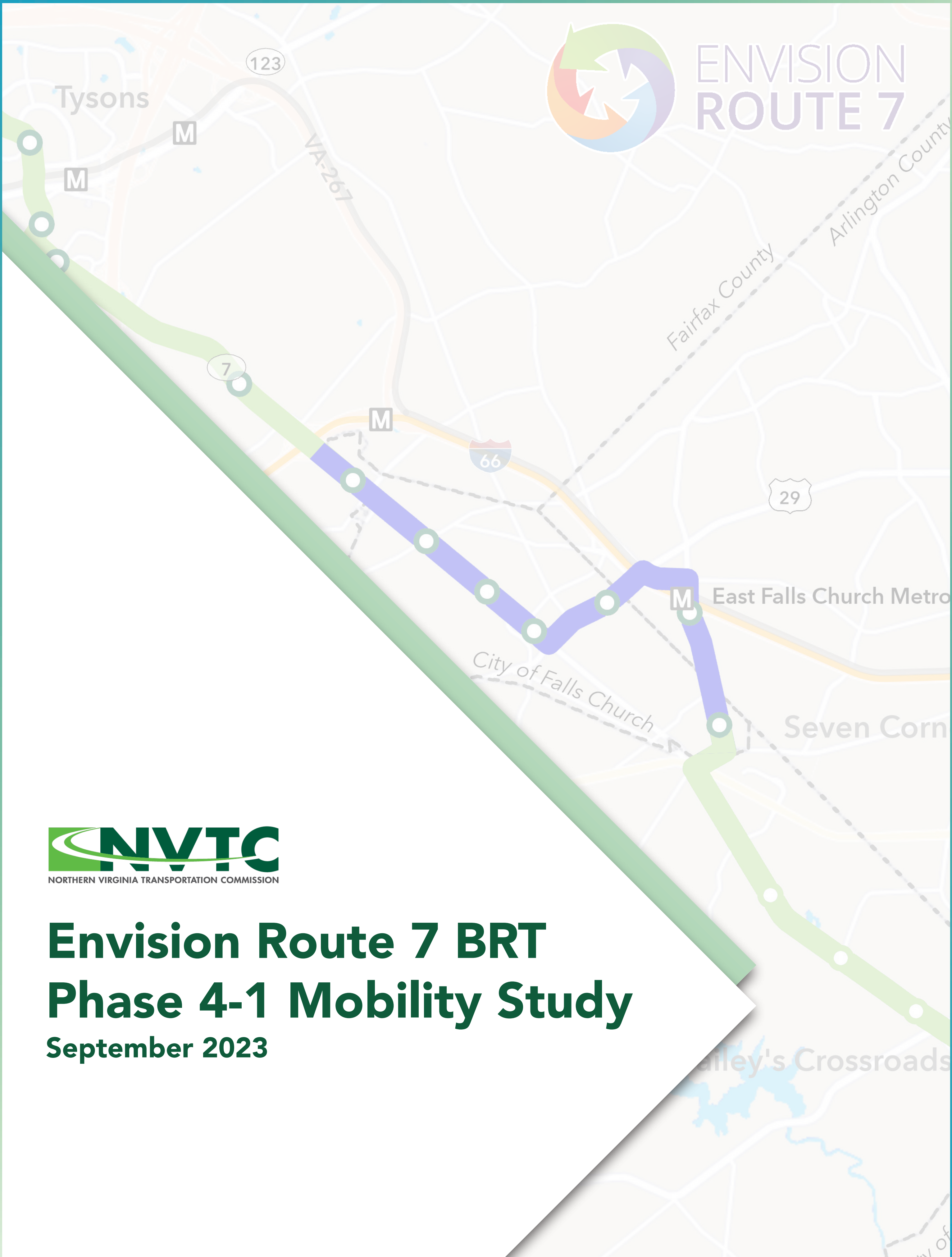


NORTHERN VIRGINIA TRANSPORTATION COMMISSION

Envision Route 7 BRT Phase 4-1 Mobility Study

September 2023

Page Intentionally Left Blank

ENVISION ROUTE 7 PHASE 4-1 MOBILITY STUDY

Prepared for:
Northern Virginia
Transportation Commission
2300 Wilson Boulevard
Suite 230
Arlington, VA 22201

Prepared by:
Kittelson & Associates, Inc.
100 M Street SE, Suite 910
Washington, DC 20003
202.450.3710

Project Manager:
Burak Cesme, PhD
Associate

Project Principal:
Jamie Henson
Principal Planner

October 13, 2023

Page Intentionally Left Blank

TABLE OF CONTENTS

LIST OF FIGURES

EXECUTIVE SUMMARY

1 INTRODUCTION

2 DATA COLLECTION AND ANALYSIS METHODOLOGY

3 EXISTING CONDITIONS

LIST OF FIGURES

4 2045 BASELINE CONDITIONS

5 2045 BUILD SCENARIO CONDITIONS

6 PUBLIC OUTREACH

LIST OF TABLES

1 INTRODUCTION

2 DATA COLLECTION AND ANALYSIS METHODOLOGY

3 EXISTING CONDITIONS

4 2045 BASELINE CONDITIONS

LIST OF TABLES

5 2045 BUILD SCENARIO CONDITIONS

6 PUBLIC OUTREACH

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Northern Virginia Transportation Commission (NVTC) is leading the process to advance the Envision Route 7 project, a bus rapid transit (BRT) line that will connect the Mark Center in Alexandria to Tysons via Bailey's Crossroads, Seven Corners, and the City of Falls Church along the Route 7 corridor (Route 7). The study corridor is the central portion of the larger project, extending approximately 3.5 miles from just South of Interstate 66 (I-66) through the City of Falls Church and Arlington County to the Seven Corners area. The Envision Route 7 project will improve overall mobility by providing high-speed, high-frequency, and reliable transit service across multiple jurisdictions, between multiple Metrorail stations, and to the proposed West End Transitway.

A multi-phase process began in 2013 that identified the need for transit, the mode of transit, the alignment of a transit facility, as well as the right-of way needs. The current effort, Phase 4-1, completed a mobility analysis to evaluate and determine the benefits and potential impacts of the proposed BRT on Route 7 between I-66 and Seven Corners. The objectives of the Phase 4-1 effort are to (1) assess the mobility benefits of BRT along Route 7, (2) evaluate the potential vehicle traffic implications, and (3) facilitate public understanding of BRT.

With these objectives in mind, three build scenarios were developed to assess the effects of bus priority treatments (See **Figure ES-1**). These treatments include business access and transit (BAT) lanes, level-boarding passenger platforms, off-board fare payment kiosks, transit signal priority (TSP), and queue jumps. The descriptions of the build scenarios below highlight the major improvements recommended.

The development of Build Scenario 1 was based on the bus priority treatments outlined in the previous phases of the NVTC study. This scenario proposes priority treatments to maximize the speed, frequency, and reliability of transit within the constraints of the right-of-way. Build Scenario 1 proposes,

- BAT lanes (i.e., curb lanes used by buses and right turning vehicles only) throughout most of the study corridor, and
- TSP signal timing strategies.

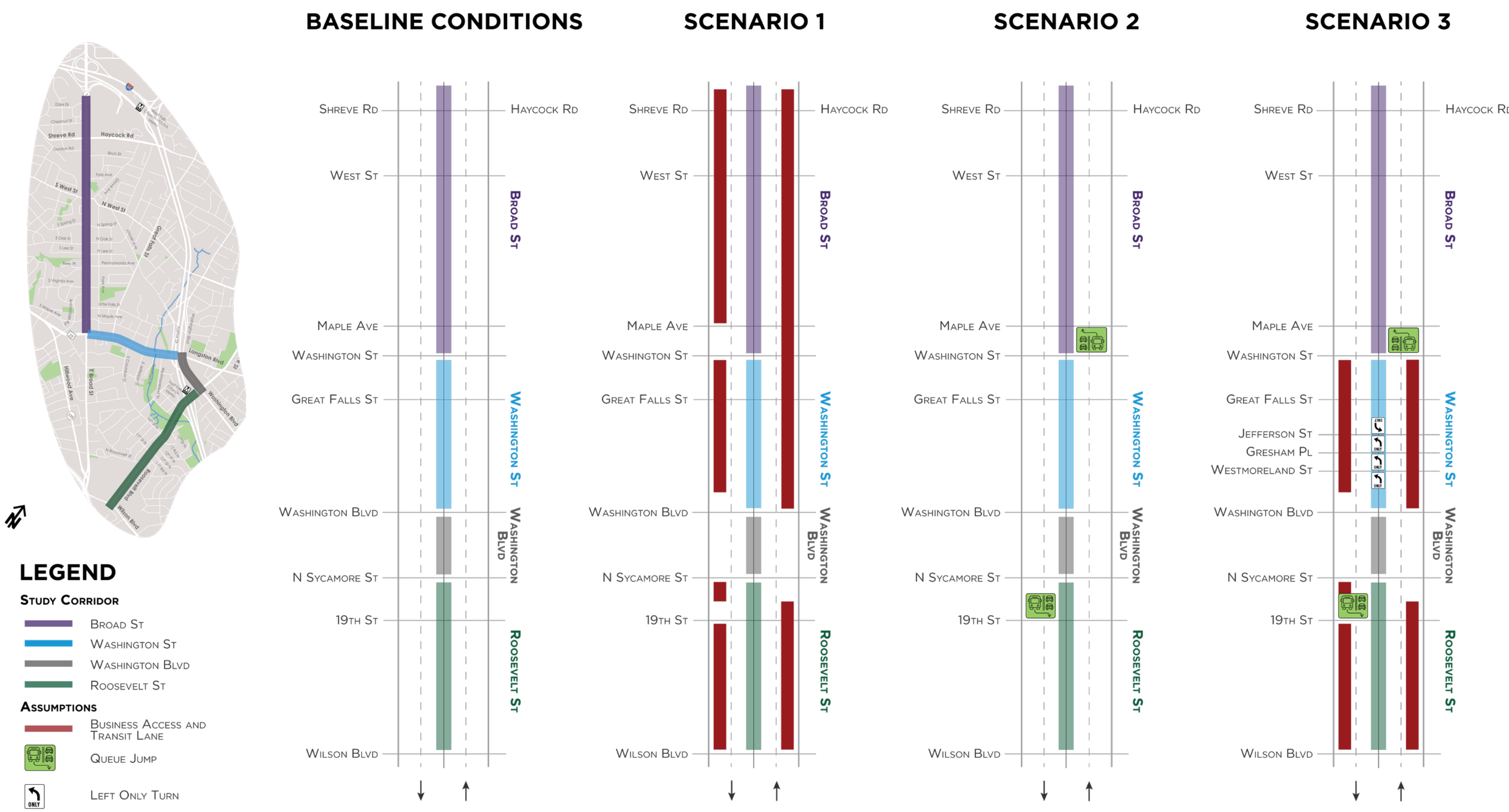
Build Scenario 2 is considered a "minimal investment" for BRT and did not assume any BAT lanes on the corridor. This scenario seeks to maintain the status quo with nominal upgrades. Build Scenario 2 proposes,

- Queue jumps at two intersections, and
- TSP signal timing strategies.

Build Scenario 3 is a combination of some of the key elements from Build Scenario 1 and Build Scenario 2. It seeks to maximize the potential benefits of BAT lanes while limiting their impacts on congestion and vehicle diversion along the corridor. Build Scenario 3 is a hybrid scenario that proposes,

- Partial BAT lanes, and
- TSP signal timing strategies.

Figure ES-1: Overview of Build Scenarios and Associated Bus Priority Treatments for the Proposed Route 7 BRT



EXECUTIVE SUMMARY

Analysis of the build scenarios using VISSIM, a microsimulation software, indicates that most of the study intersections operate with acceptable levels of delay, even with the changes to provide priority treatments for the BRT. This is partially due to vehicle diversions resulting from the repurposing of a general travel lane to provide a BAT lane in each direction. Build Scenario 1 has the highest effect on vehicle performance, especially during the evening peak hour, as this scenario includes BAT lanes throughout most of the corridor. Build Scenarios 2 and 3, on the other hand, generally have marginal effects on vehicle performance.

Figure ES-2 and **Figure ES-3** provide a comparison of vehicle and BRT corridor end-to-end travel times for the future scenarios during the morning and evening peak hours, respectively. The results show that Build Scenario 1 provides the most benefit to BRT in the peak direction with a corridor travel time reduction of 11% in the morning peak hour and 14% in the evening peak hour. However, Build Scenario 1 also increases corridor vehicle travel times, especially in the evening peak hour due to the reduction of roadway capacity. This increase in vehicle travel time in Build Scenario 1 makes vehicle and BRT travel times generally comparable throughout the corridor.

Build Scenario 2 results in minimal changes to BRT travel time compared to the Baseline conditions since it limits transit priority treatments to TSP and queue jumps at two intersections. This is not surprising as the application of TSP along major arterials with long green times typically provides small benefits. The effect of Build Scenario 2 on vehicle corridor travel times is also marginal since Build Scenario 2 has the same lane configuration and roadway capacity compared to the Baseline conditions.

Lastly, Build Scenario 3 provides modest improvements to BRT corridor travel time, but not as large as Build Scenario 1, given that Build Scenario 3 includes partial BAT lanes on certain portions of the corridor. However, because the reduction in roadway capacity is limited to certain portions of the corridor, the increase in vehicle corridor travel times is not as pronounced as in Build Scenario 1.

The Envision Route 7 project employed a public outreach process to inform project findings and gather feedback on the build scenarios. As part of a robust, community-based public outreach process, feedback was collected from existing bus passengers as well as from the general public at bus stop chats, pop-up events, and public meetings. Existing transit passengers expressed support for Build Scenario 1 to maximize improvements for BRT. However, people who drive through the corridor expressed concern about the effects of the project on vehicular congestion and noted that traffic could divert through adjacent neighborhoods. Additionally, people who walk or bike also expressed concerns regarding the lack of investment in infrastructure for walking and biking.

Figure ES-2: Comparison of Vehicle and BRT End-to-End Corridor Travel Times during the Morning Peak Hour for the Future Scenarios

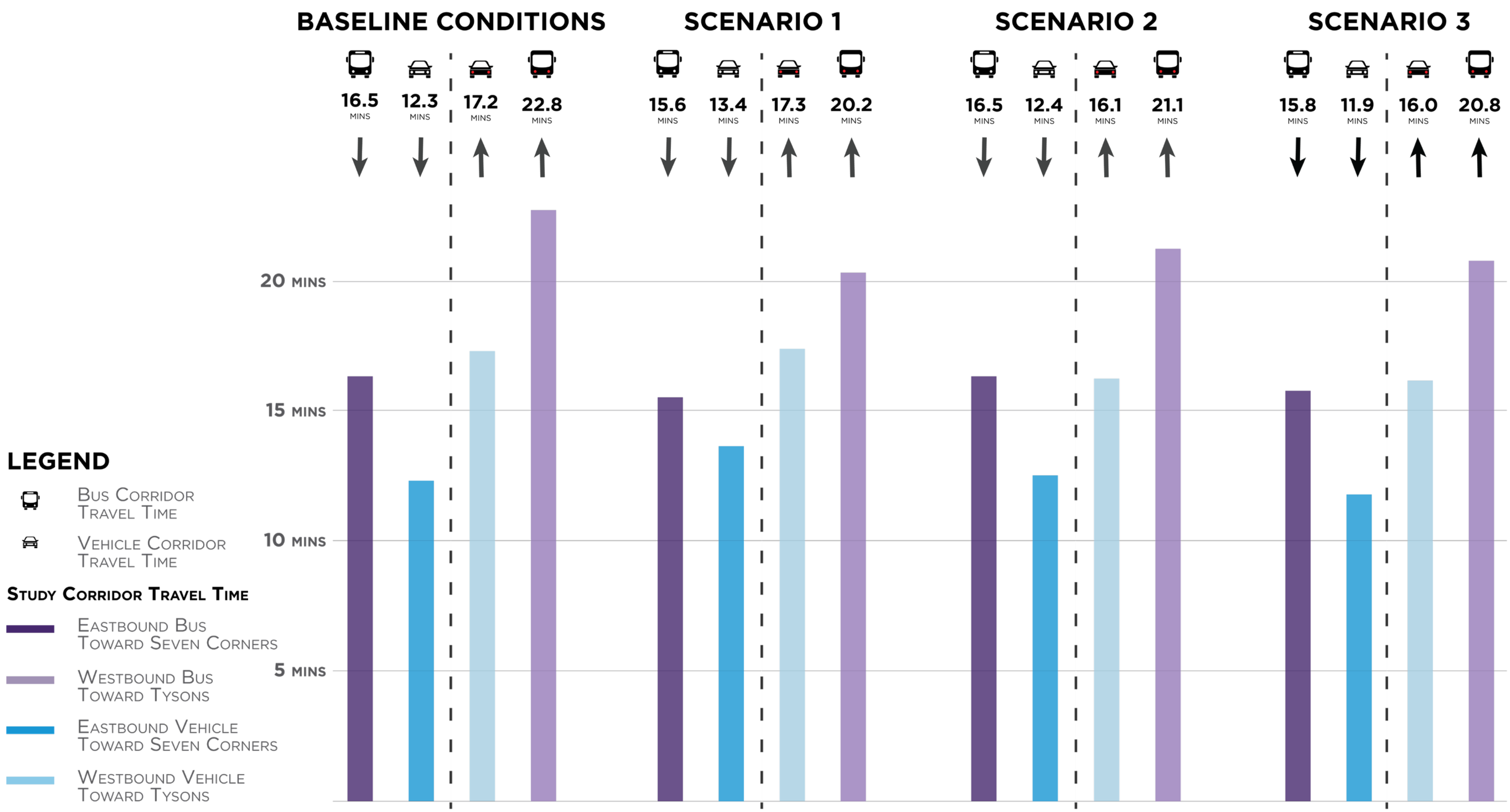
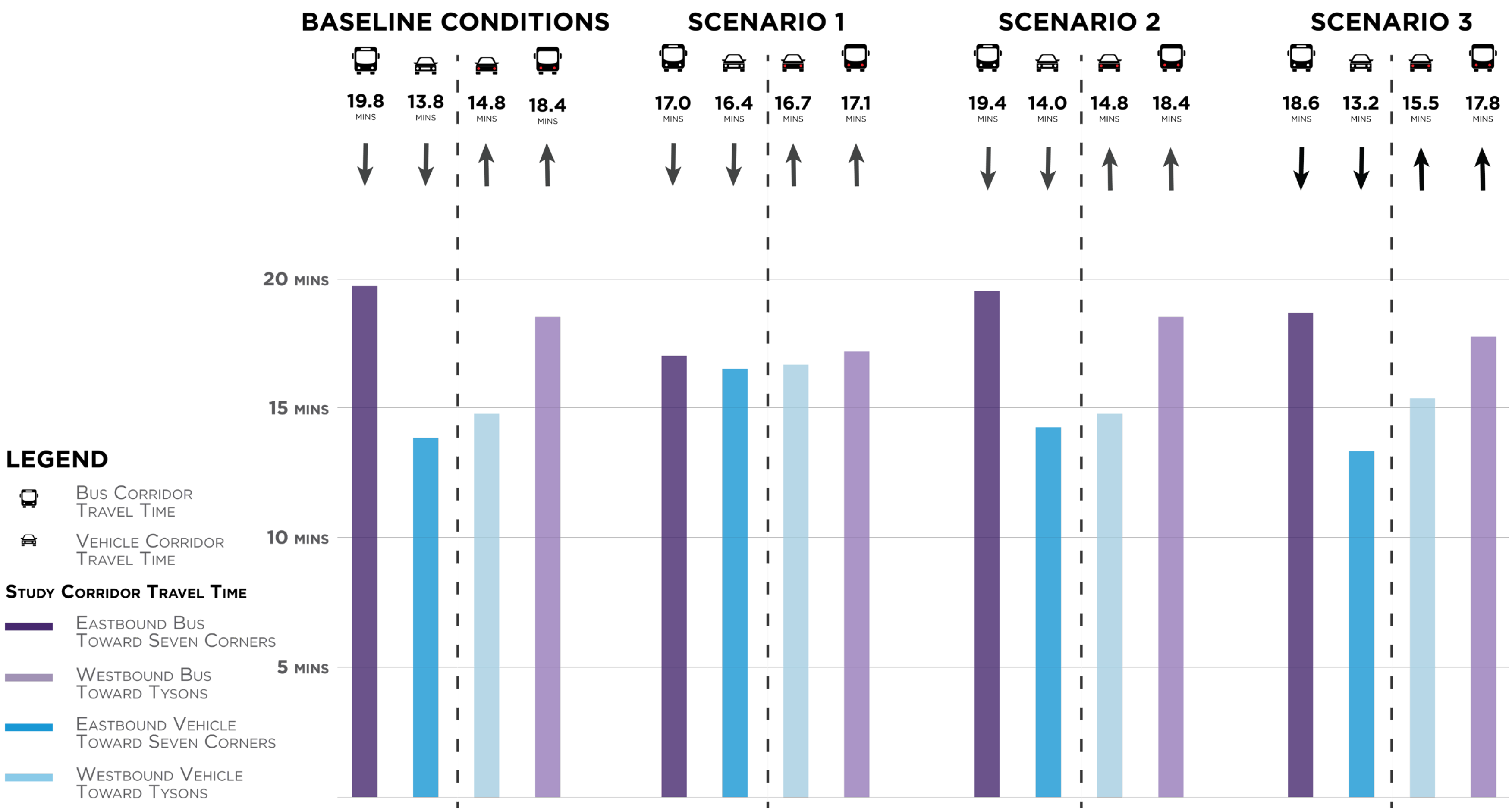


Figure ES-3: Comparison of Vehicle and BRT End-to-End Corridor Travel Times during the Evening Peak Hour for the Future Scenarios



The next phase of the project will conduct more detailed analysis and environmental review to identify benefits and potential impacts to the environment, community, and businesses in the corridor. As part of the next phase of the project, strategies to minimize and mitigate potential impacts will be developed. Specifically, strategies to minimize potential diversions onto neighborhood streets will be explored. Where necessary, mitigation measures will also be identified. The next phase will also consider improvements to pedestrian and bicycle infrastructure to enhance walking and cycling conditions in the corridor. Finally, the next phase will include engagement efforts with stakeholder agencies, specifically the City of Falls Church, to understand the City's needs for more detailed analysis and specific concerns that should be addressed as part of the environmental review.

