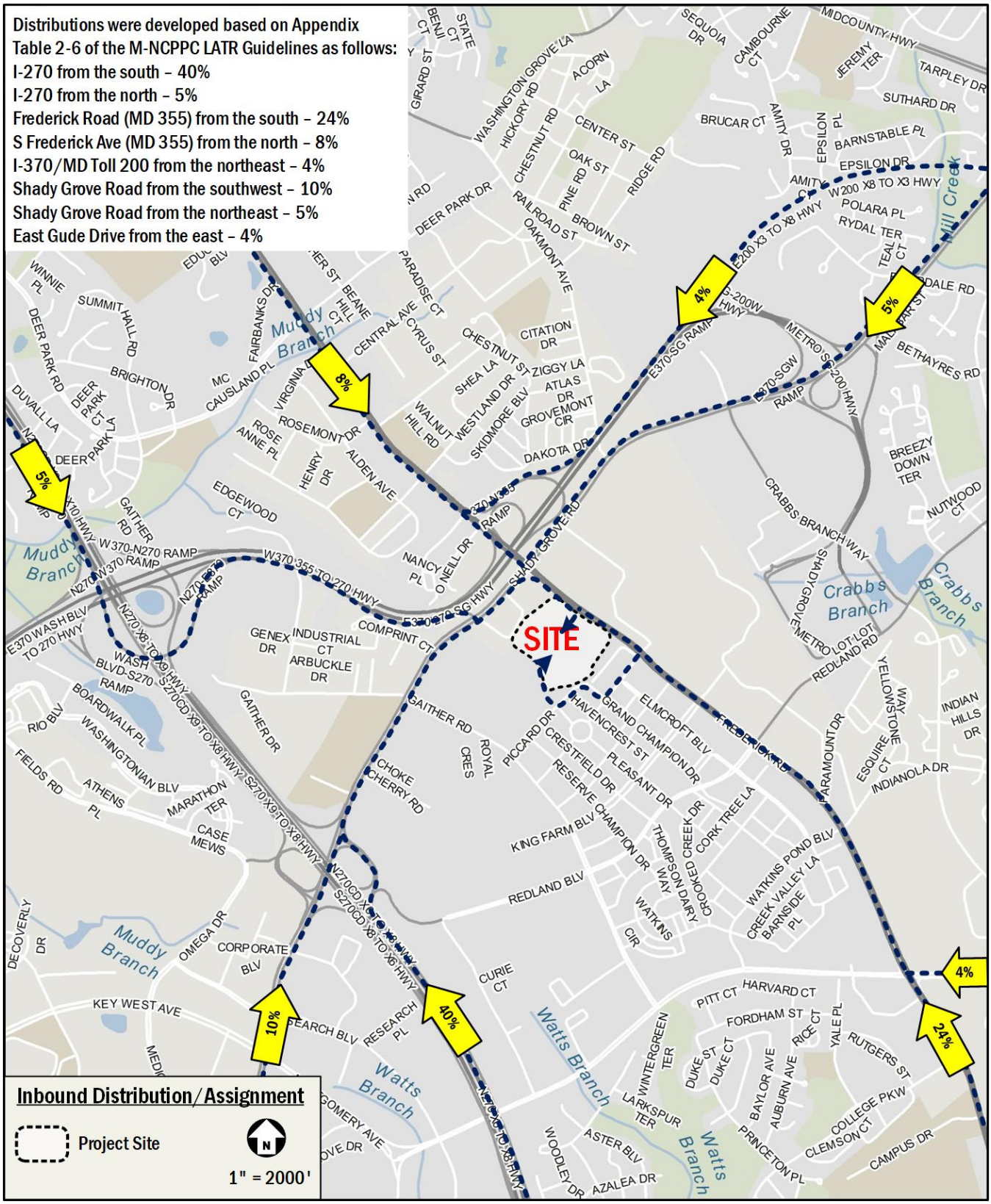

Figure 23: Inbound Distribution and Assignment

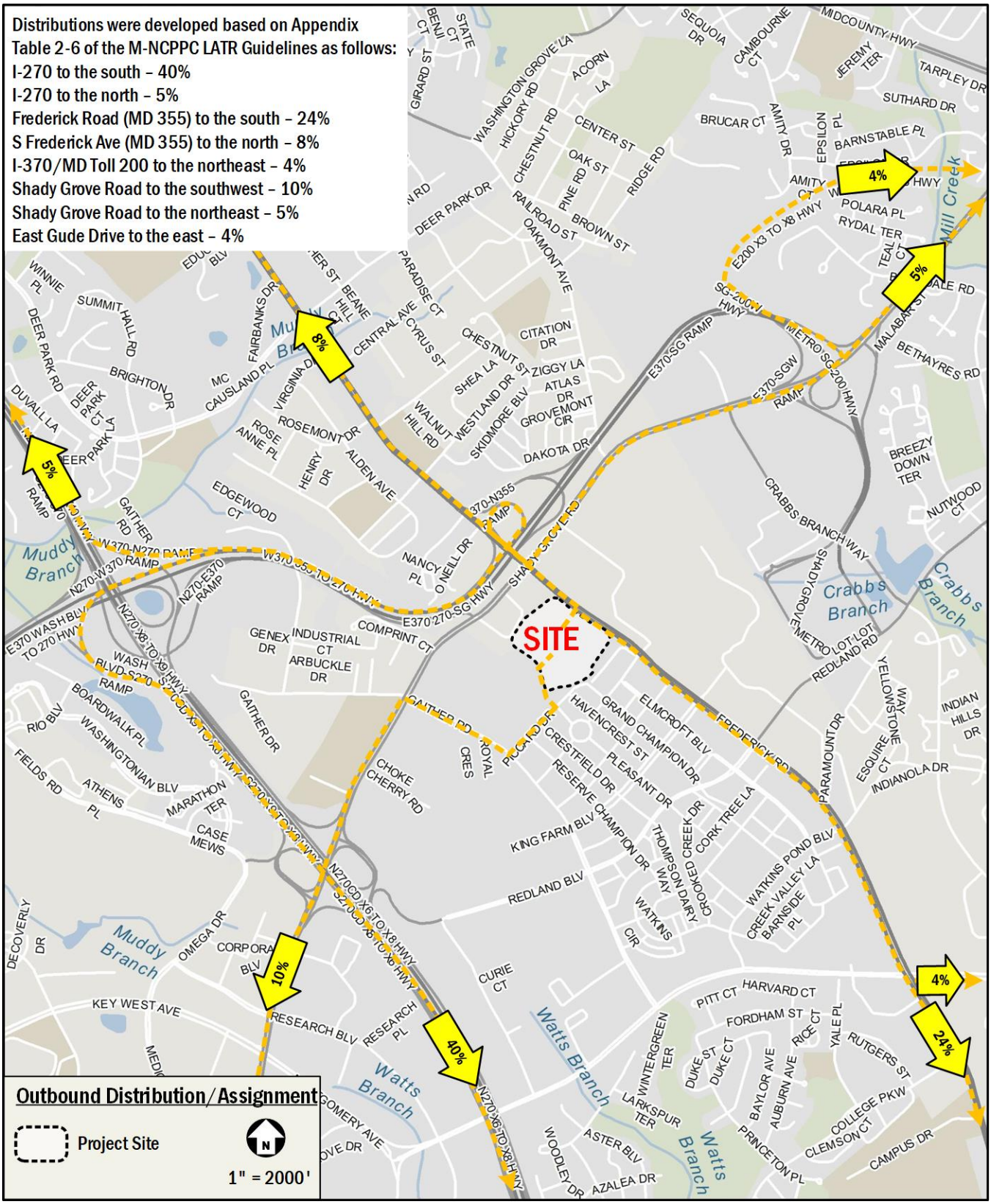

Figure 24: Outbound Distribution and Assignment

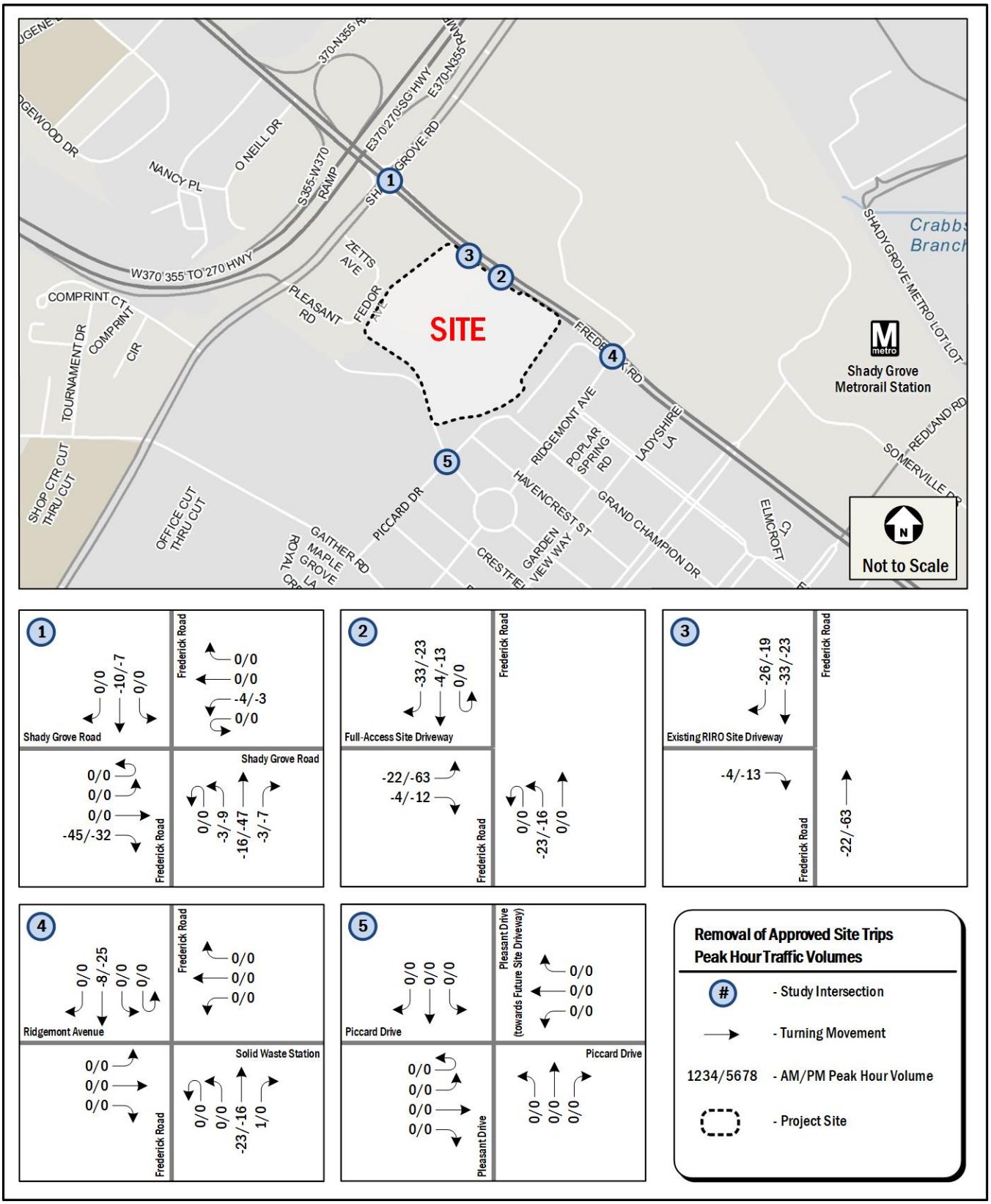

Figure 25: Removal of Approved Site Trips Peak Hour Traffic Volumes

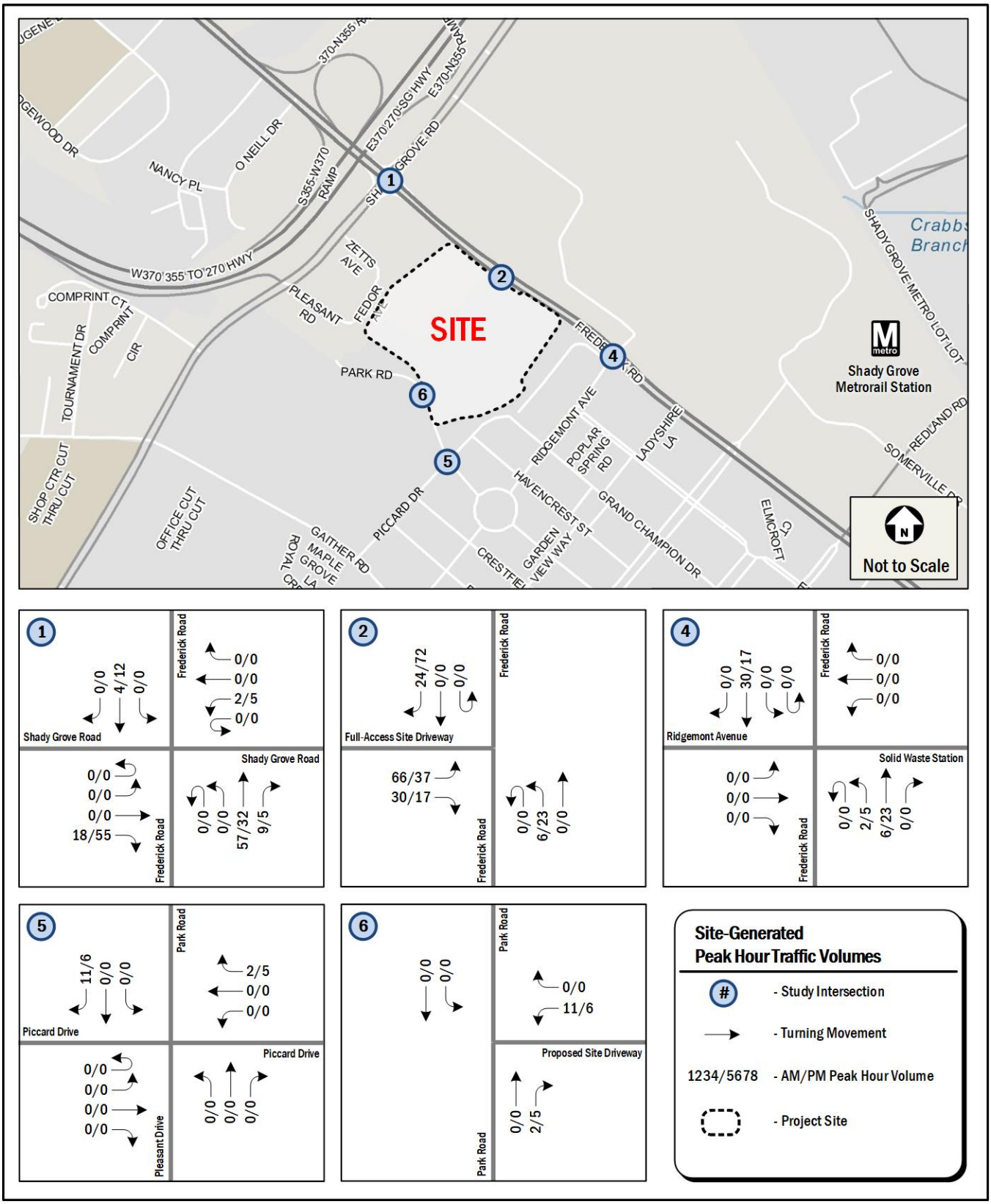

Figure 26: Site-Generated Peak Hour Traffic Volumes

Intersection Capacity Analysis for Total Future Conditions

This section summarizes the capacity analysis results at the study intersections for Total Future conditions. The Total Future traffic volumes consist of the Background volumes with the removal of the existing site volumes, shown in Figure 25, and addition of the traffic volumes generated by the proposed development (site-generated trips with reduction) shown in Figure 26. Thus, the Total Future traffic volumes include traffic generated by the existing volumes, background developments, background growth, the removal of existing site driveway volumes, and the proposed project.

Future Geometry and Operations Assumptions

The redevelopment will include a network of new internal streets that will provide internal ingress and egress points throughout the property. The future geometry and operation assumptions included in the analysis are based on the background conditions with the following improvements:

- Eliminating the existing northern right-in-right-out site driveway.
- Providing a site access connection to Park Road (northern extension of Pleasant Drive) southwest of the site.

The lane configuration and traffic controls assumed in the Total Future conditions is presented in Figure 27. Total Future traffic volumes are shown in Figure 28.

Total Future Conditions Capacity Analysis

Intersection capacity analyses were performed for the Total Future conditions at the study intersections shown in Figure 5 for the morning and afternoon peak hours. Critical lane volume (CLV) technique was used to analyze the study intersections based on the CLV methodology as outlined in the Appendix E of the CTR guidelines. Table 22 summarizes the capacity analysis results for Total Future conditions. Detailed CLV analyses are provided in the Technical Attachments.

