PROJECT PIPELINE

ST-23-08: FREDERICK COUNTY
FAIRFAX PIKE (ROUTE 277) FROM MAIN STREET (US ROUTE 11) TO STICKLEY DRIVE (ROUTE 1085)

DRPT Office of INTERMODAL Planning and Investment VDOT

DRPT Office of INTERMODAL Planning and Investment VDOT Virginia Department of Transportation PROJECT PIPELINE

Fairfax Pike (Route 277) from Main Street to Stickley Drive

Final Report

July 2024

Prepared for

VDOT Virginia Department of Transportation

Prepared by

ATCS

13861 Sunrise Valley Drive, Suite 200

Herndon, Virginia 20171

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Chapter 1:

Needs Evaluation and Diagnosis

Introduction:

Project Pipeline is a performance-based planning program to identify cost-effective solutions to multimodal transportation needs in Virginia. Through this planning process, projects and solutions may be considered for funding through programs, including SMART SCALE, revenue sharing, interstate funding, and others. Visit the Project Pipeline webpage for additional information: vaprojectpipeline.org.

This study focuses on concepts targeting identified needs including congestion mitigation, safety improvement, pedestrian and bicycle infrastructure along the corridor, and transit access. The objectives of Project Pipeline are shown below in **Figure 1.**

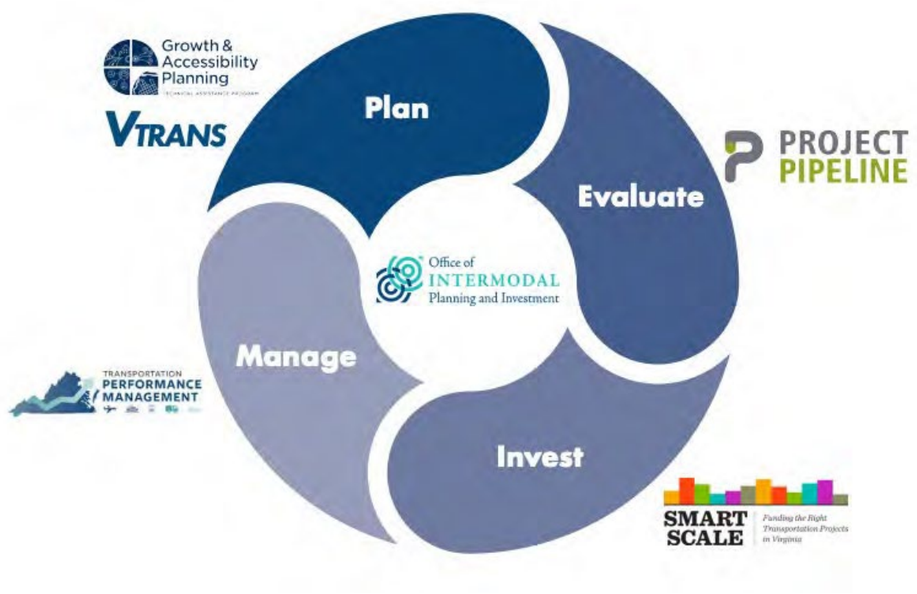


Figure 1. Project Pipeline Objectives

Background

The Office of Intermodal Planning and Investment (OIPI) prepared the VTrans Virginia's statewide transportation plan for the Commonwealth Transportation Board (CTB) in which mid-term needs (0 - 10 years) were identified for different categories listed in **Table 1**. This study focuses on addressing needs identified in VTrans, and those previously identified by the localities.

Table 1: List of VTrans Needs

VTrans Needs
Safety Improvement
Transportation Demand Management
Congestion Mitigation
Pedestrian Safety Improvement
Transit Access
Capacity Preservation
Bicycle Access

Methodology

The study is broken down into three phases. Phase I is the problem diagnosis and brainstorming alternatives, Phase II is the alternative evaluation and sketch level analysis, and Phase III is the investment strategy and cost estimates. Details on methods and solutions for each study phase are outlined below in **Figure 2**.

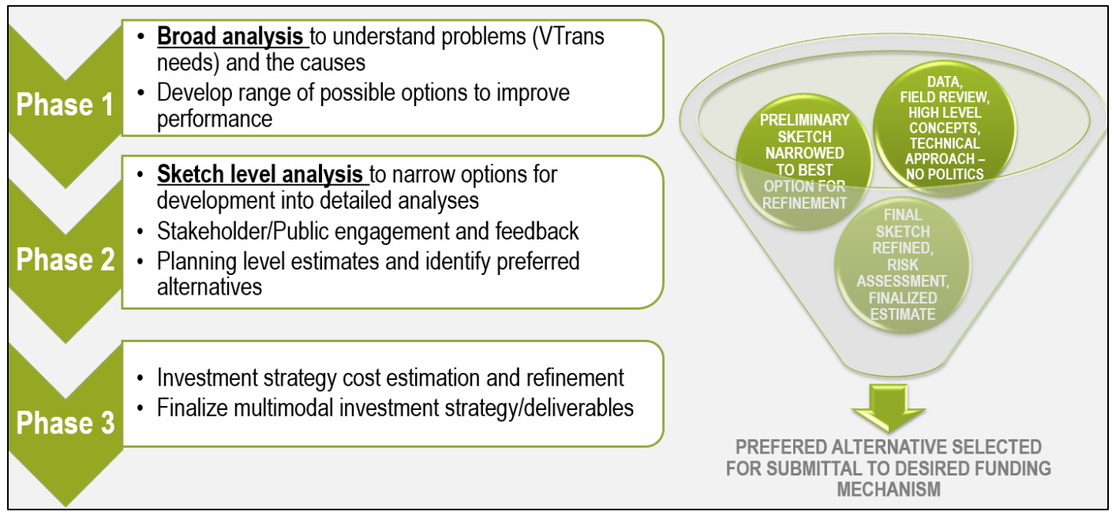


Figure 2. Study Phase Methods and Solutions

The study team is broken down into Technical Teams to improve the efficiency and effectiveness of the study process through extensive collaboration and synchronicity. To achieve the intended efficiency and consistency, it is generally expected that the same Technical Team will be responsible for all studies within a district for the duration of the cycle.

Each Technical Team will include certain leadership and technical roles that will be needed for each study, including the following:

- VDOT District Planning Project Manager – Provides leadership and direction; has overall responsibility for the study progress and outcomes.
- Consultant Team Manager – Provides direct support to the VDOT District Planning Project Manager; coordinates the work and technical efforts of consultant staff.
- District Planning Staff – Provides technical input regarding capacity, forecasting, land use, multimodal, and planning.
- District Traffic Engineering Staff – Provide technical input regarding safety and operations.
- Consultant Team Technical Staff – Provides multidisciplinary input, analysis, technical support, and expertise for the identified VTrans need categories.

A sample organizational chart, including the roles, responsibilities, and structure of a Technical Team is shown below in **Figure 3**.

Figure 3. Structure of a Technical Team

Additional team members and roles should be considered where appropriate. Certain roles may not be necessary for all studies. However, the following roles may contribute to study success during different stages and/or for different types of study areas, as shown in **Table 2**.

Table 2. Roles and Responsibilities for the Technical Team and SWGs

Phase	Responsibility	Role					
		OIPI/Program Support	District	Consultant	DRPT	Locality	VDOT Central Office
Study Selection & Initiation	Identify Study Needs and Priorities		X		X	X	
	Coordinate with CTB Members	X	X				
	Approve final study locations	X					
	Data Collection Planning		X				
	Data Dashboards	X					
	Assign Consultants & Issue Consultant Task Orders	X					X
Phase 1	Initiate Study & Hold Kickoff Meeting		X	X	X		
	Prepare Framework Document		X	X			
	Approve Framework Document		X		X	X	
	Provide Existing Data		X		X	X	
	Collect New Data			X			
	Coordinate with local leaders					X	
	Conduct & Support Initial Public Outreach (if desired)	X	X	X		X	X
	Diagnose Existing Needs			X			
	Brainstorm & Develop Preliminary Alternatives		X	X	X		X
	Present Diagnosis & Alternatives to SWG			X			
	Provide Feedback and Input on Analysis & Alternatives					X	
	Develop Phase 2 Scope of Work			X			
	Approve Scope & Issue Consultant Task Orders	X					X
Phase 2	Conduct Detailed Analysis of Alternatives			X			
	Develop Refinements to Alternatives		X	X	X		X
	Present Alternative Analysis Findings to SWG		X	X			
	Provide Feedback on Alternatives				X	X	X
	Prepare Planning Level Cost Estimates			X			
	Conduct & Support Public Outreach on Alternatives	X	X	X		X	
	Concurrence on Preferred Alternative(s)		X		X	X	X
	Develop Phase 3 Scope of Work			X			
	Approve Scope & Issue Consultant Task Orders	X					X
Phase 3	Conduct Alternative Risk Assessment		X	X			X
	Develop Practical Concept Design & Address Risk of Preferred Alternative		X	X			
	Prepare Cost Estimate with Workbook			X			
	Document Assumptions & Basis of Cost			X			
	Review & Concur with Concept & Estimate		X		X		X
Investment, Application, & Closeout	Prepare Final Study Deliverables, Design Packages, and Estimates			X			
	Apply for Funding of Preferred Alternative(s)				X	X	
	Application Support	X	X	X			
	Submit and Documentation and All Related Work			X			
	Review and approve final deliverables for public visibility		X		X		
	Program Closeout and Summary	X					

Study Area

The Fairfax Pike (Route 277) study corridor from Main Street (US 11) to Stickley Drive (Route 1085) is located in Frederick County, Virginia. The Fairfax Pike corridor is classified as a minor arterial road within the study area. The posted speed limit is 25 MPH for Fairfax Pike. A map detailing the locations of the study intersections along Fairfax Pike is shown below in **Figure 4.**

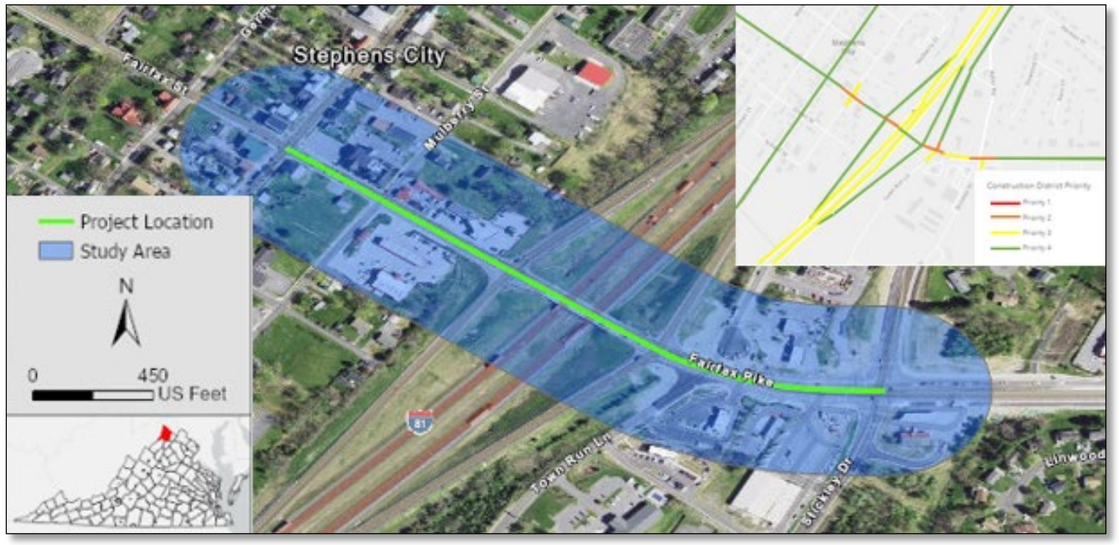


Figure 4. Fairfax Pike Study Area Map

VTrans is Virginia's statewide transportation plan. It identifies and prioritizes locations with transportation needs using data-informed transparent processes. The policy for identifying VTrans mid-term needs establishes multimodal need categories corresponding to the Commonwealth Transportation Board-adopted VTrans visions, goals, and objectives.[1] Each need category has one or more performance measures and thresholds to identify one or more needs. Visit the Vtrans policy guide for additional information: https://vtrans.org/resources/VTrans_Policy_Guide_v6.pdf.

The mid-term needs, as identified in VTrans for the Fairfax Pike study corridor, were identified as 'High' for Safety Improvement and Transportation Demand Management, 'Medium' for Bicycle and Transit Access, and 'Low' for Congestion Mitigation and Pedestrian Access needs, as presented in **Table 3.**

Table 3. VTrans Needs in Study Area

VTRANS IDENTIFIED NEEDS	PRIORITIES
Bicycle Access	Medium
Capacity Preservation	None
Congestion Mitigation	Low
IEDA (UDA) Access	None
Pedestrian Access	Low
Safety Improvement	High
Pedestrian Safety Improvement	None
Reliability	None
Rail On-time Performance	None
Transit Access	Medium
Transit Access for Equity Emphasis Areas	None
Transportation Demand Management	High

These mid-term needs, identified in VTrans, are prioritized on a tier from 1 to 4, with 1 being the most critical and 4 being the least critical. The segments ranked as "Priority 1" represent those with multiple categories identified as high in need. **Figure 5** presents a map of the study area with the 2019 VTrans mid-term needs prioritized for District construction.

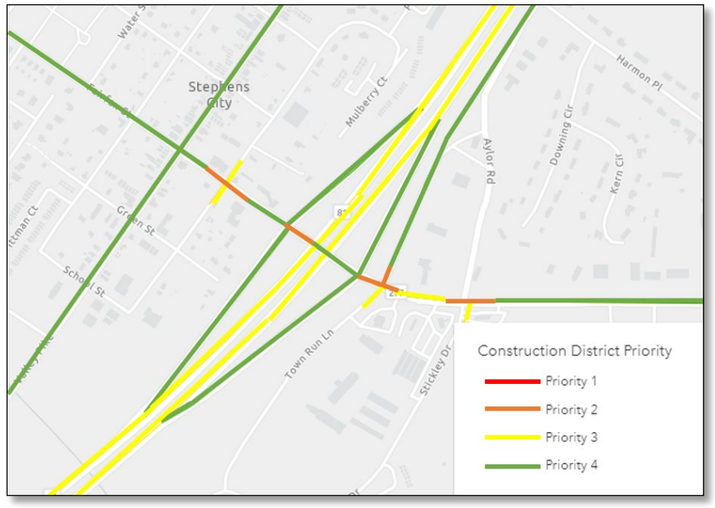
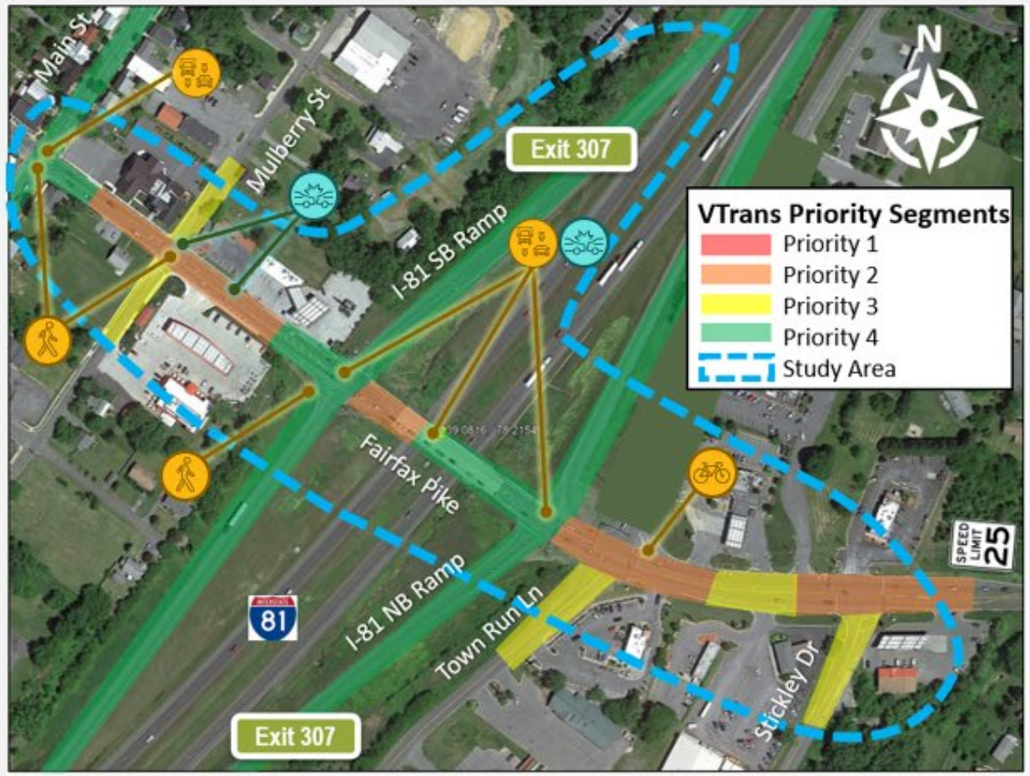
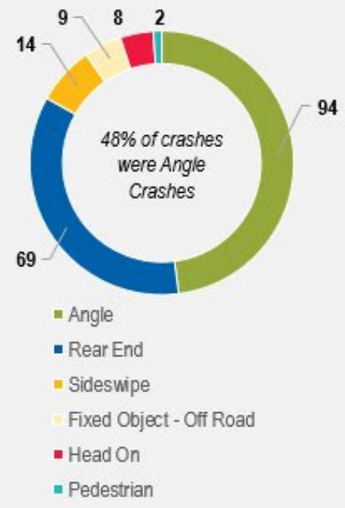


Figure 5. 2019 VTrans Prioritized Mid-term Needs in the Study Area

[1] Commonwealth Transportation Board, Actions to Approve the 2019 VTrans Vision, Goals, Objectives, Guiding Principles and the 2019 Mid-term Needs Identification Methodology and Accept the 2019 Mid-term Needs, January 15, 2020





Project Fact Sheet	
VDOT District	Staunton
Locality	Frederick County
Corridor Length	0.4 mile
Nearby Transit Connections	WinTran Laurel Ridge Route
Nearby Bikeways	Shared-Use-Path on the south side of Fairfax Pike, east of Stickley Drive
Functional Classification	Minor Arterial
Speed Limit	25 mph

Issues in the Study Area

92 incidents (2015-2022) within 1200 feet between Main St & I-81 NB On ramp. 41 incidents associated with I-81 SB & NB ramp intersections. Access management concerns between Mulberry St & I-81 SB Off ramp.