1

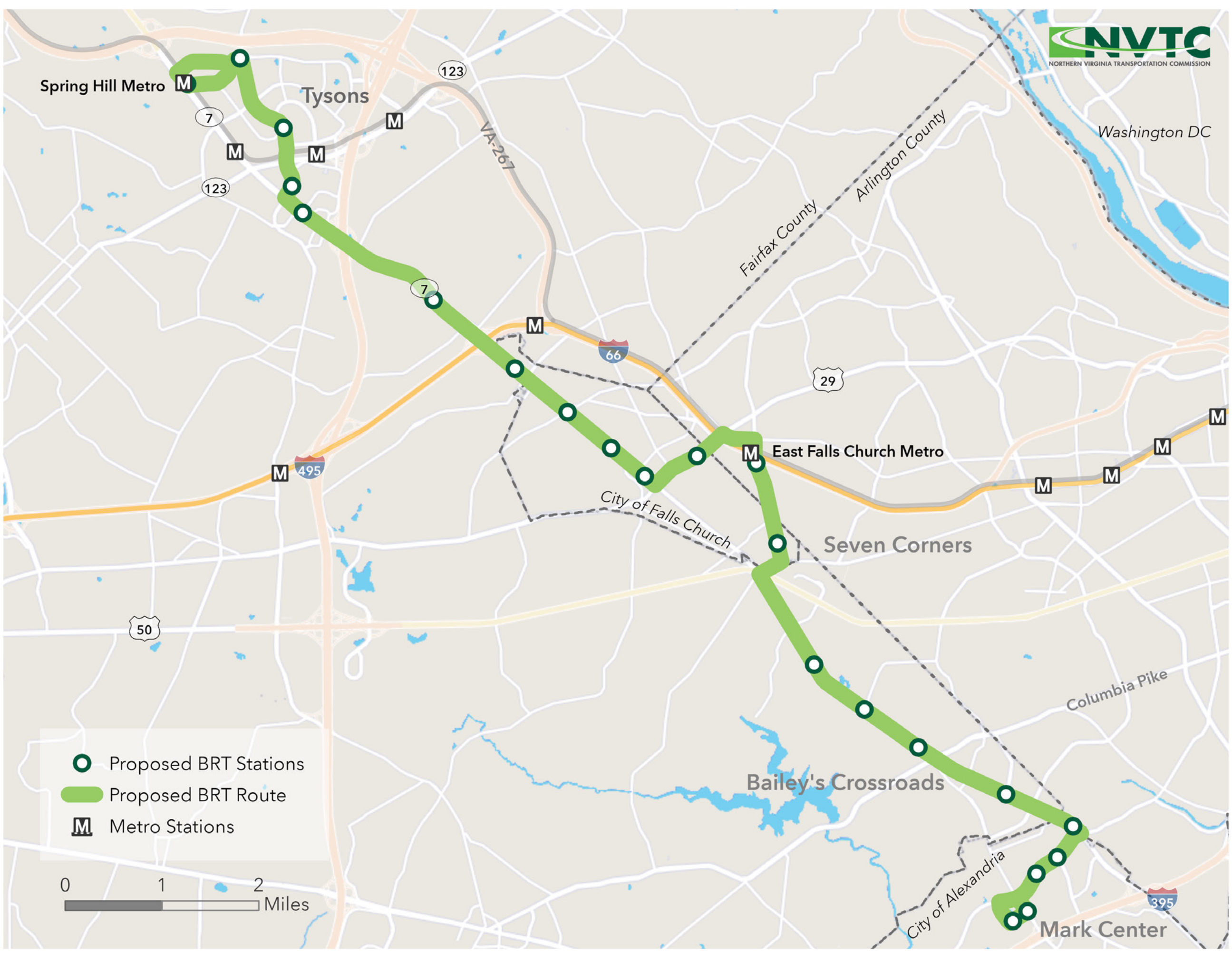
INTRODUCTION

INTRODUCTION

The Northern Virginia Transportation Commission (NVTC) is leading the Envision Route 7 project, a bus rapid transit (BRT) planning effort focused on connecting the Mark Center in Alexandria to Tysons via Bailey's Crossroads, Seven Corners, and the City Falls Church along the Route 7 corridor (Route 7). **Figure 1-1** shows the proposed BRT route between Mark Center in Alexandria and Tysons, as well as the proposed BRT stations.

Currently, Route 7 is one of the busiest bus corridors in Northern Virginia. While COVID-19 and subsequent work from home policies had a significant negative impact on public transit ridership throughout the United States, bus ridership on Route 7 remained strong. Adding to the existing demand for transit service, it is projected that by 2040 population and employment opportunities along Route 7 will grow by 35%.

Figure 1-1: Proposed Envision Route 7 Project BRT Route between Mark Center in Alexandria and Tysons in Fairfax County



The Envision Route 7 project aims to address the anticipated vehicular congestion along the corridor and improve overall mobility by providing high-speed, high-frequency, and reliable transit service and connections across multiple jurisdictions, between multiple Metrorail stations, and to the proposed West End Transitway. When implemented with dedicated transit lanes and/or innovative preferential treatments (e.g., transit signal priority, off-board fare collection, elevated platforms, enhanced stations, etc.), BRT on Route 7 can offer high-speed and reliable transit service that maximizes person capacity and reduces person delay.

1.1 STUDY OVERVIEW

The Envision Route 7 project is a multi-phase project that began in 2013 and has resulted in a substantial amount of work completed to date. Phase 1 assessed the existing issues along Route 7 and identified the potential opportunities that could be leveraged to improve mobility and accessibility. Phase 2 focused on determining the mode, alignment, and termini to best serve Route 7. Phase 3 conducted a conceptual engineering study to refine the project cost, identify potential areas of concern, develop a potential staging strategy, and provide guidance on preserving the required right-of-way.

The Envision Route 7 project is currently on Phase 4. This effort focuses on Phase 4-1 of Phase 4 and performs a mobility analysis using microsimulation to evaluate and determine the benefits and impacts from the proposed BRT on Route 7 between Interstate-66 (I-66) and Seven Corners. The study corridor extends approximately 3.5 miles within the City of Falls Church and Arlington County. **Figure 1-2** highlights the extents of the Phase 4-1 study corridor.

1.2 GOALS, OBJECTIVES, AND MEASURES OF EFFECTIVENESS

Phase 4-1 of the study focuses on the mobility effects for the Envision Route 7 project and assesses the ability of BRT to travel through the core of the corridor. As such, this study focuses on a small subset of larger needs for the BRT service.

The overall objectives of the Phase 4-1 project are:

- Assess the mobility benefits of BRT along Route 7 and document the incremental benefit that will be obtained from the extension of dedicated bus lanes through the City of Falls Church to Seven Corners,
- Provide an understanding of potential traffic impacts and operational issues of BRT with a particular focus on the section within the City of Falls Church, and
- Facilitate public understanding of BRT along the corridor by demonstrating how a BRT service would affect mobility for corridor residents and access to employees and residents.

INTRODUCTION

Figure 1-2: The Envision Route 7 Project Phase 4-1 Study Corridor

The goals, objectives, and measures of evaluation (MOE) for the project were selected based on the needs of the Phase 4-1 effort, which are also consistent with the overall goals of the Route 7 BRT project. For additional information, please refer to the Goals, Objectives, and Measures of Effectiveness Technical Memorandum.

Table 1-1 shows the goals, objectives and recommended MOEs for this study. The table also includes the associated tool/software and data sources that were utilized to calculate the selected measures.

Table 1-1: Goals, Objectives, and Selected MOEs

GOAL 1: PROVIDE EFFICIENT MOVEMENT OF PEOPLE ALONG THE CORRIDOR			
Objectives	**MOEs**	**Software/Tools for Analysis**	**Data Source(s) for Analysis**
Improve Transit Operations in the Corridor	BRT corridor travel time and speed BRT corridor travel time reliability	VISSIM Travel demand model and previous study forecasts (for ridership estimation)	BRT proposed frequency Boarding/alighting at stations
Minimize Disruptions on Traffic Operations in the Corridor	Vehicle level of service and delay by intersection, approach, and lane group at study intersections Average and maximum queue length at study intersections Corridor vehicle travel time and speed Network delay, network throughput, and unmet (latent) demand	VISSIM	Intersection turning movement volumes Signal timing plans
GOAL 2: ADVANCE SUSTAINABLE TRANSPORTATION SERVICE AND REDUCE GREENHOUSE GAS EMISSIONS			
Meet Increased Travel Demand through Non-Auto Modes	Vehicle miles traveled and person miles traveled by mode	Travel demand model and previous study forecasts	Projected traffic volumes and trip tables
GOAL 3: INCREASE MULTIMODAL ACCESSIBILITY TO BRT STATIONS			
Maintain Good Service and Low Pedestrian Delay at Intersections with BRT Stations	Average pedestrian crossing times at key signalized intersections	VISSIM	Signal timing plans BRT station locations Proposed cross section and number of travel lanes

2

DATA COLLECTION AND ANALYSIS METHODOLOGY

DATA COLLECTION AND ANALYSIS METHODOLOGY

This section describes the data collection and analysis methodology followed by the project team to generate the selected MOEs previously discussed. First, the data collection methodology is described. Next, the analysis methodology along with the tools and methodologies used are presented.

2.1 DATA COLLECTION

The initial data collection plan for this study was to collect turning movement counts (TMCs) at the study intersections and tube counts at a few select locations in late 2021/ early 2022. Following the COVID-19 pandemic and the resulting economic slowdown in 2020 and 2021, the team was concerned with travel behaviors, as well as if and how travel demand would recover in the study corridor. To understand the recent travel demand and traffic patterns in the study area, the project team compared StreetLight[1] data in November 2019, November 2020, and September 2021. **Table 2-1** shows the StreetLight volume comparisons at three key intersections during the morning and evening peak periods.

The StreetLight analysis revealed that the traffic volumes were substantially lower in 2021 compared to 2019 (i.e., pre-pandemic conditions). To confirm the StreetLight analysis findings using field data, TMCs were also collected at two select intersections (Broad Street at West Street and Broad Street at Washington Street) in April 2022.

Table 2-1: StreetLight Vehicle Volume Comparison to Understand the Effect of COVID-19 on Travel Demand

MORNING PEAK (7 AM – 9 AM)		
INTERSECTION	**% CHANGE IN TEV (2021 VS. 2019)**	**% CHANGE IN TEV (2020 VS. 2019)**
Route 7 and Washington St	-24%	-34%
Route 7 and Haycock Rd	-44%	-48%
Route 7 and West St	-43%	-45%
EVENING PEAK (7 AM – 9 AM)		
INTERSECTION	**% CHANGE IN TEV (2021 VS. 2019)**	**% CHANGE IN TEV (2020 VS. 2019)**
Route 7 and Washington St	-12%	-16%
Route 7 and Haycock Rd	-6%	-21%
Route 7 and West St	-16%	-20%

Note: TEV refers to the total number of vehicles entering an intersection

[1] StreetLight data uses anonymized location records from smart phones and navigation devices in connected cars and trucks to show travel patterns and order of magnitude travel demand.

Compared to the 2019 data, TMC data from April 2022 also indicated large reductions in intersection volumes. As a result, alternative approaches were developed to estimate intersection volumes for the development of the VISSIM model. Note that these two intersections were selected because they are critical signalized intersections along the corridor with heavy cross street traffic and included 2019 TMC data that allowed comparison to pre-COVID-19 traffic conditions.

2.1.1 TRAFFIC VOLUME DEVELOPMENT

For traffic volume development, historic data was utilized to estimate intersection volumes at the study intersections. The project team assumed 2019 as the "existing" conditions (i.e., existing base year conditions) and collected historic, but recent peak period TMC data at study intersections from the City of Falls Church and Arlington County. Historic TMCs were from 6 AM to 9 AM for the morning peak period and from 3 PM to 7 PM for the evening peak period. Using the peak period TMCs, peak hours were then selected for the study area, which indicated 7:30 AM to 8:30 AM for the morning peak and 4:30 PM to 5:30 PM for the evening peak. **Figure 2-1** shows the availability of traffic counts at study intersections as well as the dates the data were collected.

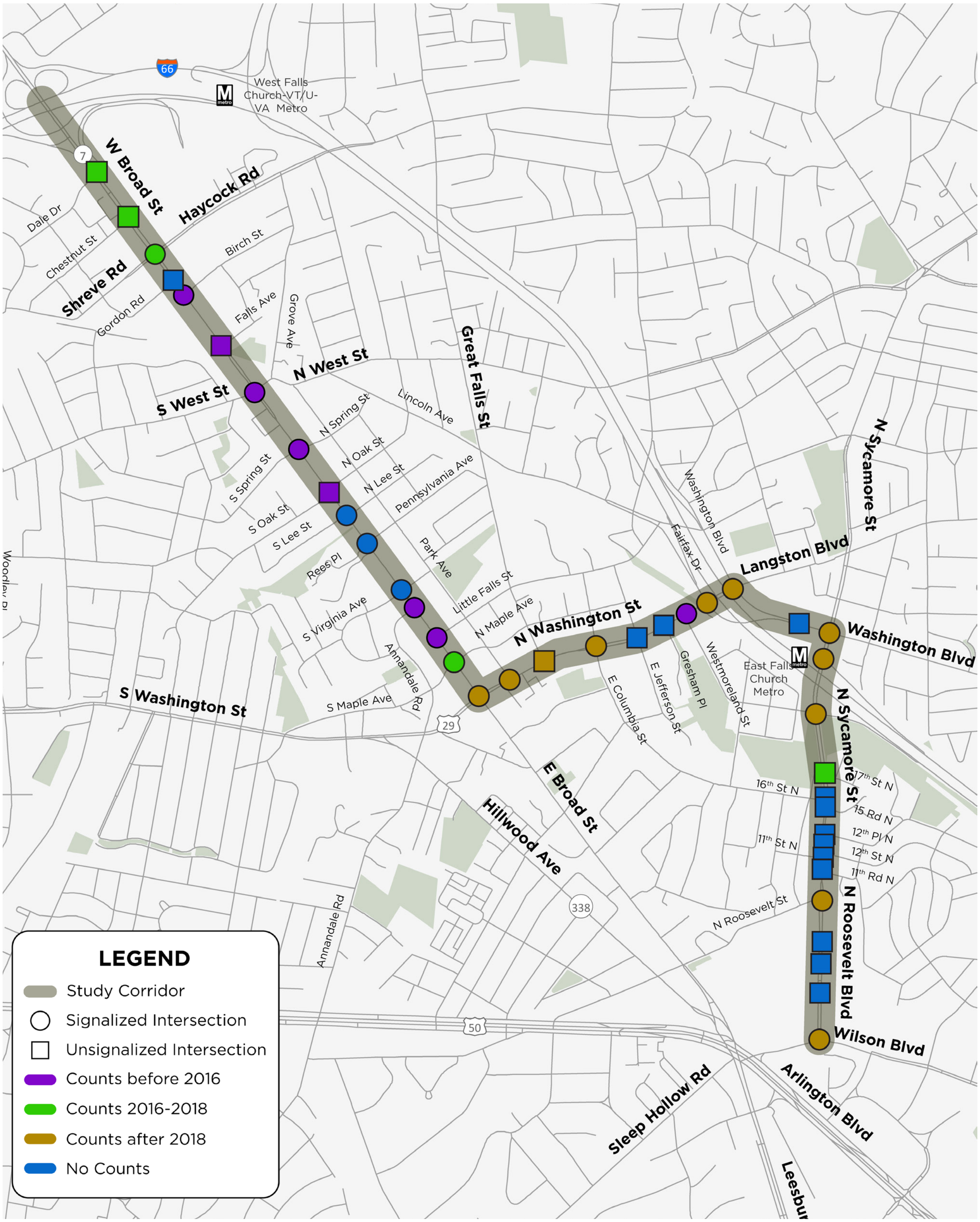
As can be observed in **Figure 2-1**, peak hour TMCs are available at most of the signalized intersections in the study area. Counts at intersections along Route 7 were mostly collected between 2016 and 2018 with some counts before 2016 (mostly in 2013). Available counts at intersections along Washington Street and Roosevelt Street are relatively more recent and were collected in 2018 and 2019.

For the volume development, 2018 and 2019 TMCs were used as the basis since data was recently collected and could accurately capture 2019 conditions. For intersections in which data was collected before 2016 and that are adjacent to the 2018 and 2019 intersections without major intersection or major driveway in between, the volumes were adjusted to match the 2018 and 2019 volumes through volume balancing. For volume balancing, the 2018 and 2019 volumes were held steady and adjacent intersection volumes with 2013 data were adjusted proportionally based on their original (i.e., 2013) volumes. For intersections without any volume data (typically unsignalized intersections), link volumes were first developed based on the input and output volumes. Then, the link volumes were supplemented with pre-COVID-19 pandemic StreetLight data from 2019 to obtain turn proportions and estimate turning movement volumes.

Finally, the volumes were balanced between intersections to provide a more representative picture of traffic conditions for analysis purposes. The existing vehicle traffic volumes used in the analysis are provided in **Appendix A**.

DATA COLLECTION AND ANALYSIS METHODOLOGY

Figure 2-1: Availability of Traffic Counts at Study Intersections



2.1.2 VEHICLE TRAVEL TIME DATA

In addition to traffic volumes, travel time data on critical segments within the study area were needed for the calibration and development of the VISSIM model. Similar to the volume data, the initial plan for the speed data collection was to use the floating car technique and supplement that with the travel time data extracted from the Regional Integrated Transportation Information System (RITIS) platform. However, due to the impacts of COVID-19 on traffic, travel time was collected on select segments using only the INRIX[2] XD probe data from the RITIS platform.

The travel time data were collected for the mid-week weekday morning peak period (6 AM - 9 AM) and evening peak period (4 PM - 7 PM) for October 2019 on each detailed link in the XD data. The travel time data on these selected segments were then analyzed to obtain morning and evening peak hour travel times to compare against simulated travel time for model calibration. The detailed calibration results are documented in the calibration memo in **Appendix C**.

2.1.3 BUS SPEED DATA

Bus travel time and speed data were collected to evaluate bus operations along the corridor as well as congested segments that cause slower bus speeds. Bus speed was also used for model calibration as described in the calibration memo in **Appendix C**. Bus speed data were obtained from the Washington Metropolitan Area Transit Authority (WMATA) using their Ridecheck Plus data for weekdays in October 2019. This data provides bus running times by time point pair where each time point typically includes several bus stops.

2.2 ANALYSIS METHODOLOGY

A variety of analysis techniques were employed to evaluate the existing operations of the transportation network. One of the primary analysis tools used for this project is the PTV VISSIM microsimulation software. VISSIM Version 11 model was used in this project to be consistent with the other models developed in previous phases of the Envision Route 7 project. The existing conditions VISSIM model was calibrated to closely replicate real-world conditions and accurately reflect field conditions. The detailed calibration results and findings are documented in the VISSIM calibration memo in **Appendix C**. Once the VISSIM model was calibrated, it was used for the evaluation of vehicular operations, as well as transit and pedestrian conditions. Evaluation methodologies for the various modes are described below.

[2] INRIX probe data was generated using Global Positioning System (GPS) trajectory data collected from a wide array of commercial vehicle fleets, connected cars, and mobile applications. INRIX provides speed and travel time data at different levels of granularity. INRIX XD data is the type with high granularity. INRIX XD data segments can quickly capture changes in traffic conditions compared to traditional INRIX Traffic Message Channel (TMC) data. At the same time, the XD data may produce a high data volume that require additional storage and higher processing time and power.

2.2.1 VEHICULAR ANALYSIS METHODOLOGY

Vehicle conditions were analyzed using intersection level, corridor level, and network level performance measures. Vehicle delay, level of service (LOS), and vehicle queues for existing intersections were obtained from the simulation model. Vehicle travel times and speeds to measure corridor performance for existing conditions were obtained and analyzed using INRIX as previously discussed. Finally, as congestion was expected to be present at study intersections, overall network performance was also analyzed in VISSIM to understand the extent of vehicle congestion and network performance. Vehicular observations were conducted to inform and supplement VISSIM model results.

2.2.1.1 LEVEL OF SERVICE

Level of service is typically used to quantify vehicular conditions during specific analysis periods. LOS is defined in terms of average total vehicle delay of all movements (i.e., through, left, right) through the intersection. The assigned LOS value reflects the average delay experienced per vehicle at the intersection during the analysis period (typically a one-hour AM and PM peak). LOS A can be considered free-flow or near free-flow (less than or equal to 10 seconds of average delay per vehicle) and LOS F indicates highly congested conditions, with more than 80 seconds of average delay at a signalized intersection.

It should be noted that LOS for unsignalized intersections is determined based on the critical movement that experiences the highest delay, consistent with the Highway Capacity Manual (HCM) LOS methodology for unsignalized intersections. A summary of LOS delays for signalized and unsignalized intersections is provided in **Table 2-2**.

Table 2-2: LOS and Delay Summary for Signalized and Unsignalized Intersections

LOS	SIGNALIZED INTERSECTION AVERAGE CONTROL DELAY PER VEHICLE (SEC)	UNSIGNALIZED INTERSECTION AVERAGE CONTROL DELAY PER VEHICLE (SEC)
A	≤10	≤10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

2.2.1.2 VEHICLE QUEUES

Vehicle queues are also typically used to quantify vehicular conditions during specific analysis periods. Vehicle queues represent how far backward a line of vehicles extends from the intersection stop bar. The project team calculated average and maximum queues at the study intersections.

2.2.1.3 NETWORK PERFORMANCE

In addition to analyzing individual intersection operations, VISSIM can also evaluate overall network performance. Network performance measures are especially critical when intersections experience congested conditions. Four network performance measures were selected for analysis:

- ***Average Vehicle Delay:*** Reflects the typical delay for vehicles that travel in the network, and therefore generally includes delay from multiple intersections.
- ***Vehicle Arrivals:*** Reflects the total number of vehicles that can be processed by the transportation network, making it a helpful measure for congested areas.
- ***Latent Demand:*** Represents the total number of vehicles that are unable to enter the study network because of congestion.
- ***Delay for Latent Demand:*** Represents the total amount of delay for vehicles that are unable to enter the study network.

2.2.2 TRANSIT ANALYSIS METHODOLOGY

The existing transit conditions were evaluated using transit routes and schedules in the study area, automated passenger count (APC) data for transit ridership, and automated vehicle location (AVL) data for transit travel times and speeds. To be consistent with the vehicle analysis methodology and account for the effect of the pandemic, transit data were collected from 2019. For transit routes and schedules, the General Transit Feed Specification (GTFS) data was used while coding the public transit lines for the existing network to obtain routes from October 2019. Similarly, APC and AVL data were provided by WMATA for Fall 2019 to ensure data reflected pre-COVID 19 pandemic conditions.

2.2.3 PEDESTRIAN ANALYSIS METHODOLOGY

The project team also analyzed pedestrian crossing times at key study intersections using VISSIM microsimulation software. Pedestrian crossing times were analyzed at select major intersections along the corridor where pedestrian crossing times are relatively long including: Route 7 and Washington Street, Route 7 and West Street, and Route 7 and Haycock Road. Pedestrian crossing times include both signal delay pedestrians experience while waiting for the “Walk” indication and the time to cross an intersection once the “Walk” indication is displayed, thus reflecting both the effect of signals as well as crossing distance.

3

EXISTING CONDITIONS

EXISTING CONDITIONS

The following sections provide an overview of existing conditions and presents key analysis results and findings. The analysis evaluated transit service, vehicular operations, and pedestrian conditions. In reporting the analysis results for existing conditions, the project team utilized field data to the extent possible. For example, bus and vehicle speeds were reported using bus AVL data and INRIX vehicle probe data, respectively. However, for other MOEs where using field data was either not possible or practical, the project team relied on the VISSIM microsimulation results (e.g., intersection delay, LOS). For future build scenarios, since field data does not exist, all results were based on the microsimulation analysis.