It was found that under Total Future conditions, all study intersections, except the intersection of Frederick Road (MD 355) and Shady Grove Road, operate under the impact thresholds during both the morning and afternoon peak hours, which is the similar to the results for background conditions.

A supplemental analysis was requested by City of Rockville staff and MDOT SHA. Signalized intersections along the Frederick Road (MD 355) corridor were analyzed using the Highway Capacity Manual (HCM) methodology in addition to the required CLV analyses. Synchro Version 10 was used to analyze the signalized study intersections of Frederick Road (MD 355)/Shady Grove Road and Frederick Road (MD 355)/Ridgemont Avenue.

Table 23 shows a comparison of the results of the HCM capacity analysis between Background and Total Future conditions. It was found that with the development, the overall delay at the Frederick Road (MD 355) and Shady Grove Road intersection decreases slightly during the morning peak hour and increases less than three (3) seconds during the afternoon peak hour, which can be attributed to the removal of existing approved site trips and the introduction of an additional site access point on Park Road/Pleasant Drive.

Table 24 shows the SimTraffic microsimulation queueing analysis results for the study intersections along the Frederick Road (MD 355) corridor. It was found that the Frederick Road (MD 355) and Shady Grove Road intersection exhibits that the 95th percentile queues of one or more lane group exceed the given storage length in the Total Future conditions consistent with the background conditions, including the following:

- Eastbound Left (PM)
- Eastbound Left/Through (PM)
- Eastbound Through (PM)
- Eastbound Through/Right (PM)
- Eastbound Right (PM)
- Westbound Left (AM)
- Westbound Left/Through (AM)
- Westbound Right (PM)
- Northbound Left (PM)
- Southbound Left (AM & PM)