The closest park & ride lot is at Double Tollgate/White Post (5 miles to the east of Exit 307)

The existing Shared Use Path (SUP) is on the south side, east of the new Stickley Drive intersection.

No existing bus stops or nearby park & ride lots. At present, the WinTran Laurel Ridge Route departs downtown Winchester every 70 minutes connecting to Laurel Ridge Community College, operating Mon – Fri from 7:10 AM to 9:10 PM.

Congestion is the number one public concern in the study area. Queueing was observed at Main Street WB and on intersections with the I-81 ramps.

Sidewalks are continuous on the north side only. Crosswalks have inconsistent markings if present and many curb ramps are not ADA compliant. Ped signals - with buttons and countdown heads and APS only at NB on-ramp.

Project Purpose, Goals, & Objectives

Analyze the operational and safety issues identified along Fairfax Pike near I-81, with a focus on providing enhanced safety and transportation demand management.

Identify cost-effective preferred improvement alternatives that address the deficient conditions and prioritize safety and accessibility.

Figure 6. Project Overview for Fairfax Pike from Main Street to Stickley Drive

Previous Study Efforts

Three other studies were performed that may impact geometric and traffic conditions in the study area, which are discussed in the following subsections.

I-81, Exit 307 Interchange Improvement/Relocation Study
The I-81, Exit 307 Interchange Improvement/Relocation Study was completed in 2017 and focused on the feasibility of relocating the existing interchange to the south of its existing location, tying into the planned Stephens City bypass roadway in the Frederick County Comprehensive Plan. This study was conducted to improve local traffic conditions for Exit 307 and its interchange with Route 277. The purpose of the study was to improve mobility and accessibility for vehicular and non-vehicular traffic, enhance corridor safety conditions, and improve access to designated development areas. Given the many challenges and impacts involved in implementing such a large project and the presence of existing issues, the present study effort focuses on solutions at the existing Exit 307 interchange.

I-81, Exit 307 Interchange roundabout concept technical memo
The I-81, Exit 307 Barbell/Dual Roundabout concept memo was completed in 2018. Based on the analysis results, two teardrop roundabouts were recommended at the I-81 northbound and southbound Exit 307 ramps along Route 277. The proposed roundabouts would provide significant operations benefits with both existing and forecasted traffic volumes. The proposed improvements are shown in **Figure 7** with the 2040 PM movement Level of Service. This study was limited in its depth of analysis. The concepts from the memo will be examined as part of the present study effort.

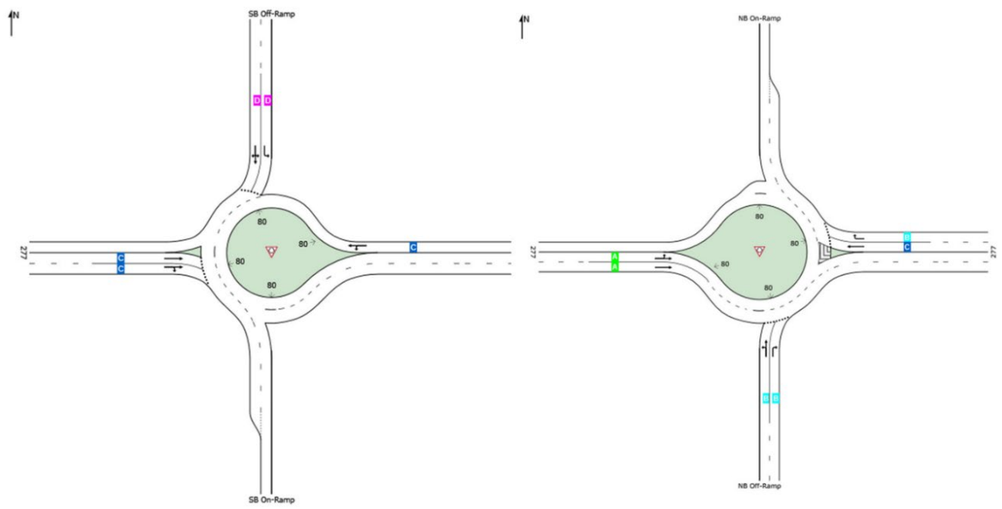


Figure 7. Exit 307 Roundabout Study Proposed Improvements (2040 PM)

STARS Route 277 Corridor Study
The STARS Route 277 Corridor Study was completed in 2012. The purpose of this study was to access existing operational conditions, develop future traffic volumes anticipated along the corridor, evaluate roadway capacity requirements to support future traffic demands, develop and evaluate roadway capacity improvement alternatives, and recommend capacity, operational, and safety improvements. The major recommendation from this study was the widening of Route 277 from the current two-lane undivided configuration to a four-lane, median-divided typical section from Town Run Lane to Warrior Drive.

The preliminary concept included the following general improvements:

- Widening of the Route 277 corridor to a four-lane divided typical section from the I-81 Northbound Ramps to White Oak Road/Hudson Hollow Road. Construction of the first phase of widening from the I-81 Northbound Ramps to Double Church Road was completed in 2022. The remainder of the proposed widening has not been funded.
- Construction of exclusive left- and right-turn lanes along Route 277 at nearly all signalized and unsignalized intersections within the project limits.
- Limited capacity improvements at select side street locations.
- Signal phasing and safety improvements per the STARS report.
- Relocation of Aylor Road to align with the existing Route 277/Stickley Drive intersection.
    - *This was completed in 2022, with the original concept shown in **Figure 8**, and the final plan shown in **Figure 9**.*

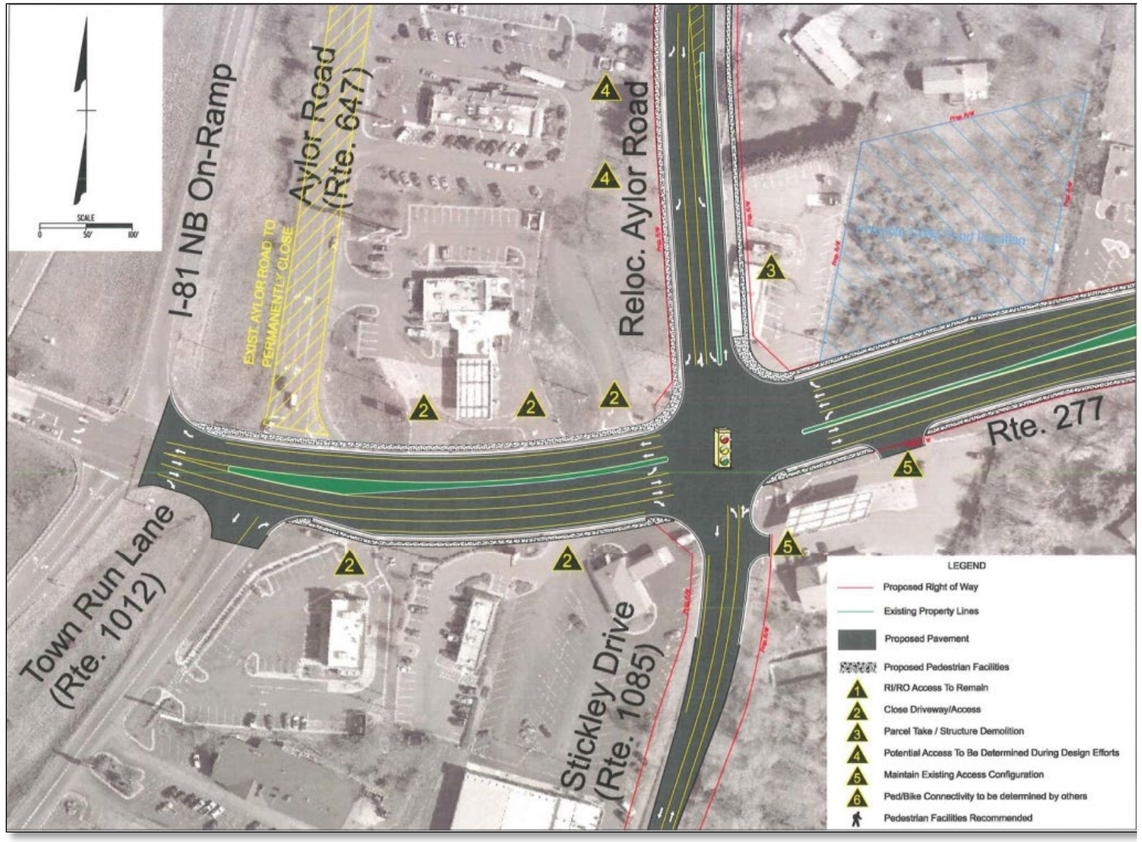


Figure 8. STARS Route 277 Corridor Study - Proposed Improvements to Aylor Road/Stickley Drive

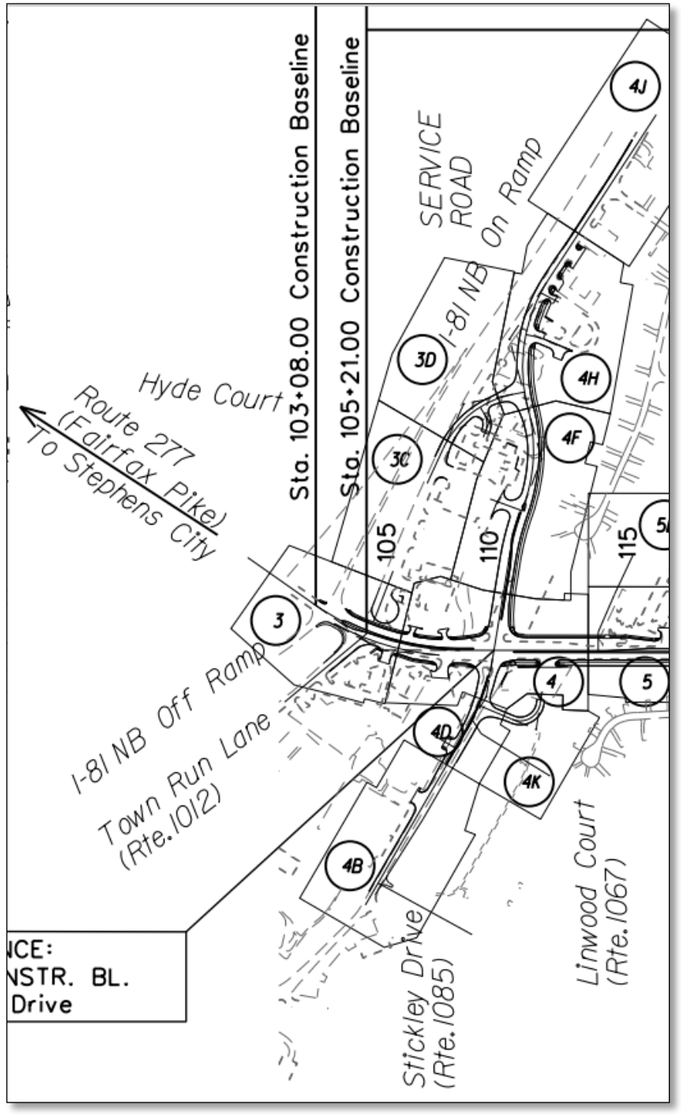


Figure 9. STARS Route 277 - Final Plan for Aylor Road/Stickley Drive

FHWA STEAP Tool Analysis

The FHWA Screening for Equity Analysis of Projects (STEAP) Tool was reviewed for the corridor and surrounding areas. This tool is used to discover the key population metrics and needs of the study area to raise awareness of equity needs in the selection of alternatives. The data source used for the analysis was the American Community Survey 2016 – 2020 and a 0.5-mile radius was used for the analysis buffer. The results of the STEAP Tool analysis are shown in **Figure 10** through **Figure 14** and presented below:

- The majority of the population (57%) within the study area is between ages 18 and 64 as shown in **Figure 10**.
- There is very high personal vehicle ownership, with 71% of households owning two or more vehicles as shown in **Figure 11**. Only 4% of households do not own a personal vehicle.
- The majority of the respondents speak English very well, however, there are 1% of respondents who speak English "not well" as shown in **Figure 12**.
- When compared to Stephens City, Frederick County, and the State of Virginia, the study area has lower than average number of veterans, people with disabilities, households with no computers, and households without internet connection, as shown in **Figure 13**.
- The study area has slightly higher than average households with income between $15,000 and $25,000 compared to Stephens City, Frederick County, and the State of Virginia. However, the majority of the households (55%) have household income greater than $75,000, as shown in **Figure 14**.