3.1 TRANSIT CONDITIONS

3.1.1 BUS ROUTE FREQUENCIES

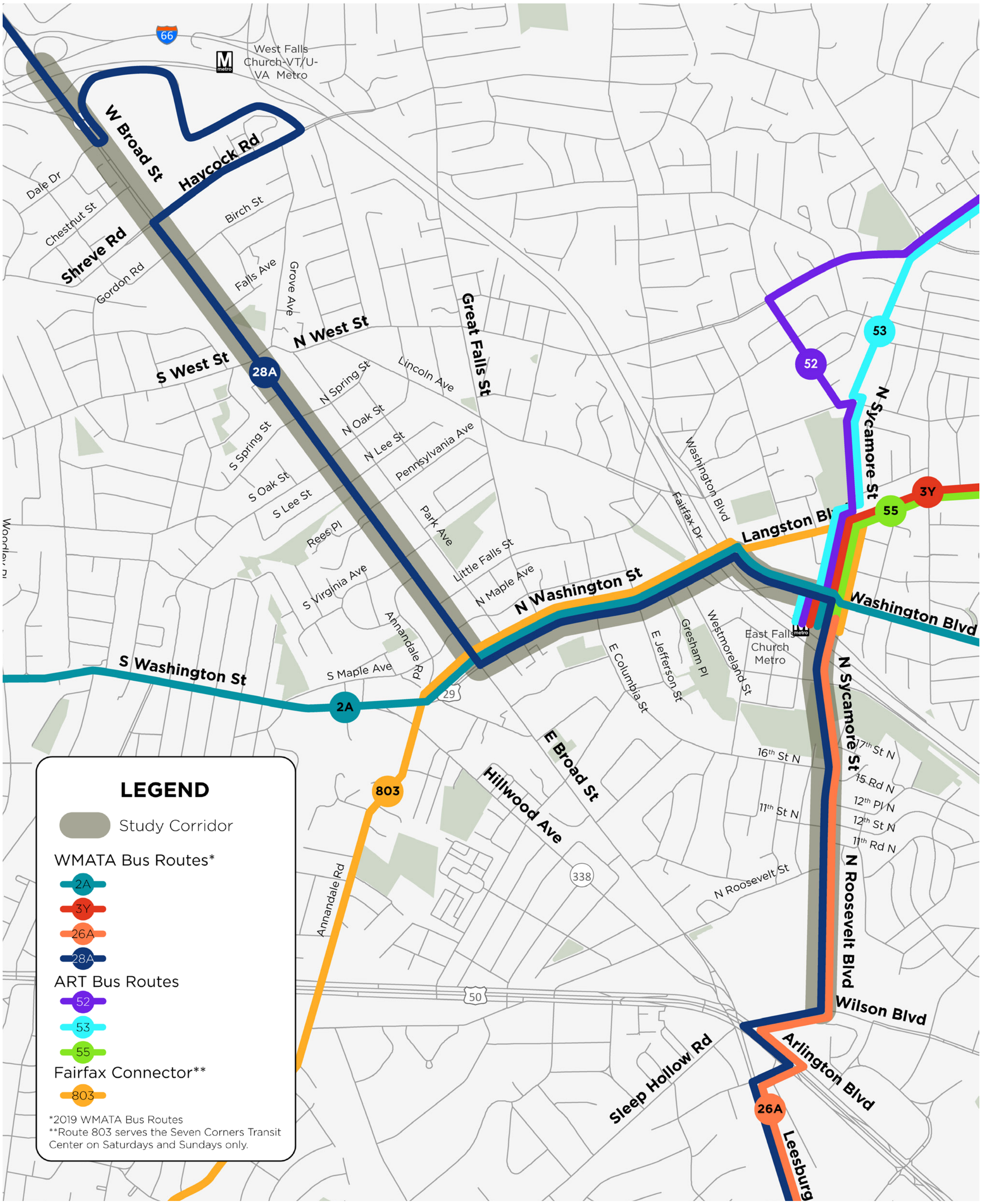
During 2019 pre-COVID-19 pandemic conditions, four WMATA bus routes operated within the study area including 2A, 3Y, 26A, and 28A. In addition to the WMATA routes, the Fairfax Connector and Arlington Transit (ART) also served the study area. **Figure 3-1** displays the bus routes in the study area based on data from 2019.

Route 28A provides service between King Street Metrorail Station and Tysons Metrorail Station and runs along Route 7 in the study area, closely matching the future proposed BRT service along the corridor. Additionally, each of these routes serves the East Falls Church Metro Station stop to provide connection to Metrorail. Lastly, note that for Route 26A, temporary service suspension was enacted in August 2020 as part of the response to the COVID-19 pandemic, however it is displayed on the map as route frequencies are based on the October 2019 data, consistent with the vehicular analysis.

3.1.2 BUS RIDERSHIP

Bus ridership was calculated using weekday passenger boarding and alighting data for all the WMATA routes serving the corridor at each stop during the morning peak period (6 AM - 9 AM). Peak period ridership was calculated rather than the daily ridership to focus on the activity during the peak periods. Additionally, only morning peak period boarding and alighting are calculated and presented here assuming there is generally a symmetry between morning boarding and evening alighting (vice versa) at bus stops. **Figure 3-2** and **Figure 3-3** display morning peak period boarding and alighting in the eastbound direction (toward Seven Corners) and westbound direction (toward Tysons), respectively.

Figure 3-1: Study Area Bus Routes*



*For transit routes and schedules, GTFS data were used to obtain routes from October 2019

Figure 3-2: Weekday Morning Peak Period (6 AM – 9 AM) Boarding and Alighting in the Eastbound Direction (toward Seven Corners)

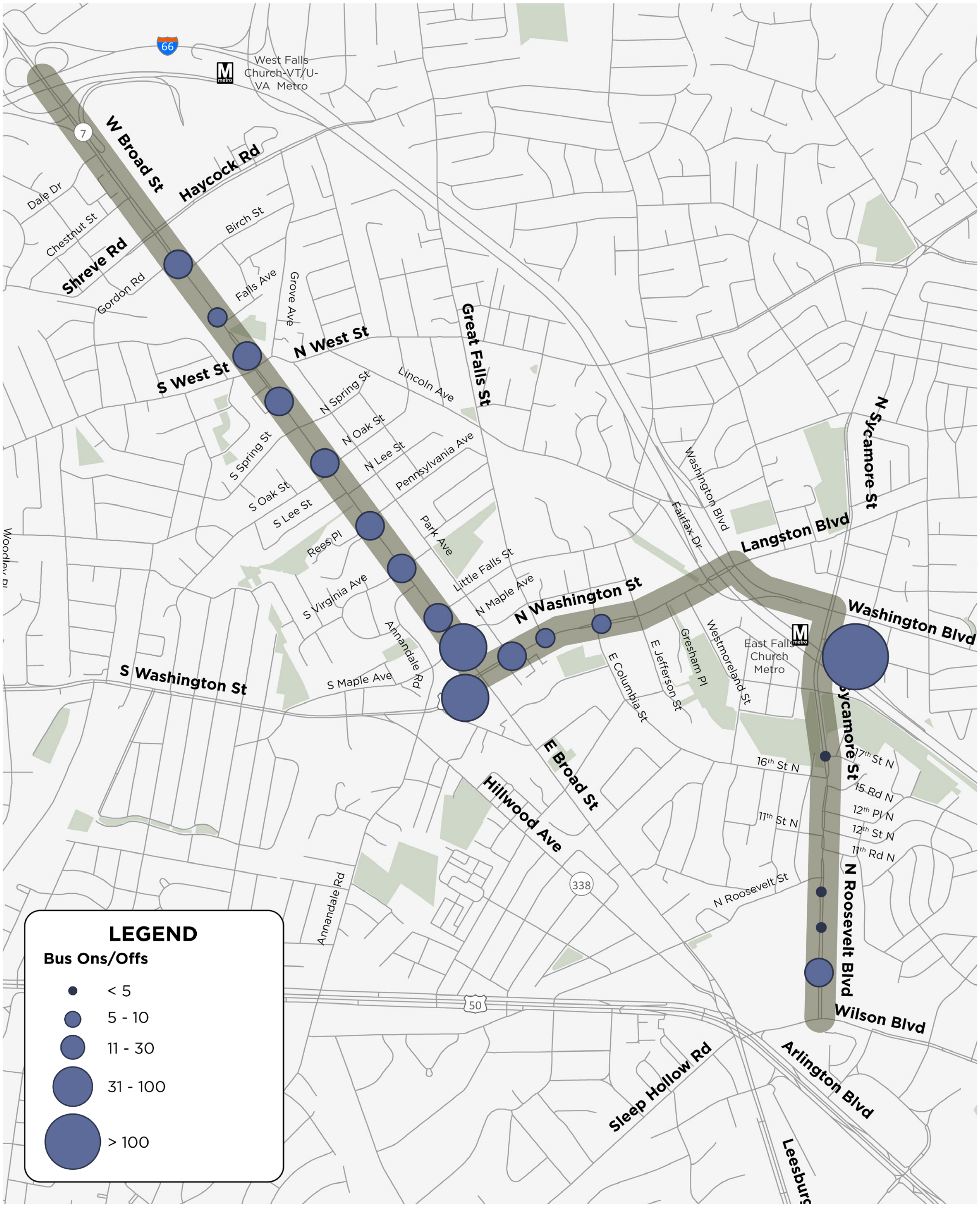
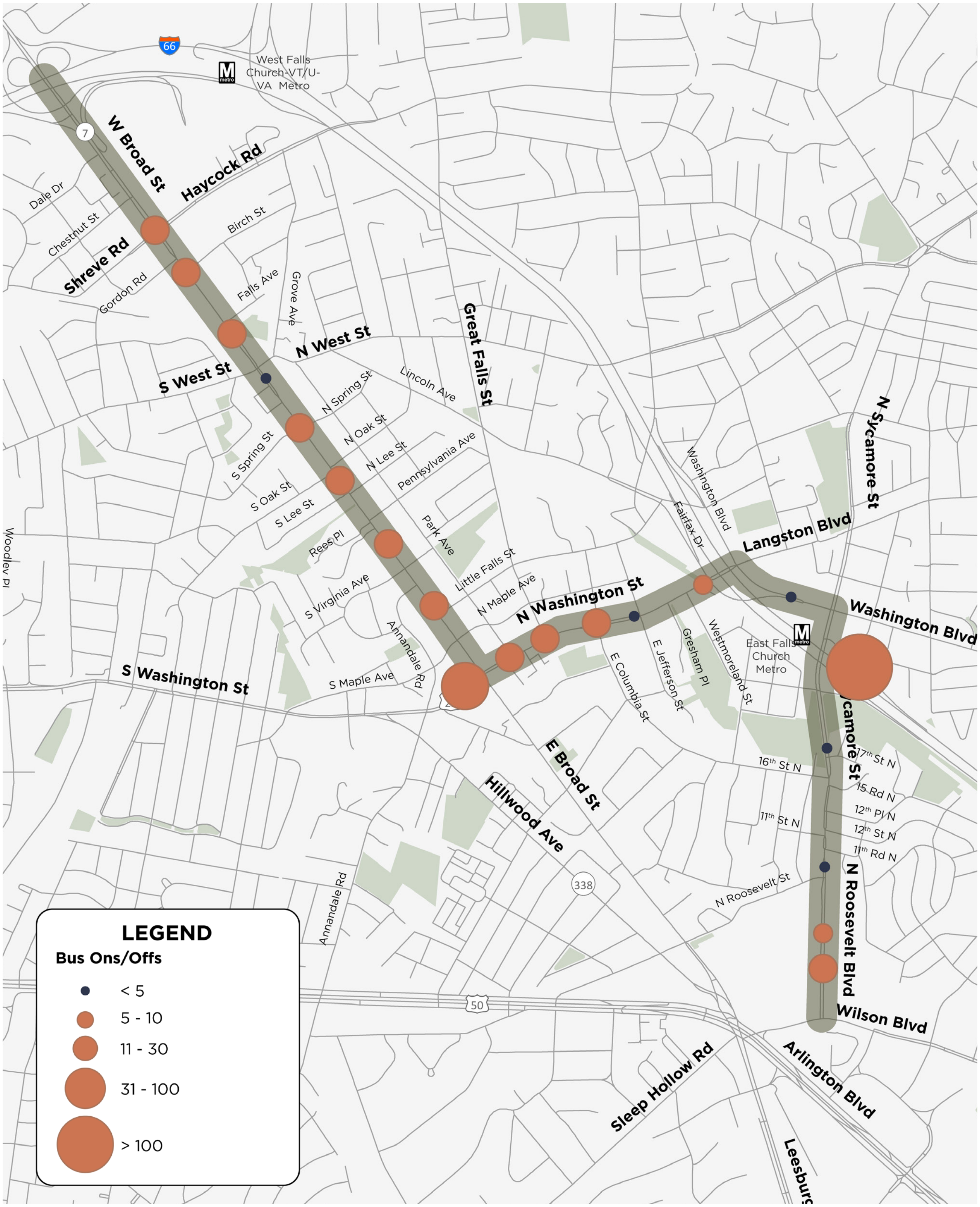


Figure 3-3: Weekday Morning Peak Period (6 AM – 9 AM) Boarding and Alighting in the Westbound Direction (toward Tysons)



Results show that the East Falls Church Metro Station has the most boarding and alighting in both directions within the study area as it provides a key connection to Metrorail service. In the eastbound direction, boarding and alighting at the East Falls Church Metro Station during the morning peak is over 200 passengers while the ridership is approximately 100 passengers in the westbound direction. The other high ridership bus stop in the study area includes the intersection of S Washington Street and Broad Street with more than 30 boarding and alighting in the morning peak period in both directions.

3.1.3 BUS FREQUENCY

Figure 3-4 shows bus frequency, reported in headways, in the study corridor during the morning peak. WMATA's Route 28A has the most frequent transit route served by a single route along the corridor with a peak headway of 12 minutes (5 buses per hour). While ART Route 55 has the same headway as Route 28A, it only serves a small portion of the study corridor. Washington Street between Route 7 and I-66 has more frequent service as it is served by multiple routes, therefore increasing bus frequency to 9 buses during the peak hour. Lastly, as can be observed in subsequent pages, all the bus routes in the corridor provide access to East Falls Church Metrorail Station to allow for transfers to/from Metrorail.

3.1.4 PEAK PERIOD BUS SPEED AND RELIABILITY

Table 3-1 and **Table 3-2** show average and 10th percentile bus speeds for the morning and evening peak hour, respectively, using the AVL data. 10th percentile bus speeds were analyzed and reported as a way of assessing bus speed reliability in the corridor. Note that results were obtained from WMATA's Route 28A as this route travels along Route 7 and follows approximately the same route as the proposed future BRT service. Both in the morning and evening peak hours, the time point from Broad Street at Washington Street to Seven Corners Transit Center led to slower bus speeds (an average speed of 6.9 mph in the morning peak hour and 5.7 mph in the evening peak hour). This is mostly attributed to the congestion that occurs outside of the study area as buses try to access the Seven Corners Transit Center from Wilson Boulevard. Another important finding is that in the eastbound direction between the West Falls Church Station to Broad Street at Washington Street, evening bus speeds are substantially lower than the morning peak hour. This is consistent with the vehicle speeds along the corridor where lower vehicle speeds observed in the eastbound direction during the evening peak hour. Lastly, while there is some variability in bus speeds as can be observed from the 10th percentile bus speeds, the variability is almost uniform and changes little between directions, time points, or time periods.

Figure 3-4: Study Corridor Bus Frequency (reported in headways) for the Morning Peak

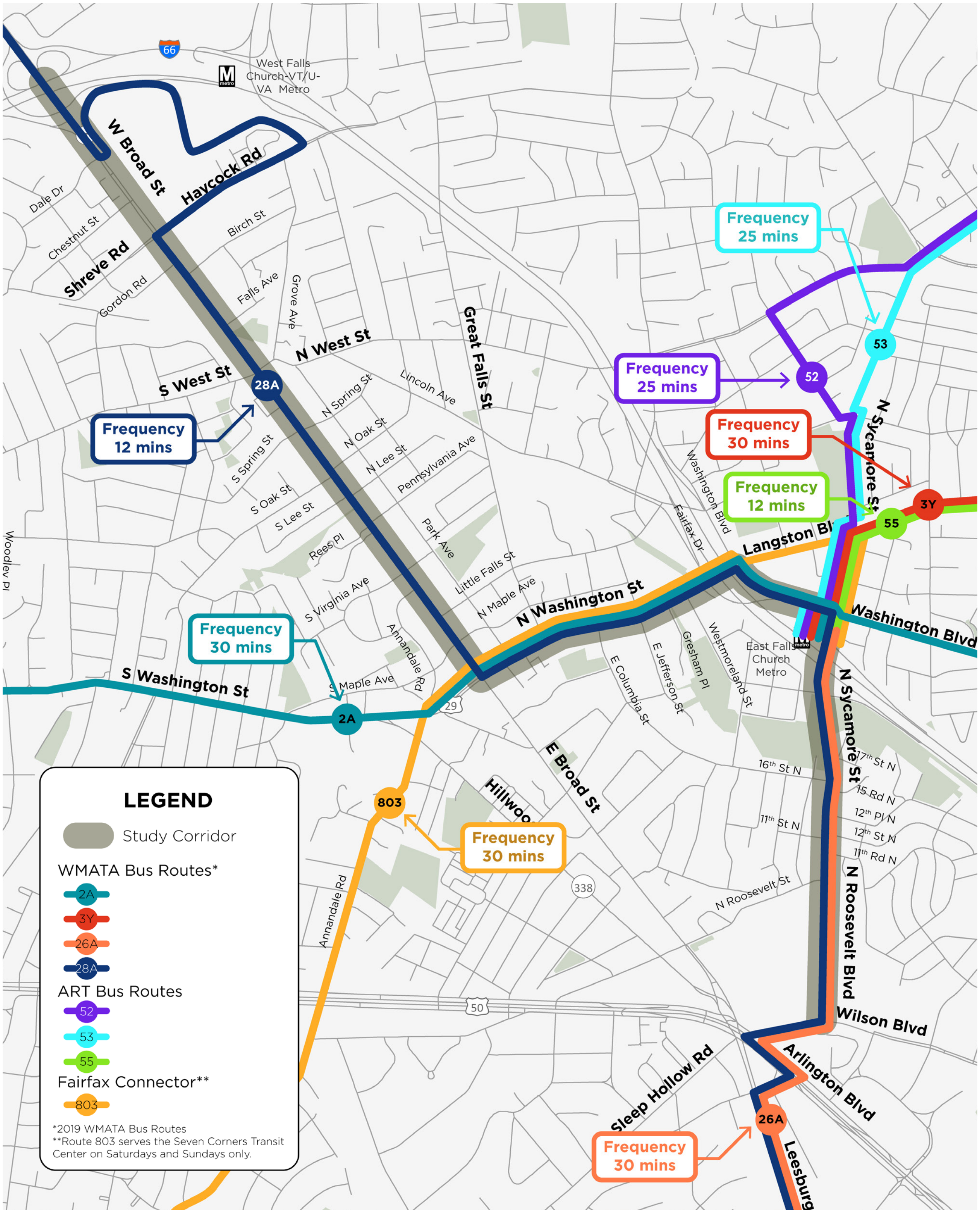


Table 3-1: Average and 10th Percentile Bus Speeds for the Morning Peak Hour using AVL Data Obtained from WMATA Route 28A

DIRECTION	SEGMENT	AVERAGE (10TH PERCENTILE) BUS SPEED (MPH)
EASTBOUND	West Falls Church Station to Broad Street at Washington Street	11.8 (10.1)*
	Broad Street at Washington Street to Seven Corners Transit Center	6.9 (5.1)*
WESTBOUND	Seven Corners Transit Center to Broad Street at Washington Street	10.2 (8.5)*
	Broad Street at Washington Street to West Falls Church Station	13.8 (10.3)*

*Values in parentheses indicate 10th percentile speeds

Table 3-2: Average and 10th Percentile Bus Speeds for the Evening Peak Hour using AVL Data Obtained from WMATA Route 28A

DIRECTION	SEGMENT	AVERAGE (10TH PERCENTILE) BUS SPEED (MPH)
EASTBOUND	West Falls Church Station to Broad Street at Washington Street	7.9 (6.5)*
	Broad Street at Washington Street to Seven Corners Transit Center	5.7 (4.0)*
WESTBOUND	Seven Corners Transit Center to Broad Street at Washington Street	10.4 (8.6)*
	Broad Street at Washington Street to West Falls Church Station	14.4 (12.5)*

*Values in parentheses indicate 10th percentile speeds

3.2 VEHICULAR OPERATIONS

3.2.1 INTERSECTION LOS AND VEHICLE DELAY

Intersection LOS and vehicle delay results for existing conditions are shown in **Table 3-3** for the weekday morning and evening peak hour, respectively. Results were obtained from the VISSIM microsimulation model. LOS and delay results for the morning and evening peak hours are also displayed in **Figure 3-5** and **Figure 3-6**, respectively. Detailed operational results including maximum queues, turning movement volumes, and delay by movement and approach are included in **Appendix B**.

During the evening peak hour, all study intersections operate at LOS D or better. During the morning peak hour, all study intersections currently operate at LOS D or better except for the Washington Boulevard and Langston Boulevard intersection (operates at LOS E) located at the northeastern edge of the study network.

High intersection delay at this location can be explained as follows:

- The review of the simulation at this location indicates that the heavy westbound right-turn demand heading toward I-66 resulted in long queues and delay for the westbound approach. However, this intersection is located at the boundary of the study network and the westbound right-turn vehicles are traveling out of the analysis network. Therefore, this does not impact the operation on the Route 7 corridor or the portion of Washington Street that contain the future proposed BRT service.
- The northbound through movement also experiences long delays at this intersection, leading to LOS E for the intersection. Like the westbound approach, there is heavy demand for vehicles heading north from Washington Boulevard to I-66. The simulation and INRIX XD data consistently indicate that there is congestion at this segment of Washington Boulevard during the AM peak period.

Table 3-3: VISSIM Intersection LOS and Vehicle Delay Summary

INTERSECTION	TRAFFIC CONTROL	MORNING PEAK HOUR		EVENING PEAK HOUR	
		LOS	DELAY (SECS)	LOS	DELAY (SECS)
Dale Rd & Route 7	Unsignalized	A	7.1	A	7.2
Chestnut Rd & Route 7	Unsignalized	A	7.1	B	13.7
Haycock Rd & Route 7	Signalized	D	38.4	D	48.3
Gordon Rd & Route 7	Unsignalized	C	16.8	A	9.1
Birch St & Route 7	Signalized	B	15.0	B	13.3
Falls Ave & Route 7	Unsignalized	B	13.2	A	3.7
West St & Route 7	Signalized	C	33.2	C	29.1
Spring St & Route 7	Signalized	A	7.2	A	6.0
Oak St & Route 7	Unsignalized	C	20.5	A	3.2
Lee St & Route 7	Signalized	B	11.1	A	7.9
Rees Pl/Pennsylvania Ave & Route 7	Signalized	A	7.0	A	6.5
Virginia Ave & Route 7	Signalized	A	8.0	A	8.7
Annadale Rd & Route 7	Signalized	B	16.9	B	12.9
Little Falls St & Route 7	Signalized	A	6.1	A	9.7
Maple Ave & Route 7	Signalized	B	12.0	B	18.4
Washington St & Route 7	Signalized	C	34.2	C	27.4
Washington St & Park Ave	Signalized	B	14.5	B	16.2
Washington St & Great Falls St	Unsignalized	B	13.4	A	4.8
Washington St & Columbia St	Signalized	B	17.7	C	21.0
Washington St & Jefferson St	Unsignalized	B	10.8	A	1.8
Washington St & Gresham Pl	Unsignalized	B	12.4	A	4.2

Table 3-3 (Continued): VISSIM Intersection LOS and Vehicle Delay Summary

INTERSECTION	TRAFFIC CONTROL	MORNING PEAK HOUR		EVENING PEAK HOUR	
		LOS	DELAY (SECS)	LOS	DELAY (SECS)
Washington St & Westmoreland St	Signalized	B	14.4	B	14.9
Washington St & Fairfax Dr/VA 237	Signalized	C	28.4	C	26.0
VA 237/Washington Blvd & Lee Highway	Signalized	**E**	**73.8**	C	28.9
EFC Metro Parking & Washington Blvd (VA 237)	Unsignalized	C	18.9	A	7.5
Washington Blvd (VA 237) & Sycamore St	Signalized	C	34.3	D	44.3
Sycamore St & I-66 WB off-ramps	Signalized	B	18.0	C	20.2
Sycamore St & 19th St North	Signalized	C	20.4	D	38.8
Sycamore/Roosevelt St & 17th St North	Unsignalized	B	10.3	A	0.9
Roosevelt St & 16th St North	Unsignalized	A	7.3	A	1.5
Roosevelt St & 15th Rd North	Unsignalized	C	16.3	A	0.6
Roosevelt St & 12th Pl North	Unsignalized	A	8.7	A	1.5
Roosevelt St & 12th St North	Unsignalized	A	9.4	A	0.5
Roosevelt St & 11th St	Unsignalized	B	13.1	A	0.9
Roosevelt St & 11th Rd North	Unsignalized	B	14.7	A	1.3
Roosevelt St & Roosevelt Blvd	Signalized	A	7.0	B	14.3
Roosevelt Blvd & Oakwood Apartments Access (1)	Unsignalized	A	9.6	A	0.7
Roosevelt Blvd & Roosevelt Towers Access (1)	Unsignalized	B	10.0	A	0.3
Roosevelt Blvd & Oakwood Apartments Access (2)	Unsignalized	B	11.7	A	0.8
Roosevelt Blvd & Wilson Blvd	Signalized	C	20.2	C	28.7

Figure 3-5: Morning Peak Hour Intersection LOS and Vehicle Delay

Figure 3-6: Evening Peak Hour Intersection LOS and Vehicle Delay

3.2.2 CORRIDOR VEHICLE SPEEDS

The corridor vehicle speed heat maps using the INRIX XD data during morning and evening peak periods are shown in **Figure 3-7** and **Figure 3-8.** The speeds are displayed in five-minute intervals with varying color codes in which slower speeds are shown in red. Overall, except for a few intersections, vehicle speeds are relatively fast, typically higher than 15 mph. During the morning peak in the westbound direction, Sycamore Street at Washington Boulevard and Langston Boulevard at Washington Boulevard are the main intersections that cause slower speeds. In the eastbound direction during the morning peak, the main congestion occurs at the intersection of Route 7 and Washington Street. In the evening peak, there is more congestion on the corridor compared to the morning. Most congestion occurs at the same locations listed for the morning peak, but also at the intersection of Route 7 and West Street, especially for the eastbound direction.