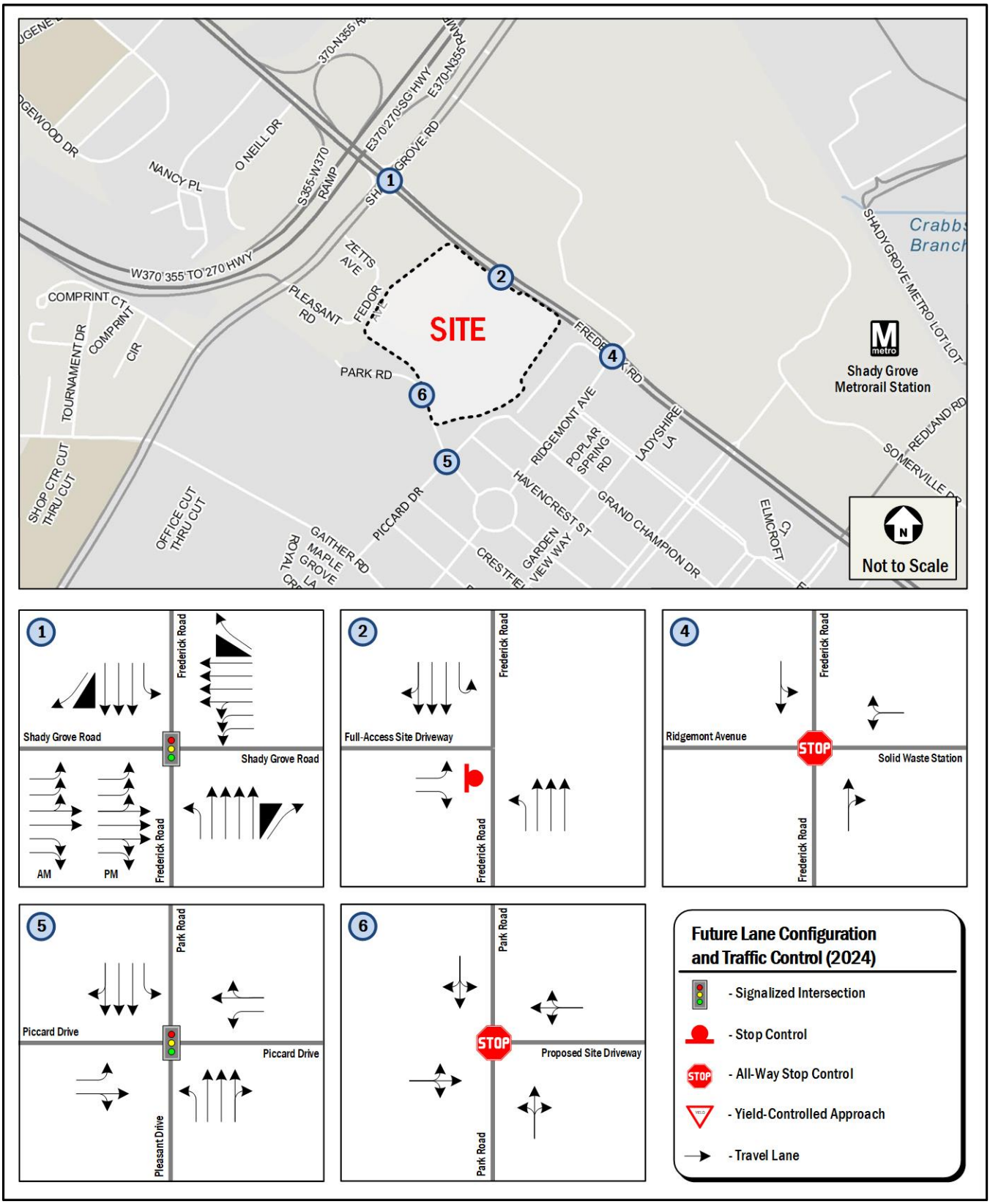

Figure 27: Future Lane Configuration and Traffic Control

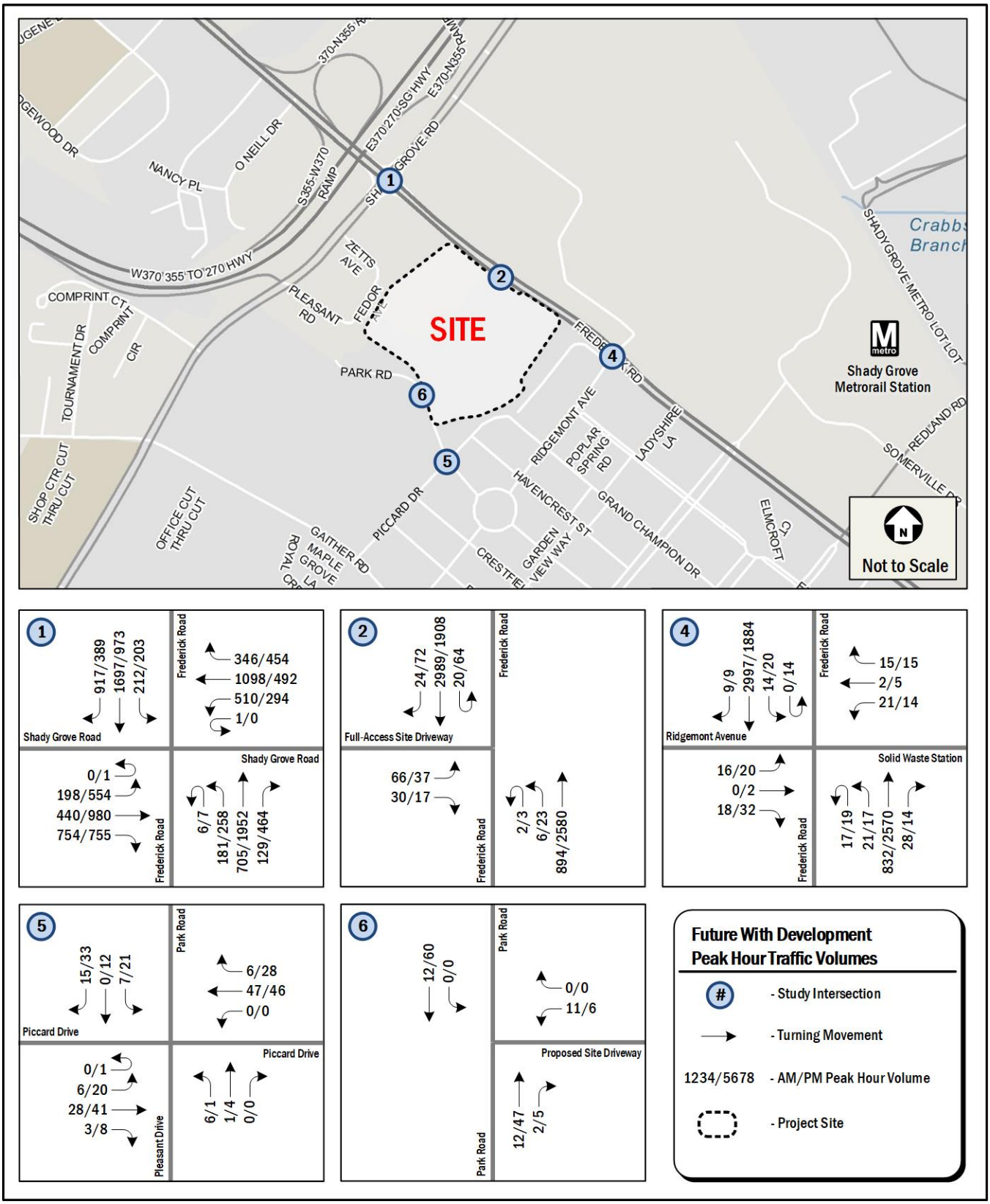

Figure 28: Future with Development Peak Hour Traffic Volumes

Table 22: Summary of Total Future Conditions Intersection Capacity Results

Intersection	Traffic Control	Intersection Capacity		v/c Threshold	LOS Threshold	MOE	2020 Existing Conditions		2024 Background Conditions		2024 Total Future Conditions	
		AM	*PM*				*AM*	*PM*	*AM*	*PM*	*AM*	*PM*
Frederick Road & Shady Grove Rd	Signalized	1550	1550	0.99	E	CLV	1481	1279	1582	1494	1563	1491
						v/c	0.96	0.83	1.02	0.96	1.01	0.96
						LOS	E	D	F	E	F	E
Frederick Road & Full-Access Site Driveway	Unsignalized	1600	1600	0.99	E	CLV	1092	999	1174	1100	1197	1066
						v/c	0.68	0.62	0.73	0.69	0.75	0.67
						LOS	B	B	C	B	C	B
Frederick Road & RIRO Site Driveway	Unsignalized	1600	1600	0.99	E	CLV	1099	706	1140	756	N/A	N/A
						v/c	0.69	0.44	0.71	0.47	N/A	N/A
						LOS	B	A	C	A	N/A	N/A
Frederick Road & Ridgemont Avenue	Signalized	1650	1650	0.99	E	CLV	1146	984	1185	1039	1195	1042
						v/c	0.69	0.60	0.72	0.63	0.72	0.63
						LOS	B	A	C	B	C	B
Piccard Drive & Pleasant Drive	Unsignalized	1600	1600	0.89	D	CLV	77	155	77	155	90	166
						v/c	0.05	0.10	0.05	0.10	0.06	0.10
						LOS	A	A	A	A	A	A
Park Road & Rear Site Driveway	Unsignalized	1600	1600	0.79	C	CLV	N/A	N/A	N/A	N/A	25	67
						v/c	N/A	N/A	N/A	N/A	0.02	0.04
						LOS	N/A	N/A	N/A	N/A	A	A

Table 23: Summary of Total Future Conditions Intersection Capacity Results (HCM)*

Intersection	Existing Conditions (2020)				Background Conditions (2024)				Total Future Conditions (2024)			
	AM Peak Hour		*PM Peak Hour*		*AM Peak Hour*		*PM Peak Hour*		*AM Peak Hour*		*PM Peak Hour*	
	Delay (s)	*LOS*	*Delay (s)*	*LOS*	*Delay (s)*	*LOS*	*Delay (s)*	*LOS*	*Delay (s)*	*LOS*	*Delay (s)*	*LOS*
Frederick Road & Shady Grove Road	69.1	E	94.8	F	88.2	F	127.1	F	83.6	F	129.5	F
Frederick Road & Ridgemont Avenue	11.9	B	7.5	A	12.4	B	7.6	A	12.6	B	7.8	A

* HCM analysis results presented as supplementary information only, as requested for signalized intersections operating at or near capacity along the Frederick Road (MD 355) corridor.

Table 24: Total Future Conditions SimTraffic 50th and 95th Percentile Queueing Results for Study Intersections along Frederick Road (MD 355)

Intersection	Lane Group	Storage Length (ft)	Existing Conditions (2020)				Background Conditions (2024)				Total Future Conditions (2024)			
			AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
			50th	95th	50th	95th	50th	95th	50th	95th	50th	95th	50th	95th
Frederick Road & Shady Grove Road	Eastbound L	600	1	20	179	279	23	100	265	407	24	102	263	400
	Eastbound L	600	139	251	459	630	235	389	674	727	222	337	676	716
	Eastbound LT	920	218	294	543	724	315	445	936	1050	307	412	943	1011
	Eastbound T	920	171	251	471	636	268	398	926	1053	257	353	934	1040
	Eastbound R/TR	920	317	508	435	605	465	695	921	1071	285	430	931	1042
	Eastbound R	920	287	474	372	548	429	662	893	1083	252	394	916	1065
	Westbound L	550	159	252	27	98	186	289	39	133	169	271	30	113
	Westbound L	550	398	541	184	272	441	584	200	305	445	578	301	286
	Westbound LT	550	494	643	243	318	545	693	279	353	554	692	276	348
	Westbound T	620	411	540	179	259	452	594	214	298	461	598	216	295
	Westbound T	620	278	368	68	175	326	423	114	219	328	419	122	225
	Westbound T	620	177	268	6	65	234	342	22	134	229	328	13	82
	Westbound R	170	7	63	50	187	29	157	66	215	16	114	77	225
	Northbound L	500	169	296	180	297	272	458	391	652	221	221	317	504
	Northbound T	810	133	189	374	476	139	193	497	793	140	140	398	519
	Northbound T	810	132	192	382	488	136	196	485	762	136	136	407	530
	Northbound T	810	99	160	356	468	106	161	382	548	105	105	378	513
	Northbound T	810	36	94	284	404	42	106	303	417	42	42	313	450
	Northbound R	410	--	--	119	295	1	15	164	350	--	--	177	377
	Southbound L	525	247	546	183	303	410	665	409	639	388	664	419	613
	Southbound T	720	532	695	318	420	513	545	436	599	509	557	411	575
	Southbound T	720	480	634	269	366	498	562	329	511	485	567	317	469
	Southbound T	720	392	553	158	257	481	582	246	426	451	594	214	337
	Southbound R	700	218	456	--	--	424	649	21	153	413	638	18	106
Frederick Road & Full-Access Site Driveway (Unsignalized)	Eastbound LR	-	15	54	167	299	227	258	236	253	--	--	--	--
	Eastbound L	-	--	--	--	--	--	--	--	--	235	247	236	262
	Eastbound R	70	--	--	--	--	--	--	--	--	10	63	8	61
	Northbound L	250	8	0	0	5	53	191	0	4	1	12	2	3
	Northbound T	1020	30	0	0	3	4	60	3	38	0	0	0	1
	Southbound U	240	11	33	62	125	11	34	71	162	11	33	78	199
	Southbound T	800	3	67	0	5	1	9	0	0	9	139	12	121
	Southbound T	800	7	112	--	--	--	--	--	--	--	--	0	4
	Southbound TR	800	1	10	0	3	1	9	0	0	7	127	0	5
Frederick Road & Ridgemont Avenue	Eastbound L	360	15	44	18	48	15	44	25	57	18	51	23	57
	Eastbound TR	180	17	47	28	63	17	49	30	64	21	53	26	59
	Westbound L	100	24	57	18	47	20	53	21	55	23	55	15	43
	Westbound TR	100	15	42	17	46	13	40	14	44	13	39	18	47
	Northbound L	320	29	67	19	49	27	63	20	46	31	70	22	51
	Northbound T	930	43	114	99	226	36	99	124	279	39	102	118	256
	Northbound T	930	17	65	72	188	10	43	89	227	13	51	82	210
	Northbound TR	930	11	39	71	176	9	33	78	196	11	41	78	193
	Southbound L	250	9	29	22	56	8	28	19	49	8	57	21	52
	Southbound T	1020	145	333	18	65	125	289	22	71	149	351	26	81
	Southbound T	1020	167	361	47	108	143	322	54	118	172	387	55	124
	Southbound TR	1020	172	372	62	134	146	327	65	137	186	399	65	140

Other Studies

This section outlines special studies requested by the City during the scoping process. These studies include the following:

- A complete signal warrant study for the proposed main site access driveway on Frederick Road (MD 355),
- Queueing analysis for the northbound left turn at the main site access and Frederick Road (MD 355) intersection,
- An evaluation for the possible cut-through traffic from the proposed site into the existing King Farm community, and
- A pedestrian study for pedestrians crossing Frederick Road (MD 355) under the existing conditions and under the proposed signalization at the main site access, if warranted.

Signal Warrant Analysis

As requested by the City in the scoping agreement, a signal warrant analysis was conducted at the intersection of the main full-access site driveway and Frederick Road (MD 355) due to the number of site-generated trips and the high traffic volumes on Frederick Road.

The warrants were performed using methodologies prescribed in Section 4C of the MDOT SHA *Manual on Uniform Traffic Control Devices (*MdMUTCD*),* 2011 Edition.

A 24-hour weekday period tube count was conducted on northbound and southbound Frederick Road just south of the study intersection in front of the site. Per M-NCPPC's policy on the new traffic counts, an adjustment factor of 1.07 was applied to traffic volumes captured before 4:30 PM. The detailed traffic counts are presented in the Technical Attachments.