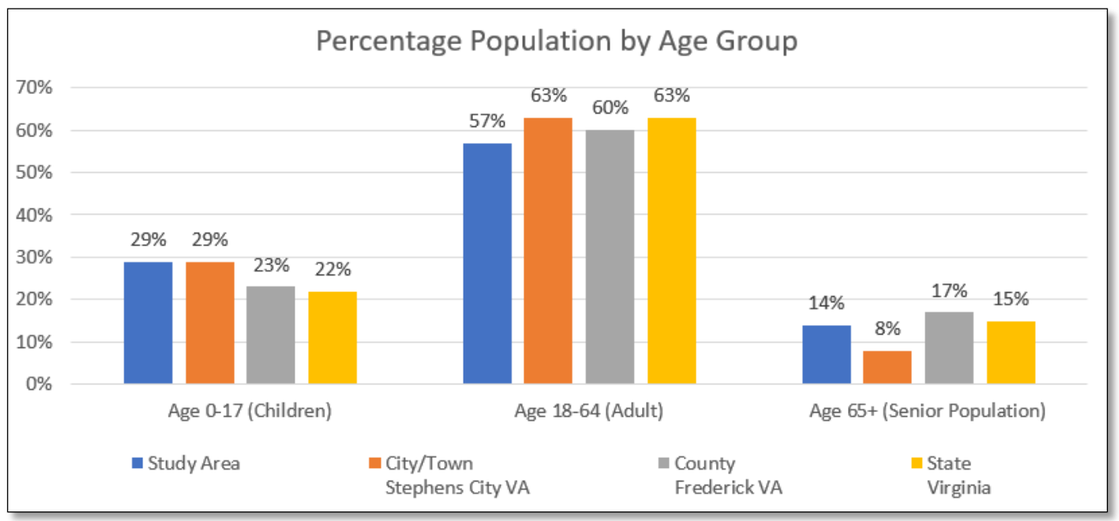


Figure 10. STEAP Tool Analysis Population by Age Group

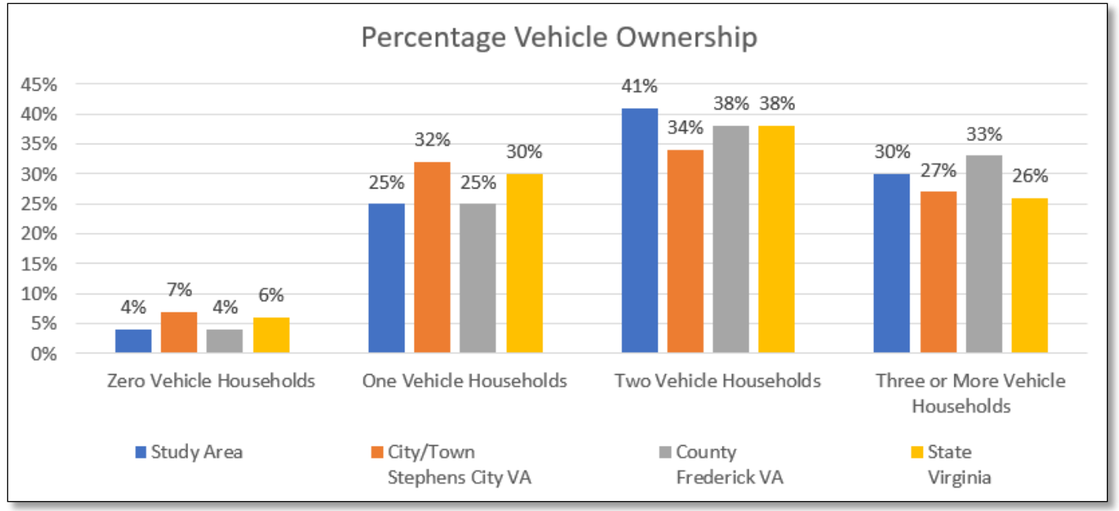


Figure 11. STEAP Tool Analysis Vehicle Ownership

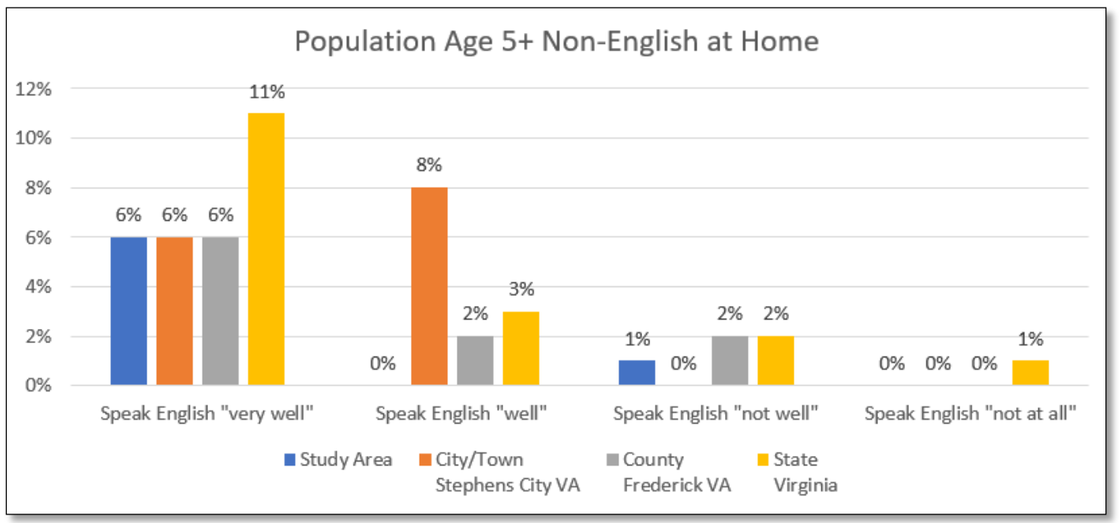


Figure 12. STEAP Tool Analysis Non-English at Home

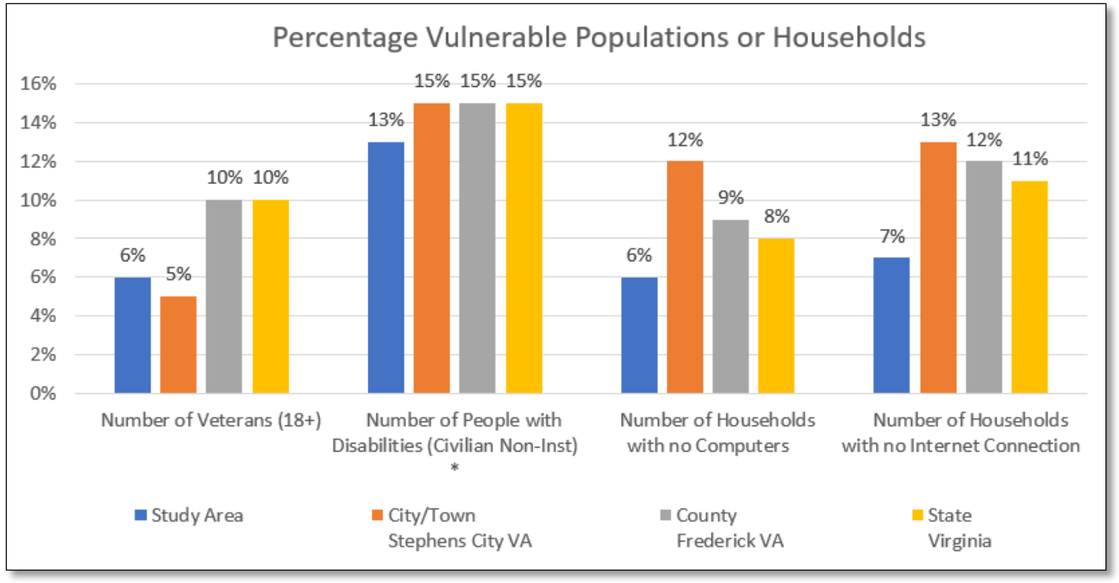


Figure 13. STEAP Tool Analysis Vulnerable Populations

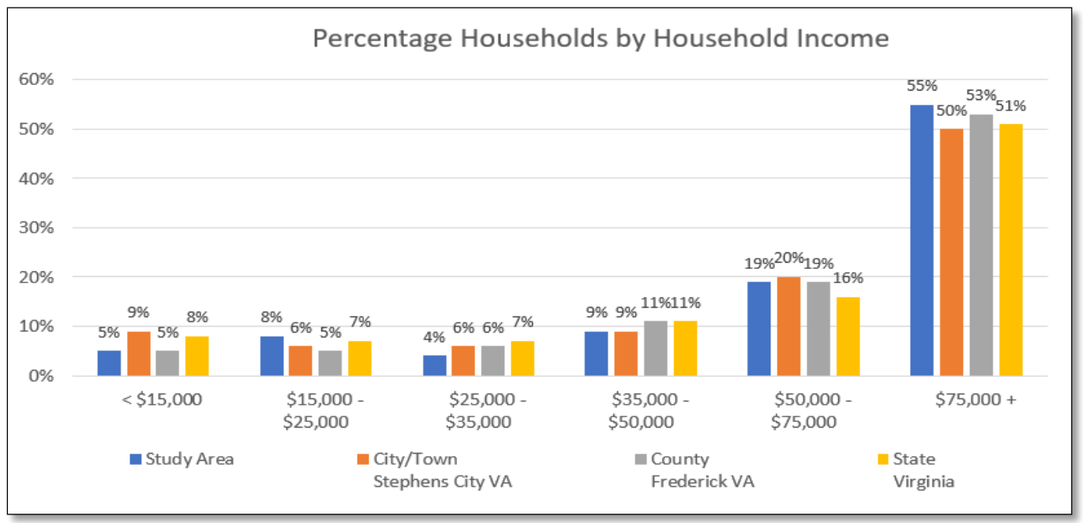


Figure 14. STEAP Tool Analysis Household Income

Traffic Operations:

Existing conditions traffic operational analysis was performed using Vissim 11 software. Vissim is a microscopic traffic simulation software, developed by PTV Group, used for modeling traffic flow and analyzing transportation systems. Vissim modeling inputs and analysis methodologies followed the VDOT Traffic Operations and Safety Analysis Manual (TOSAM) Version 2.0 guidelines. Both AM and PM peak hours were analyzed for the existing year 2023. The analysis revealed that the PM peak hour was more critical than the AM peak hour. Consequently, the results from the PM peak hour analysis will be used to discuss the findings throughout this section.

Traffic Data

The traffic data for the study area was obtained from Turning Movement Counts (TMC) collected on Thursday, April 27, 2023, a typical weekday when schools were in session. The morning counts were collected from 6:00 AM to 9:00 AM and the evening counts were collected from 3:30 PM to 6:30 PM. The corridor AM peak hour was determined to be 7:15 AM to 8:15 AM and the corridor PM peak hour was determined to be 4:30 PM to 5:30 PM. The balanced peak hour TMC is shown in **Figure 15**.

Measures of Effectiveness

A measure of effectiveness (MOEs) is a factor in traffic operations analysis used to quantify operational and safety objectives and provide a basis for evaluating the performance of a transportation network. The following Traffic Operations Analysis MOEs are utilized for the evaluation of the study corridor performance:

- Microsimulation Delay (measured in seconds per vehicle – sec/veh)
- Travel Time, sec
- Maximum Queue Length, (measured in feet – ft)

Traffic Operations Analysis Results

To identify operational needs along the study corridor, a Vissim model was developed to represent the observed traffic conditions and match the collected field data. The model was calibrated to reflect local, existing traffic operational behavior. VDOT TOSAM guidelines were followed for the calibration process. The calibration memo containing the MOE results from Vissim analysis is provided in **Appendix A. Table 5** and **Table 6** present the PM peak hour analysis results summary for the existing conditions in 2023. A summary of the observed vs simulated queue lengths is presented in **Figure 16**.

The observations from the existing conditions traffic analysis are presented in this section. There is a high-volume demand at the southbound and northbound I-81 off-ramp approaches in the PM peak hour. At the I-81 southbound off-ramp intersection, the SB left turn movement with a demand of 363 vehicles experienced a delay of 39.9 sec/veh. The maximum queue length experienced at this approach was 475 feet. At the I-81 northbound off-ramp intersection, the NB left turn movement with a demand of 61 vehicles, experienced a delay of 54.8 sec/veh. The maximum queue length experienced at this approach was 325'. Other notable observations from the existing conditions traffic analysis are summarized below.

Fairfax Street at Main Street (Signalized)

- The left turn from the Main Street northbound approach and both eastbound and westbound approaches of Fairfax Street experienced delays greater than 35 sec/veh.
- Compared to the remaining study intersections, this intersection experienced the highest overall intersection delay of 29.9 sec/veh Because of the lack of dedicated left turn lanes from Fairfax Street onto Main Street, the left turn vehicles do not have a safe space to wait without blocking through traffic. This increases overall delays and reduces intersection efficiency.

Fairfax Pike at Stickley Drive (Signalized)

- The through and left turn movements from the minor street approaches of Stickley Drive and Aylor Road experienced delays greater than 40 sec/veh.

Travel Time Analysis

To evaluate the reliability of traffic operations, the travel time indexes, and average speeds were obtained from the VDOT Pipeline Round 2 Dashboards, for an average weekday in April. The source for reliability data is the Regional Integrated Transportation Information System (RITIS). The results, presented in **Figure 17**, indicate significant travel time increases during the AM and PM peak hours compared to other times of day, resulting in average speeds of lower than 20 MPH.

Travel time results for the Fairfax Pike study corridor between Main Street and Stickley Drive were generated from the existing conditions Vissim analysis, as part of the calibration process. The results are provided in the following **Table 4.**

Table 4 Fairfax Pike Travel Time Comparison - PM Peak Hour

Segment	From	To	Field Travel Time (sec)	Vissim Travel Time (sec)	Diff (%)
Fairfax St/Pk EB	Main St	Stickley Dr	128.1	128.9	1%
Fairfax St/Pk WB	Stickley Dr	Main St	145.1	137.1	-5%

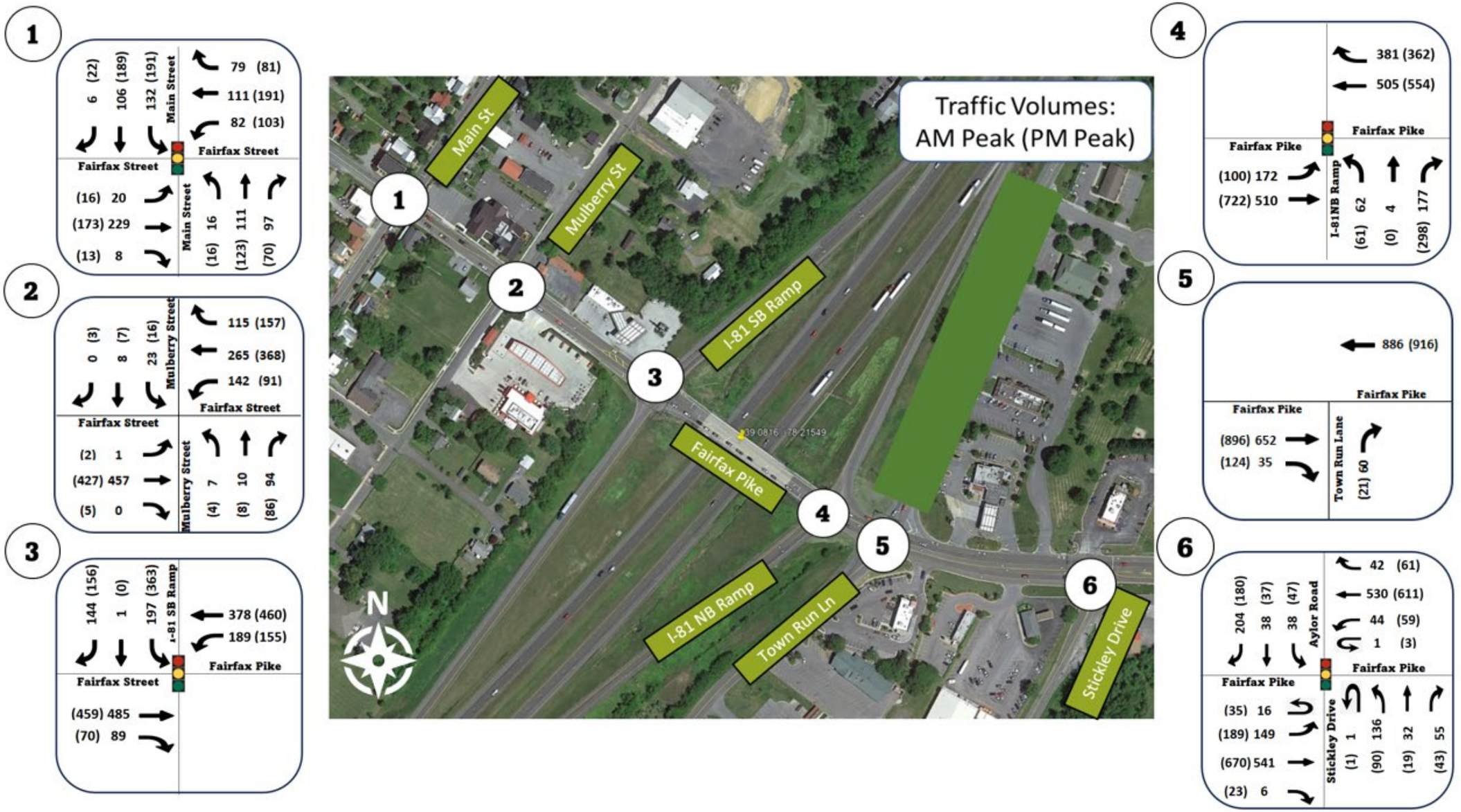


Figure 15. Turning Movement Counts

Table 5: 2023 Existing Conditions PM Peak Hour Traffic Operations Results (west)

Traffic Control	Intersection	Approach	Mov't	Demand Volume (vph)	Throughput Volume (vph)	Vol Diff (vph)	Delay (sec/veh)		
							Mov't	Approach	Int Overall
Signalized	Fairfax St & Main St	Fairfax St	EBL	16	17	1	47.4	35.0	29.9
			EBT	173	173	0	34.2		
			EBR	13	11	-2	29.8		
		Fairfax St	WBL	103	103	0	36.5	33.3	
			WBT	190	186	-4	33.0		
			WBR	81	77	-4	29.9		
		Main St	NBL	16	17	1	36.2	32.7	
			NBT	123	118	-5	33.2		
			NBR	70	68	-2	30.9		
		Main St	SBL	191	191	0	26.7	22.7	
			SBT	189	186	-3	19.4		
			SBR	22	21	-1	15.5		
Unsignalized	Fairfax St & Mulberry St	Fairfax St	EBL	2	2	0	8.7	2.4	6.6
			EBT	427	423	-4	2.4		
			EBR	5	7	2	1.7		
		Fairfax St	WBL	91	89	-2	6.6	8.2	
			WBT	368	356	-12	9.2		
			WBR	157	148	-9	6.8		
		Mulberry St	NBL	4	4	0	31.5	13.6	
			NBT	8	8	0	22.4		
			NBR	86	85	-1	11.9		
		Mulberry St	SBL	16	16	0	17.1	16.2	
			SBT	7	5	-2	16.1		
			SBR	3	4	1	12.6		
Signalized	Fairfax St & I-81 SB Ramp	Fairfax St	EBT	459	450	-9	10.6	10.5	21.7
			EBR	70	68	-2	10.3		
		Fairfax St	WBL	155	152	-3	30.0	23.4	
			WBT	460	434	-26	21.1		
		I-81 SB Off Ramp	SBL	363	360	-3	39.9	31.0	
			SBR	156	159	3	10.9		

Table 6: 2023 Existing Conditions PM Peak Hour Traffic Operations Results (east)