Figure 3-7: AM Peak Corridor Vehicle Speed Heat Map

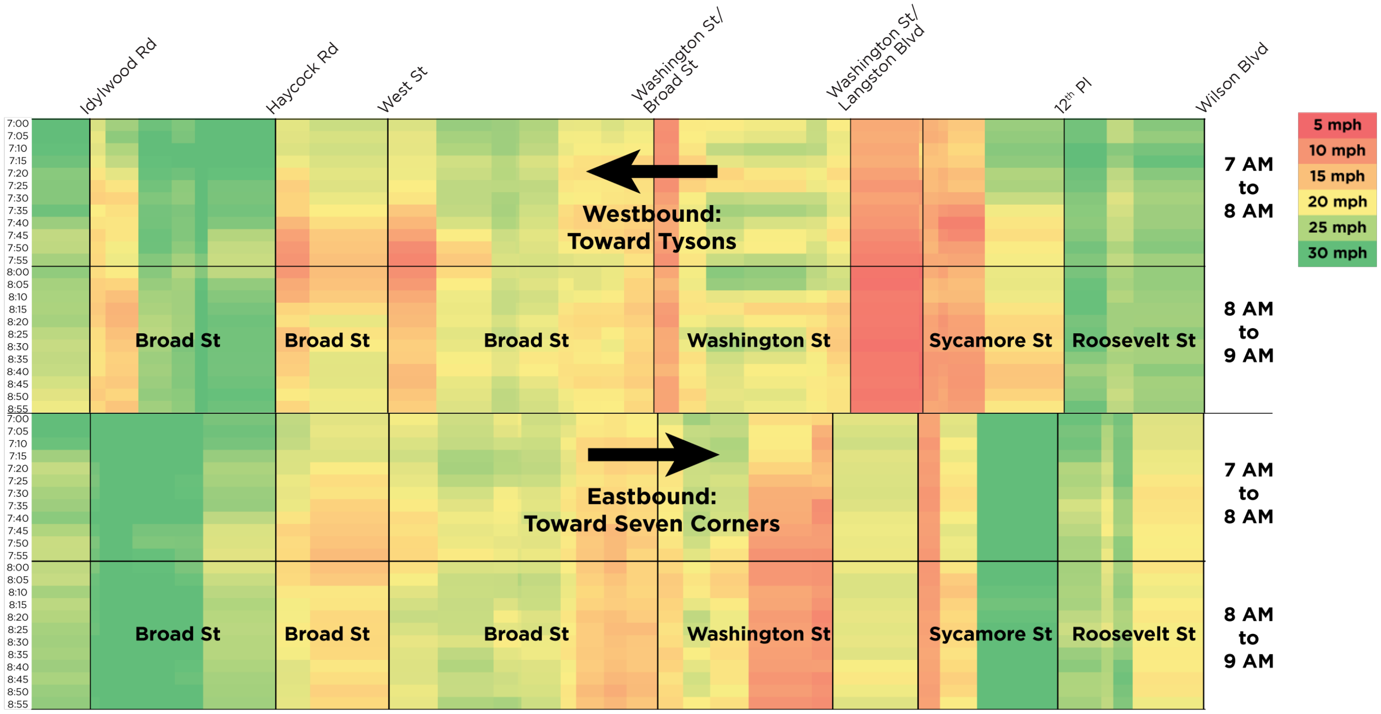
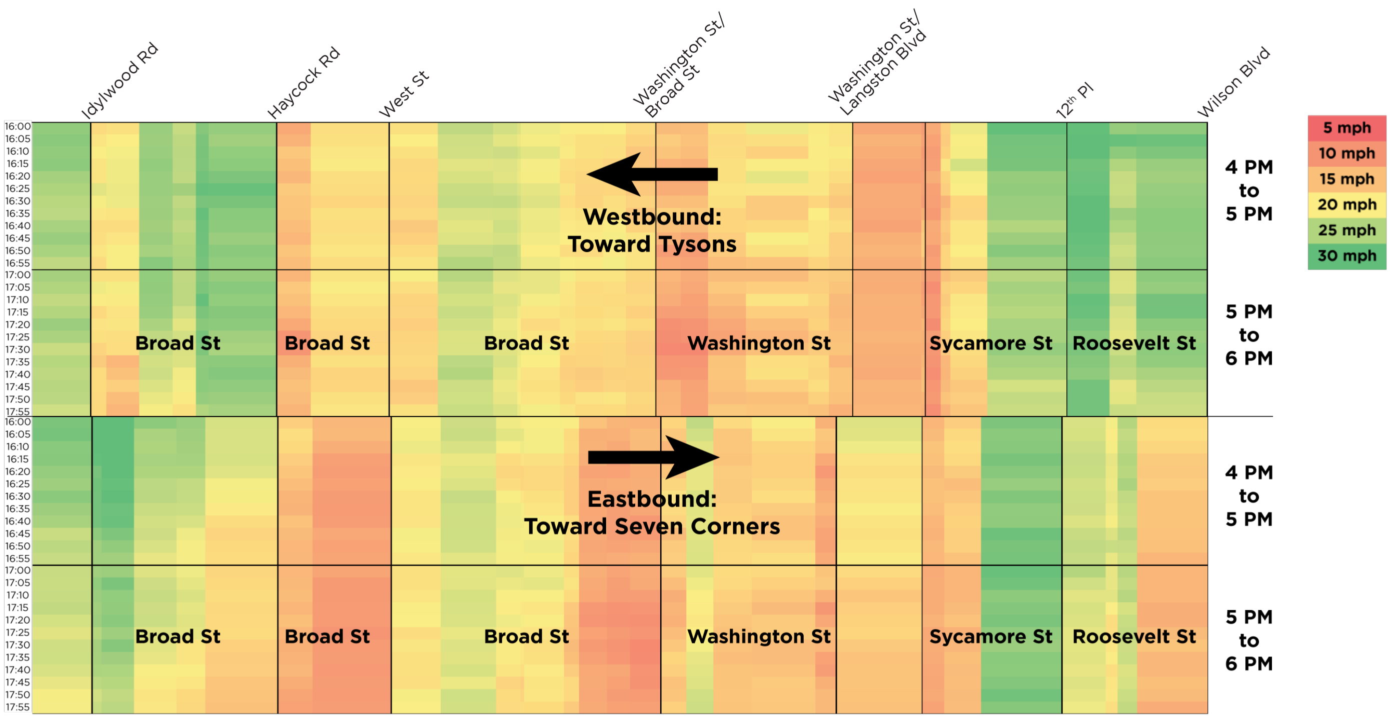


Figure 3-8: PM Peak Corridor Vehicle Speed Heat Map



3.2.3 NETWORK PERFORMANCE

The network performance measures for vehicles are summarized in **Table 3-4** for the morning and evening peak hour. Results show that during the morning peak hour, average network delay for vehicles is slightly higher than the evening peak hour (100 seconds versus 87 seconds). This can partly be attributed to high vehicle delay and long queues experienced at the intersection of Washington Boulevard and Langston Boulevard. Latent demand, which is a metric for unserved vehicles, is zero for the evening peak hour and generally low for the morning peak hour (20 vehicles). This, again, is due to the intersection of Washington Boulevard and Langston Boulevard. Overall, results show that network congestion is generally limited and does not extend beyond the study corridor, and that most vehicles are served within the peak hour.

Table 3-4: VISSIM Intersection LOS and Vehicle Delay Summary

PERFORMANCE MEASURE	MORNING PEAK HOUR	EVENING PEAK HOUR
Average Delay (seconds)	99.8	87.1
Number of vehicles arrived (vehicles)	17,782	20,587
Unmet (Latent) Demand (vehicles)	20	≈0
Delay for Unmet (Latent) Demand (vehicle.hours)	7.6	0.9

3.3 PEDESTRIAN CONDITIONS

Average pedestrian crossing times at three selected signalized intersections were calculated for the morning and evening peak hours using VISSIM. The average pedestrian crossing time is defined as the time it takes a pedestrian to cross the mainline of the intersection (i.e., Route 7 in the table below). The pedestrian crossing time considers the actual crossing time as well as signal delay while waiting for the "Walk" indication. **Table 3-5** provides a summary of crossing times at select intersections.

As shown in **Table 3-5**, on average it takes pedestrians approximately 1.5 to 2.5 minutes to cross Route 7. At the Haycock Road intersection, crossing times are longer compared to the other two intersections. The reason is that Haycock Road operates with a longer cycle length (210 seconds) during both morning and evening peak hours compared to other intersections along the study corridor. Therefore, pedestrians are experiencing relatively longer signal delays while crossing the main approaches of Route 7. Additionally, the crossing distance at Haycock Road is slightly longer than the crossing distances at the other two locations.

Table 3-5: VISSIM Pedestrian Crossing Times at Select Intersections during the Morning and Evening Peak Hour

INTERSECTION	CROSSING TIME (MINUTES)
MORNING PEAK HOUR	
Route 7 and Washington St	1.45
Route 7 and West St	1.45
Route 7 and Haycock Rd	2.50
EVENING PEAK HOUR	
Route 7 and Washington St	1.55
Route 7 and West St	1.50
Route 7 and Haycock Rd	2.50

4

2045 BASELINE CONDITIONS

2045 BASELINE CONDITIONS

4.1 OVERVIEW OF BASELINE CONDITIONS

The 2045 No Build Baseline Scenario (Baseline Scenario) represents the alternative to which all the proposed build scenarios were compared. While the build scenarios, which will be discussed in Section 5, will incorporate varying priority treatments commonly associated with high capacity, high frequency transit service in the study corridor, the Baseline Scenario will only consider transit, land use, and transportation improvements previously identified for the study corridor. The transit priority treatments for the study corridor's Baseline Scenario include level passenger boarding platforms, off-board fare payment kiosks, and TSP at four (4) intersections including Leesburg Pike at Haycock Road/Shreve Road; Broad Street at W Annandale Road; Broad Street at Little Falls Street; and Broad Street at Maple Avenue.

To properly analyze the 2045 Baseline Scenario (and the proposed build scenarios), the project team utilized a travel demand forecasting model to develop intersection volumes at the study intersections and ridership forecasts to estimate dwell times for the proposed BRT. The land use and transportation network assumptions used for the study corridor in the travel demand forecasting model are discussed in detail in the subsequent sections.

4.2 2045 TRAVEL DEMAND MODEL ASSUMPTIONS

The intersection volumes and ridership forecasts were developed using the latest officially adopted production-use version of the Metropolitan Washington Council of Governments/Transportation Planning Board (MWCOG/TPB) travel demand forecasting model (Ver. 2.4). The model and its associated input files (networks and land use data) are from the June 15, 2022, Air Quality Conformity (AQC) Analysis of the 2022 Update to Visualize 2045, a Long-Range Transportation Plan (LRTP) for the National Capital Region, and the FY 2023 - 2026 Transportation Improvement Program (TIP). Two major inputs to the model include: (1) land use that represents the number and location of jobs and employment across the region from the MWCOG Round 9.2 Cooperative Land Use Forecasts; (2) the multimodal transportation network that represents the Visualize 2045 and FY 2023 - 2026 TIP.

4.2.1 BASELINE LAND USE ASSUMPTIONS

The MWCOG Round 9.2 Cooperative Land Use Forecasts were adopted in 2021. In this latest version of land use forecasts, most revisions to the prior forecasts were geographically focused, with changes to regional projections being very limited. The MWCOG/TPB modeling team adjusted the TAZ-level employment data for some jurisdictions to ensure that a consistent definition was used across the entire modeled area.

4.2.2 BASELINE TRANSPORTATION NETWORK ASSUMPTIONS

Major 2045 Baseline assumptions for highway and transit are tabulated in **Table 4-1**.

Table 4-1: Baseline Transportation Network Assumptions

NETWORK ASSUMPTIONS	DETAILS ON ASSUMPTIONS
STATUS OF WIDENING IMPROVEMENTS ON ROUTE 7	– Route 7 widening projects south of Dulles Toll Road (IDs VP2B, VP2N, & VP2LB) to provide lanes for the proposed BRT (not for general traffic)* – Route 7 widening projects north of Dulles Toll used for general traffic – All other CLRP projects proceed as planned
FUTURE BRT SERVICE	
– Station Locations	– Stations as provided in the Envision Route 7 Project Conceptual Engineering Phase III report (dated November 5, 2019)
– Headway assumptions	– Peaks: 10-minute headway – Off-Peaks: 15-minute headway
– Presumed BRT travel speed reflecting travel time improvement from BRT lanes outside of the study area	– Peaks: BRT: 14.4 mph – Off Peaks: BRT: 16.0 mph – (Full route peak period averages)
CHANGES TO THE EXISTING BUS ROUTE SERVICE AFTER BRT IS INTRODUCED	– No Changes – existing routes remain

*In the Baseline Scenario, it is assumed that Route 7 would have dedicated lanes for the BRT outside of the study area.

2045 BASELINE CONDITIONS

4.2.2.1 BUS RAPID TRANSIT ASSUMPTIONS

The 2045 Baseline Scenario assumes BRT service in the study corridor, operating in mixed traffic (i.e., no BAT lanes in the study corridor), and without any additional signal priority treatments (e.g., TSP). TSP is currently active at the following intersections, and therefore included in the Baseline Scenario.

- Leesburg Pike at Haycock Road/ Shreve Road (Fairfax County),
- Broad Street at W Annandale Road (Falls Church),
- Broad Street at Little Falls Street (Falls Church), and
- Broad Street at Maple Avenue (Falls Church).

Outside of the study corridor, BRT service includes dedicated bus lanes for BRT accommodated by future widening projects such as the Route 7 widening projects south of the Dulles Toll Road.

The Baseline BRT includes station locations that were proposed in the Envision Route 7 Conceptual Engineering Phase 3 report dated November 5, 2019. In the study area, the stations include:

- Haycock Road,
- West Street,
- Pennsylvania Avenue,
- Maple Avenue,
- Jefferson Street,
- East Falls Metro Station, and
- North Seven Corners.

The Baseline BRT assumes a 10-minute headway in the morning and evening peak periods and a 15-minute headway in the off-peak periods. Its operating speed will be higher than the existing buses running on the corridor (such as the 28A) because of speed and travel time improvements for the BRT operation, especially on those segments with dedicated lanes south of the Dulles Toll Road and north of I-66.

4.2.2.2 HIGHWAY ASSUMPTIONS

The 2045 Baseline assumes the same number of traffic lanes in the study corridor as existing conditions. Route 7 widening projects north of the Dulles Toll Road will create new lanes that will be used by general traffic. All other projects identified in the MWCOG financially Constrained Long-Range Plan (CLRP) will proceed as planned, including those on I-66 that may affect the travel on the Route 7 corridor.

4.2.3 VOLUME DEVELOPMENT FOR THE BUILD SCENARIOS

Post-processing was conducted to correct variations of the outputs from the raw model from the observed data in the base year. The post-processing refinement applies a set of procedures as outlined in NCHRP Report 765 - Analytical Travel Forecasting Approaches for Project-Level Planning and Design, including the ratio and difference methods. Model variations were computed based on the differences between the observed count data (2019 turning movements) and the model output for the key intersections for both the morning and evening peak hours in the study area for the 2019 validation year. The differences in the count and model results were applied to the future-year 2045 forecasts in the form of delta and/or ratios. The differences were computed as an absolute (delta) and a percentage (ratios); the two were averaged and used as adjustments. In some cases, the growth ratio or absolute difference was chosen, depending on evaluation of the reasonableness of the adjustment magnitudes by different methods.

Once the post-processing was complete, the project team refined the volumes further during volume balancing before incorporating the volumes into the VISSIM microsimulation analysis. **Appendix A** provides projected volumes at the study intersections for all the build scenarios (both the Baseline Scenario and the three build scenarios).

4.3 2045 BASELINE ANALYSIS RESULTS

This section presents the 2045 Baseline analysis results for the morning and evening peak hours. First, key analysis results and MOEs on transit and BRT will be discussed. Then, analysis findings related to vehicular operations at the study intersections and network-wide will be provided. And finally, results from pedestrian delay at select study intersections will be discussed.

2045 BASELINE CONDITIONS

4.3.1 2045 BASELINE CONDITIONS BRT OPERATIONS

4.3.1.1 2045 BASELINE CORRIDOR BRT SPEEDS

Table 4-2 and **Table 4-3** show BRT station-to-station and corridor speeds (including dwell times) during the morning and evening peak hours, respectively for the 2045 Baseline conditions. To provide a comparison, WMATA's Route 28A bus speed is also provided since Route 28A travels along the study corridor and follows approximately the same route as the proposed future BRT service. Note that the comparison of Route 28A and the BRT speeds for each station can be misleading as sometimes Route 28A has multiple stops or stops with a high likelihood of skipping between stations. Therefore, the percent change comparison is only provided for the corridor speed.

Results show that both during the morning and evening peak hours, the proposed BRT service in the Baseline conditions increases transit speeds on the corridor. This is mostly attributed to the reduced number of stops for the proposed BRT service along with the proposed station improvements that reduce dwell times including level boarding and off-board fare payment. Overall, BRT speed on the corridor ranges from approximately 10 mph to 12 mph for the Baseline conditions. Stations with high dwell time such as the East Falls Church Metro Station result in considerably lower BRT speeds on the corridor. Additionally, congestion along certain portions of the corridor reduce BRT speeds such as the segment of East Falls Church Metro Station to Jefferson Street in the morning peak hour (note that dwell times are included in the latter station of the station pairs, that is, at Jefferson Street for this segment).

Table 4-2: 2045 Baseline Conditions BRT Station-to-Station and Corridor Speeds during the Morning Peak Hour

DIRECTION	SEGMENT	2045 BASELINE CONDITIONS: ROUTE 28A SPEED (MPH)	2045 BASELINE CONDITIONS: BRT SPEED (MPH)
EASTBOUND DIRECTION (TOWARD SEVEN CORNERS)	Dale Dr to Chestnut St	19.4	12.8
	Chestnut St to West St	12.6	14.0
	West St to Penn Ave	10.3	13.9
	Penn Ave to Maple Ave	10.4	10.6
	Maple Ave to Jefferson St	8.0	9.9
	Jefferson St to E Falls Church Station	10.1	9.6
	E Falls Church Station to N Seven Corners	22.3	18.1
	AVERAGE CORRIDOR SPEED	**11.5**	**12.2 (6.1%)***
WESTBOUND DIRECTION (TOWARD TYSONS)	Wilson Blvd to N Seven Corners	10.7	11.4
	N Seven Corners to E Falls Church Station	14.5	7.8
	E Falls Church Station to Jefferson St	8.6	8.6
	Jefferson St to Maple Ave	7.6	10.3
	Maple Ave to Penn Ave	7.9	10.2
	Penn Ave to West St	8.5	10.9
	West St to Chestnut St	9.4	10.6
	AVERAGE CORRIDOR SPEED	**9.3**	**9.6 (3.2%)***

*Indicates percent change in BRT speed compared to the Route 28A speed

2045 BASELINE CONDITIONS

Table 4-3: 2045 Baseline Conditions BRT Station-to-Station and Corridor Speeds during the Evening Peak Hour

DIRECTION	SEGMENT	2045 BASELINE CONDITIONS: ROUTE 28A SPEED (MPH)	2045 BASELINE CONDITIONS: BRT SPEED (MPH)
EASTBOUND DIRECTION (TOWARD SEVEN CORNERS)	Dale Dr to Chestnut St	18.0	9.9
	Chestnut St to West St	11.2	13.5
	West St to Penn Ave	12.5	13.5
	Penn Ave to Maple Ave	10.2	11.0
	Maple Ave to Jefferson St	8.2	10.7
	Jefferson St to E Falls Church Station	6.5	5.9
	E Falls Church Station to N Seven Corners	15.6	13.9
	AVERAGE CORRIDOR SPEED	**9.9**	**10.1 (2.0%)***
WESTBOUND DIRECTION (TOWARD TYSONS)	Wilson Blvd to N Seven Corners	9.8	10.7
	N Seven Corners to E Falls Church Station	13.1	11.6
	E Falls Church Station to Jefferson St	11.8	12.4
	Jefferson St to Maple Ave	7.1	11.1
	Maple Ave to Penn Ave	8.6	13.3
	Penn Ave to West St	14.9	14.7
	West St to Chestnut St	9.4	10.8
	AVERAGE CORRIDOR SPEED	**10.4**	**11.9 (14.4%)***

*Indicates percent change in BRT speed compared to the Route 28A speed

4.3.1.2 2045 BASELINE BRT TRAVEL TIME RELIABILITY

Table 4-4 shows the average and 90th percentile BRT corridor travel times for the morning peak hour. **Table 4-5** displays the results for the evening peak hour. Note that the 90th percentile travel time is used to quantify BRT travel time reliability on the corridor. Results show that the difference between the average and 90th percentile travel times are larger in the direction with more congestion and higher BRT travel times. This is expected as congestion typically disrupts reliability, increasing the 90th percentile BRT travel times.