In response to Staff comments, the signal warrant analysis was also conducted using Saturday traffic data. The 12-hour count collected on Frederick Road on Saturday, June 5, 2021, is included in the Technical Attachments.

In order to determine if the warrants are met as a result of the proposed development, the Total Future scenario was considered for the warrant analysis. The Total Future traffic volumes consists of the existing volumes, based on the collected tube counts, traffic generated by background developments, regional traffic growth, and site-generated volumes. Per the scoping agreement with the City, the warrant was based on the total site generated traffic without any reduction for existing uses. The projected hourly traffic volumes for the townhouses were calculated using the time-of-day distribution data from the ITE *Trip Generation Manual*, 10th Edition, supplemented with trip generation directional distribution data. Details are presented in the Technical Attachments.

Warrant 1: Eight-Hour Vehicular Volume

Warrant 1 is satisfied when for each of any 8 hours of an average day, the traffic volumes given in Table 25 exist on the major-street and on the higher-volume minor-street approaches to the intersection. If the vehicles per hour given in both of the 100% columns in the MdMUTCD Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection and satisfy either Condition A or Condition B for any eight hours of an average day, then Warrant 1 is satisfied. The condition for the major-street and minor-street shall be for the same 8 hours. On the minor-street, the higher volume shall not be required to be on the same approach during each of these 8 hours.

The 80% columns may be used in place of the 100% columns when street volumes for both the major-street and minor-street approaches meet or exceed the 80% values set forth in the MdMUTCD and satisfy both Conditions A and B for each of any 8 hours of an average day. The condition for the major-street and minor-street shall be for the same 8 hours but do not need to be the same for Condition A and Condition B. On the minor-street, the higher volume shall not be required to be on the same approach during each of these 8 hours.

The analysis was based using the existing configuration of two (2) lanes of moving traffic on the major approaches and two (2) lanes on the minor outbound approach (site driveway). The MdMUTCD Table 4C-1 volumes applicable to this analysis are shown on Table 25.

Table 25: MdMUTCD Table 4C-1 Warrant 1, Eight-Hour Vehicular Volumes

# of Lanes of Each Major Approach	Major street Volumes		# of Lanes of Each Minor Approach	Minor Street Volumes	
	100%	80%		100%	80%
Condition A - Minimum Vehicular Volume					
2	600	480	2	200	160
Condition B - Interruption of Continuous Traffic					
2	900	720	2	100	80

Table 26 shows the approach volumes on a weekday used to evaluate the site's impact under Warrant 1 criteria and the corresponding results. Based on the results, the projected future weekday hourly volumes on the major-street and higher-volume minor street do not meet the minimum requirements under Conditions A or Conditions B for any of the thresholds.

Table 27 shows the approach volumes on Saturday used to evaluate the site's impact under Warrant 1 criteria and the corresponding results. Based on the results, the projected future hourly volumes on a Saturday on the major-street and higher-volume minor street do not meet the minimum requirements under Conditions A or Conditions B for any of the thresholds.

Therefore, **Warrant 1: Eight-Hour Vehicular Volume is not satisfied under the Total Future analysis scenario**.

Table 26: Total Future Traffic Volumes and Signal Warrant 1 Results (Weekday)

Hour	Volumes (Major/Minor)	Standard 4C.02.04 Either Condition A or B Must be Satisfied		Standard 4C.02.07 Both Condition A and B Must be Satisfied	
		Condition A (600/200)	*Condition B (900/100)*	*Condition A (480/160)*	*Condition B (720/80)*
7:00 - 8:00 AM	2321 / 119	Y/N	Y/Y	Y/N	Y/Y
8:00 - 9:00 AM	2417 / 102	Y/N	Y/Y	Y/N	Y/Y
9:00 - 10:00 AM	2414 / 86	Y/N	Y/N	Y/N	Y/Y
10:00 - 11:00 AM	2685 / 65	Y/N	Y/N	Y/N	Y/N
11:00 AM - 12:00 PM	2698 / 86	Y/N	Y/N	Y/N	Y/Y
12:00 - 1:00 PM	3017 / 42	Y/N	Y/N	Y/N	Y/N
1:00 - 2:00 PM	3012 / 36	Y/N	Y/N	Y/N	Y/N
2:00 - 3:00 PM	3139 / 44	Y/N	Y/N	Y/N	Y/N
3:00 - 4:00 PM	3426 / 48	Y/N	Y/N	Y/N	Y/N
4:00 - 5:00 PM	3424 / 59	Y/N	Y/N	Y/N	Y/N
5:00 - 6:00 PM	3130 / 70	Y/N	Y/N	Y/N	Y/N
6:00 - 7:00PM	2415 / 61	Y/N	Y/N	Y/N	Y/N
	Total Hours Met:	**0**	**2**	**0**	**4**
	Warrant Results:	**Not Met**		**Not Met**	

Table 27: Total Future Traffic Volumes and Signal Warrant 1 Results (Saturday)

Hour	Volumes (Major/Minor)	Standard 4C.02.04 Either Condition A or B Must be Satisfied		Standard 4C.02.07 Both Condition A and B Must be Satisfied	
		Condition A (600/200)	*Condition B (900/100)*	*Condition A (480/160)*	*Condition B (720/80)*
7:00 - 8:00 AM	1605 / 74	Y/N	Y/N	Y/N	Y/N
8:00 - 9:00 AM	2153 / 44	Y/N	Y/N	Y/N	Y/N
9:00 - 10:00 AM	2653 / 189	Y/N	Y/Y	Y/Y	Y/Y
10:00 - 11:00 AM	3248 / 261	Y/Y	Y/Y	Y/Y	Y/Y
11:00 AM - 12:00 PM	3554 / 290	Y/Y	Y/Y	Y/Y	Y/Y
12:00 - 1:00 PM	3841 / 106	Y/N	Y/Y	Y/N	Y/Y
1:00 - 2:00 PM	3844 / 97	Y/N	Y/N	Y/N	Y/Y
2:00 - 3:00 PM	3503 / 70	Y/N	Y/N	Y/N	Y/N
3:00 - 4:00 PM	3470 / 77	Y/N	Y/N	Y/N	Y/N
4:00 - 5:00 PM	3232 / 77	Y/N	Y/N	Y/N	Y/N
5:00 - 6:00 PM	2914 / 132	Y/N	Y/Y	Y/N	Y/Y
6:00 - 7:00PM	2571 / 112	Y/N	Y/Y	Y/N	Y/Y
	Total Hours Met:	**2**	**6**	**3**	**7**
	Warrant Results:	**Not Met**		**Not Met**	

Warrant 2: Four-Hour Vehicular Volume

The Four-Hour Vehicular Volume signal warrant conditions are intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal.

The need for a traffic control signal shall be considered if an engineering study finds that, for each of any four (4) hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) all fall above the applicable curve in Figure 4C-1 of MdMUTCD for the existing combination of approach lanes. On the minor street, the higher volume shall not be required to be on the same approach during each of these four (4) hours.

The Warrant 2 weekday analysis results are presented in Figure 29. The warrant was based on the scenario of the configuration of two (2) lanes of moving traffic on the major approaches and two (2) outbound lanes on the site driveway, represented by the "Major-2, Minor-2" curve in Figure 29. Based on the results, only one (1) hour was found to fall above the applicable curve. Therefore, the projected future weekday hourly volumes on the major-street and higher-volume minor street do not meet the minimum requirements under the weekday traffic conditions.

The warrant analysis was also conducted using Saturday volume data. The Warrant 2 results using Saturday volumes are presented in Figure 30. Based on the results, four (4) hours were found to fall above the applicable curve. Therefore, the projected future hourly volumes on the major-street and higher-volume minor street **meet the minimum requirements** and **Warrant 2: Four-Hour Vehicular Volume is satisfied under the Total Future analysis scenario under the Saturday traffic conditions. Signalization is warranted as a result of the proposed development based on Warrant 2.**

Warrant 3: Peak Hour

The Peak Hour signal warrant is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street.

The plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4C-3 of MdMUTCD for the existing combination of approach lanes.

Figure 31 shows the results for the Warrant 3 using the weekday commuter peak hour traffic volumes. Neither of the AM or the PM peak hour volume was found to fall above the applicable "Major-2, Minor-2" curve.

The warrant analysis was also conducted using Saturday volume data. The Warrant 3 results using Saturday volumes are presented in Figure 32. The Saturday peak hour volume combination falls above the applicable "Major-2, Minor-2" curve. **Warrant 3 is therefore satisfied under the Total Future analysis scenario based on Saturday volumes.**

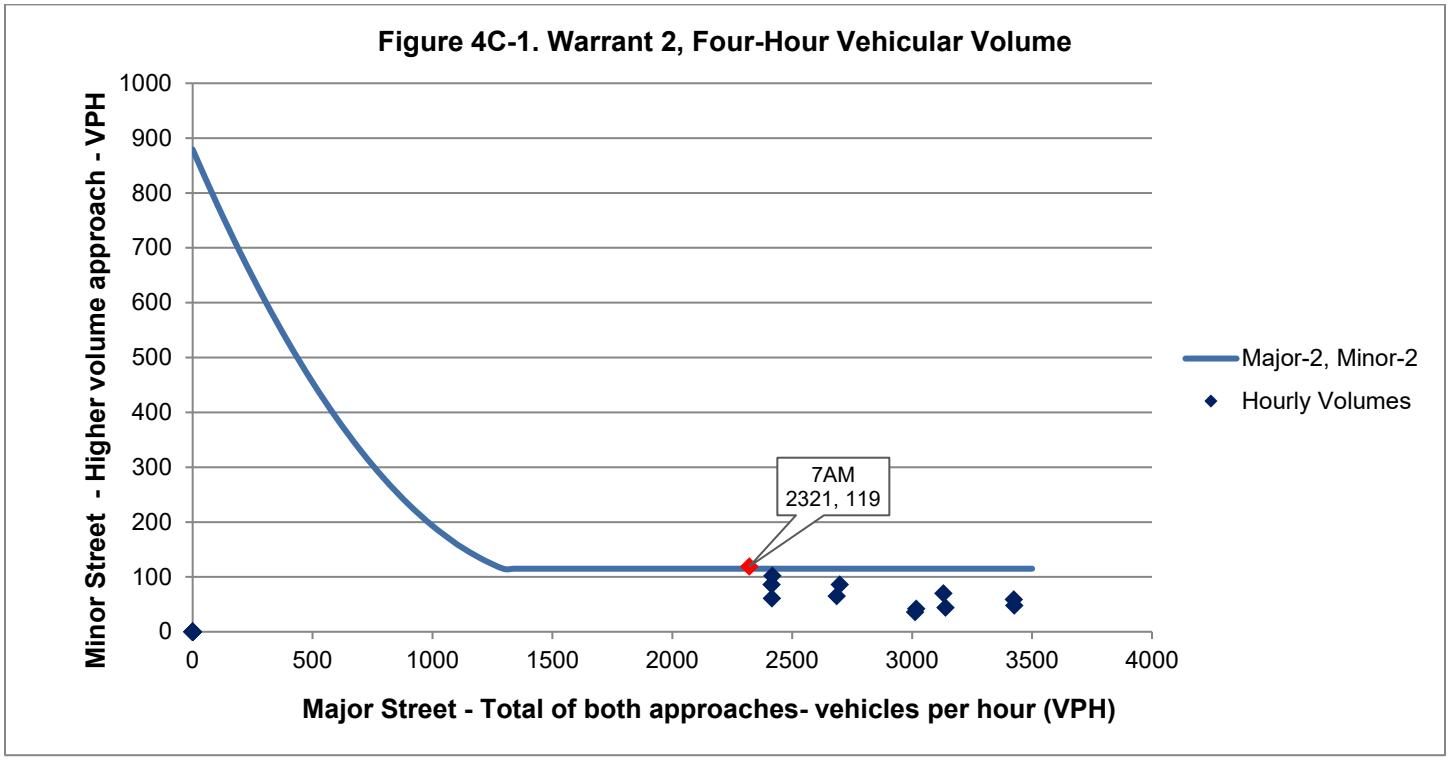

Figure 29: Signal Warrant 2 Results (Weekday)