Traffic Control	Intersection	Approach	Mov't	Demand Volume (vph)	Throughput Volume (vph)	Vol Diff (vph)	Delay (sec/veh)		
							Mov't	Approach	Int Overall
Signalized	Fairfax Pk & I-81 NB Ramp	Fairfax Pk	EBL	100	100	0	20.9	6.8	10.5
			EBT	722	707	-15	4.8		
		Fairfax Pk	WBT	554	530	-24	6.1	5.4	
			WBR	362	388	26	4.3		
		I-81 NB Off Ramp	NBL	61	57	-4	54.8	32.1	
			NBR	298	299	1	27.8		
Unsignalized	Fairfax Pk & Town Run Ln	Fairfax Pk	EBT	896	890	-6	0.6	0.6	0.7
			EBR	124	118	-6	0.4		
		Town Run Ln	NBR	21	20	-1	4.7	4.7	
Signalized	Fairfax Pk & Stickley Dr	Fairfax Pk	EBU	35	38	3	21.8	15.4	19.8
			EBL	189	187	-2	21.7		
			EBT	670	663	-7	13.7		
			EBR	23	24	1	2.4		
		Fairfax Pk	WBU	3	3	0	23.5	20.7	
			WBL	59	58	-1	18.8		
			WBT	611	605	-6	22.4		
			WBR	61	61	0	4.9		
		Stickley Dr	NBU	1	1	0	40.0	33.8	
			NBL	90	90	0	45.2		
			NBT	19	19	0	44.8		
			NBR	43	42	-1	4.4		
		Aylor Rd	SBL	47	46	-1	44.7	25.0	
			SBT	37	38	1	58.2		
			SBR	180	180	0	13.0		

Figure 16. Observed vs. Simulated Queue Length Comparison in the PM Peak Hour

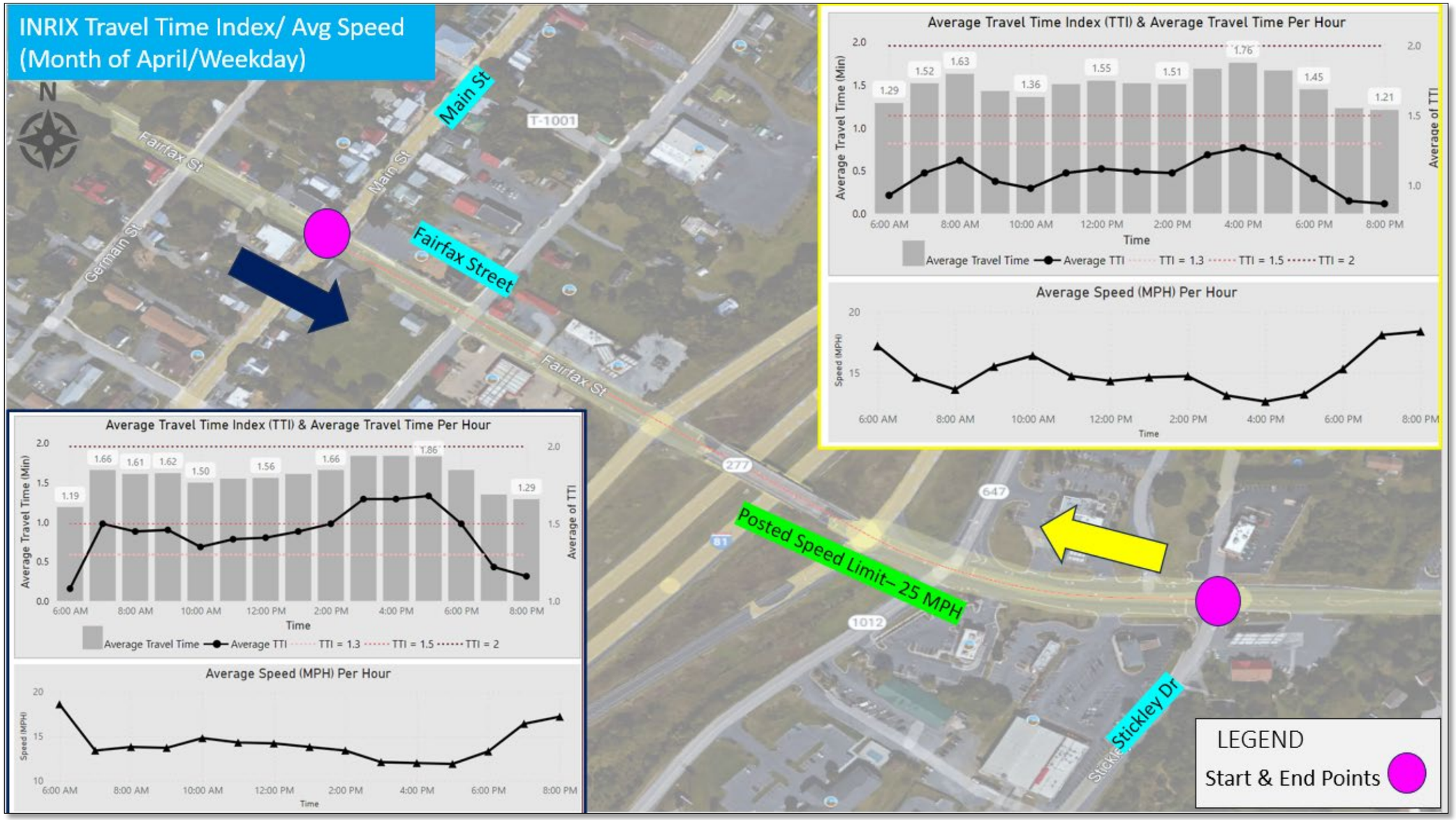


Figure 17. INRIX Travel Time Index and Average Speed

Safety

For the analysis of existing safety conditions, the VDOT Crash Analysis PowerBI Tool was utilized to determine the crash history at the study intersections and along the study corridor on Fairfax Pike. Crash data was collected and analyzed for an eight-year period spanning from January 2015 to December 2022. The study team reviewed the FR-300 reports provided by VDOT to determine specific trends and "hot spot" areas for consideration in developing alternative improvement concepts. For this analysis, "injury crashes" is defined as the sum of type A (severe injury), B (visible injury), and C (non-visible injury) crashes. Raw crash data is provided in **Appendix B**.

Safety Analysis Results

The crash severity within the study area is summarized by year and type in **Table 7** and **Table 8**, respectively. This crash summary does not include the crashes related to Aylor Road, due to the geometric changes completed in 2020 that relocated Aylor Road to align with the Stickley Drive intersection.

Table 7: Study Area Crash Severity by Year

Crash Year and Severity	K. Fatal Injury	A. Severe Injury	B. Visible Injury	C. Nonvisible Injury	PDO. Property Damage Only	Total
2015	0	0	5	0	8	**13**
2016	0	0	0	0	9	**9**
2017	0	0	2	0	8	**10**
2018	0	1	2	0	8	**11**
2019	0	0	3	0	10	**13**
2020	0	0	2	0	13	**15**
2021	0	1	0	1	10	**12**
2022	0	1	1	0	12	**14**
Total	**0**	**3**	**15**	**1**	**78**	**97**

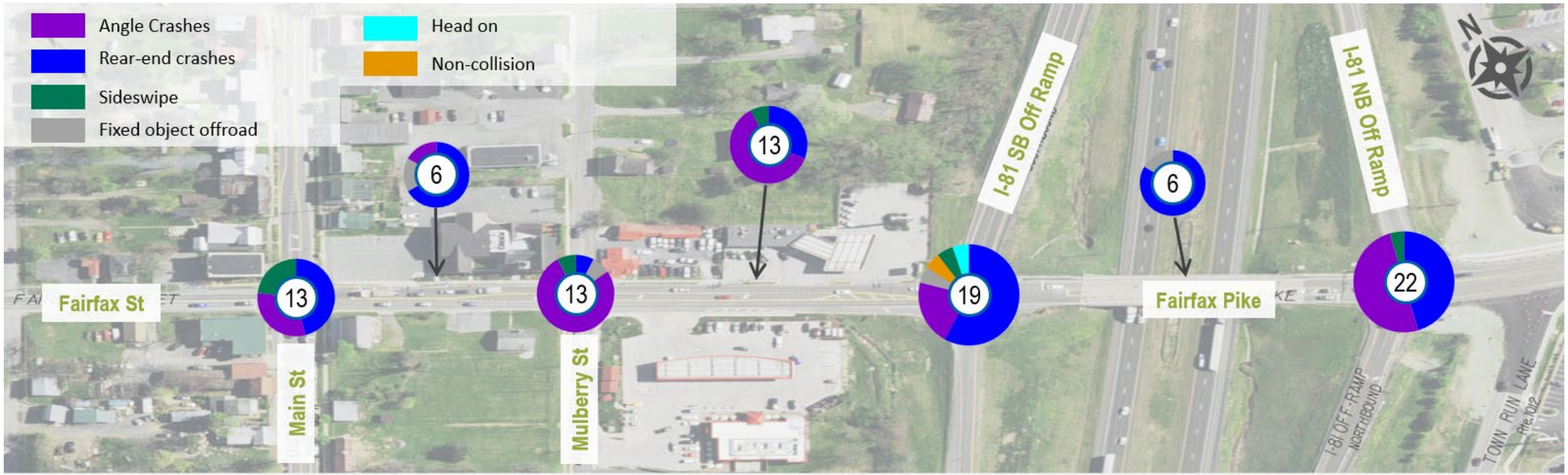
Table 8: Study Area Crash Severity by Type

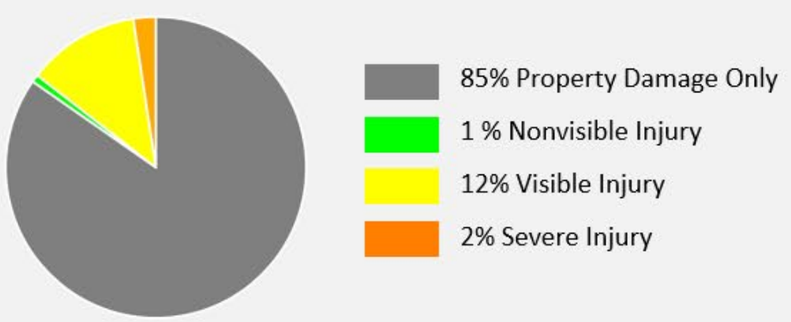
Crash Year and Severity	K. Fatal Injury	A. Severe Injury	B. Visible Injury	C. Nonvisible Injury	PDO. Property Damage Only	Total
Rear End	0	2	10	0	32	**44**
Angle	0	1	1	1	35	**38**
Head On	0	0	2	0	0	**2**
Sideswipe - Same Direction	0	0	0	0	6	**6**
Sideswipe - Opposite Direction	0	0	0	0	1	**1**
Non-Collision	0	0	0	0	1	**1**
Fixed Object - Off Road	0	0	1	0	3	**4**
Pedestrian	0	0	1	0	0	**1**
Total	**0**	**3**	**15**	**1**	**78**	**97**

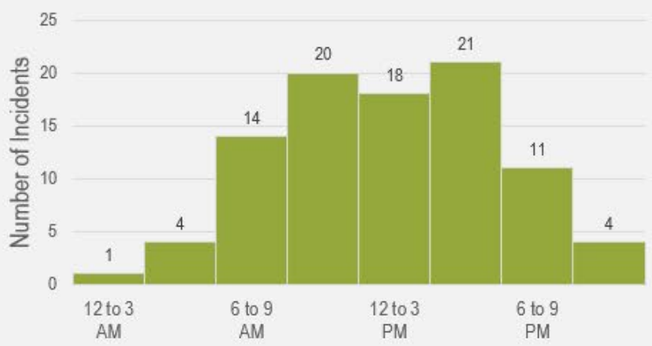
A total of 97 crashes were reported within the Fairfax Pike study area during the eight-year study period. Key takeaways from the crash data are as follows:

1. Year-over-year crash occurrence varies with the highest number of crashes (15) occurring in 2020, followed by 14 in 2022, as shown in **Table 7.**
2. The approximate average number of reported crash incidents per year is 12.
3. The majority of reported crash incidents within the corridor are rear-end and angle crashes. Combined, these constitute approximately 84.5% of the total crashes, as shown in **Table 8.**
4. A total of 19 crash incidents were associated with injuries, which account for approximately 20% of the total reported crashes within the corridor.
5. One pedestrian-related crash incident occurred on November 24, 2020, along Main Street, north of Fairfax Pike, which involved a vehicle traveling northbound on Fairfax Pike hitting a pedestrian crossing Fairfax Pike at night.
6. A total of 41 crashes occurred in the vicinity of the I-81 northbound and southbound ramps.

A summary of the safety diagnosis is provided in **Figure 18** shows that the two ramp intersections experienced the highest number of crash incidents along the study corridor with 19 occurring at the southbound ramp and 22 at the northbound ramp.







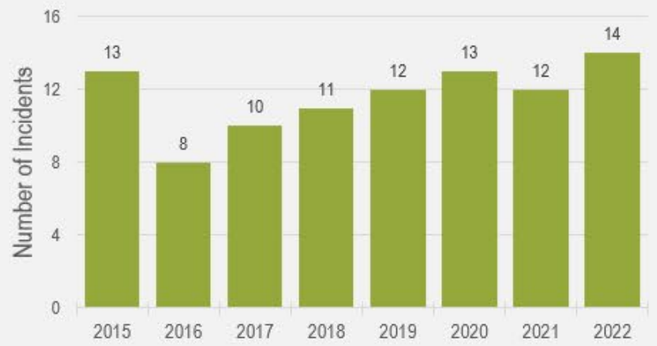


Figure 18. Safety Diagnosis Summary

Pedestrian and Bicycle Access

To identify the needs concerning accessibility, the study team reviewed existing conditions of pedestrian and bicycle infrastructure. Overall, there is a continuous sidewalk on the north side of Fairfax Pike, but crosswalks are inconsistent throughout the corridor. Additionally, many of the curb ramps are not ADA compliant and there are no pedestrian signals at all the signalized intersections. There is a pedestrian signal with APS at the northbound I-81 on-ramp. There is an existing shared-use path on the south side of Fairfax Pike for bicycle access east of the new Stickley Drive intersection.

The following pedestrian and bicycle improvements will be further investigated for feasibility.

- Installation of a new sidewalk on the south side of Fairfax Pike to fill in the gaps west of the bridge.
- Installation of new Pedestrian signals and crosswalks for the north leg of the I-81 southbound off-ramp, the west leg of the I-81 southbound off-ramp, and all legs of the Main Street Intersection
- Additionally, the Win-Fred MPO Bicycle & Pedestrian Mobility Plan (2007) calls for bike lanes along Fairfax Pike from Main Street to Clarke County, so there is an opportunity to extend the shared-use-path on the eastern portion of the corridor, transitioning to on-street facilities west of the I-81 southbound on-ramp.

Rail, Transit, and TDM:

The study team reviewed public transit routes and Park and Ride locations near the study area. Currently there is no existing rail infrastructure or Park and Ride locations within the study area, and WinTran provides public transit loop route service through the study area from Winchester on the north to the Laurel Ridge Community College campus, in Middletown, south of Stephens City. There is no Virginia Breeze intercity bus service in the study area. The closest Virginia Breeze stop is 9.5 miles to the southeast off of Route 522, in the Riverton Commons Shopping Center Parking Lot, north of Front Royal and I-66. The closest existing Park and Ride locations are 9 miles to the south at Oranda, 5 miles to the east at Double Tollgate/White Post and 8.5 miles to the east at Waterloo.