Table 4-4: 2045 Baseline Conditions BRT Station-to-Station and Corridor Speeds during the Morning Peak Hour

BRT TRAVEL TIME (MINUTES)	2045 BASELINE CONDITIONS
Average Travel Time in the Eastbound Direction	16.3
90th Percentile Travel Time in the Eastbound Direction	17.8
Average Travel Time in the Westbound Direction	22.9
90th Percentile Travel Time in the Westbound Direction	26.0

Table 4-5: 2045 Baseline Conditions BRT Station-to-Station and Corridor Speeds during the Evening Peak Hour

BRT TRAVEL TIME (MINUTES)	2045 BASELINE CONDITIONS
Average Travel Time in the Eastbound Direction	18.9
90th Percentile Travel Time in the Eastbound Direction	22.4
Average Travel Time in the Westbound Direction	18.2
90th Percentile Travel Time in the Westbound Direction	20.1

4.3.2 2045 BASELINE CONDITIONS VEHICULAR OPERATIONS

4.3.2.1 2045 BASELINE INTERSECTION LOS AND VEHICLE DELAY

Table 4-6 and **Table 4-7** show intersection LOS and vehicle delay during the morning and evening peak hours, respectively, for the 2045 Baseline conditions. Results from existing conditions are also provided as a comparison. Results are also displayed in **Figure 4-1** and **Figure 4-2**. Analysis findings indicate that vehicle delays are generally comparable to existing conditions except for a few intersections. This is partly because some intersections have excess capacity and the increase in traffic volumes do not affect their operation as much.

The other reason vehicle delays remain similar (or improve at some locations) is signal timing refinements in the Baseline condition, improving intersection performance. During the morning peak hour, only one study intersection operates with LOS E while all other intersections operate with LOS D or better. During the evening peak hour, three intersections operate with LOS E, one of which is an unsignalized intersection (where LOS thresholds are lower compared to signalized intersections).

Table 4-6: Intersection LOS and Vehicle Delay during the Morning Peak Hour

INTERSECTION	TRAFFIC CONTROL	EXISTING CONDITIONS		2045 BASELINE CONDITIONS	
		LOS	DELAY (SECS)	LOS	DELAY (SECS)
Dale Rd & Route 7	Unsignalized	A	7.1	C	24.6
Chestnut Rd & Route 7	Unsignalized	A	7.1	B	12.8
Haycock Rd & Route 7	Signalized	D	38.4	D	40.0
Gordon Rd & Route 7	Unsignalized	C	16.8	C	15.9
Birch St & Route 7	Signalized	B	15.0	B	17.9
Falls Ave & Route 7	Unsignalized	B	13.2	B	12.8
West St & Route 7	Signalized	C	33.2	D	48.1

Table 4-6 (Continued): Intersection LOS and Vehicle Delay during the Morning Peak Hour

INTERSECTION	TRAFFIC CONTROL	EXISTING CONDITIONS		2045 BASELINE CONDITIONS	
		LOS	DELAY (SECS)	LOS	DELAY (SECS)
Spring St & Route 7	Signalized	A	7.2	A	9.4
Oak St & Route 7	Unsignalized	C	20.5	C	17.5
Lee St & Route 7	Signalized	B	11.1	B	13.2
Rees Pl/Pennsylvania Ave & Route 7	Signalized	A	7.0	B	10.1
Virginia Ave & Route 7	Signalized	A	8.0	A	8.3
Annadale Rd & Route 7	Signalized	B	16.9	B	17.3
Little Falls St & Route 7	Signalized	A	6.1	A	8.2
Maple Ave & Route 7	Signalized	B	12.0	C	20.0
Washington St & Route 7	Signalized	C	34.2	D	36.4
Washington St & Park Ave	Signalized	B	14.5	B	15.1
Washington St & Great Falls St	Unsignalized	B	13.4	C	17.9
Washington St & Columbia St	Signalized	B	17.7	C	20.7
Washington St & Jefferson St	Unsignalized	B	10.8	B	14.6
Washington St & Gresham Pl	Unsignalized	B	12.4	C	16.1
Washington St & Westmoreland St	Signalized	B	14.4	B	15.5
Washington St & Fairfax Dr/VA 237 and Washington Blvd & Lee Highway	Signalized	C	28.4	C	28.8
VA 237 and Washington Blvd & Lee Highway	Signalized	**E**	**73.8**	**E**	**69.2**
EFC Metro Parking & Washington Blvd (VA 237)	Unsignalized	C	18.9	C	16.7
Washington Blvd (VA 237) & Sycamore St	Signalized	C	34.3	D	37.5

Table 4-6 (Continued): Intersection LOS and Vehicle Delay during the Morning Peak Hour

INTERSECTION	TRAFFIC CONTROL	EXISTING CONDITIONS		2045 BASELINE CONDITIONS	
		LOS	DELAY (SECS)	LOS	DELAY (SECS)
Sycamore St & I-66 WB off-ramps and Bus Bay Entrance EFC Metro	Signalized	B	18.0	C	23.9
Sycamore St & 19th St North and I-66 on-ramps	Signalized	C	20.4	D	35.8
Sycamore/Roosevelt St & 17th St North	Unsignalized	B	10.3	B	14.8
Roosevelt St & 16th St North	Unsignalized	A	7.3	A	8.7
Roosevelt St & 15th Rd North	Unsignalized	C	16.3	C	20.6
Roosevelt St & 12th Pl North	Unsignalized	A	8.7	A	8.8
Roosevelt St & 12th St North	Unsignalized	A	9.4	B	10.1
Roosevelt St & 11th St	Unsignalized	B	13.1	C	16.5
Roosevelt St & 11th Rd North	Unsignalized	B	14.7	B	14.2
Roosevelt St & Roosevelt Blvd	Signalized	A	7.0	A	8.0
Roosevelt Blvd & Oakwood Apartments Access (1)	Unsignalized	A	9.6	A	4.0
Roosevelt Blvd & Roosevelt Towers Access (1)*	Unsignalized	B	10.0	B	11.2
Roosevelt Blvd & Oakwood Apartments Access (2)*	Unsignalized	B	11.7	N/A*	N/A*
Roosevelt Blvd & Wilson Blvd	Signalized	C	20.2	D	37.3

*Intersections were unsignalized in 2019 (the year for the existing conditions analysis) and converted to signalized intersections in 2021, therefore one delay result is reported for the Baseline conditions.

Table 4-7: Intersection LOS and Vehicle Delay during the Evening Peak Hour

INTERSECTION	TRAFFIC CONTROL	EXISTING CONDITIONS		2045 BASELINE CONDITIONS	
		LOS	DELAY (SECS)	LOS	DELAY (SECS)
Dale Rd & Route 7	Unsignalized	A	7.2	A	7.7
Chestnut Rd & Route 7	Unsignalized	B	13.7	B	13.2
Haycock Rd & Route 7	Signalized	D	48.3	**E**	**59.0**
Gordon Rd & Route 7	Unsignalized	A	9.1	A	7.2
Birch St & Route 7	Signalized	B	13.3	B	10.7
Falls Ave & Route 7	Unsignalized	A	3.7	A	2.9
West St & Route 7	Signalized	C	29.1	C	32.4
Spring St & Route 7	Signalized	A	6.0	A	5.1
Oak St & Route 7	Unsignalized	A	3.2	A	3.6
Lee St & Route 7	Signalized	A	7.9	B	10.6
Rees Pl/Pennsylvania Ave & Route 7	Signalized	A	6.5	A	9.7
Virginia Ave & Route 7	Signalized	A	8.7	A	9.6
Annadale Rd & Route 7	Signalized	B	12.9	B	13.9
Little Falls St & Route 7	Signalized	A	9.7	B	14.1
Maple Ave & Route 7	Signalized	B	18.4	C	22.9
Washington St & Route 7	Signalized	C	27.4	C	28.4
Washington St & Park Ave	Signalized	B	16.2	B	17.2
Washington St & Great Falls St	Unsignalized	A	4.8	A	6.9
Washington St & Columbia St	Signalized	C	21.0	C	22.6

2045 BASELINE CONDITIONS

Table 4-7 (Continued): Intersection LOS and Vehicle Delay during the Evening Peak Hour

INTERSECTION	TRAFFIC CONTROL	EXISTING CONDITIONS		2045 BASELINE CONDITIONS	
		LOS	DELAY (SECS)	LOS	DELAY (SECS)
Washington St & Jefferson St	Unsignalized	A	1.8	A	3.0
Washington St & Gresham Pl	Unsignalized	A	4.2	A	5.7
Washington St & Westmoreland St	Signalized	B	14.9	B	13.9
Washington St & Fairfax Dr/VA 237 and Washington Blvd & Lee Highway	Signalized	C	26.0	C	28.7
VA 237 and Washington Blvd & Lee Highway	Signalized	C	28.9	**E**	**55.3**
EFC Metro Parking & Washington Blvd (VA 237)	Unsignalized	A	7.5	**E**	**36.8**
Washington Blvd (VA 237) & Sycamore St	Signalized	D	44.3	D	47.5
Sycamore St & I-66 WB off-ramps and Bus Bay Entrance EFC Metro	Signalized	C	20.2	B	15.6
Sycamore St & 19th St North and I-66 on-ramps	Signalized	D	38.8	D	36.3
Sycamore/Roosevelt St & 17th St North	Unsignalized	A	0.9	A	1.1
Roosevelt St & 16th St North	Unsignalized	A	1.5	A	1.9

Table 4-7 (Continued): Intersection LOS and Vehicle Delay during the Evening Peak Hour

INTERSECTION	TRAFFIC CONTROL	EXISTING CONDITIONS		2045 BASELINE CONDITIONS	
		LOS	DELAY (SECS)	LOS	DELAY (SECS)
Roosevelt St & 15th Rd North	Unsignalized	A	0.6	A	0.8
Roosevelt St & 12th Pl North	Unsignalized	A	1.5	A	2.0
Roosevelt St & 12th St North	Unsignalized	A	0.5	A	0.6
Roosevelt St & 11th St	Unsignalized	A	0.9	A	0.9
Roosevelt St & 11th Rd North	Unsignalized	A	1.3	A	2.0
Roosevelt St & Roosevelt Blvd	Signalized	B	14.3	B	14.5
Roosevelt Blvd & Oakwood Apartments Access (1)	Unsignalized	A	0.7	A	3.3
Roosevelt Blvd & Roosevelt Towers Access (1)*	Unsignalized	A	0.3	A	2.4
Roosevelt Blvd & Oakwood Apartments Access (2)*	Unsignalized	A	0.8	N/A*	N/A*
Roosevelt Blvd & Wilson Blvd	Signalized	C	28.7	D	45.5

*Intersections were unsignalized in 2019 (the year for the existing conditions analysis) and converted to signalized intersections in 2021, therefore one delay result is reported for the Baseline conditions.

2045 BASELINE CONDITIONS

Figure 4-1: Intersection LOS and Vehicle Delay for the 2045 Baseline Conditions during the Morning Peak Hour

Figure 4-2: Intersection LOS and Vehicle Delay for the 2045 Baseline Conditions during the Evening Peak Hour

4.3.2.2 2045 BASELINE CORRIDOR VEHICLE SPEEDS

Table 4-8 and **Table 4-9** show Baseline condition vehicle speeds during the morning and evening peak hours, respectively. The results from existing conditions are also included to provide comparison. Results show that both during the morning and evening peak hours, vehicle speeds are lower than the existing conditions due to the increased traffic volumes in the corridor.

Speed reductions are more pronounced in the morning peak compared to the evening peak hours. Additionally, even with the speed reductions for the Baseline conditions, vehicle speeds are generally in the range of 15 mph, except for the westbound direction speed in the morning peak hour.

Table 4-8: 2045 Baseline Conditions Vehicle Speeds during the Morning Peak Hour

DIRECTION	SEGMENT	EXISTING CONDITIONS: VEHICLE SPEED (MPH)	2045 BASELINE CONDITIONS: VEHICLE SPEED (MPH)
EASTBOUND DIRECTION (TOWARD SEVEN CORNERS)	Dale Dr to Chestnut St	24.7	21.4
	Chestnut St to West St	16.6	16.4
	West St to Penn Ave	18.6	17.2
	Penn Ave to Maple Ave	17.2	15.2
	Maple Ave to Jefferson St	15.2	13.3
	Jefferson St to E Falls Church Station	17.1	14.0
	E Falls Church Station to N Seven Corners	24.7	23.2
	AVERAGE CORRIDOR SPEED	**18.2**	**16.3 (-10.4%)***
WESTBOUND DIRECTION (TOWARD TYSONS)	Wilson Blvd to N Seven Corners	21.4	15.1
	N Seven Corners to E Falls Church Station	20.4	16.2
	E Falls Church Station to Jefferson St	13.7	9.7
	Jefferson St to Maple Ave	12.2	12.5
	Maple Ave to Penn Ave	15.1	16.1
	Penn Ave to West St	14.5	12.5
	West St to Chestnut St	13.7	11.8
	AVERAGE CORRIDOR SPEED	**15.2**	**12.7 (-16.6%)***

*Indicates percent change in vehicle speed compared to the existing conditions

Table 4-9: 2045 Baseline Conditions Vehicle Speeds during the Evening Peak Hour

DIRECTION	SEGMENT	EXISTING CONDITIONS: VEHICLE SPEED (MPH)	2045 BASELINE CONDITIONS: VEHICLE SPEED (MPH)
EASTBOUND DIRECTION (TOWARD SEVEN CORNERS)	Dale Dr to Chestnut St	15.6	17.6
	Chestnut St to West St	13.9	15.7
	West St to Penn Ave	20.3	19.4
	Penn Ave to Maple Ave	15.4	14.2
	Maple Ave to Jefferson St	16.6	17.4
	Jefferson St to E Falls Church Station	10.7	8.9
	E Falls Church Station to N Seven Corners	21.1	19.5
	AVERAGE CORRIDOR SPEED	**15.3**	**14.6 (-4.6%)***
WESTBOUND DIRECTION (TOWARD TYSONS)	Wilson Blvd to N Seven Corners	18.0	14.4
	N Seven Corners to E Falls Church Station	18.7	17.2
	E Falls Church Station to Jefferson St	14.8	13.1
	Jefferson St to Maple Ave	12.7	13.1
	Maple Ave to Penn Ave	17.2	17.2
	Penn Ave to West St	18.8	19.0
	West St to Chestnut St	11.9	12.8
	AVERAGE CORRIDOR SPEED	**15.5**	**14.8 (-4.5%)***

*Indicates percent change in vehicle speed compared to the existing conditions

4.3.2.3 2045 BASELINE NETWORK PERFORMANCE MEASURES

Table 4-10 and **Table 4-11** show network performance measures for the Baseline conditions for the morning and evening peak hours, respectively. Existing conditions results are also provided for comparison. Results show that both during the morning and evening peak hours, average vehicle network delay increases considerably due to the increase in vehicle volumes in the 2045 Baseline conditions.

The change in vehicle volumes can be observed from the number of vehicles arrived metric during both peak hours (approximately a 9% increase in the morning peak and a 6% in the evening peak). Additionally, unmet demand and the associated delay for those vehicles increased in the Baseline conditions, especially during the morning peak hour. This can be attributed to the side street delay at a few major intersections such as the intersection of VA 237 and Washington Boulevard & Lee Highway.

Table 4-10: 2045 Baseline Network Performance Measures during the Morning Peak Hour

PERFORMANCE MEASURE	EXISTING CONDITIONS	2045 BASELINE CONDITIONS
Average vehicle delay (seconds)	99.8	128.2
Number of vehicles arrived (vehicles)	17,782	19,363
Unmet (latent) demand (vehicles)	20	122
Delay for unmet (latent) vehicles (vehicle. hours)	7.6	56.7

Table 4-11: 2045 Baseline Network Performance Measures during the Evening Peak Hour

PERFORMANCE MEASURE	EXISTING CONDITIONS	2045 BASELINE CONDITIONS
Average vehicle delay (sec)	87.1	101.9
Number of vehicles arrived (vehicles)	20,587	21,922
Unmet (latent) demand (vehicles)	≈0	21
Delay for unmet (latent) vehicles (vehicle. hours)	0.9	14.7

4.3.3 2045 BASELINE CONDITIONS PEDESTRIAN OPERATIONS

Table 4-12 shows pedestrian crossing times (for crossing the mainline) at three intersections in the study corridor during the morning and evening peak hours. These intersections are selected as they are in proximity to the proposed BRT stations and represent varying cycle length and roadway cross-sections on the corridor. Results from the existing conditions are also shown to provide comparison.

Results show that during both peak hours, pedestrian crossing times are almost identical in the Baseline conditions compared to the existing conditions. This is expected because the roadway cross-section remains the same in the Baseline conditions and no changes were made to intersection cycle lengths, which is the primary signal timing parameter that influences pedestrian delay. Additionally, the intersection of Route 7 and Haycock Road results in the highest crossing times for pedestrians as it has longer cycle lengths compared to the other intersections, therefore increasing signal delay, along with a larger right-of-way, increasing crossing times.

Table 4-12: 2045 Baseline Pedestrian Crossing Times during the Morning and Evening Peak Hour

INTERSECTION	EXISTING CONDITIONS (MINUTES)	2045 BASELINE CONDITIONS (MINUTES)
MORNING PEAK HOUR		
Route 7 and Washington St	1.45	1.54
Route 7 and West St	1.45	1.55
Route 7 and Haycock Rd	2.50	2.50
EVENING PEAK HOUR		
Route 7 and Washington St	1.55	1.57
Route 7 and West St	1.50	1.50
Route 7 and Haycock Rd	2.50	2.47

5

2045 BUILD SCENARIO CONDITIONS

2045 BUILD SCENARIO CONDITIONS

5.1 OVERVIEW OF BUILD SCENARIOS

This study is part of a larger effort focused on addressing anticipated congestion and providing high-speed, high-frequency, and reliable transit services on one of the busiest bus corridors in Northern Virginia. While the study considers continuity between the various transit infrastructure investments planned for the entire Route 7 study area between Tysons and Alexandria, this specific phase focuses on the benefits and impacts on mobility within the 3.5 miles between the City of Falls Church and Arlington County. To that end, three build scenarios were developed to test the effects of various bus priority treatments commonly associated with BRT. These treatments include BAT lanes, level passenger boarding platforms, off-board fare payment kiosks, TSP, and queue jumps.

A BAT lane is a travel lane exclusively for transit vehicles which permits other vehicles to enter the lane to make right turns in the immediate vicinity of driveways and intersections.

The proposed BAT lanes for the study corridor are repurposed general travel lane that are adjacent to the curb. Newly constructed travel lanes are not proposed for this segment of the corridor.

The development of Build Scenario 1 was based on the bus priority treatments outlined in the previous phase of the NVTC study and included BAT lanes on most of the corridor's extent, in addition to signal timing strategies including TSP. Build Scenario 2 considered a "minimal investment" scenario for BRT and did not assume any BAT lanes on the corridor to understand the effects on transit and vehicle operations. Therefore, Build Scenario 2 only tested queue jumps at two intersections along with TSP. Based on the key findings from the analysis of Build Scenario 1 and Scenario 2, the project team developed Build Scenario 3, which provides a hybrid solution with partial BAT lanes on the corridor. The location of the BAT lanes was selected based on the simulation results and feedback received from stakeholders with the goal of improving BRT conditions along the corridor while limiting the impact on vehicular traffic. **Table 5-1** and **Figure 5-1** provide a summary of bus priority treatments assumed in the analysis for each build scenario.

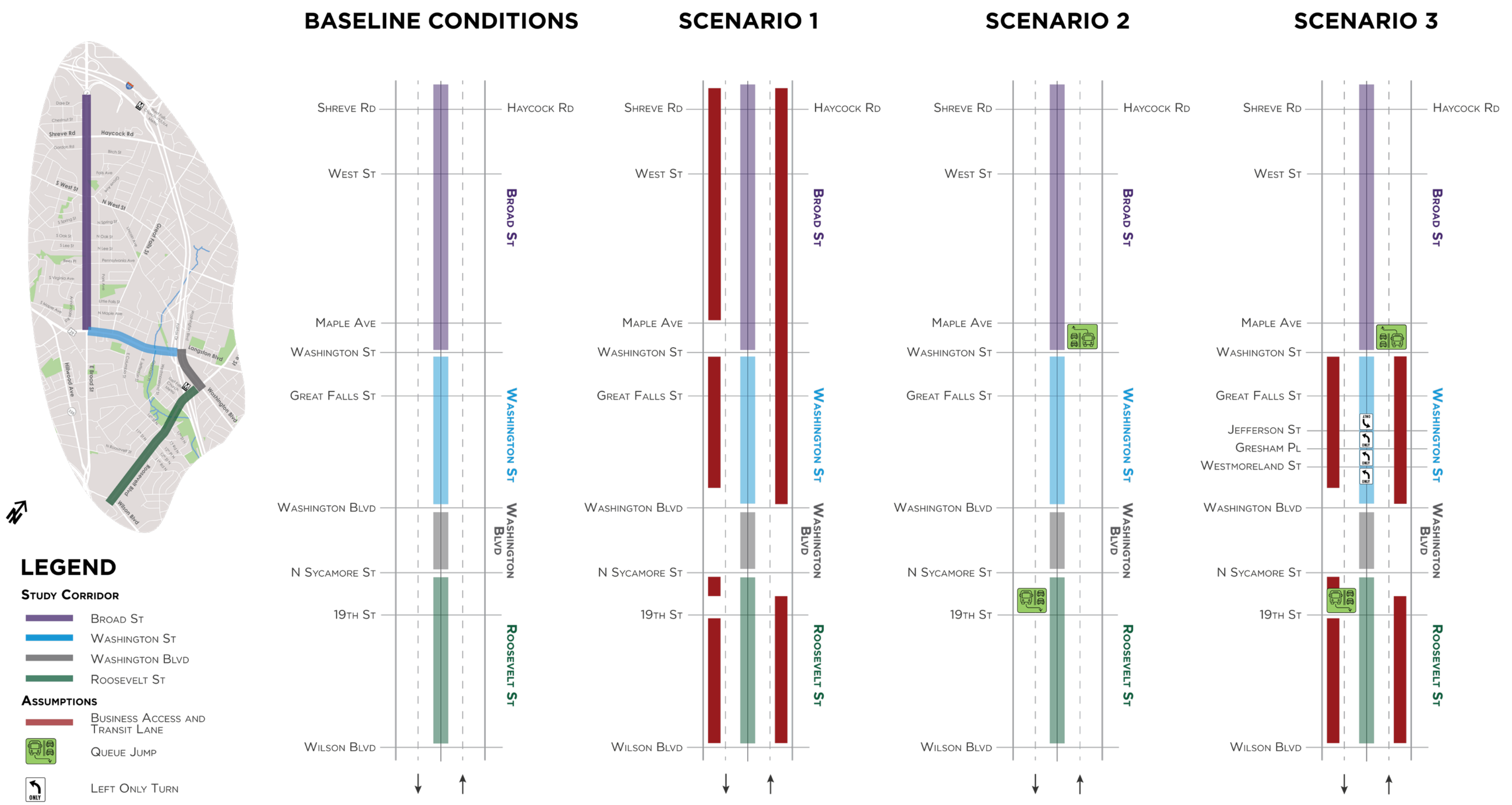
Table 5-1: Summary of Bus Priority Treatments for each Build Scenario

BUS PRIORITY TREATMENT/ ELEMENT	BASELINE CONDITIONS	BUILD SCENARIO 1	BUILD SCENARIO 2	BUILD SCENARIO 3
BAT Lanes	No BAT lanes	BAT lanes for almost the entire corridor	No BAT lanes	Partial BAT lanes (Washington St & Sycamore St/ Roosevelt St)
Boarding/ Alighting	Level boarding	Level boarding	Level boarding	Level boarding
Fare Payment	Off-board fare payment	Off-board fare payment	Off-board fare payment	Off-board fare payment
TSP	At four intersections*	Almost at all intersections	Almost at all intersections	Almost at all intersections
Queue Jump Lanes	None	None	Southbound at 19th St & I-66 on ramp Westbound at Maple Ave & Route 7	Southbound at 19th St & I-66 on ramp Westbound at Maple Ave & Route 7

*As of April 2023, four intersections had active TSP on the corridor. For the Baseline conditions, it is assumed that these locations would continue to have TSP.