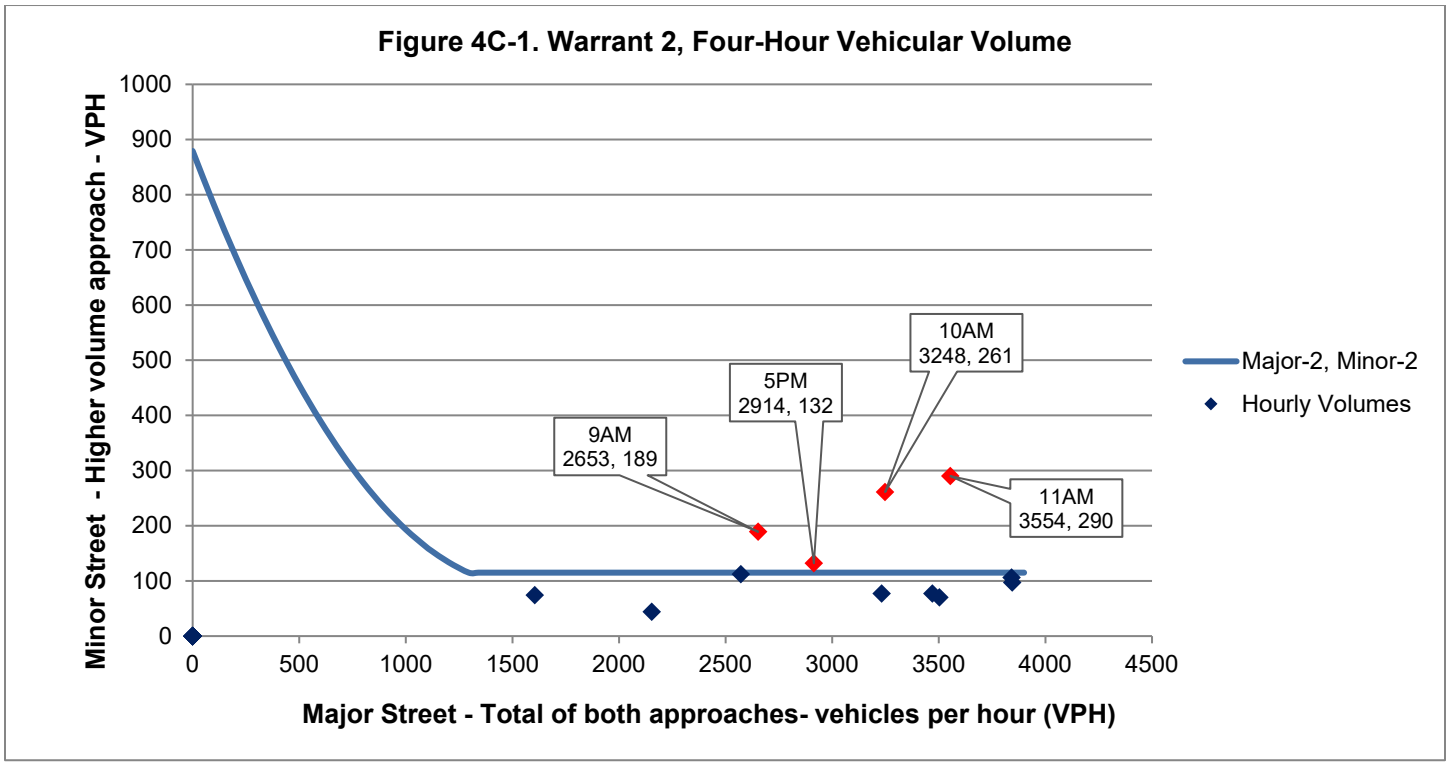

Figure 30: Signal Warrant 2 Results (Saturday)

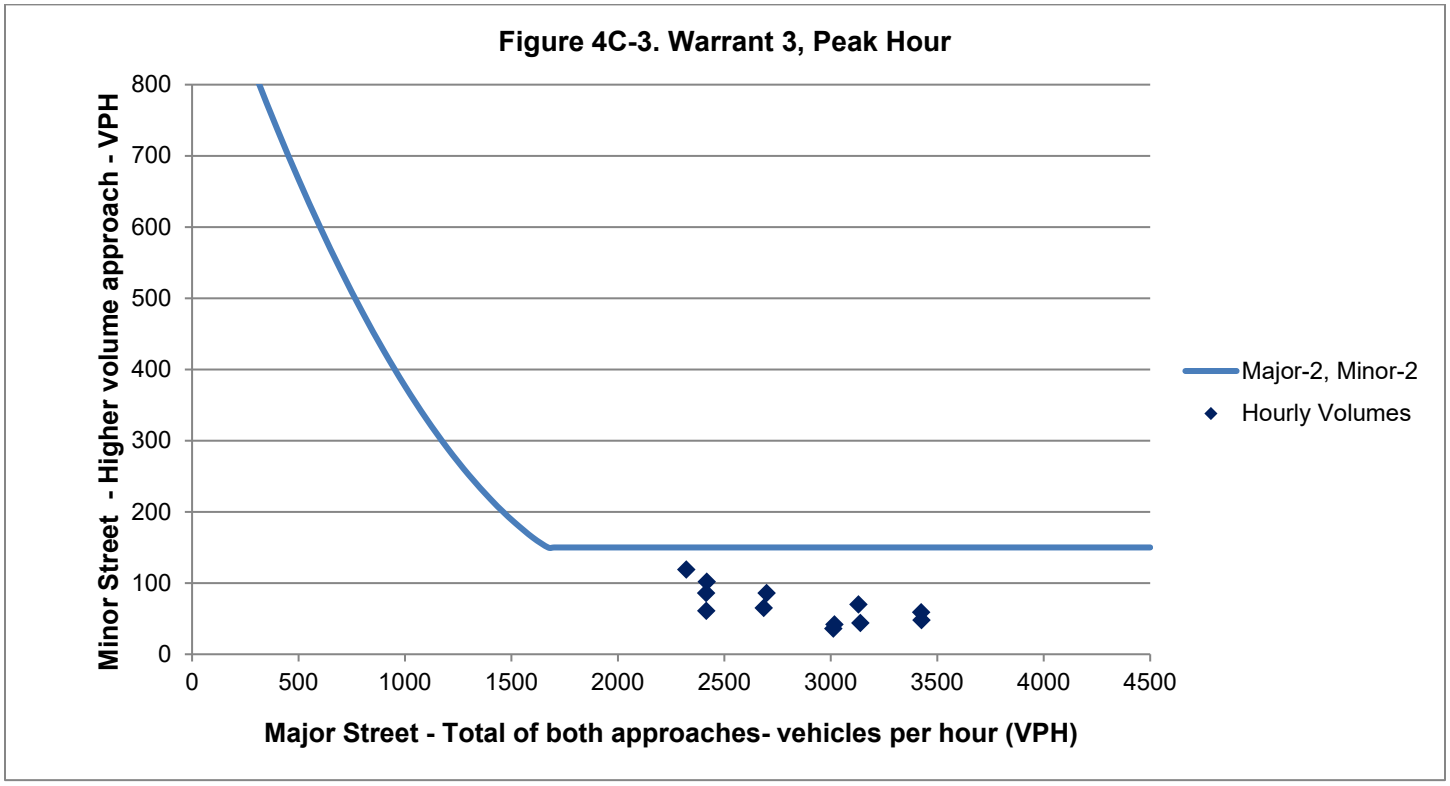

Figure 31: Signal Warrant 3 Results (Weekday)

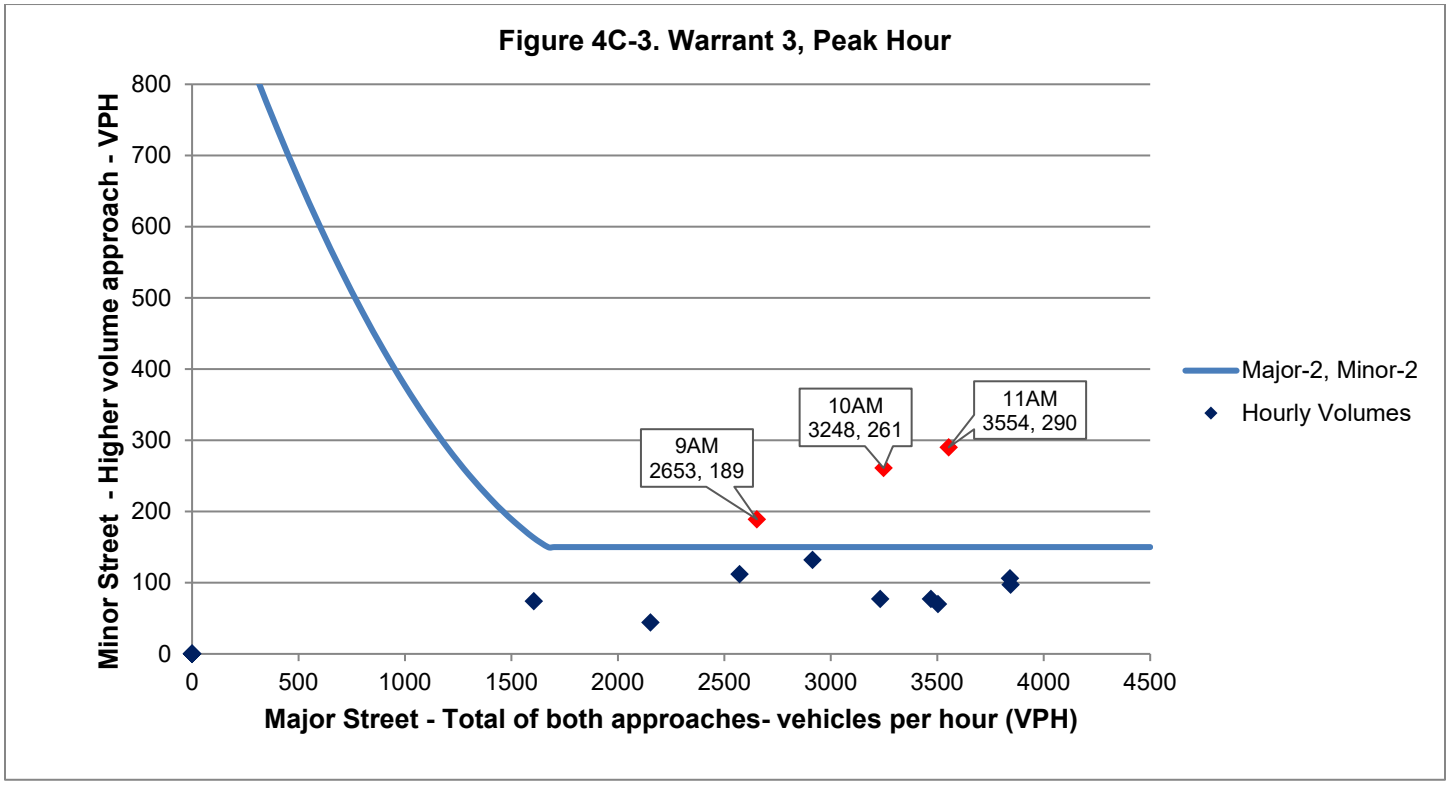

Figure 32: Signal Warrant 3 Results (Saturday)

Warrant 4: Pedestrian Volume

Warrant 4 is applicable where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street. Warrant 4 is satisfied if one of the following criteria is met:

A. For each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) all fall above the curve in Figure 4C-5 of MdMUTCD; or

B. For 1 hour (any four consecutive 15-minute periods) of an average day, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) fall above the curve in Figure 4C-7 of MdMUTCD.