VTrans Needs and Diagnosis Summary:

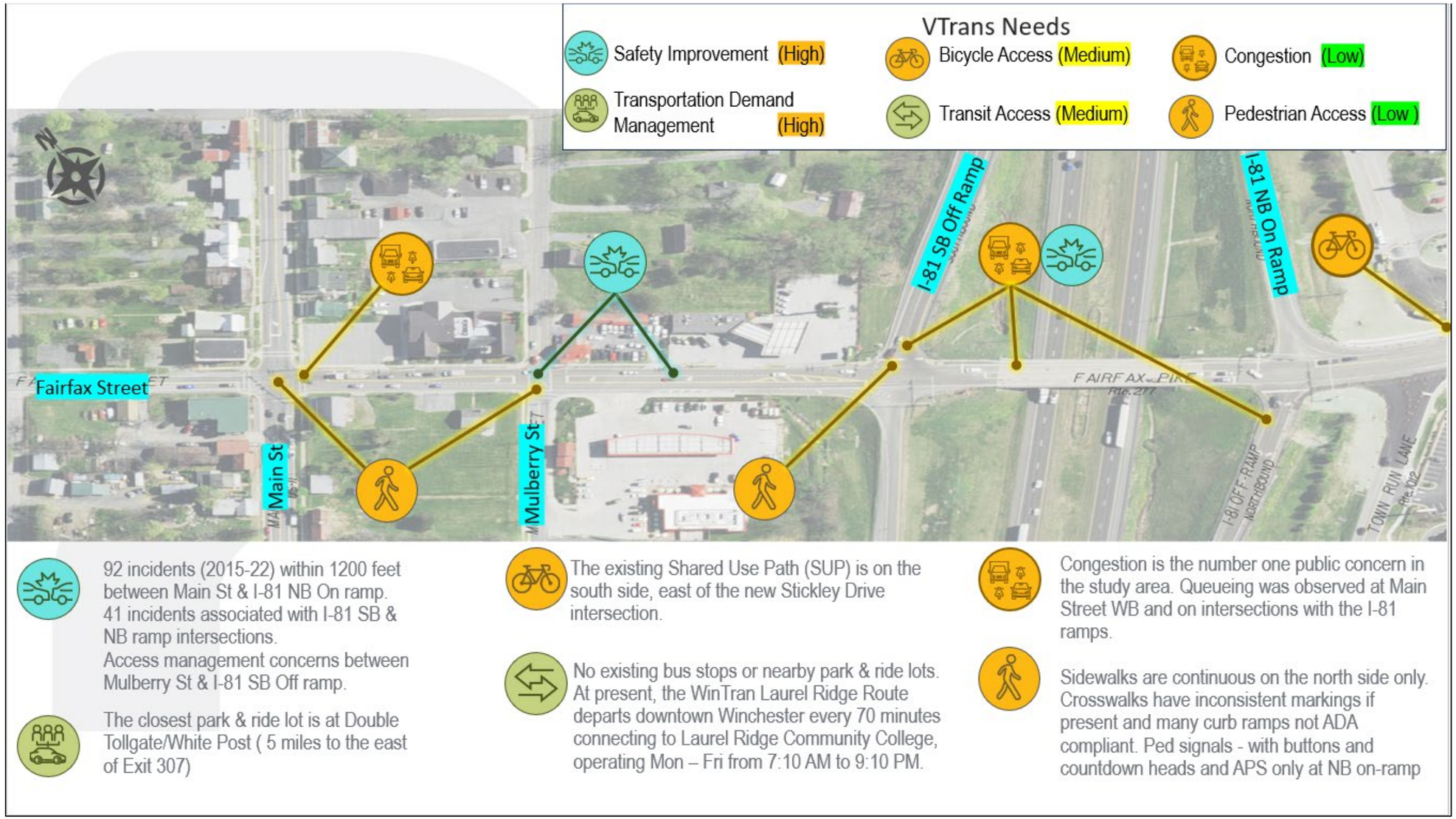


Figure 19. VTrans Needs and Diagnosis

Phase 1 Corridor/Existing Conditions Public Outreach & Involvement

Initial Public Outreach was conducted to inform the public about the study efforts and goals and to solicit feedback on the public's priorities and perceptions of the corridor for inclusion in the evaluation of potential alternatives. The survey was conducted through Publicinput.com and there were 1054 participants. The survey shows that the top two major needs of the respondents were congestion mitigation and safety, as shown in **Figure 20**. A word cloud was generated out of the survey responses, as shown in **Figure 21**. The size of the tile indicates the repetition of the keyword used by the respondent. Congestion and signal timing were the top two repeated keywords in the survey response. **Figure 22** presents screenshots of the public survey responses to some of the key questions asked.

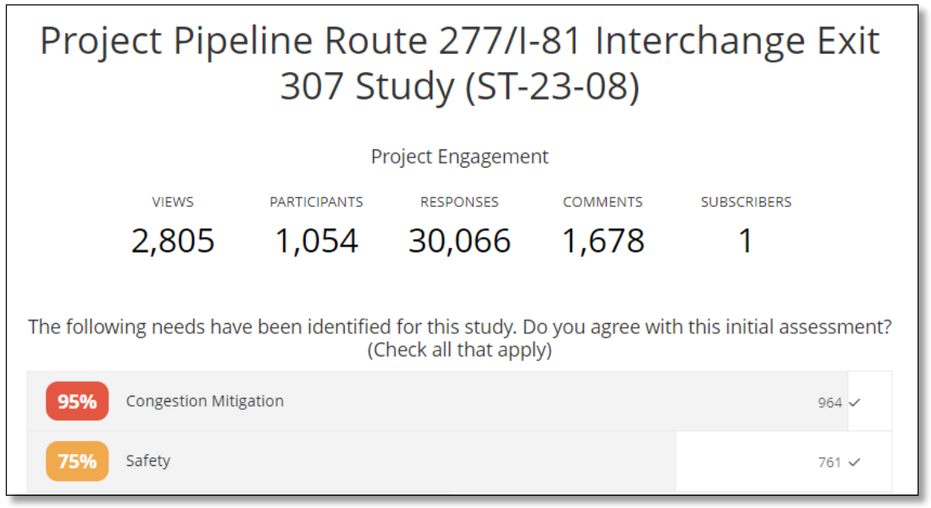


Figure 20. Public Input Survey Results

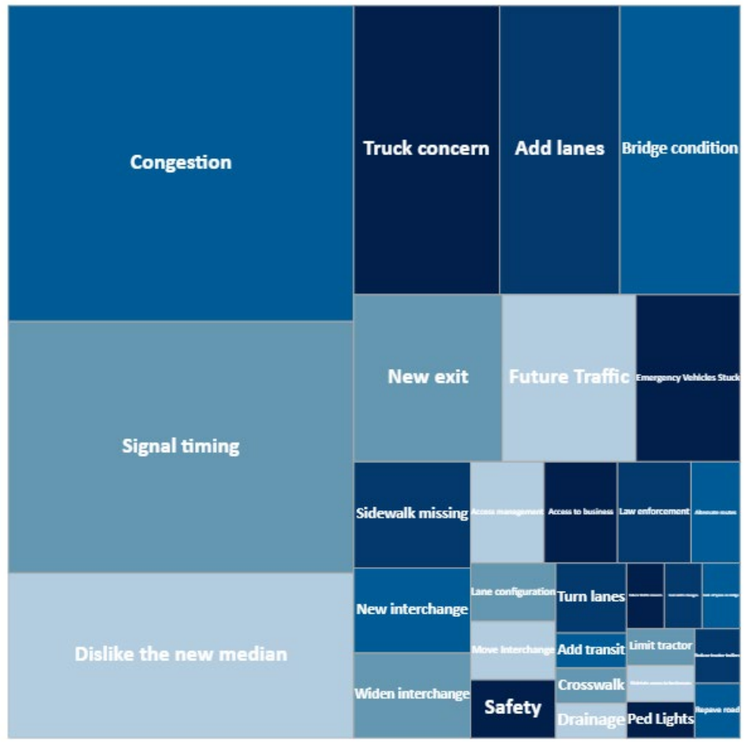


Figure 21. Issues along the Study Corridor

The notable comments from the survey responses are summarized below:

- *Turn lanes at the intersection of the main street should be added.*
- *Reduce tractor-trailers through the area.*
- *Too many semi-trucks using 277 to skirt the weigh station. By reducing the amount of semi-truck traffic over the bridge, you would drastically reduce the congestion.*
- *Roundabouts at the lights would make for smoother traffic flow and keep it from building up throughout the main area.*

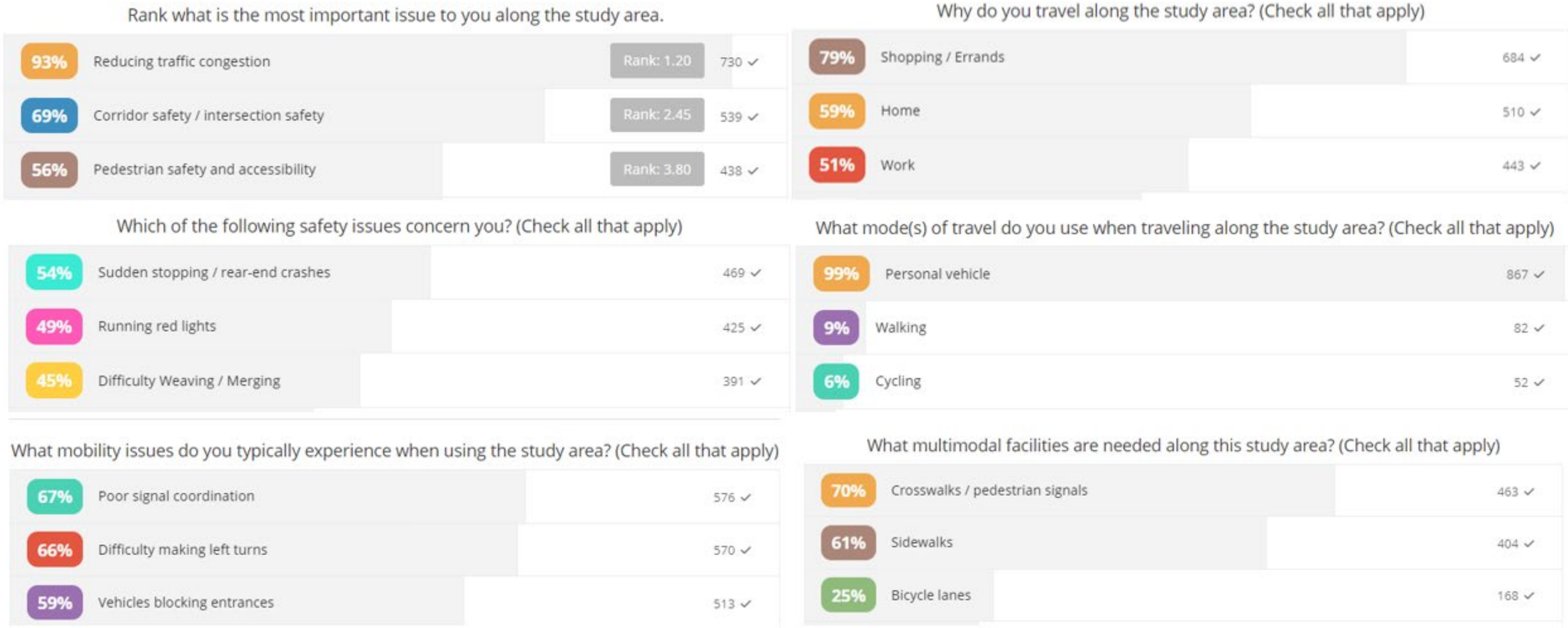


Figure 22. Public Input Survey Responses

Chapter 2:

Alternative Development and Refinement

Alternative Development and Screening:

To develop alternative concepts to address the needs and incorporate diagnosis identified in Chapter 1, a thorough review of the existing conditions operations and safety analysis was performed. The following intersections were identified as priority areas.

1) Fairfax Street at Main Street – This intersection experienced the highest overall intersection delay of 29.9 sec/veh in the PM peak hour. Because of the lack of dedicated left turn lanes from Fairfax Street onto Main Street, the left turn vehicles from both approaches do not have a safe space to wait without blocking through traffic. This increases overall delays and reduces intersection efficiency. There are limitations in the geometric improvements that can be explored at this intersection due to its proximity to two businesses, one history center, and a church at its four corners.
2) Fairfax Street/ Pike at I-81 ramps - The two ramp intersections experienced a high-volume demand at the southbound and northbound I-81 off-ramp approaches in the PM peak hour. At the I-81 southbound off-ramp intersection, the SB left turn movement with a demand of 363 vehicles experienced a delay of 39.9 sec/veh and a maximum queue length of 475 feet. At the I-81 northbound off-ramp intersection, the NB left turn movement with a demand of 61 vehicles, experienced a delay of 54.8 sec/veh and a maximum queue length of 325'. These two intersections experienced the highest number of crash incidents along the study corridor with 19 and 22 respectively between 2015 and 2022. The interchange is scheduled for deck rehab in 2025 and a full bridge replacement in 2040. The potential acceleration of bridge replacement would enable consideration of other interchange alternatives at the two intersections.

A screening-level analysis will be performed in the VDOT Junction Screening Tool (VJuST) to identify potential alternative interchange options at the two ramp intersections. VJuST is a screening tool that helps in the decision-making process of identifying innovative interchange configurations, which are most appropriate in reducing congestion and improving safety to advance to further study, analysis, and design. Alternative interchange configurations will be evaluated using the future design year volumes as part of the screening process. The future year volumes were forecasted using WinFred MPO Model, discussed in the next section. Details of the VJuST analysis performed and the alternative interchanges considered are provided in the subsequent section.

Future Traffic Forecasting

The future year traffic volumes for the opening year, 2034, and the design year, 2054, were developed based on the 2040 WinFred MPO Travel Demand Forecast Model (TDFM) obtained from VDOT. The TDFM provided a forecast for the year 2040, with the year 2015 as the base year. The count data was from 2023, so a reduction factor was applied based on the average linear growth on the study corridor, Fairfax Street/ Pike. To generate the traffic forecast from 2023 to 2040, the factor applied was 0.83. The following **Table 9** summarizes the percent growth for each approach link from the base year of 2023 to the year 2040 for the six intersections in the study area.

The forecasts for the opening year, 2034, and design year, 2054, were pivoted from 2040, as that was the available land use and network data. To adjust the forecast from the year 2040 to the year 2034, a factor of 0.90 was applied. The forecast for the year 2054 did not have any specific input and was generated by applying a 0.5% linear growth rate from 2040 to 2054, as directed by VDOT. The Traffic Forecasting Memo, showing the full methodology and validation, is provided in **Appendix C**.

Table 9. Growth Factor from 2023 to 2040 by Intersection Approach Leg

Intersection	West	East	North	South	Overall
Fairfax Street (VA 277) & Main Street	1.36	1.39	1.69	1.29	1.43
Fairfax Street (VA 277) & Mulberry Street	1.36	1.31	1.68	1.38	1.36
Fairfax Street (VA 277) & I-81 southbound ramps	1.31	1.41	1.20	1.19	1.33
Fairfax Pike (VA 277) & I-81 northbound ramps	1.50	1.43	1.22	1.21	1.41
Fairfax Pike (VA 277) & Town Run Lane	1.41	1.41	-	1.65	1.42
Fairfax Pike (VA 277) & Stickley Drive	1.43	1.43	1.72	1.88	1.51

VJuST Analysis

As part of future alternative intersection screening, VDOT Junction Screening Tool (VJuST) analysis was performed for the intersections of Fairfax Pike at the I-81 Southbound Off-Ramp and the I-81 Northbound Off-Ramp. The VJuST aids transportation engineers and planners in determining which innovative intersection or interchange might be appropriate at a specific location[2]. It uses traffic volume as input and generates alternatives along with their maximum volume-to-capacity (v/c) ratio. The v/c ratio, also known as the degree of saturation, is a measure of how well an intersection can handle vehicular demand. A v/c ratio less than 0.85 generally indicates that adequate capacity is available, and vehicles are not expected to experience significant queues and delays. As the v/c ratio approaches 1.0, traffic flow may become unstable, and delay and queuing conditions may occur. Once the demand exceeds the capacity, a v/c ratio greater than 1.0, traffic flow is unstable, and excessive delay and queuing are expected. **Table 10** provides a description of capacity based on the v/c ratio.

Table 10. Capacity Description based on v/c Ratio

V/C Ratio	Description of Capacity
<0.85	Under capacity
0.85-0.95	Near capacity
0.95-1.0	At capacity
>1.0	Over capacity

Source: Highway Capacity Manual 2010

It is to be noted that VJuST analysis does not consider the influence of adjacent intersections on traffic patterns. Therefore, it was conducted for screening purposes only with detailed analyses performed using the microsimulation software Vissim. The VJuST analysis was completed for the design year 2054. Future alternatives that were considered based on their feasibility at the study intersection and by review of VJuST design considerations at the I-81 interchange are provided below. **Table 11** compares weighted total conflict points and maximum v/c ratio for the alternatives considered with the lowest v/c ratio highlighted in bold. The 2054 VJuST analysis results show that a traditional diamond option with a 5-lane bridge overall provides the best operational and safety benefit at the interchange. See **Appendix D** for 2054 AM and PM VJuST spreadsheets.