2045 BUILD SCENARIO CONDITIONS

Figure 5-1: Summary of Bus Priority Treatments for each Build Scenario

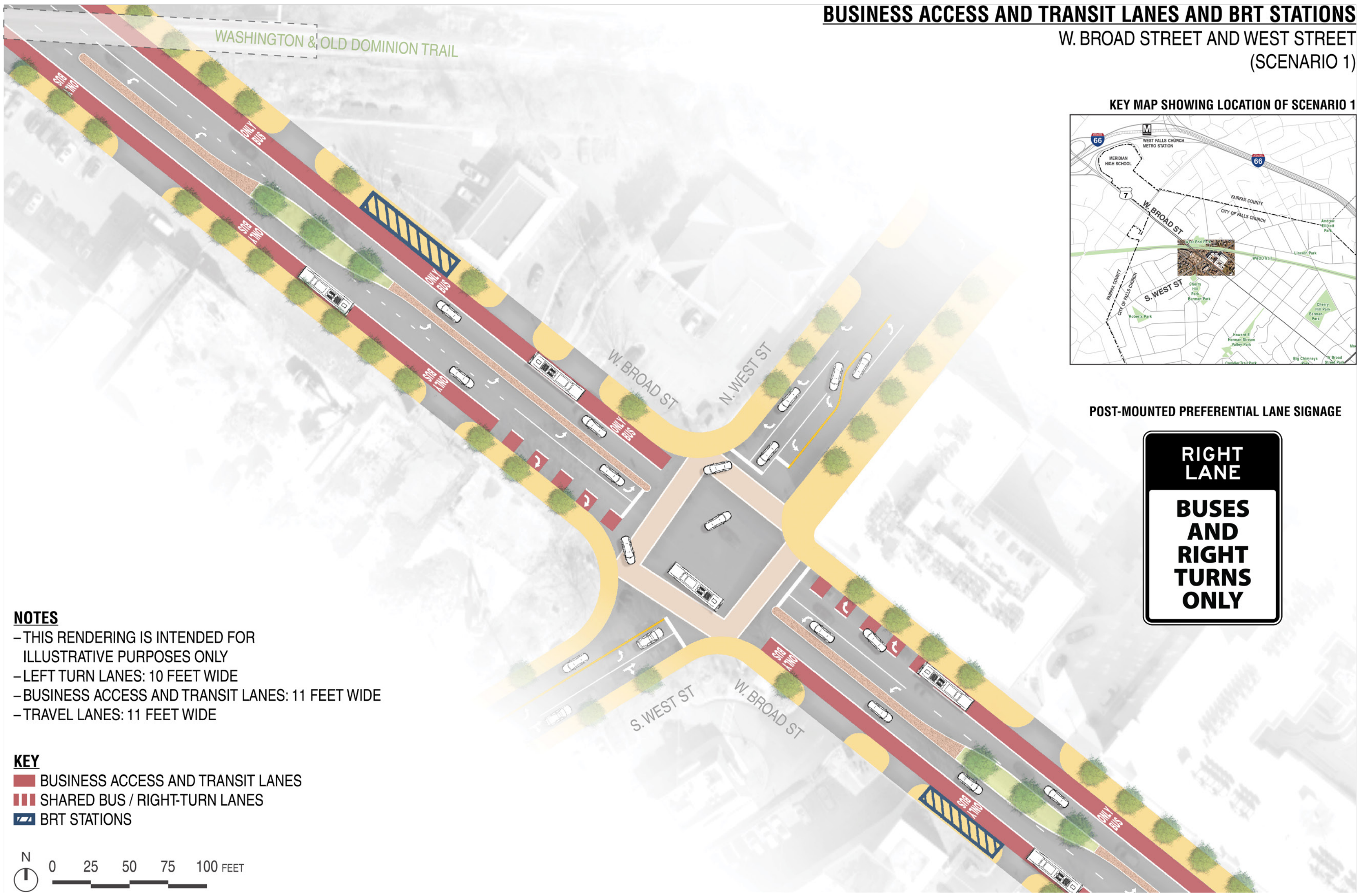


All proposed build scenarios include level passenger boarding platforms, off-board fare payment kiosks, and TSP at most of the signalized intersections. The distinction between the build scenarios is whether BAT lanes and/or queue jumps were included. Build Scenario 1 includes BAT lanes along most of the corridor. This would require repurposing an existing general travel lane to a BAT lane in each direction to only allow bus travel and vehicular right turns at intersections. **Figure 5-2** provides a representation of BAT lanes on Route 7 at West Street.

Build Scenario 2 does not include BAT lanes to understand the effect of a minimal investment scenario. Instead, Build Scenario 2 proposes queue jumps at two select locations (i.e., southbound at 19th Street/I-66 on-ramp, westbound at Maple Avenue) along the corridor where buses would benefit from skipping long queues. The selection of the queue jumps was based on the availability of right turn lanes (or intersections where through lanes can be converted to right turn lanes) to maintain existing right-of-way, as well as analysis of intersection conditions where queue jumps can be beneficial. **Figure 5-3** provides an example of the queue jumps proposed for Build Scenario 2 at the intersection of N. Sycamore Street and 19th Street/I-66 on-ramp intersection.

2045 BUILD SCENARIO CONDITIONS

Figure 5-2: BAT Lanes Proposed for Build Scenario 1



Build Scenario 3 is a hybrid of Build Scenario 1 and Build Scenario 2. As discussed previously, Build Scenario 1 repurposes one of the two existing general travel lanes along most of the study corridor as a BAT lane and subsequently reduces vehicular capacity. While Build Scenario 1 would result in some mode shift from driving to transit or from driving to another mode (e.g., biking, walking), the reduction in roadway capacity would also result in the diversion of motorists from Route 7 into the surrounding neighborhood. Build Scenario 2 would not introduce BAT lanes, thus maintaining the existing roadway capacity and minimizing potential motorist diversion. Instead, Build Scenario 2 proposes prioritizing transit by strategically introducing queue jumps and providing TSP to reduce delay at signalized intersections. The "infrastructure-lite" approach of Build Scenario 2 seeks to minimize the impact on vehicular operations, but it also limits the travel time and reliability benefits that BAT lanes could provide. To accommodate the need for improved transit speeds and reliability without major impacts on vehicular capacity and motorist diversion, Build Scenario 3 is proposed as a hybrid option. Instead of BAT lanes on most of the study corridor, Build Scenario 3 proposes partial BAT lanes on Washington Street and Sycamore Street/Roosevelt Street, as well as queue jumps southbound at the intersections of N. Sycamore Street and 19th Street/I-66 on-ramp and westbound at the intersection of Route 7 and Maple Avenue.

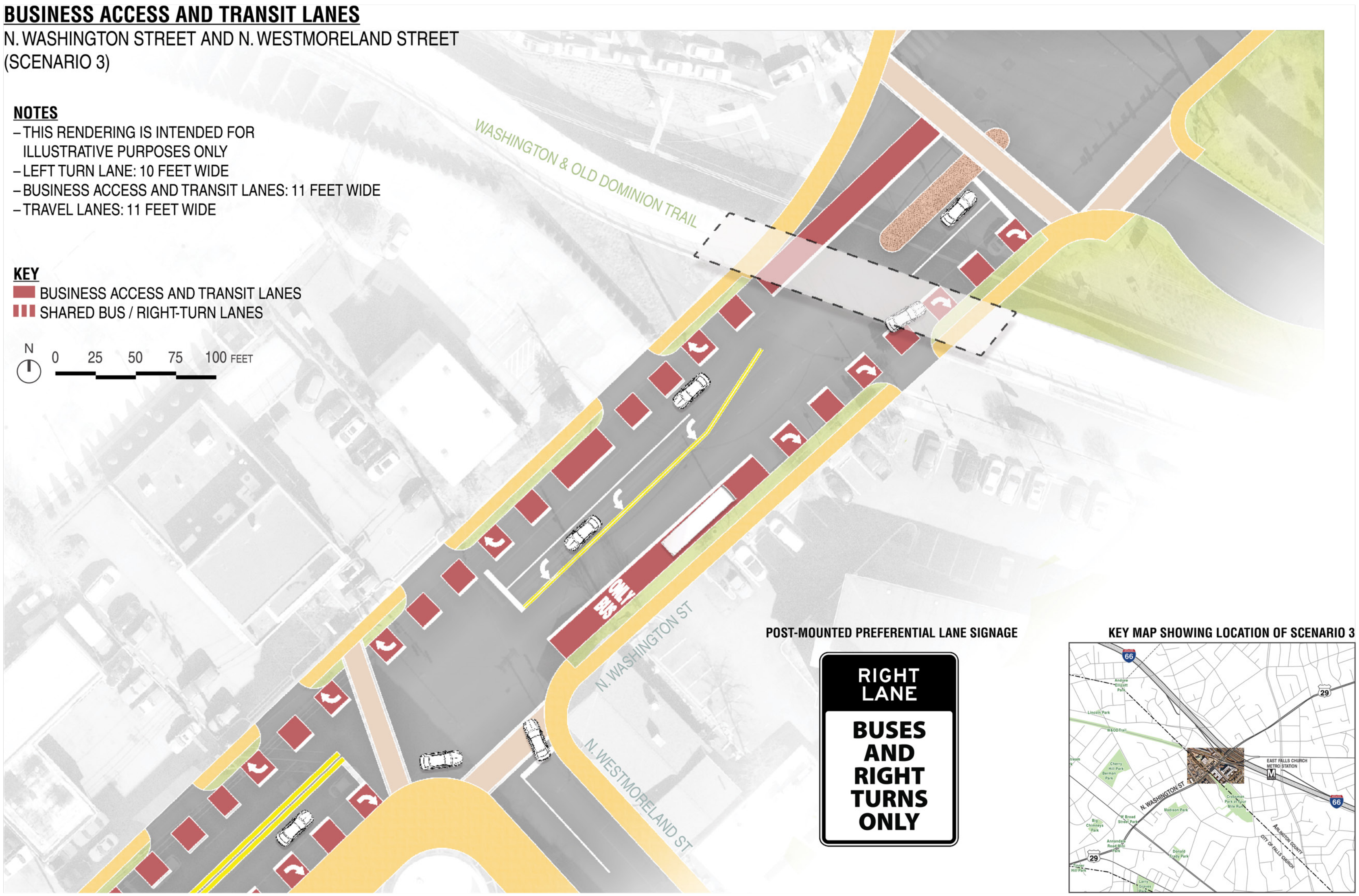
Additionally, Build Scenario 3 proposes limiting the impacts to vehicular capacity and delay on Washington Street by introducing short left turn pockets at the following locations:

- Eastbound and westbound left turn pockets at Washington Street and Jefferson Street,
- Eastbound left turn pocket at Gresham Place, and
- Eastbound left turn pocket at Westmoreland Street.

Given the constraints on existing roadway along Washington Street, the feasibility of the left turn lane pockets should be assessed further. **Figure 5-4** provides an example of BAT lanes and proposed left turn pockets for Build Scenario 3.

Figure 5-3: Queue Jumps Proposed for Build Scenario 2

Figure 5-4: BAT Lanes and Left Turn Pocket Proposed for Build Scenario 3



2045 BUILD SCENARIO CONDITIONS

5.2 2045 BUILD SCENARIOS ANALYSIS RESULTS

5.2.1 2045 BUILD SCENARIOS BRT OPERATIONS

This section presents results from the VISSIM analysis with a focus on BRT operations. All three build scenarios are discussed here and the results from the Baseline conditions are also included to provide a comparison of BRT operations.

5.2.1.1 2045 BUILD SCENARIOS CORRIDOR BRT SPEEDS

Build Scenario 3, which includes BAT lanes on certain portions of the corridor, provides results between Build Scenario 1 and Build Scenario 2. Speed improvements in this scenario range between approximately 3% and 10% depending on the peak hour and travel direction.

Table 5-2 and **Table 5-3** show BRT station-to-station and corridor speeds (including dwell times) during the morning and evening peak hours, respectively for the build scenarios along with the results from the Baseline conditions. Note that dwell times are slightly higher in the build scenarios compared to the Baseline conditions due to the increased ridership (with Build Scenario 1 having the highest ridership compared to the other build scenarios).

Results show that Build Scenario 1 offers the highest speed improvement to the proposed BRT service. In the peak direction (westbound during the morning peak and eastbound during the evening peak), BRT speed is increased by 12.5% and 16.6% in the morning and evening peak hours, respectively. This is mostly attributed to the proposed BAT lanes on the corridor and TSP at the study intersections. Note that these speed improvements are achieved in Build Scenario 1 even with increased dwell times compared to the Baseline conditions.

Build Scenario 2 results in marginal changes in BRT speeds as this scenario does not include BAT lanes and, subsequently, BRT vehicles travel in mixed traffic. The only exception in Build Scenario 2 is in the westbound direction during the morning peak hour where BRT speeds are increased by approximately 8%. This is mostly due to the signal timing improvements between E. Falls Church Station and Jefferson Street, which alleviated traffic congestion, and increased both vehicle speeds and BRT speeds.

Build Scenario 3, which includes BAT lanes on certain portions of the corridor, provides results between Build Scenario 1 and Build Scenario 2. Speed improvements in this scenario range between approximately 3% and 10% depending on the peak hour and travel direction.

Table 5-2: 2045 BRT Station-to-Station and Corridor Speeds for the Build Scenarios during the Morning Peak Hour

DIRECTION	SEGMENT	2045 BASELINE CONDITIONS: BRT SPEED (MPH)	BUILD SCENARIO 1: BRT SPEED (MPH)	BUILD SCENARIO 2 BRT SPEED (MPH)	BUILD SCENARIO 3 BRT SPEED (MPH)
EASTBOUND DIRECTION (TOWARD SEVEN CORNERS)	Dale Dr to Chestnut St	12.8	13.4	12.4	13.5
	Chestnut St to West St.	14.0	16.7	14.3	14.5
	West St to Penn Ave	13.9	12.8	13.2	12.6
	Penn Ave to Maple Ave	10.6	11.3	10.5	11.3
	Maple Ave to Jefferson St	9.9	10.7	10.2	11.9
	Jefferson St to E Falls Church Station	9.6	10.3	9.7	9.7
	E Falls Church Station to N Seven Corners	18.1	18.7	18.1	18.9
	AVERAGE CORRIDOR SPEED	**12.2**	**12.9 (6.2%)***	**12.2 (0.0%)***	**12.7 (4.5%)***
WESTBOUND DIRECTION (TOWARD TYSONS)	Wilson Blvd to N Seven Corners	11.4	14.8	12.3	14.7
	N Seven Corners to E Falls Church Station	7.8	7.7	8.1	8.4
	E Falls Church Station to Jefferson St	8.6	10.5	10.8	9.8
	Jefferson St to Maple Ave	10.3	10.0	10.6	10.6
	Maple Ave to Penn Ave	10.2	9.0	9.9	8.9
	Penn Ave to West St	10.9	14.2	11.8	12.4
	West St to Chestnut St	10.6	14.8	10.8	12.2
	AVERAGE CORRIDOR SPEED	**9.6**	**10.8 (12.5%)***	**10.4 (7.9%)***	**10.6 (9.6%)***

*Indicates percent change in vehicle speed compared to the existing conditions

2045 BUILD SCENARIO CONDITIONS

Table 5-3: 2045 BRT Station-to-Station and Corridor Speeds for the Build Scenarios during the Evening Peak Hour

DIRECTION	SEGMENT	2045 BASELINE CONDITIONS: BRT SPEED (MPH)	BUILD SCENARIO 1: BRT SPEED (MPH)	BUILD SCENARIO 2 BRT SPEED (MPH)	BUILD SCENARIO 3 BRT SPEED (MPH)
EASTBOUND DIRECTION (TOWARD SEVEN CORNERS)	Dale Dr to Chestnut St	9.9	11.6	10.6	10.3
	Chestnut St to West St	13.5	15.0	13.6	13.4
	West St to Penn Ave	13.5	14.3	13.1	13.5
	Penn Ave to Maple Ave	11.0	11.3	11.3	9.7
	Maple Ave to Jefferson St	10.7	10.7	11.0	9.7
	Jefferson St to E Falls Church Station	5.9	8.2	6.2	7.3
	E Falls Church Station to N Seven Corners	13.9	16.1	13.5	16.2
	AVERAGE CORRIDOR SPEED	**10.1**	**11.8 (16.6%)***	**10.4 (2.2%)***	**10.8 (6.3%)***
WESTBOUND DIRECTION (TOWARD TYSONS)	Wilson Blvd to N Seven Corners	10.7	12.7	10.7	16.3
	N Seven Corners to E Falls Church Station	11.6	11.9	11.9	11.3
	E Falls Church Station to Jefferson St	12.4	11.9	12.7	10.0
	Jefferson St to Maple Ave	11.1	12.6	10.8	14.2
	Maple Ave to Penn Ave	13.3	11.4	12.4	10.8
	Penn Ave to West St	14.7	17.4	15.1	14.1
	West St to Chestnut St	10.8	14.1	10.8	13.4
	AVERAGE CORRIDOR SPEED	**11.9**	**12.8 (7.6%)***	**11.9 (-0.2%)***	**12.3 (2.9%)***

*Indicates percent change in vehicle speed compared to the existing conditions

5.2.1.2 BRT TRAVEL TIME RELIABILITY FOR THE BUILD SCENARIOS

Table 5-4 shows the average and 90th percentile BRT corridor travel times for the morning peak hour for the build scenarios. **Table 5-5** displays the results for the evening peak hour. Analysis findings from the Baseline conditions are also provided for comparison.

Results show that the 90th percentile travel times are shorter in Build Scenario 1 compared to the other build scenarios, indicating improved BRT travel time reliability. This is mostly attributed to the proposed BAT lanes in the corridor in Scenario 1. Additionally, when compared to the Baseline conditions, the travel time difference between the average and 90th percentile is generally smaller in the build scenarios, especially in the travel direction with longer BRT travel times. This is again due to the proposed bus priority treatments, which typically help with travel time reliability.

2045 BUILD SCENARIO CONDITIONS

Table 5-4: Average and 90th Percentile BRT Corridor Travel Times for the Build Scenarios during the Morning Peak Hour

BRT TRAVEL TIME (MINUTES)	BASELINE CONDITIONS	BUILD SCENARIO 1	BUILD SCENARIO 2	BUILD SCENARIO 3
Average Travel Time in the Eastbound Direction (minutes)	16.3	15.5	16.5	15.8
90th Percentile Travel Time in the Eastbound Direction (minutes)	17.8	17.3	18.0	17.3
Average Travel Time in the Westbound Direction (minutes)	22.9	19.8	21.0	20.7
90th Percentile Travel Time in the Westbound Direction (minutes)	26.0	21.9	22.9	22.3

Table 5-5: Average and 90th Percentile BRT Corridor Travel Times for the Build Scenarios during the Evening Peak Hour

BRT TRAVEL TIME (MINUTES)	BASELINE CONDITIONS	BUILD SCENARIO 1	BUILD SCENARIO 2	BUILD SCENARIO 3
Average Travel Time in the Eastbound Direction (minutes)	18.9	16.7	19.1	18.4
90th Percentile Travel Time in the Eastbound Direction (minutes)	22.4	19.2	21.9	20.3
Average Travel Time in the Westbound Direction (minutes)	18.2	17.0	18.1	17.8
90th Percentile Travel Time in the Westbound Direction (minutes)	20.1	19.3	19.9	19.7

5.2.2 VEHICULAR OPERATIONS FOR THE 2045 BUILD SCENARIOS

5.2.2.1 INTERSECTION LOS AND VEHICLE DELAY FOR THE BUILD SCENARIOS

Table 5-6 and **Table 5-7** show intersection LOS and vehicle delay during the morning and evening peak hours, respectively, for the build scenarios. **Figure 5-5** through **Figure 5-10** display intersection LOS and vehicle delay at the study intersections for all the build scenarios during the morning and evening peak hours.

Results show that compared to the Baseline conditions, Build Scenario 1 increases vehicle delays at a few intersections. This is largely due to reducing vehicle capacity by repurposing a general travel lane to a BAT lane. By reducing vehicle capacity, vehicle trips are diverted to other regional or local roadways to avoid the segment with reduced vehicle capacity, thus reducing the total vehicle travel demand on the facility. Vehicular diversion for the build scenarios with proposed BAT lanes is discussed later in Section 5.2.3. The increase in delay is most pronounced at key intersections that are the primary bottlenecks such as the intersection of Route 7 and West Street in the morning peak and Washington Boulevard and Sycamore Street in the evening peak hour.

For the remainder of the intersections, while intersection delay tends to increase in Build Scenario 1, most of these intersections continue to operate with LOS D or better. Build Scenario 2 typically has marginal impacts on vehicle delay as vehicle capacity remained the same compared to the Baseline conditions. Lastly, Build Scenario 3 leads to comparable results to Build Scenario 2 (and Baseline conditions) along Route 7 as no BAT lanes are proposed along this section (therefore has the same vehicle capacity). Additionally, Build Scenario 3 has similar results to Build Scenario 1 along Roosevelt Boulevard as this section includes BAT lanes. The only exception is the intersection of Washington Boulevard and Lee Highway during the morning peak hour, which operates with LOS F. The reason for higher vehicle delays at this intersection for Build Scenario 3 when compared to Build Scenario 1 is because vehicle volumes are generally higher along this segment compared to Build Scenario 1 (full BAT lanes results in lower roadway capacity), while the vehicle capacity and the number of lanes is the same as Build Scenario 1 at this intersection. As a result, higher vehicle delays are observed at this intersection.