If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 35mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-6 of MdMUTCD may be used in place of Figure 4C-5 of MdMUTCD to evaluate Criterion A and Figure 4C-8 of MdMUTCD may be used in place of Figure 4C-7 of MdMUTCD to evaluate Criterion B.

There are sidewalks along Frederick Road. There are existing crosswalks across Frederick Road at Shady Grove Road and at Ridgemont Avenue. The intersection will be improved with a crosswalk across Frederick if a traffic signal is installed, increasing pedestrian connectivity. **Due to the unknown number of pedestrians crossing this intersection with the development, Warrant 4 is not pursued at this time.**

Warrant 5: School Crossing

Warrant 5 is applicable where the fact that schoolchildren cross the major street is the principal reason to consider installing a traffic control signal. Warrant 5 is satisfied when an engineering study of the frequency and adequacy of gaps in the vehicular traffic stream as related to the number and size of groups of schoolchildren at an established school crossing across the major street shows that the number of adequate gaps in the traffic stream during the period when the schoolchildren are using the crossing is less than the number of minutes in the same period and there are a minimum of 20 schoolchildren during the highest crossing hour.

An established school crossing is not located at this intersection. Therefore, **Warrant 5 is not applicable**.

Warrant 6: Coordinated Signal System

Warrant 6 is satisfied if an engineering study finds that on a two-way street, adjacent traffic control signals do not provide the necessary degree of platooning and the proposed and adjacent traffic control signals will collectively provide a progressive operation. This warrant should not be applied where the resultant spacing of traffic control signals would be less than 1,000 feet.

Currently the closest signal on Frederick Road is approximately 940 feet to the northwest at Shady Grove Road. The resultant spacing of traffic control signals would thus be less than 1,000 feet. Therefore, per MdMUTCD guidance, **Warrant 6 is not applicable**.

Warrant 7: Crash Experience

Warrant 7 is applicable where the severity and frequency of crashes are the principal reasons to consider the installation of a traffic control signal. Warrant 7 is satisfied if all of the following criteria are met:

A. Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency; and

B. Five or more reported crashes of types susceptible to correction by a traffic control signal, have occurred within a 12-month period. Each crash should involve personal injury or property damage apparently exceeding the applicable requirements for a reportable crash; and

C. For each of any 8 hours of an average day, the vehicles per hour given in both of the 80 percent columns of Condition A in the Table 4C-1, or the vehicles per hour in both of the 80 percent columns of Condition B in the Table 4C-1 exists on the major-street and the higher-volume minor-street approach, respectively, to the intersection, or the volume of the pedestrian traffic is not less than 80 percent of the requirements specified in Warrant 4. These major-street and minor-street volumes shall be for the same 8 hours. On the minor street, the higher volume shall not be required to be on the same approach during each of the 8 hours.

As shown in Table 26, the projected future hourly volumes do not meet Criterion C of Warrant 7. In addition, Maryland Statewide Vehicle Crashes database shows only five (5) collisions occurred around the study intersection during the most recent five (5) years. Therefore, **Warrant 7 is not satisfied due to not meeting all of the criteria**.

Warrant 8: Roadway Network

Warrant 8 is satisfied when the common intersection of two or more major routes meets one or both of the following criteria:

A. The intersection has a total existing, or immediately projected, entering volume of at least 1,000 vehicles per hour during the peak hour of a typical weekday and has 5-year projected traffic volumes, based on an engineering study, that meet one or more of Warrants 1, 2, and 3 during an average weekday; or

B. The intersection has a total existing or immediately projected entering volume of at least 1,000 vehicles per hour for each of any 5 hours of a non-normal business day (Saturday or Sunday).

The minor street of this intersection is a site driveway. Hence, the intersection does not qualify as an intersection of two major routes. Therefore, **Warrant 8 is not applicable**.

Warrant 9: Intersection Near a Grade Crossing

Warrant 9 should be applied only after adequate consideration has been given to other alternatives or after a trial of an alternative has failed to alleviate the safety concerns associated with the grade crossing (railroad crossing).

A grade crossing is not in close proximity to the study intersection; therefore, **Warrant 9 is not applicable**.

Queueing Analysis

A queueing analysis was conducted at the intersection of the main full-access site driveway and Frederick Road (MD 355). Synchro Version 10 was used for the LOS and delay analysis based on the HCM 2010 TWSC methodology, and SimTraffic Version 10 was used for the microscopic queueing analysis along the Frederick Road (MD 355) corridor.

Table 28 shows the queue results as well as delay and LOS at the study intersection for the Total Future conditions. Based on the results, the northbound left turn queue itself is not found to be a notable issue. The 95th percentile queue is less than one (1) vehicle during both the morning and the afternoon peak hours. The left turn storage length is approximately 210 feet, sufficient to accommodate the queues generated by the proposed project.

With respect to the outbound traffic from the site driveway, this internal approach operates at a LOS F and experiences unacceptable delays during both the morning and afternoon peak hours without the proposed signal. This is due to the difficulty of making left turns onto northbound Frederick Road given the high volumes on Frederick Road.

Conditions are improved with the installation of a traffic signal at the site driveway intersection. Signalization at this intersection was analyzed. The cycle length assumed is consistent with the upstream and downstream intersections on Frederick Road (MD 355). The splits at this intersection as well as the offsets for the intersections on the Frederick Road (MD 355) corridor were optimized. Table 28 shows the delay and queue results for the intersection of Frederick Road (MD 355) and the main site driveway assuming this intersection becomes signalized. It was found that delays and queue lengths are improved, especially for the eastbound approach, northbound left turns, and southbound U-turns. Detailed queueing worksheets are included in the Technical Attachments.

Table 29 presents the SimTraffic queueing simulation results with signalization at the main site driveway intersection. The storage length of the northbound approach of the Frederick Road (MD 355) and Shady Grove Road intersection is approximately 810 feet, which was found to be adequate to accommodate the 95th percentile queue length. Therefore, the northbound queue at the Frederick Road (MD 355) and Shady Grove Road intersection is not expected to spill back onto the signalized site driveway intersection.

Table 28: 95th Percentile Queue and Delay Results for the Main Site Driveway Intersection without and with Proposed Signalization

Intersection	Approach /Movement	Total Future Conditions without Signal (2024)						Future with Traffic Signal (2024)					
		AM Peak Hour			*PM Peak Hour*			*AM Peak Hour*			*PM Peak Hour*		
		Delay (s)	*LOS*	*95th Queue (ft)**	*Delay (s)*	*LOS*	*95th Queue (ft)**	*Delay (s)*	*LOS*	*95th Queue (ft)**	*Delay (s)*	*LOS*	*95th Queue (ft)**
Frederick Road & Full-Access Site Driveway	**Overall**	**830.8**	**--**	**--**	**75.7**	**--**	**--**	**29.2**	**C**	**--**	**9.1**	**A**	**--**
	Eastbound	17622.6	F	--	4290.6	F	--	69.5	E	--	73.2	E	--
	Eastbound L	25491.1	F	247	6249.6	F	262	74.2	E	134	76.6	E	101
	Eastbound R	311.8	F	63	26.9	D	61	59.2	E	85	65.9	E	58
	Northbound	3.2	--	--	0.4	--	--	6.8	A	--	8.2	A	--
	Northbound L	358.1	F	12	39.8	E	13	96.9	F	114	67.5	E	64
	Southbound	0.1	--	--	2.5	--	--	32.6	C	--	7.5	A	--
	Southbound U	10.7	B	33	79.7	F	199	71.5	E	60	63.3	E	130

*95th percentile queue from SimTraffic results

Table 29: SimTraffic 50th and 95th Percentile Queueing Results for Study Intersections along Frederick Road (MD 355) with Proposed Signalization of Site Driveway

Intersection	Lane Group	Storage Length (ft)	Background Conditions (2024)				Future with Signalization (2024)			
			AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
			50th	95th	50th	95th	50th	95th	50th	95th
Frederick Road & Shady Grove Road	Eastbound L	600	23	100	265	407	26	107	274	414
	Eastbound L	600	235	389	674	727	208	322	679	680
	Eastbound LT	920	315	445	936	1050	276	375	946	990
	Eastbound T	920	268	398	926	1053	232	341	931	1028
	Eastbound R/TR	920	465	695	921	1071	307	533	924	1039
	Eastbound R	920	429	662	893	1083	275	496	899	1052
	Westbound L	550	186	289	39	133	166	263	37	126
	Westbound L	550	441	584	200	305	437	568	207	292
	Westbound LT	550	545	693	279	353	541	679	281	362
	Westbound T	620	452	594	214	298	442	567	221	303
	Westbound T	620	326	423	114	219	313	402	115	221
	Westbound T	620	234	342	22	134	210	304	17	110
	Westbound R	170	29	157	66	215	12	99	90	248
	Northbound L	500	272	458	391	652	219	381	407	643
	Northbound T	810	139	193	497	793	137	202	389	712
	Northbound T	810	136	196	485	762	132	195	384	685
	Northbound T	810	106	161	382	548	107	165	312	535
	Northbound T	810	42	106	303	417	55	130	242	368
	Northbound R	410	1	15	164	350	0	0	123	302
	Southbound L	525	410	665	409	639	441	672	398	605
	Southbound T	720	513	545	436	599	512	564	404	576
	Southbound T	720	498	562	329	511	494	567	309	462
	Southbound T	720	481	582	246	426	471	584	217	359
	Southbound R	700	424	649	21	153	423	647	7	67
Frederick Road & Full-Access Site Driveway (Signalized)	Eastbound LR	-	227	258	236	253	--	--	--	--
	Eastbound L	-	--	--	--	--	68	134	41	101
	Eastbound R	70	--	--	--	--	31	85*	19	58
	Northbound L	250	53	191	0	4	9	39	27	64
	Northbound T	1020	4	60	3	38	49	114	155	283
	Northbound T	1020	--	--	--	--	31	85	137	263
	Northbound T	1020	--	--	--	--	22	71	135	265
	Southbound U	240	11	34	71	162	23	60	65	130
	Southbound T	800	1	9	0	0	127	279	87	195
	Southbound T	800	--	--	--	--	149	302	105	213
	Southbound TR	800	1	9	0	0	165	320	114	229
Frederick Road & Ridgemont Avenue	Eastbound L	360	15	44	25	57	19	56	22	57
	Eastbound TR	180	17	49	30	64	17	48	26	57
	Westbound L	100	20	53	21	55	23	60	16	45
	Westbound TR	100	13	40	14	44	14	40	20	55
	Northbound L	320	27	63	20	46	30	63	21	50
	Northbound T	930	36	99	124	279	42	105	116	228
	Northbound T	930	10	43	89	227	13	49	77	184
	Northbound TR	930	9	33	78	196	13	44	63	146
	Southbound L	250	8	28	19	49	9	29	25	58
	Southbound T	1020	125	289	22	71	40	138	21	89
	Southbound T	1020	143	322	54	118	55	154	32	106
	Southbound TR	1020	146	327	65	137	63	161	39	118

** The AM peak 95th percentile queue on the right turn lane was found to exceed about 15 ft (one car). The right turn lane cannot be extended due to site constraints. The left turn lane has capacity to accommodate the queue.*

Cut-Through Traffic Evaluation

Due to the planned site driveway connection to Pleasant Drive, possible cut-through traffic from the proposed site into or out of the existing King Farm community was evaluated. Vehicles along southbound Frederick Road may bypass the signal at Ridgemont Avenue or King Farm Boulevard and turn into the site, exiting out onto Pleasant Drive. Vehicles exiting from the King Farm community using Ridgemont Avenue may want to bypass the signal at Ridgemont Avenue by cutting through the site and turning into northbound Frederick Road using the modified driveway at the median break.