1) Alt 0: No Build Alternative, where the existing lane configuration is maintained.
2) Alt 1A: Hybrid (Teardrop) roundabouts, where the existing three-lane configuration is maintained and the two ramp intersections are converted to teardrop roundabouts, with two lanes in the eastbound direction and one lane in the westbound direction.
3) Alt 1B: Double (Teardrop) roundabouts, where a new four-lane configuration and the two ramp intersections are converted to teardrop roundabouts, with two lanes in the eastbound direction and one lane in the westbound direction.
4) Alt 1C: Roundabout at Fairfax Pike & northbound ramp intersection, where a new five-lane bridge is proposed. The northbound ramp intersection is converted to a two-lane teardrop roundabout, and the southbound ramp intersection is maintained as a conventional signal with dual eastbound and westbound through lanes, and one westbound left turn lane.
5) Alt 2: Diverging Diamond Interchange (4 lane), where opposing traffic crosses to the other side at both ends of the interchange to reduce conflict points and provide more efficient merging movements. This configuration would allow two lanes in the eastbound direction and two lanes in the westbound direction.
6) Alt 3A: Traditional Diamond (5 lane), where a new five-lane bridge is proposed. The westbound direction would maintain two through lanes entering the bridge area, with the leftmost lane becoming a dedicated left turn lane onto the southbound interchange on-ramp. The eastbound direction would maintain two through lanes joined by a dedicated left turn lane onto the northbound interchange on-ramp.
7) Alt 3B: Traditional Diamond (5 lane) similar to Alternative 3A. Both eastbound and westbound directions would feature two through lanes, and a central left turn lane would transition from one side to the other to accommodate on-ramp traffic.
8) Alt 3C: Traditional Diamond (4 lane) similar to Alternative 3B. The westbound direction would maintain one dedicated through lane. The eastbound direction would maintain two dedicated through lanes. The fourth central turn lane would transition from one side to the other to accommodate on-ramp traffic.
9) Alt 4: Single Point Urban Interchange (SPUI), where a new five-lane bridge is proposed. All movements travel through a single signalized intersection, except for right turns. This configuration would allow two through lanes in the eastbound direction, two through lanes in the westbound direction, and a central left turn lane.

[2] https://www.vdot.virginia.gov/about/our-system/highways/innovative-intersections/virginia-icap/T

Table 11. 2054 PM Peak Hour VJuST Analysis Results Summary

Alternative	Number of Lanes on Bridge*	Weighted Total Conflict Points	Fairfax Pike at I-81 Interchange PM Peak Hour Maximum v/c
Alt 0: No-Build	3	28	0.99
Alt 1A: Hybrid Roundabout	3	8	1.06
Alt 1B: Double Roundabout	4	16	1.06
Alt 1C: Roundabout at NB Ramp	5	20	0.92
Alt 2: Diverging Diamond	4	20	0.69
Alt 3A: Traditional Diamond	5	28	0.67
Alt 3B: Traditional Diamond	5	28	**0.62**
Alt 3C: Traditional Diamond	4	28	0.83
Alt 4: Single Point Urban Interchange (SPUI)	5	32	0.59

**More than three lanes require a new bridge construction*

As shown in **Table 11**, all the alternatives, except the Hybrid Roundabout, will require a bridge replacement to account for the additional lanes needed or reconfigured. Due to the high v/c ratio of the Hybrid Roundabout, it is not selected for a detailed analysis. As mentioned in the previous section, the interchange is scheduled for deck rehab in 2025 and a full bridge replacement in 2040. The potential acceleration of bridge replacement would enable consideration of other interchange alternatives at the two intersections. Alternatives 3A and 3B, both featuring a traditional diamond design with a five-lane bridge, provided the best v/c ratio among all the alternatives considered for the interchange.

Alternative Analysis:

Based on the VJuST screening analysis conducted for an interchange alternative, Alternatives 3A and 3B were found to be more feasible and provided the best v/c ratio (see **Table 11**). Therefore, these two alternatives were selected for detailed analysis. The design feasibility of Alternative 3A and 3B were evaluated and concept sketches were developed. The shared design features for the two select alternatives are provided below.

- A dedicated westbound left turn lane at Main Street
- Traffic signals remain in place at both I-81 ramps
- Dual eastbound through lanes starting at the southbound off-ramp intersection
- Dual northbound off-ramp right turn lanes
- Dual southbound off-ramp left turn lanes
- Free flow right turn lane from Fairfax Pike to the I-81 northbound on-ramp
- Sidewalk on both sides of the bridge

The unique design features of the two alternatives are provided in the following **Table 12**. Using the proposed concept sketch as a base, the traffic operations of the two alternatives were evaluated in Vissim for the future year scenarios of the opening year (2034) and design year (2054). The concept sketches for the two alternatives are shown in **Figure 23** and **Figure 24** below. The details of the traffic operations analysis for future year scenarios and the final recommendation based on the analysis findings are provided in the following section.

Table 12. Unique Design Features of Alternative 3A Vs. 3B

Location	Unique Design feature	
	Alternative 3A	Alternative 3B
Between Main St and I -81 SB ramp	Existing lane configuration	No turn lanes; One EB thru Dual WB thru
Between I-81 SB ramp and I-81 NB ramp	Eastbound – Two thru + One Left Westbound – One thru + One Left	Eastbound – Two thru + One Left Westbound – Two thru + One Left

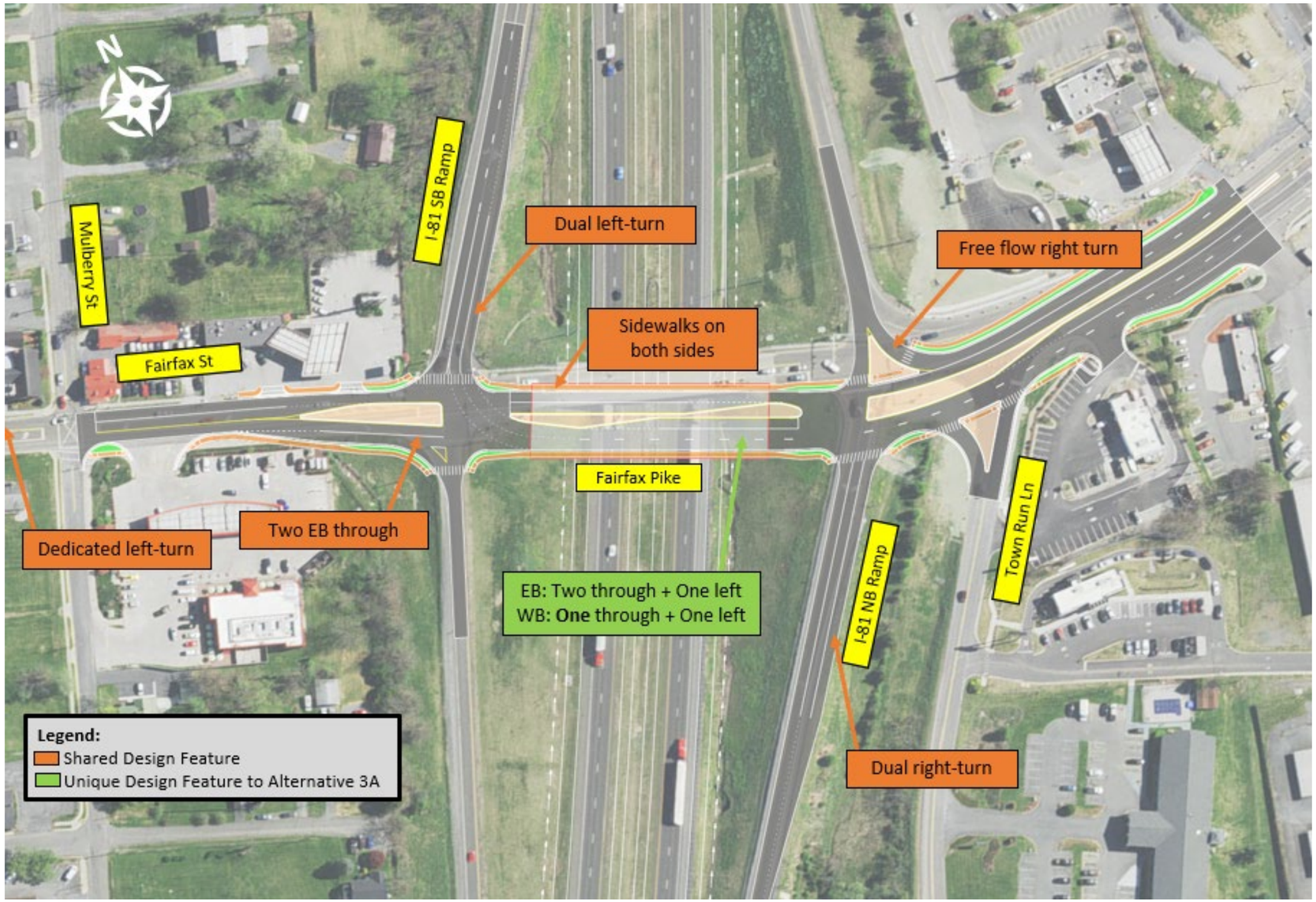


Figure 23. Alternative 3A concept sketch

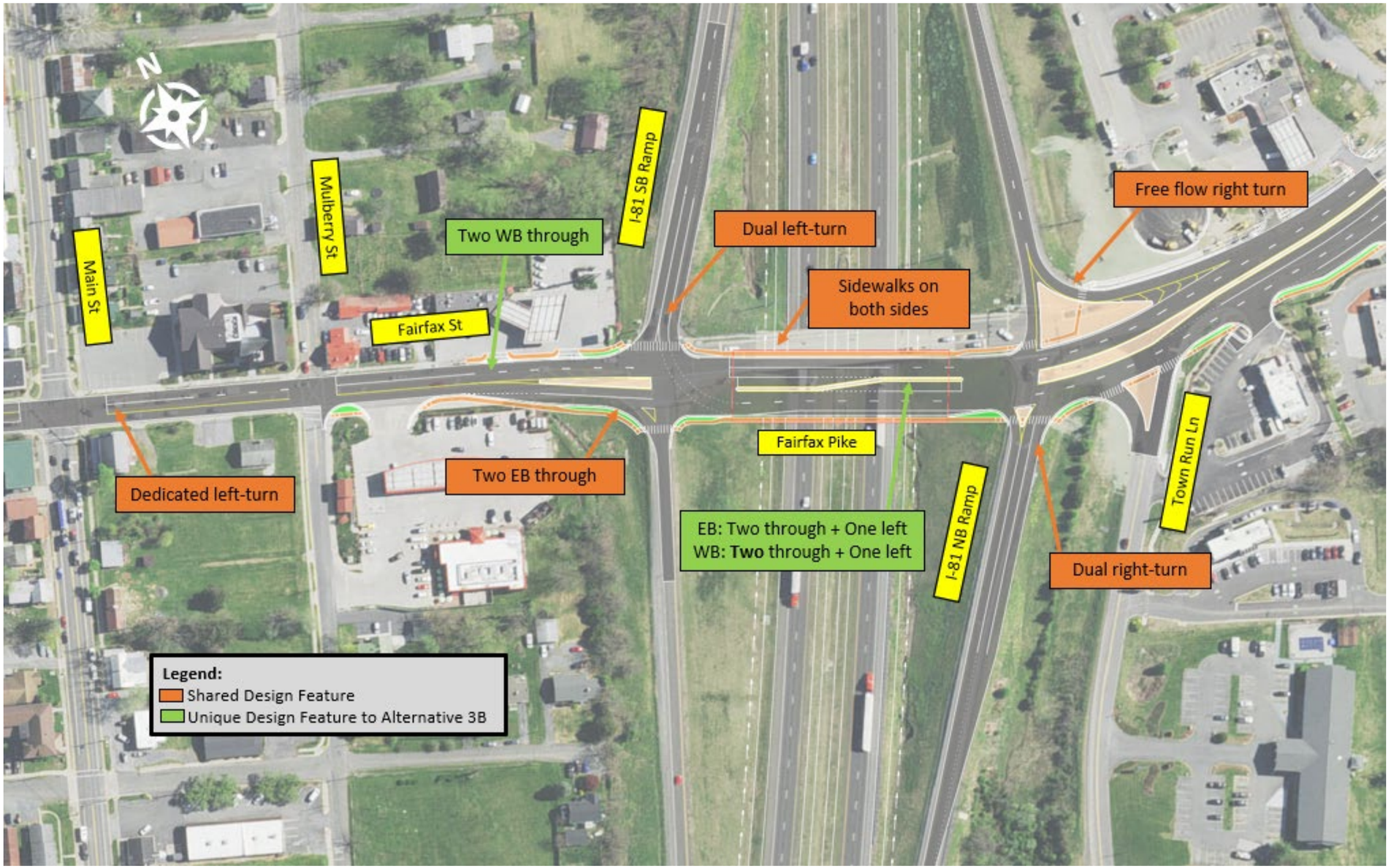


Figure 24. Alternative 3B concept sketch

Operations Analysis:

The following three alternatives were selected for future year analysis:

- No-Build, where the existing lane configuration and traffic control are maintained.
- Alternative 3A
- Alternative 3B

To evaluate and compare traffic operations between the No-Build and the preferred alternatives 3A and 3B, a detailed analysis was performed using Vissim microsimulation software. Both AM and PM peak hours were analyzed for the future year scenario. The analysis revealed that the PM peak hour was more critical than the AM peak hour. Consequently, the results from the PM peak hour analysis will be used to discuss the findings throughout this section. The following **Table 13** compares PM Peak hour intersection delays for the three alternatives- No Build, alternative 3A, and alternative 3B for the design year, 2054. Both alternatives 3A and 3B perform significantly better than the No-build scenario and were selected as the preferred alternatives.

Table 13. Alternative Analysis Comparison - Intersection Delays (sec/veh)

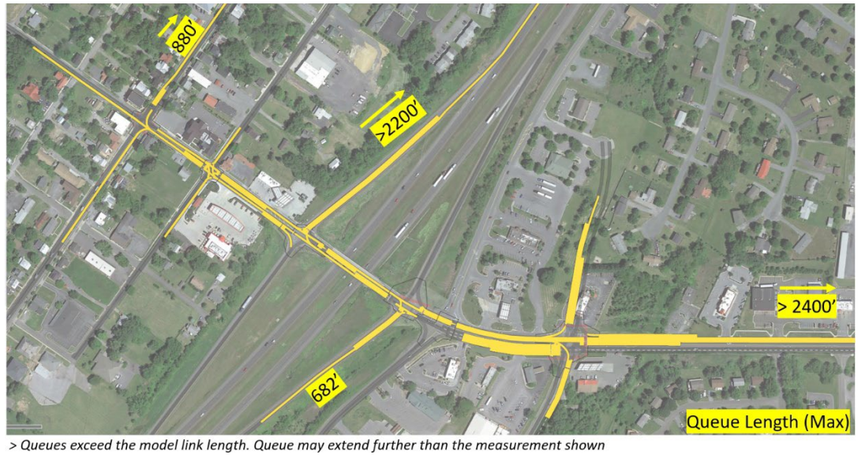
Intersection	Traffic Control	Intersection Delays (sec/veh)		
		No-Build	Alt. 3A	Alt. 3B
Fairfax St & Main St	Signal	80.2	37.3	38.1
Fairfax St & Mulberry St	TWSC	21.8	15.2	9.3
Fairfax St & I-81 SB ramp	Signal	137.3	19.7	15.8
Fairfax Pk & I-81 NB ramp	Signal	21.1	9.0	9.5
Fairfax Pk & Stickley Dr	Signal	126.9	31.3	32.5

The travel times along the study corridor between Main Street and Stickley Drive intersection in both directions were evaluated for the two preferred alternatives, 3A and 3B, to quantify their benefits compared to the No-Build scenario, shown in **Table 14**. The travel time benefits of Alt. 3B was found to be significantly better than Alt. 3A with travel time savings of more than 30% in both directions in the opening year, 2034, and the design year, 2054. Therefore, Alt. 3B was selected as the preferred alternative.

Table 14. Alternative Analysis Comparison – Corridor Travel Times

Future Year	Direction	Travel Time (mm:ss)			Change (%) from No-Build 2054	
		No-Build	Alt. 3A	Alt. 3B	Alt. 3A	Alt. 3 B
2034	Eastbound	-	01:47	01:33	-22%	-33%
	Westbound	-	01:50	01:19	-43%	-60%
2054	Eastbound	02:17	01:43	01:32	-25%	-35%
	Westbound	03:15	02:06	01:26	-35%	-56%

The network performance of Alt. 3B in comparison to No-Build for the design year is illustrated through maximum queue lengths observed in the following **Figure 25** and **Figure 26.** In the No-Build scenario, the queues on the I-81 southbound off-ramp are forecasted to spill back onto the I-81 mainline in the future year, 2054. The detailed Vissim analysis results are provided in **Appendix E**.