2045 BUILD SCENARIO CONDITIONS

Table 5-6: Build Scenarios Intersection LOS and Vehicle Delay (secs) during the Morning Peak Hour

INTERSECTION	TRAFFIC CONTROL	2045 BASELINE		BUILD SCENARIO 1		BUILD SCENARIO 2		BUILD SCENARIO 3	
		LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY
Dale Rd & Route 7	Unsignalized	C	24.6	A	5.3	C	16.1	A	8
Chestnut Rd & Route 7	Unsignalized	B	12.8	A	7.9	B	10.1	A	9
Haycock Rd & Route 7	Signalized	D	40.0	D	40.9	D	38.1	D	37
Gordon Rd & Route 7	Unsignalized	C	15.9	A	8.4	C	15.7	B	12.5
Birch St & Route 7	Signalized	B	17.9	B	17.6	B	16.2	B	13.7
Falls Ave & Route 7	Unsignalized	B	12.8	A	6.4	B	11.2	A	0.0
West St & Route 7	Signalized	D	48.1	**F**	**80.6**	D	48.3	D	44.6
Spring St & Route 7	Signalized	A	9.4	C	25.6	A	9.7	A	9.1
Oak St & Route 7	Unsignalized	C	17.5	B	10.9	C	17.1	C	15.8
Lee St & Route 7	Signalized	B	13.2	B	15.5	B	13.8	B	13.9
Rees Pl/Pennsylvania Ave & Route 7	Signalized	B	10.1	B	15.7	B	10.7	A	8.9
Virginia Ave & Route 7	Signalized	A	8.3	B	19.4	A	7.8	A	8.6
Annadale Rd & Route 7	Signalized	B	17.3	C	25.1	B	16.6	B	16.9
Little Falls St & Route 7	Signalized	A	8.2	A	9.4	A	8.1	A	8.5
Maple Ave & Route 7	Signalized	C	20.0	C	25.6	C	25.5	C	20.6
Washington St & Route 7	Signalized	D	36.4	D	42.8	D	40.3	C	32.3
Washington Street & Park Avenue	Signalized	B	15.1	B	18.7	B	14.7	C	22.8
Washington St & Great Falls St	Unsignalized	C	17.9	A	8.0	C	16.8	B	13.6
Washington St & Columbia St	Signalized	C	20.7	C	25.0	C	20.6	C	31.5
Washington Street & Jefferson Street	Unsignalized	B	14.6	A	10.0	B	15.0	B	12.5
Washington St & Gresham Pl	Unsignalized	C	16.1	A	5.6	B	13.3	A	7.5

Table 5-6 (Continued): Build Scenarios Intersection LOS and Vehicle Delay (secs) during the Morning Peak Hour

INTERSECTION	TRAFFIC CONTROL	2045 BASELINE		BUILD SCENARIO 1		BUILD SCENARIO 2		BUILD SCENARIO 3	
		LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY
Washington St & Westmoreland St	Signalized	B	15.5	B	15.3	B	15.1	B	10.4
Washington St & Fairfax Dr/VA 237 and Washington Blvd & Lee Highway	Signalized	C	28.8	**E**	**56.7**	C	31.7	C	24.2
VA 237 and Washington Blvd & Lee Highway	Signalized	**E**	**69.2**	D	42.1	**E**	**58.2**	**F**	**91.7**
EFC Metro Parking & Washington Blvd (VA 237)	Unsignalized	C	16.7	B	11.6	C	18.0	A	0.0
Washington Blvd (VA 237) & Sycamore St	Signalized	D	37.5	C	32.1	C	32.3	D	54.4
Sycamore St & I-66 WB off-ramps and Bus Bay Entrance EFC Metro	Signalized	C	23.9	B	10.3	C	24.6	B	10.5
Sycamore St & 19th St North and I-66 on-ramps	Signalized	D	35.8	C	26.1	C	33.9	C	29.4
Sycamore/Roosevelt St & 17th St North	Unsignalized	B	14.8	A	6.2	C	16.2	C	18.9
Roosevelt St & 16th St North	Unsignalized	A	8.7	A	9.9	A	8.6	B	11.3
Roosevelt St & 15th Rd North	Unsignalized	C	20.6	A	7.6	C	18.3	A	9.4
Roosevelt St & 12th Pl North	Unsignalized	A	8.8	A	6.3	A	8.9	B	10.0
Roosevelt St & 12th St North	Unsignalized	B	10.1	A	5.7	A	10.0	A	7.6
Roosevelt St & 11th St	Unsignalized	C	16.5	B	13.5	C	16.3	A	0.0
Roosevelt St & 11th Rd North	Unsignalized	B	14.2	B	10.6	B	14.3	B	12.9
Roosevelt St & Roosevelt Blvd	Signalized	A	8.0	A	8.9	A	8.1	A	9.0
Roosevelt Blvd & Oakwood Apartments (1)	Unsignalized	A	4.0	A	4.9	A	4.0	A	5.1
Roosevelt Blvd & Roosevelt Towers (1)	Unsignalized	B	11.2	B	11.7	B	12.0	B	11.2
Roosevelt Blvd & Wilson Blvd	Signalized	D	37.3	B	19.2	C	32.6	C	20.5

2045 BUILD SCENARIO CONDITIONS

Table 5-7: Build Scenarios Intersection LOS and Vehicle Delay (secs) during the Evening Peak Hour

INTERSECTION	TRAFFIC CONTROL	2045 BASELINE		BUILD SCENARIO 1		BUILD SCENARIO 2		BUILD SCENARIO 3	
		LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY
Dale Rd & Route 7	Unsignalized	A	7.7	A	8.0	A	6.9	A	6.1
Chestnut Rd & Route 7	Unsignalized	B	13.2	C	29.2	B	11.9	B	11.0
Haycock Rd & Route 7	Signalized	**E**	**59.0**	**E**	**55.4**	D	43.0	D	38.0
Gordon Rd & Route 7	Unsignalized	A	7.2	B	12.6	A	6.2	A	5.4
Birch St & Route 7	Signalized	B	10.7	C	27.5	B	10.6	B	11.0
Falls Ave & Route 7	Unsignalized	A	2.9	C	21.2	A	3.2	A	2.7
West St & Route 7	Signalized	C	32.4	D	44.0	C	33.4	C	34.3
Spring St & Route 7	Signalized	A	5.1	B	10.7	A	4.8	A	3.9
Oak St & Route 7	Unsignalized	A	3.6	D	33.9	A	3.7	A	4.1
Lee St & Route 7	Signalized	B	10.6	C	20.7	B	10.4	B	10.7
Rees Pl/Pennsylvania Ave & Route 7	Signalized	A	9.7	C	22.0	A	9.3	A	8.6
Virginia Ave & Route 7	Signalized	A	9.6	C	29.5	A	9.4	A	9.9
Annadale Rd & Route 7	Signalized	B	13.9	D	46.5	B	13.2	B	15.6
Little Falls St & Route 7	Signalized	B	14.1	C	25.3	B	14.5	B	15.9
Maple Ave & Route 7	Signalized	C	22.9	C	25.2	C	25.1	C	25.0
Washington St & Route 7	Signalized	C	28.4	D	35.4	C	30.0	C	31.8
Washington St & Park Ave	Signalized	B	17.2	B	16.7	B	17.2	B	15.4
Washington St & Great Falls St	Unsignalized	A	6.9	B	11.4	A	6.6	B	10.7
Washington St & Columbia St	Signalized	C	22.6	C	29.0	C	22.5	C	25.7
Washington St & Jefferson St	Unsignalized	A	3.0	A	7.3	A	2.8	A	3.7
Washington St & Gresham Pl	Unsignalized	A	5.7	B	10.3	A	5.3	A	2.5

Table 5-7 (Continued): Build Scenarios Intersection LOS and Vehicle Delay (secs) during the Evening Peak Hour

INTERSECTION	TRAFFIC CONTROL	2045 BASELINE		BUILD SCENARIO 1		BUILD SCENARIO 2		BUILD SCENARIO 3	
		LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY
Washington St & Westmoreland St	Signalized	B	13.9	B	12.5	B	14.1	A	7.6
Washington St & Fairfax Dr/VA 237 and Washington Blvd & Lee Highway	Signalized	C	28.7	D	42.1	D	35.9	C	32.5
VA 237 and Washington Blvd & Lee Highway	Signalized	**E**	**55.3**	**E**	**58.1**	**E**	**57.4**	**E**	**66.6**
EFC Metro Parking & Washington Blvd (VA 237)	Unsignalized	**E**	**36.8**	A	6.2	D	29.7	A	1.7
Washington Blvd (VA 237) & Sycamore St	Signalized	D	47.5	**F**	**99.9**	D	47.2	**E**	**69.6**
Sycamore St & I-66 WB off-ramps and Bus Bay Entrance EFC Metro	Signalized	B	15.6	B	18.5	B	15.4	B	12.6
Sycamore St & 19th St North and I-66 on-ramps	Signalized	D	36.3	D	36.6	D	35.7	C	29.0
Sycamore/Roosevelt St & 17th St North	Unsignalized	A	1.1	A	2.5	A	1.1	A	3.5
Roosevelt St & 16th St North	Unsignalized	A	1.9	A	3.0	A	1.8	A	2.8
Roosevelt St & 15th Rd North	Unsignalized	A	0.8	A	3.3	A	0.8	A	3.7
Roosevelt St & 12th Pl North	Unsignalized	A	2.0	A	4.9	A	2.0	A	6.0
Roosevelt St & 12th St North	Unsignalized	A	0.6	A	1.4	A	0.6	A	2.1
Roosevelt St & 11th St	Unsignalized	A	0.9	A	1.6	A	0.9	A	2.2
Roosevelt St & 11th Rd North	Unsignalized	A	2.0	A	4.0	A	1.9	A	3.3
Roosevelt St & Roosevelt Blvd	Signalized	B	14.5	B	14.9	B	14.2	B	13.0
Roosevelt Blvd & Oakwood Apartments (1)	Unsignalized	A	3.3	A	3.5	A	3.3	A	4.0
Roosevelt Blvd & Roosevelt Towers (1)	Unsignalized	A	2.4	A	4.6	A	2.3	A	4.0
Roosevelt Blvd & Wilson Blvd	Signalized	D	45.5	C	27.7	D	46.5	C	25.6

2045 BUILD SCENARIO CONDITIONS

Figure 5-5: Build Scenario 1 Intersection LOS and Vehicle Delay for the Morning Peak Hour

Figure 5-6: Build Scenario 1 Intersection LOS and Vehicle Delay for the Evening Peak Hour

2045 BUILD SCENARIO CONDITIONS

Figure 5-7: Build Scenario 2 Intersection LOS and Vehicle Delay for Morning Peak Hour

Figure 5-8: Build Scenario 2 Intersection LOS and Vehicle Delay for Evening Peak Hour

2045 BUILD SCENARIO CONDITIONS

Figure 5-9: Build Scenario 3 Intersection LOS and Vehicle Delay during the Morning Peak Hour

Figure 5-10: Build Scenario 3 Intersection LOS and Vehicle Delay during the Evening Peak Hour

2045 BUILD SCENARIO CONDITIONS

5.2.2.2 CORRIDOR VEHICLE SPEEDS FOR THE BUILD SCENARIOS

Table 5-8 and **Table 5-9** show vehicle speeds on the corridor for the build scenarios during the morning and evening peak hours, respectively. Results from the Baseline conditions are also provided as a comparison.

Results show that Build Scenario 1 decreases vehicle speeds considerably, especially in the peak travel direction, because of the reduction in roadway capacity (i.e., reduction in the number of travel lanes) on the corridor. Except for the westbound direction in the morning peak, the reduction in vehicle speeds in Build Scenario 1 is in the range of approximately 10% to 15%.

The results in the westbound direction during the morning peak hour can be misleading for all the build scenarios compared to the Baseline conditions. Congestion and low speeds observed in the Baseline conditions for the segment between E. Falls Church Station and Jefferson Street were mitigated in the build scenarios due to a reduction in vehicular capacity, and subsequently vehicle volumes. This change in vehicle volumes led to much higher speeds and the distortion of corridor vehicle speed results.

Table 5-8: 2045 Corridor Vehicle Speeds for the Build Scenarios during the Morning Peak Hour

DIRECTION	SEGMENT	2045 BASELINE CONDITIONS: VEHICLE SPEED (MPH)	BUILD SCENARIO 1 VEHICLE SPEED (MPH)	BUILD SCENARIO 2 VEHICLE SPEED (MPH)	BUILD SCENARIO 3 VEHICLE SPEED (MPH)
EASTBOUND DIRECTION (TOWARD SEVEN CORNERS)	Dale Dr to Chestnut St	21.4	20.4	21.2	21.3
	Chestnut St to West St	16.4	14.6	16.6	16.9
	West St to Penn Ave	17.2	13.8	17.0	17.7
	Penn Ave to Maple Ave	15.2	13.8	14.6	16.3
	Maple Ave to Jefferson St	13.3	11.4	12.7	13.8
	Jefferson St to E Falls Church Station	14.0	15.6	14.5	15.5
	E Falls Church Station to N Seven Corners	23.2	20.9	22.9	21.2
	AVERAGE CORRIDOR SPEED	**16.3**	**15.0 (-8.1%)***	**16.2 (-0.7%)***	**16.8 (3.4%)***
WESTBOUND DIRECTION (TOWARD TYSONS)	Wilson Blvd to N Seven Corners	15.1	19.1	16.3	19.8
	N Seven Corners to E Falls Church Station	16.2	15.3	16.7	15.3
	E Falls Church Station to Jefferson St	9.7	13.1	12.5	11.4
	Jefferson St to Maple Ave	12.5	10.0	10.9	10.9
	Maple Ave to Penn Ave	16.1	12.8	16.0	15.5
	Penn Ave to West St	12.5	8.9	12.6	13.1
	West St to Chestnut St	11.8	13.6	13.0	14.5
	AVERAGE CORRIDOR SPEED	**12.7**	**12.7 (-0.4%)***	**13.6 (7.2%)***	**13.7 (7.5%)***

*Indicates percent change in vehicle speed compared to the existing conditions

2045 BUILD SCENARIO CONDITIONS

Table 5-9: 2045 Corridor Vehicle Speeds for the Build Scenarios during the Evening Peak Hour

DIRECTION	SEGMENT	2045 BASELINE CONDITIONS: VEHICLE SPEED (MPH)	BUILD SCENARIO 1 VEHICLE SPEED (MPH)	BUILD SCENARIO 2 VEHICLE SPEED (MPH)	BUILD SCENARIO 3 VEHICLE SPEED (MPH)
EASTBOUND DIRECTION (TOWARD SEVEN CORNERS)	Dale Dr to Chestnut St	17.6	14.1	17.4	17.0
	Chestnut St to West St	15.7	11.7	15.4	15.6
	West St to Penn Ave	19.4	10.9	19.4	19.3
	Penn Ave to Maple Ave	14.2	9.3	13.9	14.2
	Maple Ave to Jefferson St	17.4	13.1	14.6	13.2
	Jefferson St to E Falls Church Station	8.9	11.1	9.3	12.9
	E Falls Church Station to N Seven Corners	19.5	18.2	20.0	18.3
	AVERAGE CORRIDOR SPEED	**14.6**	**12.3 (-15.7%)***	**14.4 (-1.3%)***	**15.2 (4.6%)***
WESTBOUND DIRECTION (TOWARD TYSONS)	Wilson Blvd to N Seven Corners	14.4	17.7	14.0	17.4
	N Seven Corners to E Falls Church Station	17.2	17.0	17.3	16.1
	E Falls Church Station to Jefferson St	13.1	10.7	14.2	10.4
	Jefferson St to Maple Ave	13.1	9.8	11.7	12.0
	Maple Ave to Penn Ave	17.2	13.0	17.9	16.5
	Penn Ave to West St	19.0	16.3	19.6	18.3
	West St to Chestnut St	12.8	12.8	12.8	14.8
	AVERAGE CORRIDOR SPEED	**14.8**	**13.1 (-11.1%)***	**14.8 (0.1%)***	**14.1 (-4.3%)***

*Indicates percent change in vehicle speed compared to the Baseline conditions

Build Scenario 2 performs similarly to the Baseline conditions (again, except for the westbound direction in the morning peak). This is expected because no changes were made to the number of travel lanes in Build Scenario 2. Scenario 3 has mixed results with speed changes in the range of 5% compared to the Baseline conditions. The reduction in vehicle speeds is mostly due to the reduction in roadway capacity on certain portions of the network, while the increase in vehicle speeds can be explained by the signal timing improvements and TSP, which typically provides more green time for the mainline to improve bus speeds that also favor corridor vehicle operations.

5.2.2.3 NETWORK PERFORMANCE MEASURES FOR THE BUILD SCENARIOS

Table 5-10 and **Table 5-11** display network performance measures for the build scenarios. Results from the Baseline conditions are also provided for comparison. Both for the morning and evening peak hours, Build Scenario 1 led to a reduction in the number of vehicles arrived in the network, approximately 3% in the morning peak compared to the Baseline and 5% in the evening peak. This is due to the reduction in roadway capacity associated with the repurposing of a travel lane from vehicle use to BAT lanes. Build Scenario 3 also reduced the number of vehicles arrived, but to a lesser extent since BAT lanes were provided only for a certain portion of the corridor. The number of vehicles arrived in Build Scenario 2 is consistent with the Baseline conditions.

Another important finding is that, except for Scenario 1 in the evening peak hour, Build Scenarios 1 and Build Scenario 3 did not increase average vehicle delay in the network. While this may be counterintuitive as the number of lanes were reduced in both build scenarios, the results can be explained as follows:

- Both in Scenario 1 and Scenario 3, roadway capacity and subsequently vehicle demand was reduced considerably because of the lane repurposing for BAT lanes for certain portions of the corridor. This alleviated congestion at intersections where the number of lanes remained the same (e.g., Langston Boulevard and Washington Boulevard).
- TSP is provided in both scenarios, increasing the amount of green duration for the mainline, which also helps reduce vehicle delay on the corridor.
- In both Build Scenario 1 and Build Scenario 3, a few critical intersections serve as bottlenecks for the network, controlling the number of vehicles that can enter the network. The resulting metering of vehicles at these locations contributes to limited delay at non-critical intersections, even though the number of lanes was reduced.

Finally, Build Scenario 2 performs similarly to the Baseline conditions. This is expected because the only difference between the Baseline conditions and Build Scenario 2 is the number of intersections with TSP and the two intersections with queue jumps.

2045 BUILD SCENARIO CONDITIONS

Table 5-10: 2045 Baseline Network Performance Measures during the Morning Peak Hour

PERFORMANCE MEASURE	BASELINE CONDITIONS	BUILD SCENARIO 1	BUILD SCENARIO 2	BUILD SCENARIO 3
Average vehicle delay (seconds)	128.2	103.4	123.7	108.7
Number of vehicles arrived (vehicles)	19,363	18,848	19,376	19,002
Unmet (latent) demand (vehicles)	122	70	120	96
Delay for unmet (latent) vehicles (vehicle.hours)	56.7	34.9	58.0	46.4

Table 5-11: 2045 Baseline Network Performance Measures during the Evening Peak Hour

PERFORMANCE MEASURE	BASELINE CONDITIONS	BUILD SCENARIO 1	BUILD SCENARIO 2	BUILD SCENARIO 3
Average vehicle delay (seconds)	101.9	109.3	101.9	94.9
Number of vehicles arrived (vehicles)	21,922	20,620	21,938	21,172
Unmet (latent) demand (vehicles)	21	21	25	30
Delay for unmet (latent) vehicles (vehicle.hours)	14.7	17.4	20.6	35.3

5.2.3 VEHICLE DIVERSION

The proposed build scenarios attempt to balance the capacity needs of transit and motor vehicles. The build scenarios take various approaches to shift capacity between travel modes while making minimal changes to the physical infrastructure. To maintain the existing right-of-way along the corridor, an existing travel lane in each direction is proposed to be repurposed from mixed traffic (i.e., vehicles and buses can always use the travel lane) to BAT lanes where buses are the only vehicles allowed to use the lane except when motorists are turning right at an intersection or to access a driveway.

The conversion of the mixed traffic lane to a BAT lane reduces the available capacity for vehicles. The trade off for a reduction in roadway capacity to accommodate a BAT lane is the diversion of vehicles from the study corridor. Given the travel lane reduction, motorists will identify alternate routes to arrive at their destinations and may "cut through" residential streets to avoid congestion and delay. The potential diversion of vehicle traffic through the study area is depicted in **Figure 5-11**. Given the recommendation for BAT lanes, only Build Scenario 1 and Build Scenario 3 demonstrate the potential for traffic diversion. Therefore, only results from these two scenarios are shown below.

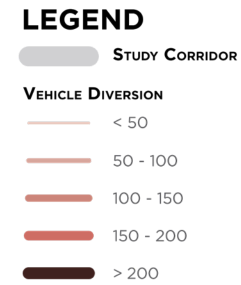
Traffic diversion for Build Scenario 1 primarily affects I-66 as well as connector streets through residential neighborhoods like Haycock Road, Grove Avenue, and West Street. Since Build Scenario 3 proposes partial BAT lanes on Washington Street and Sycamore St/Roosevelt St, most of the traffic diversion is to the south of West Street and the impact of vehicle diversions is much less pronounced compared to the Build Scenario 1.

2045 BUILD SCENARIO CONDITIONS

Figure 5-11: Vehicle Diversion for Build Scenario 1 and Build Scenario 3

Build Scenario 1

Build Scenario 3



Note: The vehicle diversion estimates presented in the figures above for Build Scenario 1 and Build Scenario 3 are representative of rush hour traffic volumes. Additionally, they reflect vehicles being diverted in both directions of traffic. Vehicle diversion for Build Scenario 2 is not shown given that the assumed transit improvements resulted in minor vehicle diversion.

5.2.4 2045 CONDITIONS PEDESTRIAN OPERATIONS

Table 5-12 shows pedestrian crossing times (for crossing the mainline) for the build scenarios at three select intersections in the study corridor during the morning and evening peak hours. Results from the Baseline conditions are also shown to provide comparison.

Similar to the previous findings, pedestrian crossing times are almost identical in the build scenarios compared to existing conditions. This is because the roadway cross-section remains the same in the Baseline conditions and no changes were made to intersection cycle lengths, which is the primary signal timing parameter that influences pedestrian delay.

Table 5-12: Pedestrian Crossing Times for the Build Scenario during the Morning and Evening Peak Hour

INTERSECTION	2045 BASELINE CONDITIONS (MINUTES)	BUILD SCENARIO 1 (MINUTES)	BUILD SCENARIO 2 (MINUTES)	BUILD SCENARIO 3 (MINUTES)
MORNING PEAK HOUR				
Route 7 and Washington St	1.54	1.55	1.54	1.54
Route 7 and West St	1.55	1.50	1.56	1.55
Route 7 and Haycock Rd	2.50	2.51	2.49	2.48
EVENING PEAK HOUR				
Route 7 and Washington St	1.57	1.54	1.54	1.54
Route 7 and West St	1.50	1.51	1.50	1.57
Route 7 and Haycock Rd	2.47	2.42	2.47	2.46

6

PUBLIC OUTREACH

PUBLIC OUTREACH

This section discusses the public outreach process followed by the project team and presents key public outreach findings. As part of the public outreach process, the project team's primary goals were to inform and collect feedback from the community regarding the draft BRT design concepts through Falls Church to Seven Corners, with a particular focus on the section in the City of Falls Church.

The public engagement goals were:

- Related to information sharing:
  - Enhance community awareness about the previous phases of the project along with the project goals of Phase 4-1 and awareness about BRT,
  - Increase awareness for the spring 2023 opportunities to encourage feedback from the public, and
  - Provide preliminary information about build scenarios and details as to how public feedback will be incorporated in the next phase of the project.
- Related to information gathering:
  - Written and electronic comment opportunity at the public meetings,
  - Input regarding potential BRT enhancements along the study corridor via electronic survey, and
  - Opportunity for the public to engage with NVTC staff and the project team during the public meetings for Q&A with an opportunity to provide feedback.

6.1 OVERVIEW OF PUBLIC OUTREACH PROCESS

The public outreach process employed a community-based approach, which targeted both current bus riders and potential users of the proposed BRT system along Route 7. The objective was to gather valuable feedback from users of the corridor by actively going to where they were during their day-to-day activities. Three event formats were utilized to achieve the goals for the public outreach, including: bus stop chats, pop-ups, and two public meetings.

The combination of digital and in-person bus stop chats, pop-up events, and the public meetings demonstrated a robust and diverse approach to reaching this phase's outreach goals. A bilingual digital communications toolkit spread the word via digital

assets of NVTC and its stakeholders. The feedback gathered through these events informed the development of the build scenarios to better serve the community's transportation needs along this vital thoroughfare.

The next sections discuss the events and activities conducted throughout the outreach process.

6.1.1 BUS STOP CHATS

The locations for the bus stop chats were selected based on transit ridership data from the study corridor. Using the ridership information, the project team identified the busiest bus stops along the corridor and strategically selected locations to maximize engagement with transit users during their daily commute. These targeted locations maximized opportunities to promote the project and upcoming open house, initiate conversations, collect survey responses, and address concerns and/or questions. Bilingual street teams distributed the survey to bus riders waiting for the bus to arrive or upon their return and distributed printed promotional collateral.

During bus stop chats, through designated areas near the bus stops, the bilingual street team initiated conversations in an informal approach to gather feedback. Additionally, the project team promoted the upcoming public meetings and addressed concerns and/or questions from bus riders. **Table 6-1** provides a summary of the bus stop chat activities.