Historical traffic volumes from MCDOT's Intersection Analysis online application are available at the following two (2) intersections:

- Frederick Road (MD 355) & Ridgemont Avenue, collected Thursday, September 27, 2018
- Frederick Road (MD 355) & King Farm Boulevard, collected Thursday, September 27, 2018

The number of vehicles turning right from southbound Frederick Road onto these streets were as follows:

- Southbound right turns onto Ridgemont Avenue during AM and PM peak hours were minimal, with only nine (9) and seven (7) vehicles, respectively.
- Southbound right turns onto King Farm Boulevard during AM and PM peak hours were 75 and 85 vehicles, respectively.

It can be seen that the majority of southbound traffic entering the King Farm community from Frederick Road would make the right turn at the King Farm Boulevard intersection (89 percent during the morning peak hour and 92 percent during the afternoon peak hour when drivers are most likely to seek cut-through routes) instead of the Ridgemont Avenue intersection. Therefore, as a similar situation with the new site driveways, it is assumed that very few vehicles would cut through the site on a circuitous route to enter King Farm community using the proposed site driveway instead of turning right at the Ridgemont Avenue intersection or the King Farm Boulevard intersection.

The number of vehicles exiting King Farm community and turning onto northbound Frederick Road were as follows:

- Left turns from Ridgemont Avenue onto northbound Frederick Road during AM and PM peak hours were 16 and 18 vehicles, respectively.
- Left turns from King Farm Boulevard onto northbound Frederick Road during AM and PM peak hours were 29 and 104 vehicles, respectively.

The majority of northbound traffic exiting King Farm community would make the left turn at the King Farm intersection (64 percent during the morning peak hour and 85 percent during the afternoon peak hour when drivers are most likely to seek cut-through routes) instead of Ridgemont Avenue. Therefore, as a similar situation, it is assumed that very few vehicles exiting King Farm community would cut through the site on a circuitous route to enter northbound Frederick Road using the site driveway instead of turning left at the Ridgemont Avenue intersection or the King Farm Boulevard intersection.

Overall, given the low amount of turning traffic volume at the intersection of Frederick Road and Ridgemont Avenue, it is concluded that **the impact of cut-through traffic is negligible, and feasible cut-through routes through the proposed site would serve the residential units located immediately southeast of the proposed development**.

Pedestrian Study

Per the City's Staff request, a Pedestrian Study was conducted and summarized in this section.

The purpose of the Pedestrian Study is primarily to evaluate the existing and proposed pedestrian accommodations, as well as the delay for pedestrians crossing Frederick Road (MD 355) to access the Shady Grove Metrorail station.

Pedestrian Facilities and Accommodations

Under existing conditions, the sidewalks along both sides of Frederick Road (MD 355) are generally 8 feet in width, which exceeds the minimum width of five (5) feet required by SHA guidelines and the Rockville Sidewalk Prioritization Policy. However, buffer strips are not adequately provided. There is no grass strip or protective berm separating the sidewalks from the adjacent roadway. As part of the proposed development, sidewalks will be improved along the site frontage on Frederick Road.

The curb ramps at all four corners of the Frederick Road and King Farm Boulevard/Metro Station Access Road intersection and the Frederick Road and Ridgemont Avenue intersection meet SHA and ADA standards. At least 48" clearance has been provided between the diagonal curb ramps. Detectable warning surfaces have been installed on all the curb ramps.

The streetlight inventory was reviewed under the existing conditions. Currently, there are streetlights installed on the utility poles along both sides of Frederick Road (MD 355) between Shady Grove Road and King Farm Boulevard, providing adequate lighting conditions for pedestrians during the nighttime.

Pedestrian Volumes and Travel Pattern

In order to evaluate pre-COVID-19 pedestrian travel patterns, the 13-hour pedestrian counts for the intersections of Frederick Road & King Farm Boulevard/Metro Station Access Road and Frederick Road & Ridgemont Avenue published on MCDOT's Intersection Analysis online application collected on Thursday, September 27, 2018, were used.

Figure 33 shows the 12-hour distribution of pedestrian volumes crossing Frederick Road at King Farm Boulevard/Metro Station Access Road. Figure 34 shows the 12-hour distribution of pedestrian volumes crossing Frederick Road at Ridgemont Avenue. As Figure 33 and Figure 34 indicate, the vast majority of pedestrian traffic accessing the Metro station uses the Frederick Road and King Farm Boulevard/Metro Station Access Road intersection.

Based on the existing pedestrian travel pattern, the generated pedestrian traffic from the proposed development is expected to mostly utilize the crosswalks at the Frederick Road and King Farm Boulevard/Metro Access Road intersection. However, if the traffic signal is installed and a new crosswalk is proposed at the Frederick Road and main site driveway intersection, it is expected that a significant portion of the site-generated pedestrian traffic will utilize the proposed crosswalk to cross Frederick Road and access the Metro station.

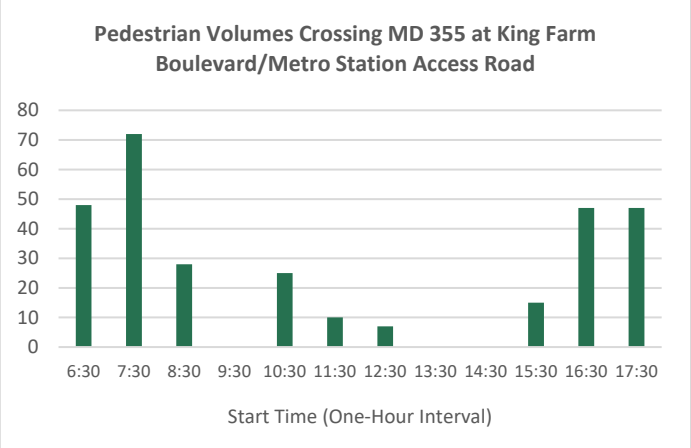

Figure 33: Pedestrian Volumes Crossing MD 355 at King Farm Boulevard/Metro Station Access Road

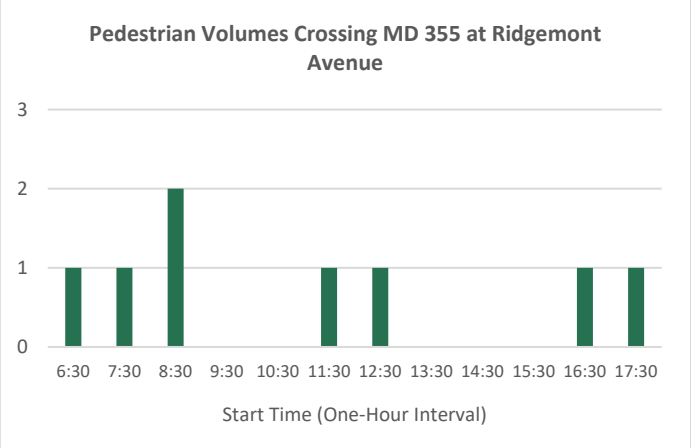

Figure 34: Pedestrian Volumes Crossing MD 355 at Ridgemont Avenue

Pedestrian Crossing Time, Distance, and Delay

As discussed and shown in Table 14 of the Existing Pedestrian Facilities section of this report, a pedestrian crossing distance analysis was conducted at study intersections to determine the existing crossing distance and time necessary to meet the required pedestrian crossing needs. Based on the results of the analysis, both intersections the Frederick Road and Shady Grove Road intersection and the Frederick Road and Ridgemont Avenue intersection provide sufficient crossing time.

The proposed signalized intersection at the site driveway provides 28 seconds of pedestrian crossing time in the current analysis, consistent with that at the Frederick Road and Ridgemont Avenue intersection.

According to the signal timing information provided by MCDOT, the split interval for the major approaches at the Frederick Road and King Farm Boulevard/Metro Station Access intersection is 114 seconds in total, including protected left turn phase and through movement phase, during both the morning and the afternoon peak hours. The split interval for the minor approaches on King Farm Boulevard/Metro Station Access Road is 36 seconds in total, including 3 seconds of leading pedestrian interval (LPI) and 33 seconds of vehicular phase, during both the morning and the afternoon peak hours. Therefore, it is expected that pedestrians crossing Frederick Road at the Frederick Road and King Farm Boulevard/Metro Station Access intersection will experience a maximum of 114 seconds of waiting time or delay. The LPI enhances the safety conditions for pedestrians crossing Frederick Road and accessing the Metro Station or the King Farm Community.

Similarly, the split interval for the major approaches at the Frederick Road and Ridgemont intersection is 116 seconds in total, including protected left turn phase and through movement phase, during both the morning and the afternoon peak hours. Therefore, it is expected that pedestrians crossing Frederick Road at the Frederick Road and King Farm Boulevard/Metro Station Access Ridgemont intersection will experience a maximum of 116 seconds of waiting time or delay.

For the proposed signalized intersection at the site driveway, optimized signal timing provides 116 seconds for the major approaches and 34 seconds for the minor approach. Thus, it is expected that pedestrians crossing Frederick Road at the Frederick Road and Site Driveway intersection will experience a maximum of 116 seconds of waiting time or delay.

Proposed On-Site Transportation

This section reviews the proposed transportation components of the King Buick residential development, including the proposed vehicular access, pedestrian access and facilities, and bicycle access and facilities. This section discusses the City's zoning requirements on loading, vehicle parking, and bicycle parking.

Vehicular Access and Parking

Vehicular access to the site is expected to occur via two driveways. The existing full-access driveway at the median break will be improved to serve as the primary access for the residential subdivision. The three (3) other existing curb cuts along Frederick Road will be removed. A second access is proposed to the southwest of the site to provide a connection to Pleasant Drive. The site plan with the layout of the site access is shown in Figure 3 in the Project Overview section.

The site is currently zoned as MXCD - Mixed Use Corridor District. Under City of Rockville Zoning Ordinance Article 16-25.16.03, townhouses with one (1) or two (2) bedrooms are required to provide 1.5 vehicle parking spaces per dwelling unit, and townhouses with three (3) or more bedrooms are required to provide two (2) vehicle parking spaces per dwelling unit. Community center is required to provide one (1) vehicle parking space per 200 SF of gross floor area. According to the Zoning Ordinance, in order to limit excessive off-street parking and encourage parking reductions in the MXCD zones, the number of parking spaces to be provided is limited to no more than the standards mentioned above.

Given that the proposed residential development consists of 368 townhome units and up to 5,000 SF community center, it results in the following maximum vehicle parking spaces requirements:

- Townhouses:

  Up to 736 vehicle parking spaces

- Community Center:

  Up to 25 vehicle parking spaces

The proposed development will provide vehicle parking spaces meeting the zoning requirements.

Pedestrian Access and Facilities

Primary pedestrian access to the site is expected to occur via sidewalks along the site frontage on Frederick Avenue.

The site will be served by an internal sidewalk network that will provide extensive connections throughout the development. The proposed internal sidewalks will connect to Pleasant Drive south of site and provide pedestrian access to the King Farm community.