> Queues exceed the model link length. Queue may extend further than the measurement shown

Figure 25. No Build 2054 PM Peak Hour Maximum queue lengths

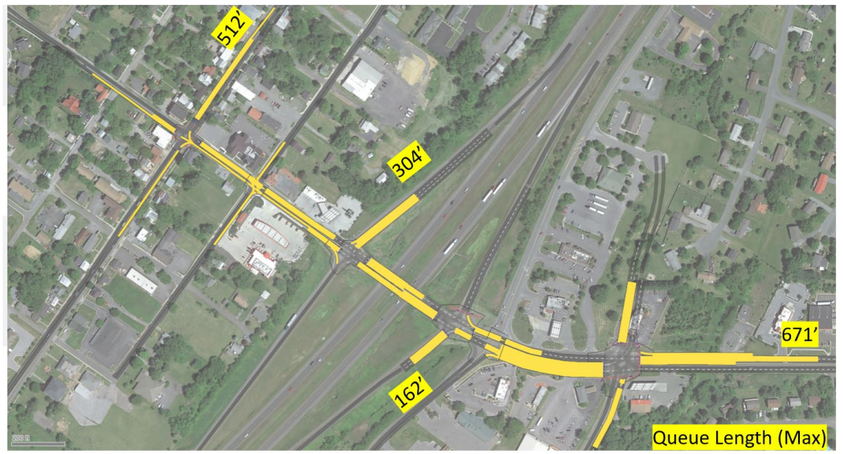


Figure 26. Alt.3B 2054 PM Peak Hour Maximum queue lengths

Safety Analysis:

Crash modification factors (CMF) are applied to compute the expected crash reduction with the preferred Alternative 3B concept. A summary of the CMFs applicable to the preferred alternative is provided in the following **Figure 27**. A table with the select CMFs provided in **Table 15.** The expected reduction in crash incidents after applying the CMFs is provided in **Table 16**. **Appendix F** contains the crashes selected for the CMF analysis.

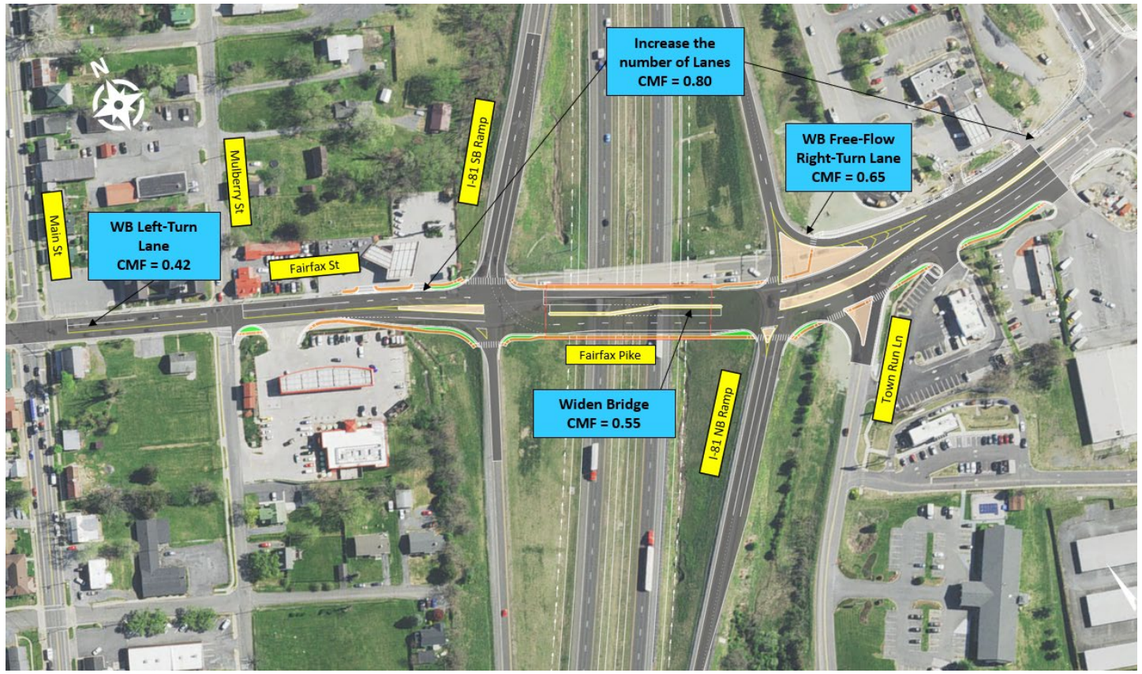


Figure 27. Summary of CMFs applicable to the preferred Alternative 3B

Table 15. CMF Table for Proposed Improvements

Location	Proposed Improvements	Applicable Crash Type	Crash Severity	CMF Value					Source
				All	K	A	BC	PDO	
Fairfax Street at Main Street	Add Fairfax St WB Left Turn Lane & add turn phase	Fairfax St WB Left Turn & Rear End	All	0.42	0.42	0.42	0.42	0.42	FHWA Desktop Guide (Page 18)
Fairfax Pike at I-81 SB ramps to NB ramps	Widen Bridge	All	All	0.55	0.55	0.55	0.55	0.55	FHWA CMF Desktop Ref. Guide (Page 54)
Fairfax Pike at I-81 SB ramps to Stickley Dr	Increase the Number of Lanes	All	All	0.80	0.80	0.80	0.80	0.80	FHWA CMF Desktop Ref. Guide (Page 60)
Fairfax Pike at I-81 NB ramp	Add Free Flow Right Turn Lane on WB Fairfax Pk to I-81 NB On-Ramp	WB Fairfax Pk to I-81 NB On-Ramp	Fatal+ Injury	0.65	0.65	0.65	0.65	0.65	FHWA CMF Desktop Ref. Guide (Page 27)

Table 16. Total Number of Crashes and % Crash Reduction

	All	K	A	BC	PDO
Total Crashes	61	0	2	14	51
Predicted Crashes After applying CMFs	40	0	1	10	33
Percent Crash Reduction	34%	-	51%	29%	35%

VTrans Needs Summary:

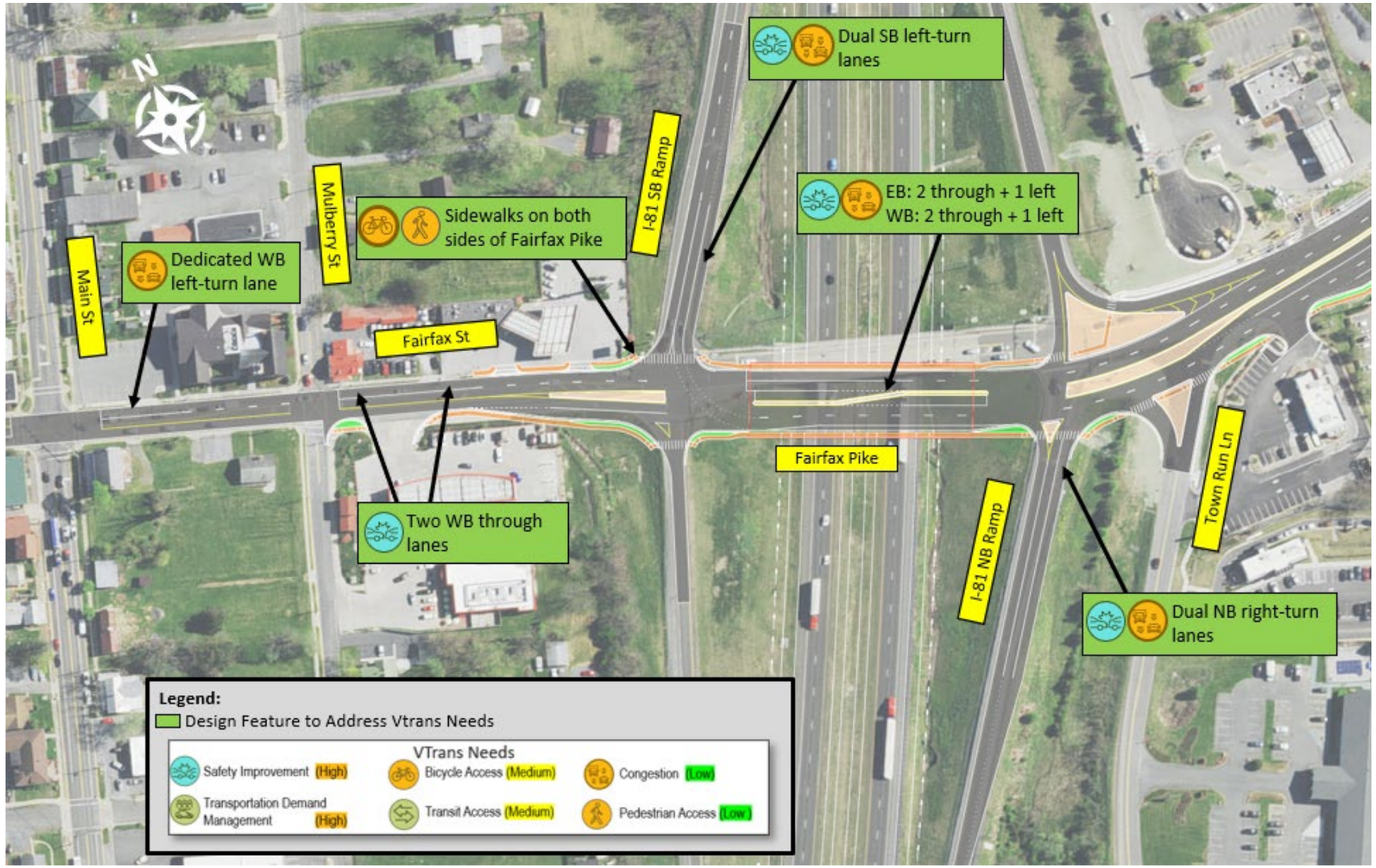


Figure 28. Summary of Design Features to Address VTrans Needs

Chapter 3:

Public and Stakeholder Outreach and Feedback

Public Involvement:

Following the development and analysis of the Preferred Build Alternative, a public involvement survey was developed to determine the public's response to the recommended improvements and what they perceived as the relevant issues within the study area. This survey was available online for 14 days spanning from May 20, 2024 to June 4, 2024.

Survey Design

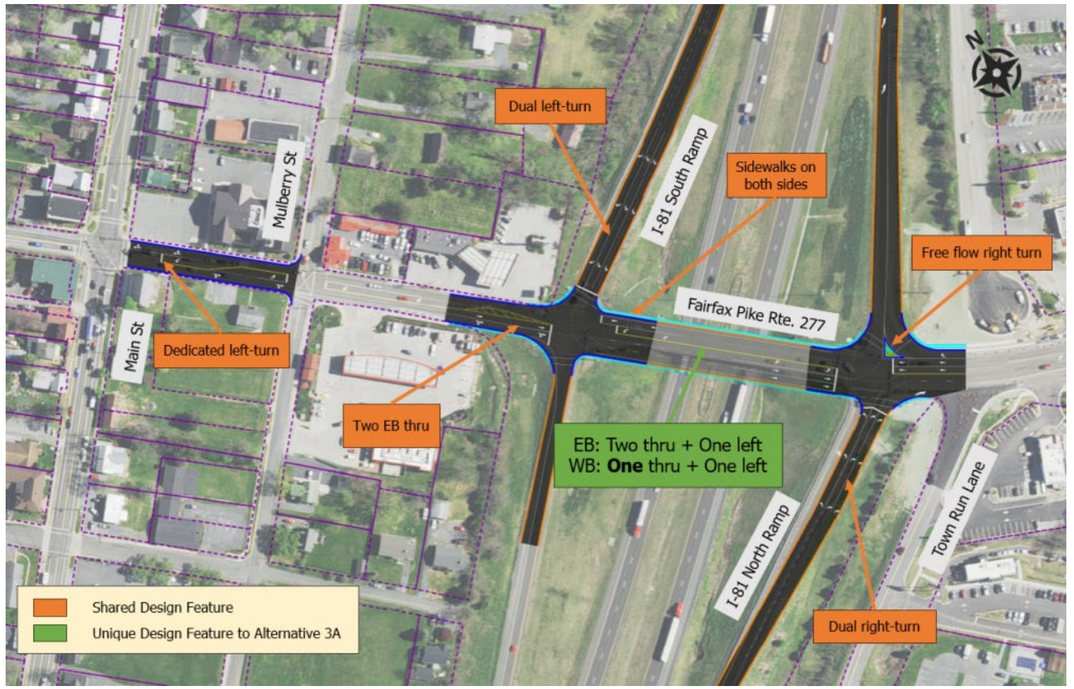
The public was involved in this study through an online survey developed on *Public Input*, an online engagement platform designed to educate the public while gathering informed feedback. This public outreach effort aimed to present relevant issues, inform the public about the recommended improvement concepts outlined in Chapter 2, and receive the public's feedback on the proposed improvements.

Overall, the survey is divided into four sections, which include the following:

1. Welcome/introduction with an overview of the project and study area.
2. Description of Existing Conditions.
3. Recommended improvements in the study area & improvement feedback.
4. Wrap up with demographic questions.

The first section provides an overview of the study area and the project initiative. In the second section, participants were informed about the existing conditions of the corridor, including the crash data. In the following sections, a summary of the recommended improvements and benefits along the Fairfax Pike corridor was provided, as shown in **Figure 29** and **Figure 30**. For these recommended improvement concepts, participants were asked to rate them based on their opinion from one to five, one being very unfavorable, three being neutral, and five being strongly in favor. They were also provided with an option to input comments or concerns. At the end of the survey, the participants were asked a few demographic questions such as; "What is your age?" and "What is your home zip code?". A total of 873 people participated in the survey producing a total of 6,830 question responses.

Next, participants were presented with the Preferred Alternative design concepts for the study corridor to rate improvements in each section on a scale from one to five stars, where one is the least favorable and five is the most favorable. The design concepts that were originally provided to the participants along with the participants' responses are shown in **Figure 29** and **Figure 30**. Overall, the participants showed a favorable response to the proposed concepts.



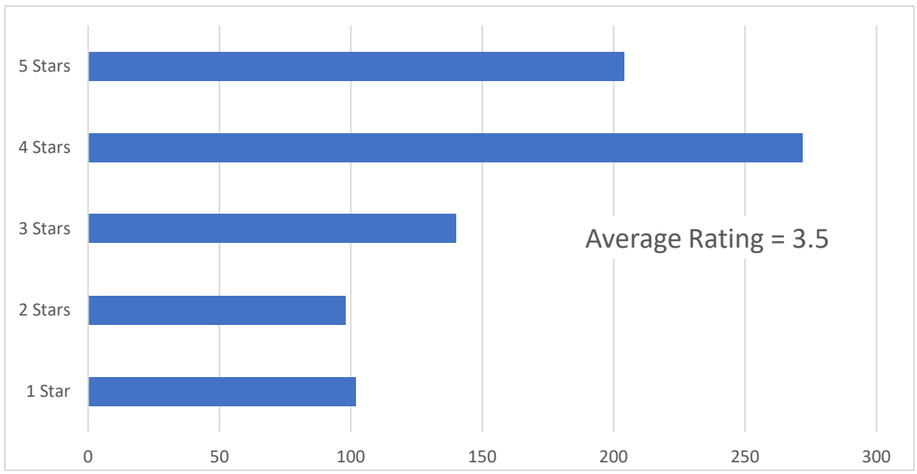
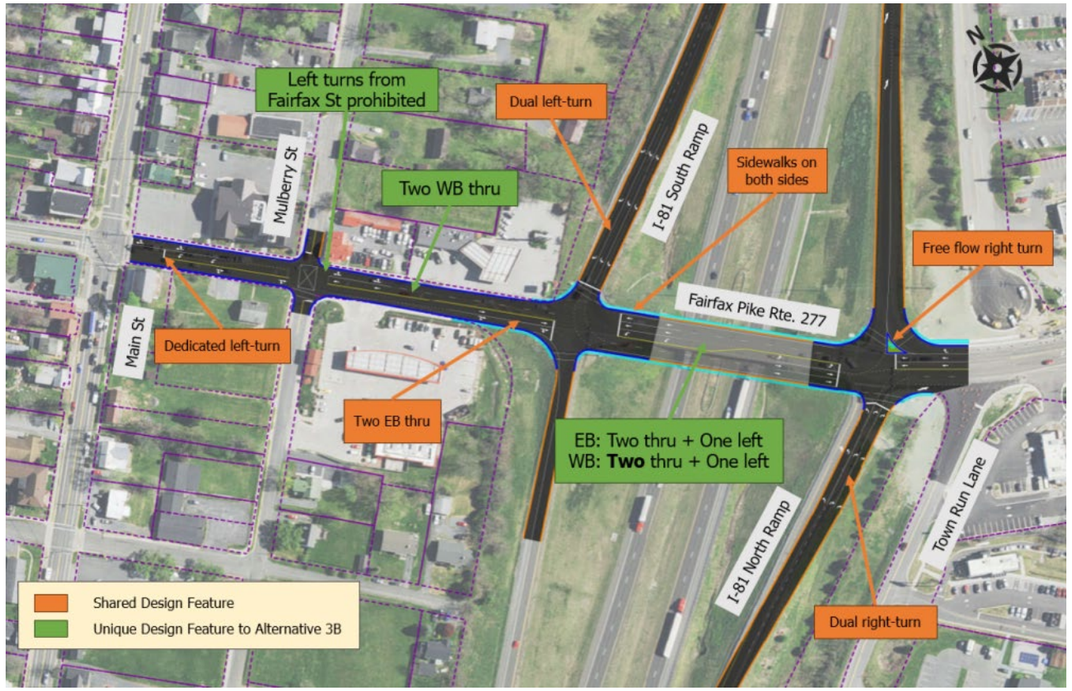


Figure 29. Alternative 3A Design and Rating



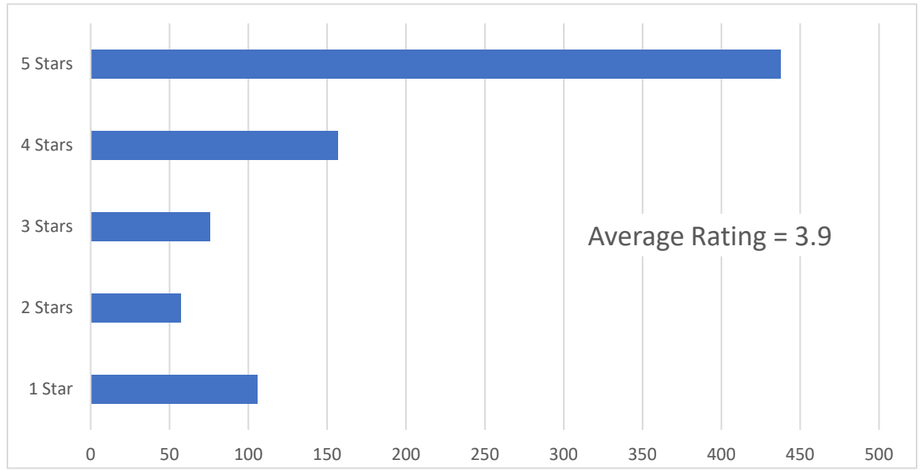


Figure 30. Alternative 3B Design and Rating

Conclusions

The summary of the public survey on the Preferred Alternative improvements are shown in **Table 17**. There is overall support for both Alternative 3A and 3B with Alternative 3B being the most favored alternative.