Table 6-1: Summary of Bus Stop Chat Activities

EVENT	EVENT DATE AND TIME	SPANISH / ENGLISH RACK CARDS DISTRIBUTED	TOTAL INTERACTIONS IN ENGLISH	TOTAL NON-ENGLISH INTERACTIONS	TOTAL INTERACTIONS
West Broad St & South Maple Ave	Wednesday, May 3, 2023: 3 PM – 7 PM	53	49	8	57
East Falls Church Metro Station	Wednesday, May 10, 2023: 3 PM – 7 PM	400	412	13	425

6.1.2 POP-UP EVENTS

Pop-up events were organized in targeted community locations to educate, inform, and collect feedback from the greatest quantity of potential riders and non-riders who may not be familiar with the existing bus service or the proposed BRT. These events were held at a farmers' market, Metrorail station, and a local international shopping center. Pop-up booths were staffed with bilingual street teams who spoke Spanish, Vietnamese, and Korean and staged in locations to attract attention and intercept people passing by to engage in conversations about the corridor's BRT concepts. By bringing the outreach efforts into the community's everyday spaces, the team interacted with a broader audience.

At the pop-up events, the outreach staff employed various strategies to raise project awareness and gather valuable feedback. In addition to engaging in conversations about public transportation, the staff distributed postcards to further raise awareness about BRT and the Envision Route 7 project. These postcards contained key information on the project along with information on the public meetings, which allowed community members to stay informed and aware of their opportunities to provide feedback. **Table 6-2** provides a summary of activities from these pop-up events.

Table 6-2: Summary of Activities from Pop-Up Events

EVENT	EVENT DATE AND TIME	SPANISH / ENGLISH RACK CARDS DISTRIBUTED	TOTAL RACK CARDS DISTRIBUTED	TOTAL INTERACTIONS IN ENGLISH	TOTAL NON-ENGLISH INTERACTIONS	TOTAL NUMBER OF INTERACTIONS
Good Fortune Supermarket (Eden Center)	Saturday, May 7, 2023, 11 AM – 3 PM	125	425	75	107	182
West Falls Church Metro Station	Thursday, May 11, 2023, 3 PM – 7 PM	300	950	370	12	382
Falls Church Farmers Market	Saturday, May 13, 2023, 8 AM – 12 PM	120	700	145	0	145

6.1.3 PUBLIC MEETINGS

Two public meetings were organized to provide an opportunity for community members to attend and provide feedback. During both public meetings, the attendees were given a presentation on the Envision Route 7 project from NVTC staff, its progress, and upcoming project plans. The focus of the meetings was to inform the public about the project and ensure that community members had the opportunity to contribute their perspectives and concerns to help shape the future of transit and BRT along this corridor.

The first public meeting was organized to introduce the Envision Route 7 project to the community, providing an opportunity for residents to gain insights into its progress and understand the concept of BRT. The meeting commenced with a detailed presentation that provided updates on the current phase of the project. The presentation discussed various elements of BRT, explaining their key features, benefits, and how it can improve travel conditions along the study corridor. In addition to the presentation, informative boards were utilized. The boards presented an overview of existing conditions and provided examples of how BRT would typically operate.

The second public meeting included a brief presentation and informative boards to facilitate engagement of the public. The presentation and boards provided attendees with an overview of the Envision Route 7 project, the build scenarios analyzed, key findings from the analysis of the build scenarios, and next steps for the project. Community members gained insights into the project's planning and implementation process, as well as its potential impact on the community. **Table 6-3** provides a summary of the public meetings and includes the number of attendees for each meeting.

Table 6-3: Summary of Activities from the Community Open House

LOCATION	EVENT DATE AND TIME	NUMBER OF ATTENDEES
MERIDIAN HIGH SCHOOL	Tuesday, October 11, 2022, 6:30 PM – 8:00 PM	19
MARY RILEY STYLES PUBLIC LIBRARY	Tuesday, May 16, 2023 6:30 PM – 8:00 PM	42

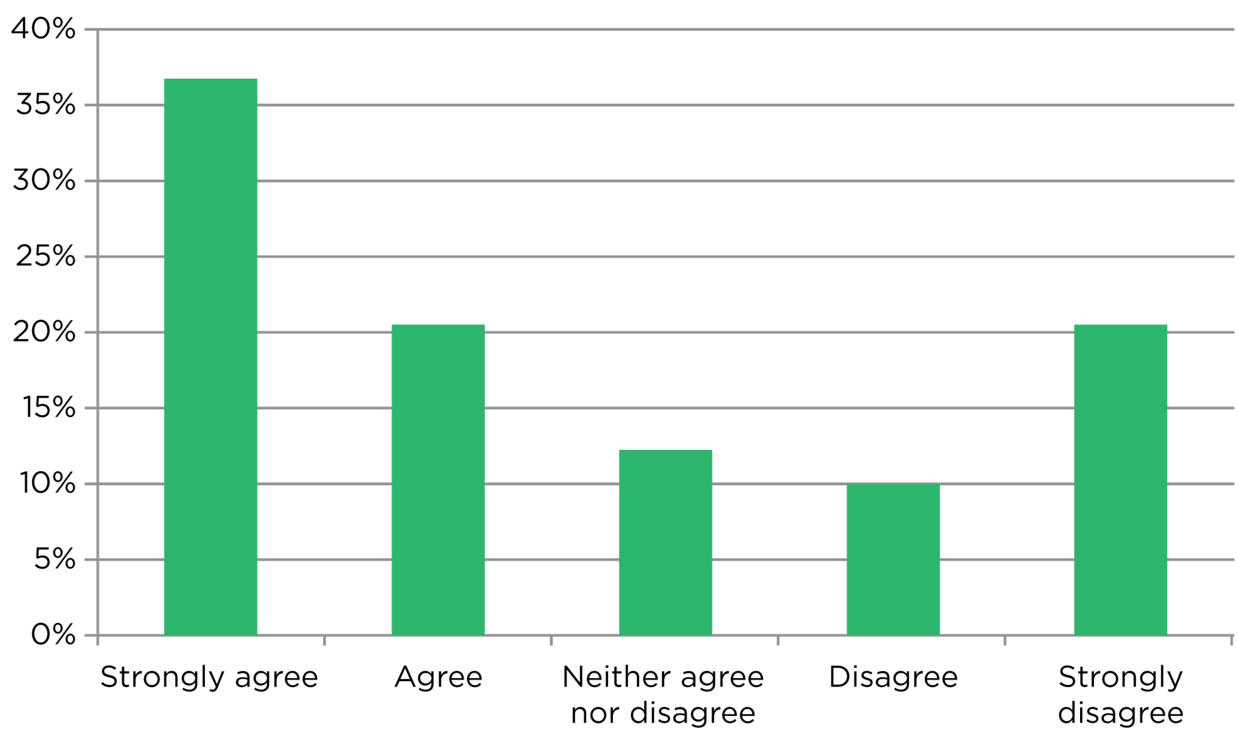
6.1.4 SURVEY

In addition to the project team's efforts to engage the community via public meetings, bus stop chats, and community chats, the project team also prepared a brief survey (see **Appendix D** for survey questions) that could be administered in person or electronically. The intent of the survey was to understand travel behavior through the study corridor and perception regarding the proposed build scenarios along Route 7.

In total, 192 participants responded to the survey. Of the respondents, the majority (42%) typically travel along the study corridor by a private vehicle. However, transit (i.e., Metrorail, bus) and non-motorized (i.e., walk, bicycle) modes of transportation also accounted for a substantial amount, 30% and 27% respectively. The survey did not specifically ask if participants used multiple modes for the same trip along the study corridor.

Question 2 inquired about the importance of improving bus speed and reliability along the study corridor. Based on the survey responses, irrespective of the mode used along the study corridor, 57% of all the respondents either strongly agreed or agreed that improving bus speed and reliability along the study corridor was a high priority. When only people who use transit are considered, 24% of the overall respondents either strongly agreed or agreed that improving bus speed and reliability

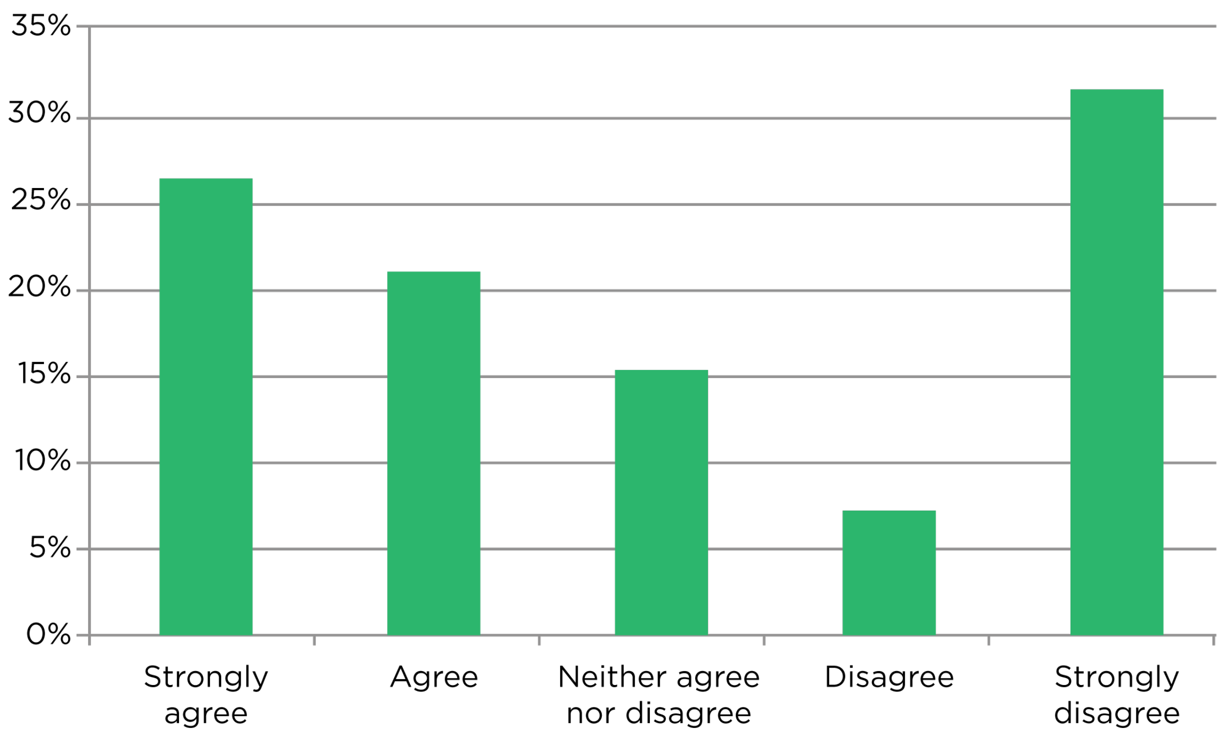
Figure 6-1: Are Improved Bus Speed and Reliability a High Priority?



was a high priority. In contrast only 31% of all respondents disagreed or strongly disagreed that improving bus speed and reliability should be a high priority (see **Figure 6-1** in the previous page). Of the respondents who disagreed or strongly disagreed, the majority traveled through the study corridor via vehicle.

Despite the strong emphasis on enhancing bus speed and reliability expressed in question 2, survey respondents showed a lack of consensus regarding the acceptability of additional vehicle delay in favor of improved bus service along the study corridor. A combined 47% of respondents either strongly agreed or agreed that additional vehicle delay would be justified for improved bus service. On the other hand, a substantial percentage also disagreed or strongly disagreed (38%) with the notion that additional vehicle delay should be incurred to improve bus service. The majority of these respondents used vehicles as their primary mode. A smaller percentage neither agreed nor disagreed (15%). Overall, the results indicate a divided opinion on whether additional vehicle delay is acceptable to enhance bus service in the corridor. Refer to **Figure 6-2** for the survey results.

Figure 6-2: Does Improved Bus Speed and Reliability Warrant Additional Vehicle Delay?



Questions 4, 5, and 6 asked respondents to consider the various build scenarios analyzed and indicate their thoughts regarding whether the proposed bus priority treatments in those scenarios had the potential to improve transit service while moving people efficiently and reliably through the study corridor. Build Scenario 1 received the most support – approximately 54% of respondents agreed or strongly agreed that the BAT lanes proposed for the alternative would improve transit service. People who travel through the corridor on transit or by walking/biking accounted for the majority of respondents that agreed that Scenario 1 could improve transit service. However, there was a substantial portion of respondents who disagreed (9%) and strongly disagreed (27%) with the potential benefits of the proposed BAT lanes. Refer to **Figure 6-3** for the survey results.

While responses to Build Scenario 1 included strong agreement or disagreement, Build Scenario 2 and Build Scenario 3 responses were more neutral. As can be seen in **Figure 6-4** and **Figure 6-5**, more people felt neutral about the impact of Build Scenario 2 and Build Scenario 3 on transit.

Figure 6-3: Respondent Opinions Regarding Build Scenario 1

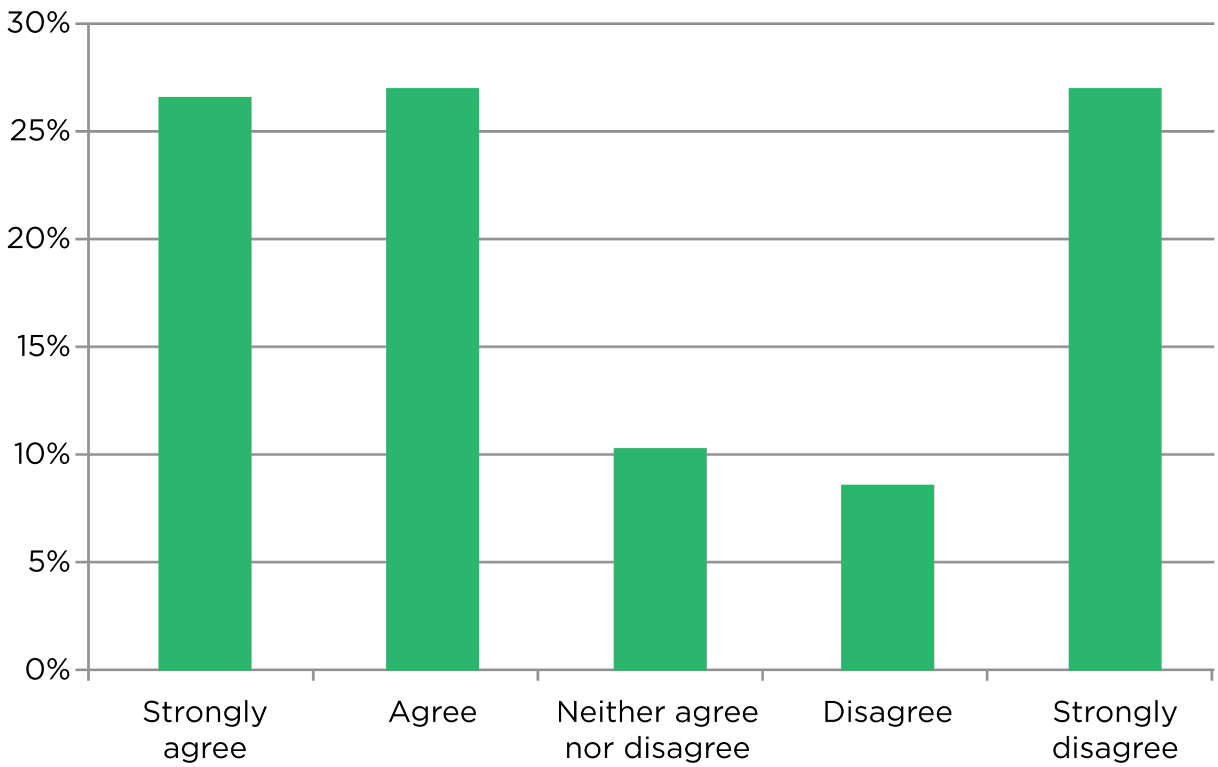


Figure 6-4: Respondent Opinions Regarding Build Scenario 2

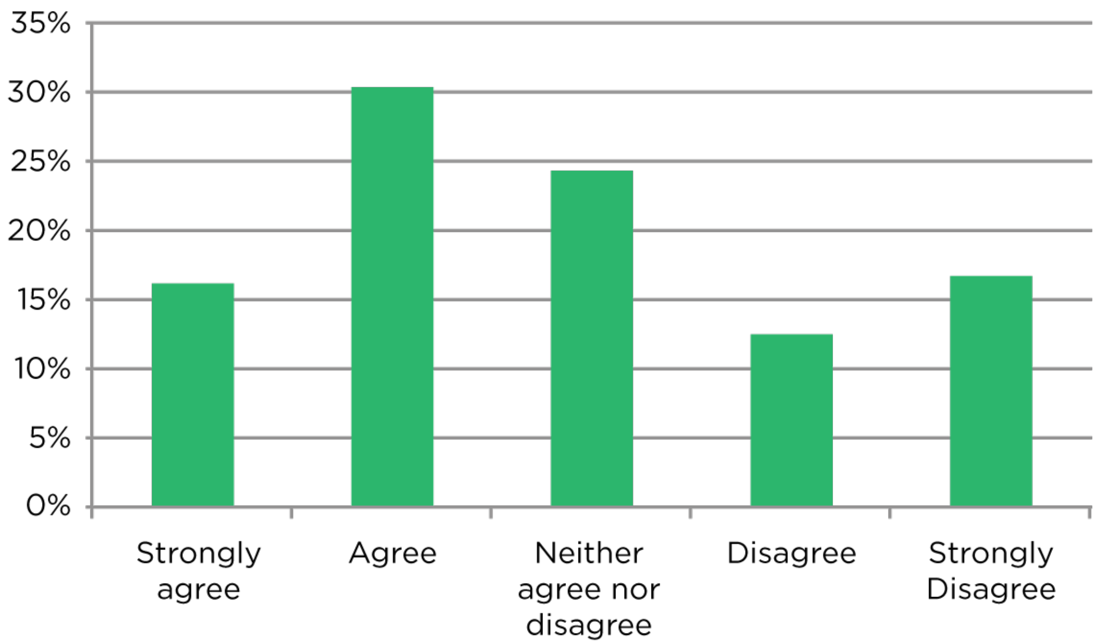
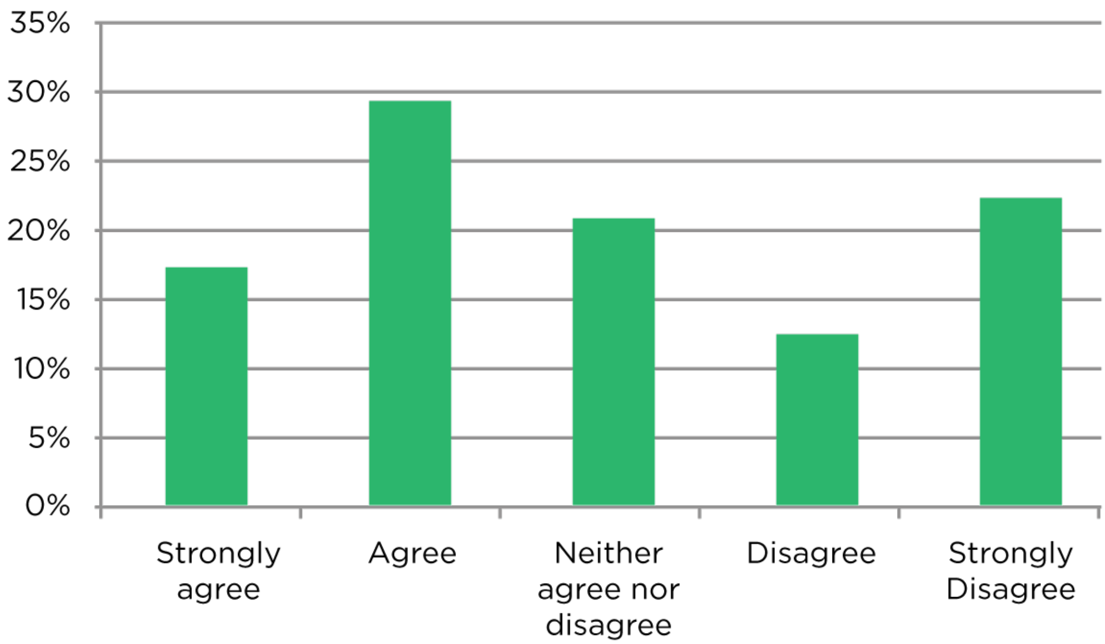


Figure 6-5: Respondent Opinions Regarding Build Scenario 3



PUBLIC OUTREACH

In addition to the multiple-choice questions, respondents were also afforded the opportunity to provide feedback via an open-ended question. Approximately 50% (~100) of respondents shared their thoughts on the project and the proposed build scenarios.

Responses ranged from general support to concern, as well as calls for additional considerations. Seven of the hundred respondents who left a comment used transit as their primary mode through the corridor and supported the project. Twenty-one respondents either walked or used their bicycled through the corridor. These respondents expressed some support for the project, but generally focused more on the congestion impacts, safety concerns, and the need for more bicycle and pedestrian infrastructure. Finally, fifty respondents who left a comment use a vehicle as their primary mode through the study corridor. These respondents overwhelmingly expressed concern with the potential impact the proposed build scenarios would have on roadway capacity, vehicular congestion, and traffic diversion onto local residential streets. Other concerns for motorists included the impact the proposed build scenarios would have on the city's small-town feel and local businesses, as well as the financial feasibility of the overall project.

7

CONCLUSIONS

CONCLUSIONS

The Envision Route 7 project will improve overall mobility by providing high-speed, high-frequency, and reliable transit service and connections across multiple jurisdictions, between multiple Metrorail stations, and to the proposed West End Transitway.

As part of the Phase 4-1 effort, three build scenarios were developed to assess the effects of various bus priority treatments. These treatments include BAT lanes, level-boarding passenger platforms, off-board fare payment kiosks, TSP, and queue jumps.

The description of each build scenario is provided below:

- ***Build Scenario 1:*** BAT lanes (i.e., curb lanes used by buses and right turning vehicles only) throughout most of the corridor and TSP signal timing strategies.
- ***Build Scenario 2:*** Queue jumps at two intersections and TSP signal timing strategies.
- ***Build Scenario 3:*** Partial BAT lanes and TSP signal timing strategies.

CONCLUSIONS

Build Scenario 1 offers the most benefit to BRT with approximately 10-15% reduction in corridor travel time. However, Build Scenario 1 also increases corridor vehicle travel times. Build Scenario 2 results in minimal changes to BRT travel time compared to the Baseline conditions. The effect of Build Scenario 2 on vehicle corridor travel times is also marginal. Build Scenario 3 provides modest improvements to BRT corridor travel time, but not as large as Build Scenario 1. However, because the reduction in roadway capacity is limited to certain portions of the corridor, the increase in vehicle corridor travel times is not as pronounced as in the Build Scenario 1.

The Envision Route 7 project also employed a public outreach process to inform project findings and gather feedback on the Build scenarios. Existing transit passengers expressed support for Build Scenario 1 to maximize improvements for BRT. However, people who drive through the corridor expressed concern about the potential impacts of the project on vehicular congestion and traffic diversion. Additionally, people who walk or bike also expressed concerns regarding the lack of investment in infrastructure for walking and biking.

The next phase of the project will conduct more detailed analysis and environmental review to identify benefits and potential impacts to the environment, community, and businesses in the corridor. As part of the next phase of the project, strategies to minimize and mitigation potential impacts will be developed. Specifically, strategies to minimize potential diversions onto neighborhood streets will be explored. Where necessary, mitigation measures will also be identified. The next phase will also consider improvements to pedestrian and bicycle infrastructure to enhance walking and cycling conditions in the corridor. Finally, the next phase will include engagement efforts with the City of Falls Church to understand the City's needs for more detailed analysis and environmental review.