As a result of the development, pedestrian facilities along the perimeter of the site will be improved. The development will improve sidewalks adjacent to the site such that they meet or exceed SHA and ADA requirements and provide an improved pedestrian environment.

As part of the efforts to further improving pedestrian accommodations, the project will propose raised concrete islands on Pleasant Drive at the rear site driveway. High-visibility crosswalks are also proposed at this intersection. The proposed islands narrow the vehicular travel lanes which slow vehicular travel speeds and shorten pedestrian crossing distance.

At the Pleasant Drive and Piccard Drive intersection, the northwest corner will be improved. The existing curb radii will be reduced, and the curb will be extended further into the intersection. Such improvement will decrease pedestrian crossing distance and slow down the speed of right turning vehicles as well. Separated curb ramps with at least 48" clearance are proposed at this corner to replace the existing diagonal curb ramp. High-visibility crosswalks are also proposed across Pleasant Drive and Piccard Drive. It should be noted that these proposed pedestrian improvement measures are still being coordinated with the City.

Proposed Bicycle Access and Facilities

Primary bicycle access to the site is expected to occur via the existing shared use path on Piccard Drive and signed shared roadway on Grand Champion Drive through the King Farm community.

The project proposes to implement the part of the Master Plan along the site frontage on Frederick Road. The project will provide amenities that cater to cyclists including short-term bicycle racks. The additional bicycle facilities leading to and from the site will make using a bicycle a convenient and comfortable option for residents of the development.

Under City of Rockville Zoning Ordinance Article 16- 25.16.03, townhouses are not required to provide bicycle parking spaces. Community center is required to provide two (2) short-term

bicycle parking spaces and one (1) long-term bicycle parking space per 10,000 SF of gross floor area.

Given that the proposed residential development consists of 368 townhome units and 5,000 SF community center, it results in the following minimum bicycle parking spaces requirements:

- Townhouses:

  None

- Community Center:

  One (1) short-term bicycle parking space

  One (1) long-term bicycle parking space

The proposed development will provide bicycle parking spaces meeting the zoning requirements. Short-term bicycle parking will be placed near the main entrance of the community center. Short-term bicycle parking will include inverted U-racks placed in high-visibility areas.

Mitigation Requirements

This section reviews the mitigation requirements outlined in the City's CTR guidelines. Applicable mitigation requirements are summarized, and potential mitigation measures are proposed, as necessary.

Site Impact and Mitigation Requirements

Per the CTR guidelines, mitigation requirements are determined by new peak hour site trips before trip reductions have been applied. Based on the site trip generation without reductions, the proposed project will generate greater than 30 and fewer than 125 peak hour trips during weekday morning and afternoon peak hours and Saturday peak hour. Therefore, according to the CTR guidelines, a Transportation Improvement Fee is required, and intersection mitigation may be required if the impact exceeds the specified thresholds.

Transportation Improvement Fee

Developments generating 30 or more trips are required to pay a Transportation Improvement Fee. The one-time fee is $1.50 per square foot of gross floor area or $900 per unit of multi-unit residential development.

Intersection Mitigation Requirements

For any development activity whose impact is a volume/capacity ratio increase of 0.01 (a full one percent) or more at intersections where the LOS for background traffic conditions exceed acceptable congestion thresholds outlined in Table 4 and Table 5 of this report, the mitigation requirement is:

- Mitigate at least half of the impact if the impact is 0.01-0.06; and
- Mitigate the impact to 0.03 or less if the impact is greater than 0.06.

In addition, developments causing General Traffic Impact, as outlined below, will be responsible for mitigating the intersection impact through intersection improvements regardless of whether or not the LOS or v/c ratio exceeds acceptable congestion thresholds. The General Traffic Impact includes:

- A deterioration in intersection LOS by one level (0.10 v/c, ten percent) or greater;
- Automobile trips that cause the City's criteria for acceptable traffic volumes on residential streets to be exceeded, as outlined in the Master Plan;
- Contributing significantly toward the need for, or modification of, a traffic signal or other traffic control devices as established in the Manual on Uniform Traffic Control Devices or determined by the Director of Public Works or designee;
- Exceeding the capacity of a turn lane as established in the Policy on Geometric Design of Highways and Streets (AASHTO) or determined by the Director of Public Works or designee;
- Contradicting principles of proper design and location for driveways, medians and median openings, service drives, and similar facilities; and
- Any condition creating or aggravating a safety hazard for motorists, pedestrians, or bicyclists.

Site Impact

Under Background conditions and Total Future conditions, all other study intersections, except the intersection of Frederick Road (MD 355) and Shady Grove Road, operate below the intersection impact thresholds and the deterioration in intersection v/c is less than 0.1 during both the morning and afternoon peak hours, as shown in Table 22.

The intersection of Frederick Road (MD 355) and Shady Grove Road operates at unacceptable congestion levels under Background Conditions, with a v/c greater than 1.0 during the morning peak hour. Under Total Future conditions, the intersection experiences a decrease of 0.01 in v/c during the morning peak hour while the v/c remains unchanged during the afternoon peak hour, as compared to the Background conditions. Therefore, **mitigation is not triggered at any of the study intersections**.

As presented in the traffic signal warrant analysis section of this report, the **traffic conditions with the proposed development satisfy Warrant 2: four-hour vehicular volume and Warrant 3: peak hour** at the intersection of Frederick Road (MD 355) and the full-access site driveway. The addition of proposed site trips "contributes significantly toward the need for a traffic signal", and thus **meets** one of the criteria outlined in the **General Traffic Impact.** The effects of signalization, as an intersection improvement, have been discussed in the previous Other Studies – Queueing Analysis of this report.

Summary and Conclusions

The report is a Comprehensive Transportation Review (CTR) for the King Buick site redevelopment. This report reviews the transportation aspects of the project's Preliminary Plan application in compliance with City of Rockville's Comprehensive Transportation Review (CTR) guidelines.

The purpose of this study is to evaluate whether the project will generate a detrimental impact to the surrounding transportation network. This evaluation is based on a technical comparison of the existing conditions, background conditions, and total future conditions. The following conclusions were reached based on this technical analysis:

- All of the study intersections identified by City for evaluation will operate within acceptable levels after considering existing volumes, background developments, background growth and site-generated traffic (total future conditions) without the need for mitigation measures; and,
- A signal warrant analysis at the full-access site driveway at Fredrick Road determined that future conditions at this intersection meet the four-hour signal warrant and the peak-hour signal warrant with the projected traffic volumes from the proposed project.

This report concludes that **the project will not have a detrimental impact** to the surrounding transportation network assuming that all planned site design elements are implemented.

Proposed Project

The site, located at 16200 Frederick Road, is currently occupied by the King Buick/GMC/Mitsubishi car dealership. The site is generally bounded by Frederick Road (MD 355) to the east, commercial uses to the north, and the King Farm residential community to the south and west. The property currently straddles the City of Rockville and Montgomery County while the property is in the process of being annexed into the City of Rockville from Montgomery County.

The project will replace the car dealership site and the existing vacant grass area with a residential subdivision, consisting of 368 townhomes and an approximately 5,000 square feet community center.

Pedestrian facilities along the perimeter of the site on Frederick Road will be improved and designed so that they meet or exceed County, Maryland Department of Transportation State Highway Administration (SHA), and Americans with Disabilities Act (ADA) standards for sidewalks, crosswalks, and curb ramps. This includes sidewalks that meet or exceed the width requirements, crosswalks at all necessary locations, and curb ramps with detectable warnings. Existing pedestrian facilities connect the site to Frederick Road and the Shady Grove Metrorail station to the northeast, encouraging non-auto travel.

Access to the existing car dealership is provided along Frederick Road through two (2) curb cuts. Two (2) additional curb cuts along the frontage of the site are not active and are currently used as space to showcase cars. The existing full-access driveway at the median break will be improved to serve as the primary access for the residential subdivision. The three (3) other existing curb cuts along Frederick Road will be removed. A second access to the development is proposed to the southwest of the site to provide a connection to Pleasant Drive.

Multi-Modal Overview

Transit

The site is adequately served by regional and local transit services such as Metrorail, MARC, and Ride On-Montgomery County. The site is approximately 0.7 miles from the Shady Grove Metrorail station. The nearest Ride On stop is located approximately 0.1 miles south of the site on Frederick Road. Three (3) Ride On-Montgomery County routes directly service the site, providing a good connection to Metrorail and other destinations. Additional Ride On stops are located along Shady Grove Road approximately 0.2 miles from the site.

Pedestrian

The site is surrounded by a pedestrian network providing good connectivity to nearby points of interests. Most roadways within a quarter-mile radius provide sidewalks and acceptable crosswalks and curb ramps, particularly along primary walking routes.

As a result of the development, pedestrian facilities along the perimeter of the site will be improved. The development will install a shared-use path along the site frontage on the southbound side of Frederick Road. The site will be served by a new internal sidewalk network. These sidewalks will provide extensive pedestrian connections within the development. The proposed internal sidewalk network will connect the site with Pleasant Drive, providing inter-community connections for pedestrians. The proposed sidewalks will meet or exceed SHA

and ADA requirements and provide an improved pedestrian environment.

Bicycle

The site has access to existing bicycle facilities. There are existing shared use paths along Gaither Road and Piccard Drive to the south and west of the site, and existing shared roadway routes along King Farm Boulevard and Grand Champion Drive to the south and east of the site. According to the Montgomery County Bicycle Master plan, separated bikeway routes will be proposed along the site frontage on Frederick Road and along Shady Grove Road to the north of the site. The separated bikeways allow shared use between bicyclists and pedestrians, providing connectivity to the cores of City of Rockville and City of Gaithersburg.

Vehicular

The site is directly served by Frederick Road (MD 355) and is in close proximity to Shady Grove Road, both principal arterials providing a robust network of local and regional connectivity. These roadways connect the site to the nearby I-370 and I-270, which provide access to the Intercounty Connector (MD 200) and the Capital Beltway (I-495).

Site Impact and Mitigation Measures

In order to determine if the proposed development will have a negative impact on this transportation network, this report projects future conditions with and without the development of the site and performs intersection capacity analyses using the Critical Lane Volume (CLV) technique. The intersection volume/capacity (v/c) ratios and the corresponding Level of Service (LOS) are compared to the intersection impact thresholds for transit-oriented areas (TOAs) and non-transit-oriented areas (non-TOAs) set by City of Rockville CTR standards to determine if the site will negatively impact the study area. Signalized intersections that operate at or near capacity under existing conditions were further analyzed using the Highway Capacity Manual (HCM) methodology.

A signal warrant analysis was conducted for the intersection of Frederick Road (MD 355) and the full-access site driveway. The analyses conclude that this intersection **meets Warrant 2 (the four-hour warrant) and Warrant 3 (the peak-hour warrant)** based on traffic volumes in future conditions with the development.

Summary and Recommendations

This report concludes that the proposed development will not have a detrimental impact to the surrounding transportation network assuming that all planned site design elements are implemented. The full-access site driveway and Fredrick Road intersection meets the four-hour signal warrant and the peak-hour signal warrant with the projected Saturday traffic volumes from the proposed project. Signalizing the site driveway and Frederick Road (MD 355) intersection will reduce the delay for inbound and outbound site trips and provide a connection for pedestrians to the Shady Grove Metro station.

The development has several positive elements contained within its design that minimize potential transportation impacts, including:

- The site’s proximity to the Metrorail Red Line, MARC Train Brunswick Line, and several local and regional bus lines;
- The site being located within a well-connected pedestrian network; and
- The pedestrian and bicycle facilities adjacent to and within the site being that will be improved as part of the project.