Table 17. Summary of the Representative Public Comments

Alternative	Areas of Concern	Average Rating	Public Comment Summary
Alternative 3A	Congestion	3.5	There is overall support for Alternative 3A with an average rating of 3.5 out of 5. The major comments were regarding concerns with congestion along Fairfax Pike. A representative comment is: “While eastbound generally sees a longer backup, I've come much closer to having accidents when going westbound due to congestion - the area is so stop-and-go across the bridge currently. Even with the extended left turn lane onto 81 SB, I worry that the single through lane option in 3A won't be sufficient at congested times. With either solution, I would support limiting left turns onto Fairfax - but am concerned that Sheetz's location would cause left turns and congestion as people try to enter or exit the business.”
Alternative 3B	Congestion	3.9	There is overall support for Alternative 3B with an average rating of 3.9 out of 5. The proposed two through lanes in each direction on the bridge and dedicated left-turn lanes are highly favored. A representative comment is: “Both Alternative 3A and Alternative 3B would address the significant traffic congestion issues that occur within the study area, with Alternative 3B being my preferred choice. As a 20-year resident of Stephens City, I have witnessed the incredible growth of our neighborhoods, businesses, and vehicular traffic that naturally arises as a result. The existing 3-lane bridge has proven insufficient to support existing congestion during peak hours for several years, and I frequently witness dangerous/negligent driving behaviors when traveling through the area (following too close, failure to yield, failure to indicate, failure to stop at stop signs, failure to heed traffic signals including entering intersections after signal lights have turned yellow/red, speeding to "beat the lights" to avoid being stuck on Fairfax Pike in the study area, etc.). Perceived "time gains" lead drivers to operate their vehicles recklessly to arrive at their destinations as fast as possible. Because of this correlation, the solution that delivers the best improvement to travel time efficiency would be Alternative 3B with its increased efficiency over Alternative 3A.”

Chapter 4:

Preferred Alternative Design Refinement & Investment Strategy

Intent of Phase 3

Phase 3 of the Pipeline Effort is intended to develop detailed concepts of the Phase 2 Preferred Alternative that will carry through to funding applications and project validation. The goal is to ensure that projects are defined to the maximum extent possible and to identify and mitigate potential risks. Utilizing technical resources of both VDOT and consultant teams, a multidisciplinary design approach is part of the overall effort that provides the needed input and problem-solving to ensure funding applications are thoroughly vetted and taken past a planning level sketch and estimate.

The goal is to develop more detailed, quantity based, deterministic estimates and designs paired with thoughtful risk assessment and mitigation. The team will use practical design and common-sense engineering methods to document the assumptions and approaches that lead to the most efficient and effective project scopes. The effort maintains focus on the purpose and needs identified through Phase 1 and 2 that address the VTRANS priorities.

Technical resources utilize Phase 3 for thorough communication and collaboration with District, Central Office, FHWA, or other key partners and stakeholders that may have decision making authority or input on final designs if projects are selected for funding. An intended outcome is that projects, if funded, will have the documentation and support for innovation and flexibility that may be necessary to achieve success.

The Phase 3 Technical Team developed the analysis, design, deliverables, and documentation that will serve as the basis for future Preliminary Engineering work on the projects. At the conclusion of Phase 3, projects should achieve a solid foundation of understanding from a planning and preliminary engineering focus that will ensure applications are well validated, reasonably scoped, meet the needs originally established in studies, and have a high probability of success.

Assumptions

The following are key design assumptions that informed the concept development and cost estimate preparation:

- Roadway geometry:
  - The design assumes widening the existing roadway and realigning Route 277 to the south to accommodate stage construction of the existing bridge over I-81. Roadway improvements include milling and overlaying Route 277 between Germain Street and Mulberry Street, maintaining the existing paved width. As the roadway approaches the I-81 interchange the alignment will be shifted to the south to cross I-81 at a more perpendicular angle reducing the crossing length and accommodating stage construction of the existing bridge over I-81. East of the I-81 overpass the roadway will shift to the north and tie into the recently completed Route 277 Widening project improvements approximately 375-ft east of Town Run Drive.
  - Interchange ramps will be improved to include a new SB off-ramp left turn lane, NB off-ramp right turn lane and extending the NB on-ramp accelerating lane on the ramp.
  - New pedestrian improvements will include upgrading the curb ramps at Germain Street, Main Street and Mulberry Street intersections. New sidewalk will be constructed along both EB and WB Route 277 between Mulberry Street and the eastern project limits connecting to the existing facilities. At the overpass, pedestrian fencing will be included with the project.
    - Existing entrance locations will be maintained and will require access management waivers.
- Pedestrian accommodation:
  - New pedestrian improvements will include upgrading the curb ramps at Germain Street, Main Street and Mulberry Street intersections. New sidewalk will be constructed along both EB and WB Route 277 between Mulberry Street and the eastern project limits connecting to the existing facilities. At the overpass, pedestrian fencing will be included with the project.
- Hydraulics:
  - New storm drain system will be required to accommodate the new curb lines along Route 277. Within the interchange the existing 6'x5' box culvert crossing the SB off-ramp

will need to be extended, and the existing 6'x5' box culvert crossing the interstate will need to be reconstructed south of the new bridge structure.

- Stormwater management:
    - Stormwater management would be provided with two new pond locations: 1. south of Route 277 along the SB on ramp and 2. along Town Run Lane between the NB off-ramp accommodate drainage. Additional details will be required to size the facilities.
- Traffic:
    - New traffic signals will be required at the interchange terminals, and pedestrian signals and pushbuttons will be required at the Route 277 and Main Street intersection.
- Utility impacts:
    - The existing overhead utilities are along WB Route 277 and will largely be unaffected by the project. The existing pole at the SB ramp terminal may need to be relocated.
- Right of Way:
    - The proposed improvements will involve acquiring right of way and easements on nine (9) commercial and residential parcels along Route 277 and Town Run Lane. The project is proposing to maintain all existing entrance locations. Refer to the concept design exhibits and Right of Way Data Sheet for more details.
    - Per VDOT Estimate dated 7/17/2024: "*SS Est Rnd #6. Prop acq areas calc from R/W DS prov by PM. Asphalt, Crete, Trees & Shrubs, (1) Sign, Parking lot light, IP's. Assumptions: No TTs; All parcels to retain reasonable access; Condemn elev due to recent attorney involvemnt; Dam elev due to loss several Comm prking spots; Gas canopies and UG tanks on Parcels 06 & 07 not to be disturbed, Signs in/close to TCE will not be disturbed; Add fee R/W 18,600 assumed on Parcel 08 (Uneconomic Remnant) (25% Contingency added to MIR). [DWL]*"

Risk Assessment/Contingency

As part of the risk assessment process, a risk register was developed to identify major/high impact project risk elements. The guidance provided in VDOT's Cost Estimating Manual (Chapter 5) and IIM PMO-15.0 was followed and identified after assessing collected data, field visits, stakeholder input, and concept development. Risks were organized by broad categories including Maintenance of Traffic (MOT), Roadway Design, Right-of-Way, Utilities, Mobilization/Construction Survey, Hydraulics, Traffic, Structures/Bridge Design, Geotechnical, and Environmental. The major risks identified in this project include:

- Right-of-way impacts due to the likely damages associated with the right-of-way impacts, and the limited right-of-way for relocation of utility poles.
- MOT plans have not been developed at this stage. The concept has been developed to a stage that to feel confident that stage construction option is viable. The MOT phasing for this project is anticipated to be complex, it is recommended to use the Most Likely Estimate (MLE) for pre-scoping.
- The hydraulic design is based on general field conditions, review of record plans and project CAD plan information, any changes to the concept may impact the conceptual design. Drainage calculations have not been performed and pipe sizes are based on engineering judgement. It is assumed the box culvert will be jacked and bored under the interstate, any deviations to the alignment or length assumed will impact the cost. Two basins were assumed, however additional basins or the size and location of the basins may impact the costs.
- The concept has been developed to be constructed as a stage construction operation. Additional bridge width may be required if the project would like to account for dual left turn lanes from the NB off ramp.
- Earthwork quantities are based on LiDAR surface data. Detailed cross sections were not performed for the project. The subsurface conditions are not known, and rock or karst excavation may be required.

The project is considered Moderately Complex. However, the level of concept design development is relatively detailed (between Pre-Scoping and PFI level of design); therefore, the MLE contingency would be more accurately in the 40% to 45% range. Each individual risk was "scored" based on probability, cost impacts, and time impacts. Scoring was used to assign contingencies per risk line item. These line-item risk contingencies were then aggregated to determine a contingency amount per category to include preliminary engineering, right-of-way and utilities, mobilization/construction survey, MOT, roadway design, hydraulics, traffic, and earthwork/geotechnical.

Cost Estimate

The project cost estimate was developed using the following methodology:

- Understanding the goals of the project and scope of improvements to be implemented.
- Gathering and reviewing as much information about the project as possible including site visits and stakeholder input.
- Establishing design criteria and developing a detailed design concept.

- Performing quantity takes offs and identifying unit prices based on Bid Express, and historical VDOT cost data (2-year District and Statewide average) to develop “defined costs”.
- Developing “allowance costs” for some elements based on potential impacts and complexity. Allowances add costs for elements based on percentage of the base construction cost.
    - MOT 15% Allowance
    - 1.25% for a field office to account for a 36-month construction schedule
    - Roadside Development at 1%
    - $142,500 for additional pavement overlay to correct pavement cross slopes
    - 10% for Stormwater Management (SWM) and 5% for Erosion and Sediment Control (E&SC) measures
    - In-Plan Utilities 2% Allowance to cover minor water and sanitary sewer adjustments
    - Traffic Signals: $500,000 for each of the 3-legged ramp terminal intersections, $200,000 for the signal at the NB on-ramp and $125,000 for pedestrian improvements at Main Street.
    - An allowance of 2% is included each for pavement markings and signing replacement/improvements
    - $165,000 for unsuitable soils
- Identifying proposed property impacts, developing a Right of Way Data Sheet and coordinating with VDOT to develop Right-of-Way costs. Note, nine (9) parcels are anticipated to be impacted, including $15,000 for administrative costs.
- Performing a risk assessment as outlined above and identifying appropriate contingency percentages by category.
- Developing Preliminary Engineering costs by category based on a percentage of the Construction cost.

Concept Revisions & Final Estimate

Based on VDOT and Stakeholder input from Phase 2 and the site visit performed at the commencement of Phase 3, the concept was advanced, refining key elements of the preferred alternative, as shown in **Figure 31**. As the design progressed, several elements were altered from the concept that resulted from Phase 2 to include:

- Adding ADA curb ramps at the intersections of Fairfax Street and Germain Street, Fairfax Street and Main Street, and Fairfax Street and Mulberry Street.
- Adding a left turn lane along eastbound Fairfax Street at Main Street.
- Turning movements permitted from both approaches along Fairfax Street onto Mulberry Street.
    - Convert the existing westbound left-turn lane into a shared left-turn/through lane.

Cost Estimate Breakdown

The total project cost is estimated to be $62,490,215 and broken down by Phase/Major area as shown in **Table 18** below. This cost includes contingencies and represents uninflated 2024 dollars.

Table 18: Cost Estimate Breakdown

Phase	Total
Preliminary Engineering Phase	$7,055,100
Right-of-Way and Utilities Phase	$1,313,008
Construction Phase (without CEI)	$45,598,940
Construction Phase (with CEI)	$54,122,107
Total	**$62,490,215**

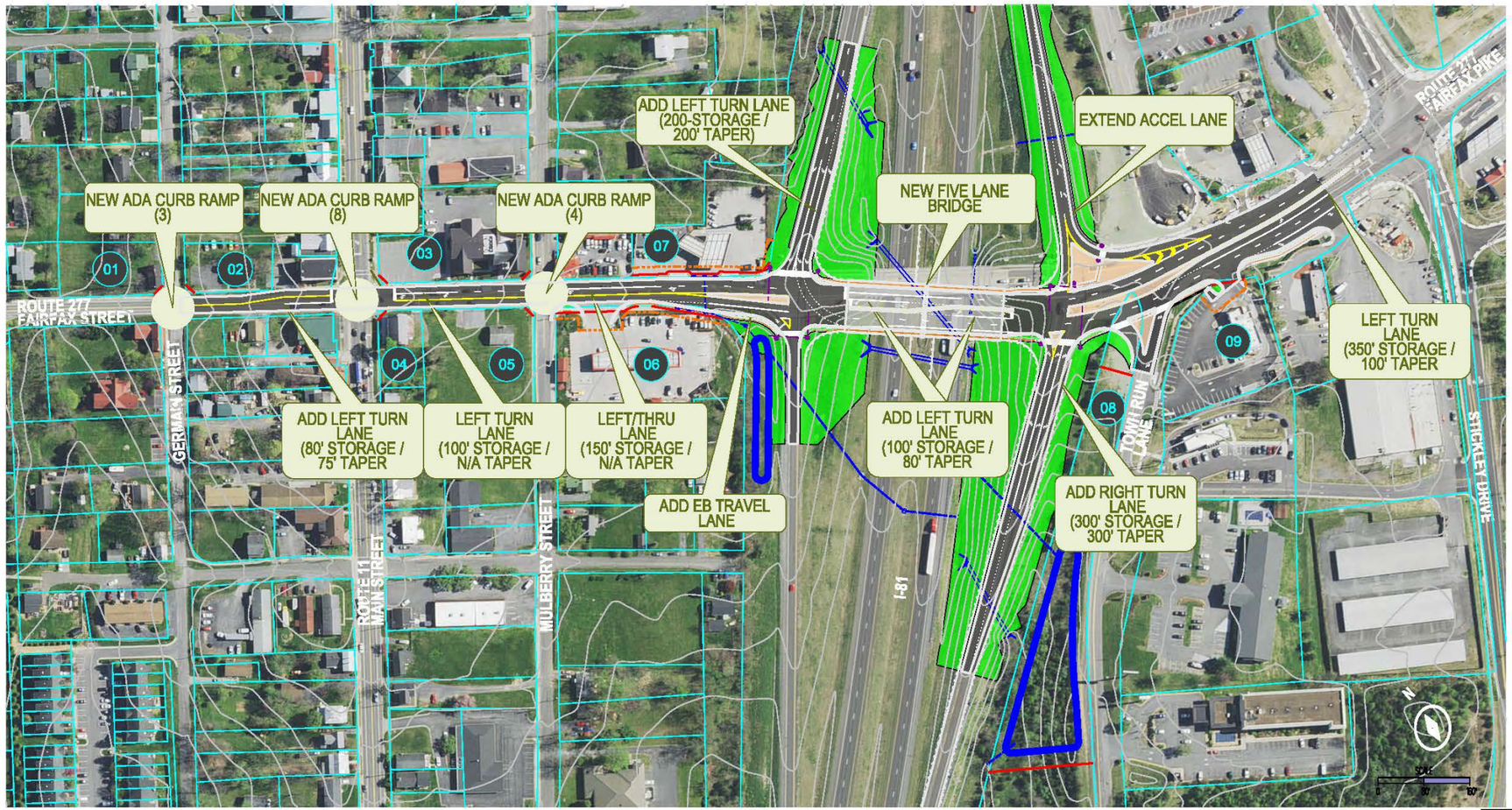


Figure 31: Exit 307 Improvements